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Primordial features and non-Gaussianities as probes of fundamental physics

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During the primordial universe such as the inflationary epoch, all particles with mass up to the Hubble parameter or higher are excited quantum-mechanically or classically. These particles left their imprints in the primordial density perturbations, as primordial features and non-Gaussianities, which may be probed by astrophysical observations of the large-scale structure of the universe today. These informations include the particle mass and spin spectra, and the scale factor evolutionary history $a(t)$ of the primordial universe. The latter would provide a direct evidence for the inflation or an alternative scenario. As an example, we present an inflationary primordial feature model that can explain both the large and small-scale feature anomalies in the currently measured CMB anisotropy spectra, revealing a clip of adventurous history of the Universe during its primordial epoch and realizing some of the properties outlined above. We show how to further test such models in future experiments.

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