T 99: Searches/BSM V

Time: Friday 9:00–10:30 Location: KH 02.014

T 99.1 Fri 9:00 KH 02.014

Next-to-Leading-Order QCD and EW Corrections to the Dark Matter Relic Density in the Framework of the CxSM — •Pavao Brica[1], Karim El Yaouti[1], Pedro Gabriel[2], Milada Margarete Mühlleitner[1], and Rui Santos[2] — [1]Karlsruher Institut für Technologie — [2]Universidade de Lisboa

This talk presents the computation of the next-to-leading-order (NLO) QCD and electroweak (EW) corrections to the annihilation of dark matter particles into the dominant final states, processes that play a key role in determining the dark matter relic density. The analysis is performed within the Complex Singlet Extension of the Standard Model (CxSM), which enlarges the Standard Model scalar sector by a complex singlet field and provides a viable dark matter candidate. The treatment of the ultraviolet (UV) and infrared (IR) divergences encountered in the calculation is briefly discussed. The relic density is evaluated at NLO accuracy, and the impact of the QCD and EW corrections on the final prediction is examined together with its phenomenological implications.

T 99.2 Fri 9:15 KH 02.014

Dark Matter phenomenology in an Effective Field Theory framework — •Maria Gonçalves[1,2], Margarete Mühlleitner[1], Rui Santos[2,3], and Tomás Trindade[2] — [1]Karlsruher Institut für Technologie - ITP, Karlsruhe, Germany — [2]Faculdade de Ciências da Universidade de Lisboa - CFTC, Lisboa, Portugal — [3]Instituto Politécnico de Lisboa - ISEL, Lisboa, Portugal

Dark matter (DM) remains one of the greatest mysteries in modern physics. From a particle physics perspective, effective field theories (EFTs) provide a powerful tool to explore possible extensions of the Standard Model (SM). In this work, we use current experimental data to constrain the coefficients of higher-dimensional operators in the EFT description. This approach allows us to identify promising directions for extending the SM to include viable DM candidates.

T 99.3 Fri 9:30 KH 02.014

AutomaticConstruction of Green's Bases for Effective Field Theories with AutoEFT — •Lars Bündgen[1], Robert Harlander[1], and Magnus Cornelius Schaaf[2] — [1]RWTH Aachen University, Germany — [2]Technical University of Munich, Germany

Effective field theories (EFTs) are an important tool in particle physics. They can be used both for describing the low-energy behavior of Standard Model processes, as well as for model-independent searches for BSM physics.

Working in an EFT requires a basis of independent operators. There are two types of bases: One is the on-shell basis, where each Wilson coefficient is an independent parameter to the observables. The other basis is one of independent Green's functions. It contains additional operators and is required for calculations such as renormalization and RGE evolution, which happen at the level of Green's functions.

In this talk I present a new version of the program AutoEFT that can construct both on-shell and Green's bases for EFTs. The algorithm supports EFTs with particles of spin 0 and spin 1/2, as well as gauge bosons of internal $SU(n)$ and $U(1)$ symmetries. A group-theoretical approach is used to determine the invariants of the Lorentz and gauge groups and to eliminate the redundancies between them.

Finally I will explore how a projection algorithm for EFT operators can be implemented. This is important because the choice of basis operators is arbitrary, so different authors may be using different bases for their calculations. A projection algorithm will facilitate the translations of results between different bases.

T 99.4 Fri 9:45 KH 02.014

New Physics Models in Recola2 — •Luis Miguel Marques Lourenco — JMU, Emil-Hilb-Weg 22, 97074 Würzburg

Our understanding of fundamental interactions depends on our ability to make high precision predictions for observables that can be compared with experimental measurements. After the Higgs discovery, the focus in elementary particle physics has shifted toward precision tests of the Standard Model (SM) and the search for possible extensions motivated by the unresolved shortcomings of the SM. Precise theoretical predictions for BSM scenarios are needed to interpret deviations and identify which model they might indicate.

In recent years, the automation of one-loop QCD and electroweak corrections has substantially improved our ability to produce such predictions across a wide range of models. Recola2 provides automated one-loop matrix elements, including QCD and EW corrections, in the SM as well as for several BSM scenarios. A central ingredient in this progress is the use of flexible universal model formats that can encode not only tree-level interactions but also the counterterm information needed for higher-order calculations. The UFO framework, and its extended version UFO2, provide a practical way to supply such information to modern matrix-element generators. In this talk, I will present a new UFO2 interface for Recola2, which translates the UFO2 files into Recola's Fortran model files. This tool will enable the use of Recola for external models that already include the necessary counterterms, and streamline the path from model building to more precise phenomenological studies, which will be the objective of future work.

T 99.5 Fri 10:00 KH 02.014

Simulation of Heavy Neutral Lepton production and decay with the Sherpa event generator. — •Antonia Bähr[1], Marzieh Bahmani[2], Michael Kobel[1], and Frank Siegert[1] — [1]IKTP, TU Dresden, Dresden, Germany — [2]HU Berlin, Berlin, Germany

Although the Standard Model has been proven to be a successful theory for explaining the fundamentals of particle physics, some question still remain unanswered: Contrary to its initial assumption, neutrinos have been shown to possess mass. However, their masses are much lighter ($m < 0.45$ eV) than those of all other fundamental fermions ($m \sim 0.5$ MeV ... 0.2 TeV).

There are numerous theories trying to explain these findings. In this talk, we focus on the type 1 see-saw mechanism, where heavy neutral leptons (HNLs) emerge as additional mostly right-handed mass eigenstates.

I will present the implementation of production and decay of HNLs, for masses of a few GeV at the LHC with Sherpa, a Monte Carlo event generator for the simulation of high-energy particle reactions. Besides validating the simulation results by comparing them to simulations done by Madgraph+Pythia, I will especially focus on the inclusion of semileptonic decay channels and the successful consideration of spin-correlation in the Sherpa simulations, which is not available for the other generators.

T 99.6 Fri 10:15 KH 02.014

On-the-fly reweighting for beyond Standard Model parameter variations in the Sherpa Event Generator — •Florens Förster and Frank Siegert — TUD Dresden University of Technology, Institute of Nuclear and Particle Physics

The research for Beyond the Standard Model physics relies on the study of different models containing higher dimensional operators. The effects of these models, which depend on certain model parameters, can be simulated, for example using the Sherpa event generator. Currently, the simulation with different parameters can only be done by changing their values manually and running the event generation once for each variation, which is neither user friendly nor particularly efficient.

In this study, the variation of model parameters is implemented within the Sherpa event generator using on-the-fly reweighting. This is supposed to save computational resources and make the usage of BSM Models easier in Sherpa. The newly implemented features are then tested and validated by studying the effects of BSM physics on certain scattering processes, particularly the electroweak $\gamma\gamma$jj production.