# SMEFT-Tools 2022



# Report of Contributions

Contribution ID: **1**                                                    Type: **not specified**

# Introductory talk

*Wednesday, 14 September 2022 09:00 (45 minutes)*

**Presenter:**   SANTIAGO, Jose

**Session Classification:**   Session

Contribution ID: **2** Type: **not specified**

# RGEs in generic EFTs

*Thursday, 15 September 2022 09:45 (45 minutes)*

We shall present the motivation, as well as the current status of our calculation of Renormalization Group Equations (RGEs) in generic Effective Field Theories (EFTs) up to operators of dimension six.

**Co-author:** MISIAK, Mikolaj

**Presenters:** MISIAK, Mikolaj; IGNACY , Nalecz

**Session Classification:** Session

Contribution ID: **3**                                          Type: **not specified**

# Automatic generation of EFT operators

*Wednesday, 14 September 2022 11:00 (45 minutes)*

Effective field theories (EFTs) are a powerful tool for the exploration of potential new physics in a model-independent way. At a time when there is a lack of clarity on how to extend the Standard Model, the Standard Model effective field theory (SMEFT) and related EFTs have been receiving an increasing amount of attention. For example, the number of SMEFT operators, up to high mass dimensions, has been counted with several techniques in the last few years. Building an explicit basis of operators is more complicated, but here too there has been notable progress. In this talk, I will go through my recent work on using the software packages GroupMath and Sym2Int to automatically build explicit bases of operators for EFTs, given their fields and symmetries.

**Presenter:**   FONSECA, Renato (University of Granada)

**Session Classification:**   Session

Contribution ID: **4**                                              Type: **not specified**

# CoDEx: Matching BSMs to SMEFT

*Wednesday, 14 September 2022 11:45 (45 minutes)*

I will present the Mathematica package - CoDEx that integrates out heavy fields of spin-0, 1/2, 1 and computes SMEFT effective operators up to mass dimension-6 and associated Wilson coefficients upto 1-loop-level in terms of the model parameters. The computation of Wilson coefficients is based on the evaluation of effective action formulae. I will discuss model implementation in CoDEx, technical details and future directions.

**Primary author:**   DAS BAKSHI, Supratim (Granada University)

**Presenter:**   DAS BAKSHI, Supratim (Granada University)

**Session Classification:**   Session

Contribution ID: **5**                                            Type: **not specified**

# MATCHETE - Automated One-Loop Matching with Function Methods

*Wednesday, 14 September 2022 14:00 (45 minutes)*

In this talk I will present an overview of the Mathematica software suite "MATCHETE". Starting from a Lagrangian provided by the user, MATCHETE determines the effective low-energy Lagrangian with matching conditions up to one-loop order using functional methods. I will discuss the matching procedure and highlight some of the technical challenges arising from operator reduction and evanescent operators.

**Primary author:**   KÖNIG, Matthias

**Presenter:**   KÖNIG, Matthias

**Session Classification:**   Session

Contribution ID: **6**                                                      Type: **not specified**

# Matching dictionaries at one loop

*Wednesday, 14 September 2022 14:45 (45 minutes)*

The complete matching between the SMEFT and any of its UV completions is known at tree level, and it has been collected in the form of a dictionary connecting BSM fields and their couplings to the corresponding low-energy effective interactions. The recent developments in matching codes will allow to extend this dictionary to one loop in the near future. The large amount of data generated in this setting makes it necessary to build automatic tools for its storage and practical use. In this talk, I will present a general abstract format and a concrete python implementation for this purpose. The applicability of these tools goes beyond this context, including, for instance, the matching between the SMEFT and the WET, and between EFTs with extra fields beyond the SM ones.

**Primary author:**   CRIADO, Juan Carlos

**Presenter:**   CRIADO, Juan Carlos

**Session Classification:**   Session

Contribution ID: **7** Type: **not specified**

# Towards a global SMEFT likelihood

*Wednesday, 14 September 2022 16:00 (45 minutes)*

I will report on recent developments concerning the Python package smelli, which implements a global likelihood function in the space of dimension-six Wilson coefficients in the Standard Model Effective Field Theory and the Weak Effective Theory above and below the electroweak scale, respectively. This likelihood can serve as a basis either for model-independent fits or for testing dynamical models.

**Primary author:** STANGL, Peter (University of Bern)

**Presenter:** STANGL, Peter (University of Bern)

**Session Classification:** Session

Contribution ID: **8**                                                            Type: **not specified**

# SMEFT operators in MadGraph

*Wednesday, 14 September 2022 16:45 (45 minutes)*

I will review the status and prospects for the implementation of SMEFT operators in UFO models for MadGraph5_aMC@NLO.

**Primary author:**   MIMASU, Ken

**Presenter:**   MIMASU, Ken

**Session Classification:**   Session

Contribution ID: **9** Type: **not specified**

# More on the geoSMEFT

*Thursday, 15 September 2022 09:00 (45 minutes)*

Some recent developments in the SMEFT using the geoSMEFT formulation of this theory

**Primary author:** TROTT, Michael

**Presenter:** TROTT, Michael

**Session Classification:** Session

Contribution ID: **10**                                              Type: **not specified**

# Positivity bounds in the SMEFT

*Wednesday, 14 September 2022 09:45 (45 minutes)*

I will discuss the constraints that unitarity and locality impose on the Wilson coefficients of effective field theories, and particularly on the SMEFT, clarifying recent results on their range of applicability. I will discuss the relevance of different tools for arriving at the previous results, as well as ongoing work to enhance the power of these tools to tackle phenomenological problems.

**Primary author:** CHALA, Mikael

**Presenter:** CHALA, Mikael

**Session Classification:** Session

Contribution ID: **11**                                                Type: **not specified**

# Finite counterterms in chiral gauge theories

*Thursday, 15 September 2022 16:00 (45 minutes)*

We discuss the finite one-loop counterterm required to restore the Ward Identities broken by the regularization scheme in chiral gauge theories. As a concrete application, we work out the finite counterterm in the Standard Model, within dimensional regularization and the Breitenlohner-Maison-'t Hooft-Veltman prescription for the $\gamma_5$ matrix.

**Primary author:**   VECCHI, Luca

**Presenter:**   VECCHI, Luca

**Session Classification:**   Session

Contribution ID: **12**                                    Type: **not specified**

# RG Equation for Chiral Theories in DimReg & BMHV scheme: Application to Chiral-QED at 2 loops

*Thursday, 15 September 2022 11:45 (45 minutes)*

I discuss how renormalization group equations can be consistently established for chiral theories in the BMHV dimensional renormalization scheme, where the BRST symmetry has been restored with finite counterterms, by using notions from Algebraic Renormalization.

**Presenter:**   BÉLUSCA-MAÏTO, Hermès

**Session Classification:**   Session

Contribution ID: **13**                                          Type: **not specified**

# Matchmakereft and its future developments

*Thursday, 15 September 2022 14:00 (45 minutes)*

**Primary author:**   LAZOPOULOS, Achillefs (ETH Zurich)

**Presenter:**   LAZOPOULOS, Achillefs (ETH Zurich)

**Session Classification:**   Session

Contribution ID: **14**                                                      Type: **not specified**

# Consistent calculations at dim8 order

*Thursday, 15 September 2022 14:45 (45 minutes)*

I will discuss how to perform consistent calculations at SMEFT including dim6, dim6^2 and dim8 corrections. Further I will present the automatic tools facilitating such calculations and directly expressing the results in terms of user-defined set of input quantities (usually observables taken from the experiment). I will illustrate the results with few chosen examples.

**Primary author:** ROSIEK, Janusz

**Presenter:** ROSIEK, Janusz

**Session Classification:** Session

Contribution ID: **15**                                                    Type: **not specified**

# Monte Carlo SMEFT predictions for the LHC

*Friday, 16 September 2022 09:00 (45 minutes)*

SMEFT predictions for LHC processes are typically extracted via Monte Carlo event generation. The first part of the talk will give an overview of the state of the art of these simulations in terms tools and methodologies. The second part will focus in more detail on the SMEFTsim UFO models, discussing their main features and presenting the most recent updates (v3).

**Primary author:**   BRIVIO, Ilaria

**Presenter:**   BRIVIO, Ilaria

**Session Classification:**   Session

Contribution ID: **16**                                   Type: **not specified**

# DsixTools

*Friday, 16 September 2022 09:45 (45 minutes)*

**Primary author:**   VICENTE, Avelino (IFIC (CSIC - U. Valencia))

**Presenter:**   VICENTE, Avelino (IFIC (CSIC - U. Valencia))

**Session Classification:**   Session

Contribution ID: **17**                                          Type: **not specified**

# Gamma5 in Dimensional Regularization: The BMHV scheme at two loop

*Thursday, 15 September 2022 11:00 (45 minutes)*

We investigate the application of the BMHV scheme for treating Gamma5 in Dimensional Regularization. Looking at a toy example of a chiral QED, we observe that the BRST symmetry is broken in the presence of a non-anticommuting Gamma5. The symmetry breaking can be repaired by finite symmetry restoring counter terms which can be systematically calculated from insertions of evanescent operators. The renormalization procedure at two loop is exemplarily presented.

**Primary author:**   KÜHLER, Paul

**Presenter:**   KÜHLER, Paul

**Session Classification:**   Session

Contribution ID: **18**                                                 Type: **not specified**

# Lepton Flavour Violation in the SMEFT

*Thursday, 15 September 2022 16:45 (45 minutes)*

I will discuss an Effective Field Theory parametrisation of Lepton Flavour Violation (LFV). I will present a bottom-up analysis of LFV observables in WET and SMEFT, and I will discuss the challenges that the SMEFT calculations present.

**Primary author:**   ARDU, Marco

**Presenter:**   ARDU, Marco

**Session Classification:**   Session

Contribution ID: **19**                                                    Type: **not specified**

# HEPfit: a code for the combination of indirect and direct constraints on high energy physics models

*Friday, 16 September 2022 11:00 (45 minutes)*

⬚⬚⬚⬚⬚ is a flexible open-source tool which, given the Standard Model or any of its extensions, allows to i) fit the model parameters to a given set of experimental observables; ii) obtain predictions for observables. ⬚⬚⬚⬚⬚ can be used either in Monte Carlo mode, to perform a Bayesian Markov Chain Monte Carlo analysis of a given model, or as a library, to obtain predictions of observables for a given point in the parameter space of the model, allowing ⬚⬚⬚⬚⬚ to be used in any statistical framework. In the present version, around a thousand observables have been implemented in the Standard Model and in several new physics scenarios. In this talk, I will describe the general structure of the code as well as some of the models and observables implemented, with especial focus on the capabilities for studies within the framework of the dimension-6 SMEFT.

**Presenter:**   DE BLAS, Jorge (Universidad de Granada)

**Session Classification:**   Session

Contribution ID: **20**                                                    Type: **not specified**

# EOS

*Friday, 16 September 2022 11:45 (45 minutes)*

I present EOS, an open-source software dedicated to a variety of tasks in the processing of flavor physics observables. EOS is written in C++ and offers both a C++ and a Python interface. It is developed for three main tasks, the production of theoretical predictions for flavor physics observables; the inference of theoretical parameters from an extensible database of likelihoods; and the production of Monte Carlo samples of flavor processes for sensitivity studies.

**Primary author:**   REBOUD, Meril

**Presenter:**   REBOUD, Meril

**Session Classification:**   Session

Contribution ID: **21**                                                    Type: **not specified**

# HighPT: a tool for Drell-Yan tails beyond the Standard Model

*Wednesday, 14 September 2022 17:30 (45 minutes)*

The high-pT tails in Drell-Yan processes can provide useful complementary information to low-energy and electroweak observables when investigating the flavour structure beyond the Standard Model. The Mathematica package HighPT allows to compute Drell-Yan cross sections for dilepton and monolepton final states at the LHC. The observables can be computed at tree-level in the SMEFT, including the relevant operators up to dimension-eight, with a consistent expansion up to $\mathcal{O}(\Lambda^{-4})$. Furthermore, hypothetical TeV-scale bosonic mediators can be included at tree level in the computation of the cross-sections, thus allowing to account for their propagation effects.

Using the Run-2 searches by ATLAS and CMS, the LHC likelihood for all possible leptonic final states can be constructed within the package, which therefore provides a simple framework for high-pT Drell-Yan analyses.

We illustrate the main functionalities of HighPT by deriving constraints on semileptonic dimension-six operators in the SMEFT, discussing also the impact of dimension-eight terms, and on the couplings of TeV-scale leptoquarks.

Finally, we revisit the leptoquark explanations of the charged-current $B$ anomalies, showing the complementarity of high-pT constraints and low-energy observables.

**Presenter:**   ALLWICHER, Lukas

**Session Classification:**   Session