



UNIVERSITÀ
DEGLI STUDI
DI PADOVA

GWSKY - Mapping the Universe with Gravitational Waves

While scientists observed the night sky with telescopes for centuries, only in the past decade have we begun to probe it with gravitational waves (GWs). Next-generation GW observatories, if properly exploited in synergy with current and future galaxy surveys, have the potential of mapping the structure of the Universe in a fully independent and complementary fashion with respect to what has been done so far. In particular, by studying GW propagation across cosmological distances and GW sources spatial distribution, we can shed light on dark matter and dark energy properties, and also on what the correct theory of gravity is. Even if numerous studies have already investigated the theoretical feasibility of this kind of analysis under relatively simplistic assumptions, none of them have ever provided a framework that demonstrates how this goal is, in fact, achieved. The purpose of this project is to bridge the gap between the current idealised analysis and an actual realistic implementation, ultimately capable of informing us about the underlying properties of these GW sources and our Universe. In other words, I aim to provide an end-to-end framework that fully characterizes how GWs can be used to trace the three-dimensional large scale structure of the Universe. This project is divided into three main stages. First, I will provide a robust methodology to create realistic mock catalogs of GW sources spatial distribution for different classes of compact objects. Second, I will develop a statistical procedure to create optimal GW sky maps both from detected and undetected GW events, aiming to minimize the amount of statistical and systematic noise. Finally, I will forecast the capability of future GW experiments in synergy with galaxy surveys to characterize different populations of compact objects. Completing this program will allow me to not only shape the design of future experiments, but also to provide a starting point for real-data analyses.

UNIPD Supervisor: Alvise Raccanelli

MSCA Fellow: Nicola Bellomo

Department: Physics and Astronomy "Galileo Galilei"

Coordinator: Università degli Studi di Padova (Italy)

Total EU Contribution: Euro 209.483,28

Call ID: HORIZON-MSCA-2024-PF-01

Project Duration in months: 24

Find out more: <https://cordis.europa.eu/projects/en>