Título/Title:

Was Einstein 100% right?

Orientador/Supervisor:

Diego Rubiera-Garcia (drgarcia@fc.ul.pt)

Local do Estágio/Host Place:

IA-Lisbon (FCUL)

Descrição/Description:

The recent observation of gravitational waves by LISA/VIRGO Collaborations is consistent with the predictions of Einstein's General Theory of Relativity for the merger of two black holes and a black hole-neutron star system. This observation is added to the pool of experimental evidence supporting the reliability of this theory to describe gravitational interaction. However, there are strong theoretical and observational arguments supporting the need to extend this theory for both strong and weak gravitational fields, which has triggered a lot of attention in the astrophysics/cosmology community.

The aim of this project is to review the nature of these problems and to develop a training to investigate extensions of General Relativity and their applications to specific scenarios. More specifically the student will deal with the following topics:

- Understanding of the core principles building GR, both from a physical and a mathematical perspective, as well as their current observational constraints.
- Training on modifications of GR via additional geometrical elements such as non-metricity and torsion.
- Specific applications in black hole physics and cosmology: resolution of theoretical problems (black hole and Big Bang singularities) and astrophysical (for instance in neutron star physics) applications.

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

- An understanding of the basic theoretical elements to investigate extensions of General Relativity
- 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/1704.03351.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.