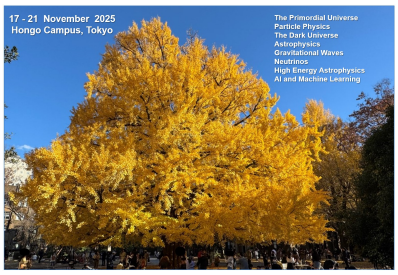

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Cosmic Inflation: From Small to Large Scales

mardi 18 novembre 2025 11:50 (25 minutes)

Structures in the universe can be formed because of small inhomogeneities at a very early time. These inhomogeneities originate from quantum fluctuations stretched by cosmic inflation. As we know from wave mechanics, fluctuations are characterized by amplitude and wavelength. Fluctuations with wavelength as long as observable universe, with amplitude around 0.00001, can explain cosmic microwave background observations and galaxies density correlations in large-scale structures. However, for the short-wavelength one, so far there have been no observational constraints on the amplitude. If the amplitude exceeds 0.1, they can collapse to form primordial black holes. These primordial black holes can have interesting consequences, such as explaining dark matter or LIGO-Virgo-KAGRA black holes. So far, these theoretical predictions rely on linear perturbation theory. However, it is reasonable to expect large nonlinearities due to large fluctuations, which are manifested in coupling between small and large scales. In this talk, I will review primordial black holes formation in single-field inflation and recent progress on nonlinear computation. I will argue that large amplitudes of short-wavelength fluctuations can coherently amplify the long-wavelength one by loop corrections. I will also explain some issues on regularization and renormalization of these loops.

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