Título/Title:
Black hole mysteries

Orientador/Supervisor:
Diego Rubiera-Garcia (IA- Faculdade de Ciências da Universidade de Lisboa) drgarcia@fc.ul.pt

Descrição/Description:
Black holes are one of the most intriguing objects in Nature. 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.

In this project, the student will be taught the basic tools to describe black holes, split in three main aspects. First, we will review basic notions of differential geometry, useful to study different problems of gravitational physics. Second, we will study the theoretical characterization of the threesome of classical black holes in General Relativity (vacuum, charged, and rotating), with special emphasis on the understanding of the nature of the event horizon that characterizes these objects as well as their associated thermodynamic properties. And third, we will discuss the nature and implications of the existence of spacetime singularities in the innermost region of black holes, which is one of the largest threats to the internal consistence of General Relativity.

The main goal of this project is to provide the student with the basic geometrical, physical and computational tools employed in gravitational and black hole physics, 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 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.