Contribution ID : **21** Type : **not specified**

Perturbative cosmological phase transitions in a broad temperature range

Saturday, 27 September 2025 09:00 (30)

Cosmological phase transitions, particularly the electroweak one, continue to draw attention due to their potential to generate a stochastic gravitational wave background and to provide a possible mechanism for baryogenesis.

In this talk, I will discuss the perturbative description of such transitions, focusing on recent developments in high-temperature effective field theory (EFT) relevant to transition thermodynamics. Key aspects include the automated construction of the high-temperature EFT, the identification of the effective transition scale for nucleation, and the incorporation of the final perturbative order of soft fluctuations in the effective potential. Ultimately, by examining the structure of higher-dimensional operators in the EFT, we gain an appreciation for the limitations of the high-temperature expansion, particularly in describing the strongest transitions.

Confronted with these limitations, I will conclude by outlining old and new strategies to systematically extend perturbative control beyond the high-temperature regime, enabling descriptions valid across a broader temperature range.

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Session Classification : Plenary