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Primordial non-Gaussianities: What are they, why do we care, and how do we measure them

Friday, 7 November 2025 11:15 (40 minutes)

In this talk, I will explain why primordial non-Gaussianities are considered to be one of the most exciting targets in cosmology, on par with primordial gravitational waves (and certainly more exciting than the Hubble tension!). Primordial non-Gaussianities cause the initial conditions to contain moments beyond the variance or power spectrum (second moment) and can be caused by a variety of mechanisms, including multiple (scalar) fields in the early universe or the presence of massive particles. Current leading upper limits on the primordial non-Gaussianity are derived from measuring the bispectrum (skewness) of the cosmic microwave background (CMB), the oldest light in our universe. While a detection is certainly possible within the next few years, the strength of the signal is empirically small. A possible detection would benefit from measuring as many (linear) modes as possible, where modes can be considered samples of independent measurements (due to the cosmological principle). I will explain how such signatures are typically measured and provide an update on the current status of state-of-the-art CMB experiments. Unfortunately, while the CMB currently provides the strongest upper limits on non-Gaussianity, due to the two-dimensional nature of the CMB as a last-scattering surface, the number of cosmological modes is finite. Future observations of the 21cm radiation field could, in principle, provide many more modes, but besides massive foregrounds, I will explain that even under ideal circumstances, there are limitations. I will further allude to adopting machine learning to mitigate some of these limitations.

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