7th Heidelberg International Symposium on High-Energy Gamma-Ray Astronomy

Report of Contributions

https://indico.icc.ub.edu/e/gamma2022

Contribution ID: **222** Type: **Contributed talk**

Gamma-ray emission of hadronic origin from nova RS Oph revealed by the MAGIC telescopes

Wednesday, July 6, 2022 3:00 PM (15 minutes)

The recurrent symbiotic nova RS Ophiuchi (RS Oph), which exhibits eruptive events once every 15 years, displayed its latest major outburst on August 2021. This eruption was detected from radio up to very-high-energy (VHE) gamma rays, making of RS Oph the first nova discovered in the VHE regime. After receiving the optical and high-energy triggers, the MAGIC telescopes performed a followed-up campaign on this source and detected the nova from August 09 to 12. The emission observed by MAGIC prove a hadronic origin of the gamma-ray component. In this talk, we will report on the results obtained by MAGIC during the RS Oph 2021 eruption, coupled with some modeling interpretations.

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Presenter: LÓPEZ-ORAMAS, Alicia (Instituto de Astrofísica de Canarias (IAC))

Session Classification: Contributed Talks

Contribution ID: **223** Type: **Contributed e-poster**

Discovery of non-equilibrium ionization plasma around the Fermi Bubble; new evidence of past activity of the Galactic center

Fermi bubbles are giant gamma-ray structure toward the Galactic center (GC) with symmetrical north-south extension perpendicular to the galactic plane. Such giant structures toward the GC are also observed in various wavelengths from radio to X-rays, such as WMAP haze, North Polar Spur (NPS), and most recently, eROSITA bubbles. We investigated the detailed plasma condition of the NPS/Loop I around Fermi bubble using archival $Suzaku$ data. In previous research collisional ionization equilibrium (CIE) have been assumed for plasma state, but we also assume non-equilibrium ionization (NEI) to check the plasma condition in more detail. We found that most of the plasma in the NPS/Loop I favors the state of NEI, and has the density-weighted ionization timescale of $n_e t \sim 10^{11-12}$ s cm^{-3} and the electron number density $n_e \sim$ a few $\times$ 10^{-3} cm^{-3}. The plasma shock age, t, or the time elapsed after the shock front passed through the plasma, is estimated to be on the order of a few Myr for the NPS/Loop I, which puts a strict lower limit to the age of the whole NPS/Loop I structure. We found that NEI results in significantly higher temperature and lower emission measure than those currently derived under CIE assumption. The electron temperature under NEI is estimated to be as high as 0.5~keV toward the brightest X-ray NPS ridge at $\Delta\theta = -20°$, which decreases to 0.3 keV at $-10°$, and again increases to ~ 0.6 keV towards the outer edge of Loop I at $\Delta\theta \sim 0°$, about twice the currently estimated temperatures.Here, $\Delta\theta$ is the angular distance from the outer edge of Loop I. We discuss the implication of introducing NEI for the research in plasma states in astrophysical phenomena.

Authors: Ms YAMAMOTO, Marino (Faculty of Science and Engineering, Waseda University); Prof. KATAOKA, Jun (Faculty of Science and Engineering, Waseda University); Prof. SOFUE, Yoshiaki (Institute of Astronomy, The University of Tokyo)

Presenter: Ms YAMAMOTO, Marino (Faculty of Science and Engineering, Waseda University)

Session Classification: Contributed posters

Contribution ID: **224** Type: **Contributed talk**

Assessing the Impact of Hydrogen Absorption on the Characteristics of the Galactic Center Excess

Monday, July 4, 2022 5:45 PM (15 minutes)

We present a new reconstruction of the distribution of atomic hydrogen in the inner Galaxy that is based on explicit radiation-transport modelling of line and continuum emission and a gas-flow model in the barred Galaxy that provides distance resolution for lines of sight toward the Galactic Center. The main benefits of the new gas model are, a), the ability to reproduce the negative line signals seen with the H*I*4PI survey and, b), the accounting for gas that primarily manifests itself through absorption.

We apply the new model of Galactic atomic hydrogen to an analysis of the diffuse gamma-ray emission from the inner Galaxy, for which an excess at a few GeV was reported that may be related to dark matter. We find with high significance an improved fit to the diffuse gamma-ray emission observed with the Fermi-LAT, if our new H*I* model is used to estimate the cosmic-ray induced diffuse gamma-ray emission. The fit still requires a nuclear bulge at high significance. Once this is included there is no evidence for a dark-matter signal, be it cuspy or cored. But an additional so-called boxy bulge is still favoured by the data.
This finding is robust under the variation of various parameters, for example the excitation temperature of atomic hydrogen, and a number of tests for systematic issues.

Authors: POHL, Martin (Uni Potsdam / DESY); Dr MACIAS, Oscar (GRAPPA / University of Amsterdam); COLEMAN, Phaedra (University of Canterbury); Dr GORDON, Chris (University of Canterbury)

Presenter: POHL, Martin (Uni Potsdam / DESY)

Session Classification: Contributed Talks

Contribution ID: **225** Type: **Contributed talk**

Making sense of recent results on electrons and positrons from cosmic ray experiments

Thursday, July 7, 2022 5:30 PM (15 minutes)

The new AMS-02 measurements of the cosmic-ray (CR) electron and positron energy spectra have provided spectacular confirmation of the earlier claim by PAMELA and FERMI of a rising positron-over-electron fraction and, for the first time, have identified a sharp drop-off of the positron flux above ~300 GeV and a tiny change of the electron slope at ~40 GeV. At the same time, HESS, CALET and DAMPE have reported substantial steepening of the total lepton spectrum at ~TeV with a spectral index softening by about 1.
I will present the results of a novel calculation of the flux of electrons and positrons as produced by SNRs, Pulsar Wind Nebulae (PWN) and secondary interactions of CRs in the Galaxy. In particular, I will show under which conditions for the injection and transport of these particles the reported spectral features can be consistently reproduced and I will discuss the connection with the recent detection of extended "Tev Halos"around Pulsars.
Finally, I will review the consequences of the stochasticity in the occurrence of source events specifically if these are correlated with the spiral arms of the Galaxy, and I will oppose the scenario in which the observed features are the effect of prominent nearby sources.

Author: EVOLI, Carmelo (Gran Sasso Science Institute)

Presenter: EVOLI, Carmelo (Gran Sasso Science Institute)

Session Classification: Contributed Talks

Contribution ID: **230** Type: **Review, Highlight, or Invited talk**

Cosmic Rays and Neutrinos at the Highest Energies

Tuesday, July 5, 2022 9:30 AM (45 minutes)

Ultrahigh energy cosmic rays (UHECRs), i.e., cosmic rays with energies above 10^18 eV (=1 EeV), are the most energetic particles ever observed. Their sources are still a mystery. Giant ground-based observatories, such as the Pierre Auger Observatory and the Telescope Array, have shown that the sources of UHECRs are extragalactic. The observed UHECR spectrum has subtle features that can be explained by a combination of interactions with cosmic backgrounds, a changing composition of the primaries, and a maximum acceleration energy of the dominant sources. Hints of anisotropies begin to appear at energies above tens of EeV, just when statistics become very limited. We review the progress over the last decade of UHECR observations, the implication for the neutrino and photon counterparts, and the future outlook for discovering the origin of UHECRs.

Author: OLINTO, Angela

Presenter: OLINTO, Angela

Session Classification: Review Talks

Contribution ID: **233** Type: **Review, Highlight, or Invited talk**

Multi-wavelength view of pulsars: from millisecond pulsars to magnetars

Wednesday, July 6, 2022 10:15 AM (45 minutes)

In this review talk I will present the state-of-the-art of pulsar observations in different observing bands, from radio to very high energy gamma-rays, with a particular focus on the different emission mechanisms in place. Furthermore, I will focus on the low-B millisecond pulsars and the high-B magnetars, comparing their multi-band spectra and showing new interesting results of the past few years.

Author: REA, Nanda

Presenter: REA, Nanda

Session Classification: Review Talks

Contribution ID: **234** Type: **Review, Highlight, or Invited talk**

Multi-messenger High-Energy Astrophysics results

Thursday, July 7, 2022 9:30 AM (45 minutes)

I will discuss some selected instruments, which are key for current multi-messenger results. Then I will focus on diffuse fluxes, namely the cosmogenic fluxes and galaxy fluxes, which can be better estimated through multiple messengers. I will look into more detail to some galactic sources probable cosmic-ray-gamma-ray-neutrino messengers. On extragalactic sources, I will review recent IceCube results on blazars and starburst galaxies. Finally GRBs as sources connecting gamma-rays and GWs and possibly in the future neutrinos.

Author: MONTARULI, Teresa (Universite de Geneve)

Presenter: MONTARULI, Teresa (Universite de Geneve)

Session Classification: Review Talks

Contribution ID: **236** Type: **Review, Highlight, or Invited talk**

GRBs and their afterglows at VHEs

Monday, July 4, 2022 11:30 AM (25 minutes)

Recently, the observational study of gamma-ray bursts (GRBs) in the very-high-energy (VHE) regime has advanced with several long-awaited detections with MAGIC and H.E.S.S. telescope systems. Currently, the list of GRBs with robustly measured VHE emissions contains GRB 180720B, GRB 190114C, and GRB 190829A. Three more bursts were reported as source candidates by the MAGIC Collaboration. This candidate list includes a short GRB, which was detected with low significance (GRB 160821B), and a very distant GRB 201216C (from z=1.1), which was detected with high significance (>5\sigma). Although in the latter case the analysis has still a preliminary status. Detection of GRB afterglows in the VHE regime allows obtaining essential information on particle acceleration by relativistic shock waves. This makes GRB afterglows to be important sources for high-energy astrophysics and their studies have an exceptionally broad scope. However, the extragalactic origin of GRB implies a severe constrain for their observational study in the VHE domain. Namely, attenuation of multi TeV photons by extragalactic background light (EBL) becomes significant at cosmological distances. The EBL absorption hardens the detection of GRBs and deforms their TeV spectrum, which makes nearly impossible any reliably determination of the intrinsic gamma-ray spectrum. The fortunate proximity of one of the detected GRBs (GRB 190829A occurred at z~0.08) allowed an unexpectedly long signal detection, up to 56 hours after the trigger, and accurate spectral determination in a broad energy interval, spanning between 0.18 and 3.3TeV. The obtained temporal and spectral properties of the VHE emission appeared to be remarkably similar to those seen in the X-ray band with Swift-XRT. Comparison to other detected GRB afterglow shows that SEDs and lightcurves obtained from GRBs share much in common, which disfavors the chances for GRB 190829A being an exceptional event. This suggests a need for a revision of the theoretical scenarios used to
predict the broadband emission from GRB afterglows.

Author: KHANGULYAN, Dmitry (Rikkyo University)

Presenter: KHANGULYAN, Dmitry (Rikkyo University)

Session Classification: Highlight Talks topical

Contribution ID: **238** Type: **Review, Highlight, or Invited talk**

Stellar Clusters as Pevatron Candidates

Tuesday, July 5, 2022 11:55 AM (25 minutes)

Massive stars blow powerful winds and eventually explode as supernovae. By doing so, they inject energy and momentum in the circumstellar medium, which is pushed away from the star and piles up to form a dense and expanding shell of gas. The effect is larger when many massive stars are grouped together in bound clusters or associations. Large cavities form around clusters as a result of the stellar feedback on the ambient medium. They are called superbubbles and are characterised by the presence of turbulent and supersonic gas motions. This makes star clusters ideal environments for particle acceleration, and potential contributors to the observed Galactic cosmic ray intensity.

Author: GABICI, Stefano (APC)

Presenter: GABICI, Stefano (APC)

Session Classification: Highlight Talks topical

Contribution ID: **240** Type: **Review, Highlight, or Invited talk**

Gamma-ray emitting binaries

Wednesday, July 6, 2022 11:30 AM (25 minutes)

Binary systems are today well established gamma-ray emitters, and the variety of the processes responsible for this emission is a hard act to follow among any other high-energy source class. After years of faithful perspectives, extensive theoretical modelling and complex MHD simulations, GeV/TeV detectors have reported a too rich phenomenology to be predicted just a few years ago. I will review in this talk some of the most challenging highlights in binary systems in the gamma-ray domain, from orbitally modulation to orphan flares in pulsar gamma-ray binaries to gamma-rays in microquasar jet/medium interactions regions and powerful explosions in novae systems.

Author: BORDAS, Pol (ICCUB)

Presenter: BORDAS, Pol (ICCUB)

Session Classification: Highlight Talks topical

Contribution ID: **241** Type: **Review, Highlight, or Invited talk**

Multi-wavelength Astronomy with Gravitational Waves

Thursday, July 7, 2022 10:15 AM (25 minutes)

On 2017 August 17, the merger of a binary neutron-star system observed through gravitational waves and multi-wavelength emission from gamma rays, X-ray, ultraviolet-optical-near infrared, to radio marked the history of multi-messenger astronomy, showing its tremendous potential probe the physics of the most energetic events of the Universe. Multi-messenger discoveries are unveiling the rich physics of neutron star mergers in association with gamma-ray bursts and kilonovae, probing relativistic astrophysics, nuclear physics, nucleosynthesis, and cosmology. This talk will give an overview of observational challenges and perspectives of the multi-wavelength follow-up of gravitational-wave sources based on the current knowledge of the electromagnetic counterparts.

Author: BRANCHESI, Marica (Gran Sasso Science Institute/INFN)

Presenter: BRANCHESI, Marica (Gran Sasso Science Institute/INFN)

Session Classification: Highlight Talks topical

Contribution ID: **243** Type: **Review, Highlight, or Invited talk**

Pulsar Wind Nebulae

Thursday, July 7, 2022 11:30 AM (25 minutes)

Pulsar wind nebulae (PWNe) are multi-wavelength bright sources produced by the interaction of the relativistic, magnetized and cold plasma emanating from the neutron star with the surrounding material, either the ejecta of the supernova explosion or the interstellar medium, depending on their phase of evolution.
They will constitute the widest class of Galactic gamma-ray sources of future surveys, with around 300 new detections expected in the first Galactic Plane Survey of the Cherenkov Telescope Array. Moreover PWNe are known to be efficient particle accelerators, with the class prototype, the Crab nebula, the unique firmly identified leptonic PeVatron of the Galaxy.
Last years observations at X-rays and gamma-rays have proved they efficiently release particles in the ambient medium in their late evolutionary phases, being connected to the formation of elongated X-ray jets and extended TeV halos.
Almost all the LHAASO's recently detected PeVatrons have a pulsar in their surroundings, leaving open the possibility that all of them are actually illuminated by a pulsar or a pulsar wind nebula that is not resolved by LHAASO.
Being able to model and identify these sources through their different evolutionary stages is then extremely important for the interpretation of future gamma-ray data. Here I will discuss where we are in this respect.

Author: OLMI, Barbara

Presenter: OLMI, Barbara

Session Classification: Highlight Talks topical

Contribution ID: **245** Type: **Review, Highlight, or Invited talk**

Diffusive Shock Acceleration: Recent Developments

Author: MALKOV, Michael

Presenter: MALKOV, Michael

Session Classification: Highlight Talks topical

Contribution ID: **251** Type: **Review, Highlight, or Invited talk**

LHAASO Highlights in gamma-ray Astronomy

Wednesday, July 6, 2022 12:20 PM (25 minutes)

The Large High Altitude Air Shower Observatory (LHAASO) as the largest ground based Gamma Ray detector array is built up. The full array has been operated for months. Many VHE gamma ray sources has been observed including well known sources such as the Crab and Mkr421. With many sources found having strong emission of gamma rays in UHE(> 0.1 PeV) band, LHAASO starts the era of the UHE gamma ray astronomy. With its unprecedented sensitivity at energies above 10 TeV and extremely high background rejection capability, super-PeV gamma-like events, including the record high energy of 1.4 PeV, are detected first time in history. With also measured SEDs of several galactic gamma sources above 0.1 PeV, LHAASO reveals that our galaxy is full of PeVatrons. The extreme features of the electron PeVatron inside the Crab pose strong challenges to models and even more fundamental theories. Those discoveries enable an exploring for hadronic PeVatrons, i.e. origins of cosmic rays. The highest energy photons provide opportunities of checking for validity of fundamental rules, such as the Lorentz Invariance.

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Presenter: CAO, Zhen (Institute of High Energy Physics)

Session Classification: Highlight Talks observational

Contribution ID: **252** Type: **not specified**

POSTER time

Author: TAVANI, Marco

Co-author: TAVANI, Marco

Presenter: TAVANI, Marco

Session Classification: Highlight Talks observational

Contribution ID: **253** Type: **Review, Highlight, or Invited talk**

CTA Science in the multimessenger era

Friday, July 8, 2022 9:30 AM (20 minutes)

High-energy photons are a powerful tool to understand the most violent phenomena in our Universe. Space instruments, as well as ground-based ones, are now producing a steady flow of important results often in conjunction with observatories working at different wavelengths. Multimessenger astronomy is the newly born discipline to which high-energy gamma-ray detectors provide an essential contribution. Indeed high-energy gamma-rays provide a natural link between electromagnetic astronomy and gravitational as well as neutrino ones. Although high-energy astrophysics is enjoying a true golden age, not all the long-standing problems have been solved. The origin of cosmic rays is still challenging us. To pinpoint the ultimate accelerators sky coverage, together with sensitivity and high angular resolution are badly needed. The Cherenkov Telescope Array promises to be a game changer and we are eagerly waiting for it.

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Co-author: HOFMANN, Werner

Presenter: CARAVEO, Patrizia (IASF-INAF)

Session Classification: Invited Talks (Aula Magna Biologia) Chair: Stefano Vercellone

Contribution ID: **254** Type: **Review, Highlight, or Invited talk**

CTAO Overview

Friday, July 8, 2022 9:50 AM (20 minutes)

Very-high-energy (VHE) gamma-ray astroparticle physics is a relatively young field, and observations over the past decade have surprisingly revealed almost 250 VHE emitters which appear to act as cosmic particle accelerators. These sources are an important component of the Universe, influencing the evolution of stars and galaxies. At the same time, they also act as a probe of physics in the most extreme environments known - such as in supernova explosions, and around or after the merging of black holes and neutron stars. However, the existing experiments have provided exciting glimpses, but often falling short of supplying the full answer. A deeper understanding of the TeV sky requires a significant improvement in sensitivity at TeV energies, a wider energy coverage from tens of GeV to hundreds of TeV and a much better angular and energy resolution with respect to the currently running facilities. The next generation gamma-ray observatory, the Cherenkov Telescope Array Observatory (CTAO), is the answer to this need. In this talk I will present this upcoming observatory from its design to the construction, and its potential science exploitation. CTAO will allow the entire astronomical community to explore a new discovery space that will likely lead to paradigm-changing breakthroughs. In particular, CTAO has an unprecedented sensitivity to short (sub-minute) timescale phenomena, placing it as a key instrument in the future of multi-messenger and multi-wavelength time domain astronomy.

Author: RIGHI, Chiara (INAF O.A. Brera)

Co-author: ZANIN, Roberta

Presenter: RIGHI, Chiara (INAF O.A. Brera)

Session Classification: Invited Talks (Aula Magna Biologia) Chair: Stefano Vercellone

Contribution ID: **256** Type: **Review, Highlight, or Invited talk**

Status of ASTRI Project

Friday, July 8, 2022 10:30 AM (20 minutes)

We will describe the current status of the ASTRI Mini-Array, under construction at the Teide Astronomical Observatory in Tenerife, Spain. The final layout of the array will include 9 small Cherenkov telescopes covering an area of about 650 x 270 square meters. The ASTRI telescopes adopt a dual-mirror Schwarzchild-Couder optical design. In the focal plane, the ASTRI camera, based on silicon photon-multipliers detectors, will cover a large field-of-view (~10 deg in diameter). This system provides a good gamma-ray sensitivity also at very high energies (VHE, above 100 TeV) and large off-axis angles (up to ~5 degrees), combined with a good angular resolution.
The scientific goals of the ASTRI Mini-Array include spectral and morphological characterization of the LHAASO sources and other Pevatron candidates, studies of PWNe and TeV halos, Blazar monitoring at VHE, fundamental physics and follow-up of transient events. The beginning of the scientific operations is planned in late 2024. The first 3 years will be dedicated to the core science and the ASTRI Mini-Array will be run as an experiment. During the following years it will gradually move towards an observatory model, open to the community.

Author: GIULIANI, Andrea (INAF - IASF Milano)

Presenter: GIULIANI, Andrea (INAF - IASF Milano)

Session Classification: Invited Talks (Aula Magna Biologia) Chair: Stefano Vercellone

Contribution ID: **257** Type: **Review, Highlight, or Invited talk**

Status of SWGO Project

Friday, July 8, 2022 10:50 AM (20 minutes)

The HAWC and LHAASO observatories have demonstrated the power of ground-level particle detection for very high energy gamma-ray astronomy. The wide-field and high duty cycle nature of this approach is highly complementatary to the more well-established imaging atmospheric Cherenkov Technique technique. The Southern Wide-field Gamma-ray Observatory (SWGO) is a global effort towards a next generation observatory of this type, to be located in the Andes of South America. SWGO is targetting transient astrophysics, large-scale diffuse emission and ultra-high energy emission. As the first instrument of its type in the southern hemisphere there is huge discovery potential, and SWGO will strongly complement the CTA Southern Array to be built in Chile. The project is currently in an R&D phase but the international collaboration is now well established and major design decisions and site choice are on the horizon. In this presentation I will discuss the science goals and the current status and timeline of the project.

Author: HINTON, Jim (MPIK Heidelberg)

Presenter: HINTON, Jim (MPIK Heidelberg)

Session Classification: Invited Talks (Aula Magna Biologia) Chair: Stefano Vercellone

Contribution ID: **258** Type: **not specified**

Rapporteur: Extragalactic Science

Friday, July 8, 2022 12:10 PM (30 minutes)

Author: MUKHERJEE, Reshmi (Barnard College, Columbia University)

Presenter: MUKHERJEE, Reshmi (Barnard College, Columbia University)

Session Classification: Reports (Aula Magna Biologia) Chair: Josep M. Paredes

Contribution ID: **259** Type: **not specified**

Rapporteur: Galactic Science

Friday, July 8, 2022 11:40 AM (30 minutes)

Author: RIBÓ, Marc (mribo@fqa.ub.edu)

Presenter: RIBÓ, Marc (mribo@fqa.ub.edu)

Session Classification: Reports (Aula Magna Biologia) Chair: Josep M. Paredes

Contribution ID: **260** Type: **Contributed talk**

Probing the intergalactic magnetic field through gamma-ray observations with the Fermi LAT and H.E.S.S.

Wednesday, July 6, 2022 3:00 PM (15 minutes)

Magnetic fields in galaxies and galaxy clusters are believed to be the result of the amplification of seed fields during structure formation. However, the origin of this intergalactic magnetic field (IGMF) remains unknown. Observations of high-energy gamma rays from distant blazars offer an indirect probe of the IGMF. Gamma-rays interact with the extragalactic background light to produce electron-positron pairs, which can subsequently initiate electromagnetic cascades whose gamma-ray signature depends on the IGMF. Here, we report on a new search for the cascade emission using a combined data set from the Fermi Large Area Telescope (LAT) and the High Energy Stereoscopic System (H.E.S.S.). Using state-of-the-art Monte Carlo predictions for the cascade signal, our preliminary results exclude an IGMF $< 7 \times 10^{-16}$G for a coherence length of 1 Mpc even when blazar duty cycles as short as 10 years are assumed. This improves previous limits by a factor of 2.

Author: MEYER, Manuel (University of Hamburg)

Presenter: MEYER, Manuel (University of Hamburg)

Session Classification: Contributed Talks

Contribution ID: **261** Type: **Contributed e-poster**

Characteristic multi-wavelength emission signatures from strong shock-shock interactions in perturbed relativistic jets

The diffusive shock acceleration of a population of relativistic electrons on internal shocks is one of the main scenarios to account for the multi-wavelength (MWL) flux variability observed in relativistic jets of active galactic nuclei. In addition to observations of flux variability, constraints are also provided by very-long-baseline interferometry (VLBI), which shows a large variety of moving and standing emission zones with distinct behavior.
We will present a model combining relativistic magneto-hydrodynamic jet simulations (MPI-AMRVAC code) with radiative transfer (RIPTIDE code). We simulate the evolution of standing and moving emission zones in the jet and study their MWL signatures from the radio to the very-high-energy (VHE) gamma-ray band by taking into account relativistic effects (Doppler beaming and light crossing time).
We focus our attention on strong interactions between a fast moving shock and stationary recollimation shocks, to study how such events lead to a significant perturbation of the stationary jet structure. Various jet geometries and large-scale magnetic field structures are tested.
Sufficiently strong shock - shock interactions are shown to lead to the appearance of trailing components, which appear in the wake of the leading moving shock. We characterize such relaxation shocks by two observational markers, one in the radio band in the time-distance plot of bright VLBI components and one at higher frequencies under the form of « flare echoes ». Our results provide a coherent interpretation of radio VLBI observations in several radio galaxies.

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Presenter: FICHET DE CLAIRFONTAINE, Gaëtan (Laboratoire Univers et Théories, Observatoire de Paris, Université PSL, Université de Paris Cité, CNRS)

Session Classification: Contributed posters

Contribution ID: **262** Type: **Contributed talk**

Shear acceleration in AGN jets

Monday, July 4, 2022 3:00 PM (15 minutes)

X-ray observations of kilo-parsec scale jets indicate that a synchrotron origin of the sustained non-thermal emission is likely. This requires distributed acceleration of electrons up to near PeV energies along the jet. The underlying acceleration mechanism is still unclear. Shear acceleration is a promising candidate. We studied the details of shear acceleration by solving the steady-state Fokker-Planck-type equation and provide a simple general solution for trans-relativistic jets for a range of magnetohydrodynamic turbulent power-law spectra. In general, the accelerated particle population is a power-law spectrum with an exponential-like cut-off, where the power-law index is determined by the turbulence spectrum and the balance of escape and acceleration of particles. We find that in this framework the multi-wavelength spectral energy distribution of X-ray jets, such as Centaurus A and 3C 273, can be well explained and protons can be accelerated up to $\sim$ EeV. Relativistic MHD simulations using PLUTO have been performed to physically motivate the shear profile and turbulence spectrum.

Authors: WANG, Jieshuang (Max-Planck-Institut für Kernphysik); Dr REVILLE, Brian; Prof. RIEGER, Frank; LIU, Ruo-Yu (DESY); Prof. AHARONIAN, Felix (MPIK, DIAS, NASRA)

Presenter: WANG, Jieshuang (Max-Planck-Institut für Kernphysik)

Session Classification: Contributed Talks

Contribution ID: **263** Type: **Contributed talk**

Particle acceleration at pulsar wind termination shocks revisited: shear, reconnection and giant plasmoids

Thursday, July 7, 2022 3:00 PM (15 minutes)

Particle acceleration in relativistic shocks is quenched in the presence of a transverse magnetic field, even for a moderately low upstream magnetization. Pulsar wind nebulae form downstream of an ultra-relativistic magnetized shock; yet these objects are one of the most efficient particle accelerators known in the Galaxy. We propose that the key to this striking discrepancy lies in the anisotropic nature of the magnetic field profile in the pulsar wind. Using particle-in-cell simulations, we show that it has a dramatic impact on the structure and evolution of the shock. The formation of a current sheet in the equatorial plane, combined with a large-scale velocity shear flow lead to strong plasma turbulence and efficient non-thermal particle acceleration near the Bohm limit. The interplay between these processes may power the bright synchrotron nebula surrounding pulsars and possibly the puzzling Crab gamma-ray flares. Another important feature of the predicted shock structure is the presence of hot macroscopic filaments whose formation is driven by reconnection along the equatorial plane. We argue that these compact plasma structures (giant plasmoids) may explain the mysterious knots contained within the Crab Nebula inner ring.

Authors: Mr CERUTTI, Benoît (CNRS & Université Grenoble Alpes); Mr GIACINTI, Gwenaël (Max--Planck-Institut für Kernphysik & Tsung-Dao Lee Institute)

Presenter: Mr CERUTTI, Benoît (CNRS & Université Grenoble Alpes)

Session Classification: Contributed Talks

Contribution ID: **264** Type: **Contributed talk**

Relativistic magnetic bombs

Wednesday, July 6, 2022 5:00 PM (15 minutes)

We develop models of magnetically-driven relativistic explosions, with application to flares from Soft Gamma-Ray Repeaters and Fast Radio Bursts. Non-stationarity, and the conservation of magnetic flux make magnetized explosion qualitatively different from stationary MHD flows, as well as fluid explosions. We study generation of relativistic coronal ejection, conditions for generating causally-disconnected flows, and later dynamics of ejected structures.

Author: LYUTIKOV, Maxim (Purdue University)

Presenter: LYUTIKOV, Maxim (Purdue University)

Session Classification: Contributed Talks

Contribution ID: **265** Type: **Contributed e-poster**

A hybrid numerical approach to model pulsar magnetosphere.

The study of pulsar magnetospheres has developed quickly in recent years thanks to the development of high-performance computing. Two complementary numerical methods have been used to model these objects thus far: the magnetohydrodynamic (MHD) and the particle-in-cell (PIC) techniques. The MHD approach is well-suited to describe the plasma at large scales, while the PIC method is appropriate to capture the microphysics but it is computationally expansive. Our objective is to combine the strengths of both approaches into the same numerical framework in order to achieve a larger scale separation and magnetic field strength. This approach will allow us to make realistic predictions of particle and electromagnetic spectra for pulsar, therefore bridging the gap between observations and ab-initio models. In this contribution, I will present a first application of this approach to the aligned pulsar magnetosphere.

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Presenter: SOUDAIS, Adrien (CNRS & Université Grenoble Alpes)

Session Classification: Contributed posters

Contribution ID: **266** Type: **Contributed e-poster**

An Off-axis Jet Model for Multi-wavelength Afterglow Emission of GRB 190829A detected by H.E.S.S.

Recently, ground-based Imaging Atmospheric Cherenkov Telescopes, such as MAGIC and H.E.S.S., have reported the detection of very-high-energy (VHE) gamma-rays from four gamma-ray bursts (GRB 180720B, 190114C, 190829A, 201216C). One of them, GRB 190829A, was triggered by the Swift satellite, and about 20000 s after the burst onset the VHE gamma-ray emission was detected by H.E.S.S. with ~ 20 sigma significance. This event had more unusual features than the other VHE gamma-ray events. First, it had much smaller isotropic equivalent gamma-ray energy than typical long gamma-ray bursts and is classified as low-luminosity GRB. Second, early X-ray and optical afterglow emission showed a rising part and simultaneously peaked at about 2000 s. We propose an off-axis jet model that explains these observational results. In this model, the relativistic beaming effect is responsible for the apparently small isotropic gamma-ray energy and spectral peak energy. Using a jetted afterglow model, we find that the narrow jet, which has the initial Lorentz factor of 300-500 and the initial jet opening half-angle of 0.01-0.02 rad, viewed off-axis can describe the observed achromatic behavior in the X-ray and optical afterglow. Another wide, baryon-loaded jet is necessary for the later-epoch X-ray and radio emissions. Our model parameters determined by X-ray, optical and radio afterglows may roughly explain observed VHE gamma-ray flux.

Author: SATO, Yuri (Aoyama Gakuin University)

Co-authors: Ms OBAYASHI, Kaori (Aoyama Gakuin University); Prof. YAMAZAKI, Ryo (Aoyama Gakuin University); MURASE, Kohta (Penn State); Dr OHIRA, Yutaka (University of Tokyo); TANAKA, Shuta (Aoyama Gakuin University)

Presenter: SATO, Yuri (Aoyama Gakuin University)

Session Classification: Contributed posters

Contribution ID: **267** Type: **Contributed e-poster**

Optical studies of gamma-ray binaries and candidate systems

Highly accurate photometry of the optical companion in gamma-ray binary systems has the potential to enable the exploration of previously unknown phenomena. Here we report the discovery of repeated optical flares evolving on time scales of about one day in the optical light curve of the well known system LSI +61303. Their amplitude does not exceed 0.01-0.02 magnitudes and, therefore, they are only within reach of space observatories such as the Transiting Exoplanet Survey Satellite (TESS) in the 600-1000 nm bandpass. We tentatively propose that these flaring events are shock-powered in nature as the compact object in LSI+61303 interacts with the circumstellar envelope of its Be star companion. Comparison with other systems (MWC 148 and MWC 656) is also addressed. Moreover, the TESS data appears as a useful complementary tool to search for signatures of binarity in other stellar objects tentatively associated with unidentified gamma-ray sources.

Authors: MARTÍ, Josep (Universidad de Jaén); LUQUE-ESCAMILLA, Pedro L. (Universidad de Jaén); MESTRE, Enrique (Universidad de Jaén); Dr SÁNCHEZ-AYASO, Estrella (Universidad de Huelva); PAREDES, Josep Maria (Universitat de Barcelona); DEL SER BADIA, Daniel (ICCUB, Observatori Fabra); Prof. NÚÑEZ, Jorge (Universitat de Barcelona, Observatori Fabra)

Presenter: MARTÍ, Josep (Universidad de Jaén)

Session Classification: Contributed posters

Contribution ID: **268** Type: **Contributed e-poster**

Prospects for annihilating dark matter from observations of the M31 and M33 nearby spiral galaxies with the Cherenkov Telescope Array

M31 and M33 are the closest spiral galaxies and the largest members (together with the Milky Way) of the Local group, which makes them interesting targets for indirect dark matter searches. In this paper we present studies of the expected sensitivity of the Cherenkov Telescope Array (CTA) to an annihilation signal from weakly interacting massive particles from M31 and M33. We show that a 100 h long observation campaign will allow CTA to probe annihilation cross-sections up to $\langle \sigma v \rangle \approx 5 \cdot 10^{-25}\ \mathrm{cm^3 s^{-1}}$ for the $\tau^+\tau^-$ annihilation channel (for M31, at a DM mass of 0.3 TeV), improving the current limits derived by HAWC by up to an order of magnitude.
We present a robust estimate of the expected CTA sensitivity, by also taking into account the contributions of the astrophysical background and other possible sources of systematic uncertainty. We show that CTA might be able to detect the extended emission from the bulge of M31, detected at lower energies by the Fermi/LAT.

Author: Mr MICHAILIDIS, Miltiadis (IAAT-University of Tuebingen)

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Presenter: Mr MICHAILIDIS, Miltiadis (IAAT-University of Tuebingen)

Session Classification: Contributed posters

Contribution ID: **269** Type: **Contributed e-poster**

Origin of Gamma-rays from the Circumgalactic medium of Andromeda Galaxy

I will highlight a recent, very interesting observation (https://arxiv.org/abs/1903.10533) of gamma-ray signatures in the Circumgalactic medium (CGM) of Andromeda (M31) galaxy (~100 kpc) in the light of hadronic interaction of cosmic ray (CR) protons with the cold protons of CGM. We used two fluids (thermal + Cosmic ray) hydrodynamical simulation code PLUTO in order to simulate this scenario. Many recent studies have tried to explain this obseravation in light of Dark matter annihilation as well as leptonic interaction of CR electrons in accretion shocks. However, we intend to motivate that one can explain this observation with simple physics of star-formation and hadronic interaction without going into exotic physics of Dark matter annihilation. In our picture, CR particles are accelerated in star formation activity in the M31 disc as well as in-situ in the shocks and combined effect of advection due to outflow and diffusion can help those CRs to reach the CGM of M31. These CRs interact hadronically with CGM protons and give rise to the observed gamma-ray signature.

Authors: ROY, Manami (PhD Student at Raman Research Institute, Pre-doctoral fellow at Center for computational astrophysics, Flatiron Institute); NATH, Biman (Raman Research Institute)

Presenter: ROY, Manami (PhD Student at Raman Research Institute, Pre-doctoral fellow at Center for computational astrophysics, Flatiron Institute)

Session Classification: Contributed posters

Contribution ID: **270** Type: **Contributed e-poster**

Multimessenger Parameter Estimation of GW170817: From Jet Structure to the Hubble Constant

The electromagnetic radiation that followed the neutron star merger event GW170817 revealed that gamma-ray burst afterglows from jets misaligned with our line of sight exhibit a light curve with slowly rising flux. The slope of the rising light curve depends sensitively on the angle of the observer with respect to the jet axis, which is likely to be perpendicular to the merger plane of the neutron star binary. Therefore, the afterglow emission can be used to constrain the inclination of the merging system. Here, we calculate the gamma-ray burst afterglow emission based on the realistic jet structure derived from general-relativistic magnetohydrodynamical simulations of a black hole torus system for the central engine of the gamma-ray burst. Combined with gravitational wave parameter estimation, we fit the multi-epoch afterglow emission of GW170817. We show that with such a jet model, the observing angle can be tightly constrained by multimessenger observations. The best fit observing angle of GW170817 is $\theta_{\rm v} = 0.38 \pm 0.02$ rad. With such a constraint, we can break the degeneracy between inclination angle and luminosity distance in gravitational wave parameter estimation, and substantially increase the precision with which the Hubble constant is constrained by the standard siren method. Our estimation of the distance is $D_{\rm L} = 43.4 \pm 1$ Mpc and the Hubble constant constraint is $\rm H_0 = 69.5 \pm 4\,km\,s^{-1}\,Mpc^{-1}$. As a result, multimessenger observations of short-duration gamma-ray bursts, combined with a good theoretical understanding of the jet structure, can be powerful probes of cosmological parameters. https://arxiv.org/abs/2009.04427

Authors: WANG, Hao (Department of Physics and Astronomy, Purdue University); Prof. GIANNIOS, Dimitrios (Department of Physics and Astronomy, Purdue University)

Presenter: WANG, Hao (Department of Physics and Astronomy, Purdue University)

Session Classification: Contributed posters

Contribution ID: **271** Type: **Contributed talk**

New cosmic-ray acceleration sites detected by the Fermi-LAT in our Galaxy

Tuesday, July 5, 2022 3:30 PM (15 minutes)

Cosmic rays are mostly composed by protons accelerated to relativistic speeds. When those protons encounter interstellar material, they produce neutral pions which in turn decay into gamma rays. This offers a compelling way to identify the acceleration sites of protons. A characteristic hadronic spectrum was detected in the gamma-ray spectra of four Supernovae Remnants (SNRs), IC 443, W44, W49B and W51C, with the Fermi Large Area Telescope. This detection provided direct evidence that cosmic-ray protons are (re-)accelerated in SNRs.

In this review, we present the results from a comprehensive search for low energy spectral breaks. We use 8 years of data from the Fermi Large Area Telescope between 50 MeV and 1 GeV. This search is based on the 4FGL catalog from which we extracted the unidentified sources or those associated to SNRs with a significance above 3 sigma at low energy in both cases. Several SNRs, binaries and one star forming region as well as a handful of unidentified sources are detected with our search.
These best candidates will be presented, focusing on the most intriguing cases such as Eta Carinae and the Cygnus star forming region, thus enlarging our view to potential new cosmic-ray acceleration sites.

Authors: LEMOINE-GOUMARD, Marianne (LP2I Bordeaux); Dr BALLET, Jean (CEA); Dr REPOSEUR, Thierry (LP2I Bordeaux)

Presenter: LEMOINE-GOUMARD, Marianne (LP2I Bordeaux)

Session Classification: Contributed Talks

Contribution ID: **272** Type: **Contributed e-poster**

Is GLIMPSE-C01 really a gamma-ray emitter?

GLIMPSE-C01 is a globular cluster located in the direction of Aquila (Kobulnicky et al 2005). More than a decade ago, we proposed it as a gamma ray emitter given its coincidence with the 9.6 arcmin 95% confidence error radius of the Fermi source 0FGL J1848.6-0138 (Luque-Escamilla et al 2009). The recent update of the Fermi catalogue confirms the gamma-ray detection, being now named as 4FGL J1848.7-0129, and a much more precise location is available (95% ellipse error or of only 2.0 × 1.9 arcmin). The Fermi source is currently associated to GLIMPSE-C01 with a Bayesian probability of 99.94%, thus in principle supporting our initial guess.

Lately, GLIMPSE-C01 came into the spotlight because a faint X-ray transient named MAXI J1848-015 has recently been discovered inside the cluster. Although the associated gamma ray emission has no confident variability, this transient object was proposed to be related to the Fermi source (ATel #14420).

In view of this outcome, we have revisited the multi-wavelength data available for GLIMPSE-C01. In particular, we found that the all-sky radio survey with the Giant Metrewave Radio Telescope in Pune (India) detected an obvious source at 150 MHz just in the middle of the latest 4FGL J1848.7-0129 ellipse, which is well offset from the center of the cluster. In fact, this radio source has no detected higher radio frequency counterpart, indicating a likely non-thermal spectral index. Moreover, it displays, a radio morphology strongly reminiscent of a one-sided jet emitter. There is also a Chandra counterpart to the core of this new radio source that exhibits clear X-ray variability and remained unnoticed until now. Therefore, we have collected serious evidences of the existence of a new blazar candidate to be tentatively associated with 4FGL J1848.7-0129 source instead of GLIMPSE C01. Further observational studies of this new counterpart candidate will hopefully give more credit to this latest identification proposal.

Authors: LUQUE-ESCAMILLA, Pedro (UJA); MARTÍ, Josep (Universidad de Jaén); MESTRE, Enrique (Universidad de Jaén); Dr COMBI, Jorge (Universidad de Jaén); Dr ALBACETE-COLOMBO, Juan Facundo (Universidad de Rio Negro, Sede Atlantica - CONICET, Viedma CP8500, Argentina)

Presenters: LUQUE-ESCAMILLA, Pedro (UJA); MARTÍ, Josep (Universidad de Jaén)

Session Classification: Contributed posters

Contribution ID: **273** Type: **Contributed e-poster**

Probing the multiwavelength emission scenario of GRB 190114C

The multiwavelength observation of GRB 190114C, one of the extremely bright gamma-ray bursts (GRBs), opens a new window for studying the emission mechanism of GRBs. The Very-High-Energy (VHE; >100 GeV) detection by MAGIC suggested the inverse Compton process as the emission mechanism for the VHE gamma-rays during the early afterglow phase of the burst. However, other VHE GRB detections have casted doubt on this scenario as the inverse-Compton emission has not been clearly observed in other bursts. Furthermore, in GRB190114C, only a limited number of statistical and systematic studies on the emission scenario have been performed. Here, we perform the full likelihood analysis with the multiwavelength dataset: Swift-XRT, Swift-BAT, Fermi-GBM, Fermi-LAT, and MAGIC. We compute the statistical preference of the combined synchrotron (syn) and synchrotron self-Compton (SSC) model over the syn-only model, and check the stability of this preference.

Author: KLINGER, Marc (DESY Zeuthen)

Co-authors: TAYLOR, Andrew (DESY Zeuthen); TAK, Donggeun (DESY Zeuthen); ZHU, Sylvia (DESY Zeuthen)

Presenter: KLINGER, Marc (DESY Zeuthen)

Session Classification: Contributed posters

Contribution ID: **274** Type: **Contributed talk**

The peculiar short-duration GRB 200826A and its supernova

Monday, July 4, 2022 5:30 PM (15 minutes)

Short Gamma-ray burst (sGRBa) are linked to the merger of compact objects. However the **GRB 200826A is peculiar** because by definition it was a SGRB, with a rest-frame duration of ~ 0.5 s, but this event was energetic and soft, which is consistent with long GRBs (LGRBs) associated with the end states of very massive stars. The relatively low redshift (z=0.75) motivated a multi-wavelength follow-up campaign to understand the origin of this burst. To this aim we obtained a combination of deep near-infrared (NIR) imaging in adaptive optics, coupled with optical imaging and spectroscopy. *Our analysis reveals an optical and NIR bump in the light curve whose luminosity and evolution is in agreement with several LGRB-SNe.* It is not compatible with both theoretical models of kilonovae (KNe) and with AT2017gfo, the KNa associated with the gravitational wave signal GW 170817. Analysis of the prompt GRB shows that *this event follows the Amati relation* found for LGRBs. The host galaxy is a low-mass star-forming galaxy, typical for LGRBs, but with one of the highest specific star-formation rates. **We conclude that GRB 200826A is a typical collapsar event in the low tail of the duration distribution of LGRBs.**
ADS link: https://ui.adsabs.harvard.edu/abs/2021arXiv210503829R/abstract

Author: ROSSI, Andrea (INAF - Osservatorio di Astrofisica e Scienza dello Spazio)

Presenter: ROSSI, Andrea (INAF - Osservatorio di Astrofisica e Scienza dello Spazio)

Session Classification: Contributed Talks

Contribution ID: **275** Type: **Contributed e-poster**

The very high-z GRB 210905A

We present the discovery of the very energetic **GRB 210905A at the high redshift z=6.312** and its luminous X-ray and optical afterglow. With an *isotropic gamma-ray energy of Eiso*$\sim 10^{54}$ *erg*, GRB 210905A lies in the top 7% GRBs in the Konus-Wind Catalog in terms of energy released. *Its afterglow is also among the most luminous ever observed, and, in particular in the optical at* $>$*0.5 d (rest frame).* The early afterglow light curve can be explained by energy injection and the spectral energy distribution is in agreement with slow cooling in a constant-density environment. The half-opening angle is within the range covered by closer events and thus argues against recent claims of an inverse dependence of the half-opening angle on the redshift. *The collimation-corrected released gamma-ray energy of'1×1052erg which is also among the highest ever measured.*
Despite the great released energy, our findings demonstrate that the properties of this burst are in agreement with those of less distant burst. ADS link: https://ui.adsabs.harvard.edu/abs/2022arXiv2202045

Author: ROSSI, Andrea (INAF - Osservatorio di Astrofisica e Scienza dello Spazio)

Presenter: ROSSI, Andrea (INAF - Osservatorio di Astrofisica e Scienza dello Spazio)

Session Classification: Contributed posters

Contribution ID: **276** Type: **Contributed e-poster**

Detecting of the High-Energy Cutoffs for a Sample of Bright Fermi (GBM+LLE) GRBs

Gamma-ray bursts (GRBs) are extremely energetic explosions that are powered by ultra-relativistic jets. It is suggested that the shape of the GRB spectrum in the high- energy spectral cutoff region is relevant to the cutoff region of the primary particles within the prompt emission. In this article, a joint-fit Fermi (GBM+LLE) spectral analysis is provided with a sample of 36 GRBs that were detected simultaneously. Attempts have been made to constrain the high-energy cutoff Ec achievable by the high-energy observations to > 130 MeV using the BandCut model. we approved only three out of 36 GRBs that show such high energy cutoff Ec. Whereas others (4 GRBs) show an energy break, Eb, instead. The occurrence of the energy break Eb somewhere in the spectrum between 100-300 keV is due to the BandCut model not be well con- strained towards the end of the high-energy LLE band at >130 MeV. Which then results in spectral parameter values being obtained that are somewhat equivalent to the values obtained from the simple Band model with an energy peak Epeak. This is seemingly close to the high-energy cutoff Ec obtained from the BandCut model, and hence estimate Lorentz factor Γ for three GRBs in the sample.

Author: MONEER, Eman (Dr)

Presenter: MONEER, Eman (Dr)

Session Classification: Contributed posters

Contribution ID: **277** Type: **Contributed e-poster**

Dark matter searches through correlations of the gamma-ray sky with neutral hydrogen, cosmic voids and galaxies surveys

Dark matter in cosmic structures is expected to produce signals that originate from its particle-like nature, among which the electromagnetic emission represents a relevant opportunity. However, this emission is very faint and contribute only to the unresolved background radiation. This background emission is isotropic at first order, but exhibits a degree of anisotropy since it originates from clustered dark matter haloes. This fact implies that the anisotropies in the radiation field will be correlated to the matter distribution in the Universe.

In this work we propose to exploit this correlation by using neutral hydrogen intensity mapping via the 21cm emission line as a tracer of the matter distribution, and gamma rays as the tracer of dark matter annihilation. Intensity mapping (IM) offers excellent redshift information since it measures a line emission. Also, IM has the advantage of not being flux limited in the measurement of the matter distribution, as opposed to galaxy surveys, since it does not need to resolve individual galaxies. We show the expected signal from this cross-correlation channel and we forecast constraints through the combination of Fermi-LAT gamma-ray data and the next-generation radio telescope Square Kilometre Array. We extended this powerful technique by including the complementary information offered by cosmic voids. Finally, we present the preliminary results of the cross-correlation between galaxy surveys and the gamma-ray flux from the upcoming gamma-ray detector CTA.

Author: PINETTI, Elena (Fermilab)

Presenter: PINETTI, Elena (Fermilab)

Session Classification: Contributed posters

Contribution ID: **278** Type: **Contributed talk**

Radio pulsations from LS I 61 303

Wednesday, July 6, 2022 5:00 PM (15 minutes)

LS I +61 303 303 is one of the rare gamma-ray binaries, emitting most of their luminosity in photons with energies beyond 100 MeV. The ~26.5 d orbital period is clearly detected at many wavelengths. Additional aspects of its multi-frequency behavior make it the most interesting example of the class. The morphology of high-resolution radio images changes with orbital phase displaying a cometary tail pointing away from the high-mass star. LS I +61 303 303 also shows superorbital variability. A couple of energetic (~ 10^37 erg/s), short, magnetar-like bursts have been plausibly ascribed to it. LS I +61 303 303's phenomenology has been put under theoretical scrutiny for decades, but the lack of certainty regarding the nature of the compact object in the binary has prevented advancing our understanding of the source. Here, using observations done with the Five-hundred-meter Aperture Spherical radio Telescope (FAST), we report on the existence of transient radio pulsations from the direction of LS I +61 303 303. We find a period P=269.15508 (\pm) 0.00016 ms at a significance of > 20 sigma. This is the first evidence for pulsations from this source at any frequency, and strongly argues for the existence of a rotating neutron star in LS I +61 303 303. We try to put this measurement in the context of models of the source, analyzing the possible state such pulsar could be in, and what kind of magnetospheric gamma-ray emission could be expect from it, if any.

Partly based on the paper published in Nature Astronomy (March 2022)
(https://doi.org/10.1038/s41550-022-01630-1)
by Shan-Shan Weng, Lei Qian, Bo-Juan Wang, D. F. Torres, A. Papitto, P. Jiang, Renxin Xu, Jian Li, Jing-Zhi Yan, Qing-Zhong Liu, Ming-Yu Ge, and Qi-Rong Yuan

Author: TORRES, Diego F (ICREA & Institute of Space Science (ICE, CSIC))

Presenter: TORRES, Diego F (ICREA & Institute of Space Science (ICE, CSIC))

Session Classification: Contributed Talks

Contribution ID: **279** Type: **Contributed talk**

A multi-wavelength view of gamma-ray emitting extreme BL Lacertae blazar candidates hidden within Fermi-LAT data.

Monday, July 4, 2022 3:30 PM (15 minutes)

Blazars are key-elements in the understanding of the extragalactic gamma-ray sky. These sources are jetted radio-loud active galactic nuclei dominated by non-thermal emission that extends across the electromagnetic spectrum. Their emission is a proof of cosmic particle acceleration and the production of ultra-relativistic particles within the blazar structure, and are therefore excellent astroparticle physics laboratories. Particularly interesting are extreme high-synchrotron-peak (EHSP) blazars, a subtype of blazar whose gamma-ray emission is expected to peak at TeV energies, yet surprisingly they are a minority in very high energy source catalogs. In this talk, we show a model-driven methodology to search for EHSP blazars based on data from NASA's Fermi Gamma-ray Space Telescope in addition to archival radio, optical, and X-ray data. This method allows us to study their physical properties. Our main results are (1) finding 17 new EHSP blazars, increasing significantly their number, (2) that only 2 of them seem to be detectable by TeV telescopes, and (3) these 2 objects are outliers relative to their magnetic versus kinetic energy density. We discuss some interpretations of these results.

Authors: NIEVAS ROSILLO, Mireia (IAC); Dr DOMINGUEZ, Alberto (IPARCOS-GAE); Dr CHIARO, Graziano (IASF/INAF, CIFS); Dr LA MURA, Giovanni (LIP); S. PALIYA, Vaidehi (ARIES); Dr BRILL, Aryeh (NASA)

Presenter: NIEVAS ROSILLO, Mireia (IAC)

Session Classification: Contributed Talks

Contribution ID: **282** Type: **Contributed talk**

Investigating the puzzling radio structures of the gamma-ray binary LS 5039

Wednesday, July 6, 2022 6:15 PM (15 minutes)

LS 5039 is a gamma-ray binary system hosting a compact object and a massive O-type stellar companion. It presents a broadband emission spectrum that goes from radio up to gamma rays with energies of a few dozen TeV. There are two main physical scenarios proposed to explain this emission, both of them involving charged particle acceleration up to ultra-relativistic energies and their subsequent non-thermal radiative cooling as they propagate through a relativistic outflow. In the microquasar scenario, most of the non-thermal emission is originated in jets launched from the compact object. In the pulsar-wind scenario, in which the compact object is always a non-accreting pulsar, the non-thermal radiation comes from an outflow produced by the interaction of the pulsar and stellar winds.

In this contribution, we will present a semi-analytical model that computes the dynamical evolution of the outflows of LS 5039 in both scenarios. Using this hydrodynamical information, the model also includes a consistent computation of the radiation expected from this system. In particular, with the aim of discriminating between the two scenarios, we compute the extended radio emission of LS 5039 in both the microquasar and pulsar-wind cases, and compare it with the available observational data.

Authors: MOLINA, Edgar (Universitat de Barcelona - ICCUB); BOSCH-RAMON, Valenti (Universitat de Barcelona/ICCUB)

Presenter: MOLINA, Edgar (Universitat de Barcelona - ICCUB)

Session Classification: Contributed Talks

Contribution ID: **283** Type: **Contributed e-poster**

Characterization of the GeV emission from the Kepler supernova remnant

The Kepler supernova remnant was until recently the only historic supernova remnant lacking a detection at GeV and TeV energies. Using an optimized analysis based on 12 years of Fermi-LAT observations, we report a solid >6σ detection with a spectral index of 2.1 for an energy flux above 100 MeV of 3.1×10^{-12} erg.cm^{-2}.s^{-1}. The gamma-ray excess is fully compatible with the radio, infrared or X-ray spatial distribution of the SNR.
In this presentation, we will review the morphological and spectral characteristics of the GeV source. A broad-band modeling describing the multi-wavelength observations will also be presented along with its main constraints on the accelerated particles.

Authors: LEMOINE-GOUMARD, Marianne (LP2I Bordeaux); Dr ACERO, Fabio (AIM, CEA, CNRS, Université Paris-Saclay); Dr BALLET, Jean (CEA)

Presenter: LEMOINE-GOUMARD, Marianne (LP2I Bordeaux)

Session Classification: Contributed posters

Contribution ID: **284** Type: **Contributed talk**

On the potential of bright, young pulsars to power ultra-high gamma-ray sources

Tuesday, July 5, 2022 5:30 PM (15 minutes)

The recent discovery of a new population of ultra-high-energy gamma-ray sources with spectra extending beyond $100\,\mathrm{TeV}$ revealed the presence of Galactic PeVatrons - cosmic-ray factories accelerating particles to PeV energies. These sources, except for the one associated with the Crab Nebula, are not yet identified. With an extension of 1 degree or more, most of them contain several potential counterparts, including Supernova Remnants, young stellar clusters and Pulsar Wind Nebulae (PWNe), which can perform as PeVatrons and thus power the surrounding diffuse ultra-high energy gamma-ray structures. In the case of PWNe, gamma rays are produced by electrons, accelerated at the pulsar wind termination shock, through the inverse Compton scattering of 2.7 K CMB radiation. The high conversion efficiency of pulsar rotational power to relativistic electrons, combined with the short cooling timescales, allow gamma-ray luminosities up to the level of $L_\gamma \sim 0.1\dot{E}$. The pulsar spin-down luminosity, $\dot{E}$, also determines the absolute maximum energy of individual photons: $E_{\gamma\,\mathrm{max}} \approx 0.9\dot{E}_{36}^{0.65}$ PeV. This fundamental constraint dominates over the condition set by synchrotron energy losses of electrons for young PWNe with typical magnetic field of ≈100~μG with $\dot{E} < 10^{37}\,\mathrm{erg/s}$. We will discuss the implications of $E_{\gamma\,\mathrm{max}}$ by comparing it with the highest energy photons reported by LHAASO from a dozen of ultra-high-energy sources.

Authors: DE ONA WILHELMI, Emma (DESY); LÓPEZ-COTO, Rubén (Università di Padova and INFN); Dr AMATO, Elena; Prof. AHARONIAN, Felix (MPIK, DIAS, NASRA)

Presenter: DE ONA WILHELMI, Emma (DESY)

Session Classification: Contributed Talks

Contribution ID: **285** Type: **Contributed e-poster**

A NuSTAR view of SS433

SS433 is a galactic microquasar with powerful outflows, originated in jets, accretion disk and winds, with well known orbital, precessional and nutational periods. In this work we present a characterization of different outflows parameters throughout the precessional cycle of the system, by analyzing 10 NuSTAR (3–70 keV) observations of ~30 ks that span ~1.5 precessional cycles. We have extracted averaged spectra and model them using a combination of a double thermal jet model (bjet) and pure neutral and relativistic reflection (xillverCp and relxilllpCp) over an accretion disk (diskbb). As a result, we find an average jet bulk velocity of $\beta \sim 0.29$ with an opening angle < 0.6 degrees. The western to eastern jet flux contribution becomes ~ 1 on intermediate phases, about 35% of the total precessional orbit. The 3–70 keV total unabsorbed luminosity of the jets and disk ranges from 2–20 ×10^37 erg/s, with the jet being completely soft dominated (3–10 keV) while the disk reflection component completely hard dominated (10–70 keV). The central source and lower parts of the jets could be hidden by an optically thick region of $\tau \sim NH \sim 1.5 \times 10^{22}$ cm−2 and size R ~ NH /ne0 ~ 1.5 × 10^9 cm.

Authors: Dr COMBI, Jorge Ariel (Universidad de Jaén); Dr FOGANTINI, Federico (IAR); Dr GARCÍA, Federico (IAR); Dr CHATY, Sylvain (Université de Paris, CNRS); Dr MARTI, Josep (UJA); Dr LUQUE ESCAMILLA, Pedro Luis (UJA)

Presenter: Dr COMBI, Jorge Ariel (Universidad de Jaén)

Session Classification: Contributed posters

Contribution ID: **286** Type: **Contributed talk**

An Upper Bound for the Neutrino Flux From Jets of Active Galactic Nuclei

Thursday, July 7, 2022 3:45 PM (15 minutes)

We present a bottom-up calculation of the flux of ultra-high energy cosmic rays (UHECRs) and high-energy neutrinos produced by powerful jets of active galactic nuclei (AGNs).
By propagating test particles in 3D relativistic magnetohydrodynamic jet simulations, including a Monte Carlo treatment of sub-grid pitch-angle scattering and attenuation losses due to realistic photon fields, we study the spectrum and composition of the accelerated UHECRs and estimate the amount of neutrinos produced in such sources.
We find that UHECRs are not significantly affected by photodisintegration in AGN jets, consistent with Auger's detection of heavy elements at the highest energies.
Moreover, we present estimates and \emph{upper bounds} for the flux of high-energy neutrinos expected from AGNs.
In particular, we find that:
i) source neutrinos may account for a sizable fraction, or even dominate, the expected flux of cosmogenic neutrinos;
ii) neutrinos from the β-decay of secondary neutrons produced in nuclei photodisintegration may in principle contribute to the signal observed by IceCube, but can hardly account for all of it;
iii) since the most important background for UHECR–photons interactions is the AGN non-thermal emission, a picture arises where high-energy neutrino emission can correlate with AGN flaring activity.
We discuss our results in the light of multimessenger astronomy and current/future neutrino experiments.

Author: MBAREK, Rostom (University of Chicago)

Co-authors: Prof. CAPRIOLI, Damiano (University of Chicago); MURASE, Kohta (Penn State)

Presenter: MBAREK, Rostom (University of Chicago)

Session Classification: Contributed Talks

Contribution ID: **288** Type: **Contributed talk**

Hunting the gamma-ray emission from Fast Radio Burst with Fermi-LAT

Wednesday, July 6, 2022 3:15 PM (15 minutes)

Fast radio bursts (FRBs) are one of the most exciting new mysteries of astrophysics. Their origin is still unknown, but recent observations seem to link them to soft gamma repeaters and, in particular, to magnetar giant flares (MGFs). The recent detection of a MGF at GeV energies by the Fermi Large Area Telescope (LAT) motivated the search for GeV counterparts to the >1000 currently known FRBs. To date, none of these has a known gamma-ray counterpart.
Taking advantage of more than 12 years of Fermi-LAT data, we perform a search for gamma-ray emission from almost all the reported repeating and non-repeating FRBs. We analyze on different time scales the Fermi-LAT data for each individual source separately and perform a cumulative analysis on the repeating ones. In addition, we perform the first stacking analysis at GeV energies of this class of sources in order to constrain the gamma-ray properties of the FRBs. The stacking analysis is a powerful method that allows for a possible detection from below-threshold FRBs providing important information on these objects. In this talk we present the results of our study and we discuss their implications for the predictions of gamma-ray emission from this class of sources.

Authors: PRINCIPE, Giacomo (University of Trieste); LONGO, Francesco (University of Trieste); DI VENERE, Leonardo (INFN-Bari); OMODEI, Nicola (SLAC-Stanford); DI LALLA, Niccolo' (SLAC-Stanford)

Presenter: PRINCIPE, Giacomo (University of Trieste)

Session Classification: Contributed Talks

Contribution ID: **289** Type: **Contributed e-poster**

NuSTAR and NICER observations of 4U 0114+65: a wind-accreting magnetar?

We present an X-ray spectro-temporal analysis of simultaneous NuSTAR and NICER observations of 4U 0114+65, to characterize the nature of the source. Light curves were obtained from the source in the range 3 - 79 keV. Two types of flares were identified in the light curve of the source, “large and small flare”. A pulsation of 9275 ± 2 s obtained from the analysis of the light curves was measured. This is consistent with previously found values associated with a secular spin down. Time-resolved spectra were extracted from each interval and modeled with several different models. We searched in detail for the presence of cyclotron-resonant scattering features in the spectra of both intervals, but no cyclotron resonant dispersion features are found in any interval. In order to obtain physical parameters, the Becker-Wolff self-consistent cyclotron line model was fitted, giving as a main result an estimate of the magnetic field of the order of 10^12 G.

Authors: COMBI, Jorge Ariel (Universidad de Jaén); Mr SAAVEDRA, Enzo (IAR - FCAGLP); Dr LUQUE ESCAMILLA, Pedro (UJA); Dr MARTÍ, Josep (UJA); Mr FOGANTINI, Federico (IAR); Dr GARCÍA, Federico (IAR); Dr CHATY, Sylvain (Université de Paris, CNRS); Mr CESARE MANCUSO, Giulio (IAR)

Presenter: COMBI, Jorge Ariel (Universidad de Jaén)

Session Classification: Contributed posters

Contribution ID: **290** Type: **Contributed talk**

Absorption features in gamma-ray spectra of BL Lac objects

Monday, July 4, 2022 3:45 PM (15 minutes)

The production site of gamma rays in blazars is closely related to their interaction with the photon fields surrounding the active galactic nucleus. In this work we discuss an indirect method that may help to unveil the presence of ambient structures in BL Lacs through the analysis of their gamma-ray spectrum.
Passing through structures at different distances from the black hole, gamma rays interact with the corresponding photon fields via gamma-gamma pair production, producing absorption features in their spectral energy distribution. An interaction of the gamma-ray photons with a putative broad-line region may reduce the gamma-ray flux only if its production site were very close to the central engine. On the other hand, if jet photons interact with optical-UV seed photons produced by a pc-scale narrow-line region, the consequent gamma-gamma process may cause absorption features at a few hundreds GeV.
Sources with spectra reaching TeV energies, such as HBLs and EHBLs (extreme blazars), may represent exceptional probes to investigate this topic. In this regard, we discuss recent observations of sources which may show evidence of such absorption features in their gamma-ray spectra.
Finally, we discuss how sub-TeV absorption features in the spectra of BL Lacs may affect their broadband modeling, and eventually represent a powerful diagnostic tool to constrain the gamma-ray production site and the jet environment.

Author: FOFFANO, Luca (INAF Rome (IAPS))

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Presenter: FOFFANO, Luca (INAF Rome (IAPS))

Session Classification: Contributed Talks

Contribution ID: **292** Type: **Contributed e-poster**

Observation of the galactic PeVatron candidate LHAASO J2108+5157 with the Large-Sized Telescope for the Cherenkov Telescope Array

The Cherenkov Telescope Array (CTA) Observatory will be the next generation ground-based very-high-energy gamma-ray observatory, sensitive from 20 GeV up to 300 TeV. The Large-Sized Telescope prototype (LST-1), currently in the commissioning phase, was inaugurated in October 2018 on La Palma (Spain). It is the first of four LST telescopes for CTA, to be built on La Palma. In 2021, LST-1 performed observations of one of the Galactic PeVatron candidates, LHAASO J2108+5157, recently discovered by the LHAASO collaboration. In our contribution, we will present results of our analysis of the LST-1 data, putting strong constraints on the emission of the source in the multi-TeV band. We will also present results of multi-wavelength modeling, we will test different scenarios for the parent particles producing the high energy emission and put constraints on their spectra.

Author: JURYSEK, Jakub (University of Geneva - Department of Astronomy)

Co-authors: Dr WALTER, Roland (University of Geneva - Department of Astronomy); Dr BALBO, Matteo (University of Geneva - Department of Astronomy); Dr ECKERT, Dominik (University of Geneva - Department of Astronomy); GIORGIO, Pirola (MPP)

Presenter: JURYSEK, Jakub (University of Geneva - Department of Astronomy)

Session Classification: Contributed posters

Contribution ID: **293** Type: **Contributed e-poster**

Magnetic Field Modelling Virgo Cluster

Axions are hypothetical pseudo Nabu-Goldstone bosons which arise from spontaneous symmetry breaking in the Peccei Quinn Symmetry, which in turn is a solution to the strong CP problem. Axions and Axion Like Particles (ALPs) are Dark Matter candidates considring their weak gravitational interactions and weak coupling with the Standard Model. By virtue of this coupling, theory predicts the observation of the photon-ALP oscillation phenomenon which occurs in the presence of magnetic fields. Active Galactic Nucluei in large galaxy clusters are good candidates to attempt observation of these oscillations. This is due to their strong cluster magnetic fields. Here, we attempt to use M87 in the Virgo cluster, due to the observed strong central magnetic field of Virgo (~40 μG). To model the magnetic field, we utilize the open source gammaALPs package framework to create a random magnetic field model with Gaussian turbulence. We fine tune the model parameters by simulating Faraday Rotation Measures for various random realizations of the turbulent field. This model will be used to search for photon-ALP oscillations in M87 using HESS and MAGIC telescope data obtained from periods of observed flaring in the source. This model may also be utilized for various other studies.

Authors: CECIL, Rahul (University of Hamburg); Dr MEYER, Manuel (University of Hamburg)

Presenter: CECIL, Rahul (University of Hamburg)

Session Classification: Contributed posters

Contribution ID: **294** Type: **Contributed talk**

RS Ophiuchi nova outburst detection by the LST-1

Wednesday, July 6, 2022 3:30 PM (15 minutes)

In August 2021, the recurrent symbiotic nova RS Ophiuchi experienced an outburst detected in the optical and high-energy gamma rays. This detection triggered follow-up observations of the source at very-high-energy (VHE) gamma rays with the Large-Sized Telescope prototype (LST-1) of the upcoming Cherenkov Telescope Array (CTA) Observatory. RS Ophiuchi was observed for several nights after the outburst and it was detected by the LST-1. In this contribution, we report the results of this observation campaign on the first nova ever detected at VHEs and discuss the obtained results in a multiwavelength context.

Author: AGUASCA-CABOT, Arnau

Co-authors: GREEN, David (Max-Planck-Institute for Physics); Dr BERNARDOS, Maria Isabel (Dipartimento di Fisica e Astronomia dell?Università and Sezione INFN, Padova); LÓPEZ-COTO, Rubén (Università di Padova and INFN); KOBAYASHI, Yukiho (Institute for Cosmic Ray Research, University of Tokyo)

Presenter: AGUASCA-CABOT, Arnau

Session Classification: Contributed Talks

Contribution ID: **295** Type: **Contributed talk**

Particle acceleration via magnetic reconnection near spinning black holes coupled to a surrounding disk

Wednesday, July 6, 2022 5:15 PM (15 minutes)

Accretion and ejection have been found to be tightly linked around stellar-mass and supermassive black holes. The monitoring of Sagittarius A*, M87 and Cygnus X-1 suggest that this junction is mediated by an intense and structured magnetic field embedded in a collisionless plasma within a few 10 gravitational radii. These environments are also prone to recurring non-thermal flares whose origin remains unclear.

In this talk, I will focus on configurations where a Kerr black hole is surrounded by a disk and a hot corona threaded by a large scale magnetic field connected to the BH. We performed global particle-in-cell simulations to capture the dynamics of the electromagnetic fields and of the pair plasma in the corona. We find that a hybrid magnetic topology develops with: (i) magnetic loops connecting the disk to the event horizon, which enables energy and angular momentum exchanges between the 2 components, (ii) open field lines threading the horizon and funneling a Blandford-Znajek jet, and (iii) open magnetic field lines anchored in the disk and inclined enough to launch a magneto-centrifugal wind. Although the corona is essentially force-free, a Y-point at the intersection of these 3 regions seeds a current sheet where magnetic reconnection form macroscopic plasmoids and accelerates particles up to relativistic speeds. It provides a mechanism for variable non-thermal high energy emission. Eventually, I will show particle energy distribution along with synthetic images and spectra.

Authors: EL MELLAH, Ileyk (IPAG - CNRS); Dr CERUTI, Benoît (IPAG - CNRS); Dr CRINQUAND, Benjamin (Princeton); Dr PARFREY, Kyle (Dublin College)

Presenter: EL MELLAH, Ileyk (IPAG - CNRS)

Session Classification: Contributed Talks

Contribution ID: **296** Type: **Contributed e-poster**

Event reconstruction using pattern spectra and convolutional neural networks for the Cherenkov Telescope Array

The Cherenkov Telescope Array (CTA) is the future observatory for ground-based imaging atmospheric Cherenkov telescopes. Each telescope will provide a snapshot of gamma-ray induced particle showers by capturing the induced Cherenkov emission at ground level. The simulation of such events provides camera images that can be used as training data for convolutional neural networks (CNNs) to differentiate signals from background events and to determine the energy of the initial gamma-ray events. Pattern spectra are commonly used tools for image classification and provide the distributions of the sizes and shapes of features comprising an image. The application of pattern spectra on a CNN allows the selection of relevant combinations of features within an image.
In this work, we generate pattern spectra from simulated gamma-ray images to train a CNN for signal-background separation and energy reconstruction for CTA. We compare our results to a CNN trained with CTA images and find that the pattern spectra based analysis is computationally less expensive but not competitive with the purely CTA images based analysis. Thus, we conclude that the CNN must rely on additional features in the CTA images not captured by the pattern spectra.

Author: ASCHERSLEBEN, Jann (University of Groningen)

Co-authors: Dr VECCHI, Manuela (University of Griningen); Prof. PELETIER, Reynier (University of Groningen); Dr WILKINSON, Michael H. F. (University of Groningen)

Presenter: ASCHERSLEBEN, Jann (University of Groningen)

Session Classification: Contributed posters

Contribution ID: **298** Type: **Contributed e-poster**

Modeling Variability Signatures of a Burst Process in Flaring Gamma-ray Blazars

Blazars exhibit stochastic flux variability across the electromagnetic spectrum, often exhibiting heavy-tailed flux distributions, commonly modeled as lognormal. However, the high-energy gamma-ray flux distributions of several of the brightest flaring Fermi-LAT flat spectrum radio quasars (FSRQs) are well modeled by an even heavier-tailed distribution, the inverse gamma distribution. We propose an autoregressive inverse gamma variability model in which an inverse gamma flux distribution arises as a consequence of a shot-noise process in which discrete bursts are individually unresolved and averaged over within time bins, as in the analysis of Fermi-LAT data. Long-term stochastic variability is modeled using first-order autoregressive structure. The flux distribution becomes approximately lognormal in the limiting case of many weak bursts. The fractional variability is predicted to decrease as the time bin duration increases. Using simulated light curves, we show that the proposed model is consistent with the typical gamma-ray variability properties of FSRQs and BL Lac objects. The model parameters can be physically interpreted as the average burst rate, the burst fluence, and the timescale of long-term stochastic fluctuations.

Author: BRILL, Ari (NPP Fellow, NASA GSFC)

Presenter: BRILL, Ari (NPP Fellow, NASA GSFC)

Session Classification: Contributed posters

Contribution ID: **299** Type: **Contributed talk**

Ultrahigh-energy cosmic-ray induced gamma-ray and neutrino fluxes from blazars

Tuesday, July 5, 2022 6:00 PM (15 minutes)

Blazars are potential candidates of cosmic-ray acceleration up to ultrahigh energies (> 1 EeV). For an efficient cosmic-ray injection from blazars, ⊠ collisions with the extragalactic background light and cosmic microwave background can produce gamma-ray and neutrino fluxes in the TeV and PeV-EeV energies, respectively. Such a line-of-sight cosmogenic gamma-ray flux can contribute to the spectra measured by ground-based air-Cherenkov telescopes from individual blazars, while PeV-EeV neutrinos form a "guaranteed"component in addition to any sub-PeV neutrinos produced in the blazar jet and as detected by IceCube. We calculate line-of-sight cosmogenic fluxes from the blazars TXS 0506+056, PKS 1502+106 and GB6 J1040+0617, which have been associated with IceCube neutrino events. We discuss conditions required for detection of these fluxes by current and upcoming gamma-ray and neutrino telescopes.

Author: RAZZAQUE, Soebur (University of Johannesburg Centre for Astro-Particle Physics)

Presenter: RAZZAQUE, Soebur (University of Johannesburg Centre for Astro-Particle Physics)

Session Classification: Contributed Talks

Contribution ID: **300** Type: **Contributed talk**

A shock-in-jet synchrotron mirror model

Tuesday, July 5, 2022 5:45 PM (15 minutes)

Previous work on time-dependent shock-acceleration and radiation transfer in relativistic jets has successfully reproduced many spectral variability features of blazars if flaring activity is mediated by increasingly efficient diffusive shock acceleration. However, flaring events exhibiting a significant increase of the Compton dominance, or even "orphan" gamma-ray flares, are very difficult to reproduce in this manner, suggesting that an enhancement of an external radiation field for Compton scattering may be responsible for the gamma-ray flaring. This work therefore investigates the signatures of a synchrotron mirror model in which the synchrotron emission of electrons accelerated by a mildly relativistic shock traveling along the jet, is reflected by a cloud, and the reflected synchrotron radiation acts as target photon field for enhanced Compton scattering further down the jet. The model is applied to recent flaring events exhibiting a significant enhancement of the Compton dominance in 3C279, and the expected spectral variability features are investigated in detail.

Author: BOETTCHER, Markus (North-West University)

Presenter: BOETTCHER, Markus (North-West University)

Session Classification: Contributed Talks

Contribution ID: **301** Type: **Contributed talk**

Radio-gamma-ray response in blazars as a signature of adiabatic blob expansion

Tuesday, July 5, 2022 6:15 PM (15 minutes)

Multi-wavelength light curves in long-term campaigns show that, for several blazars, the radio emission occurs with a significant delay with respect to the γ-ray band, with timescales ranging from weeks to years. Such observational evidence has long been a matter of debate and is usually interpreted as a signature of the γ-ray emission originating upstream in the jet, with the emitting region becoming radio transparent at larger scales. We show, by means of self-consistent numerical modelling, that the adiabatic expansion of a relativistic blob can explain these delays, reproducing lags compatible with the observed timescales. We use the JetSeT framework to reproduce the numerical modelling of the radiative and accelerative processes, reproducing the temporal evolution of a single blob, from the initial flaring activity and the subsequent expansion, following the spectral evolution and the corresponding light curves, investigating the relations among the observed parameters, rise time, delay, and decay time, and we identify the link with physical parameters. We find that, when adiabatic expansion is active, lags due to the shift of the synchrotron frequency occur. The corresponding time lags have an offset equal to the distance in time between the flaring onset and the beginning of the expansion, whilst the rising and decaying timescales depend on the velocity of the expansion and on the time required for the source to exhibit a synchrotron self-absorption frequency below the relevant radio spectral window. We derive an inter-band response function, embedding the parameters mentioned above, and we investigate the effects of the competition between radiative and adiabatic cooling timescales on the response. We apply the response function to long-term radio and ɣ–ray light curves of Mrk 421, Mrk 501, and 3C 273, finding satisfactory agreement on the long-term behaviour, and we use a Monte Carlo Markov Chain approach to estimate some relevant physical parameters. We discuss applications of the presented analysis to polarisation measurements and to jet collimation profile kinematics. The collimation profiles observed in radio images agree with the prediction from our model.

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Presenter: TRAMACERE, Andrea (Astronomy Department University of Geneva)

Session Classification: Contributed Talks

Contribution ID: **302** Type: **Contributed e-poster**

Detection of Supernova Remnants in the Large Magellanic Cloud at energies higher than 6 GeV by means of cluster analysis

We applied a blind search for spatial photon clusters at energies higher than 6 and 10 GeV to sky maps of Fermi-LAT events collected in the first 12 years of operation.
We used the Minimum Spanning Tree and DBSCAN algorithms, which provided fully consistent results, detecting 13 clusters above 10 GeV. Six clusters have coordinates corresponding to known SNRs within a few arcminutes, in a very good agreement with the instrumental positional accuracy.
We confirmed the detection of the known remnants N157B, N63A, N49B and report three new detections, of N49, N186D, B040-693, and the complex N44 at energies higher than 6 GeV.
An analysis of the LMC SNR population shows that these remnants are the most luminous in the X-ray band and correspond to core-collapse supernovae with shock expanding in dense HII regions. This result suggests that the hadronic emission is the most relevant process for high-energy gamma-ray loud SNRs.

Authors: Dr CAMPANA , Riccardo (INAF/OAS Bologna, Bologna, Italy); Prof. MASSARO, Enrico (INAF/IAPS Roma, Roma, Italy); Dr BOCCHINO, Fabrizio (INAF-Astronomical Observatory of Palermo, Palermo, Italy); Dr MICELI, Marco (Department of Physics and Chemistry E. Segrè, University of Palermo, Palermo, Italy INAF-Astronomical Observatory of Palermo, Palermo, Italy); Dr ORLANDO, Salvatore (INAF-Astronomical Observatory of Palermo, Palermo, Italy); Dr TRAMACERE, Andrea (Astronomy Department University of Geneva)

Presenter: Dr CAMPANA , Riccardo (INAF/OAS Bologna, Bologna, Italy)

Session Classification: Contributed posters

Contribution ID: **303** Type: **Contributed e-poster**

Broadband study of BL Lac during flare of 2020: Spectral evolution and emergence of HBL component

BL Lacertae (BL Lac) is categorized as TeV blazar and considered as a possible source of astrophysical neutrinos. In 2020, the brightest X-ray flare ever detected from it. A detailed study can answer many puzzling questions related to multiband emissions and fast-flux variability often seen in this kind of source. We found that the source has crossed all its previous limits of flux and reached the maximum ever seen from it in optical and X-rays. It is highly variable in X-rays with fractional variability above 100% (1.8397±0.0181) and the fastest variability time of 11.28 hours within a day. The broadband light curves correlation with X-ray suggests a time lag of one day. A broadband SED modeling is pursued to understand the possible physical mechanisms responsible for broadband emission. Modeling requires two emission regions located at two different sites to explain the low and high flux states. A significant spectral change is observed in the optical-UV and X-ray spectrum during the high state, which eventually leads to shifts in the location of the synchrotron peak towards higher energy, suggesting an emergence of a new HBL component.

Author: PRINCE, Raj (Center for Theoretical Physics, Warsaw, Poland)

Presenter: PRINCE, Raj (Center for Theoretical Physics, Warsaw, Poland)

Session Classification: Contributed posters

Contribution ID: **304** Type: **Contributed e-poster**

Correlations between X-ray spectral parameters of Mkn 421 using long-term Swift-XRT data

We have performed a detailed analysis of the X-ray spectra of the blazar Mkn 421 using Swift-XRT observations taken between 2005 and 2020, to quantify the correlations between spectral parameters for different models. In an earlier work, it has been shown that such spectral parameter correlations obtained from a single short flare of duration ~ 5-days of Mkn 421, can be used to distinguish spectrally degenerate models and provide estimates of physical quantities. In this work, we show that the results from the long-term spectral parameter correlations are consistent with those obtained from the single flare. In particular, that the observed spectral curvature is due to maximum cutoff energy in the particle distribution is ruled out. Instead, models where the curvature is due to the energy dependence of escape or acceleration timescale of the particles are favored. The estimated values of the physical parameters for these models are similar to the ones obtained from the single flare analysis and are somewhat incompatible with the physical assumption of the models, suggesting that more complex physical models are required. The consistency of the results obtained from the long and short-term evolution of the source, underlines the reliability of the technique to use spectral parameter correlations to distinguish physical models.

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Presenter: KHATOON, Rukaiya (IUCAA, Pune, India)

Session Classification: Contributed posters

Contribution ID: **305** Type: **Contributed talk**

Establishing the MAGIC data legacy: adopting standardised data formats and open-source analysis tools

Thursday, July 7, 2022 6:00 PM (15 minutes)

The open data access that will be provided by the next generation of gamma-ray observatories has encouraged the development of standardised data formats and open-source analysis software. Many recent publications have demonstrated the applicability of the specifications proposed by the community-driven "Data formats for gamma-ray astronomy" (GADF) initiative to ground-based gamma-ray instrument data. They have also validated the analysis of GADF-compliant data with open-source analysis tools such as Gammapy.

In this contribution, we present the effort to adopt the same specifications for the data taken with the MAGIC telescopes. We reproduce results from the literature for some reference sources, validating the Gammapy analysis against results obtained with the MAGIC closed-source software, MARS. The adoption of these standardized data formats and open-source science tools by the MAGIC Collaboration for its scientific analyses marks an important milestone in building a data legacy for its two decades of observations.

Author: NIGRO, Cosimo (Institut de Física d'Altes Energies (IFAE))

Presenter: NIGRO, Cosimo (Institut de Física d'Altes Energies (IFAE))

Session Classification: Contributed Talks

Contribution ID: **306** Type: **Contributed e-poster**

On the Propagation of Relativistic Shocks in Conductive Media

Relativistic shocks propagating in perfectly conductive plasmas have been extensively studied due to their central role in high energy astrophysical phenomena, with Gamma-Ray Bursts being the most prominent example. In the present work we investigate the mechanism by which a relativistic shock interacts with the propagation medium's electromagnetic field. We assume the propagation of a shock front with a finite length through a magnetized medium, as well as a finite electrical conductivity for the plasma in the shock front's volume. These assumptions necessitate the inclusion of one more jump condition derived through the covariant Gauss-Ampère Law and introduce a dimensionless parameter dependent on the magnetic diffusivity of the plasma in the shock front, the shock front's length, as well as on the shock's propagation four-velocity. We investigate the effects of this parameter's value on shock dynamics and discuss possible applications of this work in the study of Gamma-Ray Bursts.

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Presenter: Mr LOULES, Argyrios (Section of Astrophysics, Astronomy & Mechanics, Department of Physics, National and Kapodistrian University of Athens)

Session Classification: Contributed posters

Contribution ID: **307** Type: **Contributed e-poster**

agnpy: An open-source python package modelling the radiative processes of jetted active galactic nuclei

In recent years, jetted AGN have been increasingly studied in extensive multi-wavelength campaigns, sampling their emission from radio up to very-high-energies gamma rays. The amount of data gathered calls for the modelling effort to be open to a wide number of astrophysicists.

In this contribution we present agnpy, an open-source python package modelling the radiative processes of relativistic particles accelerated in the jets of AGN. The package includes classes describing the galaxy components responsible for line and thermal emission and it calculates the absorption due to gamma-gamma pair production on several photon fields. agnpy is thoroughly validated: we present comparisons of its results against the literature and against other open-source software. Being developed within the modern python scientific ecosystem, the package can be easily interfaced with other tools such as Gammapy to perform statistical analyses. We comment on the effort to introduce hadronic models in our software, so far considering only leptonic radiative processes.

Producing open-source modelling tools adopting modern good software practices helps us address the issues of accessibility and reproducibility inherent to the classical closed-source approach employed for physical interpretation.

Author: NIGRO, Cosimo (Institut de Física d'Altes Energies (IFAE))

Presenter: NIGRO, Cosimo (Institut de Física d'Altes Energies (IFAE))

Session Classification: Contributed posters

Contribution ID: **308** Type: **Contributed e-poster**

Lepto-hadronic jet-disc model for the multi-wavelength SED of M87

The low-luminosity Active Galactic Nuclei M87, archetype of Fanaroff-Riley I radio-galaxies, was observed in a historically quiet state in 2017. While one-zone leptonic jet models cannot explain the radio-to-gamma-ray spectrum, we explore a hybrid jet-disc scenario. In this work, we model the overall spectral energy distribution of M87's core with a dominating one-zone lepto-hadronic jet numerical emission model, coupled with the contribution from an advection-dominated accretion flow. We find sets of parameter values for which the jet component fits the radio-to-optical data as well as the gamma-ray band. These imply that a mildly relativistic $\delta_{\rm jet} = 2.3$ compact emission region of $\sim 5\, r_g$ is suitable to model the contribution of the jet. Given the jet component that we found, we are able to model the remaining X-ray observations with the accretion flow described by a set of parameters that we explored thoroughly. The crucial observational difference between purely leptonic models and lepto-hadronic ones such as ours is the production of neutrinos associated with photo-meson interaction. Thus we also calculate the predicted neutrino flux produced by such scenarios, although it remains below the current instruments' sensitivity.

Author: BOUGHELILBA, Margot (Institute for Astro- and Particle Physics, Innsbruck University)

Co-authors: Dr REIMER, Anita (University of Innsbruck); Dr MERTEN, Lukas (Ruhr-Universitaet Bochum)

Presenter: BOUGHELILBA, Margot (Institute for Astro- and Particle Physics, Innsbruck University)

Session Classification: Contributed posters

Contribution ID: **309** Type: **Contributed talk**

Efficient cosmic-ray acceleration in the recurrent nova RS Ophuichi revealed by H.E.S.S.

Wednesday, July 6, 2022 3:15 PM (15 minutes)

Recurrent Novae (RNe) undergo episodic eruptions in the form of thermonuclear explosions, due to the accumulation of material accreted by a white dwarf from a binary companion star.
The well known RN RS Ophiuchi (RS Oph) underwent its latest eruption in August 2021, triggering numerous follow-up observations, including with the High Energy Stereoscopic System (H.E.S.S.). H.E.S.S. is an array consisting of five Imaging Atmospheric Cherenkov Telescopes (IACTs) situated in Khomas Highland, Namibia, that observes the sky in the very-high-energy (VHE) gamma-ray regime of 100 GeV to a few tens of TeV.
Non-thermal emission was observed coincident with the nova eruption within the first days and up to a month after the initial burst event, establishing novae as Galactic transients reaching TeV energies. Analysis and interpretation of the data identify time-resolved acceleration of cosmic-rays, constraining models of particle energisation. Combining the data taken by H.E.S.S. with concurrent observations taken by the Large Area Telescope (LAT) on board the Fermi Gamma-ray Space Telescope, a consistent temporal and spectral profile is observed, favouring a common origin to the emission. The detection and interpretation of the non-thermal VHE emission from the RN RS Oph by H.E.S.S. will be presented.

Author: STEINMASSL, Simon (Max Planck Institut fuer Kernphysik)

Co-author: H.E.S.S. COLLABORATION

Presenter: STEINMASSL, Simon (Max Planck Institut fuer Kernphysik)

Session Classification: Contributed Talks

Contribution ID: **310** Type: **Contributed talk**

Periodic Variability in gamma-ray Emitting Blazars with Fermi-LAT

Tuesday, July 5, 2022 5:00 PM (15 minutes)

Blazars display variable emission across the entire electromagnetic spectrum, which ranges in timescales from minutes to years. This variability is generally interpreted as stochastic and unpredictable processes. However, recent studies have inferred the presence of periodic signals coming from blazars. These could be caused by, e.g. a helical jet or a precessing jet due to the presence of a supermassive black hole binary. In this talk, we will report on the largest systematic search of periodic emission in the gamma-ray lightcurves of 350 blazars. Using 12 years of Fermi-LAT data, we have built a sample of 24 blazars displaying evidence of periodic emission. These results will be interpreted in the modeling framework of supermassive black holes binaries.

Authors: PEÑIL, Pablo (Clemson University); Dr AJELLO, Pablo (Clemson University); Dr BUSON, Sara (University of Wuerzburg); Dr DOMINGUEZ, Alberto (IPARCOS-GAE); ON BEHALF OF THE FERMI-LAT COLLABORATION

Presenter: PEÑIL, Pablo (Clemson University)

Session Classification: Contributed Talks

Contribution ID: **311** Type: **Contributed talk**

Non-thermal emission from colliding-wind binaries

Wednesday, July 6, 2022 4:00 PM (15 minutes)

Here we present an overview of the physics behind the non-thermal emission from massive colliding-wind binaries (CWBs). In these systems the hypersonic and powerful stellar winds collide and give rise to strong shocks capable of accelerating relativistic particles. We introduce a model for CWBs that takes into account how relativistic particles travel along the shocked region while cooling and radiating by different mechanisms, as well as the absorption processes that affect their broadband emission. We present results from applying this model to the CWBs HD 93129A and Apep. In particular, we investigate the relativistic particle content and magnetic field intensity in the wind-collision region. We highlight the great synergy between observations at low radio frequencies and high-energy X-rays and γ-rays for studying the non-thermal processes in CWBs.

Author: DEL PALACIO, Santiago (Chalmers University of Technology)

Presenter: DEL PALACIO, Santiago (Chalmers University of Technology)

Session Classification: Contributed Talks

Contribution ID: **312** Type: **Contributed e-poster**

Combined search in dwarf spheroidal galaxies for branon dark matter annihilation signatures with the MAGIC Telescopes

One of the most pressing questions for modern physics is the nature of dark matter (DM). Several efforts have been made to model this elusive kind of matter. The largest fraction of DM cannot be made of any of the known particles of the Standard Model (SM). We focus on brane world theory as a prospective framework for DM candidates beyond the SM of particle physics. The new degrees of freedom that appear in flexible brane world models, corresponding to brane fluctuations, are called branons. They behave as weakly interacting massive particles (WIMPs), which are one of the most favored candidates for DM. We present a multi-target DM search in dwarf spheroidal galaxies for branon DM annihilation signatures with the ground-based gamma-ray telescope MAGIC leading to the most constraining branon DM limits in the multi-TeV mass range.

Author: MIENER, Tjark (IPARCOS, UCM)

Co-authors: Dr RICO, Javier; Dr NIETO, Daniel (IPARCOS, UCM); Dr KERSZBERG, Daniel (IFAE, BIST); Dr GAMMALDI, Viviana (UAM/CSIC)

Presenter: MIENER, Tjark (IPARCOS, UCM)

Session Classification: Contributed posters

Contribution ID: **313** Type: **Contributed talk**

The 2020 periastron of Eta Carinae at high-energies

Wednesday, July 6, 2022 4:15 PM (15 minutes)

Colliding-wind binaries are massive stellar systems featuring strong, interacting stellar winds. The resulting shocks may act as effective particle accelerators, making them good candidates for detection at high energies. However, only the massive binary Eta Carinae (with an orbital period of ~ 5.5 years) has been firmly identified as a gamma-ray source. A second system, Gamma² Velorum, was found positionally coincident with a gamma-ray signal, with solid evidence of orbital variability along its orbit. Thus massive binaries are a promising, emerging class of high-energy emitters.

However, the origin of the non-thermal emission in Eta Carinae is still unclear, with both leptonic and hadronic scenarios currently under discussion. Moreover, gamma-ray fluxes differ between the two periastrons previously observed by the Fermi Large Area Telescope (Fermi-LAT). Here we report the analysis of the 2020 periastron, together with a complete analysis of more than two orbits, allowing the first orbit-to-orbit variability study of Eta Carinae at GeV energies.

We discuss these results in the context of previous hard X-ray (NuSTAR) and very-high-energy (H.E.S.S.) observational results. This new analysis provides highly valuable information for the radiative scenarios and the conditions of the wind-collision region.

Author: MARTÍ-DEVESA, Guillem (University of Innsbruck)

Presenter: MARTÍ-DEVESA, Guillem (University of Innsbruck)

Session Classification: Contributed Talks

Contribution ID: **314** Type: **Contributed e-poster**

ExHaLe-jet: Modeling blazar jets with an extended hadro-leptonic radiation code

Blazars emit across all electromagnetic wavelengths. While the so-called one-zone model has described well both quiescent and flaring states, it cannot explain the radio emission and fails in more complex data sets, such as AP Librae. In order to self-consistently describe the entire electromagnetic spectrum emitted by the jet, extended radiation models are necessary. Notably, kinetic descriptions of extended jets can provide the temporal and spatial evolution of the particle species and the full electromagnetic output. Here, we present the initial results of a newly developed hadro-leptonic extended-jet code: ExHaLe-jet. As protons take much longer than electrons to lose their energy, they can transport energy over much larger distances than electrons and are therefore essential for the energy transport in the jet. Furthermore, protons induce injection of additional pairs through pion and Bethe-Heitler pair production, which can explain a dominant leptonic radiation signal while still producing neutrinos. In this talk, we discuss the differences between leptonic and hadronic dominated SED solutions, the SED shapes, evolution along the jet flow, and jet powers. We also highlight the important role of external photon fields, such as the accretion disk and the BLR.

Author: ZACHARIAS, Michael (LUTH, Observatoire de Paris)

Co-authors: Dr REIMER, Anita (University of Innsbruck); Prof. ZECH, Andreas (LUTH / Observatoire de Paris); Prof. BOISSON, Catherine (LUTH, Observatoire de Paris)

Presenter: ZACHARIAS, Michael (LUTH, Observatoire de Paris)

Session Classification: Contributed posters

Contribution ID: **315** Type: **Contributed talk**

High energy neutrinos from gamma-ray bursts

Thursday, July 7, 2022 3:00 PM (15 minutes)

Due to their non-thermal nature, gamma-ray bursts (GRBs) are promising sources of high energy neutrinos. After the years of the GRB triggered search, IceCube Collaboration has put strict upper limits on the neutrino flux. We propose new weighting technique for the neutrino search considering multi-GRB stacking analysis. We invoke known GRB spectral-energy correlations to reduce the amount of unknown and model-dependent GRB parameters. With this approach we perform stacking triggered GRB neutrino search with the open access IceCube data. Despite the prompt emission, we show that the late time X-ray transients associated with GRBs could be promising sources of TeV neutrinos. As a result of our analysis, we put constrains on the amount of protons in the GRB jets and draw prospects for the high energy neutrino detectability with the next generation IceCube-2 detector and upcoming gamma- and X-ray telescopes.

Author: OGANESYAN, Gor (Gran Sasso Science Institute)

Presenter: OGANESYAN, Gor (Gran Sasso Science Institute)

Session Classification: Contributed Talks

Contribution ID: **316** Type: **Contributed e-poster**

Variable gamma-ray emitting NLS1 galaxies

Gamma-ray emitting narrow-line Seyfert 1 galaxies (NLS1) constitute an intriguing small population of Active Galactic Nuclei (AGN) with unexpected gamma-ray emission and debated fundamental properties, similar to low power flat-spectrum radio quasars (FSRQ). They are jetted, gamma/radio-loud Seyfert galaxies, with relatively low BH masses, accreting at exceptionally high, near-Eddington rates.
Two bona-fide NLS1 1H 0323+342 and PMN J0948+0022, and one intermediate object between NLS1 and FSRQ sub-classes B2 0954+25A are considered in this work. We analyzed quasi-simultaneous multiwavelength data for two different gamma-ray activity states and present the results of their broad-band SED modelling, complemented by a maximum number of physical constraints. Two different scenarios are discussed, in the framework of a one-zone leptonic model, where the high energy emission is due to the inverse Compton scattering of BLR (EIC-BLR) or torus (EIC-torus) photons by energetic electrons of the jet. While the EIC-torus emission seems to be dominant for PMN J0948+0022, the EIC-BLR scenario is preferred for 1H 0323+342 and B2 0954+25A. We show that the transition from low to high state is well described by minimal changes in the jet parameters, favoring the stationary shock scenario at the origin of the particle acceleration. We use the multi-epoch modelling to characterize the total jet powers and discuss the intrinsic nature of gamma-ray emitting NLS1 galaxies.

Authors: LUASHVILI, Anna (Observatoire de Paris - LUTH); Prof. BOISSON, Catherine (LUTH, Observatoire de Paris); Prof. ZECH, Andreas (LUTH / Observatoire de Paris)

Presenter: LUASHVILI, Anna (Observatoire de Paris - LUTH)

Session Classification: Contributed posters

Contribution ID: **317** Type: **Contributed e-poster**

TACH: Time domain Astrophysics Coordination Hub

The General Coordinates Network (GCN) has been working as the backbone of mutlwavelength and multimessenger transient astrophysics, distributing both machine-readable notices and human-readable circulars. TACH, the Time-domain Astrophysics Coordination Hub, will modernize GCN system with various efforts: Kafka-based streaming, improved interfaces with higher flexibility, and improved event/report archiving. The Kafka-based streaming, improved interfaces with higher flexibility, and improved event/report archiving. Kafka-based streaming will provide automated event-based reporting which will collate relevant information from high-energy discovery instruments to enable and aid follow-up observations. The improved archiving system and its viewer will increase efficiency of coordinating follow-up observations and querying past observations.

Author: TAK, Donggeun

Presenter: TAK, Donggeun

Session Classification: Contributed posters

Contribution ID: **318** Type: **Contributed e-poster**

Indirect Dark-Matter Searches in VHE Gamma Rays with Legacy VERITAS Dwarf Spheroidal Observations

In the current cosmological theory, the existence and contribution of dark matter (DM) is inevitable. The weakly interacting massive particle (WIMP), expected mass in the range of tens of GeV to tens of TeV, is a DM candidate which can annihilate and/or decay into secondary particles, sequentially producing very-high-energy gamma rays (VHE; above 100 GeV). The Very Energetic Radiation Imaging Telescope Array System (VERITAS; sensitive to 100 GeV to 30 TeV gamma rays) is a ground-based VHE telescope array and can look for or detect gamma-ray signatures resulting from the annihilation of WIMPs. Since dwarf spheroidal galaxies (dSphs) are DM-rich regions, they are one of the best targets for studying indirect DM annihilation signatures. Compared to the previous DM search in dSphs (VERITAS collab., 2017), we significantly extend the observational dataset and improve our method of constraining the WIMP annihilation cross section by considering the dSph angular extension.

Author: TAK, Donggeun

Presenter: TAK, Donggeun

Session Classification: Contributed posters

Contribution ID: **319** Type: **Contributed talk**

Probe AGNs variability with the Cerenkov Telescope Array

Tuesday, July 5, 2022 4:15 PM (15 minutes)

Relativistic jets launched by blazars are among the most powerful particle accelerators in the Universe. The emission over the entire electromagnetic spectrum of these relativistic jets can be extremely variable with scales of variability from less than few minutes up to several years. These variability patterns, which can be very complex, contain information about the acceleration processes of the particles and the area(s) of emission. Thanks to its sensitivity, five-to twenty-times better than the current generation of Imaging Atmospheric Cherenkov Telescopes depending on energy, CTA will be able to follow the emission from these objects with a very accurate time sampling and over a wide spectral coverage from 20 GeV to 300 TeV and thus reveal the nature of the acceleration processes at work in these objects. We will show the first results of our lightcurve simulations and long-term behavior of blazars as will be observed by CTA, based on state-of-art particle acceleration models.

Author: CANGEMI, Floriane (CNRS/IN2P3/LPNHE)

Presenter: CANGEMI, Floriane (CNRS/IN2P3/LPNHE)

Session Classification: Contributed Talks

Contribution ID: **320** Type: **Contributed talk**

MAGIC observations of the putative PeVatron SNR G106.3+2.7 in the proximity of the Boomerang PWN

Monday, July 4, 2022 3:00 PM (15 minutes)

MAGIC observations of the putative PeVatron SNR G106.3+2.7 in the proximity of the Boomerang PWN.
The supernova remnant SNR G106.3+2.7 in the proximity of the Boomerang PWN has recently gained a lot of attention due to the emission above 100 TeV detected by HAWC, Tibet AS\gamma, and LHAASO. This SNR shows a characteristic comet-like morphology in radio observations, with a head and a tail. Due to the limited angular resolution of air shower experiments, it is not clear if the emission comes from the head, where an energetic pulsar wind nebula is located, or from the tail, where a clump of molecular cloud is present. The MAGIC telescopes, with an angular resolution better than 0.1 degrees, observed G106.3+2.7 for 122 hours and found a significant gamma-ray excess elongated along the axis of the comet shape. We performed a spectro-morphological analysis, and found the spectrum of the tail to be harder than the one in the head. This suggests that the 100 TeV emission detected by air shower experiments is from the tail. The multiwavelength spectrum of the tail emission favors proton acceleration up to energies of ~1 PeV, while the emission mechanism of the head could be both hadronic or leptonic.

Authors: SAITO, Takayuki; OKA, Tomohiko; Dr STRZYS, Marcel; KUBO, Hidetoshi

Presenter: SAITO, Takayuki

Session Classification: Contributed Talks

Contribution ID: **321** Type: **Contributed talk**

1ES 0647+250: 10 years of multiwavelength observations

Monday, July 4, 2022 4:00 PM (15 minutes)

The High-peaked BL Lac object 1ES 0647+250 is one of the few distant blazars detected at very-high-energy (VHE, E > 100 GeV) gamma rays during non-flaring activity. Its redshift is still uncertain, but a lower limit of z>0.29 was recently calculated, based on the minimum equivalent width of absorption features expected from the host galaxy. This blazar was first detected by the MAGIC telescopes between 2009 and 2011 during its low state, displaying around 2% of the Crab Nebula flux above 100 GeV, but it has shown several periods of large activity, where the VHE gamma-ray flux increased by more than 1 order of magnitude. In this contribution, for the first time the detailed broadband spectral energy distribution (SED) will be presented for different activity levels. A long-term analysis of the variability displayed by this BL Lac object has been carried out using a rich MWL data sample extending more than 10 years. The long-term emission, variability and inter-band correlations have been evaluated. The spectral evolution will also be discussed and interpreted. The broadband emission was reproduced in the framework of different emission models for each activity level, studying the evolution of the physical parameters describing the emission of this source and the observed characteristics of its emission.

Authors: OTERO-SANTOS, Jorge (Instituto de Astrofisica de Canarias); MORCUENDE, Daniel (Universidad Complutense de Madrid); FALLAH RAMAZANI, Vandad (Ruhr-Universität Bochum); DORNER, Daniela (Universität Würzburg); PANEQUE, David (Max Planck Institute for Physics); ON BEHALF OF THE MAGIC AND FERMI-LAT COLLABORATIONS

Presenter: OTERO-SANTOS, Jorge (Instituto de Astrofisica de Canarias)

Session Classification: Contributed Talks

Contribution ID: **322** Type: **Contributed e-poster**

The mechanism of efficient electron acceleration at parallel non-relativistic shocks

Thermal electrons cannot directly participate in the process of diffusive acceleration at electron-ion shocks because their Larmor radii are smaller than the shock transition width: this is the well-known electron injection problem of diffusive shock acceleration. Instead, an efficient pre-acceleration process must exist that scatters electrons off of electromagnetic fluctuations on scales much shorter than the ion gyro radius. The recently found intermediate-scale instability provides a natural way to produce such fluctuations in parallel shocks. The instability drives comoving (with the upstream plasma) ion-cyclotron waves at the shock front and only operates when the drift speed is smaller than half of the electron Alfvén speed. Here, we perform particle-in-cell simulations with the SHARP code to study the impact of this instability on electron acceleration at parallel non-relativistic, electron-ion shocks. To this end, we compare a shock simulation in which the intermediate-scale instability is expected to grow to simulations where it is suppressed. In particular, the simulation with an Alfvénic Mach number large enough to quench the intermediate instability shows a great reduction (by two orders of magnitude) of the electron acceleration efficiency. Moreover, the simulation with a reduced ion-to-electron mass ratio (where the intermediate instability is also suppressed) not only artificially precludes electron acceleration but also results in erroneous electron and ion heating in the downstream and shock transition regions. This finding opens up a promising route for a plasma physical understanding of diffusive shock acceleration of electrons, which necessarily requires realistic mass ratios in simulations of collisionless electron-ion shocks.

Author: SHALABY, Mohamad (Leibniz Institute for Astrophysics Potsdam)

Co-authors: Mr LEMMERZ, Rouven; Mr THOMAS, Timon; Prof. PFROMMER, Christoph

Presenter: SHALABY, Mohamad (Leibniz Institute for Astrophysics Potsdam)

Session Classification: Contributed posters

Contribution ID: **323** Type: **Contributed e-poster**

Suppression of the TeV Pair-beam–Plasma Instability by a Tangled Weak Intergalactic Magnetic Field

We study the effect of a tangled sub-fG level intergalactic magnetic field (IGMF) on the electrostatic instability of a blazar-induced pair beam. Sufficiently strong IGMF may significantly deflect the TeV pair beams, which would reduce the flux of secondary cascade emission below the observational limits. A similar flux reduction may result from the electrostatic beam–plasma instability, which operates the best in the absence of IGMF. Considering IGMF with correlation lengths smaller than a kiloparsec, we find that weak magnetic fields increase the transverse momentum of the pair-beam particles, which dramatically reduces the linear growth rate of the electrostatic instability and hence the energy-loss rate of the pair beam. We show that the beam–plasma instability is eliminated as an effective energy-loss agent at a field strength three orders of magnitude below that needed to suppress the secondary cascade emission by magnetic deflection. For intermediate-strength IGMF, we do not know a viable process to explain the observed absence of GeV-scale cascade emission.

Authors: ALAWASHRA, Mahmoud (University of Potsdam); POHL, Martin (Uni Potsdam / DESY)

Presenter: ALAWASHRA, Mahmoud (University of Potsdam)

Session Classification: Contributed posters

Contribution ID: **324** Type: **Contributed talk**

Constraining leptonic emission scenarios for the PeVatron candidate HESS J1702-420 with deep XMM-Newton observations

Monday, July 4, 2022 3:30 PM (15 minutes)

The unidentified TeV source HESS J1702-420 has recently been proposed as a new hadronic PeVatron candidate, based on the discovery of a small-scale emission sub-region with extremely hard gamma-ray spectrum up to 100 TeV (named HESS J1702-420A). Given the difficulty to discriminate between a hadronic or leptonic origin of the TeV emission, based on the H.E.S.S. measurement alone, we opted for a multi-wavelength approach. A deep X-ray observation was carried out using the XMM-Newton satellite, with the goal of probing a possible association with a hidden leptonic accelerator. No evidence of a clear counterpart for HESS J1702-420A was found in the X-ray data. After excluding an association with all nearby X-ray point sources, we derived a strict upper limit on the average magnetic field in the HESS J1702-420A region, which significantly strengthen its classification as a hadronic PeVatron candidate. We additionally report the serendipitous discovery of a new possibly extended X-ray source, whose association with HESS J1702-420A is deemed unlikely but cannot be completely ruled out.

Author: GIUNTI, Luca

Co-authors: Dr KHELIFI, Bruno (APC Paris); Dr ACERO, Fabio (AIM, CEA, CNRS, Université Paris-Saclay); Dr KOSACK, Karl; Prof. TERRIER, Regis (APC Paris)

Presenter: GIUNTI, Luca

Session Classification: Contributed Talks

Contribution ID: **325** Type: **Contributed e-poster**

Preheating, Primordial Black holes, and Gravitational waves

We study the spectrum of the energy density of gravitational waves produced during the preheating phase, at the end of inflation inhomogeneities of the time-dependent field act as a source of gravitational, and the spectrum of GWs can be linked directly to the duration of preheating. Moreover, the amplification of field fluctuations during the preheating process can lead to the amplification of sufficiently large curvature perturbations which lead to the overproduction of primordial black holes (PBHs). In our work, we study PBH and GWs production from preheating. We show that gravitational wave generation during preheating can be constrained from Planck's data, and PBHs that are overpopulated during the radiation-dominated era are affected by the preheating e-folds number.

Authors: Dr EL BOURAKADI, Khalil (University Hsssan II Casablanca); Prof. SAKHI, Z. (University Hassan II Casablanca); Prof. BENNAI, M. (University Hassan II Casablanca)

Presenter: Dr EL BOURAKADI, Khalil (University Hsssan II Casablanca)

Session Classification: Contributed posters

Contribution ID: **326** Type: **Contributed talk**

Revisiting HESS J1809–193 —a very-high-energy gamma-ray source in a fascinating environment

Monday, July 4, 2022 3:15 PM (15 minutes)

HESS J1809–193 is one of the unidentified very-high-energy gamma-ray sources in the H.E.S.S. Galactic Plane Survey (HGPS). It is located in a rich environment, with an energetic pulsar and associated X-ray pulsar wind nebula, several supernova remnants, and molecular clouds in the vicinity. Furthermore, HESS J1809–193 was recently detected at energies above 56 TeV with HAWC, which makes it a candidate for a PeVatron, i.e., a source capable of accelerating cosmic rays up to PeV energies.
We present a new analysis of the TeV gamma-ray emission of HESS J1809–193 with H.E.S.S., based on improved analysis techniques. We find that the emission is best described by two components with distinct morphologies and energy spectra. We complement this study with an analysis of Fermi-LAT data in the same region. Finally, taking into account also further multi-wavelength data, we interpret our results both in a hadronic and leptonic framework.

Author: MOHRMANN, Lars (Max Planck Institute for Nuclear Physics, Heidelberg)

Co-authors: JOSHI, Vikas (FAU Erlangen-Nürnberg); HINTON, Jim (MPIK Heidelberg); FUNK, Stefan (FAU Erlangen-Nürnberg)

Presenter: MOHRMANN, Lars (Max Planck Institute for Nuclear Physics, Heidelberg)

Session Classification: Contributed Talks

Contribution ID: **327** Type: **Contributed e-poster**

Observational constraints on the maximum energies of accelerated particles in supernova remnants

Supernova remnants (SNRs) are thought to be the most plausible sources of Galactic cosmic rays. One of the principal questions is whether they are accelerating particles up to the maximum energy of Galactic cosmic rays (~PeV). In this work, a systematic study of gamma-ray-emitting SNRs is conducted. Our purpose is to measure the evolution of maximum particle energies with the current best statistics and age estimates. We model their gamma-ray spectra to constrain the particle-acceleration parameters. Two candidates of the maximum energy of freshly accelerated particles, the gamma-ray cutoff and break energies, are found to be well below PeV. We also test a spectral model that includes both the freshly accelerated and escaping particles to estimate the maximum energies more reliably, but no tighter constraints are obtained with current statistics. The average time dependences of the cutoff energy ($\propto t^{-0.81\pm0.24}$) and break energy ($\propto t^{-0.77\pm0.23}$) cannot be explained with the simplest acceleration condition (Bohm limit) and require shock–ISM (interstellar medium) interaction. The average maximum energy during lifetime is found to be < 20 TeV $(t_M/1\ \mathrm{kyr})^{-0.8}$ with t_M being the age at the maximum, which reaches ~PeV if $t_M < 10$ yr. The maximum energies during lifetime are suggested to have a variety of 1.1–1.8 dex from object to object. Although we cannot isolate the cause of this variety, this work provides an important clue to understanding the microphysics of particle acceleration in SNRs.

Authors: Dr SUZUKI, Hiromasa (Konan University); Dr BAMBA, Aya (The University of Tokyo); Prof. YAMAZAKI, Ryo (Aoyama Gakuin University); Dr OHIRA, Yutaka (University of Tokyo)

Presenter: Dr SUZUKI, Hiromasa (Konan University)

Session Classification: Contributed posters

Contribution ID: **328** Type: **Review, Highlight, or Invited talk**

Highlights from H.E.S.S.

Monday, July 4, 2022 12:45 PM (25 minutes)

The High Energy Stereoscopic System is the only facility available for studying the Very High Energy sky in the Southern Hemisphere. In 2019 it was upgraded with a new camera on its CT5 telescope and has been continuously operated during the Covid pandemic. During this period, new sources, source classes and phenomena were discovered and in-depth surveys and analyses were conducted. This presentation describes the highlights of H.E.S.S. observations during the last three years and presents an outlook for the newly approved extension of science operations.

Author: WAGNER, Stefan (LSW, ZAH, U Heidelberg)

Presenter: WAGNER, Stefan (LSW, ZAH, U Heidelberg)

Session Classification: Highlight Talks observational

Contribution ID: **329** Type: **Contributed talk**

Astro-COLIBRI: The coincidence library for real-time inquiry for multi-messenger astrophysics

Thursday, July 7, 2022 6:15 PM (15 minutes)

Astro-COLIBRI is a novel tool that evaluates alerts of transient observations in real time, filters them by user-specified criteria, and puts them into their multiwavelength and multimessenger context. Astro-COLIBRI is a fast and easily readable software that contributes to an enhanced discovery potential of both serendipitous and follow-up observations of the transient sky.

In this talk, the key features of Astro-COLIBRI are presented. We'll outline the architecture and present the version 2.0 of the web front end. The platform being live, some use cases will also be presented showing the search for high-energy gamma-ray counterparts to high-energy neutrinos, gamma-ray bursts and gravitational waves. Astro COLIBRI is available on IOS and Android.

Authors: LEFRANC, Valentin (CEA IRFU); Dr SCHUSSLER, Fabian (CEA Irfu); Mr REICHHERZER, Patrick (Ruhr University Bochum); Mr ALKAN, atilla (ipsa)

Presenter: LEFRANC, Valentin (CEA IRFU)

Session Classification: Contributed Talks

Contribution ID: **330** Type: **Contributed e-poster**

The ASTRI Mini-Array: in the search for hidden Pevatrons

Despite the enormous efforts done in very recent years, both theoretically and experimentally, the basic three questions about the CR origin remain without clear answers: what are their sources, how are they accelerated, how do they propagate?

Gamma-ray astronomy plays a fundamental role in this field. Both relativistic protons and electrons can emit in the gamma-ray band with different processes but only the detection of hadronic gamma-ray emission can probe the acceleration of Cosmic-Ray

In particular, since the Klein-Nishina suppression of IC emission at the highest energies, the detection of gamma-ray emission above 100 TeV was thought to be a confirmation of its hadronic origin. However, the last results published by the LHAASO collaboration revealed the existence of several PeV sources likely related to PWNae, well known leptonic factories (e.g. the Crab Nebula for all). Consequently, a gamma-ray detection at PeV energies may no longer be the final proof of hadronic acceleration. However, the limited angular resolution of LHAASO makes associations uncertain and more detailed and deeper studies are needed.

In this context, the ASTRI Mini-Array, with its unprecedented sensitivity and angular resolution at E>10 TeV, not only can extend the gamma-ray spectra of candidate pevatrons but could help to distinguish emission regions from PWNae and other LHAASO sources, shedding light on the nature of the highest energies emission.

Authors: CARDILLO, Martina (IAPS-INAF); FOR THE ASTRI PROJECT (http://www.astri.inaf.it/en/library/)

Presenter: CARDILLO, Martina (IAPS-INAF)

Session Classification: Contributed posters

Contribution ID: **331** Type: **Contributed talk**

PWNe beyond the free expansion

Thursday, July 7, 2022 5:15 PM (15 minutes)

It is known that CTA will contribute to the discovery of tens or hundreds of new pulsar wind nebulae (PWNe). Many of them will be beyond the free expansion phase, thus it is necessary to study in detail what is their evolution across this phase. The current one-zone models for PWNe treat the nebulae and the supernova remnant (SNR) as an uniform system and important mismatches appear when we simulate and compare the SNR pressure outside the PWN shell with 1D hydrodynamic (HD) models during the reverberation phase where, after the arrival of the reverse shock, the shocked material of the SNR directly interacts with the PWN shell. We use TIDE, an advanced radiative code, to evaluate the impact of various parameters (properties of the supernova ejecta, inner pulsar and ambient medium) upon the extent of the reverberation phase of PWNe in properties as the starting time of the reverberation phase and how this affects the amount of the compression, and how much of this can be ascribable to the radiation processes. We also provide a new prescription for the SNR shock trajectories, updating the work already done by Truelove & McKee in 1999, with the final aim of providing a new set of semi-analytical equations to model the reverberation phase in one-zone models with 1D-HD-simulations-like accuracy.

Author: MARTIN, Jonatan (Osservatorio Astrofisico di Arcetri (INAF))

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Presenter: MARTIN, Jonatan (Osservatorio Astrofisico di Arcetri (INAF))

Session Classification: Contributed Talks

Contribution ID: **333** Type: **Contributed e-poster**

Probing the Origin of the NPS with Broadband Radio Observations: New Insights into Future X-ray and Gamma-ray Observations

The North Polar Spur (NPS) is a giant structure that is clearly observed in both radio and X-ray all-sky maps. Although half a century has passed since its discovery, two competing ideas are still being actively debated to postulate its origin: one considers a local super-bubble near the solar system,and the other is based on a remnant of AGN and/or starburst outflow from the Galactic Center (GC) over 10 Myr ago. In this context, the recent discovery of gamma-ray Fermi bubbles, as well as even larger X-ray eROSITA bubbles, may suggest a possible connection between the NPS and these large structures. In this study, we analyzed broad-band radio observations covering a range between 22 MHz (VLA) to 70 GHz (Planck) for the first time, to provide a systematic analysis of thermal/non-thermal emissions associated with the NPS. We show that the radio emission of the NPS is composed of (1) synchrotron radiation, (2) free-free radiation, and (3) dust emission, but the synchrotron emission dominates over other emissions at high galactic latitudes. In most regions, the electron spectrum indicates a power-low relationship with its index, s, of $N(\gamma) \propto \gamma^{-s}$ ($s \approx 2.2 - 3.0$), moderated by a high-energy turnover cutoff around $\gamma \sim 10^4$ ($E \sim 10$ GeV) ; this indicates that radio-emitting electrons are already cooled within the NPS. When assuming a typical magnetic field strength of $B \approx 5\ \mu G$, the resultant cooling time is ~ 10 Myr, which provides additional support that the NPS is a structure within the GC. We estimated the non-thermal energy stored in the NPS to be $\sim 2.6 \times 10^{55}\ [erg]$ in case of the GC. We also estimated that gamma-ray emission associated with the NPS, through inverse Comptonization of the CMB, peaks at approximately 100-1000 keV, with a flux of $\sim 10^{-9}\ [erg/cm^2/s/str]$, which may be a good candidate for future detection by the Athena X-ray observatory.

Authors: Mr IWASHITA, Ryoji (Faculty of Science and Engineering, Waseda University); Prof. KATAOKA, Jun (Facility of Science and Engineering, Waseda University); Prof. SOFUE, Yoshiaki (Institute of Astronomy, The University of Tokyo)

Presenter: Mr IWASHITA, Ryoji (Faculty of Science and Engineering, Waseda University)

Session Classification: Contributed posters

Contribution ID: **334** Type: **Contributed talk**

A unified picture for three different cosmic-ray observables

Wednesday, July 6, 2022 5:30 PM (15 minutes)

We present here a unified scenario that connects together three peculiar spectral features recently reported in the spectra of charged cosmic rays (CRs). The hadronic spectral hardening above $\sim 250\,\mathrm{GV}$ is here interpreted as a diffusion imprint, and modeled by means of a transport coefficient that smoothly hardens with rigidity. We implement such a propagation framework to solve the transport equation with the DRAGON2 numerical code in order to determine the large-scale contribution to the CR fluxes. On top of this solution we explore the hypothesis of a nearby, hidden Supernova Remnant (SNR) to be responsible for the high-energy (above $\sim 100\,\mathrm{GeV}$) all-lepton flux, in particular for the spectral break observed around $1\,\mathrm{TeV}$. We compute such contribution analytically adopting the same propagation setup implemented for the large-scale background. Simultaneously, we find the signature of the same source in the peculiar *bump* structure observed by the DAMPE Collaboration in the proton spectrum, consisting of a strong hardening at $\sim 500\,\mathrm{GeV}$ and a softening at $\sim 13\,\mathrm{TeV}$. We validate our hypothesis with the CR dipole-anisotropy (DA) amplitude and phase, and find that the observations below $\sim 10\,\mathrm{TeV}$ can be considered as a signature of the nearby SNR that we invoke. If confirmed, our modelling strongly constrains the propagation parameters of the charged particles in our Galaxy and sets the ground for the understanding of the high-energy γ-ray observations of the forthcoming years.

Authors: FORNIERI, Ottavio (GSSI); Dr GAGGERO, Daniele (IFIC); Dr GUBERMAN, Daniel (ICCUB); Dr DE LA TORRE LUQUE, Pedro (Stockholm University); Dr MARCOWITH, Alexandre (LUPM)

Presenter: FORNIERI, Ottavio (GSSI)

Session Classification: Contributed Talks

Contribution ID: **335** Type: **Contributed e-poster**

Particle acceleration in colliding winds of massive binaries

Wind-wind collision of massive binaries produces strong shock fronts of compressed and heated plasma, with amplified magnetic fields, where particles may be accelerated to very high energies. Here we present examples of full three-dimensional magnetohydrodynamical simulations of colliding winds, which computational code also provide kinematics of passive charged particles subject to ambient fields. A large number of thermal test particles are evolved and produce a non-thermal population with energies in the range of few tens of GeVs up to tens of TeVs, depending on the initial magnetization level of the stellar winds. We analyzes the regions where main acceleration occurs. These results show that CWBs are possible target for the next generation of high energy particle observatories.

Author: Prof. FALCETA-GONÇALVES, Diego (Universidade de Sao Paulo)

Co-author: Prof. KOWAL, G. (Universidade de Sao Paulo)

Presenter: Prof. FALCETA-GONÇALVES, Diego (Universidade de Sao Paulo)

Session Classification: Contributed posters

Contribution ID: **336** Type: **Contributed talk**

Gamma-ray Blazars above 100 MeV: density, evolution and origin of the Extragalactic Gamma-ray Background

Wednesday, July 6, 2022 3:30 PM (15 minutes)

The mystery of the extragalactic gamma-ray background (EGB) has been investigated since its first detection. To unveil its origin and composition, it is necessary to resolve the different gamma-ray emitting populations. Relying on 8 years of Fermi-Large Area Telescope data, we obtained the most sensitive source count distribution of blazars >100 MeV to date. This allowed us to derive the contribution of blazars to the EGB, highlighting that this population cannot reproduce the entire EGB and that, indeed, another source class is required to explain the residual emission. For the first time, we were also able to differentiate between possible evolutionary paths of this elusive source class, and derive that a density evolution is preferred. In this talk, I will present the latest results of our analysis in light of blazars' evolutionary models and discuss future prospects for the luminosity function study of gamma-ray blazars.

Authors: MARCOTULLI, Lea (Yale University); Prof. AJELLO, Marco (Clemson Univerisity); Dr DI MAURO, Mattia (INFN Torino)

Presenter: MARCOTULLI, Lea (Yale University)

Session Classification: Contributed Talks

Contribution ID: **337** Type: **Contributed e-poster**

Computing sky maps using the open-source package Gammapy and MAGIC data in a standardized format

The open-source Python package Gammapy, developed for the high-level analysis of gamma-ray data, requires gamma-like event lists combined with corresponding instrument response functions. For morphological analysis, this data has to include a background acceptance model. Here we report an approach to generate such a model for the MAGIC telescope data, accounting for the azimuth and zenith dependencies of the MAGIC background acceptance. We validate this method using observations of the Crab Nebula with different offsets from the pointing position.

Authors: MENDER, Simone (TU Dortmund); Dr LINHOFF, Lena (TU Dortmund University); Dr HASSAN, Tarek (CIEMAT); Dr ELSÄSSER, Dominik (TU Dortmund University); NIGRO, Cosimo (Institut de Física d'Altes Energies (IFAE))

Presenter: NIGRO, Cosimo (Institut de Física d'Altes Energies (IFAE))

Session Classification: Contributed posters

Contribution ID: **338** Type: **Contributed e-poster**

Electron pre-acceleration at merger shocks of galaxy clusters

Particle pre-acceleration constitutes a central unresolved problem in the theory of diffusive shock acceleration (DSA). This process acting at merger shocks in galaxy clusters is thought to produce relativistic electrons forming the so-called radio relics through their radio and X-ray emissions. DSA may also be a source of high- and ultra-high-energy cosmic rays and associated gamma-rays and neutrinos. We report on our recent studies of electron pre-acceleration in cluster shocks with large-scale 2D kinetic particle-in-cell simulations that allow us to investigate the effects of the ion-scale rippling of the shock front and the multi-scale turbulence in the shock transition and downstream. We show that electron injection to DSA can be provided through the process of stochastic shock-drift acceleration (SSDA), in which electrons are confined in the shock transition by pitch-angle scattering off turbulence and gain energy from the motional electric field. Through analysis of multi-scale turbulence in the shock at different pre-shock conditions we demonstrate a crucial role of the shock rippling in electron acceleration via SSDA.

Authors: NIEMIEC, Jacek (Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland); FULAT, Karol (University of Potsdam); Dr KOBZAR, Oleh (Cracow University of Technology); Dr BOULA, Stella (Institute of Nuclear Physics Polish Academy of Sciences); Dr AMANO, Takanobu (Department of Earth and Planetary Science, University of Tokyo)

Co-authors: POHL, Martin (Uni Potsdam / DESY); Prof. HOSHINO, Masahiro (Department of Earth and Planetary Science, University of Tokyo); Prof. MATSUKIYO, Shuichi (Kyushu University)

Presenter: NIEMIEC, Jacek (Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland)

Session Classification: Contributed posters

Contribution ID: **339** Type: **Contributed e-poster**

CTA perspective for the gamma-ray luminosity–SFR correlation in star-forming galaxies

Star-forming galaxies (SFGs) are unique gamma-ray emitters. The observation of a correlation between their non-thermal luminosity and their star-formation rate (SFR) strongly suggests that these gamma rays result from interactions of cosmic rays injected by phenomena connected with the SFR, such as supernova remnants and massive star winds.
We aim to investigate the effect of gamma-ray absorption processes and cosmic-ray transport footprints in SFGs at very high energies (VHE) in terms of the luminosity-SFR correlations.
We develop a model that reproduces the non-thermal emission in SFGs from radio to GeV, using the SFR as an independent variable. We build the correlation by integrating the luminosity in two energy bands that will be accessible to CTA: 0.1-10 TeV and 10 -100 TeV.
We explore how particles diffusion, protons' maximum energy, and the absorption inside galaxies and en route to Earth impact the modeled correlation.
We find that these properties substantially impact the correlation in the highest energy range and provide key information on particle transport.
In light of upcoming CTA observations, we conclude by discussing how the luminosity-SFR correlation in the VHE band can guide us in improving our understanding of CR transport and radiative processes in SFGs.

Authors: KORNECKI, Paula (CNRS/LUTH Observatoire de Paris, Site de Meudon); Dr PERETTI, Enrico; DEL PALACIO, Santiago (Chalmers University of Technology); Dr MARCOWITH, Alexandre (LUPM); Dr ARAUDO, Anabella (Astronomical Institute, Academy of Sciences, Prague, Czech Republic)

Presenter: KORNECKI, Paula (CNRS/LUTH Observatoire de Paris, Site de Meudon)

Session Classification: Contributed posters

Contribution ID: **340** Type: **Contributed e-poster**

High energy photon and neutrino emission from GRBs in the Hadronic Supercriticality expanding model

Hadronic Supercriticality (HSC) is a property of hadronic systems according to which relativistic protons lose the energy stored in them abruptly and very efficiently through the emission of violent photon outbursts. We investigate for the first time HSC in the context of an expanding system and show its direct analogy to GRB phenomenology. We simulate a variable GRB engine that injects a series of blobs, each of them having initial parameters leading to the onset of HSC. For low expansion velocities ($u_{\rm exp}$<0.01c), one blob can produce a quasi-periodic light curve. The superposition of all the light curves results in the production of a multi-pulse long duration light curve with a power spectrum similar to that of red-noise processes. For a benchmark jet Lorentz factor of 100 we find ɣ-ray luminosities reaching the values of $10^{49} - 10^{52}$ erg/sec and broadband photon spectra peaking at photon energies ~1 MeV for maximum proton energies ~10 PeV. The estimated total neutrino fluence is ~10% of the ɣ-ray fluence, while the neutrino spectra peak at lower energies (~10 TeV) compared to other standard neutrino models. The predicted quasi-diffuse flux is close to the projected IceCube-Gen2 limits in the energy range of 10-100 TeV. Therefore, the HSC model for GRBs could be tested by next-generation neutrino telescopes.

Authors: Dr FLOROU, Ioulia (National & Kapodistrian University of Athens); Prof. MASTICHIADIS, Apostolos (National and Kapodistrian University of Athens); Prof. PETROPOULOU, Maria (National & Kapodistrian University of Athens)

Presenter: Dr FLOROU, Ioulia (National & Kapodistrian University of Athens)

Session Classification: Contributed posters

Contribution ID: **341** Type: **Contributed e-poster**

Generating airshower images with conditional Generative Adversarial Networks

Here we show for the first time, the use of conditional Generative Adversarial Networks (cGANs) to synthesize novel IACT images that could be used for training future classification tasks. We will demonstrate that, using airshower data cast as time-series, cGANs can replicate the underlying features of the images, and synthesize additional signals through interpolation in the class and latent spaces. With the help of a dedicated GPU, our method is able to synthesize additional signals at unprecedented speed: one million events in just under a minute.

Author: HOANG, John

Presenter: HOANG, John

Session Classification: Contributed posters

Contribution ID: **342** Type: **Contributed e-poster**

The Fermi-LAT Light Curve Repository

We present the Fermi-LAT light curve repository, consisting of a public library of gamma-ray light curves for variable Fermi-LAT sources on a variety of timescales. The Fermi-LAT light curve repository aims to provide publication-quality light curves on timescales of days, weeks, and months for over 1500 sources deemed variable in the 4FGL-DR2 catalog. The repository consists of light curves generated through a full-likelihood analysis of the source and surrounding region, providing calibrated flux and photon index measurements for each time bin. Hosted at NASA's HEASARC, the library provides users with access to this continually updated light curve data, serving as a resource to the time-domain and multi-messenger communities.

Authors: VALVERDE, Janeth (NASA GSFC); KOCEVSKI, Daniel; BRILL, Ari; NEGRO, Michela; GARRAPPA, Simone

Presenter: VALVERDE, Janeth (NASA GSFC)

Session Classification: Contributed posters

Contribution ID: **343** Type: **Contributed talk**

Gamma-ray monochromatic line emission search from dark matter annihilation up to 100 TeV towards the Galactic Centre with MAGIC

Thursday, July 7, 2022 5:45 PM (15 minutes)

The detection of line-like TeV gamma-ray features configures as a smoking gun for the discovery of TeV-scale particle dark matter. We report the first search for dark matter spectral lines in the Galactic Centre region up to gamma-ray energies of 100 TeV with the MAGIC telescopes (La Palma, Canary Islands). The Galactic Centre region is expected to host the most promising dark matter halo due to its size and proximity and is therefore well suited for this kind of searches. Observations at large zenith angles improve sensitivity for gamma-rays in the TeV regime due to the increased telescope collection area. We present the results obtained with more than 200 hours of large-zenith angle observations of the Galactic Centre region, which allow us to obtain competitive limits to the dark matter annihilation cross-section at high particle masses ($< 5\times10^{-28}$ $\mathrm{cm^3 s^{-1}}$ at 1 TeV and $< 1\times10^{-25}$ $\mathrm{cm^3\ s^{-1}}$ at 100 TeV), improving the best current constraints above 20 TeV. In addition, we also study the impact of an inner cored dark matter halo on probing the annihilation cross-section. Finally, we use the derived limits to constrain super-symmetric wino models.

Author: INADA, Tomohiro (ICRR, UTokyo)

Co-authors: Dr KERSZBERG, Daniel (IFAE, BIST); Dr HÜTTEN, Moritz (ICRR, UTokyo); Prof. TESHIMA, Masahiro (ICRR, UTokyo/Max-Planck-Institute for Physics, Munich); Dr RICO, Javier (IFAE-BIST); Prof. KOHRI, Kazunori (KEK, IPNS/SOKENDAI/Kavli IPMU); Dr HIROSHIMA, Nagisa (University of Toyama, RIKEN iTHEMS)

Presenter: INADA, Tomohiro (ICRR, UTokyo)

Session Classification: Contributed Talks

Contribution ID: **344** Type: **Contributed e-poster**

Search for gamma rays from asteroids in the Solar System with the Fermi LAT

All known small Solar System bodies have a diameter between a few km and a few thousands of km. Based on the collisional evolution of Solar System bodies, Davis et al. proposed in 2002 a model predicting the existence of a larger number of asteroids with diameters down to 10 m. In this work we propose an extension of this model to diameters of a few cm. Like all Solar System bodies, asteroids can be passive sources of high-energy gamma rays, which are produced when energetic charged cosmic rays impinge on their surfaces. Since the majority of known asteroids lie in an orbit between Mars' and Jupiter's orbits (known as the Main Belt), we expect them to produce a diffuse emission close to the ecliptic plane. In this work, we have studied the gamma-ray emission from the ecliptic by using the data collected by the Large Area Telescope (LAT) onboard the Fermi satellite. We have fitted the LAT data with a template model for the diffuse emission of small Solar System bodies obtained with a dedicated simulation based on the FLUKA Monte Carlo toolkit. The fit results provide an upper limit on the total flux, which yields a constraint on the asteroid population model.

Authors: DE GAETANO, Salvatore (Università degli Studi di Bari, INFN sezione di Bari); DI VENERE, Leonardo (INFN-Bari); Prof. LOPARCO, Francesco (Università degli Studi di Bari Aldo Moro, INFN sezione di Bari); Dr MAZZIOTTA, Mario Nicola (INFN sezione di Bari)

Presenter: DE GAETANO, Salvatore (Università degli Studi di Bari, INFN sezione di Bari)

Session Classification: Contributed posters

Contribution ID: **345** Type: **Contributed e-poster**

Understanding the multi-wavelength emission from astrophysical shocks

Interpreting observations of astrophysical shocks from radio to gamma-rays requires a detailed understanding of how shocks accelerate particles over the course of their evolution. We present a fast, multi-zone model of particle acceleration that self-consistently accounts for magnetic field amplification and shock modification due to the presence of non-thermal particles. By incorporating results from state-of-the-art simulations, we use this model to reproduce key features in the multi-wavelength emission from a variety of sources. These features include the steep radio and gamma-ray spectra observed from supernova remnants, the gamma rays detected from fast black-hole winds, and the GeV and TeV emission from the recent outburst of symbiotic nova RS Ophiuchi.

Author: DIESING, Rebecca (University of Chicago)

Co-author: Prof. CAPRIOLI, Damiano (University of Chicago)

Presenter: DIESING, Rebecca (University of Chicago)

Session Classification: Contributed posters

Contribution ID: **346** Type: **Review, Highlight, or Invited talk**

Status of LST project

Friday, July 8, 2022 10:10 AM (20 minutes)

Thanks to their large reflectors and improved photon collection efficiency, the Large-Sized Telescopes (LSTs) of the Cherenkov Telescope Array (CTA) target the lowest gamma-ray energies observable from the ground, down to 20 GeV. A four LST sub-array is currently under construction at the CTA-North site of La Palma (Spain). The first LST, LST1, in fact was already inaugurated in 2018. I will report on the progress of the LST project in general and review the early science that LST1 is delivering during its commissioning phase.

Authors: CORTINA, Juan (CIEMAT); CTA-LST PROJECT

Presenter: CORTINA, Juan (CIEMAT)

Session Classification: Invited Talks (Aula Magna Biologia) Chair: Stefano Vercellone

Contribution ID: **347** Type: **Contributed e-poster**

Advanced Analysis of Night Sky Background Light for SSTCAM

Night Sky Background (NSB) is a complex phenomenon, consisting of all light detected by imaging atmospheric Cherenkov telescopes not attributable to Cherenkov light emission. Understanding the effect of NSB on cameras for the next-generation Cherenkov Telescope Array (CTA) is important, as it affects the astrophysical systematic errors on observations, the energy threshold, the thermal control of the cameras and the ability of the telescopes to operate under partial moonlight conditions. This capacity to observe under partial moonlight conditions is crucial for the CTA transient science programme, as it substantially increases the potential observing time. Using tools initially developed for H.E.S.S. (in combination with the prototype CTA analysis package ctapipe) we will present predictions for the NSB present in images taken by the CTA Small Sized Telescope Camera (SSTCAM), showing that SSTCAM will likely be able to meet the associated CTA requirements. Additionally, we calculate the potential observing time gain by operating under high NSB conditions.

Authors: SPENCER, Samuel (Friedrich Alexander University Erlangen-Nuremberg); Dr WATSON, Jason (DESY); Dr GIAVITTO, Gianluca (DESY); Prof. COTTER, Garret (University of Oxford); Dr WHITE, Richard (MPIK)

Presenter: SPENCER, Samuel (Friedrich Alexander University Erlangen-Nuremberg)

Session Classification: Contributed posters

Contribution ID: **348** Type: **Contributed talk**

The ASTRI Mini-Array Core Science Program

Thursday, July 7, 2022 5:00 PM (15 minutes)

Celestial sources emitting at high-energy (HE, E>100 MeV) and at very high-energy (VHE, E>100 GeV) are of the order of a few thousands and a few hundreds, respectively. On the other hand, the number of sources emitting at ultra high-energy (UHE, E> several tens of TeV) are just a few dozens, and are currently being investigated by means of both ground-based imaging atmospheric Cherenkov telescopes (IACTs) and particle shower arrays. These rare VHE and UHE sources represent a new frontier in astrophysics. An array composed of nine ASTRI Cherenkov telescopes is under construction at the Observatorio del Teide (Tenerife, Spain). The ASTRI Mini-Array aims at providing robust answers to a few selected open questions in the VHE and UHE domains. The scientific program during the first four observing years will be devoted to the following Core Science topics: the origin of cosmic rays, the extra-galactic background light and the study of fundamental physics, the novel field in the VHE domain of gamma-ray bursts and multi-messenger transients, and finally the usage of the ASTRI Mini-Array to investigate ultra high-energy cosmic rays and to undertake stellar intensity interferometry studies. We review the scientific prospects assessed through dedicated simulations, proving the potential of the ASTRI Mini-Array in pursuing breakthrough discoveries and discuss the synergies with current and future VHE facilities in the Northern hemisphere, such as MAGIC, LHAASO, HAWC, Tibet AS-gamma, and CTAO-N.

Author: VERCELLONE, Stefano (INAF-OAB)

Co-author: FOR THE ASTRI PROJECT (http://www.astri.inaf.it/en/library/)

Presenter: VERCELLONE, Stefano (INAF-OAB)

Session Classification: Contributed Talks

Contribution ID: **349** Type: **Review, Highlight, or Invited talk**

A multi-wavelength View of Active Galactic Nuclei with an Emphasis on Gamma Rays

Monday, July 4, 2022 10:15 AM (45 minutes)

Active Galactic Nuclei (AGN) are quite unique astronomical sources emitting over about 20 orders of magnitude in frequency, with different electromagnetic bands providing windows on different sub-structures and their physics. They come in a large number of flavours only partially related to intrinsic differences. I will highlight the types of sources selected by different bands, the relevant selection effects and biases, and the underlying physical processes, emphasizing the gamma-ray band. I will then look at the "big picture"by describing the most important parameters one needs to describe the variety of AGN classes. I will then conclude with a look at the most pressing open issues and the main new facilities, which will flood us with new data to tackle them.

Author: PADOVANI, Paolo (European Southern Observatory)

Presenter: PADOVANI, Paolo (European Southern Observatory)

Session Classification: Review Talks

Contribution ID: **350** Type: **Contributed e-poster**

Muti-collision lepto-hadronic models for energetic Gamma-Ray Bursts

Gamma-Ray Bursts (GRBs) are among the most energetic transients in the universe. Although mostly observed in keV to MeV energies, some GRBs have been detected in MeV to GeV energies by the Fermi-LAT. Generally, those bursts are among the brightest events of the observed population. Motivated by this, we investigate lepto-hadronic multi-wavelength models for energetic GRBs with $E_{\gamma,\mathrm{iso}} > 10^{54}$ erg. Our approach includes both a self-consistent radiative treatment (also of the secondary particle cascade) as well as a spatially resolved multi-zone internal shock model.
In this framework we investigate low- to high-energy signatures of different leptonic and hadronic processes in synchrotron and inverse-Compton dominated scenarios.
We further calculate the associated neutrino fluences and discuss the implications for (high-energy) cosmic rays.

Authors: RUDOLPH, Annika (DESY Zeuthen); PETROPOULOU, Maria (Princeton University); WINTER, Walter (DESY Zeuthen); BOŠNJAK, Željka (University of Zagreb)

Presenter: RUDOLPH, Annika (DESY Zeuthen)

Session Classification: Contributed posters

Contribution ID: **351** Type: **Contributed e-poster**

Classification of accelerated particles in plasma simulations using neural networks

Cosmic ray (CR) acceleration processes can be studied by using a fully-kinetic treatment for plasma simulations, e.g., particle-in-cell (PIC) simulations, that allow us to describe a detailed microphysics responsible for CR acceleration. Particle tracing implemented in many PIC codes is able to store full datasets for selected high-energy particles. However, the by-eye inspection of particle trajectories includes a high level of bias and uncertainty, and pinpointing the specific acceleration mechanisms is very difficult. Therefore, we propose a method to predict the energy of particles by using supervised Neural Networks (NN). The dataset used is taken from our recent PIC simulations of nonrelativistic perpendicular shocks and consists of approximately 40000 particles with 4 different variables, each associated with a time series of 1200 time steps long. These particles cross a region affected by the Buneman instability, upon which a few percentages of them reach high energies. We perform classification and regression on the dataset by using a Convolutional NN and a Multi-Layer Perceptron. Both methods are able to predict real particle energies with high precision, despite the noisy and imbalanced dataset. Proposed methodology may considerably simplify particle classification in large-scale PIC and hybrid simulations.

Authors: Mr TORRALBA PAZ, Gabriel (Institute of Nuclear Physics Polish Academy of Sciences); Dr BOHDAN, Artem (Deutsches Elektronen-Synchrotron DESY); Prof. NIEMIEC, Jacek (Institute of Nuclear Physics Polish Academy of Sciences)

Presenter: Mr TORRALBA PAZ, Gabriel (Institute of Nuclear Physics Polish Academy of Sciences)

Session Classification: Contributed posters

Contribution ID: **352** Type: **Contributed e-poster**

Constraining the prompt emission region and the ejecta speed of the distant GRB 220101A

GRB 220101A is the most distant gamma-ray burst detected by Fermi-LAT to date (z = 4.618). It is a very energetic event, with an equivalent isotropic energy $E_{iso} \sim 3.3 \times 10^{54}$ erg. We jointly analysed Fermi-GBM and LAT data with two analysis chains and obtained consistent results. They reveal a spectral break below 100 MeV in the LAT Low Energy (LLE) range during the prompt emission, associated with fast variability, which suggests that the spectral attenuation is caused by internal opacity to pair creation. Regardless of the nature of the emission processes, we find that the keV and MeV emissions were co-spatially produced above and near the photosphere, with a moderate Lorentz factor $_{bulk} \sim 100$. We will present this study and compare our findings with other LAT-detected bursts with similar properties.

Authors: SCOTTON, Lorenzo; Dr PIRON, Frédéric (CNRS/IN2P3/LUPM); OMODEI, Nicola (SLAC-Stanford); DI LALLA, Niccolo' (SLAC-Stanford)

Presenter: SCOTTON, Lorenzo

Session Classification: Contributed posters

Contribution ID: **353** Type: **Contributed talk**

Advancing the atmospheric Cherenkov-method to detect gamma-rays with one Giga electron Volt

Thursday, July 7, 2022 5:30 PM (15 minutes)

Imaging atmospheric Cherenkov-telescopes are powerful detectors for cosmic gamma-rays. Yet the detection of gamma-rays with lower energies in the domain of Giga electron Volts (so far reserved to satellites) at the high rates provided by the large collective area of the atmospheric Cherenkov-method, can be a potential advance. This will improve our understanding of short lived transients and of distant sources which have their gamma-rays with higher energies absorbed by infrared light. With telescopes, the detection of gamma-rays with lower energies implies larger mirrors, which narrow the depth-of-field, and blur the image. Larger mirrors imply an exponential increase in costs to prevent deformations of the optics. In addition, the mirror's aberrations further blur the image and limit the field-of-view. To advance, we propose a new class of instrument (the Cherenkov-plenoscope) which senses not only the direction of Cherenkov-photons but also their point of reflection on the mirror. The Cherenkov-plenoscope turns a narrow depth-of-field into the perception of depth, compensates deformations, and compensates the mirror's aberrations. We will discuss the possibility of a Cherenkov-plenoscope dedicated to the detection of gamma-rays with energies as low as one Giga electron Volt, and our current estimate of its capabilities.

Author: MUELLER, Sebastian Achim (Max Planck Institute for Nuclear Physics)

Presenter: MUELLER, Sebastian Achim (Max Planck Institute for Nuclear Physics)

Session Classification: Contributed Talks

Contribution ID: **354** Type: **Contributed talk**

Multi-messenger characterization of Mrk501 during historically low X-ray and γ-ray activity

Thursday, July 7, 2022 3:15 PM (15 minutes)

Blazars are among the most prominent and luminous objects in the γ-ray sky, but the mechanisms and particle populations behind their emission are still far from understood. The two MAGIC telescopes contribute to solving these riddles by regularly monitoring our closest blazars in the very-high-energy (>0.2 TeV, VHE) regime, which is particularly effective when accompanied with observations from other multiwavelength (MWL) instruments.

In this contribution we present the insights gained from our MWL data set of Mrk 501 collected between 2017 to 2020 with additional results gained when extending the data to the time period from 2008 to 2020. For the first time, we can identify significant correlations between the VHE γ-rays and X-rays for Mrk 501 also during very low-activity states as shown in our 4-year data set. Additionally, the measured correlations in both data sets reveal a delay of the radio emission with respect to the HE γ-rays by more than 100 days suggesting that the HE γ-ray emission is located further upstream the radio-bright regions in the jet of Mrk 501. Moreover, from the mid of 2017 to the mid of 2019 a historically low-state in both VHE as well as X-rays can be detected. The emission is stable with a VHE flux of 5% that of the Crab Nebula, as detected by MAGIC. We investigated the nature of this potential baseline emission using our MWL information together with published multi-messenger results from IceCube setting constraints on possible leptonic, lepto-hadronic and purely hadronic emission scenarios. While the stable emission could originate from a standing shock, the more variable emission in the months before the low-state can be attributed to an independent shock region traveling along the jet of Mrk 501.

Authors: HECKMANN, Lea (Max-Planck-Institut für Physik, D-80805 München, Germany); PANEQUE, David (Max-Planck-Institut für Physik, D-80805 München, Germany); GASPARYAN, Sargis (ICRANet-Armenia, Marshall Baghramian Avenue 24a, Yerevan 0019, Armenia); CERRUTI, Matteo (Institut de Ciències del Cosmos (ICCUB), Universitat de Barcelona (IEEC-UB), Martí i Franquès 1, 8 E08028 Barcelona, Spain); SAHAKYAN, Narek (ICRANet-Armenia, Marshall Baghramian Avenue 24a, Yerevan 0019, Armenia); ARBET-ENGELS, Axel (Max-Planck-Institut für Physik, D-80805 München, Germany)

Presenter: HECKMANN, Lea (Max-Planck-Institut für Physik, D-80805 München, Germany)

Session Classification: Contributed Talks

Contribution ID: **355** Type: **Contributed e-poster**

Background rejection using image residuals from large telescopes in imaging atmospheric Cherenkov telescope arrays

Identification of light coming from muons has been suggested as a promising way to dramatically improve the background rejection power of IACT arrays at high energies. However, muon identification remains a challenging task, for which efficient algorithms are still being developed. We present an approach in which, rather than identifying Cherenkov light from muons, we simply consider the presence of Cherenkov light other than the main shower image. We show that this approach results in background rejection improvements at all energies above 1 TeV, while maintaining a large gamma-ray efficiency.

Authors: REN, Helena (MPIK); OLIVERA NIETO, Laura (Max Planck Institut fur Kernphysik MPIK); HINTON, Jim (MPIK Heidelberg); Dr ALISON, Mitchell (ECAP)

Presenter: REN, Helena (MPIK)

Session Classification: Contributed posters

Contribution ID: **356** Type: **Contributed e-poster**

High-energy gamma-rays from magnetically arrested disks in nearby radio galaxies

The origins of the GeV gamma-rays from nearby radio galaxies are unknown. Hadronic emission from magnetically arrested disks (MADs) around central black holes (BHs) is proposed as a possible scenario. Particles are accelerated in the MAD by magnetic reconnection and stochastic turbulence acceleration. We investigate the feature of the radio galaxies that can be explained by the MAD model. We pick up the fifteen brightest radio galaxies in the GeV band from the Fermi 4LAC-DR2 catalog and apply the MAD model. We find that we can explain the GeV data by the MAD model if the accretion rate is lower than 0.1% of the Eddington rate. For a higher accretion rate, GeV gamma-rays are absorbed by the two-photon interaction due to copious low-energy photons. This causes the MAD model to fail to reproduce the GeV data. We also apply the MAD model to Sgr A*and find that the GeV-TeV gamma-rays observed at the Galactic center do not come from the MAD of Sgr A.*

Author: KUZE, RIku (Tohoku University)

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Presenter: KUZE, RIku (Tohoku University)

Session Classification: Contributed posters

Contribution ID: **358** Type: **Contributed talk**

Intergalactic magnetic field studies by means of the gamma-ray emission from GRB 190114C

Monday, July 4, 2022 5:45 PM (15 minutes)

The origin of the large-scale magnetic fields in the Universe is one of the long-standing problem in cosmology. To discriminate among the different explanations it is crucial to measure the intergalactic magnetic field (IGMF) in the voids among the galaxies. Gamma-rays coming from extragalactic sources can be used to constrain the IGMF due to their interaction with the intergalactic medium. Particularly, strong transients allow to constrain very weak IGMFs. We use CRPropa3 to propagate the measured very-high energy (E > 100 GeV) spectrum from GRB 190114C in the intergalactic medium. We then compute the expected cascade emission in the GeV domain for different IGMF settings and compare it with the Fermi/LAT limits for different exposure times.

Author: DA VELA, Paolo (University of Innsbruck)

Co-authors: LONGO, Francesco (University of Trieste); Dr STAMERRA, Antonio (INAF Osservatorio Astronomico di Roma); Dr SATURNI, Francesco (INAF Osservatorio astronomico di Roma); MARTÍ-DE-VESA, Guillem (University of Innsbruck); Dr VERES, Peter (Center for Space Plasma and Aeronomic Research, University of Alabama in Huntsville)

Presenter: DA VELA, Paolo (University of Innsbruck)

Session Classification: Contributed Talks

Contribution ID: **359** Type: **Contributed talk**

The SST-1M gamma-ray mini-array - early operations and prospects

Thursday, July 7, 2022 5:15 PM (15 minutes)

We present first results of the commissioning data from two Single-Mirror Small-Sized Telescopes (SST-1M) for gamma-ray detection with imaging air Cherenkov technique. SST-1M adopts a Davies-Cotton optics and a fully digitising silicon photomultipliers (SiPM) based camera. SST-1M telescopes have a lightweight and compact structure with 4 m-diameter mirror dish composed of 18 hexagonal glass mirrors and the focal ratio of 1.4. It has a wide field-of-view of 9.1◦. The innovative cameras employ digital electronics, with fully digital trigger and readout architecture, and highly performing large-area SiPM with dedicated slow control. The SST-1M telescopes are optimized to provide gamma-ray sensitivity above 500 GeV in stereo mode. They already allow fully robotic operation and they are designed for operation in harsh environment with minimal maintenance. The SST-1M mini-array is installed at the Ondřejov Observatory in the Czech Republic and undergoes commissioning and validation during which first remote observations of astronomical sources are performed. In our presentation we will report on the status of the project and present first results of early science operations.

Author: NIEMIEC, Jacek (Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland)

Presenter: NIEMIEC, Jacek (Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland)

Session Classification: Contributed Talks

Contribution ID: **360** Type: **Contributed talk**

Revisiting particle acceleration at ultra-relativistic shocks

Wednesday, July 6, 2022 5:45 PM (15 minutes)

Relativistic shocks are thought to drive the non-thermal gamma-ray emission in many astrophysical phenomena, such as GRBs and AGNs. The details of the mechanisms by which particles are accelerated to the energies required to emit gamma rays is not fully understood. Fermi acceleration at relativistic shocks relies on the the particles' ability to repeatedly cross the shock. As argued in previous studies, for acceleration to proceed, the isotropization rate in downstream must exceed the gyro-frequency. This provides an upper limit on the maximum energy, commonly referred to as the magnetized limit.

In this work, we demonstrate that the magnetization limit is in fact a weak condition, and that the maximum energy achievable at a relativistic shock can in fact exceed this limit. We discuss the implications in light of recent TeV detection of GRBs.

Authors: HUANG, Zhi-Qiu (Max-Planck-Institut für Kernphysik); REVILLE, Brian (Max-Planck-Institut für Kernphysik); KIRK, John (Max-Planck-Institut für Kernphysik); GIACINTI, Gwenael (Max--Planck-Institut für Kernphysik/Tsung-Dao Lee Institute, Shanghai Jiao Tong University)

Presenter: HUANG, Zhi-Qiu (Max-Planck-Institut für Kernphysik)

Session Classification: Contributed Talks

Contribution ID: **361** Type: **Contributed e-poster**

Search for periodicities in High Energy AGNs with a time-domain approach

This work investigates a new methodology to search for periods in light-curves of high-energy gamma-ray sources such as Active Galactic Nuclei (AGNs). High-energy light curves have significant stochastic components, making period detection somewhat challenging. In our model, periodic terms, drifts of the light-curves and random walk with correlation between flux points due to red noise are taken into account independently. The parameters of the model are obtained directly from a Markov Chain Monte-Carlo minimization. The time periods found are compared to the output of the publicly available Agatha program. The search method is applied to high-energy periodic AGN candidates from the Fermi-LAT catalogue. The significance of periodic models over pure noise models is discussed. Finally, the variability of the period and amplitude of oscillating terms is studied on the most significant candidates.

Authors: RUEDA, Héctor (IRFU - CEA); Mr BRUN, François (IRFU - CEA); Mr GLICENSTEIN, Jean-François (IRFU - CEA)

Presenter: RUEDA, Héctor (IRFU - CEA)

Session Classification: Contributed posters

Contribution ID: **362** Type: **Contributed talk**

The gamma-ray morphology of M87 and the cosmic-ray pressure in the Virgo Cluster with H.E.S.S.

Wednesday, July 6, 2022 3:45 PM (15 minutes)

The Active Galactic Nucleus feedback is a potential heating mechanism, which solves the Cooling Flow (CF) Problem in Cool Core (CC) clusters. The cosmic-ray from the jet interact with the Intra-Cluster Medium (ICM) producing neutral pions, which decay to gamma rays, originating a steady and spatially extended gamma-ray signal. However, no gamma-ray observations could yet be associated with cluster diffuse emission.

The High Energy Stereoscopic System (H.E.S.S.) is an array of five Imaging Atmospheric Cherenkov Telescopes (IACTs) located in Namibia. The H.E.S.S. telescopes are sensitive to Very-High-Energy (VHE) gamma rays between ~30 GeV and ~100 TeV and have being observing M87 since 2004. M87 is one of the closest radio-galaxies, at $\sim$16.5 Mpc from Earth, at the center of the CC Virgo Cluster.

In this work, we analyze H.E.S.S. observations of M87 and classify the source emission into low, intermediate and high states. No significant gamma-ray extension was detected in the low state, leading to a 99.7% confidence level (c.l.) upper limit on the σ extension of $0.016^\circ \approx 4.6$ kpc. The volume-averaged cosmic-ray pressure ratio <XCR> is constrained to $\leq$20% within the inner 20 kpc at 99.7% c.l., considering two different approaches and a hard proton spectral index.

A cluster emission could not be detected, although it can not be ruled out. The Cherenkov Telescope Array Observatory (CTAO) will be the next generation of IACTs. With a better sensitivity and angular resolution, it has the potential to unravel M87 extended emission and help solve the CF problem.

Authors: BARBOSA MARTINS, Victor (DESY, D-15738 Zeuthen, Germany); ARCARO, Cornelia (Centre for Space Research, North-West University, Potchefst, South Africa); ZYWUCKA, Natalia (Centre for Space Research, Potchefst, North-West University, South Africa); OHM, Stefan (DESY, D-15738 Zeuthen, Germany); DE NAUROIS, Mathieu (Laboratoire Leprince-Ringuet, École Polytechnique, CNRS, Institut Polytechnique de Paris, F-91128 Palaiseau, France); TAYLOR, Andrew (DESY, D-15738 Zeuthen, Germany)

Presenter: BARBOSA MARTINS, Victor (DESY, D-15738 Zeuthen, Germany)

Session Classification: Contributed Talks

Contribution ID: **363** Type: **Contributed e-poster**

Leptonic Nonthermal Emission from Supernova Remnants Evolving in the Circumstellar Magnetic Field

The very-high-energy gamma-ray emission observed from a number of Supernova remnants (SNRs) indicates particle acceleration to high energies at the shock of the remnants and a potentially significant contribution to Galactic cosmic rays. It is extremely difficult to determine whether protons (through hadronic interactions and subsequent pion decay) or electrons (through inverse Compton scattering on ambient photon fields) are responsible for this emission. For a successful diagnostic, a good understanding of the spatial and energy distribution of the underlying particle population is crucial. Most SNRs are created in core-collapse explosions and expand into the wind bubble of their progenitor stars. This circumstellar medium features a complex spatial distribution of gas and magnetic field which naturally strongly affects the resulting particle population. In this work, we conduct a detailed study of the spectro-spatial evolution of the electrons accelerated at the forward shock of core-collapse SNRs and their non-thermal radiation, using the RATPaC code that is designed for the time- and spatially dependent treatment of particle acceleration at SNR shocks. We focus on the impact of the spatially inhomogeneous magnetic field through the efficiency of diffusion and synchrotron cooling. It is demonstrated that the structure of the circumstellar magnetic field can leave strong signatures in the spectrum and morphology of the resulting non-thermal emission.

Authors: SUSHCH, Iurii (North West University (South Africa)); BROSE, Robert (DIAS (Ireland)); POHL, Martin (Uni Potsdam / DESY); PLOTKO, Pavlo (DESY Zeuthen (Germany)); DAS, Samata (DESY Zeuthen/University of Potsdam (Germany))

Presenter: SUSHCH, Iurii (North West University (South Africa))

Session Classification: Contributed posters

Contribution ID: **364** Type: **Contributed e-poster**

TeV Bayesian Study of the Extragalactic Background Light

The extragalactic background light (EBL) is the aggregate of all optical and infrared emissions from thermal processes since the cosmic dark ages. While the integrated light of galaxies is expected to be the main contribution to the EBL, recent measurements beyond Pluto's orbit from the New Horizon probe show a 4σ excess in the optical band. This tension can be studied within observational gamma-ray cosmology, by reconstructing EBL-induced absorption in the gamma-ray spectra of extragalactic sources at very-high energies (VHE, $E > 100$ GeV). Gamma-ray studies of the EBL remain limited by the size of the spectral corpuses and by the uncertainties on the shape of the spectra emitted at the sources. We developed a new analysis method that aims at tackling these limitations. Unlike existing studies, we employ a fully Bayesian framework, which allows us to remove arbitrary criteria for selecting intrinsic spectral models. Such an approach further enables marginalization over systematics of instrumental origin, such as the uncertainty on the energy scale of current-generation VHE observatories. In this contribution, we apply our method to the most extensive catalog of extragalactic VHE spectra to date, STeVECat. We present our latest constraints on the energy density of the EBL at redshift $z = 0$, obtained with nearly 270 archival VHE spectra from over 50 extragalactic sources with known redshift.

Author: Mr GRÉAUX, Lucas (Université Paris-Saclay, CNRS/IN2P3, IJCLab)

Co-author: Prof. BITEAU, Jonathan (Université Paris-Saclay, CNRS/IN2P3, IJCLab)

Presenter: Mr GRÉAUX, Lucas (Université Paris-Saclay, CNRS/IN2P3, IJCLab)

Session Classification: Contributed posters

Contribution ID: **365** Type: **Contributed talk**

Assessing the flaring behaviour of the Crab pulsar wind nebula system in high-energy ranges

Thursday, July 7, 2022 3:15 PM (15 minutes)

The Crab system, a bright pulsar wind nebula powered by the young energetic central pulsar PSR B0531+21, has been extensively observed across the electromagnetic spectrum. Its extreme behaviour in the gamma-ray band has been repetitively challenging our understanding of acceleration mechanisms and radiation processes. Studies have purported a flaring emission associated with the synchrotron process originating from the nebula, in energy ranges below a few hundreds of MeV.
By analysing available Fermi-LAT data across a thirteen-year-long monitoring, we study the energy-dependence and time-variability of the observed high-energy flares in energy ranges up to a few GeV. Moreover we attempt to characterise known and candidate flaring epochs, so as to investigate the short and longer term effect on the presumed steady-state emission of the system. In this presentation we shall focus on the example of selected flares showcasing intriguing spectral evolution. We discuss their observational signature in the context of particle acceleration in the Crab
pulsar wind and consider their limitations on distinguishing competing mechanisms.

Author: TSIROU, Michelle (MPIK-HD)

Co-authors: REVILLE, Brian (Max-Planck-Institut für Kernphysik); DE ONA WILHELMI, Emma (DESY); GIACINTI, Gwenaël (Max-Planck-Institut für Kernphysik & Tsung-Dao Lee Institute); KIRK, John (Max-Planck-Institut für Kernphysik)

Presenter: TSIROU, Michelle (MPIK-HD)

Session Classification: Contributed Talks

Contribution ID: **366** Type: **Contributed talk**

Searches for neutrino point sources in the Northern Sky with the IceCube Neutrino Observatory

Thursday, July 7, 2022 3:30 PM (15 minutes)

Since its first discovery in 2013, the IceCube Neutrino Observatory has been studying the properties of a diffuse flux of astrophysical high-energy neutrinos, trying to unveil the enigma of its origin. Using over 9 years of IceCube data reprocessed to the latest detector calibrations, we investigate the Northern Sky for a local excess of high-energy neutrinos over the atmospheric and cosmic background, to be associated with a neutrino point source. Our analysis allows more accurate localization and neutrino flux characterization of the sources compared to previous works, while also improving the discovery potential by up to ~30%. Furthermore, we present an analysis looking for an excess of signal coming from a population of sub-threshold neutrino sources and discuss the implications on the neutrino luminosity and local source density. In this contribution, we report on the most recent results for neutrino point sources in the Northern Sky.

Authors: BELLENGHI, Chiara (Technical University Munich); Dr GLAUCH, Theo; Dr HAACK, Christian; KONTRIMAS, Tomas; Dr NIEDERHAUSEN, Hans; Dr WOLF, Martin

Presenter: BELLENGHI, Chiara (Technical University Munich)

Session Classification: Contributed Talks

Contribution ID: **367** Type: **Contributed talk**

Neutral pion bumps in TeV spectra of X-ray flaring blazars

Monday, July 4, 2022 4:15 PM (15 minutes)

Very high-energy (VHE, $E > 100$ GeV) observations of blazar Mrk 501 with MAGIC in 2014 have revealed an unusual narrow spectral feature at ~3 TeV during an extreme X-ray flaring activity. The one-zone synchrotron-self Compton scenario, widely used in blazar broadband spectral modeling, fails to explain the narrow TeV component. Motivated by this rare observation, we propose an alternative model where narrow features in VHE blazar spectra result from the decay of neutral pions (π^0 bumps). These are in turn produced by interactions of protons with hard X-ray photons (> 50 keV) whose number density can increase during flares. No π^0 bumps are predicted in X-ray "quiescense", as the proton energy is not high enough to exceed the threshold for pion production. We explore the physical conditions needed for the emergence of narrow π^0 bumps in blazar VHE spectra and discuss their detectability with the Cherenkov Telescope Array.

Author: PETROPOULOU, Maria (NKUA)

Co-authors: MASTICHIADIS, Apostolos (NKUA); PANEQUE, David (Max Planck Institute for Physics)

Presenter: PETROPOULOU, Maria (NKUA)

Session Classification: Contributed Talks

Contribution ID: **368** Type: **Contributed e-poster**

Correlation between emission-line luminosity and gamma-ray dominance in the blazar 3C 279

Despite numerous studies, the origin of gamma-ray emission of blazars, Active Galactic Nuclei (AGN) with a jet aligned closely to the line of sight, is still debated. In particular, it is not entirely clear whether the gamma-ray emission is produced by leptonic or hadronic processes. In this study, we are testing the leptonic scenario for the Flat Spectrum Radio Quasar (FSRQ) 3C 279, assuming that the gamma-ray emission is generated by inverse Compton scattering of soft external photons from the Broad Line Region (BLR). For this purpose we use a 10-year data set of the source including publicly available optical spectroscopic monitoring data and Fermi-LAT data, and search for a possible correlation between the Compton dominance and the emission line luminosity. We find that the simultaneous measurements of these quantities display no correlation. Assuming a time lag between the emission line appearance and the Compton dominance response, the discrete correlation function (DCF) analysis shows a positive correlation at a time lag of 25 d and an anti-correlation at 60 d, indicating that the changes in the Compton dominance lag behind the changes in emission line luminosity. We consider the positive correlation to arise due to light travel time effects and derive constraints on the location of the gamma-ray emitting zone in the jet. We propose also a tentative interpretation of the observed anti-correlation as due to accretion disk activity.

Authors: DMYTRIIEV, Anton (North-West University); Prof. BOETTCHER, Markus (North-West University, South Africa); Mr MACHIPI, Thabiso (North-West University, South Africa)

Presenter: DMYTRIIEV, Anton (North-West University)

Session Classification: Contributed posters

Contribution ID: **369** Type: **Contributed e-poster**

Testing the limits of continuous-loss approximation for inverse Compton cooling in blazars

Blazar flares are perfect phenomena to probe the extreme physics of relativistic outflows. The key method for this task is physical modeling of the variable non-thermal emission from blazar jets. Most of the numerical codes developed for blazar flare modeling, are based on the kinetic approach and solve the kinetic equation governing the evolution of the particle spectrum, as well as compute the associated varying spectral energy distribution (SED). In the leptonic scenario, the blazar gamma-ray emission is considered to be produced by inverse Compton (IC) upscattering of synchrotron and/or external photons by relativistic electrons in the jet. The IC cooling of electrons is described in existing models with a continuous loss term in the kinetic equation, which however is only valid when the relative fractional losses during the electron cooling are much smaller than unity. In case the IC scattering proceeds in Klein-Nishina regime, this is no longer the case, and one has to treat properly the large relative jumps of electrons in energy. The full cooling term taking that into account, includes the integral of the electron distribution, and so the exact kinetic equation becomes an integro-differential equation. Since it is quite challenging to solve such an equation, certain authors derived a dedicated continuous loss approximation aiming to reasonably describe IC cooling in both Thomson and Klein-Nishina regime. In our study, we test the accuracy of this approximation for typical conditions during blazar flares. In order to solve the integro-differential kinetic equation, we employ our blazar flare modeling code (EMBLEM), which we extend to handle the non-continuous cooling. Using the code, we examine the effect of non-continuous cooling on the electron spectrum and SED compared to the continuous-loss approximation case. Finally, we explore the range of physical conditions in which the standard continuous-loss approximation becomes unsatisfactory.

Authors: DMYTRIIEV, Anton (North-West University); Prof. BOETTCHER, Markus (North-West University, South Africa)

Presenter: DMYTRIIEV, Anton (North-West University)

Session Classification: Contributed posters

Contribution ID: **370** Type: **Contributed talk**

Locating the blazar gamma-ray emitting zone from astrometric VLBI and Gaia data?

Tuesday, July 5, 2022 5:15 PM (15 minutes)

Although current emission models are generally able to account for the observed spectra of blazars from radio to TeV energies, unknowns remain on several fundamental questions such as the nature of the emitting particles, leptons or hadrons, the mechanism dominating the particle acceleration, and the origin of ultrafast variabilities. Some of the degeneracy between models could be removed by better localization of the gamma emission zone, which can be constrained but is not directly fixed by the low angular resolution gamma-ray data. Different locations can be considered such as the black hole magnetosphere, the radio core, the jet and knots detected in VLBI, or even more distant structures along the jets. Confronting the gamma-ray data with the very high precision absolute astrometry in the radio and optical ranges from the permanent geodetic VLBI program and the ESA Gaia mission should shed new light on this question.
We analyze a sample of about 816 active galactic nuclei (AGN) dominated by blazars, including a population of 214 BL Lacs and 488 FSRQs, cross-identified from the Gaia EDR3, the radio ICRF3, and the Fermi-LAT 4FGL catalogs. For a sub-sample of sources for which VLBI radio maps are available from the MOJAVE program, and within astrometric errors of less than 0.1 mas, most optical emissions (typically 90 %) detected by Gaia appear to be associated either with the VLBI radio core, or with a radio knot downstream in the jet at the parsec scale. We investigate the general trends of the main sample in terms of AGN classification, Gaia color indices, and GeV emission, and will discuss in particular the observed decrease of gamma-ray fluxes with the distance of the optical emission zone from the radio core, as well as the difference in behavior identified between the two populations of BL Lacs and FSRQs.

Authors: Mr PIERRON, Antonin (SYRTE); Dr LAMBERT, Sebastien (SYRTE); SOL, Helene (CNRS, LUTH, Observatoire de Paris)

Presenter: SOL, Helene (CNRS, LUTH, Observatoire de Paris)

Session Classification: Contributed Talks

Contribution ID: **371** Type: **Contributed talk**

A hard X-ray look at the Manatee nebula (W50) powered by the Galactic microquasar SS 433

Monday, July 4, 2022 4:15 PM (15 minutes)

W50/SS433 is a complex and fascinating system that represents an important test bed for many astrophysical processes. Powered by the microquasar SS 433, the W50 nebula —classified as a supernova remnant with an unusual double-lobed morphology similar to a Manatee —has been proposed to be a Galactic PeVatron candidate; a scenario that has been recently revived with the detection of very high energy TeV emission with HAWC. We present the first NuSTAR and XMM-Newton observations of the inner eastern lobe of W50, combined with archival Chandra and XMM-Newton observations spanning various regions across the eastern lobe. We resolve and characterize hard non-thermal X-ray emission detected up to 30 keV, originating from a knotty, few-arcminute size, head region located ~29 pc east of SS 433, and constrain its photon index to 1.58+/-0.05 (0.5-30 keV). The index gradually steepens away from SS 433 and all the way out to the radio ear (at ~96 pc east of SS 433) where soft thermal X-ray emission dominates. The unusually hard index and blobby structure seen from the 'head' of the eastern jet is similar to what is observed in pulsar wind nebulae as well as in extragalactic AGN jets, and challenges classical particle acceleration processes. We conclude with an outlook on upcoming and future modelling and observational studies of this system that continues to puzzle and fascinate a diverse range of researchers even more than 40 years into its discovery.

Author: SAFI-HARB, Samar (University of Manitoba)

Presenter: SAFI-HARB, Samar (University of Manitoba)

Session Classification: Contributed Talks

Contribution ID: **372** Type: **Contributed talk**

The origin of MeV gamma-ray diffuse emission from the inner Galactic region

Monday, July 4, 2022 5:30 PM (15 minutes)

The origin of the inner Galactic emission, measured by COMPTEL with a flux of 0.01 MeV/cm^2/s/sr in the 1-30 MeV range from a region of |l|<60 degree and |b|<10 degree, has remained unsettled since its discovery in 1994. We investigate the origin of this emission by taking into account the Galactic diffuse emission and individual sources which are not resolved by COMPTEL. The Galactic diffuse emission is calculated by GALPROP to reconcile the cosmic-ray and gamma-ray spectra with observations by AMS-02, Voyager, and Fermi-LAT, resulting in a flux of 20-80% of the COMPTEL emission. The source contribution is estimated for sources cross-matched between the Swift-BAT and Fermi-LAT catalogs by extrapolating the energy spectra in the hard X-ray and GeV gamma-ray ranges, resulting in a flux of at least 10% of the COMPTEL excess. We will give the details of the analysis and show that the COMPTEL emission could be reproduced by a combination of the Galactic diffuse emission, resolved sources, and likely the gamma-ray cosmic background. We will also report on the importance of future missions for MeV gamma-ray observations, which would be critical for bridging the "MeV gap" in the spectra of gamma-ray sources.

Authors: TSUJI, Naomi (Kanagawa University); Prof. INOUE, Yoshiyuki (Osaka University); MUKHERJEE, Reshmi (Barnard College, Columbia University); Dr YONEDA, Hiroki (RIKEN); Dr ODAKA, Hirokazu (Tokyo University)

Presenter: TSUJI, Naomi (Kanagawa University)

Session Classification: Contributed Talks

Contribution ID: **373** Type: **Contributed e-poster**

Cosmic-ray Escape from Supernova Remnants in the Circumstellar Medium

Cosmic rays (CRs) below 3 PeV are believed to be accelerated by the diffusive shock acceleration (DSA) in supernova remnants (SNRs). The DSA in the perpendicular shock of SNRs has been expected to accelerate CRs up to PeV without an upstream magnetic field amplification. Our recent work investigated the escape process from the perpendicular shock region of type Ia SNRs in the interstellar medium and showed that typical type Ia SNRs accelerate CRs to about 10 TeV without an upstream magnetic field amplification. In this study, we perform test particle simulations to investigate the escape process from core-collapse SNRs in the circumstellar medium and the escape-limited maximum energy. We showed that CRs are accelerated by the perpendicular shock region of core-collapse SNRs up to about 10-100 TeV without an upstream magnetic field amplification. In this talk, we will report the escape process from SNRs in the circumstellar medium and the escape-limited maximum energy.

Author: Mr KAMIJIMA, Shoma

Co-author: Dr OHIRA, Yutaka (The University of Tokyo)

Presenter: Mr KAMIJIMA, Shoma

Session Classification: Contributed posters

Contribution ID: **374** Type: **Contributed talk**

The Galactic diffuse gamma-ray emission meets the PeV frontier

Monday, July 4, 2022 5:00 PM (15 minutes)

The Tibet ASγ and LHAASO collaborations recently provided the first evidence of a diffuse γ-ray emission in the Galaxy up to the PeV from the Galactic plane. Due to the challenges this imposes to current theoretical models it is crucial to carefully study different scenarios of diffuse γ-ray production, specially towards the centre of the Galaxy. In particular, the current models of diffuse emissions struggle to reproduce ASγ and LHAASO data.
In this contribution, we show that these measurements seem to favour an inhomogeneous transport of cosmic rays throughout the Galaxy, specially motivated by the measurements of the Fermi-LAT detector. Moreover, we discuss the relevance of non-uniform cosmic-ray transport scenarios and the implications of these results for cosmic-ray physics and show that the energy spectra measured by Tibet ASγ, LHAASO, ARGO-YBJ and Fermi-LAT in several regions of the sky can be consistently described in terms of the emission arising by the Galactic cosmic-ray "sea". We also comment on the impact of other possible contributions, as the γ-ray emission from TeV halos or unresolved sources.

Authors: DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University); Dr GAGGERO, Daniele (IFIC); Prof. GRASSO, Dario (INFN Sezione di Pisa)

Co-authors: FORNIERI, Ottavio (GSSI); Dr EGBERTS, Kthrin (Potsdam University); EVOLI, Carmelo (Gran Sasso Science Institute); Dr STEPPA, Constantin (Postdam University)

Presenter: DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University)

Session Classification: Contributed Talks

Contribution ID: **375** Type: **Contributed e-poster**

Anisotropic diffusion cannot explain TeV halos

TeV halos have become a new class of astrophysical objects which were not predicted before their recent observation. They offer evidence that diffusion around sources (concretely, pulsars) is not compatible with the effective average diffusion that our models predict for the Galaxy. This directly impacts Galaxy formation, our knowledge of the propagation process throughout the Galaxy and our models of acceleration of charged particles by astrophysical sources like supernova remnants (SNRs) or Pulsar Wind Nebulae (PWN).
In this talk we show that, while anisotropic models may explain a unique source such as Geminga, the phase space of such solutions is very small and they are unable to simultaneously explain the size and approximate radial symmetry of the TeV halo population. Furthermore, we note that this conclusion holds for any CR-powered source (hadronic or leptonic), implying more generally that anisotropic diffusion does not dominate the propagation of particles near energetic sources (at least, below hundreds of TeV) because of the self-generated turbulence.

Authors: DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University); FORNIERI, Ottavio (GSSI); Prof. LINDEN, Tim (Oskar Klein Centre, Stockholm University)

Presenter: DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University)

Session Classification: Contributed posters

Contribution ID: **376** Type: **Contributed e-poster**

PIC simulations of SNR's shock waves with a turbulent upstream medium

Investigation of astrophysical shocks has major importance in understanding physics of the cosmic rays acceleration. Electrons to be accelerated at shocks must have a suprathermal energy, which implies that they should undergo some pre-acceleration mechanism. Many numerical studies examined possible injection mechanisms, however, most of them considered homogenous upstream medium, which is an unreal assumption for astrophysical environments. We will to investigate electron acceleration at high Mach number and low plasma beta shocks using 2D3V particle-in-cell simulations with a turbulent upstream medium. Here, we discuss the method of generation of the compression-dominated turbulence along with its insertion into a shock simulation. The turbulence's parameters represent the high Mach number and low plasma beta regime. Moreover, it is sufficiently long-living, and the presented matching method allows to insert it quasi-seamlessly into a shock simulation.

Authors: Mr FUŁAT, Karol (Insitute of Physics and Astronomy, University of Potsdam); Prof. POHL, Martin (Uni Potsdam / DESY); Dr BOHDAN, Artem (Deutsches Elektronen-Synchrotron DESY); Dr MORRIS, Paul (DESY)

Presenter: Mr FUŁAT, Karol (Insitute of Physics and Astronomy, University of Potsdam)

Session Classification: Contributed posters

Contribution ID: **377** Type: **Contributed talk**

Search for Dark Matter annihilation with a combined analysis of dwarf spheroidal galaxies from Fermi-LAT, HAWC, H.E.S.S., MAGIC and VERITAS

Thursday, July 7, 2022 6:00 PM (15 minutes)

Dwarf spheroidal galaxies (dSphs) are among the most dark matter (DM) dominated objects with negligible expected astrophysical gamma-ray emission. This makes nearby dSphs ideal targets for indirect searches of a DM particle signal. The accurate knowledge of their DM content makes it possible to derive robust constraints on the velocity-weighted cross section of DM annihilation. We report on a joint analysis of 20 dSphs observed by Fermi-LAT, HAWC, H.E.S.S., MAGIC, and VERITAS in order to maximize the sensitivity of DM searches towards such targets, using a common maximum likelihood approach. Results for seven annihilation channels and spanning a range of DM masses from 5 GeV to 100 TeV will be presented. Furthermore, the systematic uncertainties coming from the astrophysical J-factor calculated from the dSph dark matter distribution will be discussed by comparing results obtained from two different sets of J-factors.

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Co-authors: Dr RICO, Javier (IFAE-BIST); OAKES, Louise; CHARLES, Eric; MIENER, Tjark (IPARCOS, UCM); TOLLEFSON, Kirsten; RINCHIUSO, Lucia; ZITZER, Benjamin; GIURI, Chiara; MOULIN, Emmanuel; PUESCHEL, Elisa; POIREAU, Vincent; SALAZAR, Daniel; Dr DI MAURO, Mattia (INFN Torino); HARDING, Pat

Presenter: KERSZBERG, Daniel (IFAE-BIST)

Session Classification: Contributed Talks

Contribution ID: **378** Type: **Contributed e-poster**

Temporal and Spatial Variation of Synchrotron X-ray Stripes in Tycho's Supernova Remnant

The synchrotron X-ray "stripes" discovered in Tycho's supernova remnant (SNR) by Eriksen et al. (2011) is an intriguing structure in which protons might be accelerated up to PeV. However, its origin is still open. In this talk, we will explain an analysis of Chandra data taken in 2003, 2007, 2009, and 2015 of the stripes in the southwestern region of the SNR (Okuno, Matsuda, et al., 2020; Matsuda et al., 2020). We discover time variabilities of synchrotron X-rays in each stripe from a comparison of images obtained at different epochs. Our spectral analysis shows a strong correlation between the surface brightness and photon indices. The spectra of stripes have photon indices of $\Gamma = 2.1$ndash;2.6, which are significantly harder than those of the outer rim of the SNR in the same region with $\Gamma = 2.7$ndash;2.9. These findings indicate that the magnetic field is substantially amplified, suggesting that particle acceleration may work in the stripes through a stochastic process.

Authors: MATSUDA, Masamune (Kyoto University); TANAKA, Takaaki; Prof. UCHIDA, Hiroyuki (Kyoto University); Prof. TSURU, Takeshi (Kyoto University)

Presenter: MATSUDA, Masamune (Kyoto University)

Session Classification: Contributed posters

Contribution ID: **379** Type: **Contributed talk**

Are pulsar halos rare ?

Tuesday, July 5, 2022 6:00 PM (15 minutes)

Extended gamma-ray emission, interpreted as halos formed by the inverse-Compton scattering of ambient photons by electron-positron pairs, is observed towards a number of middle-aged pulsars. The properties of the emission suggest the possibility of a very efficient confinement of the particles over tens of parsec. The physical origin and actual commonness of the phenomenon in the Galaxy remain unclear. The level of diffusion suppression seems extreme compared to what can be achieved in most recent theoretical models.

Using a phenomenological two-zone diffusion framework in the light of Fermi-LAT, HAWC, and AMS-02 data, we searched for model setups minimizing as much as possible the extent and magnitude of diffusion suppression in the halos around J0633+1746 and B0656+14. Extrapolating these descriptions to all other nearby middle-aged pulsars, we show that the resulting combined positron flux including the contribution from Geminga would saturate the AMS-02 measurement above 100GeV for injection efficiencies that are much smaller than those inferred for the canonical halos in J0633+1746 and B0656+14, and more generally with the values typical of younger pulsar wind nebulae. This suggests the possibility that most middle-aged pulsars do not develop halos, with an occurrence rate of the phenomenon possibly being as low as ~5–10%, although the evidence supporting that depends on the actual properties of the local pulsar population and on the uncertain physics driving the formation and evolution of halos.

We searched for complementary evidence for the rarity or commonness of pulsar halos by performing a population synthesis for the Milky Way, with a simple but coherent approach for the PWN-halo evolutionary sequence. Pulsar halos are shown to be viable counterparts to a fraction of the currently unidentified sources if they develop around most middle-aged pulsars, and the number of detectable halos in existing or future surveys ranges from 30 to 80% of the number of detectable PWNe. The level of diffuse emission from unresolved populations in each survey is found to be dominated by halos and comparable to large-scale interstellar radiation powered by cosmic-rays above 0.1–1 TeV. Yet, if pulsar halos are rare, as suggested from the local positron flux constraint, the total number of currently known TeV sources including unidentified ones cannot be accounted for in our model from young PWNe only. This calls for continued efforts to model pulsar-powered emission along the full evolutionary path, including the late stages past the young nebula phase.

Authors: MARTIN, Pierrick (CNRS/IRAP); Dr MARCOWITH, Alexandre (LUPM); ABDOLLAHI, Soheila (IRAP/CNRS); Dr TIBALDO, Luigi (UPS/IRAP)

Presenter: MARTIN, Pierrick (CNRS/IRAP)

Session Classification: Contributed Talks

Contribution ID: **380** Type: **Contributed e-poster**

Inhomogeneous stellar winds in gamma-ray binaries

We study the interaction between pulsar and stellar winds in gamma-ray emitting binaries in the presence of an inhomogeneous stellar wind. In such systems, the acceleration of particles likely occurs at the region of collision between the two winds, which is typically assumed to be smooth. However, the early-type stars that are thought to be present in some gamma-ray binaries, appear to have clumpy winds. During the two-wind interaction, these clumps arrive at the acceleration region, reshape the interaction structure, and subsequently impact the related non-thermal emission. Depending on the adopted stellar wind parameters, the clumps can produce observable fluctuations in the X-ray and GeV bands. Semi-analytical calculations of the dynamical evolution and non-thermal emission are robust enough to simulate both the orbit-modulated large-scale variability and clump-induced small-scale variability of such systems.

Authors: KEFALA, Elina (Universitat de Barcelona, ICCUB, IEEC); BOSCH-RAMON, Valenti (Universitat de Barcelona/ICCUB)

Presenter: KEFALA, Elina (Universitat de Barcelona, ICCUB, IEEC)

Session Classification: Contributed posters

Contribution ID: **381** Type: **Contributed talk**

Cygnus OB2 as testing ground for particle acceleration at the wind termination shock of massive star clusters

Tuesday, July 5, 2022 3:15 PM (15 minutes)

In the last decade, the detection by diverse experiments of diffuse gamma-ray emissions toward several galactic massive star clusters has renewed the attention to these objects as potential galactic cosmic ray accelerators. Indeed, the conversion of a few percent of the power supplied by the strong winds from the massive stars into accelerated particles is enough to explain the observed gamma-ray luminosities in a pure hadronic scenario. Cygnus OB2 is one of the massive star clusters found in coincidence with diffuse gamma-ray emission detected in a broad range of energies, from a few GeV up to 1.4 PeV.
In this work, we aim to compare the morphological and spectral features of the observed gamma emission with those predicted from a theoretical model where particles are accelerated at the termination shock of the cluster wind. Both the expected gamma-ray morphology and spectrum depend on the properties of the distribution of accelerated cosmic rays, which are directly affected by the physics of acceleration at the termination shock and by the propagation in the hot expanding bubble created by the cluster wind.
We found our model to be in good agreement with the observed spectral energy distribution. The expected radial gamma-ray profile reproduces fairly well HAWC observations but is not totally in accord with Fermi results. According to the best fit model, Cygnus OB2 should be able to accelerate cosmic rays up to 1 PeV, hence resulting in a likely cosmic ray PeVatron.

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Presenter: MENCHIARI, Stefano (University of Siena)

Session Classification: Contributed Talks

Contribution ID: **382** Type: **Contributed talk**

The jets of SS 433 as seen by HESS

Monday, July 4, 2022 4:00 PM (15 minutes)

The microquasar SS 433 is the only known compact binary system in which accretion is believed to occur in the super-Eddington regime. This leads to the launching of two persistent, semi-relativistic jets that extend from the binary, almost perpendicular to the line of sight. X-ray observations reveal that these jets extend out to around 100 pc on either side of the central system, terminating at the radio structure W50. The jets of SS 433 were recently reported to be a source of TeV gamma-rays by the HAWC collaboration. We report here the result of deep observations of this system with the H.E.S.S. array of telescopes, resulting in the first detection of the system by an Imaging Atmospheric Cherenkov Telescope array. The superior energy and angular resolution of the H.E.S.S. array allow for a detailed study of the morphology and spectral energy distribution of the gamma-ray emission in the jets. This information can be used to constrain parameters of the jet dynamics, as well as provide information on the particle acceleration taking place in the jets.

Author: OLIVERA NIETO, Laura (Max Planck Institut fur Kernphysik MPIK)

Co-author: HESS COLLABORATION

Presenter: OLIVERA NIETO, Laura (Max Planck Institut fur Kernphysik MPIK)

Session Classification: Contributed Talks

Contribution ID: **383** Type: **Contributed e-poster**

Understanding the high-energy emission of pulsars with synchro-curvature radiation models

Out of the several hundreds of gamma-ray pulsars known nowadays, only a few tens have been detected to emit also non-thermal X-ray radiation. Some aspects of the high-energy magnetospheric radiation are still unclear, such as the location of emission. In this talk I will present a radiative model which aims at explaining the high-energy emission of pulsars in an effective way, relying on only three free physical parameters: the electric field, the local magnetic field and the size of the emitting region. The model computes the dynamics of an ensemble of charged particles traveling in peculiar regions of a pulsar's magnetosphere and calculates their spectral emission via synchro-curvature radiation losses. The model successfully fits the entire gamma-ray pulsar population. It also reproduces satisfactorily both the X-ray and gamma-ray bands of the spectral energy distribution of a majority of those gamma-ray pulsars emitting also non-thermal X-rays, describing their spectra across eight orders of magnitude. I will show the most relevant results of the systematic spectral fitting of our model to the known population of high-energy pulsars, after improving the injection region assumptions. Finally, I will present how the spectral fitting can constrain the probable range of the spin period for unidentified pulsar candidates.

Based on:

Viganò D., Torres D. F., Hirotani K., Pessah M. E., 2015a, MNRAS, 447, 1164–1172

Torres D. F., 2018, Nature Astronomy, 2, 247

Torres D. F., Viganò D., Coti Zelati F., Li J., 2019, MNRAS, 489, 5494

Íniguez-Pascual, D., Viganò, D., Torres, D. F. 2022a, Submitted to MNRAS

Íniguez-Pascual, D., Torres, D. F., Viganò, D. 2022b, Submitted to ApJ

Author: ÍÑIGUEZ-PASCUAL, Daniel (Institute of Space Sciences (ICE, CSIC))

Co-authors: TORRES, Diego F (ICREA & Institute of Space Sciences (ICE, CSIC)); VIGANÒ, Daniele (Institute of Space Sciences (ICE, CSIC))

Presenter: ÍÑIGUEZ-PASCUAL, Daniel (Institute of Space Sciences (ICE, CSIC))

Session Classification: Contributed posters

Contribution ID: **385** Type: **Contributed e-poster**

Quasi-periodic oscillations in the gamma-ray light curves of bright active galactic nuclei

The detection of quasi-periodic oscillations (QPOs) in the light curves of active galactic nuclei (AGNs) can provide insights on the physics of the super-massive black-holes (SMBHs) that power these systems, and could represent a signature of the existence of SMBH binaries, setting fundamental constraints on SMBH evolution through the Universe. The identification of long term QPOs, with periods of the order of months to years, is particularly challenging and can only be achieved via all-sky monitoring instruments that can provide unbiased, continuous light-curves of astrophysical objects. The Fermi-LAT satellite, thanks to its monitoring observing strategy, is an ideal instrument to reach such a goal. We aim to identify QPOs in the γ-ray light-curves of the thirty-five brightest AGNs within the Fermi-LAT catalog, including data from the beginning of the Fermi mission (August 2008) to April 2020, and energies from 100 MeV to 300 GeV. Two time binnings are investigated, 7 and 30 days. The search for quasi-periodic features is then performed using the continuous wavelet transform. The significance of the result is tested via Monte Carlo simulations of artificial light curves with the same power spectral density and probability distribution function as the original light curves. We identify thirty quasars with candidate QPOs, confirming several candidates discussed in the literature: PKS 2247-131, B2 1520+31, PKS 0426-380, PKS 0537-441, S5 0716+714, Mrk 421, PKS 1424-418, PG 1553+113, Mrk 501 and PKS 2155-304. The most significant QPO (> 4σ in the global wavelet spectrum, with a period of 1134 $\pm$ 226 days) is observed in the quasar S51044+71, and is reported here for the first time.

Authors: REN, Helena (MPIK); CERRUTI, Matteo (Institut de Ciències del Cosmos (ICCUB), Universitat de Barcelona (IEEC-UB), Martí i Franquès 1, 8 E08028 Barcelona, Spain); SAHAKYAN, Narek (ICRANet-Armenia, Marshall Baghramian Avenue 24a, Yerevan 0019, Armenia)

Presenter: REN, Helena (MPIK)

Session Classification: Contributed posters

Contribution ID: **386** Type: **Contributed e-poster**

The performance of the MAGIC telescopes using deep convolutional neural networks with CTLearn

The Major Atmospheric Gamma Imaging Cherenkov (MAGIC) telescope system is located on the Canary Island of La Palma and inspects the very high-energy (VHE, few tens of GeV and above) gamma-ray sky. MAGIC consists of two imaging atmospheric Cherenkov telescopes (IACTs), which capture images of the air showers originating from the absorption of gamma rays and cosmic rays by the atmosphere, through the detection of Cherenkov photons emitted in the shower. The sensitivity of IACTs to gamma-ray sources is mainly determined by the ability to reconstruct the properties (type, energy, and arrival direction) of the primary particle generating the air shower. The state-of-the-art IACT pipeline for shower reconstruction is based on the parameterization of the shower images by extracting geometric and stereoscopic features and machine learning algorithms like random forest or boosted decision trees. In this contribution, we explore deep convolutional neural networks applied directly to the pixelized images of the camera as a promising method for IACT full-event reconstruction and present the performance of the method on observational data using CTLearn, a package for IACT event reconstruction that exploits deep learning.

Author: MIENER, Tjark (IPARCOS, UCM)

Co-authors: Dr NIETO, Daniel (IPARCOS, UCM); Dr LÓPEZ-COTO, Rubén (INFN Padova); Mr GREEN, Jarred (MPI Munich); Dr CONTRERAS, Jose Luis (IPARCOS, UCM); Mr MARIOTTI, Ettore (INFN Padova); Dr GREEN, David (MPI Munich)

Presenter: MIENER, Tjark (IPARCOS, UCM)

Session Classification: Contributed posters

Contribution ID: **387** Type: **Contributed talk**

Probing the population of pulsar halos with Fermi-LAT

Tuesday, July 5, 2022 5:45 PM (15 minutes)

Over the past years, the detection of extended gamma-ray emission surrounding young and middle-aged pulsars has been reported in the GeV and TeV domains. This emission is interpreted as inverse-Compton scattering of ambient photons by halos of energetic electron/positron pairs accelerated in pulsars and their wind nebulae and confined in their vicinity by a mechanism yet to be elucidated. These pulsar halos offer an opportunity to probe the transport properties of energetic particles in the vicinity of their accelerators. As an emerging population of gamma-ray sources, halos can be expected to have a non-negligible contribution to the GeV–TeV emission from the Galaxy in the form of yet unidentified sources and/or spatially unresolved gamma-ray emission. We have performed a systematic search for extended > 10 GeV emission components along the Galactic plane using 13 years of Fermi-LAT data. We have found about 60 such components with angular sizes up to a few degrees, a fraction of which may be pulsar halos. We assess the likelihood of the latter possibility by comparing the properties of the whole sample of extended components to the predictions of a population synthesis model. We then present a short list of promising halo candidates possibly associated with TeV sources, together with dedicated analyses in which we investigate more in depth the morphology and spectrum of these selected targets.

Authors: ABDOLLAHI, Soheila (IRAP/CNRS); MARTIN, Pierrick (CNRS/IRAP)

Co-authors: Dr TIBALDO, Luigi (UPS/IRAP); Dr DI MAURO, Mattia (INFN Torino); ON BEHALF OF THE FERMI-LAT COLLABORATION

Presenter: ABDOLLAHI, Soheila (IRAP/CNRS)

Session Classification: Contributed Talks

Contribution ID: **388** Type: **Contributed e-poster**

Study of periodicity in Blazar light curves observed by Fermi LAT

Long term periodicity in gamma-ray Blazar light curves could be linked to the innermost zone of the complex structure of AGN, like possible presence of binary system of supermassive black holes, or it could shed light on the origin of gamma-rays emission.
The work analyses around 1500 sources, whose 12 years light curves come from the Fermi LAT Repository (https://fermi.gsfc.nasa.gov/ssc/data/access/lat/LightCurveRepository/), making use of Lomb Scargle periodogram and wavelet weighted Z transform.
All the available possibilities for the light curves in the Repository, such as different temporal samplings and the use of photon flux and energy flux, are taken into account in order to ensure more reliable results.
We found out high significance periodicity in less than 1% of the sources considered, and in few other sources hints of possible periodicity.
Our results are compliant with the findings of recent literature focused on searches of periodic modulation in AGNs.

Author: CRISTARELLA ORESTANO, Paolo (Infn and Unipg)

Presenter: CRISTARELLA ORESTANO, Paolo (Infn and Unipg)

Session Classification: Contributed posters

Contribution ID: **390** Type: **Contributed e-poster**

The Off-Axis Afterglow of GW170817: Flux Prediction at Very High Energies

The binary neutron star merger gravitational-wave event GW170817 and observations of the subsequent electromagnetic signals at different wavelengths have helped better understand the outflows that follow these mergers. In particular, the off-axis afterglow of the jetted ejecta has allowed to probe the lateral structure of such jets, especially thanks to VLBI imagery of the source. In this talk, I will present our model of this afterglow including a decelerating jet with lateral structure, while synchrotron emission and synchrotron self-Compton scatterings in the Thomson and Klein-Nishina regimes power the jet radiation. Allowing afterglow light-curve fitting, this new analysis also extends to very high energies and predicts the light curve in the energy range of H.E.S.S. and the CTA. Using these results, I will finally discuss how future detections of afterglows by these observatories can help break the degeneracies in some key physical parameter measurements like the viewing angle and the circumburst medium density, and allow to probe efficiently a sub-population of fast-merging binaries.

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Presenter: Mr PELLOUIN, Clément (Institut d'Astrophysique de Paris (IAP) - Sorbonne Université)

Session Classification: Contributed posters

Contribution ID: **391** Type: **Contributed talk**

Modelling Wind Dynamics and Gamma-Ray Emission from LS 5039

Wednesday, July 6, 2022 6:00 PM (15 minutes)

We present our numerical model for the gamma-ray binary LS 5039, where we utilise a pulsar-wind-driven scenario. In our model the high-energy particle transport is treated jointly with the simulation of the relativistic pulsar wind. Thus, dynamical effects of the turbulent interaction between stellar and pulsar wind can directly translate to the dynamics of the energetic particles. From the resulting distribution function of the energetic particles, we compute their gamma-ray emission as a function of orbital phase and presumed viewing-angle of the system. Our model reproduces observations of the main spectral features of the emission from the system. Where our results deviate from observations, we identify possibly shortcomings of the model. We end with an outlook on related model improvements, showing first-results of new high-resolution simulations of the LS-5039 system.

Authors: KISSMANN, Ralf (Universität Innsbruck); Dr DAVID, Huber (Yomi)

Presenter: KISSMANN, Ralf (Universität Innsbruck)

Session Classification: Contributed Talks

Contribution ID: **392** Type: **Contributed e-poster**

Search for new gamma-ray binaries among runaway stars

Gamma-ray binaries are systems composed of a massive O or Be-type star and a compact object that emit gamma-rays up to multi-TeV energies. Currently, only 9 of such systems are known, and those containing O-type stars are runaways. Because some properties of these systems are not fully understood, the discovery of new gamma-ray binaries may help to answer many open questions, and eventually may open new ones. To discover new gamma-ray binary systems we search for runaway stars within catalogs of massive stars using Gaia astrometric data. We present here the current status of our project with tens of new runaway O and Be stars identified, together with multi-wavelength information. We will also provide an outlook of the future steps to enlarge the population of gamma-ray binaries.

Author: CARRETERO-CASTRILLO, Mar (ICCUB, Universitat de Barcelona)

Co-authors: Dr RIBÓ, Marc (Universitat de Barcelona / ICCUB / IEEC-UB); PAREDES, Josep Maria (Universitat de Barcelona)

Presenter: CARRETERO-CASTRILLO, Mar (ICCUB, Universitat de Barcelona)

Session Classification: Contributed posters

Contribution ID: **393** Type: **Contributed e-poster**

A detailed X-ray study of the pulsar wind nebula around PSR B1853+01

We reports the results of a composite analysis of the pulsar wind nebula (PWN) around PSR B1853+01 using archival data from *Chandra*, XMM-*Newton* and NuSTAR. Both images from *Chandra* and XMM-*Newton* in hard X-rays (>2 KeV) show a PWN consisting of an extended tail-like structure trailing the pulsar and an unorthodox diffuse antennae-like feature ahead of the pulsar. Spatially resolved spectroscopy results reveal that the diffuse X-ray emission ahead of the pulsar is relatively hard compared to regions inside the tail structure. Considering that this PWN is embedded in hot plasma inside of the supernova remnant W44, this peculiar relatively hard extended emission could be explained by high energy particles escaping bow shock and then attaching to magnetic field lines.

Author: ZHANG, Xiying (Universitat de Barcelona (ICCUB))

Co-author: BORDAS, Pol (ICCUB)

Presenter: ZHANG, Xiying (Universitat de Barcelona (ICCUB))

Session Classification: Contributed posters

Contribution ID: **394** Type: **Contributed talk**

Gamma-ray observations of nearby HII regions

Monday, July 4, 2022 6:00 PM (15 minutes)

I present the analysis of the Fermi-LAT data in the region of the Vela Molecular Cloud Ridge (VMR). The latter is a dense region of gas located at approximately 1 kpc from us and it is the closest region that hosts intermediate-mass- and massive-star formation. Associations of massive stars have been proven to be powerful particle accelerators and are consequently expected to be bright gamma-ray sources. However, the gamma-ray emission associated with these sources is often of controversial origin, due to the superposition of multiple sources. Massive stars can be traced by observations of their surrounding HII regions. The latter are regions of gas which is ionized due to the strong radiation fields of the stars themselves. HII regions are identified by infrared observations and several of them have been recognized within the VMR. For the first time, we detected high-energy emission spatially coinciding with a few of these HII regions, which leaves no doubt about the identification of gamma-ray emission with massive stars. I will present the result of the morphological and spectral analysis of these sources and I will discuss the origin of their emission and their possible contribution to the large-scale diffuse emission.

Author: PERON, Giada (Max-Planck-Institut für Kernphysik, Hedielberg, Germany)

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Presenter: PERON, Giada (Max-Planck-Institut für Kernphysik, Hedielberg, Germany)

Session Classification: Contributed Talks

Contribution ID: **395** Type: **Contributed talk**

LIVelihood: Testing Lorentz Invariance Violation on Observations of Energy-dependent Time Delays from Multiple-type Gamma-ray Sources

Thursday, July 7, 2022 6:15 PM (15 minutes)

Some Quantum Gravity (QG) models allow Lorentz Invariance Violation (LIV) to emerge at the order of the Planck energy (~10^19 GeV). A possible consequence of LIV is the energy-dependent speed of light. This hypothesis can be tested using high energy gamma-ray observations of highly variable and distant sources, by measuring time lag of high energetic events. Imaging Atmospheric Cherenkov Telescopes detect Gamma-Ray Bursts (GRB), flaring Active Galatic Nuclei (AGN) and pulsars up to tens of TeV, which opens an interesting window to explore time lag at high energy. The three major IACTs experiments, H.E.S.S., MAGIC and VERITAS have formed a working group to combine all the relevant data collected in order to constrain the energy scale of LIV. In our contribution, we will present the first results of this working group and the code that was created to handle data from various observatories called LIVelihood.The LIVelihood code uses a likelihood method to analyse these different datasets and is made to perform combination of data from different observatories taking into account their respective Instrumental Response Function (IRF) and systematical uncertainties. The main features and the first results of this code will be exhibit on the combination of data from various gamma-ray observatories. The future steps for the LIVelihood code development and the combination of gamma-ray observatories will be announced.

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Presenter: CAROFF, Sami (LAPP)

Session Classification: Contributed Talks

Contribution ID: **396** Type: **Contributed e-poster**

Dark matter searches by the planned gamma-ray telescope GAMMA-400

Our work reviews the planned space-based gamma-ray telescope GAMMA-400 and evaluates in details its opportunities in the field of dark matter (DM) indirect searches. We estimated the GAMMA-400 mean sensitivity to the diphoton DM annihilation cross section in the Galactic center for DM particle masses in the range of 1–500 GeV. We obtained the sensitivity gain at least by 1.2–1.5 times (depending on DM particle mass) with respect to the expected constraints from 12 years of observations by Fermi-LAT for the case of Einasto DM density profile. The joint analysis of the data from both telescopes may yield the gain up to 1.8–2.3 times. Thus the sensitivity reaches the level of annihilation cross section $\langle\sigma v\rangle_{\gamma\gamma}(m_\chi = 100 \text{ GeV}) \approx 10^{-28}$ cm^3/s. This will allow us to test the hypothesized narrow lines predicted by specific DM models, particularly the recently proposed pseudo-Goldstone boson DM model. We also considered the decaying DM - in this case the joint analysis may yield the sensitivity gain up to 1.1–2.0 times reaching the level of DM lifetime $\tau_{\gamma\nu}(m_\chi = 100 \text{ GeV}) \approx 2 \cdot 10^{29}$ s. We estimated the GAMMA-400 sensitivity to axion-like particle (ALP) parameters by a potential observation of the supernova explosion in the Local Group. This is very sensitive probe of ALPs reaching the level of ALP-photon coupling constant $g_{a\gamma} \sim 10^{-13}$ GeV^{-1} for ALP masses $m_a \leq 1$ neV. We also calculated the sensitivity to ALPs by constraining the modulations in the spectra of the Galactic gamma-ray pulsars due to possible ALP-photon conversion. GAMMA-400 is expected to be more sensitive than the CAST helioscope for ALP masses $m_a \approx (1 - 10)$ neV reaching $g_{a\gamma}^{min} \approx 2 \cdot 10^{-11}$ GeV^{-1}. Other potentially interesting targets and candidates are briefly considered too. The talk is based on the paper JCAP 11, 049 (2020).

Author: EGOROV, Andrei

Co-author: GAMMA-400 COLLABORATION

Presenter: EGOROV, Andrei

Session Classification: Contributed posters

Contribution ID: **397** Type: **Contributed e-poster**

Correction method applied to MC simulated LST images affected by clouds

We present the results of a preliminary study of a correction method applied to the Imaging Air Cherenkov Telescope images affected by clouds. The studied data are the Monte Carlo simulations made with CORSIKA, imitating the very high energy events registered by the Large-Sized Telescopes, a type of the telescope within the future Cherenkov Telescope Array. We implement the cloud correction method in the ctapipe/lstchain analysis framework. The correction is based on a simple geometrical model of the emission. We show the effect of the correction method on the image parameters and on the stereo reconstructed shower parameters.

Author: ZYWUCKA, Natalia (University of Łódź, Poland)

Presenter: ZYWUCKA, Natalia (University of Łódź, Poland)

Session Classification: Contributed posters

Contribution ID: **398** Type: **Contributed e-poster**

Wide-field Gamma-ray Observations in a Natural Lake

Ground-level particle detection is a powerful approach to TeV gamma-ray astronomy. Ground-particle array observatories such as HAWC detect gamma-rays via water-Cherenkov detector units in tanks or buildings. This contribution is about the possibility of deploying water-Cherenkov detector units directly into a natural lake, specifically as one option for the future Southern Wide-field Gamma-ray Observatory (SWGO). In the lake concept, bladders filled with clean water are deployed near the surface of a natural lake, where each bladder is a light-tight stand-alone unit containing one or more photosensors. Possible advantages of this design, including reduced cost and improved muon-tagging performance thanks to better shielding, will be discussed, along with challenges. We will describe the tests performed at a custom-built facility and other developments towards a realistic prototype.

Authors: GOKSU, Hazal (Max-Planck-Institute for Nuclear Physics); SWGO COLLABORATION

Presenter: GOKSU, Hazal (Max-Planck-Institute for Nuclear Physics)

Session Classification: Contributed posters

Contribution ID: **399** Type: **Contributed e-poster**

The variety of extreme blazars in the AstroSat view

In this contribution, we present a spectral study of extreme blazars (also eHBL) which are known to exhibit hard intrinsic X-ray/TeV spectra and extreme SED peak energies. We study four eHBLs 1ES 0120+340, RGB J0710+591, 1ES 1101-232, 1ES 1741+196 and one HBL 1ES 2322-409 using new X-ray data from AstroSat, together with quasi-simultaneous Fermi-LAT and other archival multi-frequency data. Three of the eHBLs are non-variable, as is typically attributed. On the contrary, RGB J0710+591 shows spectral softening in both X-ray and GeV bands indicating a significant change in the synchrotron cut-off. Typically, a standard one-zone synchrotron self-Compton (SSC) model reproduces well eHBL SEDs, but often requires a large value of the Doppler factor and minimum electron energy. We have thus conducted a detailed investigation of the broadband SEDs under both leptonic and (lepto-)hadronic scenarios. We employ 1) a steady-state one-zone synchrotron-self-Compton (SSC) code and 2) a one-zone hadro-leptonic (OneHaLe) code. The latter is solved for two cases of the high energy emission –a pure hadronic case (proton synchrotron) and a lepto-hadronic case (synchrotron emission of secondary electrons from pion decay and Bethe-Heitler pair production). By fixing the Doppler factor at δ=30, we find that all models can reproduce the SEDs of eHBLs. For the normal HBL, SSC and proton synchrotron models are superior to the lepto-hadronic model. As no model is superior explaining the eHBLs, we discuss in detail the pros and cons of each model.

Authors: GOSWAMI, Pranjupriya (North-West University); ZACHARIAS, Michael (LUTH, Observatoire de Paris); CHANDRA, Sunil (SAAO, Cape Town)

Presenter: GOSWAMI, Pranjupriya (North-West University)

Session Classification: Contributed posters

Contribution ID: **400** Type: **Contributed e-poster**

STeVECat, the Spectral TeV Extragalactic Catalog

The three main collaborations operating the current generation of imaging atmospheric Cherenkov telescopes (IACTs: H.E.S.S., MAGIC, VERITAS) publish their gamma-ray data in different formats and repositories. Extragalactic sources are highly variable at very-high energies (VHE, $E > 100$ GeV), and a unified repository would enable joint analyses of collections of extragalactic VHE spectra. To this aim, we have developed the Spectral TeV Extragalactic Catalog, STeVECat, which gathers high-level products of IACT observations from 1992 to 2021. We selected all publications in journals referenced in TeVCat that presented archival spectra with at least two points. We compiled the corresponding spectral data and formatted them following the convention adopted in available public repositories (GammaCat and VTSCat). In addition to spectral points with associated physical units, meta-data feature observation periods, livetime, excess counts over background and significance, as well as the coordinates, types and redshifts of the sources whenever available. STeVECat combines observations from 270 journal publications, compared to 72 in the previous reference compilation of extragalactic gamma-ray spectra (Biteau & Williams, 2015). STeVECat is the most extensive set of VHE extragalactic spectra collected so far, with more than 365 spectra from 70 sources. The full catalog can readily be loaded with GammaPy, the Science Analysis Tools selected by the Cherenkov Telescope Array Observatory. Our compilation efforts enable population studies of extragalactic gamma-ray sources, studies of the GeV-TeV connection, and studies of absorption on the extragalactic background light.

Author: GRÉAUX, Lucas (IJCLab)

Co-authors: Prof. WILLIAMS, David A. (Santa Cruz Institute for Particle Physics and Department of Physics, University of California); Prof. BITEAU, Jonathan (Université Paris-Saclay, CNRS/IN2P3, IJCLab); NIEVAS ROSILLO, Mireia (IAC); Dr HERVET, Olivier (Santa Cruz Institute for Particle Physics and Department of Physics, University of California); Dr HASSAN, Tarek (CIEMAT)

Presenter: GRÉAUX, Lucas (IJCLab)

Session Classification: Contributed posters

Contribution ID: **401** Type: **Contributed e-poster**

Improved methods for finding transient neutrino sources with IceCube

The discovery of the neutrino flare from the potential source TXS 0506+056 triggered more searches for time-dependent neutrino emission. However, the search for transient neutrino sources imposes additional challenges. Previous approaches looking for neutrino flares were computationally very expensive. Hence, these searches either required many computational resources or the considered data had to be reduced. We present new approaches on how to identify transient sources and the respective neutrino flare that reduce the necessary computational resources while preserving the sensitivity to transient sources. In this study, we focus mainly on two approaches: the application of unsupervised learning and the parametrization of the test statistic distribution depending on the flare properties.

Author: KARL, Martina

Presenter: KARL, Martina

Session Classification: Contributed posters

Contribution ID: **402** Type: **Contributed e-poster**

A Camera for the Small Sized Telescopes of the Cherenkov Telescope Array

The Cherenkov Telescope Array (CTA) will use three telescope sizes to effectively detect cosmic gamma rays in the energy range from several tens of GeV to hundreds of TeV. The Small Sized Telescopes (SSTs) will form the largest section of the array covering an area of many square kilometres on the CTA southern site in Paranal, Chile. Up to 70 SSTs will be implemented by an international consortium of institutes as an in-kind contribution to the observatory (with 37 planned in the first stage of construction). The SSTs will provide unprecedented sensitivity to gamma rays above 1 TeV and the highest angular resolution of any instrument above the hard X-ray band. CTA has recently finalised the technology that will be used for the SSTs: the telescopes will be a dual-mirror design with ~4 m primary reflector and equipped with an SiPM-based camera with full waveform readout from 2048 channels covering a approximately 9 degree field of view. Due to the aplanatic and small plate-scale Schwarzschild-Couder configuration of the optics, the camera can be compact (diameter ~55 cm, mass <100 kg) and low cost. In this contribution we present the SST camera design and the implementation plan for series production.

Authors: WHITE, Richard (MPIK); FOR THE CTA SST PROJECT

Presenter: WHITE, Richard (MPIK)

Session Classification: Contributed posters

Contribution ID: **403** Type: **Contributed talk**

H.E.S.S. Observations of the 2021 PSR B1259-63 Periastron

Wednesday, July 6, 2022 5:30 PM (15 minutes)

PSR B1259-63 is a gamma ray binary system, hosting a confirmed pulsar in an eccentric, 3.4 year, orbit around an O9.5Ve star (LS 2883). We report results obtained in the TeV domain with H.E.S.S., from an extensive observation campaign of the 2021 periastron period. The data set comprises of over 100 hours of data spanning six months and therefore permits an unprecedented insight into the behaviour of the system at TeV energies. In the X-ray and GeV domains, the source exhibited distinct differences in its emission behaviour in 2021 than in previous periastron passages. Specifically, while the impact of the two disk crossings of the pulsar around periastron are observed in X-rays as usual, albeit with somewhat lower fluxes, a third peak has appeared at $t_p + 30$**~d**; a point around which in the past a GeV flaring event regularly occurred. Conversely, the GeV flaring event in 2021 was significantly delayed. We present the results of an X-ray/TeV light curve correlation study as well as studies of the TeV spectral variability during the periods of the third X-ray peak and the GeV flare.

Author: THORPE-MORGAN, Charles (IAAT- University of Tübingen)

Co-authors: Dr MALYSHEV, Denys (IAAT-University Tuebingen); PÜHLHOFER, Gerd; BORDAS, Pol (ICCUB); SUSHCH, Iurii (North West University (South Africa)); DE ONA WILHELMI, Emma (DESY); Dr VAN SOELEN, Brian (University of the Free State); Prof. SANTANGELO, Andrea (IAAT-University of Tuebingen); H.E.S.S. COLLABORATION

Presenter: THORPE-MORGAN, Charles (IAAT- University of Tübingen)

Session Classification: Contributed Talks

Contribution ID: **404** Type: **Contributed e-poster**

Constraining the Extragalactic Background Light using H.E.S.S Observations of M87

The diffuse Extragalactic Background Light (EBL) consists of the total emitted light from all stars throughout the history of the Universe. Through pair-production with EBL photons, Very High Energy (VHE) gamma-rays are attenuated as they travel through the Universe, leaving a unique mark on the detected spectra of VHE gamma-ray sources. Due to the relatively small EBL optical depth, most studies attempting to measure the EBL through this phenomena have used higher redshift sources. M87 is a nearby (z ~ 0.0042) radio galaxy which has been extensively studied at numerous wavelengths, and is a known source of VHE gamma-rays. In this study we attempt to measure the local EBL through its attenuation of the TeV gamma-ray spectrum of M87 during its high-states using data obtained with the High Energy Stereoscopic System (H.E.S.S). We find that an EBL-attenuated spectrum is preferred at the ~2.5 σ level to a pure power-law.

Author: ZILBERMAN, Perri

Co-authors: OHM, Stefan (DESY, D-15738 Zeuthen, Germany); PARSONS, Robert (HU Berlin); BARBOSA MARTINS, Victor; LYPOVA, Iryna (LSW); Prof. WAGNER, Stefan (LSW Heidelberg)

Presenter: ZILBERMAN, Perri

Session Classification: Contributed posters

Contribution ID: **405** Type: **Contributed talk**

VERITAS observations of gamma-ray binaries

Wednesday, July 6, 2022 5:15 PM (15 minutes)

VERITAS, an array of four 12-m imaging atmospheric Cherenkov telescopes, has been fully operational since April 2007. One of the key VERITAS science programs have included the search for and monitoring of gamma-ray binaries. The gamma-ray binary systems are composed of a massive star and a compact object, black hole or neutron star. Their spectral energy distributions peak above 1 GeV. VERITAS archive consists of more than 200 hr of datasets for HESS J0632+057 and LS I +61° 303, having orbital period of ~316.7 days and ~26.5 days, respectively. We will discuss the status and results from the VERITAS and Swift-XRT observations for these binary systems.

Author: PATEL, Sonal Ramesh (Deutsches Elektronen-Synchrotron DESY)

Presenter: PATEL, Sonal Ramesh (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Contributed Talks

Contribution ID: **406** Type: **Contributed e-poster**

Particle acceleration by relativistic shocks propagating to inhomogeneous media

It was claimed that relativistic shocks propagating to uniform media cannot accelerate particles efficiently because the shocks are perpendicular shocks. However, in reality the upstream plasma has a finite density fluctuation. The interaction between the upstream density fluctuation and the shock front generates turbulence in the downstream region, so that the downstream magnetic field is strongly disturbed. In this study, by performing a test particle simulation in a relativistic shock with such a downstream magnetic turbulence, we investigate the diffusive shock acceleration in relativistic shocks propagating to inhomogeneous plasmas.

Author: MORIKAWA, Kanji (The University of Tokyo)

Presenter: MORIKAWA, Kanji (The University of Tokyo)

Session Classification: Contributed posters

Contribution ID: **407** Type: **Contributed talk**

Revealing the particle acceleration in stellar wind shocks of massive colliding wind binaries

Wednesday, July 6, 2022 3:45 PM (15 minutes)

Binary systems comprising massive stars in relatively close orbits allow the presence of strong interaction between the two winds of the components. When the distance is close enough, an energetic shock is produced due to the collision of the two stellar winds, which can shine from radio wavelengths to very high energy gamma-rays.
These regions have proven to be extremely efficient environments to accelerate particles up to relativistic energies, involving higher mass, photon, and magnetic energy densities than their analogue processes in supernova remnants or interstellar bow-shocks. However, only a few of these systems are know to exhibit an exceptionally powerful and extreme region that could lead to emission in the high energy, and even in the very high energy range. Until recently, only Eta Carinae was the only colliding wind binary with such potential emission.

Thanks to very-high-resolution radio observations it is possible to trace in detail the wind collision region, characterizing the energy budget, magnetic field, and stellar wind properties of the two stars. Given that it is the same particle population producing the radio and the high-energy non-thermal emission, these studies allow tighter predictions on the high energy range.
In this talk I will discuss the discovery of two colliding wind binaries, HD 93129A and Apep, that have been predicted to produce emission at gamma rays, detectable by either Fermi or even CTA in the future. These sources would double the current detection of high-energy colliding wind binaries known up to now.

These studies require efforts covering the full electromagnetic spectrum, and combining both observational and theoretical point of views. To improve the relations between the different groups we have recently established the PANTERA-Stars (Particle Acceleration and Non-Thermal Emission of Radiation in Astrophysics - Stars) collaboration.

Author: MARCOTE, Benito (Joint Institute for VLBI ERIC (JIVE))

Presenter: MARCOTE, Benito (Joint Institute for VLBI ERIC (JIVE))

Session Classification: Contributed Talks

Contribution ID: **408** Type: **Contributed talk**

Characterizing the VHE emission of the extreme HBLs 1ES 1218+304 and 1ES 0229+200 with VERITAS

Monday, July 4, 2022 5:15 PM (15 minutes)

The modelling of the spectral energy distribution (SED) of some high-frequency peaked BL Lac objects (HBLs) has proved challenging for the so-called extreme candidates, which can have their TeV peak at energies > 1 TeV and a hard intrinsic TeV spectrum of $\Gamma < 2$. The HBLs 1ES 1218+304 ($z = 0.182$) and 1ES 0229+200 ($z = 0.1396$) are two characteristic examples. Historically, leptonic one-zone synchrotron self-Compton (SSC) models have been used when modelling the broadband SED of BL Lac objects with relative success, but they fail to fully describe the emission of their extreme counterparts without requiring unexpectedly large or small physical quantities, or reaching far beyond the equipartition condition, when accounting for extragalactic background light (EBL). In this work, using archival VERITAS data from 2008 to 2021 on 1ES 1218+304 and 1ES 0229+200 combined with data from the *Swift*-XRT and *Fermi*-LAT observatories for extended wavelength coverage, we provide an updated look on the modelling of extreme HBLs.

Author: BATISTA ON BEHALF OF THE VERITAS COLLABORATION, Pedro (Deutsches Elektronen-Synchrotron (DESY/Zeuthen))

Presenter: BATISTA ON BEHALF OF THE VERITAS COLLABORATION, Pedro (Deutsches Elektronen-Synchrotron (DESY/Zeuthen))

Session Classification: Contributed Talks

Contribution ID: **409** Type: **Contributed e-poster**

Shaken, not stirred: test particles in binary black hole merger environments.

In 2015 gravitational wave event GW150914 was detected by the advanced Laser Interferometer Gravitational-wave Observatory (aLIGO), with a possible weak transient electromagnetic counterpart GW150914-GBM detected by the Fermi Gamma-ray Burst Monitor (GBM) 0.4s after the detection of the gravitational wave signal. No other such detections have occurred since (specifically with respect to BH-BH mergers), with literature predicting that Binary Black Hole mergers cannot radiate significantly in the electromagnetic spectrum. In light of these detections, we simulate the dynamics of ambient test particles in the gravitational potential well of a binary black hole system following a first-order coalescing orbit, with the eventual end goal of simulating the associated electromagnetic radiation and resulting spectral energy density distribution of such a binary black hole the system, as this could shed light on binary black hole systems as high-energy accelerators and possible detection thresholds of electromagnetic counterparts to binary black hole mergers. The potentials and particle trajectories are numerically calculated using embedded Runge-Kutta methods, under the assumption of non-rotating black holes with the post-Newtonian Paczynski-Wiita potential approximation in tandem with retarded time concepts analogous to electrodynamics.

Author: VAN DER MERWE, Pieter (North-West University)

Presenter: VAN DER MERWE, Pieter (North-West University)

Session Classification: Contributed posters

Contribution ID: **410** Type: **Contributed e-poster**

Relativistic Cosmic Ray transport code

We present a prototype code which implements a new way to model relativistic Cosmic Ray transport. It is based on a numerical solution to the Vlasov-Fokker-Planck equation in conjunction with a spherical harmonic expansion of the single particle distribution function. It allows for the computation of the anisotropies in the distribution of Cosmic Rays up to very high accuracy. Such effects are essential to account for the non-diffusive transport of particles close to sources.

Authors: SCHWEEN, Nils (Max-Planck-Institut für Kernphysik); Dr REVILLE, Brian (Max-Planck--Institution für Kernphysik)

Presenter: SCHWEEN, Nils (Max-Planck-Institut für Kernphysik)

Session Classification: Contributed posters

Contribution ID: **411** Type: **Contributed talk**

NuSTAR broad-band X-ray observations and multi-wavelength investigations of Galactic TeV sources

Monday, July 4, 2022 6:15 PM (15 minutes)

We will report recent progress on the NuSTAR observations of a variety of Galactic TeV sources including PeVatron candidates. Given its sub-arcminute angular resolution and high sensitivity above 10 keV, NuSTAR's hard X-ray morphology and spectroscopy data allow us to probe sub-PeV electron populations through detecting synchrotron X-ray radiation. NuSTAR, along with other X-ray telescopes, play an important and complementary role to the ultra-high energy (> 100 TeV) gamma-ray telescopes. Our targets include 8 middle-aged pulsar wind nebulae, W50 lobes powered by the microquasar SS433, and a few other gamma-ray sources detected by HAWC, LHAASO and VERITAS. Combined with radio, GeV and TeV data, we aim to provide a complete, multi-wavelength view of the most energetic particle accelerators in our galaxy. In this presentation, we will review our observation campaign, highlight some key results and discuss our future plan of observing other sources such as Westerlund 2 and Cassiopeia A.

Author: MORI, Kaya (Columbia Astrophysics Laboratory)

Co-authors: Dr DINGUS, Brenda (Los Alamos National Laboratory); Mr MAC INTYRE, Brydyn (University of Manitoba); Prof. HAILEY, Charles (Columbia Astrophysics Laboratory); Dr GOTTHELF, Eric (Columbia Astrophysics Laboratory); Prof. AN, Hongjun (Chungbuk National University); Ms WOO, Jooyun (Columbia Astrophysics Laboratory); Prof. GELFAND, Joseph (NYU Abu Dhabi); Prof. FANG, Ke (University of Wisconsin); Dr MALONE, Kelly (Los Alamos National Laboratory); Dr CAPASSO, Massimo (Barnard College); Dr NYNKA, Melania (MIT); Mr ABDELMAGUID, Moaz (NYU Abu Dhabi); Prof. PARK, Nahee (Queens University); MUKHERJEE, Reshmi (Barnard College, Columbia University); SAFI-HARB, Samar (University of Manitoba); Dr STRAAL, Samayra (NYU Abu Dhabi); Prof. REYNOLDS, Stephen (North Carolina State University); Dr TEMIM, Tea (Princeton University)

Presenter: MORI, Kaya (Columbia Astrophysics Laboratory)

Session Classification: Contributed Talks

Contribution ID: **412** Type: **Contributed talk**

On the origin of the complex energy-dependent structure of HESS J1702-420

Tuesday, July 5, 2022 4:15 PM (15 minutes)

HESS J1702-420 is an unidentified multi-TeV gamma-ray source with a peculiar energy-dependent morphology which most naturally can be explained as a composition of two independent emission components with significantly different spatial and energy distributions. Here we propose an alternative interpretation assuming that we deal with a single hadronic accelerator injecting protons with energies extending to at least 0.5 PeV. In the suggested scenario, both the extended (elongated) component of radiation with a soft gamma-ray spectrum and the compact point-like component with a very hard spectrum have the same origin associated with the interactions of injected protons with the surrounding dense gas environment but are produced at different stages of proton propagation. The component produced at the initial (quasi) ballistic regime of proton propagation has a compact image (angular distribution) focused on the accelerator and an energy spectrum which reflects the acceleration spectrum. The second (extended) component is the result of radiation at the stage when the protons enter the diffusion stage of propagation. Thus the image of this component reflects the spatial distribution of protons. Its spectrum is steeper because of the modulation of the proton spectrum in the course of diffusion. The joint analysis of these two components allows us to
derive the power-law index of the acceleration spectrum and the proton injection rate, and the energy-dependent diffusion coefficient. Assuming the distance to the source d=3.5 kpc, the characteristic medium density of 100 cm^{-3} and diffusion coefficient $D(E) = 3 \times 10^{27}$ cm^2/s we argue that the system can be well described by the protons' injection rate $\sim 7 \times 10^{38}$~erg/s. The latter can be significantly reduced in the case of the association of HESS J1702-420 with significantly closer and denser molecular clouds seen along the line of sight in HI/CO surveys.

Authors: Prof. AHARONIAN, Felix; CHERNYAKOVA, Masha (DCU); MALYSHEV, Denys (Tubingen University)

Presenter: MALYSHEV, Denys (Tubingen University)

Session Classification: Contributed Talks

Contribution ID: **413** Type: **Contributed talk**

Radio to GeV view of PSRB 1259-63 periastron passage in 2021.

Wednesday, July 6, 2022 5:45 PM (15 minutes)

PSR B1259-63 is a gamma-ray binary system hosting a radio pulsar orbiting around a massive young star, LS 2883, with a period of ~3.4 years. The interaction of the pulsar wind with the LS 2883 outflow leads to unpulsed broadband emission in the radio, X-ray, GeV, and TeV domains. One of the most unusual features of the system is an outburst of GeV energies around the periastron, during which the energy release substantially exceeds the spin down luminosity under the assumption of the isotropic emission. In this talk, we will present the results of a recent multi-wavelength campaign (radio, optical, and X-ray bands) including the unpublished yet evolution of radio polarization and spectral slope. The campaign covered a period of more than 100 days around the 2021 periastron and revealed substantial differences from previously observed passages. In this talk we will compare the obtained data set with the predictions of the emission cone model proposed by us previously.

Authors: CHERNYAKOVA, Masha (DCU); Dr MALYSHEV, Denys (IAAT-University Tuebingen); Dr VAN SOELEN, Brian (University of the Free State); Dr MC KEAGUE, Samuel (DCU)

Presenter: CHERNYAKOVA, Masha (DCU)

Session Classification: Contributed Talks

Contribution ID: **414** Type: **Contributed talk**

An unbiased search for TeV emission from high-frequency peaked BL Lacs

Monday, July 4, 2022 5:00 PM (15 minutes)

High-frequency-peaked BL Lacs (HBLs) dominate the extragalactic TeV sky, with more than 50 objects detected with the current generation of ground-based TeV gamma-ray observatories. In the last three years, the VERITAS telescope array has observed a flux-limited sample of 36 X-ray selected HBLs with the goal of producing the first unbiased census of TeV emission from HBL blazars. The VERITAS HBL sample contains known TeV sources as well as 15 objects for which TeV emission has not been reported before. The results of this VERITAS campaign include the detection of new TeV blazars as well as unbiased estimates of the TeV flux of HBLs that have previously been reported only during flaring states. The implications of our results in understanding the intrinsic properties of HBLs as a source population will be discussed.

Authors: ERRANDO, Manel (Washington University in St Louis); ON BEHALF OF THE VERITAS COLLABORATION

Presenter: ERRANDO, Manel (Washington University in St Louis)

Session Classification: Contributed Talks

Contribution ID: **415** Type: **Contributed e-poster**

VERITAS observations of IXPE blazar targets

The Imaging X-Ray Polarimetry Explorer (IXPE) is an X-ray telescope capable of extracting information of the X-ray polarization of astrophysical sources in the 2-8 keV band. After a successful launch, IXPE started science operations in January 11 2022. During the first months of operations, IXPE obtained exposures of five TeV-emitting BL Lac-type blazars: Markarian 501, Markarian 421, S5 0716+714, BL Lacertae, and 1ES 1959+650. The VERITAS observatory has scheduled observations in the TeV band simultaneous with the IXPE observations of these objects. In this contribution, we will present the TeV light curves and spectra obtained with VERITAS and explore the potential that simultaneous observations of X-ray polarization and TeV emission have to determine the intensity and geometry of magnetic fields in relativistic jets.

Authors: ERRANDO, Manel (Washington University in St Louis); ON BEHALF OF THE VERITAS COLLABORATION

Presenter: ERRANDO, Manel (Washington University in St Louis)

Session Classification: Contributed posters

Contribution ID: **417** Type: **Contributed talk**

Magnetic field amplification driven by the relativistic shock-clump interaction

Wednesday, July 6, 2022 6:00 PM (15 minutes)

Magnetic field amplification in collisionless shocks is required for particle acceleration and high-energy synchrotron emission in high-energy astrophysical phenomena. Recent magnetohydrodynamics (MHD) simulations of shocks propagating into inhomogeneous media show that the ambient magnetic field is amplified by turbulent dynamo in the downstream region. However, post-shock density fluctuations could easily decline in a collisionless shock due to particle diffusion, so that it is not clear whether the turbulent dynamo is driven. We investigate the interaction between a relativistic magnetized collisionless shock and a dense clump by means of Particle-in-Cell (PIC) simulation for the first time. We also perform MHD simulations for the same physical condition as the PIC simulation. The PIC simulation shows that particles escape from the dense clump along the magnetic field line. As a result, the vorticity around the shocked clump is smaller than that in the MHD simulations. Moreover, in both PIC and MHD simulations, it is found that the shocked clump quickly decelerates. Because of the escape and the deceleration, the turbulent dynamo driven by the shock-clump interaction is not efficient for relativistic collisionless shocks.

Author: TOMITA, Sara (Tohoku University)

Co-authors: Dr OHIRA, Yutaka (University of Tokyo); Dr KIMURA, Shigeo (Tohoku.University); Dr TOMIDA, Kengo (Tohoku University); Dr TOMA, Kenji (Tohoku University)

Presenter: TOMITA, Sara (Tohoku University)

Session Classification: Contributed Talks

Contribution ID: **418** Type: **Contributed e-poster**

Study of pulsar wind nebula candidates seen with H.E.S.S.

Promising regions within the Galactic plane may offer more insight on the transition from younger to older pulsar wind nebulae (PWNe) evolution, as the observed very-high-energy emission provide constrains on their morphology and physical mechanisms at play. In particular, we focus on the 312° galactic longitude field of two degrees containing five powerful pulsars. Their rotational energies range from 10^{35} to 10^{37} erg.s^{-1} for ages between 13.6 and 62.8 kyr. Extended emission has been recently probed with H.E.S.S. in their vicinity, notably around the pulsar PSR J1413-6205 in the TeV domain.

We processed 124 hours of H.E.S.S observations with an analysis algorithm improving background fitting for the study of extended diffuse sources. We applied a three-dimensional likelihood analysis technique to model the different sources in the region of interest using a configuration optimized to enhance the collection area at the highest energies.

This presentation will focus on the discussion of new detections in the context of PWN-candidate searches and on the understanding of systems that might be transitioning from a PWN to a TeV gamma-ray halo.

Author: CHAMBÉRY, Pauline (LP2IB)

Co-authors: GALLANT, Yves; JARDIN-BLICQ, Armelle; LEMOINE-GOUMARD, Marianne (LP2I Bordeaux); MARANDON, Vincent; SINHA, Atreyee (UCM, Madrid); TSIROU, Michelle (MPIK-HD); H.E.S.S. COLLABORATION

Presenter: CHAMBÉRY, Pauline (LP2IB)

Session Classification: Contributed posters

Contribution ID: **419** Type: **Contributed talk**

New TeV halo candidate surrounding PSR J0359+5414 detected with the HAWC Observatory

Tuesday, July 5, 2022 6:15 PM (15 minutes)

The High Altitude Water Cherenkov (HAWC) Gamma-Ray Observatory surveys the gamma-ray sky between a hundreds of GeV and hundreds of TeV, and has detected emission surrounding a radio-quiet pulsar, PSR J0359+5414, in its almost 6 years of data. PSR J0359+5414 is gamma-ray pulsar with an age of 75 kyr and an extremely high spin-down power > 10^{36} erg/s. Its pulsar wind nebulae is detected in X-ray with a size of 30 arcseconds. We present results of the HAWC analysis of PSR J0359+5414. We show that the very-high-energy (VHE) emission around PSR J0359+5414 has a similar spectrum and extension as the TeV halo around the Geminga pulsar. Our observation of this relatively young middle-aged pulsar further confirms that particles diffuse slowly in the vicinity of pulsars.

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Co-author: Dr FANG, Ke (University of Wisconsin-Madison)

Presenter: COUTIÑO DE LEÓN, Sara (University of Wisconsin-Madison)

Session Classification: Contributed Talks

Contribution ID: **420** Type: **Contributed e-poster**

Active galactic nuclei detected at TeV energies with the HAWC Gamma-Ray Observatory

The High Altitude Water Cherenkov (HAWC) Gamma-Ray Observatory is a wide-field of view and high-duty cycle detector sensitive to photons of energies between ~0.3 and ~300 TeV. HAWC has been able to detect several sources from extragalactic origin. In this work we present the results of the search of active galactic nuclei from the Third Catalog of Hard Fermi-LAT sources using more than 1500 days of HAWC live data. We also present the detailed spectral analysis at VHE of three selected active galaxies: Markarian 421, Markarian 501 and M87, along with the modeling of their broadband spectral energy distribution.

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Co-authors: Dr CARRAMIÑANA, Alberto (Instituto Nacional de Astrofísica, Óptica y Electrónica); Dr ROSA-GONZÁLEZ, Daniel (Instituto Nacional de Astrofísica, Óptica y Electrónica); Dr LONGINOTTI, Anna Lia (Instituto de Astronomía-Universidad Nacional Autónoma de México); UREÑA-MENA, Fernando (Instituto Nacional de Astrofísica, Óptica y Electrónica)

Presenter: COUTIÑO DE LEÓN, Sara (University of Wisconsin-Madison)

Session Classification: Contributed posters

Contribution ID: **421** Type: **Contributed e-poster**

Detection of J2019+368: a case study of very-large-zenith angle observations with H.E.S.S.

Observations at very large zenith angles (VLZA) can push the sensitivity of IACTs towards higher energies. There are successful examples of VLZA observations presented by MAGIC and VERITAS. Besides covering the broader energy range, the operation of Cherenkov telescopes under VLZA could increase the exposure duty cycle for observing the transient events. The updated scientific strategy of H.E.S.S. has a significant focus on the detection of transient phenomena, which makes that the development of the VLZA technique is of crucial importance for upcoming future observations. We present a detection of the low-altitude source J2019+368 using VLZA-only operation and discuss the capabilities and limitations of H.E.S.S. instrument for this type of observations.

Authors: KOSTUNIN, Dmitriy (DESY); RUEDA, Héctor (IRFU - CEA); Mr BRUN, François (IRFU - CEA); LYPOVA, Iryna (LSW); OHM, Stefan (DESY, D-15738 Zeuthen, Germany); HESS COLLABORATION

Presenters: RUEDA, Héctor (IRFU - CEA); LYPOVA, Iryna (LSW)

Session Classification: Contributed posters

Contribution ID: **422** Type: **Contributed e-poster**

Connecting gamma-rays and high-energy neutrinos via hierarchical modeling

Gamma-rays and high-energy neutrinos offer complementary ways to study particle acceleration in energetic astrophysical sources. However, analysing these observations together is challenged by possible explanations from a range of complex models, with many uncertainties and observational effects to take into account. We present a coherent data analysis framework based on hierarchical modeling that tackles these challenges. Our framework can be used to uncover weak neutrino sources based on a proposed gamma-ray–neutrino connection and place constraints on the hadronic contribution to the gamma-ray signal from neutrino observations. We demonstrate the potential of this approach on simulated data, considering both individual sources and populations of similar objects. We find that our approach complements existing techniques and offers increased sensitivity, flexibility, and directly interpretable results.

Author: Dr CAPEL, Francesca (Max Planck Institute for Physics)

Co-authors: Dr HAACK, Christian; HA MINH, Martin (TUM/MPP); Dr NIEDERHAUSEN, Hans; Dr SCHUMACHER, Lisa (TUM)

Presenter: Dr CAPEL, Francesca (Max Planck Institute for Physics)

Session Classification: Contributed posters

Contribution ID: **423** Type: **Contributed e-poster**

Search for VHE gamma-ray emission from the TDE candidate AT 2021uqv with H.E.S.S.

Tidal Disruption Events (TDEs) are a relatively young class of transient phenomena, which occur when the star approaches the SMBH so close that it is ripped apart by the tidal forces. Part of the stellar debris forms an accretion disc, resulting in a flare of electromagnetic radiation, which is typically detected in optical/UV and X-ray energy bands. Some TDE candidates have been also detected in radio and non-thermal X-ray that suggests active particle acceleration to relativistic energies. However, up to now, there are no TDEs detected in gamma rays, neither in HE (100 MeV - 100 GeV) nor in VHE (100 GeV - 100 TeV) regime. In 2021, the H.E.S.S. collaboration observed the TDE candidate AT 2021uqv as part of its TDE program. No significant VHE gamma-ray emission was detected in ~27h of observations, and therefore, spectral upper limits are presented. In addition, we also discuss a multi-wavelength picture of AT 2021uqv.

Authors: LYPOVA, Iryna (LSW); ASHKAR, Halim (LLR); KONNO, Ruslan (DESY); KOSTUNIN, Dmitriy (DESY); LEFRANC, Valentin (CEA IRFU); OHM, Stefan (DESY, D-15738 Zeuthen, Germany); Dr SCHUSSLER, Fabian (CEA Irfu); Prof. WAGNER, Stefan (LSW Heidelberg); HESS COLLABORATION

Presenter: LYPOVA, Iryna (LSW)

Session Classification: Contributed posters

Contribution ID: **424** Type: **Contributed talk**

Can massive star clusters produce PeV photons?

Tuesday, July 5, 2022 3:00 PM (15 minutes)

The LHAASO observatory recently detected a PeV photon in the direction of the Cygnus X star-forming region. A plausible origin for this emission is the association of massive stars Cygnus OB2. This raises the question whether or not massive star clusters can accelerate particles to ultra-high energies. Clustered stars heat their surrounding medium, which inflates a cavity filled with multiple shocks, strong turbulence and amplified magnetic fields. Although these are ideal conditions for particle acceleration, it is yet unclear how the different acceleration processes can act collectively to produce ultra-high energy particles.

In this work we show that even though the maximum energy of the particles accelerated in these environments is expected to be higher than in the case of isolated massive stars or supernova remnants, it is not straightforward to account for an UHE gamma-ray emission. Amongst several possibilities of acceleration mechanisms, including embedded supernova remnants, wind termination shocks or large-scale turbulent waves, a promising scenario is that of a fast supernova shock expanding in the cold wind around compact clusters. In this case, protons could be accelerated up to 10 PeV and beyond, and subsequently interact to produce PeV photons.

Authors: VIEU, Thibault (Max-Planck-Institut für Kernphysik, Heidelberg); REVILLE, Brian (Max--Planck-Institut für Kernphysik)

Presenter: VIEU, Thibault (Max-Planck-Institut für Kernphysik, Heidelberg)

Session Classification: Contributed Talks

Contribution ID: **425** Type: **Contributed talk**

HESS J1831-098: a hadronic PeVatron or a very energetic pulsar wind nebula?

Monday, July 4, 2022 3:45 PM (15 minutes)

We will present the detection, spectral and morphological characterization of HESS J1831-098 with H.E.S.S. The source was previously identified as a hotspot in the H.E.S.S. Galactic Plane Survey catalogue. The hard power-law spectrum extends with an index of ~2.1 up to >30 TeV with no indication for a cut-off, making HESS J1831-098 an interesting PeVatron candidate. The HAWC point source 3HWC J1831-095 is located in the vicinity of HESS J1831-098 and has similar spectral properties, supporting the hypothesis of an association of these two objects. We will discuss the origin of the VHE gamma-ray emission of HESS J1831-098 in the context of a possible association with the powerful pulsar PSR J1831-0952 or with a dense molecular cloud illuminated by energetic particles escaped from a nearby SNR. In both scenarios, the hard spectrum of this H.E.S.S. source clearly testifies to the presence of an extreme particle accelerator, possibly a PeVatron.

Authors: LYPOVA, Iryna (LSW); GIUNTI, Luca; Prof. WAGNER, Stefan (LSW Heidelberg); HESS COLLABORATION

Presenter: LYPOVA, Iryna (LSW)

Session Classification: Contributed Talks

Contribution ID: **427** Type: **Contributed e-poster**

New radial velocity measurements for orbital parameter analysis of the gamma-ray binary HESS J0632+057

Gamma-ray binaries are a small subclass of high mass binaries where the SED peaks at energies greater than 1 MeV. For most systems the orbital parameters must be derived from radial velocity measurements of the optical companion. The gamma-ray binary HESS J0632+057 has two proposed but incompatible orbital solutions. In order to choose between the two solutions, new observations over multiple semesters are being undertaken with the High Resolution Spectrograph (HRS) on the Southern African Large Telescope (SALT), of the B0pe companion. We present the preliminary results from the first two observing semesters, showing the radial velocity measurements derived by both the absorption lines from the stellar surface as well as the emission lines for the circumstellar disc. These results are compared to the existing solutions.

Author: MATCHETT, Natalie (University of the Free State)

Co-authors: Prof. VAN SOELEN, Brian (University of the Free State); Prof. GRAY, Richard (Appalachian State University)

Presenter: MATCHETT, Natalie (University of the Free State)

Session Classification: Contributed posters

Contribution ID: **428** Type: **Contributed e-poster**

Detecting and characterising pulsar halos with the Cherenkov Telescope Array

The recently identified source class of pulsar halos may be populated and bright enough at TeV energies to constitute a large fraction of the sources that will be observed with the Cherenkov Telescope Array (CTA), especially in the context of the planned Galactic Plane Survey (GPS). In this study, we examine the prospects offered by CTA for the detection and characterization of such objects. CTA will cover energies from 20 GeV to 300 TeV, bridging the ranges already probed with the Fermi Large Area Telescope and High Altitude Water Cherenkov Observatory, and will also have a better angular resolution than the latter instruments, thus providing a complementray look at the phenomenon. From simple models for individual pulsar halos and their population in the Milky Way, we examine under which conditions such sources can be detected and studied from the GPS observations. In the framework of a full spatial-spectral likelihood analysis, using the most recent estimates for the instrument response function and prototypes for the science tools, we derive the spectral and morphological sensitivity of the CTA GPS, to extended sources in general and then to the specific intensity distribution of halos. From these, we quantify the physical parameters for which pulsar halos can be detected, identified, and characterized, and what fraction of the Galactic population could be accessible. We also discuss the effect of interstellar emission and data analysis systematics on these prospects.

Authors: Dr ECKNER, Christopher (LAPTh); Dr MARTIN, Pierrick (IRAP); Dr ZAHARIJAŠ, Gabrijela (University of Nova Gorica); Dr CALORE, Francesca (LAPTh); VODEB, Veronika (University of Nova Gorica)

Presenter: VODEB, Veronika (University of Nova Gorica)

Session Classification: Contributed posters

Contribution ID: **429** Type: **Contributed e-poster**

Probabilistic classification of Fermi LAT sources

Classification of sources is one of the most important tasks in astronomy and astrophysics. About one third of sources in Fermi LAT catalogs are unclassified due to absence of plausible associations. We determine probabilistic classification of unassociated sources in 3FGL and 4FGL catalogs using machine learning methods trained on associated sources. We argue that probabilistic classification can be used not only to determine the most likely classes of sources, but also to perform population studies by taking into account all unassociated sources weighted by the classification probabilities. For example, the expected density of active galactic nuclei (AGNs) including unassociated sources weighted by probabilities is approximately isotropic, while the density of either associated AGNs or most likely AGNs among unassociated sources has a dip in the Galactic plane. Another application of the probabilistic catalogs is the estimation of the number of pulsars or other Galactic sources among the unassociated sources.

Authors: MALYSHEV, Dmitry (Erlangen Center for Astroparticle Physics); BHAT, Aakash (Erlangen Center for Astroparticle Physics)

Presenter: MALYSHEV, Dmitry (Erlangen Center for Astroparticle Physics)

Session Classification: Contributed posters

Contribution ID: **430** Type: **Contributed talk**

Virial shocks in galaxy clusters

Wednesday, July 6, 2022 4:00 PM (15 minutes)

In the theory of structure formation in the Universe, galaxy clusters are thought to grow by accreting surrounding material, resulting in strong surrounding, so-called virial shocks. Such a shock is expected to accelerate relativistic electrons, thus generating a spectrally-flat leptonic virial ring. Recently, we have detected ($> 5\sigma$) virial shock signals around the expected shock radius, ~(2–3)θ_{500}, for example by stacking gamma-ray data from Fermi LAT around >100 nearby clusters. We investigate virial shock signals in a wide range of wavelengths, to better understand these shocks and their implications for astrophysics, cosmology, and plasma physics. In particular, we estimate the energies the shock deposits in relativistic particles and magnetic fields.

Authors: HOU, Kuan-Chou (Ben-Gurion University of the Negev); Dr REISS, Ido (Nuclear Research Center Negev); Prof. KESHET, Uri (Ben-Gurion University of the Negev)

Presenter: HOU, Kuan-Chou (Ben-Gurion University of the Negev)

Session Classification: Contributed Talks

Contribution ID: **431** Type: **Contributed talk**

Confronting observations of VHE gamma-ray blazar flares with reconnection models

Tuesday, July 5, 2022 5:30 PM (15 minutes)

Several models have been suggested to explain the fast gamma-ray variability observed in blazars, but its origin is still debated. One scenario is magnetic reconnection, a process that can efficiently convert magnetic energy to energy of relativistic particles accelerated in the reconnection layer. In our study, we compare results from state-of-the-art particle-in-cell simulations with observations of blazars at Very High Energy (VHE, E > 100 GeV). Our goal is to test our model predictions on fast gamma-ray variability with data and to constrain the parameter space of the model, such as the magnetic field strength of the unreconnected plasma and the reconnection layer orientation in the blazar jet. For this first comparison, we used the remarkably well-sampled VHE gamma-ray light curve of Mrk 421 observed with the MAGIC and VERITAS telescopes in 2013. The simulated VHE light curves were generated using the observable parameters of Mrk 421, such as the jet power, bulk Lorentz factor, and the jet viewing angle, and sampled as real data. This is the first time a comprehensive scan of the jet parameters has been evaluated in contrast with the observed data in a quantitative manner. With these results, we pave the way for future model-to-data comparison with next-generation Cherenkov telescopes, which will help further constrain the different variability models.

Author: JORMANAINEN, Jenni (Finnish Centre for Astonomy with ESO)

Co-authors: Dr HOVATTA, Talvikki (FINCA, Aalto University); Dr LINDFORS, Elina (FINCA); Dr PETROPOULOU, Maria (University of Athens); Dr CHRISTIE, Ian; Dr LIODAKIS, Yannis (FINCA)

Presenter: JORMANAINEN, Jenni (Finnish Centre for Astonomy with ESO)

Session Classification: Contributed Talks

Contribution ID: **432** Type: **Contributed e-poster**

Design and upgrade of the prototype Schwarzschild-Couder Telescope

The Cherenkov Telescope Array (CTA) is the next-generation ground-based observatory for very-high energy gamma-ray astronomy. CTA will have unparalleled sensitivity and angular resolution and will detect gamma-ray sources nearly 100 times faster than current arrays, enabling valuable multiwavelength and multimessenger observations. The Schwarzschild-Couder Telescope (SCT) is a candidate for the medium-sized telescope in CTA. A prototype SCT (pSCT) has been constructed at the Fred Lawrence Whipple Observatory in Arizona USA. Its camera is currently partially instrumented with 1600 pixels (2.7 degree FOV). The small plate scale of the optical system allows densely packed silicon photomultipliers to be used, which combined with high-density trigger and waveform readout electronics enable the high-resolution camera. The camera's electronics are capable of imaging air shower development with waveform readout with nanosecond resolution. The pSCT was inaugurated in January 2019, with commissioning continuing throughout that year. The first campaign of observations with the pSCT was conducted in January and February of 2020. Gamma-ray emission from the Crab Nebula was detected with a significance of 8.6 sigma. An upgrade to the pSCT camera is currently underway. The upgrade will fully populate the focal plane, increasing the field of view to 8 degrees diameter, and lower the front-end electronics noise, enabling a lower trigger threshold and improved reconstruction and background rejection.

Author: Dr TAYLOR, Leslie

Presenter: Dr TAYLOR, Leslie

Session Classification: Contributed posters

Contribution ID: **433** Type: **Contributed talk**

A multiwavelength look at the 2017 flare of OJ 287

Tuesday, July 5, 2022 3:00 PM (15 minutes)

Intermediate blazars (IBLs and LBLs) are known to present complex multiwavelength SEDs and variabilities, often requiring an interpretation beyond standard one-zone emission models. OJ 287 is the archetype of such a complex blazar. On top of hosting a binary supermassive black hole system, it presents multiple other unusual features like an extended X-ray jet, possible jet precession, mixed observed radio jet kinematics, and complex flares. We focus our attention on a peak of activity in Feb 2017, where OJ 287 displayed a soft X-ray flare with relatively minor counterparts in other wavelengths. We study the multiwavelength behavior of the source before, during, and after the flare with data in optical, UV, X-ray, gamma-ray, and for the first time, data from a very-high-energy detection above 100 GeV with VERITAS. Based on the discovery of a radio jet ejecta emerging from the core at the same period, we present a scenario in which a compact emission zone moves through the powerful emission of the core that can accurately depict the multiwavelength SED at different periods. This scenario will be discussed in the broader context of the characterization of the intermediate blazars.

Authors: HERVET, Olivier (UCSC); VERITAS COLLABORATION

Presenter: HERVET, Olivier (UCSC)

Session Classification: Contributed Talks

Contribution ID: **434** Type: **Contributed e-poster**

Looking for a repeating flaring pattern in Markarian 421, from X-ray to gamma ray

Markarian 421 is the brightest high-frequency-peaked BL Lac (HBL) observed in X-rays and gamma rays. Its radio jet, observed at a resolution below milliarcsecond with the VLBA, shows four stationary components. Interpreting these components as four stationary shocks, a distinct variability pattern is expected to be observed each time a strong perturbation propagates through the jet. Such a repeating pattern has previously been noticed in X-rays with a significance above 3 standard deviations. Preliminary results of a similar study applied to gamma-ray data will be shown, combining long-term very-high-energy datasets from VERITAS and FACT; results from Fermi-LAT observations and a 2020 radio VLBA campaign will also be presented. Finally, some of the implications of successive shocks in our current view of AGN jets emission and particle acceleration will be discussed.

Authors: HERVET, Olivier (UCSC); VERITAS COLLABORATION

Presenter: HERVET, Olivier (UCSC)

Session Classification: Contributed posters

Contribution ID: **435** Type: **Review, Highlight, or Invited talk**

Highlights from MAGIC

Monday, July 4, 2022 12:20 PM (25 minutes)

MAGIC is a system of two 17-m diameter Imaging Atmospheric Cherenkov Telescopes, located at an altitude of 2200 m in the Observatorio Roque de los Muchachos on the Canary island of La Palma. MAGIC provides a broad energy coverage, detecting gamma rays from 50 GeV and up to 100 TeV. The minimum energy can be further lowered to 15 GeV when using the SumTrigger specially optimised for low energies. A careful strategy of alert follow-ups from other facilities and the fast reposition of the telescopes as well as multi-wavelength campaigns are instrumental for the MAGIC observation program. In this presentation we will report the recent highlights from MAGIC. We will cover, among others: detections of gamma-ray burst at very high energies, the evidence for proton acceleration in the nova RS Ophiuchi, the extension of the spectra of Geminga pulsar at VHE, several campaigns on AGN and the dark matter searches.

Authors: BLANCH BIGAS, Oscar (IFAE); ON BEHALF OF THE MAGIC COLLABORATION

Presenter: BLANCH BIGAS, Oscar (IFAE)

Session Classification: Highlight Talks observational

Contribution ID: **437** Type: **Contributed e-poster**

Search for Axion-Like Particles with Observations of the Blazar Markarian 421 with VERITAS

Axion-like particles (ALPs) are light, pseudoscalar particles that are a beyond-the-standard-model generalization of the axion. Consequently, they are expected to couple to photons in external magnetic fields to compensate for spin difference. This coupling would induce modifications to the gamma-ray spectra of astrophysical sources, such as blazars, via ALP-photon oscillations in external fields near the source and in the Galactic magnetic field. In this contribution, we explore ALP-photon oscillation effects in the spectrum of the blazar Markarian 421. This work was performed using data recorded over more than a decade with the VERITAS gamma-ray observatory, with a particular focus on exceptional flare-state data. Using these observations, we investigate constraints on the two parameters defining the ALP, namely its mass and coupling constant.

Author: ADAMS, Colin (Columbia University)

Co-author: VERITAS COLLABORATION

Presenter: ADAMS, Colin (Columbia University)

Session Classification: Contributed posters

Contribution ID: **438** Type: **Contributed talk**

VERITAS Search for Gamma-ray and Optical Counterparts to Fast Radio Bursts

Wednesday, July 6, 2022 4:15 PM (15 minutes)

Detecting and understanding transients have proven one of the most fruitful areas of study in the field of multi-messenger and gamma-ray astrophysics. Imaging Atmospheric Cherenkov Telescopes explore an interesting parameter space with a high sensitivity to rapid events when compared to other instruments. One of the most rapid transients currently under study is Fast Radio Bursts (FRBs). FRBs are an expanding source class of rapid (~ms) bursts of radio emission. Many questions remain about the properties of their potential multi-wavelength counterparts. Dedicated radio instruments have enabled an order of magnitude increase in the number of bursts detected, but simultaneous multi-wavelength observations remain challenging. This is primarily due to the observational difficulties caused by their short-lived and sporadic nature. IACTs can simultaneously probe two interesting wavelength bands, optical and Very High Energy (VHE; >~100 GeV) gamma rays, making them an ideal instrument to follow-up known repeating FRBs. Following up FRBs and understanding the challenges relating to these observations is not only important for our understanding of the progenitors of FRBs but also for the future of IACT follow-up of other optical/gamma-ray targets like microquasars, pulsars, and M-dwarfs. In this talk, I will summarize the extensive FRB follow-up program at VERITAS including discussions of the simultaneous rapid optical and VHE observations of three bursts from FRB20180916B in 2021. Ongoing work with the study of 6 other repeaters and the status of the optical program at VERITAS will also be presented.

Author: LUNDY, Matthew (McGill University)

Presenter: LUNDY, Matthew (McGill University)

Session Classification: Contributed Talks

Contribution ID: **439** Type: **Contributed talk**

The Fermi and ALMA view of the Seyfert 1 AGN GRS 1734-292

The latest Fermi/LAT catalog newly included GRS 1734-292, which is a radio-quiet Seyfert galaxy. Both star formation and jet activity of this galaxy are insufficient to explain the observed gamma-ray flux. The remaining possibility is disk wind or corona. In this talk, we report the detection of the non-thermal mm-radio emission of GRS 1734-292 using the Atacama Large Millimeter/submillimeter Array (ALMA). This radio emission is likely a synchrotron counterpart of the gamma-ray emission. Based on the ALMA and Fermi measurements, we discuss the required physical conditions for corona and disk wind scenarios.

Author: MICHIYAMA, Tomonari (Osaka University)

Co-authors: Dr INOUE, Yoshiyuki; Dr DOI, Akihiro; FUKAZAWA, Yasushi; KUBO, Hidetoshi; YAMADA, Tomoya

Presenter: MICHIYAMA, Tomonari (Osaka University)

Session Classification: Contributed Talks

Contribution ID: **440** Type: **Contributed talk**

The January 2017 Orphan Gamma-ray Flare from the Radio Galaxy NGC 1275: VERITAS and Multiwavelength Results

Tuesday, July 5, 2022 3:30 PM (15 minutes)

NGC 1275 (3C84) is an active galactic nucleus (AGN) corresponding to the brightest cluster galaxy in the nearby Perseus supercluster of galaxies. As such, it has been the focus of intense study and monitoring across all wavebands for several decades. In 2010, it became one of the rare radio galaxies detected in very-high-energy gamma-ray emission (VHE;>100 GeV) with a reported flux by the MAGIC observatory of ~2.5% of the Crab Nebula and a soft energy spectrum with photon index of ~4. Since this discovery, the VERITAS observatory has monitored NGC 1275 every year. This presentation will describe the results of this long-term monitoring program with a particular focus on the extreme VHE flare displayed by NGC 1275 in early January 2017. Alerted by MAGIC on January 1, 2017 with a detection of NGC 1275 at a flux of ~150% Crab, VERITAS followed with observations on January 2, and 3, 2017 with the source still in a high state (65% Crab) but declining. Using data from radio, optical, X-ray and high-energy (HE) gamma rays, we will show the most complete simultaneous multiwavelength spectral energy distribution (SED) of the source for both the nights of January 1, and 2, 2017. It appears that the source was only flaring in gamma-rays –this 'orphan flare' condition strongly challenges standard emission scenarios. We present an emission model where the multiwavelength SED can be accurately depicted considering two interacting emitting zones at a few parsecs downstream from the core. The comparison of this scenario with other emission models proposed for NGC 1275, as well as the outstanding issues of TeV flares in radio galaxies are discussed.

Author: FORTSON, Lucy (University of Minnesota)

Co-author: FOR THE VERITAS COLLABORATION,

Presenter: FORTSON, Lucy (University of Minnesota)

Session Classification: Contributed Talks

Contribution ID: **441** Type: **Contributed e-poster**

Optical Spectroscopic Observations of Gamma-ray Blazar Candidates

A significant fraction of all γ-ray sources detected by the Large Area Telescope aboard the Fermi satellite still lacks a low-energy counterpart. In addition, there is still a large population of γ-ray sources with associated low-energy counterparts that lack firm classifications. Therefore, in the last ten years, we have undertaken an optical spectroscopic campaign to address the problem of unassociated or unidentified γ-ray sources (UGSs), mainly devoted to observing blazars and blazar candidates because they are the largest population of γ-ray sources associated to date.
Blazars represent about 62% of the sources in the γ-ray Fermi-LAT catalog and about 80% of the γ-ray sources associated with a lower-energy counterpart, dominating the γ-ray sky. In particular, about 42% of the Fermi-LAT γ-ray blazars are classified as Blazars Candidates of Uncertain type (BCUs), for which spectroscopic observations are mandatory to confirm their blazar nature. Here we report our recent spectroscopic observations and the state-of-art of our follow-up optical spectroscopic campaign aimed at identifying the nature of blazar candidates, confirming the classification of known blazars, and determining their redshift.

Our last sample of spectroscopic observations includes 62 sources classified in the Fermi-LAT catalog as BCUs, one source classified as a generic active galactic nucleus, and one source classified as a BL Lac in Fermi-LAT and as a blazar of uncertain type in the Roma-BZCAT catalog. We confirmed the blazar nature of all BCUs. We classified 33 of them as BL Lacs, 11 as Flat Spectrum Radio Quasars, and 18 as blazars with nonnegligible host-galaxy emission. We also classified the generic active galactic nucleus as a BL Lac. Finally, we confirmed the classification of the BL Lac. We also reported a lower limit redshift for 43 sources. For 20 sources, we got redshift measurements consistent with the literature values. For the other 21 sources, we obtained their first spectroscopic redshift measurement, while, for two sources, we provided lower limits on the redshift.

Including the sources studied in the present analysis, we either observed or analyzed archival spectra of 435 blazar and blazar candidates during the last nine years, including 129 blazars already included in the fifth edition Roma-BZCAT without precise classification or redshift estimate. We classified 337 sources as BZBs, 47 as BZGs, and 51 as BZQs. We also provided redshift estimates or lower limits for 82 BZBs previously without redshift.

From the results of our campaign, we confirm: that BL Lacs are the most elusive class of extragalactic γ-ray sources and the reliability of mid-IR color-based methods in selecting blazar-like candidate counterparts of unassociated or unidentified γ-ray sources. Our observational campaign is still ongoing, with observations recently acquired and more scheduled for this year.

Authors: PEÑA HERAZO, Harold A (East Asian Observatory (EAO)); Dr PAGGI, Alessandro (INAF-Osservatorio Astrofisico di Torino); Mrs GARCÍA-PÉREZ, Abigail (Instituto Nacional de Astrofísica, Óptica y Electrónica); Mr AMAYA-ALMAZÁN, Raúl A. (Instituto Nacional de Astrofísica, Óptica y Electrónica); Prof. MASSARO, Francesco (University of Turin); Dr RICCI, Federica (Dipartimento di Fisica e Astronomia, Università di Bologna); Prof. CHAVUSHYAN, Vahram (Instituto Nacional de Astrofísica, Óptica y Electrónica); Dr MARCHESINI, Ezequiel J. (INAF—Osservatorio di Astrofisica e Scienza dello Spazio); Prof. MASETTI, Nicola (INAF—Osservatorio di Astrofisica e Scienza dello Spazio); Prof. LANDONI, Marco (INAF-Osservatorio Astronomico di Cagliari); Prof. D'ABRUSCO, Raffaele (Center for Astrophysics | Harvard & Smithsonian); Prof. MILISAVLJEVIC, Dan (Department of Physics and Astronomy, Purdue University); Prof. JIMÉNEZ-BAILÓN, Elena (Instituto de Astronomía, Universidad Nacional Autónoma de México); Dr PATIÑO-ÁLVAREZ, Víctor M. (Instituto Nacional de Astrofísica,

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Presenter: PEÑA HERAZO, Harold A (East Asian Observatory (EAO))

Session Classification: Contributed posters

Contribution ID: **442** Type: **Contributed e-poster**

Probing Galaxy structure with VHE gamma rays

As an observer from within the Milky Way, it is difficult to determine its global structure. Despite extensive observational data from surveys at different wavelengths, there is no coherent picture of the structure of our own Galaxy. On the contrary, depending on the observational method, the results can differ notably. One example is the position of the Sun, with recent results ranging from 0 pc to 25 pc in height above the plane. Such differences may be due to local features or different structure formation of the objects that can be considered as indicators of the structure of the Milky Way (e.g. ISM, OB stars, globular clusters) or to observational biases in the survey of these objects. At most wavelengths, absorption contributes significantly to the observational bias.
The observation of very-high-energy (VHE) gamma rays does not suffer from absorption on Galactic scales. At the same time, typical sources of VHE gamma rays (e.g. SNRs, PWNe, molecular clouds) are closely related to classical indicators of Milky Way structure. Therefore, a less biased view of our Galaxy can be obtained with surveys in this energy range. Although most of the sources seen in VHE lack distance information, their distribution on the sky provides valuable information about the Galactic structure, such as the conspicuous asymmetry in the latitudinal distribution, which can be related to the position of the Sun above the Galactic plane. In this contribution, we will discuss the results of recent Galactic surveys with H.E.S.S. and HAWC with respect to the structure of the Milky Way and assess how future surveys can help to provide a more accurate picture.

Authors: STEPPA, Constantin (University of Potsdam); Dr EGBERTS, Kathrin (Potsdam University)

Presenter: STEPPA, Constantin (University of Potsdam)

Session Classification: Contributed posters

Contribution ID: **443** Type: **Contributed e-poster**

Magnetic Field Generation Induced by Streaming Cosmic Rays

Magnetic fields are observed in various length scales from the planetary scale to the scale of galactic clusters. A certain level of the magnetic field is implied even in the voids of large-scale structures by gamma-ray observations. However, the origin of magnetic fields has not been revealed yet. Here, we propose a new generation mechanism of magnetic fields where the Biermann battery effect is induced by streaming cosmic rays. Because the first cosmic rays are expected to be generated in supernova remnants of the first stars, this new mechanism can work just after the beginning of structure formation. We estimate the strength of the magnetic field achieved by this mechanism and show that it is sufficient for the seed of currently observed μG-level galactic magnetic fields. We compare this with the other previously proposed mechanisms and conclude that our new one dominates in relatively small-scale, low-temperature, and weakly-ionized regions.

Authors: YOKOYAMA, Shota (The University of Tokyo); Dr OHIRA, Yutaka (University of Tokyo)

Presenter: YOKOYAMA, Shota (The University of Tokyo)

Session Classification: Contributed posters

Contribution ID: **444** Type: **Contributed e-poster**

Understanding the Gamma Ray Emission around Westerlund 1

Young massive stellar clusters (YMCs) have come increasingly into the focus of discussions about the origin of PeV cosmic rays. Recently, HESS observed high-energy gamma ray emission around the YMC Westerlund 1, characterised by an energy independent, ring-like shape slightly off-set from the cluster position. We investigate the origin of this emission by modelling hadronic and leptonic emission processes with the open GAMERA library, discussing particle acceleration sites and propagation effects. Our findings support a predominately leptonic origin of the emission and highlight how the cluster's radiative and mechanical feedback facilitates particle acceleration.

Author: HÄRER, Lucia (Max-Planck Institute for Nuclear Physics)

Co-authors: Dr REVILLE, Brian (Max-Planck-Institut für Kernphysik); Dr MOHRMANN, Lars (Max-Planck-Institut für Kernphysik); Prof. HINTON, Jim (Max-Planck-Institut für Kernphysik)

Presenter: HÄRER, Lucia (Max-Planck Institute for Nuclear Physics)

Session Classification: Contributed posters

Contribution ID: **445** Type: **Contributed e-poster**

Gamma-ray emission from young supernova remnants in dense circumstellar environments

Supernova remnants are known to accelerate cosmic rays (CRs) from the detection of non-thermal emission of radio waves, X-rays, and gamma rays. However, the ability to accelerate CRs up to PeV-energies has yet to be demonstrated. The presence of cut-offs in the gamma-ray spectra of several young SNRs led to the idea that PeV energies might only be achieved during the very initial stages of a remnant's evolution.

We use the time-dependent acceleration code RATPaC to study the acceleration of cosmic rays in supernovae expanding into dense environments around massive stars, where the plentiful target material might offer a path to the detection of gamma-rays by current and future experiments. We performed spherically symmetric 1-D simulations in which we simultaneously solve the transport equations for cosmic rays, magnetic turbulence, and the hydrodynamical flow of the thermal plasma in the test-particle limit.

We investigated typical parameters of the circumstellar medium (CSM) in the freely expanding winds around red supergiant (RSG) and luminous blue variable (LBV) stars and accounted for the strong γγ absorption in the first days after explosion.

The maximum achievable energy is limited to below 600 TeV despite the strong magnetic and high mass-loss rates that we are considering. The maximum energy is not expected to surpass ≈ 200 TeV and ≈ 70 TeV for LBVs and RSG that experience moderate mass-loss prior to the explosion. We find gamma-ray peak-luminosities consistent with current upper limit and evaluated that current-generation instruments are able to detect the gamma-rays from Type-IIP explosions at distances up to ≈ 100 kpc and Type-IIn explosions up to ≈ 1.5 Mpc. We also find a good agreement between the thermal X-ray and radio synchrotron emission predicted by our models with a range of observations.

Authors: BROSE, Robert; SUSHCH, Iurii (North West University (South Africa)); Dr MACKEY, Jonathan (DIAS)

Presenter: BROSE, Robert

Session Classification: Contributed posters

Contribution ID: **446** Type: **Contributed e-poster**

The formation of gamma-ray halos around supernova remnants through particle escape

Supernova remnants (SNRs) are known to accelerate particles to relativistic energies, from the detection of nonthermal emission. The particularities of the acceleration mechanism are still debated. Here, we discuss how particle escape modifies the observable spectra as well as morphological features that might be revealed by the observational progress from radio to gamma-ray energies.

We use our time-dependent acceleration code RATPaC to study the formation of extended gamma-ray halos around supernova remnants and the morphological implications that arise when the high-energetic particles start to escape from the remnant.

We find a strong difference in the morphology of the gamma-ray emission from supernova remnants at later stages, dependent on the emission process. At early times, both the inverse-Compton and the Pion-decay morphology are shell-like. However, as soon as the maximum-energy of the freshly accelerated particles starts to fall, the inverse-Compton morphology starts to become center-filled, whereas the Pion-decay morphology keeps its shell-like structure. Both emission-spectra show a spectral softening caused by the escape of the highest-energetic particles. Escaping high-energy electrons start to form an emission halo around the remnant at this time. There are good prospects for detecting this spectrally hard emission with the future Cerenkov Telescope Array, as there are for detecting variations in the gamma-ray spectral index across the interior of the remnant. Due to the projection effects there is no significant variation of the spectral index expected with current-generation of gamma-ray observatories.

Authors: BROSE, Robert; SUSHCH, Iurii (North West University (South Africa)); POHL, Martin (Uni Potsdam / DESY)

Presenter: BROSE, Robert

Session Classification: Contributed posters

Contribution ID: **447** Type: **Contributed e-poster**

Modeling the non-thermal emission from SN 1987A

The remnant of SN 1987A is the best-studied object of its kind. The rich data-set of its thermal and non-thermal emission across the electromagnetic spectrum poses a unique testbed for the elaboration of particle-acceleration theory.

We constructed a model of the ambient medium around SN 1987A based on the detected X-ray emission from the interaction of the SNR-shock with the dense material in the equatorial plane. Two cones along prominent features of the ambient medium are then used in our time-dependent acceleration code RATPaC to model the evolution of the non-emission of SN 1987A and compare it to observational data from Radio to gamma-ray energies.

We solve for the transport of cosmic rays and the hydrodynamical flow, in the test-particle limit. The simulation code relies on 1D profiles but the large expansion speed of the young remnant renders lateral transport unimportant.

We find that the increase in thermal X-ray emission predates the increase in the low-energy gamma-ray brightness by several years. The increase of the gamma-ray brightness at lower energies is followed by a smooth increase at the highest energies. The gamma-ray spectrum at the highest energies appears soft during the brightening but hardens as more material in the equatorial ring gets shocked. The gamma-ray emission from SN1987A is boosted by the presence of dense clumps in the equatorial ring whose presence is supported by the different behavior of the soft and hard X-ray emission. The X-ray and gamma-ray brightness remain almost constant once the SNR blast-wave passed the region of peak-density in the equatorial plane.

Authors: BROSE, Robert; Dr MACKEY, Jonathan (DIAS); KELLY, Sean (DCU)

Presenter: BROSE, Robert

Session Classification: Contributed posters

Contribution ID: **448** Type: **Contributed talk**

Cosmic Rays origin studies in the W 44 region with Fermi-LAT and MAGIC observations

Tuesday, July 5, 2022 3:45 PM (15 minutes)

W 44 is a well-known Supernova Remnant (SNR) observed in high-energy gamma-rays, widely studied to investigate cosmic ray (CR) acceleration. Several analyses of the W 44 surroundings showed the presence of a gamma-ray emission offset from the radio SNR shell. This emission is thought to originate from escaped high-energy CRs.

We present a detailed analysis of the W 44 region as seen by Fermi-LAT, focusing on the spatial and spectral characteristics of both W 44 SNR and its surroundings. The spatial analysis was limited to energies above 1 GeV in order to exploit the improved angular resolution of the instrument, deriving a detailed description of the region morphology. The spectral analysis was extended down to 100 MeV, favouring the hadronic origin of gamma-rays.
Observations of the North Western region of W 44, also known as SRC-1 from previous works, were conducted with the MAGIC telescopes in the very-high-energy gamma-ray band. We analysed MAGIC data above 130 GeV exploiting the spatial information derived from the Fermi-LAT analysis above 1 GeV.

Here we show the results of both analyses and the combined Fermi-LAT and MAGIC spectra. An interpretation model was developed, assuming that the gamma-ray emission from the surroundings is due to clouds located near W 44 and illuminated by CRs escaping along the SNR's magnetic field lines, thus obtaining constraining information on the diffusion coefficient of the escaped CRs.

Author: DI TRIA, Riccardo (Università degli Studi di Bari & INFN Bari)

Co-authors: DI VENERE, Leonardo (INFN-Bari); GIORDANO, Francesco (Università degli Studi di Bari & INFN Bari); GREEN, David (Max-Planck-Institute for Physics); HAHN, Alexander (Max Planck Institute for Physics); Dr MORLINO, Giovanni (INAF - Osservatorio Astrofisico di Arcetri); PANTALEO, Francesca Romana (Politecnico di Bari & INFN Bari); Dr STRZYS, Marcel

Presenter: DI TRIA, Riccardo (Università degli Studi di Bari & INFN Bari)

Session Classification: Contributed Talks

Contribution ID: **449** Type: **Contributed talk**

The most complete multi-wavelength view of M87 to date: the 2017 campaign

Tuesday, July 5, 2022 3:45 PM (15 minutes)

In 2017, the Event Horizon Telescope (EHT) Collaboration successfully imaged the black hole at the center of the M87 galaxy. At the same time, an extensive multi-wavelength campaign was conducted involving ground and space-born instruments to cover energies from radio to very-high energy (VHE) gamma rays. We found that the core of M87 and the innermost knot HST-1 are in historically low states. In terms of X-ray energies, the core flux dominates over HST-1. We present the most extensive quasi-simultaneous spectral energy distribution (SED) and discuss the challenges of combining data with vastly different spatial resolutions. By modeling the broadband spectrum with two different types of single-zone leptonic models, we can infer that the low-state gamma-ray emission via inverse Compton must originate from a different region than the millimeter-band emission. We conclude that the gamma rays can only be generated in the inner jet if there are strongly particle-dominated regions upstream of HST-1. Our collected data has been made open access, and we encourage the application of structured jet models on these data.

Authors: HAHN, Alexander (Max Planck Institute for Physics); Dr MAZIN, Daniel (Institute for Cosmic Ray Research, University of Tokyo); EVENT HORIZON TELESCOPE MULTI-WAVELENGTH WORKING GROUP; EVENT HORIZON TELESCOPE COLLABORATION; FERMI-LAT COLLABORATION; H.E.S.S. COLLABORATION; MAGIC COLLABORATION; VERITAS COLLABORATION; EAVN COLLABORATION

Presenter: HAHN, Alexander (Max Planck Institute for Physics)

Session Classification: Contributed Talks

Contribution ID: **450** Type: **Contributed e-poster**

Spectropolarimetric behaviour of a selection of blazars

At optical wavelengths, the emission from blazars is a superposition of both unpolarised thermal emission, arising from the accretion disc, broad-line region, dusty torus and host galaxy itself, and the polarised non-thermal synchrotron radiation from the relativistic electrons moving in the jet. Measuring the degree of polarisation at optical wavelengths can be used to disentangle the contributions from these different components. Spectropolarimetry observations are used to observe the change in the polarisation as the blazar transitions from a quiescent state to a flaring state, i.e. as the dominant emission component shifts from thermal (unpolarised) to non-thermal (polarised). We are undertaking a long-term spectropolarimetry observation campaign of blazars, with the Southern African Large Telescope (SALT), complemented by photometric observations from the Las Cumbres Observatory (LCO), and the Fermi Large Area Telescope (LAT). We present an overview of the results from this campaign, showing the spectropolarimetry behaviour of flaring blazars.

Author: BARNARD, Joleen (The University of the Free State)

Co-authors: Dr VAN SOELEN, Brian (University of the Free State); Dr MARTIN-CARRILLO, Antonio (University College Dublin); Mr COOPER, Justin (University of the Free State); Prof. BÖTTCHER, Markus (Centre for Space Research, North-West University, South Africa); Dr BRITTO, Richard (University of the Free State); Dr BUCKLEY, David (South African Astronomical Observatory); Mr MARAIS, Johannes P (University of the Free State); SCHUTTE, Hester M (Centre for Space Research)

Presenter: BARNARD, Joleen (The University of the Free State)

Session Classification: Contributed posters

Contribution ID: **451** Type: **Contributed e-poster**

GeV Gamma-ray Counterparts of New Candidate Radio Supernova Remnants Detected in the GLEAM Survey

Recently the Galactic and Extra-galactic All-sky Murchison Widefield Array survey has published 27 new candidate radio supernova remnants (SNRs) which are located within the longitude ranges of 345° < l < 60° and 180° < l < 240°. To search for the gamma-ray counterparts of these candidate radio SNRs, we analyzed 14 years of Fermi-LAT data in the energy range of 0.2 - 300 GeV. There are three promising SNRs; G18.9-1.2, G23.1+0.1, and G28.3+0.2, which we detected at a significance level of 11σ , 6.1σ , and 20.6σ , respectively. Here we report the results of our morphological and spectral analyses of G18.9-1.2, G23.1+0.1, and G28.3+0.2.

Authors: Ms MEŞE, Berfin Mina (Middle East Technical University); Dr ERGIN, Tülün (Middle East Technical University, Northern Cyprus Campus)

Presenter: Ms MEŞE, Berfin Mina (Middle East Technical University)

Session Classification: Contributed posters

Contribution ID: **452** Type: **Contributed e-poster**

Using the virtual observatory to study the gamma-ray sky

Recently, the growth of astrophysical data from science space missions, ground-based telescopes, and theoretical models, which have different services and data stores, has been exorbitant. The latter led to the necessity of unified ways of describing and accessing the data.
The Virtual Observatory (VO) is a framework for astronomical datasets, tools, and services to work seamlessly, connecting the scientific with the data and services providers. To achieve this goal, VO must maintain specific standards adapted to different tools and data types following the FAIR principles (Findable, Accessible, Interoperable, Reusable). The International VO Alliance (IVOA) regulates these standards.
Here we shed light on how VO can facilitate scientific work by providing tools and utilities in the gamma-ray astronomy domain. We show how the interoperable VO tools (like TOPCAT and Aladin) can browse flux maps, search high-energy catalogs, and find available data (from Fermi and HESS) for different gamma-ray emitters together with the manipulation of this data. Furthermore, data can be analyzed with gammapy by connecting it with OPUS (Observatoire de Paris UWS System). Nevertheless, gamma-ray data still needs to adapt to VO standards.
The upcoming Cherenkov Telescope Array is evolving towards the model of a public observatory. The corresponding data will be accessible by the VO as many others, which will ease the scientific work. We conclude that VO is a continuous evolution cycle that changes with the researcher's needs and is essential for improving the scientific community.

Authors: KORNECKI, Paula (CNRS/LUTH Observatoire de Paris, Site de Meudon); Dr SERVILLAT, Mathieu (LUTH - Observatoire de Paris); Prof. BOISSON, Catherine (LUTH, Observatoire de Paris); Dr FUESSLING , Matthias (CTAO gGmbH)

Presenter: KORNECKI, Paula (CNRS/LUTH Observatoire de Paris, Site de Meudon)

Session Classification: Contributed posters

Contribution ID: **453** Type: **Contributed e-poster**

Quality Assurance of Actuators for the Medium-Sized Telescopes of the Cherenkov Telescope Array

The Cherenkov Telescope Array (CTA) is a future ground-based observatory for gamma-ray astronomy providing unparalleled sensitivity in the energy range from 20 GeV up to 300 TeV. CTA will consist of telescopes with three different sizes. The Medium-Sized Telescopes (MSTs) will have 12 m reflectors with a tessellated mirror design of 86 mirror facets each. Each mirror facet is mounted on the mirror support structure with two actuators that are adjustable in length to align the mirrors, and a freely rotating fixpoint. Image resolution and pointing accuracy constraints impose limits on the backlash and deformation of the actuators and the fixpoint under various weight and wind loads. In this contribution, the test stand to measure the backlash and deformation behaviour of actuators and fixpoints is described and the measurement procedure is explained.

Author: SALZMANN, Heiko (Institut for Astronomy & Astrophysics, University of Tuebingen)

Co-authors: Prof. SANTANGELO, Andrea (IAAT-University of Tuebingen); PÜHLHOFER, Gerd; Mr DICK, Jürgen (Institut for Astronomy & Astrophysics, University of Tuebingen); Mr DIEBOLD, Sebastian (Institut for Astronomy & Astrophysics, University of Tuebingen); Mr RENNER, Siegbert (Institut for Astronomy & Astrophysics, University of Tuebingen)

Presenter: SALZMANN, Heiko (Institut for Astronomy & Astrophysics, University of Tuebingen)

Session Classification: Contributed posters

Contribution ID: **454** Type: **Contributed e-poster**

X-ray studies of the TeV-discovered supernova remnant HESS J1534-571

HESS J1534-571 is a supernova remnant that has been discovered in the H.E.S.S. Galactic plane survey. While a radio counterpart has been identified, a putative X-ray counterpart of the shell has eluded detection so far. We present XMM-Newton observations that have been obtained towards the brightest part of the TeV shell, which complement earlier Suzaku observations of other regions of the remnant. We can now conclusively show that HESS J1534-571 emits no X-ray synchrotron emission detectable at current X-ray satellite sensitivity level. The derived upper limit is compared to models of the relativistic electron population in the remnant. Given the size of the source and the shape of the gamma-ray spectrum, a leptonic origin for the gamma-rays cannot be excluded. We find evidence in the XMM-Newton data for line emission at 6.4 keV, in agreement with the Suzaku results from other regions. This emission may stem from the low-energy (~MeV) part of a relativistic proton population potentially confined in HESS J1534-571, which is unconstrained by the gamma-ray data.

Authors: Ms NGUYEN, Nhan (Institute for Astronomy and Astrophysics of Tuebingen, Germany); Dr PUEHLHOFER, Gerd (Institute for Astronomy and Astrophysics of Tuebingen, Germany); Dr SASAKI, Manami (Dr. Karl Remeis-Observatory Bamberg, Germany); Dr BAMBA, Aya (The University of Tokyo, Japan); DOROSHENKO, Victor (Institute for Astronomy and Astrophysics of Tuebingen, Germany)

Presenter: Ms NGUYEN, Nhan (Institute for Astronomy and Astrophysics of Tuebingen, Germany)

Session Classification: Contributed posters

Contribution ID: **455** Type: **Contributed e-poster**

Theory of photon Comptonization in plasma with velocity shear: an application to structured jets in GRBs

The spectra of many astronomical objects, in particular GRBs, show a power law shape. Traditionally, this is commonly modeled as due to synchrotron emission from a population of accelerated particles following a power law distribution. However, here we show that multiple scattering of photons in shear layers, as expected in structured jets, naturally produces such a power law. The photons gain their energy by multiple scattering between different regions of different bulk Lorentz factor, thereby gaining their energy from the differential motion of the jet, before escaping inward, into regions of steady (and high) Lorentz factor, where they diffuse until escaping at the photosphere. Thus, this mechanism is an analogue to the well-known Fermi mechanism for particle acceleration. We provide an analytical expression for the obtained power law as a function of the jet structure, thereby showing that the high energy power law observed can be used as a novel tool to study the structure of relativistic jets. We also confirm the analytic predictions of the theory with Monte Carlo simulations that produce power law spectrum from these structured jets.

Author: VYAS, Mukesh Kumar (Postdoctoral Fellow)

Co-author: Prof. PE'ER, Asaf (Bar Ilan University)

Presenter: VYAS, Mukesh Kumar (Postdoctoral Fellow)

Session Classification: Contributed posters

Contribution ID: **456** Type: **Contributed talk**

FSRQ or BL Lac? MWL view of the transitional blazar OT081

Tuesday, July 5, 2022 4:00 PM (15 minutes)

We report on a multiwavelength study of the blazar OT081 during a high-activity state in July 2016, in which very-high-energy (VHE; E >100 GeV) gamma-ray emission from the source was discovered by MAGIC and H.E.S.S. telescopes, following a trigger from Fermi-LAT. OT081 is a luminous blazar well known for its variability in many energy bands, but only once detected in the VHE energy range. The presence of broad emission lines in the optical spectrum of the source challenges the categorization of OT081 as a BL Lac and hints at its transitional nature between a BL Lac and a flat spectrum radio quasar.
From the analysis of the multiwavelength light curves and of the broadband spectral energy distribution (SED), we study the evolution of the source, and identify four states of activity in the period 6 July – 20 August 2016. Instruments and facilities involved in this work are H.E.S.S., MAGIC, Fermi-LAT, Swift-XRT, Swift-UVOT, Lick/KAIT, ATOM, AZT-8+ST7, ALMA, Metsahovi, OVRO, RINGO, Steward Observatory, Tuorla Observatory, and the WEBT community. Moreover a dedicated study with the Very Long Baseline Array at 43GHz has provided key insight regarding the jet evolution. A simple one-zone synchrotron self-Compton model is not sufficient to describe the broadband SED, and external Compton is required to explain the high Compton dominance displayed by the source. We present the MWL study and the modeling, with our interpretation of the emission
mechanism, and compare our findings with the other few transitional blazars discovered so far.

Authors: MANGANARO, Marina (University of Rijeka, Department of Physics); Dr SEGLAR-ARROYO, Monica; Dr BECERRA GONZALEZ, Josefa; Dr SANCHEZ, David; Dr CERRUTI, Matteo; Prof. TAVECCHIO, Fabrizio; Dr FALLAH-RAMAZANI, Vandad; ESTEBAN GUTIERREZ, A.; Dr AGUDO, Ivan; Dr CIPRINI, Stefano; FILIPPENKO, Alexei V.; Dr HOVATTA, Talvikki; Dr JERMAK, Helen; Dr JORSTAD, Svetlana G.; KOPATSKAYA, E.N.; Dr L¨AHTEENM¨AKI, A.; LARIONOVA, L.V.; LARIONOV, V.M.; Prof. MARSHER, Alan; MOROZOVA, D.A.; Dr TORNIKOSKI, Merja; TROITSKAYA, Yu. V.; TROITSKY, I.; Dr VERRECCHIA, Francesco; WEAVER, Z.R.; Dr XIAO, H. B.; ZHENG, W.

Presenter: MANGANARO, Marina (University of Rijeka, Department of Physics)

Session Classification: Contributed Talks

Contribution ID: **457** Type: **Contributed e-poster**

A WISE view of the gamma-ray sky

Using data from the WISE all-sky survey we discovered that the non-thermal infrared emission of blazars, the largest known population of extragalactic gamma-ray sources, has peculiar spectral properties. Here I will review all results achieved on the well known "infrared-gamma-ray connection" based on the latest releases available for both the WISE and the Fermi source catalogs. I will show an updated analysis of the tight correlation between the mid-infrared colors and the gamma-ray spectral index for all gamma-ray blazars and discuss how this connection links both emitted powers and spectral shapes of particles accelerated in jets arising from blazars over ten decades in energy. I will also briefly present a comparison between the infrared-gamma-ray connection and that occurring at radio frequencies. Finally I will discuss on all developments performed in the last decade to use the infrared-gamma-ray connection to discover hundreds of new blazars within the sample of unidentified gamma-ray sources.

Author: MASSARO, Francesco (University of Turin)

Presenter: MASSARO, Francesco (University of Turin)

Session Classification: Contributed posters

Contribution ID: **458** Type: **Contributed e-poster**

Gamma-ray signatures from cosmic-ray interactions in AGN

Over the past few years the IceCube observatory has detected dozens of high-energy neutrinos in association with known blazar AGN. This emission is often explained by interactions of PeV cosmic rays with thermal or atomic photon fields surrounding the jet, leading to pion production and subsequent neutrino emission. As I will argue in this talk, the multi-wavelength emission from these interactions depends highly on the energy of the cosmic rays, the physical properties of the AGN components, the location of the emission region, and the distance of the source to Earth. I present recent results of self-consistent numerical models of different blazar AGN, and compare the signals from cosmic-ray interactions expected in the X-ray to TeV regime. I discuss the implications of these results for the high-energy monitoring and follow-up strategies of neutrino source candidates.

Author: RODRIGUES, Xavier (DESY / Ruhr University Bochum)

Presenter: RODRIGUES, Xavier (DESY / Ruhr University Bochum)

Session Classification: Contributed posters

Contribution ID: **459** Type: **Contributed e-poster**

Particle, Universe, NuClei and Hadrons for the Nationale ForschunsDatenInfrastruktur

Author: BOUYAHIAOUI, Makarim (MPIK)

Presenter: BOUYAHIAOUI, Makarim (MPIK)

Session Classification: Contributed posters

Contribution ID: **460** Type: **Contributed talk**

Modelling the Gamma-ray Morphology of the Supernova Remnant W28

Gamma-ray emission in the GeV and TeV energy regime has been detected towards the old supernova remnant (SNR) W28. This object is a prime candidate for the study of cosmic-ray acceleration and diffusion, as the adjacent molecular clouds provide target material for gamma-ray production and, due to its age, most particles have already escaped the shock front into the interstellar medium. While gamma-ray spectra from different regions around the SNR have been successfully modelled by several authors, none has ever modelled the morphology. Lacking this, we cannot fully understand the acceleration mechanisms and diffusion properties. High-energy gamma rays can be produced by the decay of neutral pions produced in inelastic collisions of protons and the interstellar gas. For accurate modelling of morphology, we need to know the location of cosmic rays and the interstellar gas in 3D, as small changes in relative position cause large differences in morphology.

In this contribution, we will introduce our novel 3D modelling and present the gamma-ray morphology around the SNR W28 using arcminute-scale molecular and atomic hydrogen gas distributions from the Mopra CO survey and the HI Southern Galactic Plane Survey. We will also discuss our grid search of SNR, diffusion and gas properties to reproduce spatial and spectral gamma-ray observations from the HESS Galactic Plane Survey and Fermi-LAT.

Author: EINECKE, Sabrina (The University of Adelaide)

Co-author: ROWELL, Gavin (The University of Adelaide)

Presenter: EINECKE, Sabrina (The University of Adelaide)

Session Classification: Contributed Talks

Contribution ID: **461** Type: **Contributed talk**

New insights towards the Galactic center from HESS

Monday, July 4, 2022 5:15 PM (15 minutes)

The Galactic center is one of the richest region in the Galaxy harboring the supermassive black hole Sagittarius A* surrounded by the Central Molecular Zone (CMZ), several supernova remnants, pulsars wind nebulae (PWNe), and star forming regions. TeV emission was revealed from individual sources (HESS J1745-290, the PWN G0.9+0.1, HESS J1746-285) and from the CMZ itself. In the CMZ the emission likely originates from cosmic rays pervading the Galactic center region and interacting with the dense gas. We present the first 3D analysis of the Galactic center region using 12 years of H.E.S.S. data and the Gammapy open-source analysis package. This analysis allows to extract for the first time, using a common field-of-view source modeling, the intrinsic spectra of the known H.E.S.S. sources HESS J1745-290, the PWN G0.9+0.1, HESS J1746-285 and HESS J1741-302.

Authors: DEVIN, Justine (CNRS - LUPM); WONG, Yu Wun (ECAP); LEMIÈRE, Anne (CNRS - APC); TERRIER, Régis (CNRS - APC); VAN ELDIK, Christopher (ECAP)

Presenter: DEVIN, Justine (CNRS - LUPM)

Session Classification: Contributed Talks

Contribution ID: **462** Type: **Contributed talk**

ALMA CO Observations in the Northwestern Shell of the Gamma-Ray SNR RX J1713.7-3946

Thursday, July 7, 2022 3:45 PM (15 minutes)

We report on results of CO observations in the northwestern shell of the supernova remnant (SNR) RX J1713.7−3946 using the Atacama Large Millimeter/submillimeter Array (ALMA). We recently found dozens of molecular cloudlets with typical radii of ∼0.03-0.05 pc and densities of $\sim 10^4$ cm^{-3}, which have survived shock passage due to their high density. These cloudlets are located not only along synchrotron X-ray filaments, but also in the vicinity of X-ray hotspots with month- or year-scale time variations. We argue that X-ray hotspots and filaments were generated by shock-cloudlet interactions through magnetic-field amplification up to mG. The gas density contrast of $\sim 10^5$, the coexistence of molecular cloudlets and low-density diffuse medium of ∼0.1 cm^{-3}, is consistent with such a magnetic field amplification and a wind-bubble scenario. The small-scale cloud structures also affect hadronic gamma-ray spectra considering the magnetic field amplification on surface and inside clouds.

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Presenter: SANO, Hidetoshi (Gifu University)

Session Classification: Contributed Talks

Contribution ID: **463** Type: **Contributed e-poster**

The Galactic TeV sky: sources or diffuse emission?

Gamma-ray observations have recently shifted the focus to higher and higher energies, with capable ground-based instruments enabling measurements in the TeV to PeV domain. While a clear prevalence of diffuse emission is observed in the GeV sky, energy-dependent cosmic-ray transport suggests a reversal of this hierarchy at higher energies. Measurements, however, are at strife regarding this question. While imaging atmospheric Cherenkov telescopes (IACTs) see a source-dominated Galactic plane, air-shower particle detectors (ASPDs) report a dominance of diffuse emission. Reconciling these claims requires a closer look at the involved instrument limitations: IACTs have a small field of view, resulting in poorer performance for large-scale emission due to the applied background subtraction technique. ASPDs have reduced resolution capabilities, resulting in unresolved sources contributing to the measurable diffuse emission signal.
Here we shed light on this controversy by investigating the amount of unresolved sources in current TeV measurements in a population synthesis approach and discuss the unique capabilities for high-resolution diffuse-emission measurements with IACTs and their possibilities for overcoming their background limitations.

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Presenter: EGBERTS, Kathrin (University of Potsdam)

Session Classification: Contributed posters

Contribution ID: **464** Type: **Contributed e-poster**

Photon and neutrino emission from AGN jets with the same baryon loading

Blazars are the most energetic subclass of active galactic nuclei (AGN) with relativistic jets pointing towards the observer. It is believed that jets are launched as cold non-relativistic Poynting-flux dominated outflows which accelerate to relativistic speeds at the expense of the available magnetic energy. Part of this energy is also thought to be converted into energy of non-thermal particles. In this work, we consider electron-proton jets and assume that particles are energized via magnetic reconnection in parts of the jet where the plasma magnetization is still high, namely $\sigma \geq 1$. Particle-in-cell simulations of reconnection have shown that the power-law slope of the particle energy distributions depends on σ, while the amount of energy transferred into relativistic protons and electrons is roughly constant. Neutrino production is also expected to occur via photohadronic interactions between relativistic protons and photons. In our calculations, we worked under the assumption that all jets are launched with the same total energy flux per unit rest-mass energy flux, μ. This relates to the plasma magnetization and bulk Lorentz factor as $\mu = (\sigma + 1)\Gamma$. We adopt an observationally motivated relation between Γ and the mass accretion rate $\dot{m}$, which also controls the luminosity of external radiation fields. We compute self-consistently the multi-messenger emission from blazar jets as a function of μ, σ, and $\dot{m}$, and present our results for BL Lac objects and flat spectrum radio quasars.

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Presenter: PSARRAS, Filippos (National and Kapodistrian University of Athens)

Session Classification: Contributed posters

Contribution ID: **465** Type: **Contributed e-poster**

Comprehension of jet physics from the analysis of Swift Gamma-Ray Bursts

The first observation of a short Gamma-Ray Burst in association with a Gravitational Wave opened a new era in the high energy astrophysics. The measured T90 of GRB170817A, of about 2 s, reinforces the necessity of a new way of classification. For this reason, we analyse at the Swift-BAT prompt emission data by applying a classification procedure that uses a machine learning technique that searches for similarities in the light curves. Two distinct groups could be identified, although still correlated with standard T90 duration. Since a jet viewed off-axis could explain the emission from GRB170817A, the modelling of this kind of sources is of great importance. A public code called JetFit, based on the "boosted fireball"model, is applied to fit Swift-XRT afterglow light curves of short and long Gamma-Ray Bursts, with known redshift, from 2005 to 2021. JetFit does not model the flaring activity. For this reason, a new procedure to remove the flaring phases has been developed. The distributions of the best-fit parameters, grouped according to the classification given by the machine learning algorithm, describe the physics of our sample. The mean values of the JetFit parameters can be used to compute the Synchrotron part of a typical Gamma-Ray Bursts afterglow emission model. Given the Synchrotron mechanism, it is possible to obtain a prediction on the Synchrotron Self-Compton high-energy component by building a general model based on physical parameters of the afterglow.

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Session Classification: Contributed posters

Contribution ID: **466** Type: **Contributed talk**

Multiwavelength studies of Galactic PeVatron candidates with VERITAS

Tuesday, July 5, 2022 4:00 PM (15 minutes)

The spectral change of the cosmic ray flux at 10^15 eV (PeV) has been suggested as an indication of the maximum energy obtainable by Galactic accelerators. Since leptonic particles lose their energies rapidly as their energies increase, the detection of hard-indexed gamma-ray emission beyond ~100 TeV may indicate that those sources accelerate hadronic particles up to the PeV energy range. Recent results from ground-based air shower gamma-ray observatories, such as HAWC and LHAASO, have revealed a few of these PeVatron candidates. Combined information from multi-wavelength observations is essential to probe the nature of these PeVatron candidates. Observations with imaging atmospheric Cherenkov telescopes (IACTs) provide further information about the spatial and spectral energy distributions of the gamma-ray emission from these sources since IACTs have better angular resolution and better sensitivity from ~100 GeV up to ~10 TeV compared to the air shower gamma-ray observatories. Meanwhile, observations of non-thermal X-ray emission provide properties of the leptonic particles around the source regions, allowing modelling of the expected leptonic contributions at TeV energies. Here, we present the status of VERITAS observations of the PeVatron candidates including follow-up observations of LHAASO sources, and multi-wavelength studies of the Boomerang pulsar wind nebula.

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Presenter: PARK, Nahee (Queen's University)

Session Classification: Contributed Talks

Contribution ID: **467** Type: **Contributed e-poster**

Validation of Monte Carlo Simulations for an analysis chain in H.E.S.S.

Imaging Air Cherenkov Telescopes (IACTs) indirectly detect very high energetic (VHE) gamma rays. They observe the Cherenkov light emitted in electromagnetic shower cascades the gamma rays induce in the atmosphere. A precise reconstruction of a primary photon's energy and the source flux depends heavily on accurate Monte Carlo (MC) simulations of the shower propagation and the detector response, and therefore on adequate assumptions about the atmosphere at the site and time of a measurement.
Here, we present the results of an extensive validation of the MC simulations for an analysis chain of the H.E.S.S. experiment with special focus on the recently installed FlashCam camera on the large 28 m telescope. One goal of this work was to create a flexible and easy-to-use framework to facilitate the detailed validation of MC simulations also for past and future phases of the H.E.S.S. experiment.
Motivated by the underlying physics, the detector simulation and the atmospheric transmission profiles were gradually improved until low level parameters such as trigger rates matched within a few percent between simulations and observational data. This led to instrument response functions (IRFs) with which the analysis of current H.E.S.S. data can ultimately be carried out within percent accuracy, substantially improving earlier simulations.

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Presenter: LEUSCHNER, Fabian (IAAT / University of Tuebingen)

Session Classification: Contributed posters

Contribution ID: **468** Type: **Contributed e-poster**

Constraints on Dark Matter annihilations signals with the H.E.S.S. Inner Galaxy Survey

Dark Matter (DM) can explain many astrophysical and cosmological measurements. However, its underlying nature remains a mystery. Weakly interacting massive particles (WIMPs) are among the most promising candidates to explain DM. The former have mass and coupling strength at the electroweak scale. If WIMPs are thermally-produced in the early universe, a relic density should still be present and consistent with that needed to explain the non-visible matter. Self-annihilating WIMPs would produce Standard Model particles and gamma-rays in the final state, which have been searched for a long time to probe DM. The inner halo of the Milky Way is predicted as the brightest source of DM annihilation. Several degrees of this region have been surveyed by the H.E.S.S. Collaboration for the Inner Galaxy Survey (IGS), with the aim of achieving the best sensitivity to faint and diffuse emissions. To search for DM signal, we performed an analysis of about 550 hours of observations in the IGS dataset collected between 2014 and 2020 with the full five-telescope array. Since no significant excess was found, we derived new limits on the velocity-weighted annihilation cross-section of WIMPs. Different annihilation channels can be inspected to probe thermal DM in the TeV mass range.

Authors: Mr MONTANARI, Alessandro (CEA Saclay / Irfu-DPhP - Université Paris Saclay); Dr MOULIN, Emmanuel (CEA-Saclay/DPhP-Irfu); Dr MALYSHEV, Denys, for the H.E.S.S. Collaboration (University of Tuebingen - IAAT)

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Session Classification: Contributed posters

Contribution ID: **471** Type: **Contributed e-poster**

Lepto-hadronic radiation models for GRB afterglows and prospects for VHE detection

Gamma-Ray Bursts (GRBs) are intense and short flashes of gamma rays followed by a long lasting multiwavelength afterglow emission, detected along the whole electromagnetic spectrum. Recently Very High Energy (VHE) emision (>100 GeV) has been obtained during the afterglow of a couple of GRBs. In this preliminary work we numerically investigate the production of VHE photons in GRB afterglows. We adopt the Relativistic Blast Wave (RBW) model which is thought to describe the production of a GRB after the initial explosion and examine numerically the temporal and spectral evolution of the multi-wavelength emission of VHE detected afterglows. We use firstly a one zone leptonic model assuming that synchrotron and synchrotron self-Compton is the radiative mechanism that produces the VHE emission and, as a second step, involve a hadronic component to the problem. In the latter case, we investigate how the secondary pairs produced via the photo-hadronic interactions affect the broadband afterglow spectrum and we estimate the all-flavor neutrino fluence produced by this model.

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Session Classification: Contributed posters

Contribution ID: **472** Type: **Contributed talk**

High-energy neutrinos and gamma rays from winds and tori in active galactic nuclei

Thursday, July 7, 2022 4:00 PM (15 minutes)

Powerful winds with wide opening angles, likely driven by accretion disks around black holes, are observed in the majority of active galactic nuclei (AGN) and can play a crucial role in AGN and galaxy evolution. If protons can be accelerated in the wind near the black hole, e.g. via diffusive shock acceleration, $p\gamma$ processes with photons from the nucleus generate neutrinos, as well as $\gamma\gamma$ cascade emission from the gamma-ray to radio bands. The TeV neutrinos tentatively detected by IceCube from the obscured Seyfert galaxy NGC 1068 can be interpreted consistently if the shock velocity $\sim$1000 km s^{-1}, which may correspond to a failed, line-driven wind that is physically well motivated. While the $p\gamma$ cascade is mostly $\gamma\gamma$-attenuated above MeV energies, the GeV photons observed from NGC 1068 and some other radio-quiet AGN may arise from an outer shock where the wind impacts the obscuring torus, e.g. via pp processes, along with some observable radio emission. Observational tests and implications of this scenario are discussed. Neutrinos may offer a unique probe of the launching sites of AGN winds, particularly for objects obscured in photons.

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Presenter: INOUE, Susumu (Bunkyo U. / RIKEN)

Session Classification: Contributed Talks

Contribution ID: **473** Type: **Contributed talk**

Adiabatic-radiative shock systems in non-relativistic astrophysical jets: a key to enhance the gamma-ray emision

Thursday, July 7, 2022 5:00 PM (15 minutes)

Of all the processes in the Universe, the bipolar ejection of collimated plasma outflows from the inner regions of the accretion disc around a central object are among the most remarkable. The shocks that form in highly supersonic jets are ideal sites for particle acceleration. By combining multi-wavelength observational data, numerical simulations, and plasma physics we study diffusive shock acceleration and gamma-ray emission in jets in protostars and supersonic outflows in classical novae. The coexistence of an adiabatic and a radiative shock is expected in the jet termination region, being this scenario very promising for particle acceleration and high-energy emission. Particles accelerated in the adiabatic shock can radiate through proton-proton collisions and relativistic Bremsstrahlung in the dense layer separating the adiabatic and radiative shock downstream regions. We find that protostellar jets can reach detectable levels of gamma-ray emission in this framework, not detected to date. Nova outflows have been detected in the gamma-ray domain, and we propose here an alternative scenario to explain the high-energy emission. Furthermore, the parameters for scaled laboratory experiments are very much in line with plasma conditions achievable in high-power laser facilities opening the door to new means for studying novae outflows never considered before.

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Presenter: ARAUDO, Anabella

Session Classification: Contributed Talks

Contribution ID: **474** Type: **Contributed e-poster**

Simulating galaxies with cosmic rays - the multi-frequency view

Previously, the non-thermal emission from galaxies has only been modelled with parametrised 1D or 2D models, which is insufficient to explain a multitude of new, spatially resolved multi-messenger data of cosmic ray (CR) spectra, at gamma-rays and in the radio. Instead, we perform high-resolution magneto-hydrodynamic (MHD) simulations of galaxies using the moving mesh code AREPO with self-consistent CR physics. In post-processing, we calculate steady-state spectra of CRs including all relevant cooling and escape losses. Consistent with Voyager-1 and AMS-02 data, our models show a turn-over of proton spectra below GeV energies due to Coulomb interactions so that electrons start to dominate the total particle spectra and match the shape of the positron fraction up to 10 GeV. Furthermore, from our CR spectra, we calculate multi-frequency spectra, from the radio up to the TeV energy regime, due to all non-thermal emission processes, i.e. synchrotron, bremsstrahlung, inverse Compton (IC) emission and gamma-ray emission from neutral pion decay. This allows us to produce detailed emission maps, luminosities and spectra of our simulated galaxies, that range from dwarfs to Milk-Way analogues to starburst galaxies, at different evolutionary stages. Within our simulations, we can successfully reproduce the observed far infrared (FIR)-gamma-ray and FIR-radio relations. We find that highly star-forming galaxies are close to the calorimetric limit and hence, their gamma-ray emission is dominated by neutral pion decay. However, in low star-forming galaxies, escape losses due to diffusion steepen the spectra and in turn, an increasing contribution from IC emission is needed to reproduce the observed gamma-ray spectra. As a next step, we scrutinise the steady-state modelling in two ways. On the one hand, we evolve CR electron spectra in time which allows us to study highly dynamical regions such as outflows from star-forming galaxies in unprecedented detail, where the steady-state assumption breaks down. Furthermore, we investigate for the first time the influence of spectrally resolved CR protons in MHD simulations on the hadronic gamma-ray emission of star-forming galaxies, revealing new insights into the observational signatures of CR transport both spectrally and spatially.

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Presenter: WERHAHN, Maria (Leibniz Institute for Astrophysics, Potsdam (AIP))

Session Classification: Contributed posters

Contribution ID: **475** Type: **Contributed talk**

Particle escape from supernova remnant shocks: gamma-ray and cosmic-ray signatures

Thursday, July 7, 2022 4:00 PM (15 minutes)

In the context of the supernova remnant (SNR) paradigm for the origin of Galactic cosmic rays (CRs), the escape process of accelerated particles represents a fundamental piece of information to interpret both the observed CR spectrum and the gamma-ray spectral signatures emerging from these sources. Under the assumption that in the spatial region immediately outside of the remnant the diffusion coefficient is suppressed with respect to the average Galactic one, we found that a significant fraction of particles can still be located inside the SNR long time after their nominal release from the acceleration region. This fact results into a gamma-ray spectrum arising from hadronic collisions that resembles a broken power law, similar to those observed in several middle-aged SNRs. Above the break, the spectral steepening is determined by the diffusion coefficient outside of the SNR and by the time dependence of maximum energy. Consequently, the comparison between SNR data and model predictions will possibly allow to determine these two quantities. Additionally, by further assuming that protons and electrons are accelerated at SNR shocks with the same slope, CR spectral measurements on Earth can then be reproduced if electrons are injected with a spectrum steeper than protons for energies above ~ 10 GeV. A possible scenario that can in principle justify the observed steeper electron spectrum relies on the combination of energy losses, due to synchrotron radiation in an amplified magnetic field, and time dependent acceleration efficiency.

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Presenter: CELLI, Silvia (Sapienza University & INFN)

Session Classification: Contributed Talks

Contribution ID: **477** Type: **Contributed e-poster**

Multiwavelength observations of the extreme HBL H 1426+428

H 1426+428 is a, so called, extreme high-frequency-peaked BL Lac object (extreme HBL) located at a redshift of z = 0.129 that was detected on a number of occasions by the previous generation of ground-based gamma-ray telescopes (Whipple, CAT and HEGRA), with its VHE flux ranging up to 80% of the Crab Nebula (Crab Units, CU) above a few hundred GeV. Current-generation TeV observatories (VERITAS, MAGIC) have, however, only reported low-flux detections with the flux typically ranging from 1-3% CU. In this contribution we report the results of a multi-year monitoring program with VERITAS covering the period 2008-2016, which revealed an average steady flux of ~2% CU, with no variability detected on timescales of days to years. We incorporate multi-wavelength data including optical, Swift UVOT, Swift XRT, Swift BAT, and Fermi-LAT, and construct and model the time-averaged spectral energy distribution, constraining the low state of this extreme HBL. Additionally, in 2021 VERITAS detected a significantly elevated state of H 1426+428 compared to the 2008-2016 data sets and conducted an intensive observation program. During this period, no cutoff is detected in the observed TeV energy spectrum up to at least 6 TeV. The results of this period are presented along with contemporaneous Swift XRT and NuSTAR observations.

Authors: O'BRIEN, Stephan (McGill); HORAN, Deirdre (Laboratoire Leprince-Ringue,Ecole polytechnique); LIEN, Amy (University of Tampa); LUSEN, Piatra (University of California, Santa Cruz); SADUN, Alberto (University of Colorado Denver)

Presenter: O'BRIEN, Stephan (McGill)

Session Classification: Contributed posters

Contribution ID: **478** Type: **Contributed e-poster**

Possible 1000 TeV gamma-ray modeling of 1ES1741+196

1ES1741+196 is one of the luminous sources that have been observed in the multi-wavelengths with the archived highest energy events observed by Magic at 80 GeV to 3 TeV within the time period 10 April 2010 until 26 May 2011. Meanwhile, the Tibet AS+MD array has observed diffuse gamma rays with energy 338 TeV-1000 TeV. These are the highest energy gamma rays that have been observed to date. We have searched for a spatial correlation between the gamma-ray events above |b|>20 degrees with the TeVCat extragalactic sources. The search resulted in one event being correlated with the source 1ES1741+196 within 4 degrees. Hence here we present the lepto-hadronic modelling of the source for the highest energy gamma rays.

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Presenter: ., Sunanda (Indian Institute of Technology Jodhpur, Rajasthan India)

Session Classification: Contributed posters

Contribution ID: **479** Type: **Contributed talk**

Gammapy - an open source package for high energy astrophysics

Thursday, July 7, 2022 5:45 PM (15 minutes)

Gammapy, an open source python package selected as the CTA Science tools, is a community-developed, open source Python package built on Numpy, Scipy and Astropy using open FITS based data formats. It is used for the analysis of gamma-ray data of many instruments including Imaging Atmospheric Cherenkov Telescopes (IACT; eg: CTA, H.E.S.S. and MAGIC), Water Cherenkov Detectors (WCD; eg: HAWC), as well as space based observatories (eg: Fermi-LAT).

Starting from event list and instrument response functions at the so called "Data Level 3", gammapy provides pipelines for reduction of the input data to binned WCS, HEALPix or region based data structures. A variety of background reduction methods, including traditional techniques like the Reflected and Ring regions, as well as novel 3D Field of View Likelihood techniques, are supported. Counts, background and IRFs data are bundled in datasets ("Data Level 3") and can be serialised, rebinned and stacked.

Modelling of datasets are supported using Poisson maximum likelihood fitting. While a variety of in-built spectral, temporal and spatial models are supplied, it also supports custom user defined models, eg: energy dependent morphology for galactic accelerators or temporal models with spectroscopic variability for blazars. Moreover, it enables joint likelihood analysis between different datasets, thus providing a simple platform for handling time dependent instrument response, different classes of events, or performing a combined multi-instrument analysis. Gammapy also implements methods to estimate flux points, including likelihood profiles per energy bin, light curves as well as flux and signficance maps in energy bins

Gammapy is heavily in development, and new features are added every few months. This contribution will present and overview of the package, describing the development history and future plans towards a stable release, and also demonstrate some key analysis features using H.E.S.S, Fermi-LAT and simulated CTA data.

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Presenter: SINHA, Atreyee (UCM, Madrid)

Session Classification: Contributed Talks

Contribution ID: **480** Type: **Contributed e-poster**

Low-Energy Cosmic-Ray distribution in the Galactic Centre Region : A study of the Sagittarius B2 molecular cloud

The Centre of the Milky Way galaxy (GCR), approximately 8 kpc from the Earth, is a peculiar region due to its high density of stars, the resulting amount of stellar activity, and the existence of a Supermassive Black Hole among other reasons. The acceleration and transport of Cosmic rays (CR) in such a region is naturally a subject of high interest.

Gamma-ray observations and H3+ column density measurements are indirect ways of estimating the CR density in a faraway region. The latter, in particular, is related to the CR ionization rate, and hence to the distribution of Low-energy Cosmic rays (LECR). Most recent observations suggest that the ionization rate in the GCR is about 1000 times larger than the Spitzer value observed locally. Can we conclude that the LECR population is 1000 times larger as well? An estimation of the LECR population in the GCR can help answer this question.

A significant sample of this region that we focus on here, is the Sagittarius B2 molecular cloud (MC). It is the densest and most massive MC in the Galaxy and it is located approximately 120 pc from Sgr A*. We intend to constrain the LECR population in this MC using H3+ measurements, X-ray observations of Fe K Alpha line emissions, and Gamma rays from Synchrotron radiation and Non-thermal bremsstrahlung radiation.

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Presenter: Ms RAVIKULARAMAN, Sruthiranjani (APC, Paris)

Session Classification: Contributed posters

Contribution ID: **481** Type: **Contributed talk**

Origin of the very high energy gamma-ray emission from the Crab nebula

LHAASO has detected gamma-ray emission from the Crab Nebula up to PeV energies. We show here that our recent model for electron acceleration at pulsar wind termination shocks can fit well both the inverse Compton and the synchrotron emission from the Nebula. Integrating individual particle trajectories in a model of the magnetic field and flow pattern near the shock, we find that drift motion on the shock surface maintains either electrons or positrons on Speiser orbits in a ring-shaped region close to the equatorial plane of the pulsar, where they are accelerated up to multi-PeV energies by the first-order Fermi mechanism. We calculate the inverse Compton emission from these electrons, and demonstrate that the observed > TeV gamma-ray emission from the Crab Nebula can be well reproduced for reasonable parameters of the Crab pulsar wind and turbulence levels in the nebula. Comparing to the LHAASO observations of the Crab Nebula, we can place novel constraints on parameters of the Crab pulsar wind that are still poorly known.

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Presenter: GIACINTI, Gwenael (MPIK Heidelberg)

Session Classification: Contributed Talks

Contribution ID: **482** Type: **Contributed e-poster**

Classification of GRBs using Machine learning techniques

GRBs (gamma-ray burst) events are one of the highest energy explosions in distant galaxies. Classically GRBs are classified into two classes on the basis of their time duration T(90). Here we have tried to check for the classification of GRBs using Machine Learning algorithms. Specifically, we will study the classification for GRB parameters like T90, T50, and other flux model parameters.

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Presenter: KUMAR, MANISH (INDIAN INSTITUTE OF TECHNOLOGY JODHPUR)

Session Classification: Contributed posters

Contribution ID: **483** Type: **Contributed e-poster**

Inverse Compton emission from relativistic particles accelerated at shear layers in relativistic jets

Both observational evidence as well as theoretical considerations from MHD simulations of jets suggest that the relativistic jets of active galactic nuclei (AGN) are radially stratified, with a fast inner spine surrounded by a slower-moving outer sheath. The resulting relativistic shear layers are a prime candidate for the site of relativistic particle acceleration in the jets of AGN and gamma ray bursts (GRBs). In this talk, we will present results of particle-in-cell simulations of magnetic-field generation and particle acceleration in the relativistic shear boundary layers (SBLs) of jets in AGN and GRBs including the self-consistent calculation of the radiation spectrum produced by inverse Compton scattering of relativistic electrons in an external soft photon field.

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Presenter: Mr CHAND, Tej Bahadur (Centre for Space Research, North-West University Potchefstroom 2520, South Africa)

Session Classification: Contributed posters

Contribution ID: **484** Type: **Contributed talk**

On the role of galactic wind termination shocks in accelerating cosmic rays

Wednesday, July 6, 2022 6:15 PM (15 minutes)

The origin of cosmic rays above the \textit{knee} at PeV energies is an unsolved problem. We examine whether the re-acceleration of Galactic cosmic rays at the termination shock developed by the Galactic wind can contribute to the observed spectrum beyond the knee. In particular, in the context of a cosmic-ray-driven galactic wind we study the transport of cosmic rays up to the Galactic wind termination shock, where the re-acceleration occurs through diffusive shock acceleration. We find that the re-accelerated particles can achieve rigidities up to several tens of PV/c and can propagate back to the Galactic disk, potentially contributing to the measured spectrum. We show that the re-accelerated component can contribute to $\sim 10\%$ of the observed all-particle spectrum under standard parametric assumption and up to $\sim$ 40–50\% when optimistic configurations are considered. We finally compute the escaping flux of re-accelerated particles seeding the intergalactic medium with protons of energies up to $\sim$ 100 PeV, and heavier nuclei with energies up to $\sim$ 1 EeV. Finally we explore the associated multimessenger flux in terms of gamma rays and neutrinos resulting from the hadronic interactions of re-accelerated cosmic rays in the whole Galactic wind volume.

Authors: MUKHOPADHYAY, Payel (Stanford University); Prof. BLANDFORD, Roger (Stanford University); Dr PERETTI, Enrico (NBI, Copenhagen); Dr GLOBUS, Noemie (UC Santa Cruz); Dr PAUL, Simeon

Presenter: MUKHOPADHYAY, Payel (Stanford University)

Session Classification: Contributed Talks

Contribution ID: **485** Type: **Contributed e-poster**

Particle acceleration via magnetic reconnection in large scale jet simulations

The energy content and dissipation mechanisms leading to the observed spectra and variability properties in AGN jets are still debated. Magnetic reconnection (MR) is the most promising dissipation mechanism to account for acceleration of particles with a non-thermal energy distribution in magnetized jets. Kinetic simulations have shown how the resulting particle distribution depends on the surrounding plasma conditions. In this talk, a first step towards the implementation of MR in relativistic magnetohydrodynamic simulations on more realistic physical scales will be presented. The developed algorithm is able to identify reconnection sites and determine the local plasma parameters. I will concentrate on the results of a set of 2D and 3D simulations and discuss the implications on the predicted particle spectra for leptons and ions, which are continuously updated during the evolution. Finally I will present the planned developments of this work to study, for the first time, the spectral and variability properties of the radiative emission of AGN jets in large scale simulations.

Author: NURISSO, Matteo (SISSA)

Presenter: NURISSO, Matteo (SISSA)

Session Classification: Contributed posters

Contribution ID: **486** Type: **Contributed talk**

Multiple shock acceleration in AGN jets

Monday, July 4, 2022 3:15 PM (15 minutes)

Radiogalaxies are the subclass of active galactic nuclei where large-scale relativistic jets are detected. In this work we study the acceleration of particles in a multiple shock scenario produced by the collision of the relativistic jets with embedded massive stars. We solve the transport equation taking into account not only the spatial and radiative losses but also the collective effect of the shocks and the possible reacceleration, and evaluate the maximum energies that the particles can achieve. Finally, we compute the gamma-ray emission expected in this scenario and discuss the detection possibilities.

Authors: MÜLLER, Ana Laura (ELI Beamlines, Institute of Physics, Czech Academy of Sciences); Dr ARAUDO, Anabella (Montpellier Universe and Particles Laboratory, CNRS, and Institute of Physics, Czech Academy of Sciences)

Presenter: MÜLLER, Ana Laura (ELI Beamlines, Institute of Physics, Czech Academy of Sciences)

Session Classification: Contributed Talks

Contribution ID: **487** Type: **Contributed e-poster**

CORSIKA simulation for massive quarks in hadronic showers

We simulated hadronic showers at PeV-EeV energy with CORSIKA to study the massive quark production and decay modes. In this regard, we specifically studied charm meson production and their decay channels with SYBILL and QGSJet models. This understanding would possibly help implement bottom quark production and their decay in these models. The massive quark decays contribute to the atmospheric high-energy gamma-rays and neutrinos. Hence, this study would be essential to significantly observe high-energy gamma rays and neutrinos fluxes from astrophysical objects.

Author: PANT, Bhanu (Indian Institute of Technology Jodhpur)

Co-authors: PRADHAN, Anil Kumar (Indian Institute of Technology Jodhpur); Dr MOHARANA, Reetanjali (Indian Institute of Technology Jodhpur, India)

Presenter: PANT, Bhanu (Indian Institute of Technology Jodhpur)

Session Classification: Contributed posters

Contribution ID: **488** Type: **Contributed talk**

Perspectives of observing prompt very-high-energy gamma emission from binary neutron star mergers

Monday, July 4, 2022 6:00 PM (15 minutes)

The prompt emission in Gamma-ray bursts is usually observed 10 keV-10 MeV range. However, to date, at higher energies, it has not been detected yet. Although the current generation very-high-energy (VHE; E > 30 GeV) gamma-ray detectors (MAGIC and H.E.S.S.) have successfully demonstrated the capability of detection of the afterglow of GRB, the prompt phase of detection has remained unexplored. Here, we investigate the perspectives of multi-messenger observations to detect the prompt emission of short GRBs at very-high-energies. Considering binary neutron star merger as progenitor of short GRBs, we evaluate the joint detection efficiency of the Cherenkov Telescope Array observing in synergy with the third generation of gravitational wave detectors, such as the Einstein Telescope and Cosmic Explorer. We evaluate taking the expected capabilities to detect and localize gravitational wave events in the inspiral phase and to provide an early warning alert able to drive the VHE detection. We demonstrate that the sensitivities of CTA make it possible the detection of the VHE emission even if it is several orders fainter than the one observed at 10 keV–10 MeV. We discuss the results in terms of possible scenarios of prompt VHE counterparts of binary neutron star mergers, such as the synchrotron self Compton components in the leptonic GRB model, high energy tail of the hadronic GRB model, and external Inverse Compton emission.

Authors: BANERJEE, Biswajit (Gran Sasso Science Institute, Viale F. Crispi 7, I-67100, LAquila (AQ), Italy); OGANESYAN, Gor (Gran Sasso Science Institute); Dr BRANCHESI, Marica; Mr RONCHINI, Samuele (GSSI); Dr GONCHAROV, Boris (GSSI)

Presenter: BANERJEE, Biswajit (Gran Sasso Science Institute, Viale F. Crispi 7, I-67100, LAquila (AQ), Italy)

Session Classification: Contributed Talks

Contribution ID: **489** Type: **Contributed e-poster**

Modelling the large scale morphology of AGN jets using fluid-particle hybrid simulations

Radio loud Active galactic nuclei (AGN) emit synchrotron emission over a wide region of the electromagnetic spectrum. In these types of AGN the synchrotron emission is predominantly produced by non-thermal electrons in a relativistic jet. In order to study how the observed large scale radio morphology of these jets relates to the jet's their physical properties, fluid dynamic simulations can be employed. In this contribution we present 3D RMHD simulations of relativistic jet environments created using the PLUTO code. The jet model consists of a kinetically dominated jet with a helical magnetic field, injected into a stratified background medium. To model the sychrotron emission that would be produced by these simulated environments we implemented the particle hybrid module in PLUTO. This module allows for the injection of Lagrangian particles that are representative of non-thermal electrons. The Lagrangian particles are injected with a pre-determined power law distribution and then evolved with time. By making use of this module we can calculate the simulated synchrotron-self absorption spectrum and integrate it along a line of sight to produce intensity maps for the simulated environment. The calculated intensity maps take into account relativistic and geometric effects. We present the simulated intensity maps at different frequencies from radio up to optical. In addition to this the effects of viewing angle with respect to the axis of the jet is presented.

Author: VAN DER WESTHUIZEN, Izak (University of the Free State)

Co-authors: Dr VAN SOELEN, Brian (University of the Free State); Dr VAIDYA, Bhargav (IIT Indore)

Presenter: VAN DER WESTHUIZEN, Izak (University of the Free State)

Session Classification: Contributed posters

Contribution ID: **490** Type: **Contributed e-poster**

Pursuing the Origin of the Gamma Rays in RX J1713.7-3946 Quantifying the Hadronic and Leptonic Components

We analyzed the TeV gamma-ray image of a supernova remnant RX J1713.7-3946 (RX J1713) through a comparison with the interstellar medium (ISM) and nonthermal X-rays. The gamma-ray data sets at two energy bands of >2 TeV and >250-300 GeV were obtained with H.E.S.S. and utilized in the analysis. We employed a new methodology, which assumes that the gamma-ray counts can be expressed as a linear combination of two terms: one is proportional to the ISM column density and the other proportional to the X-ray count. We then assume that these represent the hadronic and leptonic components, respectively. By fitting the expression to the data pixels, we find that the gamma-ray counts are well represented by a flat plane in the 3D space formed by the gamma-ray counts, the ISM column density, and the X-ray counts. The results using the latest H.E.S.S. data at $4.8'$ resolution show that the hadronic and leptonic components constitute (67 ± 8)% and (33 ± 8)% of the total gamma rays, respectively, where the two components have been quantified for the first time. The hadronic component is greater than the leptonic component, which reflects the massive ISM of $\sim 10^4\ M_\odot$ associated with the remnant, lending support for the acceleration of cosmic-ray protons. There is a marginal hint that the gamma rays are suppressed at high gamma-ray counts, which may be ascribed to second-order effects including the shock-cloud interaction and the effect of penetration depth.

Authors: Prof. FUKUI, Yasuo (Nagoya University); Dr SANO, Hidetoshi (Gifu University)

Co-authors: Dr YAMANE, Yumiko (Nagoya University); Dr HAYAKAWA, Takahiro (Nagoya University); Prof. INOUE, Tsuyoshi (Konan University); Prof. TACHIHARA, Kengo (Nagoya University); Prof. ROWELL, Gavin (The University of Adelaide); Dr EINECKE, Sabrina (The University of Adelaide)

Presenter: Prof. FUKUI, Yasuo (Nagoya University)

Session Classification: Contributed posters

Contribution ID: **491** Type: **Contributed talk**

Origin of pulsar radio emission

Tuesday, July 5, 2022 5:15 PM (15 minutes)

For more than five decades, the origin of pulsar coherent radio emission has been one of the major unsolved problems in astrophysics. In this talk, I describe the results of our first-principles simulations of electron-positron pairs creation near magnetic poles of neutron stars - the process responsible for filling pulsar magnetosphere with dense pair plasma - which provide a clue to this long-standing mystery. We directly demonstrate that the intermittency of the pair creation process and its naturally-arising non-uniformity across magnetic field lines lead to the emission of strong coherent electromagnetic waves with properties commensurate with that of the observed pulsar radio emission. These waves are only moderately damped by dense plasma and should escape the magnetosphere and be observable as coherent radio emission. Our findings will lay the theoretical foundation for the interpretation of a plethora of observational phenomena seen in radio pulsars, magnetars, and possibly FRBs.

Author: TIMOKHIN, Andrey (University of Zielona Gora)

Co-authors: PHILIPPOV, Alexander (Flatiron Institute, USA); TOLMAN, Elizabeth (Institute for Advanced Study, USA)

Presenter: TIMOKHIN, Andrey (University of Zielona Gora)

Session Classification: Contributed Talks

Contribution ID: **493** Type: **Contributed talk**

Cosmology, fundamental physics and Multi-Messenger Astrophysics with Gamma-Ray Bursts

Thursday, July 7, 2022 4:15 PM (15 minutes)

Gamma-Ray Bursts constitute one of the most fascinating and relevant phenomena in modern science, with strong implications for several fields of astrophysics, cosmology and fundamental physics. Indeed, the huge luminosity, the redshift distribution extending at least up to z~10 and the association with the explosive death of very massive stars make long GRBs (i.e., those lasting up to a few minutes) potentially extremely powerful probes for investigating the early Universe (pop-III stars, cosmic re-ionization, SFR and metallicity evolution up to the "cosmic dawn") and measuring cosmological parameters. The combination of extreme distances, the huge number of photons emitted over about three orders of magnitude in photon energy and the variability down to few ms makes these phenomena also a uniquely powerful and promising tool for performing tests of fundamental physics like Lorentz Invariance Violation (LIV) with unprecedented accuracy. At the same time, as demonstrated by the GW170817 event, short GRBs (lasting no more than a few s) are the most prominent electromagnetic counterpart of gravitational-wave sources like NS-NS and NS-BH merging events, and both long and short GRBs are expected to be associated with neutrino emission. My review will include the status, concepts and expected performances of space mission projects (e.g, THESEUS, Gamow Explorer) aiming at fully exploiting these unique potentialities of the GRB phenomenon, thus providing an ideal synergy with the large e.m. facilities of the future like LSST, ELT, TMT, SKA, CTA, ATHENA in the e.m. domain, advanced second generation (2G++) and third generation (3G) GW detectors and future large neutrino detectors (e.g., Km3NET).

Author: AMATI, Lorenzo (INAF - OAS Bologna)

Presenter: AMATI, Lorenzo (INAF - OAS Bologna)

Session Classification: Contributed Talks

Contribution ID: **494** Type: **Review, Highlight, or Invited talk**

Nova explosions

Wednesday, July 6, 2022 11:55 AM (25 minutes)

Classical and recurrent nova explosions occur on top of white dwarfs accreting H-rich matter from a companion main sequence or red giant star, in a close binary system. In the recent years, since the launch of the Fermi Gamma-Ray satellite by NASA in 2008, several novae have been detected by Fermi/LAT (LAT: Large Area Telescope) in High-Energy Gamma Rays, with energies larger than 100 MeV. This emission is known to be related to the acceleration of particles in the internal and/or external shocks occurring early after the thermonuclear nova explosion. However, Very High Energy Gamma-Rays produced as a consequence of nova explosions have only being discovered very recently, in the recurrent nova RS Oph, that had an outburst in August 2021. These require the acceleration of protons, and not only of electrons; this was in fact predicted theoretically - based in observations at other wavelengths - in the previous eruption of RS Oph, in 2006, but has not been confirmed observationally until now.

I will review the origin of the different types of gamma-ray emission in novae and highlight the relevance of the recent VHE gamma-rays discoveries for the nova theory, mainly in the field of the mass ejection and the associated particle (electrons and protons) acceleration processes.

Author: HERNANZ, Margarita (Instituto de Ciencias del Espacio (CSIC) & IEEC)

Presenter: HERNANZ, Margarita (Instituto de Ciencias del Espacio (CSIC) & IEEC)

Session Classification: Highlight Talks topical

Contribution ID: **495** Type: **Contributed talk**

GRB prompt emission from the synchrotron radiation of relativistic electrons in a decaying magnetic field

Monday, July 4, 2022 6:15 PM (15 minutes)

The parameters of observed prompt gamma-ray burst spectra provide the key constraint for the proposed emission models. The low energy slope of the photon spectrum depends on the involved emission process, and observations show that it is often not consistent with the simple assumptions of the synchrotron model. We studied the effect of the synchrotron cooling of relativistic electrons in a decaying magnetic field on the spectrum. The numerical simulations of the emitted spectrum in the comoving frame performed for a large parameter space will be presented, and the derived low energy spectral slopes will be discussed.

Author: BOŠNJAK, Željka (University of Zagreb)

Co-author: Prof. DAIGNE, Frédéric (Institut d'Astrophysique de Paris - Sorbonne Université)

Presenter: BOŠNJAK, Željka (University of Zagreb)

Session Classification: Contributed Talks

Contribution ID: **496** Type: **Contributed e-poster**

TeV emission from unstable cosmic-ray nuclei in Centaurus A

Centaurus (Cen) A is the closest active galaxy, and evidence suggests it may be a local source of ultra-high-energy cosmic rays. The spectrum of Cen A from radio up to the GeV regime is well explained by electrons accelerated in the jet core. However, recent observations by the H.E.S.S. telescopes have revealed TeV gamma-ray emission from a region extending over a kiloparsec down the jet, suggesting a different emission mechanism. In this talk I will discuss the scenario where cosmic-ray nuclei heavier than protons are co-accelerated in the core of the Cen A jet. Using a novel numerical model, we simulate all nuclear and electromagnetic interactions, including photon emission from electromagnetic cascades and nuclear decay. I will show that some unstable cosmic-ray isotopes will escape the core region, subsequently decay further down the jet, and thus emit a TeV signal consistent with H.E.S.S. observations.

Author: MOREJON, Leonel (BUW)

Presenter: MOREJON, Leonel (BUW)

Session Classification: Contributed posters

Contribution ID: **497** Type: **Review, Highlight, or Invited talk**

Highlights from HAWC

Tuesday, July 5, 2022 12:45 PM (25 minutes)

The High Altitude Water Cherenkov (HAWC) Gamma-ray Observatory in the high mountains of Mexico is giving us a new view of the TeV sky. HAWC operates 24hrs/day with over a 95% on-time and observes the entire overhead sky (~8sr over the course of the day). HAWC has accumulated more seven years of data and has recently completed our "Pass 5"re-analysis giving us significant improvements in our low energy response, angular resolution, background rejection and an expanded field of view. This talk will present an overview of these recent HAWC results showing our updated sky catalog, our view of the highest energy gamma-ray sky (including sources above 50 and 100 TeV), long-term monitoring of nearby AGN and recent observations of galactic Pevatrons. In addition, we will present recent limits on primordial black holes, Lorentz invariance violation and multi-messenger observations, as well as comparisons of HAWC and IACT measurements.

Author: GOODMAN, Jordan (University of Maryland)

Presenter: GOODMAN, Jordan (University of Maryland)

Session Classification: Highlight Talks observational

Contribution ID: **498** Type: **Review, Highlight, or Invited talk**

Theory of Gamma-Ray loud AGN

Monday, July 4, 2022 9:30 AM (45 minutes)

The last decade has seen tremendous developments in gamma-ray astronomy with the extragalactic sky becoming highly populated by AGN.
I will highlight some of the progress in AGN research achieved over the years, and then discuss exemplary advances in the theory of gamma-ray loud AGN, including black-hole magnetospheric processes, the physics of pc-scales jets, as well as particle acceleration and high-energy emission in the large-scale jets of AGN.

Author: RIEGER, Frank (ITP Univ Heidelberg & MPIK)

Presenter: RIEGER, Frank (ITP Univ Heidelberg & MPIK)

Session Classification: Review Talks

Contribution ID: **499** Type: **Review, Highlight, or Invited talk**

Relativistic Reconnection

Thursday, July 7, 2022 12:20 PM (25 minutes)

In the most powerful astrophysical sources, reconnection and turbulence operate in the "relativistic"regime, where the magnetic field energy exceeds even the rest mass energy of the plasma. Here, reconnection and turbulence can lead to fast dissipation rates and efficient particle acceleration, thus being prime candidates for powering the observed fast and bright flares of high-energy non-thermal emission. With fully-kinetic particle-in-cell (PIC) simulations and analytical theory, we investigate the physics of relativistic reconnection and turbulence, and demonstrate that they can be the "engines"behind: (1) high-energy flares in blazar jets; and (2) the hard-state spectra of black hole X-ray binaries and Active Galactic Nuclei.

Author: SIRONI, Lorenzo (Columbia University)

Presenter: SIRONI, Lorenzo (Columbia University)

Session Classification: Highlight Talks topical

Contribution ID: **500** Type: **Contributed e-poster**

Pre-acceleration in the Electron Foreshock by Electron Acoustic Waves

To undergo diffusive shock acceleration, electrons need to be pre-accelerated to increase their energies by several orders of magnitude, else their gyro-radii are smaller than the finite width of the shock. In oblique shocks, where the upstream magnetic field orientation is neither parallel or perpendicular to the shock normal, electrons can escape to the shock upstream, modifying the shock foot to a region called the electron foreshock. To determine the pre-acceleration in this region, we undertake PIC simulations of oblique shocks while varying the obliquity and in-plane angles. We show that while the proportion of reflected electrons is negligible for $\theta_{\mathrm{Bn}} = 74.3°$, it increases to $R \sim 5\%$ for $\theta_{\mathrm{Bn}} = 30°$, and that, via the electron acoustic instability, these electrons power electrostatic waves upstream with energy density proportional to $R^{0.6}$ and a wavelength $\approx 2\lambda_{\mathrm{se}}$, where λ_{se} is the electron skin length. While the initial reflection mechanism is typically a combination of shock surfing acceleration and magnetic mirroring, we show that once the electrostatic waves have been generated upstream they themselves can increase the momenta of upstream electrons parallel to the magnetic field. In $< 1\%$ of cases, upstream electrons are prematurely turned away from the shock and never injected downstream. In contrast, a similar fraction are re-scattered back towards the shock after reflection, re-interact with the shock with energies much greater than thermal, and cross into the downstream.

Authors: MORRIS, Paul (DESY); Dr BOHDAN, Artem (Deutsches Elektronen-Synchrotron DESY); Dr WEIDL, Martin (Max-Planck-Institut für Plasmaphysik, Garching); POHL, Martin (Uni Potsdam / DESY)

Presenter: MORRIS, Paul (DESY)

Session Classification: Contributed posters

Contribution ID: **502** Type: **Review, Highlight, or Invited talk**

The Latest Discoveries in High Energy Neutrino Astrophysics

Thursday, July 7, 2022 10:40 AM (25 minutes)

Current knowledge of the Universe is based on information carried by electromagnetic radiation, gravitational waves, neutrinos, and cosmic rays. For over a century, scientists have observed cosmic rays, but the understanding of their place of production is limited. As a product of cosmic ray interaction, neutrinos can shed light on the extreme part of the Universe. IceCube Neutrino Observatory has been leading neutrino astronomy research over the last ten years and is the only observatory with the exposure to detect high-energy neutrinos beyond Earth's atmosphere. This presentation will highlight the IceCube observations, including new recent results. Despite the exiting times, with IceCube operating alone and limited by the South Pole location and cubic-km scale, the neutrino astronomy efforts have yet to advance the field past infancy. It is clear that more observatories and larger telescopes, ultimately linked via a global network, are needed to advance fundamental discoveries in astro and particle physics. In this direction, a new opportunity has emerged over the last years to construct a new large volume neutrino telescope, the Pacific Ocean Neutrino Experiment (P-ONE), which will be based for the first time, within an existing oceanographic infrastructure. I will summarize how we have established a scientific relationship with Ocean Networks Canada to pioneer their global network as a testbed infrastructure and identified the optimal location and prepared the ground for the first case deployment.

Author: RESCONI, Elisa (Technical University of Munich)

Presenter: RESCONI, Elisa (Technical University of Munich)

Session Classification: Highlight Talks topical

Contribution ID: **503** Type: **Review, Highlight, or Invited talk**

Dark Matter Searches with Gamma Rays and Cosmic Rays

Tuesday, July 5, 2022 10:15 AM (45 minutes)

The existence of dark matter - the dominant, non-baryonic, neutral and cold matter component of our Universe - is inferred from its gravitational effects at galactic and cosmological scales, as well as from the power spectrum of the temperature anisotropies of the cosmic microwave background. Several theoretically plausible dark matter candidates, such as WIMPs, axions or primordial black holes, would produce distinct spectral and/or morphological signatures in the measured fluxes of different cosmic ray species. Thus, identification of such signatures (a procedure known as "indirect" dark matter detection) could help pinpoint the nature of dark matter. In this talk, I will review several of the existing experimental methods aimed at indirect detection of dark matter signatures, as well as the latest results in the field.

Author: RICO, Javier (IFAE-BIST)

Presenter: RICO, Javier (IFAE-BIST)

Session Classification: Review Talks

Contribution ID: **504** Type: **Review, Highlight, or Invited talk**

Recent Results in Supernova Remnants at Highest Energies

Thursday, July 7, 2022 11:55 AM (25 minutes)

Supernova remnants (SNRs) are now established as cosmic particle accelerators through observations of non-thermal emissions from radio to gamma-ray domain in the past decades. In the context of Galactic cosmic-ray origin, one of the key questions was if they are proton accelerators. At least for some SNRs, gamma-ray emissions are solidly attributed to decay of neutral pions, providing long-awaited evidence for proton acceleration. The next and current burning question is if SNRs are accelerators up to the knee at ~ PeV. I will review recent gamma-ray results with particular emphasis on this topic. Information from other wavelengths is essential for this topic as well. X-rays work as probes for electrons accelerated up to very high energies. Synchrotron X-ray variability, if attributed to amplified magnetic fields, gives important information in discussing maximum attainable energies of particles accelerated in SNRs. Interstellar gas clouds observed with radio line emissions not only serve as targets for accelerated protons to produce neutral pions, but also amplify magnetic fields through shock-cloud interactions. I will also review recent X-ray and radio observational results related to particle acceleration in SNRs.

Author: TANAKA, Takaaki (Konan University)

Presenter: TANAKA, Takaaki (Konan University)

Session Classification: Highlight Talks topical

Contribution ID: **505** Type: **Review, Highlight, or Invited talk**

Particle acceleration and gamma-ray emission from starburst galaxies

Tuesday, July 5, 2022 11:30 AM (25 minutes)

The intense star-forming activity typical of starburst galaxies results in unique conditions for high-energy particles. The enhanced supernova rate associated with such star formation can in fact transfer a large amount of power to non-thermal particles which, in turn, can lose most of their energy in the dense and perturbed starburst environment before being able to escape it.
I will discuss the transport conditions in starburst galaxies and their multimessenger implications in terms of gamma rays and high-energy neutrinos.
The starburst activity can also launch and sustain powerful galactic wind bubbles extending for several kiloparsecs. I will illustrate how particles can be accelerated up to hundreds of PeV at shocks produced in such winds and I will highlight the associated high-energy radiation.
Finally, by taking into account the star formation history of the Universe, I will assess the potential contribution of starburst galaxies to the observed diffuse flux of gamma rays, high-energy neutrinos and cosmic rays at energies beyond the Knee.

Author: PERETTI, Enrico (Niels Bohr Institute)

Presenter: PERETTI, Enrico (Niels Bohr Institute)

Session Classification: Highlight Talks topical

Contribution ID: **506** Type: **Review, Highlight, or Invited talk**

Galactic Cosmic Rays

Wednesday, July 6, 2022 9:30 AM (45 minutes)

Significant advances have been made in cosmic-ray measurements in recent years, particularly with successful space missions and long-duration balloon flights over Antarctica. The high precision data from these missions over a wide energy range led to surprising discoveries, such as an excess of positrons at high energies and hardening of the elemental spectra. These unexpected spectral features present significant challenges for Galactic cosmic-ray models on their origin, propagation, and acceleration. Recent results and their implications will be presented, and the outlook will be discussed.

Author: SEO, Eun-Suk (University of Maryland)

Presenter: SEO, Eun-Suk (University of Maryland)

Session Classification: Review Talks

Contribution ID: **507** Type: **Contributed talk**

Multiwavelength investigation of LHAASO J1908+0621: an unidentified galactic PeVatron

Tuesday, July 5, 2022 5:00 PM (15 minutes)

Recently LHAASO has detected more than a dozen of ultra-high energy (UHE) γ-ray sources in our Galaxy. Many of these seem to be connected with PWNe or SNRs (see Cao et al., 2021).
Among these sources, one of the best PeVatron candidates is LHAASO J1908+0621, a remarkable source for its hard spectrum extending beyond 100 TeV and with no evidence of a cutoff. This source was also detected by other γ-ray instruments as HAWC, VERITAS and HESS.
Due to the complexity of the morphological structure of the source and the limited angular resolution, the origin of its γ-ray emission has not yet been unambiguously identified. There are several objects in the region which could serve as counterparts to the TeV emission, including a supernova remnant (SNR G40.5-0.5) and various pulsars, precluding a firm identification of the extreme accelerator and making it difficult to distinguish between a hadronic or leptonic nature of the emission. Additionally, the LHAASO source is associated with an ICECUBE neutrino hotspot, although the significance is still too low (see Aartsen et al., 2020).

We performed a multi-wavelength analysis of LHAASO J1908+0621 to investigate its nature and the origin of its ultra high-energy emission (see Crestan
et al., 2021). Using the Nobeyama Radio Observatory data on ^{12}CO and ^{13}CO molecular line emission, we found evidence of dense molecular clouds spatially correlated with the source region. Moreover, the 12-year analysis of Fermi-LAT data stresses the presence of a counterpart with a hard spectrum between 10 GeV and 1 TeV. Our new analysis of the XMM-Newton data translates into better constraints on the X-ray flux from this source. Thanks to the multi-wavelength approach, we showed that a single zone model cannot explain the whole set of multi-wavelength data, regardless of whether it accelerates protons or electrons, but a 2-component model is needed to explain the emission from LHAASO J1908+0621. The UHE emission appears most likely the superposition of a TeV PWN powered by PSR J1907+0602, in the southern part, and of the interaction between the supernova remnant G40.5-0.5 and the molecular clouds towards the northern region.

Authors: CRESTAN, silvia (INAF-IASF Milano); Dr GIULIANI, Andrea (INAF - IASF Milano); Dr MEREGHETTI, Sandro (INAF - IASF Milano); Dr SIDOLI, Lara (INAF - IASF Milano); Dr PINTORE, Fabio (IASF - INAF Milano); Dr LA PALOMBARA, Nicola (INAF - IASF Milano)

Presenters: CRESTAN, silvia (INAF-IASF Milano); Dr GIULIANI, Andrea (INAF - IASF Milano); Dr MEREGHETTI, Sandro (INAF - IASF Milano); Dr SIDOLI, Lara (INAF - IASF Milano); Dr PINTORE, Fabio (IASF - INAF Milano); Dr LA PALOMBARA, Nicola (INAF - IASF Milano)

Session Classification: Contributed Talks

Contribution ID: **508** Type: **Contributed e-poster**

Multiwavelength view of OJ 287 during 2017-2020

The blazar OJ 287 has been proposed as a binary black hole system based on its periodic optical outburst. Black hole binary systems are scarce among blazars with parsec scale jets, and hence this source is exciting to study. The BL Lac OJ 287 is an interesting object for multiwavelength study due to its periodic outbursts. We analyzed the optical, X-ray, and γ-ray data of OJ 287 for the period 2017–2020. There are several high states in optical–UV and X-ray frequencies during this period. Based on the observed variability in optical and X-ray frequencies, the entire period 2017–2020 is divided into five segments, referred as A, B, C, D, and E. A detailed temporal and spectral analysis is performed to understand the nature of the flaring activities of OJ 287. To understand the temporal variability in this source we studied the intraday and fractional variability for all the various
states. In addition, fast variability time was also estimated in order to understand the nature of variability. Furthermore, the multiwavelength spectral energy distribution (SED) modeling was performed to know more about the physical processes responsible for the simultaneous broadband emission and the fast variability. The Fermi-LAT observations show a moderate flux level of this source in γ-ray frequency throughout this period, though flux variability has been observed. The source has shown a strong flux variability in X-ray, optical, and UV during early 2017 and mid-2020 when the source was in a very high state. A single-zone synchrotron self-Compton emission model is considered to model the SED, and this helps us to explore the nature of this BL Lac with binary supermassive black holes.

Authors: AGARWAL, Aditi (Raman Research Institute); Dr PRINCE, Raj (Center for Theoretical Physics, Polish Academy of Sciences)

Presenters: AGARWAL, Aditi (Raman Research Institute); Dr PRINCE, Raj (Center for Theoretical Physics, Polish Academy of Sciences)

Session Classification: Contributed posters

Contribution ID: **509** Type: **Contributed e-poster**

A Study of Far Infrared Cavity At -3.6° Galactic Latitude

We have present properties like inclination angle, dust color temperature, and dust mass of core region in far-infrared located nearby White dwarf WD2236+541. The size of the cavity is 0.84 pc×0.51 pc. The cavity is formed by high pressure at the time of white dwarf formation. The dust color temperature varies from 22.42K to 27.43 K. The inclination angle of the cavity is 54.2°. The position of the white dwarf is found at R.A. J (2000)= 22h38m24s and Dec. J (2000)= +54°26m19s.

Author: GHALE, Yuvraj (Tribhuvan University-Tri-chandra Multiple Campus)

Presenter: GHALE, Yuvraj (Tribhuvan University-Tri-chandra Multiple Campus)

Session Classification: Contributed posters

Contribution ID: **510** Type: **Review, Highlight, or Invited talk**

Highlights from VERITAS

Tuesday, July 5, 2022 12:20 PM (25 minutes)

VERITAS is one of the world's most sensitive detectors of astrophysical VHE (E > 100 GeV) gamma rays. This array of four 12-m imaging atmospheric Cherenkov telescopes, located in southern Arizona, USA, has operated for ~15 years. VERITAS science spans Galactic topics, including pulsar wind nebulae, binary systems, and supernova remnants; extra-galactic topics, including studies of blazars and radio galaxies, searches for gamma-ray bursts and fast radio bursts; multi-messenger science; and astroparticle physics topics including searches for dark matter. VERITAS has also pioneered the use of IACTs for optical astronomy, particularly via intensity interferometry. Recent highlights from the VERITAS observing program and scientific results will be presented.

Authors: HUMENSKY, Brian (University of Maryland - College Park); FOR THE VERITAS COLLABORATION; QUINN, John (University College Dublin)

Presenter: QUINN, John (University College Dublin)

Session Classification: Highlight Talks observational

Contribution ID: **521** Type: **Contributed talk**

Non-thermal radiation from super-Eddington winds in AGNs

Tuesday, July 5, 2022 3:15 PM (15 minutes)

Accretion onto supermassive black holes can proceed in different regimes. When the accretion rate significantly exceeds the Eddington limit, the innermost part of the disk inflates as the radiation pressure becomes dominant and important mass loss in the form of a radiation-driven wind occurs. We will present the results of an investigation of the effects of these winds on clouds of the broad line region that surrounds the supermassive black hole in some Active Galactic Nuclei. Non-thermal radiation is produced by particles locally accelerated in the bow shocks formed around the clouds. The radio emission so generated can explain the detection of synchrotron radiation in non-jetted and usually radio quiet Seyfert galaxies.

Author: ROMERO, Gustavo E. (Instituto Argentino de Radioastronomía (IAR))

Co-author: SOTOMAYOR-CHECA, Pablo (Instituto Argentino de Radioastronomía (IAR), CPNICET--CIC-UNLP)

Presenter: ROMERO, Gustavo E. (Instituto Argentino de Radioastronomía (IAR))

Session Classification: Contributed Talks

Contribution ID: **528** Type: **Review, Highlight, or Invited talk**

TeV Emission from GRB Afterglows - Theory

Monday, July 4, 2022 11:55 AM (25 minutes)

GRBs'progenitors are also sources of gravitational waves. Binary neutron star mergers that are progenitors of short GRBs are the classical sources of chirping GW signals. Long GRBs arise from Collapsars. While GWs haven't been observed yet from collapsing stars, a non-spherical collapse would be a source of a burst of GWs. In addition, both long and short GRBs involve the acceleration of relativistic jets. The acceleration of these jets is an additional source of memory type gravitational waves - Jet-GWs. The characteristic frequency depends on the acceleration mechanism and the duration of the jet, while the amplitude depends on the jet's energy and its distance. Detection of Jet-GWs would reveal information on GRBs'central engines and the jet acceleration mechanic that cannot be observed otherwise. While typical GRBs are too far for detection of their Jet-GWs in the near future, detection of Jet-GWs from hidden jets taking place within regular SNe is likely with next generation detectors. Detection of a jet within a galactic SGR giant-flare would be possible even with LIGO and Virgo.

Author: Prof. PIRAN, Tsvi

Presenter: Prof. PIRAN, Tsvi

Session Classification: Highlight Talks topical

Contribution ID: **529** Type: **Contributed talk**

High-mass gamma-ray binaries as very efficient accelerators

Thursday, July 7, 2022 3:30 PM (15 minutes)

Presenter: BOSCH-RAMON, Valenti (Universitat de Barcelona/ICCUB)

Session Classification: Contributed Talks

Contribution ID: **530** Type: **not specified**

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Thursday, July 7, 2022 4:15 PM (15 minutes)

Session Classification: Contributed Talks