Título/Title:

Time Domain Astronomy: Following the tessellation of the Universe.

Área/Area:

Gravitação e Cosmologia

Orientador/Supervisor:

António da Silva (ajosilva@fc.ul.pt)

José Pedro Mimoso (jpmimoso@fc.ul.pt)

Local do Estágio/Host Place:

IA-Lisbon (FCUL)

Descrição/Description:

The remarkable improvement in the quality of astronomical observational data, makes it now possible to envisage a novel program of observations denoted Time Domain Astronomy. Until now cosmological observations were devoted to obtaining detailed "snapshots" of the universe at increasing remote epochs, with time-limited scanning strategies or exposition times. This allows to impose constrains to the underlying cosmology and structure formation mechanism, inferred from the statistics of an ensemble of sources/signal acquired at a given time. A new complementary and potentially powerful observation method is to follow the evolution of a set of individual sources, continuously in time (the so-called time domain astronomy) and from these infer model constraints. Given its potential, it is now time to devise a new set of cosmology time domain observables and sources to be use as future cosmological tests.

The underlying idea of this project is to study the evolution of a set of large-scale structure sources in fields, at intermediate and deep cosmological scales, and follow their tessellation patterns with time. The Voronoi tessellation of a given area is a polygonal tiling of the surface that follows a simple rule of proximity between neighboring points. The student will apply this technique to obtain the tessellation patterns of a given sky patch, using the positions of sources in the patch as tessellation seeds, and model their redshift evolution for different cosmologies. The ultimate objective of the study is to assess the potential of tessellation related properties as probes of cosmology for future time-domain astronomy proposals. Where possible the student will compare simulated tessellation patterns with those obtained from present observations.

Besides the scientific goals underlying this project, the student will develop fundamental skills which will enable him to further develop the subject into a MSc or PhD research program

Requisitos/Requirements:

Part of the work will require the use of a data programming language, such as Python or R. Prior knowledge on Computational Physics, General Relativity and Galactic Astrophysics would be advantageous. However, in the course of the development of the project the student will be able to get acquainted with the required concepts and will acquire a working knowledge of what will be needed for the project.