MP 11: Quantum Field Theory III (QED and Particle Detection)

Time: Thursday 16:00–17:00 Location: ZEU/0250

MP 11.1 Thu 16:00 ZEU/0250

Asymptotic Completeness and Particle Detectors in Quantum Field Theory — •Janik Kruse — Adam Mickiewicz University in Poznań, Poland

A quantum field theory is asymptotically complete if every quantum state is a scattering state (i.e. a state that allows a particle interpretation). A physical criterion that is known to be necessary and sufficient for asymptotic completeness is the detector criterion: A quantum field theory is asymptotically complete if and only if every quantum state causes a click in some particle detector. In this talk, I will explain why particle detectors do not detect non-scattering states and how this result could be used to characterise asymptotically complete theories by more fundamental criteria than the detector criterion.

MP 11.2 Thu 16:20 ZEU/0250

Electron-Positron Pair Production in High-Intensity Electromagnetic Fields — •Christian Kohlfürst[1], Naser Ahmadiniaz[1], Johannes Oertel[2], and Ralf Schützhold[1,3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [2]Universität Duisburg-Essen, 47057 Duisburg, Germany — [3]Technische Universität Dresden, 01062 Dresden, Germany

In ultra-strong electric fields energy in terms of photons can be converted into electrons and positrons. We introduce a novel approach to calculate the mean particle number in collisions of short-pulsed laser fields. In this regard, we further discuss the different regimes of pair production in terms of their unique signatures in particle phase-space and relate our findings to currently ongoing experiments.

Reference: [1] Christian Kohlfürst, Naser Ahmadiniaz, Johannes Oertel, Ralf Schützhold, Sauter-Schwinger effect for colliding laser pulses, arXiv:2107.08741 [hep-ph], to appear in Physical Review Letters.

MP 11.3 Thu 16:40 ZEU/0250

Pair production spectrum in a space-time dependent field from worldline instantons — •Gianluca Degli Esposti[1] and Greger Torgrimsson[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden, Germany — [2]Department of Physics, Umeå University, SE-901 87 Umeå, Sweden

The Worldline Formalism has proven to be an efficient tool for the computation of scattering amplitudes in a number of interesting cases. In the context of Strong-Field QED, it provides a useful representation of the full propagator in a background electromagnetic field, and in the present work, we use such representation in the LSZ reduction formula to compute the pair production spectrum in a space-time dependent electric field.

Unlike the closed-loop method that provides the total integrated probability from the effective action using unitarity, we work with the LSZ on the amplitude level, which allows us to obtain the spectrum. We use the saddle-point approximation to obtain a semiclassical result.

The instantons are the saddle points of the path integral. They represent tunneling near the turning point and free real particles asymptotically. We find such instantons numerically by solving the Lorentz force equation.