Contribution ID: **146** Type: **not specified**

Gravitational waves production by inflationary transitions in U(1) aligned natural inflation

Tuesday 27 May 2025 17:20 (20 minutes)

The original axion natural inflation model predicts a tensor-to-scalar ratio exceeding experimental limits. In contrast, aligned axion inflation allows for inflationary trajectories that begin near a saddle point of the two-field potential and terminate due to an instability in the orthogonal direction. These solutions are consistent with current observational constraints, and upcoming CMB experiments will probe a range of parameter values.
Previous studies have suggested the possibility of two distinct inflationary stages separated by a transition characterized by rapid oscillations of the fields. In this work, we demonstrate that the existence of these two stages is a generic feature of the model. We explore a possible phenomenological signature of the transition when the model is coupled to a U(1) gauge field, namely, the production of gravitational waves (GWs) sourced by gauge quanta generated during the transition. We find that the resulting GW power spectrum exhibits a sharp peak at the transition scale, potentially detectable by future GW experiments. This mechanism produces a feature similar to that seen in spectator axion models but emerges naturally within the framework of saddle-point inflation in the aligned axion model.

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Session Classification: Inflation