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Gravitational production after inflation : Boltzmann and Bogoliubov approaches

Thursday 25 September 2025 14:00 (18 minutes)

In this talk, I consider spectator scalar fluctuations generated by gravity during inflation and reheating. This framework can be applied to the production of Dark Matter (DM) or Standard Model (SM) scalar degrees of freedom. I first review the perturbative approach describing gravitational portals from gravity EFT and solving the Boltzmann equation for the distribution function of scalar modes. Then, a non-perturbative Bogoliubov treatment is described and compared to the perturbative approach. In recent work, we obtained both long and short-wavelength spectra, highlighting that the spectral index in the IR regime varies depending on the post-inflationary equation of state (EoS) for a wide range of momenta and masses. In the UV regime, we identify high-frequency oscillations in the spectrum due to the inflaton background dynamics during reheating, which leads to interference. Remarkably, we found that for a large range of EoS, the spectral index in the UV is independent of the EoS. We corroborate our results by comparing the Bogoliubov treatment with perturbative methods, solving the Boltzmann equation. We show agreement across all EoS in the UV regime for the two approaches. Finally, we discuss the gravitational reheating scenario and address constraints from primordial gravitational wave overproduction, finding that successful gravitational reheating is achievable for sufficiently high EoS.

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