

Título/Title:

Understanding the nature and properties of black holes

Orientador/Supervisor:

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Local do Estágio/Host Place:

IA-Lisbon (FCUL)

Descrição/Description:

Black holes are one of the most intriguing objects in Nature. Identified in the popular lore as cosmic monsters able to swallow everything that falls into their domains, from an astrophysical perspective they are believed to arise as remnants of full-exhausted stars and represent regions of space-time from which nothing can escape, not even the light. Recently, the discovery of gravitational waves out of the gravitational merger of two astrophysical-size black holes has increased the interest on the theoretical and computational understanding of these objects, which could help to observationally discriminate between different compact objects and gravitational theories beyond General Relativity. Black holes have connections with many aspects of fundamental physics, such as the unification of General Relativity and Quantum Mechanics (Quantum Gravity), the understanding and resolution of space-time singularities, the information loss problem, and so on.

In this project, the student will be taught basic and advanced properties of black holes as follows:

- Understanding and characterization of the threesome of classical black holes in General Relativity (vacuum, charged, and rotating).
- Unavoidability of the existence of space-time singularities deep inside black holes, and the lessons that this brings to our understanding of the physics beyond General Relativity.
- The astrophysical aspects of these objects, most notably the emission of gravitational waves out of black hole mergers.

This main goal of this project is to provide the student with:

- An understanding of the basic theoretical elements to investigate black hole physics.
- A technical training on standard mathematical methods of the field: variational methods, resolution of field equations, advanced methods, numerical methods (Mathematica), and so on.
- An introduction to organization and presentation of scientific results, to the way Science is performed in current times, and to the research life as a whole.

The student will join the research topics of Dr. Diego Rubiera-Garcia (FCT fellow) which are of current interest on the community. For a taste of this research check <https://arxiv.org/pdf/1504.07015.pdf>. If successful, this research could set the ground for publications and future research on these topics at the MSc/PhD level. For further information do not hesitate to contact me at drgarcia@fc.ul.pt.

Requisitos/Requirements:

Previous experience on differential geometry and/or General Relativity 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. A reasonable commitment in terms of time dedication is expected.