

Cosmological inflation and Large-Scale Structure

Time & Place: to be determined

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Office hours: by appointment

Course webpage: <http://abuchel.apmaths.uwo.ca/~public/cosmo2005/>

Prerequisites:

This course is geared for M.Sc. and Ph.D. students enrolled in Collaborative Ph.D. Program in Theoretical Physics. Required previous course work: Quantum Field Theory (AM516 or equivalent) and General Relativity (at the level "Gravitation" by Thorne and Miller or equivalent; preferably "General Relativity" by Wald)

Course outline:

I. The Hot Big-Bang Cosmology:

- a. Basics of the Big-Bang Model (Friedmann equations, cosmological epochs, concept of particle horizon)
- b. Shortcomings of the Standard Big-Bang Theory (flatness problem, entropy problem, horizon problem)

II. Standard inflationary universe:

- a. Inflation and the resolution of the Hot Big-Bang puzzles
- b. Inflation and the inflaton (slow-roll conditions, stages of inflation and reheating, survey of inflationary models)

III. Inflation and the cosmological perturbations:

- a. Quantum fluctuations of a generic massless (massive) scalar field during inflation (scalar field fluctuations in de-Sitter spacetime, quantum to classical transition, power spectrum, scalar field fluctuations in a quasi de-Sitter spacetime)
- b. Quantum fluctuations during inflation (metric fluctuations, issue of gauge invariance, gauge-invariant computations of the curvature perturbations, gravitational waves)

IV. Post-inflationary evolution and the origin of large-scale structure:

(matter power spectrum, CMB anisotropy, galaxy formation)

V. Inflation in string theory:

(cosmological backgrounds in string theory, the Landscape of String Theory, Braneworld inflation, open questions)

Text:

The primary text are lecture notes "Inflation and the Theory of Cosmological Perturbations" by Antonio Riotto, hep-ph/0210162, and a book by Andrew R. Liddle and David H. Lyth "Cosmological Inflation and Large-Scale Structure". Additional resources will be posted on/linked to the course webpage.

Course evaluation:

Course grade will be based on a number of homework assignments (to be specified). There will be no final exam.

Feedback to the instructor regarding the quality, speed, and content of presentation is especially appreciated during the semester!