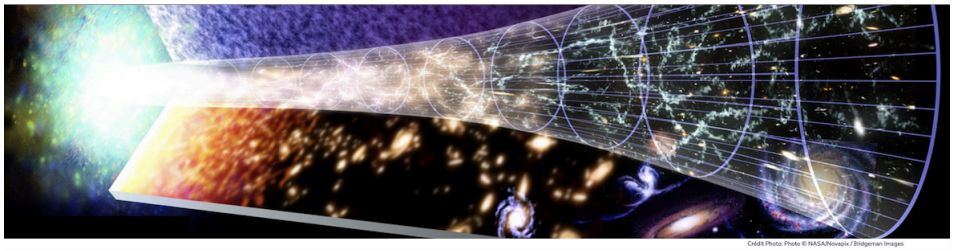

ID de Contribution: **33** Type: **Non spécifié**

Thermal particle production in the primordial plasma: the axion case

lundi 14 avril 2025 17:50 (25 minutes)

The axion is a hypothetical particle that was first proposed to solve an open problem in QCD known as the "strong CP problem". It was later realized that the axion has implications in cosmology as a dark matter candidate. In this talk however, we concentrate on the ultra-relativistic component of the axion population, produced in the early Universe by interacting with the Standard Model (SM) plasma. This population can contribute measurably to the energy density of the Universe as dark radiation with the quantity of phenomenological interest here being the so-called "effective number of neutrinos" Neff, which can be determined experimentally via CMB telescopes like Planck or the recently launched Simons Observatory. The main motivation for our research is to evaluate Neff as a function of the SM-axion couplings as precisely as possible, so that experimental results may be used to place constraints on the values of those parameters. Specifically, this talk focuses on new results obtained in the Kim-Shifman-Vainshtein-Zakharov (KSVZ) model where the axion couples only to gluons and the only parameter is the axion scale. The most important part of any computation of thermal production is the implementation of the collective effects of the medium which cure would-be divergences caused by soft particle exchange. Here, I present two new schemes for accounting for such thermal effects and compare them to ones already present in the literature. Those new schemes solve issues of production rate negativity and gauge dependence that appeared in previous computations. Finally, I show how the various computation schemes lead to different behaviors of the production rate at soft axion momenta. Once the production rate has been obtained, the axion contribution to Neff can be computed by solving the Boltzmann equation. The difference between the values of Neff obtained in different schemes allow us to gain an understanding of the theory uncertainty of the computation. As an outlook, I will also touch on the automated techniques that were used in this research, and how they could be extended to automate the entire production rate computation. The results presented in this talk are published in 2404.06113, written by myself and Jacopo Ghiglieri.

Orateur: BOUZOUD, Killian