T 55: Invited Topical Talks 4

Time: Wednesday 11:00–12:40 Location: T-H16

Invited Topical Talk T 55.1 Wed 11:00 T-H16

Machine Learning for LHC Theory — •Anja Butter — Institut für Theoretische Physik, Heidelberg, Germany

Over the next years, measurements at the LHC and the HL-LHC will provide us with a wealth of data. The best hope of answering fundamental questions like the nature of dark matter, is to adopt machine learning techniques for particle experiment and theory. LHC physics relies at a fundamental level on our ability to simulate events efficiently from first principles. In the coming LHC runs, these simulations will face unprecedented precision requirements to match the experimental accuracy. Neural networks can overcome limitations from the calculation of amplitudes and event generation. Generative networks can achieve high-precision in simulations while maintaining control over training stability and associated uncertainties. Since networks in the form of normalizing flows can be inverted, they also open new avenues in LHC analyses. The access to the density of the generated distribution enables new methods for anomaly detection, while their interpretation in terms of probability densities leads to new methods for multi-dimensional unfolding.

Invited Topical Talk T 55.2 Wed 11:25 T-H16

Towards high-precision deep learning for astroparticle physics — •Christoph Weniger — University of Amsterdam, Netherlands

Observational data relevant for astroparticle physics and astrophysical searches for dark matter becomes increasingly complex and detailed. We are in a situation where often what we can learn from new observations is limited not by the amount of data, but by the sophistication of our analysis tools and the quality and detail of our physical models. Classical statistical techniques, like Markov Chain Monte Carlo, severely limit model realism and complexity, due to their high simulation requirements and limitation on the number of free parameters. Neural simulation-based inference algorithms have the capability to break through these barriers in surprising ways. However, using these new classes of algorithms without compromising the precision and accuracy of statistical inference results remains challenging. I will present both successful examples and discuss typical pitfalls related to the application of neural simulation-based inference algorithms to dark matter searches with astrophysical data.

Invited Topical Talk T 55.3 Wed 11:50 T-H16

The quest for the mechanism behind the matter-antimatter asymmetry — •Julia Harz — Technische Universität München, München, Germany

Our own existence is still a mystery, as some yet unknown mechanism had to generate an excess of matter over antimatter during the evolution of the Universe. After an introduction on why physics beyond the Standard Model is needed in order to explain the observed matter-antimatter asymmetry, I will give an overview of different theoretical mechanisms that are potentially able to explain such an asymmetry. Hereby, I will highlight interesting possible connections to neutrino physics and dark matter. Moreover, I will discuss the challenges of probing baryogenesis models and review promising experimental strategies.

Invited Topical Talk T 55.4 Wed 12:15 T-H16

Towards the lightest dark matter in direct searches — •Belina von Krosigk — Karlsruhe Institute of Technology, Institute for Astroparticle Physics, Eggenstein-Leopoldshafen, Germany

In the last decades, astronomical observations have consistently indicated that most of the matter in the Universe remains hidden to even the most sensitive telescopes because it is nonluminous - because it is dark. Observing the respective dark matter particles became one of the most tantalizing endeavors of modern physics. A new generation of large exposure direct search experiments is at the ready to observe weak-scale dark matter particles, with their successors already in the planning. At the same time a new era has begun towards a direct detection of ever lighter dark matter candidates. Novel detector designs are reaching ultra-low detection thresholds with which new detection channels can be exploited and unprecedentedly low dark matter masses can be probed. State-of-the-art direct detection searches most sensitive to light dark matter will be reviewed together with an outlook on where the near future is expected to take us in this quest towards dark matter discovery in the laboratory.