

Course title:

Inflation in the Early Universe: theoretical developments and observational predictions"

Duration [number of hours]: 12

PhD Program [MERC/MPS/SPACE]: SPACE

Name and Contact details of unit organizer(s):

Prof: Sabino Matarrese

Affiliation: Dipartimento di Fisica e Astronomia "G. Galilei" – Università degli Studi di Padova

Email: sabino.matarrese@pd.infn.it

Course Description: I will review the main properties of the model of Inflation in the Early Universe. I will first describe the most relevant shortcomings of the standard cosmological model; I will then introduce the idea of inflation as a suitably long period of accelerated expansion in the early Universe, as a solution of such problems. The dynamics of inflation will then be discussed, starting from the "old-inflation" model introduced by Guth in 1981, and then moving to slow-roll models, including chaotic inflation. The idea of "eternal inflation" will also be introduced. Next, I will deal with the generation of scalar (energy density) and tensor (gravitational wave) perturbations from quantum vacuum oscillations. Finally, I will discuss observational predictions of inflation in connection with CMB anisotropies and polarization, statistics of galaxy clustering and the prospects for the detection of primordial gravity waves.

Syllabus:

1. Shortcomings of the standard cosmological model (horizon, flatness, generation of inhomogeneities)
2. Kinematics of inflation and solution of the horizon and flatness problem
3. Dynamics of inflation
4. Old inflation, new inflation, chaotic and eternal inflation
5. Generation of scalar and tensor perturbations during inflation
6. Evolution of perturbations and the gauge issue.
7. Observational predictions of inflation: CMB anisotropies and polarization, Large-Scale cosmic structures. Primordial gravitational waves and prospects for their future detection.

Assessment:

Suggested reading and online resources:

1. Lecture slides
2. Proposed literature references: D. Baumann, <https://arxiv.org/abs/0907.5434> - N. Bartolo et al.: *Phys.Rept.* 402 (2004) 103-266. e-print: astro-ph/0406398
3. Notes on specific topics