



Contribution ID: 1077

Type: **Oral**

Quark matter at four loops

Completing the perturbative four-loop pressure of cold quark matter (QM) has been shown to significantly constrain the neutron-star-matter equation of state. Building on the milestone results in [1, 2], where all screened gluonic contributions to the QM pressure at this order were computed, the remaining challenge lies in evaluating the missing hard contributions arising from four-loop QCD vacuum diagrams at finite density. In this talk, we will present the latest progress in calculating these four-loop contributions [3], with a particular focus on the new algorithmic technique based on Loop Tree Duality (LTD), originally developed for perturbative computations in high-energy collider physics, which we recently generalized to finite density [4]. This novel approach tackles multiloop computations via direct numerical integration of entire Feynman diagrams, enabling the treatment of complex four-loop diagrams at finite density that were previously considered impossible to evaluate.

[1] Gorda, Kurkela, Paatelainen, Säppi, Vuorinen, *Phys.Rev.Lett.* 127 (2021)

[2] Gorda, Paatelainen, Säppi, Seppänen, *Phys.Rev.Lett.* 131 (2023)

[3] Kärkkäinen, Navarrete, Nurmela, Paatelainen, Seppänen, Vuorinen, In preparation

[4] Navarrete, Paatelainen, Seppänen, arxiv:2403.02180

Category

Theory

Collaboration (if applicable)

Primary author: PAATELAINEN, Risto

Co-authors: VUORINEN, Aleks (University of Helsinki); SEPPÄNEN, Kaapo; Mr NAVARRETE, Pablo (University of Helsinki)

Presenter: PAATELAINEN, Risto

Track Classification: QCD matter in astrophysics