SYMD 1: SMuK Dissertation Prize 2020

Time: Monday 14:30–16:00 Location: H-Aula/HS I/HS X

Invited Talk SYMD 1.1 Mon 14:30 H-Aula/HS I/HS X
***N*-Particle Scattering and Asymptotic Completeness in Wedge-Local Quantum Field Theories** — •Maximilian Duell — Mathematisches Institut der Universität München, Theresienstr. 39, München

In this talk, I will present a mathematical theory of N-particle scattering reactions in wedge-local quantum field theories (wQFT), developed during my PhD project (Advisor: W. Dybalski, TU München). The investigation of wQFTs is an active area of research in mathematical physics with applications in the construction of integrable QFTs (e.g. Sinh-Gordon, $O(n)$-Sigma models).

In my work, N-particle states with arbitrary particle numbers are constructed in a general framework of wQFT. Using wedge-swapping symmetry a geometric pitfall is resolved, which has restricted previous investigations of other authors to 2-particle reactions. The new method yields a well-defined N-particle scattering matrix in various known wQFT models. Most notably, non-trivial wQFTs have already been established with full mathematical rigour, in contrast to the still widely open Yang-Mills Existence problem. By means of the present wedge-local scattering theory, a class of wQFT models constructed by Grosse and Lechner are exhibited as first examples of relativistic (wedge-local) QFT in four-dimensional space-time, which are provably interacting and asymptotically complete.

I gratefully acknowledge funding by the DFG, grant DY107/2-1.

Invited Talk SYMD 1.2 Mon 15:00 H-Aula/HS I/HS X
First observation of double electron capture in Xe-124 with the dark matter detector XENON1T — •Alexander Fieguth — Stanford University, 94305 Stanford, CA, USA

For almost a century observations point towards a non-luminous and non-baryonic form of matter, which we call Dark Matter. This elusive constituent of the universe has evaded a direct detection despite the fact about 80% of the total mass content of the universe are made of it. One of the most sensitive detectors built for the purpose of directly observing an interaction with Dark Matter was the XENON1T detector. While setting the most stringent limits on the standard interaction of Weakly Interacting Massive Particles (WIMPs) with masses above a few GeV/c^2, no positive signal was observed.

However, the efforts necessary to reach sensitivities which probe cross sections as low as $10^{-47}\mathrm{cm}^2$, especially in terms of background mitigation, understanding and reduction, made this detector an exciting tool for exploring various so far un-probed parameter spaces in particle and nuclear physics.

This talk will focus on the utilization of XENON1T as a detector for the two-neutrino double electron capture of ^{124}Xe. A process which is within the Standard Model of particle physics but due to its long half-life (1.8×10^{22} yrs), has not been observed directly before. In addition to this, the talk will shed some light on standard assumptions in the search for direct dark matter interaction and introduce a new interaction channel through a WIMP-Pion interaction, which was tested for the first time using XENON1T.

Invited Talk SYMD 1.3 Mon 15:30 H-Aula/HS I/HS X
Anisotropic Transport of Galactic Cosmic Rays based on Stochastic Differential Equations — •Lukas Merten — University of Innsbruck, Innsbruck, Austria — Ruhr University Bochum, Bochum, Germany

The sources of cosmic rays (CRs) are not yet unambiguously revealed. The deflection of charged CRs in magnetic fields makes an inference of the CR origin by observation of their arrival direction impossible. Modelling the transport of CRs allows to indirectly learn about their sources.

In this work, a new opportunity to describe the anisotropic transport in arbitrary magnetic background fields is introduced. Here, the equivalence between Fokker-Planck and stochastic differential equations is used. In doing so, the solution of the transport equation does not need to be discretized on a spatial grid. This method has been implemented as part of the open source software CRPropa.

The software extension allowed to model the large influence of the magnetic field morphology on observable quantities, like the stationary distribution of cosmic rays. Furthermore, the Galactic termination shock is examined as a possible source for CRs in the range above the knee at PeV energies.