Título/Title:
What do we know about the Big Bang and the Universe?

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Descrição/Description:
In the last two decades, Cosmology has undergone a metamorphosis driven by the development of new technologies and ambitious observational surveys performed by international collaborations. All these efforts have provided detailed information about the cosmic distribution of supernovae, the statistical properties of large scale structure, or the tiny anisotropies in the temperature pattern of the cosmic microwave background. The access to this vast amount of information has allowed to shape a standard model of cosmology, the so-called Lambda-CDM model, framed within General Relativity (GR), and consisting on a hot Big Bang model with a tiny positive cosmological constant, a cold dark matter component and an early phase of inflationary expansion.
The goal of this project is to teach the student to reconstruct the cosmological background evolution history of the universe using standard mathematical and physical techniques of Cosmology. The project is split in three main aspects. First, we will review basic notions of differential geometry, useful to study different problems of gravitational physics. Second, the student will acquire the necessary background to understand and solve Einstein's equations under the assumptions of homogeneity and isotropy, leading to the so-called Friedman equations, which govern the large-scale cosmological evolution. And third, he/she will interpret and backtrack such equations in order to determine the estimated current age of the Universe as well as its fate in the future.
The main goal of this project is to provide the student with the basic geometrical, physical and computational tools employed in gravitational physics and Cosmology, so as to set the ground for a potential future research on these topics at the MsC/PhD level.

Requisitos/requirements:
To have taken a previous course on differential geometry and/or General Relativity and/or Cosmology would be certainly helpful, but it is not a prerequisite. In this sense, the level/deep of the project will be properly adjusted to student's knowledge, skills and interests.