Exploring the quantum chromodynamics phase diagram: from hadrons and nuclei to matter under extreme conditions (HADNUCMAT)

Report of Contributions

Contribution ID: **2** Type: **Talks**

New physics searches in hadronic processes

Wednesday 28 January 2026 10:45 (35 minutes)

I will talk about signals of New Physics in Hadronic Processes

Author: GONZALEZ-SOLIS, Sergi (Universitat de Barcelona & ICCUB)

Presenter: GONZALEZ-SOLIS, Sergi (Universitat de Barcelona & ICCUB)

Contribution ID: **3** Type: **Talks**

Insights on the neutron star matter equation of state from different model perspectives

Monday 26 January 2026 10:00 (45 minutes)

The composition of the core of neutron stars is still under debate. Agnostic descriptions of the equation of state are a powerful tool to determine the allowed region in the pressure-energy density or mass-radius space defined by observations and theoretical ab-initio calculations. These methods, however, cannot really give information on the neutron star composition. Understanding the microphysics that spanns the regions determined by agnostic descritpions is, therefore, necessary. In particular, we are interested in identifying signatures of the onset of exotic degrees of freedom or quark matter. With the next generation of GW observatories it is expected that the postmerger waveforms will bring information on the equation of state.
We will consider the predictions of agnostic descritpions and discuss how they translate into the possible existence of hadronic and hybrid stars. Microscopic models are used to describe the different phases of matter, including RMF models, chiral symmetric models, and quark models, considering Bayesian inference to determine their parameters. Within these microscopic models, the properties of neutron stars and nuclear matter are calculated and the effect of different compositions of matter are discussed. Different compositions of neutron stars are compatible with current observational data. The implications of possible information on the local derivatives from the mass-radius diagram in neutron star matter are analysed. Some effects of dark matter on the neutron star properties will also be referred. It is expected that the next generation of gravitational wave and electromagnetic detectors will allow the determination of the neutron star radius and mass with a small uncertainty, which will have an important impact on the information that can be extracted about the high density equation of state of baryonic matter. The possible role of machine learning methods to recover the equation of state will be referred.

Author: PROVIDÊNCIA, Constança (University of Coimbra)

Presenter: PROVIDÊNCIA, Constança (University of Coimbra)

Contribution ID: **4** Type: **Talks**

Imaging Nuclear Ground States with High-Energy Collisions

Monday 26 January 2026 11:50 (45 minutes)

A wealth of experimental results from the BNL Relativistic Heavy Ion Collider and the CERN Large Hadron Collider indicates that the final states of high-energy nuclear collisions encode detailed information about the spatial distributions and correlations of nucleons in the ground states of the colliding nuclei. The prospect of imaging these quantum many-body states arises naturally from the unique kinematics of such reactions: ultra-fast QCD interactions effectively provide billions of snapshots of the nuclear wave function, whose long-range features leave a pronounced imprint on the subsequent hydrodynamic evolution of the quark–gluon plasma.

While these observations have traditionally been interpreted within classical frameworks based on nuclear shapes, a paradigm shift is underway. The relevant observables are being understood in terms of novel many-body operators in quantum mechanics, whose expectation values can be accessed experimentally through multi-particle correlation measurements. In this way, high-energy nuclear collisions offer a unique laboratory for probing and characterizing many-body correlations of nucleons directly in the ground state of nuclei. I will outline the progress made along these lines and how this emerging perspective may influence nuclear physics research more broadly.

Author: GIACALONE, Giuliano (CERN)

Presenter: GIACALONE, Giuliano (CERN)

Contribution ID: **5** Type: **Talks**

Precision $\beta\beta$ decay nuclear matrix elements

Tuesday 27 January 2026 15:20 (15 minutes)

The exploration of physics Beyond the Standard Model within nuclear physics is closely tied to the investigation of rare electroweak transitions. The most promising process correspond to the neutrinoless double-beta decay ($0\nu\beta\beta$) which is a transition in nuclei where two neutrons simultaneously transform into two protons, accompanied by the emission of only two electrons [1]. This second-order decay, if observed, would prove that neutrinos are Majorana particles (their own antiparticles), shed light on the existence of massive neutrinos, and help explain the predominance of matter over antimatter in the universe.
The half-lives depend on the square of the nuclear matrix elements (NMEs), which must be computed since $0\nu\beta\beta$ has not been observed yet.

In this talk, I will discuss computations of the NMEs at the next-to-next-to-leading order (N^2LO) [2] corrections within the nuclear shell model (NSM) and quasi-particle random phase approximation frameworks. These calculations aim to reduce the uncertainty surrounding the NMEs. Then, I will briefly present new predictions for two-neutrino $\beta\beta$ half-lives from 0^+ ground state to the first 0^+ excited state [3] with novel next-to-leading order (NLO) terms [4] at the NME level.

M. Agostini *et al.* Rev. Mod. Phys. **95**, 025002 (2023)

L. Jokiniemi, D. Castillo, P. Soriano, J. Menéndez, Phys. Lett. B **860**, 139181 (2025).

D. Castillo, D. Frycz, B. Benavente, J. Menéndez, arXiv:2507.21868

S. el Morabit *et al.* JHEP **06**, 082 (2025)

Authors: CASTILLO GARCIA, Daniel (University of Barcelona/ICCUB); FRYCZ, Dorian (University of Barcelona); MENÉNDEZ, Javier

Presenter: CASTILLO GARCIA, Daniel (University of Barcelona/ICCUB)

Contribution ID: **6** Type: **Talks**

The shape of the nucleus: shape invariants and connection to $2\nu\beta\beta$

Monday 26 January 2026 15:00 (35 minutes)

The complex nature of the nucleon-nucleon interaction allows for spherical, oblate and prolate deformations to appear at similar energies within the same nucleus. This phenomenon, known as shape coexistence, is widespread across the nuclear chart, and it provides a crucial role in understanding nuclear structure [1].

In our study we perform shell-model calculations [2] to infer shape coexistence from multiple electric observables such as: quadrupole moments, $E2$ transitions, and shape invariants. The combination of all these hints allows us to understand the complexities of shape coexistence and the notion of nuclear shape itself. We also compare these traditional low-energy methods with novel nuclear-imaging techniques based on heavy-ion collisions [3].

Particularly, the shape invariants provide a model-independent framework to quantify the deformation parameters and their fluctuations [4], which are significant in most nuclei. We analyze how nuclear shapes evolve across the band using an extended sum-rule method to compute the shape invariants for $J \neq 0$ states [5]. This method sheds light on long-standing questions, such as whether doubly-magic nuclei are truly spherical, whether rigid triaxial nuclei exist, and how axially symmetric prolate and oblate nuclei really are.

For instance, ^{28}Si presents a competition between the oblate ground state and the excited prolate rotational band (6.5 MeV), with a possible superdeformed structure at higher energies ($\sim$ 10-20 MeV). We find that $sdpf$ excitations are needed to correctly describe ^{28}Si and that superdeformed shapes appear at 18-20 MeV [6]. We analyze the fluctuations of the deformation parameters associated to these states.

Additionally, we study the impact of differences in shapes of the initial and final nuclei for double-beta decay, including triaxiality. We find that larger deformation differences between the initial and final states lead to smaller nuclear matrix elements [7].

[1] P. E. Garrett, M. Zielińska, and E. Clément, Prog. Part. Nucl. Phys. 124, 103931 (2022).

[2] E. Caurier and F. Nowacki, Acta Phys. Pol. B 30, 705 (1999).

[3] STAR Collaboration, Nature 635, 67 (2024).

[4] A. Poves, F. Nowacki, Y. Alhassid, Phys. Rev. C 101, 054307 (2020).

[5] D. Frycz, A. Poves, J. Menéndez, in preparation

[6] D. Frycz, J. Menéndez, A. Rios, B. Bally, T. R. Rodríguez, and A. M. Romero, Phys. Rev. C 110, 054326 (2024).

[7] D. Castillo, D. Frycz, B. Benavente, J. Menéndez, arXiv:2507.21868

Author: FRYCZ, Dorian (University of Barcelona)

Co-authors: POVES, Alfredo (Universidad Autónoma de Madrid); MENÉNDEZ, Javier; CASTILLO GARCIA, Daniel (University of Barcelona/ICCUB); RIOS HUGUET, Arnau (University of Barcelona)

Presenter: FRYCZ, Dorian (University of Barcelona)

Contribution ID: **7** Type: **Talks**

Achievements and perspectives for nuclear Density Functional Theory

Tuesday 27 January 2026 11:50 (45 minutes)

In this contribution, I will attempt to review some recent progress in DFT and discuss open perspectives, albeit with a personal bias. A confrontation with ab initio methods will be carried out. Most of the physics cases will be examples from the structure of finite nuclei but the link with nuclear matter and astrophysical applications will be highlighted as well.

Author: COLÒ, Gianluca (University of Milano and INFN)

Presenter: COLÒ, Gianluca (University of Milano and INFN)

Contribution ID: **8** Type: **Talks**

Time-Dependent Neural Quantum States: a new approach for quantum dynamics

Wednesday 28 January 2026 15:35 (35 minutes)

Neural Quantum States (NQS) leverage the parameterization of the wave function with neural-networks. In contrast to other variational methods, they are highly scalable with system size and capable of capturing complex behaviours.

Here, we present proof-of-principle time-dependent NQS simulations to illustrate the ability of this approach to effectively capture key aspects of quantum dynamics in the continuum, from the simple quantum harmonic oscillator to the Gross-Piraevskii Equation.

These results highlight the potential of NQS for studying quantum dynamics and open the way for applications in more complex many-body systems, including ultracold atoms, nuclear physics, and quantum simulation.

Author: ROMERO-ROS, Alejandro (Universitat de Barcelona)

Co-authors: RIOS HUGUET, Arnau (University of Barcelona); ROZALÉN SARMIENTO, Javi (Universitat de Barcelona)

Presenter: ROMERO-ROS, Alejandro (Universitat de Barcelona)

Contribution ID: **9** Type: **Talks**

Hyperons in neutron star mergers

Monday 26 January 2026 10:45 (35 minutes)

We study the influence of hyperons on neutron star mergers. Using a large sample of hyperonic equations of state, we make a systematic analysis of the effects triggered by the appearance of hyperons. A characteristic increase of the dominant post-merger gravitational wave frequency by a few per cent is directly linked to the appearance of thermal hyperons in matter. We also find that during the post-merger phase of the binary neutron star collision, the average temperature is lower and the maximum density of the hot medium is higher when they are present in matter. In addition, we also study the hyperonic imprints onto the ejected mass and the threshold mass before collapse. Our findings are of special interest as a venue for addressing the fundamental question of whether strangeness is present in ultra-dense and hot matter.

Authors: BAUSWEIN, Andreas; RAMOS, Angels (Universitat de Barcelona, Institut de Ciencies del Cosmos); LIOUTAS, Georgios; KOCHANKOVSKI, Hristijan (Departament de Fisica Quantica i Astrofisica and Institut de Ciencies del Cosmos, Universitat de Barcelona, Marti i Franques 1, 08028, Barcelona, Spain); TOLOS, Laura (ICE (CSIC, Barcelona))

Presenter: KOCHANKOVSKI, Hristijan (Departament de Fisica Quantica i Astrofisica and Institut de Ciencies del Cosmos, Universitat de Barcelona, Marti i Franques 1, 08028, Barcelona, Spain)

Contribution ID: **10** Type: **Talks**

Hadro- and Photo-Production of Exotic Mesons

Wednesday 28 January 2026 15:00 (20 minutes)

I will present a theoretical and experimental overview of the production of eta-pi and eta'-pi with pion beam (COMPASS) and photon beam (GlueX).
These two-meson systems are known to have odd angular waves with exotic quantum numbers.
The JPAC collaboration has been analyzing the COMPASS and GlueX data in order to extract the properties of the lightest exotic meson, the pi_1(1600). In this talk, I will review the main features and present the plan for future work.
This talk will be based on the following publications:

A.~Rodas et al. [JPAC],
"Determination of the pole position of the lightest hybrid meson candidate,"
Phys. Rev. Lett. 122 (2019) 042002

L.~Bibrzycki et al. [JPAC],
"pi^-p –> eta', pi^- p in the double-Regge region"
Eur. Phys. J. C 81 (2021), 647
[erratum: Eur. Phys. J. C 81 (2021) 915]

G.~Montaña et al.
"High-energy
photoproduction and the nature of exotic waves,"
Phys.Lett.B 872 (2026) 140101.

Authors: MONTANA, Gloria (Universitat de Barcelona & ICCUB); MATHIEU, Vincent (UB)

Presenter: MATHIEU, Vincent (UB)

Contribution ID: **11** Type: **Talks**

Recent insights into baryon Interactions with Lattice QCD

Wednesday 28 January 2026 12:35 (20 minutes)

Lattice QCD has become a powerful nonperturbative tool for exploring the low-energy strong interaction directly from the QCD Lagrangian. It now provides quantitative insights into multi-nucleon interactions, nuclear binding, hypernuclear forces, and electroweak matrix elements relevant to neutrino scattering and double beta decay. Despite challenges such as signal-to-noise degradation and computational scaling, recent advances enable increasingly precise ab initio calculations of hadronic and nuclear observables.
In this talk, I will highlight key lattice QCD results on nuclear observables, focusing on baryon-baryon interactions from the NPLQCD collaboration and comparing them with other lattice efforts.

Author: PARREÑO, Assumpta (Universitat de Barcelona)

Presenter: PARREÑO, Assumpta (Universitat de Barcelona)

Contribution ID: **12** Type: **Talks**

Learning the Ground State with Neural Quantum States

Tuesday 27 January 2026 15:35 (20 minutes)

The quantum many-body problem lies at the heart of a wide spectrum of physical phenomena, ranging from interacting quarks to molecular dynamics, yet it poses a great computational challenge that remains unsolved. Traditional approaches often face a trade-off between accuracy and tractability, due to an underlying issue commonly known as the "curse of dimensionality". In this context, the method of Neural Quantum States (NQS) [1] offers a promising way around these difficulties. The Variational Monte Carlo framework tames the exponentially growing number of states, while the use of neural network ansätze equips it with great representation power. In this talk, I will introduce the core ideas behind NQS and highlight some of their most successful applications, ranging from Quantum Chemistry [2, 3] to ab-initio Nuclear Structure [4-6]. I will also discuss current challenges in the field and outline major research directions shaping the development of NQS methods.

[1] G. Carleo and M. Troyer, Science 355 602-606 (2017)
[2] D. Pfau, J. Spencer et al., Phys. Rev. Research 2, 033429 (2020)
[3] D. Pfau, S. Axelrod et al., Science 385 (2024)
[4] J. Keeble and A. Rios, Phys. Lett. B 135743 (2020)
[5] A. Gnech, B. Fore et al., Phys. Rev. Lett.133, 142501 (2024)
[6] M. Rigo, B. Hall et al., Phys. Rev. E 107, 025310 (2023)

Authors: RIOS HUGUET, Arnau (University of Barcelona); Dr KEEBLE, James (University of Bielefeld); ROZALÉN SARMIENTO, Javi (Universitat de Barcelona); Dr DRISSI, Mehdi (TU Darmstadt)

Presenter: ROZALÉN SARMIENTO, Javi (Universitat de Barcelona)

Contribution ID: **13** Type: **Talks**

A variational approach to quantum field theory

Wednesday 28 January 2026 12:55 (15 minutes)

In strongly coupled field theories, perturbation theory cannot be employed to study the low-energy spectrum. Thus, non-perturbative techniques are required. One possibility is the Lagrangian approach, where energies are extracted from the Euclidean-time dependence of correlation functions. This method suffers from excited-state contamination at shorter times and rapidly growing statistical noise at larger times, leaving only a narrow time window to extract the energy of the system. An alternative is the variational approach in the Hamiltonian formalism, which does not present such signal-to-noise problem. However, it recquires the choice of a trial wave function. In this work, we study the viability of employing a neural network as a variational ansatz. As a first step towards more phenomenologically interesting strongly coupled theories, like quantum chromodynamics, we study scalar field theories with quartic couplings.

Author: ROVIRA I PONS, Martí

Co-authors: PARREÑO, Assumpta (Universitat de Barcelona); Dr PERRY, Robert (University of Barcelona)

Presenter: ROVIRA I PONS, Martí

Contribution ID: **14** Type: **Talks**

Relativistic heavy-ion collisions: from the initial to the final state

Monday 26 January 2026 15:35 (20 minutes)

I will introduce the stages of relativistic heavy-ion collisions, with particular emphasis on the initial state and the characterization of the final hadronic outcome.
For the initial state, I will connect to the HADNUCMAT project, which studies nuclear deformation and its relevance in heavy-ion physics.
Concerning the final state, I will emphasize the application of femtoscopy correlation functions of final-state hadrons produced in proton-proton and ion-ion collisions, and connect to the HADNUCMAT femtoscopy project carried out by the PhD student Marc Piquer. He will conclude the talk by discussing baryon-baryon femtoscopy and the application of machine-learning techniques.

Author: TORRES-RINCON, Juan (ICCUB)

Presenter: TORRES-RINCON, Juan (ICCUB)

Contribution ID: **15** Type: **Talks**

Toward improved nuclear energy density functionals

Tuesday 27 January 2026 12:35 (20 minutes)

Nuclear energy density functional theory provides a powerful and widely used framework for describing nuclear structure across the nuclear chart. Despite its overall success, recent high-precision experimental data and astrophysical observations have challenged existing nuclear energy density functionals, particularly in the isovector sector. For example, both relativistic and non-relativistic functionals face difficulties in simultaneously reproducing parity-violating electron scattering results for Pb208 and Ca48 (PREX-II and CREX), as well as nuclear electric dipole polarizabilities. These difficulties motivate further theoretical developments. In this talk, I will briefly discuss the possible role of isovector spin-orbit effects in this context and outline possible strategies for improving Fayans energy density functionals using Bayesian inference.

Author: QIU, MENGYING (Sun Yat-sen University)

Presenter: QIU, MENGYING (Sun Yat-sen University)

Contribution ID: **16** Type: **Talks**

Addressing the pΩ femtoscopy correlation function using baryon-baryon effective potentials

Monday 26 January 2026 15:55 (15 minutes)

Following up on the topic presented by Dr. Juan Torres-Rincon, we will discuss the pΩ femtoscopy correlation functions, obtained through an updated version of the pΩ potential for low-energy interactions based on an effective field theory approach. This potential has been used to solve the Schrödinger equation and obtain the scattering wave functions. With these, we have computed the pΩ femtoscopic correlation functions and compared the results with those published by the ALICE collaboration of the LHC. We will also introduce the inverse problem of computing the parameters of the potential from the measured correlation function using neural networks, in which we are currently working on.

Authors: PARREÑO, Assumpta (Universitat de Barcelona); TORRES-RINCON, Juan (ICCUB); PIQUER I MÉNDEZ, Marc (Universitat de Barcelona)

Presenter: PIQUER I MÉNDEZ, Marc (Universitat de Barcelona)

Contribution ID: **17** Type: **Talks**

Quantum computing for nuclear simulations

Tuesday 27 January 2026 11:05 (15 minutes)

Building upon the Quasiparticle mapping framework for nuclear many-body systems introduced by E. Costa, this talk addresses the algorithmic complexity and experimental validation of these protocols on quantum hardware.

We first present a complexity analysis comparing the QP hard-core boson encoding against standard fermionic mappings (Jordan-Wigner). We demonstrate that the QP framework significantly reduces circuit depth and gate count, a crucial advantage for minimizing noise accumulation in NISQ devices.

Experimentally, we report a cross-architecture benchmark. On the superconducting BSC MareNostrum-Ona processor, we discuss energy measurement protocols and the impact of symmetry-based error mitigation. Furthermore, we present the successful execution of the full QP-ADAPT-VQE protocol on IonQ trapped-ion hardware. Introducing a physics-informed measurement strategy reconstructing the wavefunction, we achieve ground state fidelities exceeding 99.9% and recover the ground state energy with an accuracy of 0.2%. These results validate the potential of quasiparticle encodings to perform high-precision nuclear simulations on near-term devices.

Author: MORÓN RODRÍGUEZ, Arnau

Presenter: MORÓN RODRÍGUEZ, Arnau

Contribution ID: **18** Type: **Talks**

Machine learning approaches to amplitude analyses

Wednesday 28 January 2026 15:20 (15 minutes)

Hadron resonances are rigorously defined as poles of scattering amplitudes in the complex energy plane. Experimentally, however, we only have access to data along the real-energy axis, and even there, measurements are limited to observables such as cross sections, which are only sensitive to the squared modulus of the underlying complex amplitude. As a result, reconstructing the full scattering amplitude and extracting resonance parameters from noisy data is a highly ill-posed inverse problem. In this talk, I will review recent efforts to address these challenges using machine-learning techniques. In particular, I will focus on ongoing work that leverages physics-informed generative models to reconstruct scattering amplitudes in a way that respects unitarity and other physical constraints.

Author: MONTANA, Gloria (Universitat de Barcelona & ICCUB)

Presenter: MONTANA, Gloria (Universitat de Barcelona & ICCUB)

Contribution ID: **19** Type: **Talks**

Quasiparticle pairing encoding of atomic nuclei for quantum simulations

Tuesday 27 January 2026 10:45 (20 minutes)

Quantum computing is emerging as a promising tool in nuclear physics. However, the cost of encoding fermionic operators hampers the application of algorithms in current noisy quantum devices. In this talk, we discuss an encoding scheme based on pairing nucleon modes. This approach significantly reduces the complexity of the encoding, while maintaining a high accuracy for the ground states of semimagic nuclei across the and shells and for tin isotopes. In addition, we also explore the encoding ability to describe open-shell nuclei within the above configuration spaces. When this scheme is applied to a trotterized quantum adiabatic evolution, our results demonstrate a computational advantage of up to three orders of magnitude in CNOT gate count compared to the standard Jordan-Wigner encoding. Our approach paves the way for efficient quantum simulations of nuclear structure using quantum annealing, with applications to both digital and hybrid quantum computing platforms.

Author: COSTA, Emanuele (University of Barcelona)

Presenter: COSTA, Emanuele (University of Barcelona)

Contribution ID: **20** Type: **Talks**

Quantum Krylov Diagonalization for Nuclear Shell Model simulations

Tuesday 27 January 2026 12:55 (15 minutes)

Estimating low-energy spectra is a central problem in many-body physics. For nuclei, this is typically addressed with the nuclear shell model (NSM), but calculations of excited states are limited by the exponential growth of the basis with particle number. While quantum computers are expected to overcome this challenge, most proposed methods for the NSM focus only on ground-state energies [1,2]. Here, we apply the recently proposed Quantum Krylov Diagonalization [3] to compute excited states. We quantify the required resources and evaluate accuracy with and without Trotterization. For studied nuclei, the results show good agreement with classical benchmarks, while not suitable for real hardware.

[1] Pérez-Obiol, A., Romero, A.M., Menéndez, J. et al. Nuclear shell-model simulation in digital quantum computers. Sci Rep 13, 12291 (2023).
[2] Costa, E., Perez-Obiol, A., Menendez, J., Rios, A., Garcia-Saez, A., & Julia-Diaz, B. (2024). A Quantum Annealing Protocol to Solve the Nuclear Shell Model arXiv:2411.06954. (2024)
[3] Yoshioka, N., Amico, M., Kirby, W. et al. Krylov diagonalization of large many-body Hamiltonians on a quantum processor. Nat Commun 16, 5014 (2025).

Authors: RIOS HUGUET, Arnau (University of Barcelona); GALLEGO LIZARRIBAR, Kerman (University of Barcelona)

Presenter: GALLEGO LIZARRIBAR, Kerman (University of Barcelona)

Contribution ID: **21** Type: **Talks**

Quantum Complexity and Quantum Simulations of Nuclear Systems

Tuesday 27 January 2026 10:00 (45 minutes)

Understanding how many-body phenomena are rooted in quantum information is key to building quantum simulation algorithms that faithfully capture their complexity while optimally distributing computation across classical and quantum resources.
I will explore aspects of multipartite entanglement and non-stabilizerness in nuclear systems in relation with emergent collective phenomena, and will discuss efforts towards leveraging these concepts to develop resource-efficient quantum simulations with both NISQ and fault-tolerant quantum computers.

Author: ROBIN, Caroline (Bielefeld University)

Presenter: ROBIN, Caroline (Bielefeld University)

Contribution ID: **22** Type: **Talks**

Precision Tests of the Standard Model with EFTs for particle and nuclear physics

Wednesday 28 January 2026 10:00 (45 minutes)

The search for beyond-the-Standard Model physics is typically associated to large collider experiments. On the other hand, low-energy precision experiments provide a complementary path to answer major open questions in particle physics and cosmology. The success of this program depends on the interplay of high-precision experiments and high-precision theoretical calculations. This is often complicated because experiments use complex systems such as hadrons, nuclei, atoms, or even molecules. In this talk I will discuss how effective field theory techniques can be used to facilitate such calculations focusing on 2 examples of promising precision experiments: neutrinoless double beta decays and electric dipole moments.

Author: DE VRIES, Jordy (University of Amsterdam)

Presenter: DE VRIES, Jordy (University of Amsterdam)

Contribution ID: **23** Type: **Talks**

Isobar relativistic nucleus-nucleus collisions: what can we learn?

Monday 26 January 2026 12:35 (35 minutes)

Relativistic Heavy-Ion collisions (RHICs) not only bring us the opportunity to study strongly interacting mat-
ter under extreme temperatures and densities, but also these can be a powerful tool to probe subtle nuclear
structure differences, like neutron skin or nuclear deformations.
In this talk, firstly I'll focus on hybrid model simulation of RHICs, where different phases or stages of the
reaction are simulated with different (physically most suitable!) theoretical approaches. In our group we use
SMASH+vHLLE+SMASH (hadronic cascade + viscous hydrodynamics + hadronic cascade) combination of
modules.
Secondly, I'll explain how RHICs can be used as a tool to study nuclear structure employing isobar collisions.
Finally, I will compare the preliminary results of our group with experimental data from Ru+Ru (Ruthenium-
96) and Zr+Zr (Zirconium-96) collisions measured at RHIC@BNL.

Authors: DORIAN, Frycz; MENÉNDEZ, Javier; TORRES-RINCON, Juan (ICCUB); Prof. MAGAS, Volodymyr (University of Barcelona & ICC, Spain); REINA RAMÍREZ, Ángel (Universitat de Barcelona)

Presenter: REINA RAMÍREZ, Ángel (Universitat de Barcelona)

Contribution ID: **24** Type: **not specified**

Toward quantum simulation of scattering in gauge theories and other strongly correlated systems

Wednesday 28 January 2026 11:50 (45 minutes)

Presenter: DAVOUDI, Zohreh (University of Maryland, College Park)

Contribution ID: **25** Type: **not specified**

Testing fundamental symmetries with nuclei

Tuesday 27 January 2026 15:00 (20 minutes)

Searches for violation of fundamental symmetries are among the most sensitive probes of physics of and beyond the Standard Model. Currently, precision measurements of parity P and time reversal T invariance through electric dipole moments (EDMs) in atoms and molecules are a powerful tool to probe physics at high energies, for some parameters even beyond the energy tested at high-energy colliders.

In this talk I will present two recent developments related to symmetry-violating observables in nuclei. First, I will discuss nuclear-structure calculations relevant for connecting EDM measurements in paramagnetic molecules to the proton and neutron EDMs. Second, I will introduce an extension of the in-medium similarity renormalization group (IMSRG) that enables the consistent treatment of parity-violating observables by generalizing the SRG flow equations to evolve parity-violating operators. Results obtained with this method are benchmarked against no-core shell-model calculations in light nuclei.

Presenter: ROMEO, Beatriz (University of North Carolina at Chapel Hill)

Contribution ID: **26** Type: **not specified**

Talk on WP B

Tuesday 27 January 2026 15:55 (15 minutes)

Presenter: AINAUD FONDEVILA, Joan (Universitat de Barcelona)