

**Course title:**

INTRODUCTION TO COSMOLOGY

**Duration** [number of hours]: **24**

**PhD Program** [MERC/MPS/SPACE]: **SPACE**

**Name and Contact details of unit organizer(s):**

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**Course Description** [max 150 words]:

The course aims at introducing Modern Cosmology. We discuss the theoretical and observational bases of the standard cosmological model in terms of space-time symmetries and components of the present-day energy budget. We then derive the Friedmann equations describing the evolution of the Universe on large scales. The main physical concepts are introduced to describe the thermal history of the Universe, including the earliest phase of inflation, baryogenesis, nucleosynthesis of light elements, hydrogen recombination and decoupling of particle species. Finally, we discuss the process of cosmic structure formation, as well as the generation of cosmic microwave background anisotropies from primordial inhomogeneities. Furthermore, we give basic information on the estimation of theoretical predictions through observational data.

**Syllabus:**

1. The Cosmological Principle and the Friedmann-Lemaître-Robertson-Walker metric.
2. The standard cosmological model.
3. Observational evidences for the cosmic dark sector. Acceleration of the Universe and the dark energy puzzle.
4. Thermal history of the Universe: main concepts.
5. Perturbation theory and Inflation.
6. Gravitational instability scenario and formation of cosmic structures.
7. Main properties of the Cosmic Microwave Background.
8. Precision Cosmology and main observational probes.
9. Elements of numerical calculations in cosmology.

**Assessment:**

The final assessment may consist of either an oral examination focusing on the main concepts introduced during the course, or, alternatively, a presentation (short seminar) where a specific topic covered during the course is analyzed in detail by the student.

**Suggested reading and online resources:**

1. "Cosmology", by N. Vittorio (2017).
2. "An Introduction to modern cosmology", by A.R. Liddle (2015).
3. "Cosmology", by D. Baumann (2022).