

# Universo Primitivo 2019-2020 (1º Semestre)

Mestrado em Física – Astrofísica e  
Cosmologia

## Universo Primitivo / Primordial Universe

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Regent:

**Prof. António da Silva** ([ajosilva@ciencias.ul.pt](mailto:ajosilva@ciencias.ul.pt), gab. 8.1.42):

Teórica: T11

Tutorial: TP11;

Resources:

**Fenix:** <https://fenix.ciencias.ulisboa.pt/courses/up-1128979398395741>

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## HORÁRIO

	Seg 9/17	Ter 9/18	Qua 9/19	Qui 9/20	Sex 9/21	Sáb 9/22	Dom 9/23
07:00							
08:00							
09:00							
10:00							
11:00				11:00 - 13:00 TP 8.2.14			
12:00							
13:00							
14:00	14:00 - 16:00 T 8.2.02						
15:00							
16:00							
17:00							
18:00							
19:00							
20:00							

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## OBJECTIVES

The study of the physics of the Primordial Universe in the context of the **Standard Model of Cosmology** – the **Hot Big-Bang theory**. The students are presented with the key concepts of the model and are expected to learn how to apply these concepts to solve problems related with the physics of the Primordial Universe, Cosmology and Astroparticle physics.

TP lectures will be given, as much as possible, in a “tutorial regime”. There students can interact with the lecturer and colleagues to find ways of solving the proposed exercises and discuss subjects and questions that may arise in their individual studies of the course’s topics”.

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## PROGRAMA

1. The observed Universe
2. The Standard Model of Cosmology
3. Thermodynamics in a expanding Universe
4. Neutrino Decoupling
5. Dark Matter and WIMP relics
6. Big-Bang Nucleosynthesis
7. Recombination and CMB decoupling
8. Baryogenesis
9. The theory of Inflation
10. Perturbation theory during inflation
11. Evolution of perturbations after inflation
12. Dark Energy



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## BIBLIOGRAPHY

### Main:

- **Edward Kolb and Michael Turner - 'The early universe' - Addison Wesley 1990.**
- Patrick Peter and Jean-Philippe Uzan, "Primordial Cosmology", Oxford U. Press, 2009;
- Scott Dodelson - 'Modern Cosmology' - Academic Press, Elsevier, 2003;
- **Daniel Boumann, Cosmology, Part III Mathematical Tripos, Course Lectures**

### Other:

- A. Liddle and D. Lyth - 'Cosmological inflation and large-scale structure' - CUP 2000
- Barbara Ryden - "Introduction to Cosmology" - Addison Wesley, 2003
- Inflation and the theory of Cosmological Perturbations, A. Riotto, Lectures on Astroparticle , Physics and Cosmology



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## EVALUATION

Final grades will be computed as a weighted score of the grades obtained by the student in the following proposed activities:

- **Exercise sheets** (40%);
- Individual research work (50%) on a topic (chosen from a proposed list or an accepted topic proposed by the student). This research work has two component:
  - **Written article** (25%): to be submitted electronically (using a latex based platform such as Overleaf – word based docs are to be avoided as much as possible) for the book of “proceedings” of the Primordial Universe 2019/2020 course)
  - **Presentation** (25%): Maximum duration is 30 minutes.
- **“Continuous assessment”** (10 %): e.g., participation in the discussion of topics in the theoretical and practical lectures