

## Hybrid cosmological collider of (iso)curvature

*Tuesday, 7 May 2024 11:50 (10 minutes)*

If a sector other than inflaton survives in the late universe, its quantum fluctuation generically brings isocurvature modes. The typical case is the complex scalar with spontaneous symmetry breaking, with the remaining  $U(1)$  global symmetry and the associated massless goldstone boson. The goldstone mode can be recognized as the QCD axion or axion-like particle (ALP) and form cold dark matter via the misalignment mechanism. We found a whole new suite of cosmological observables for cold dark matter isocurvature, which could help test the presence of axions, as well as its coupling to the inflaton and other heavy spectator fields during inflation such as the radial mode of the Peccei-Quinn field. They include correlated clock signals in the curvature and isocurvature spectra, and mixed cosmological-collider non-Gaussianities involving both curvature and isocurvature fluctuations with shapes and running unconstrained by the current data analyses. We will also briefly mention further developments in progress.

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**Session Classification:** Session 6