

Phenomenology 2025 Symposium



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Real-time simulation of CP violation in electroweak baryogenesis

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Baryogenesis is a dynamical out-of-equilibrium process generating the baryon asymmetry of the Universe. Focusing on the mechanism of electroweak baryogenesis, where baryon number is generated through CP-violating scattering of the fermions with the bubble wall during a first-order electroweak phase transition, perturbative calculations for the relevant processes are known to suffer from various issues, motivating the development of lattice calculations. However, conventional lattice calculations based on Euclidean formulation in the imaginary time domain are limited to equilibrium dynamics. Real-time simulation is necessary for proper understanding of the out-of-equilibrium dynamics of baryogenesis. In our work, we focus on the fermion scattering process during electroweak baryogenesis, and develop a real-time simulation framework by mapping the fermions onto a spin system. Using tensor network methods, we perform numerical simulations and systematically analyze lattice artifacts. Our studies take a first step towards real-time simulation of baryogenesis, and are expected to shed light on real-time non-perturbative calculations of general out-of-equilibrium processes in the early Universe.

Mini Symposia (Invited Talks Only)

Plenary (Invited talks only)

Authors: OU, Tong; Prof. CARENA, Marcela (Perimeter Institute for Theoretical Physics); Dr LI, Ying-Ying (Institute of High Energy Physics, Beijing); Dr SINGH, Hersh (Fermilab)

Presenter: OU, Tong

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