MP 12: Quantum field theory for particle physics and plasmas

Time: Thursday 17:15–18:15 Location: MP-H5

MP 12.1 Thu 17:15 MP-H5

Quantum Backreaction in Laser-driven Plasma — Gudrid Moortgat-Pick, Ananta Effendie, and •Victor Rogner — Universität Hamburg

High-intensity laser-matter interactions are of interest for both experimental and theoretical physicists alike. New and more intense lasers could introduce inconsistencies into the classical approach on which the theories of the interactions have been calculated.

In light of new approaches to the quantisation of laser-driven Plasma that do not rely on particle-in-cell codes that are commonly used to model events on the quantum-scale, field theories are constructed through means including various attributes (like multi-particle effects) from the out-set.

In this Talk we will try to enable a better understanding of quantum-field-theory under the constraints given by a uniform plasma. Central to our work, we follow a different Ansatz namely the path integral quantisation of a Bi-Scalar field, which will be constructed through the successive introduction of quantum properties to the classical theory of laser driven plasma.

Starting from the classical equations governing the behaviour of laser-driven Plasma, we will extrapolate equations from the path integral quantisation and in doing so, find linearised field equations for our scalar fields that dictate the dynamics of a monochormatic Laser propagating through a uniform plasma.

We will then compare with results from literature.

MP 12.2 Thu 17:35 MP-H5

Quantum Backreaction in Laser-Driven Plasma — Gudrid Moortgat-Pick, Victor Rogner, and •Ananta Effendie — University of Hamburg

Similarly to the statistical mechanics as they pertain to gases, the sets of mechanics for a plasma will need to be modeled separately from that of other states of matter.

In particular, the electrons behave as if free inside a plasma, the intense laser-pulse interactions of which are of interest in the understanding of a laser-driven plasma. In contrast to the particle-in-cell approach already explored thoroughly and canonized in EPOCH, an approach considering multi-particle effects will yield separate mathematical insights.

The proposed method of integral quantisation utilizes the action in respect to the Lagrangian and allows quantum considerations from quantum-field-theory and quantum-electrodynamics to be introduced, the effects of which are largely ignored through the particle-in-cell approach.

This yields field equations describing a laser-driven plasma, including backreactions of quantum fluctuations, which can be linearised to describe a uniform, monochromatic laser beam propagating through a uniform plasma. The resulting quantum perturbations appear non-trivial.

MP 12.3 Thu 17:55 MP-H5

Higgs Mechanism — •Abhishek Goswami — Adam Mickiewicz University, Poznan, Poland

In the Standard Model of particle physics, the interaction of a particle with the Higgs boson is responsible for its mass generation. This principle is known as the Higgs mechanism. In this talk, I will discuss a rigorous, non-perturbative proof of the Higgs mechanism. I will start with a weakly coupled U(1) Higgs theory on a unit lattice and show the exponential decay of correlations of the observable electromagnetic field strength tensor. This is the mass gap. I will also discuss the application of a new power series cluster expansion to this problem and explain how it provides a clean and simple alternative to decoupling cluster expansions in Constructive QFT.

Reference- Goswami, A. Mass Gap in Weakly Coupled Abelian Higgs on a Unit Lattice. Ann. Henri Poincaré 20, 3955-3996 (2019).