

Master 1 or 2 *INTERNSHIP PROPOSAL*

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Thesis possibility after M2 internship: NO

The cosmological flow

According to cosmological inflation, all the structures in the universe arise from microscopic fluctuations that were stretched to cosmological scales during a primordial epoch of accelerated expansion. Inflation predicted the statistical properties of these primordial fluctuations before they were detected, and it has passed stringent observational tests with flying colors. Yet, its physics is still elusive. To get more clues, upcoming observations of the Cosmic Microwave Background and of the large scale structure of the universe will enable us to probe fine details of inflation. This precision physics necessitates accurate theoretical predictions, in particular of higher-order correlation functions of primordial fluctuations. These so-called primordial non-Gaussianities are a measure of the interactions of the fields active during inflation, and can help to establish a standard model of inflationary cosmology. However, predictions for non-Gaussianities are only available in restricted classes of scenarios that are analytically tractable. The recently developed cosmological flow approach enables one to address this issue by numerically following the time evolution of primordial correlators in a systematic manner in all inflationary scenarios, using the framework of the effective field theory of inflationary fluctuations.

The student will work on extending this approach, currently developed to predict the 3-point correlation function, in order to predict the connected 4-point correlator. This observable provides a way to discriminate amongst inflationary theories that are otherwise degenerate, and its knowledge is crucial to understand the properties of gravitational-wave backgrounds generated during inflation.

Through this internship with both analytical and numerical approaches, the student will discover inflationary cosmology and quantum field theory in curved spacetimes.

References:

- [1] Cosmological Flow of Primordial Correlators, Werth, Pinol, Renaux-Petel, [2302.00655](#)
- [2] The Cosmological Flow: A Systematic Approach to Primordial Correlators, Pinol, Renaux-Petel, Werth, [2312.06559](#)
- [3] CosmoFlow: Python Package for Cosmological Correlators, Werth, Pinol, Renaux-Petel, [2402.03693](#)
- [4] [Buchalter cosmology prize](#) for the cosmological flow