

Marco Bonici PhD third year report

My PhD supervisors are INFN staff researcher Stefano Davini and Professor Nicola Maggiore.

Research Subject

During the last year of my PhD I continued my research in the context of the Euclid Mission. Euclid is a medium size ESA space mission, whose main scientific tasks are related to fundamental physics such as the nature of Dark Energy, Dark Matter and the neutrinos mass scale. Euclid will observe about a billion galaxies obtaining a measure of the matter distribution in the Universe. Furthermore, from the shapes of the observed galaxies, it will also obtain an estimate of the gravitational lensing, the light distortion due to the underlying mass distribution.

I am studying, cooperating with the Milan INAF section, the cross-correlation between lensing and the cosmic voids distribution. Cosmic voids are among the biggest large scale structures of the Universe and they are underdense regions; for this reason, their features are really sensitive to Dark Energy and neutrinos. In order to study this cross-correlation, I have developed a Python code which forecast the values of these observables in several cosmological scenarios and their sensitivity to cosmological parameters. After several systematic checks and the validation of my scientific results, I have written the paper on my work which has been sent to the Euclid collaboration and is currently undergoing an internal review and soon will be published.

Furthermore, with my colleague Luca Paganin, we have been extending my code to perform a similar analysis to the one I have already performed. In particular, we are studying the cross-correlation between the spectroscopic and the photometric galaxy samples of Euclid, which have different properties and characteristics. The spectroscopic sample is composed by galaxies whose redshift has been measured with spectroscopy; this technique gives accurate redshifts but the number of galaxies observed is lower than the number of galaxies in the photometric samples. On the other hand, photometric redshifts are less accurate than the spectroscopic ones. The cross-correlation of different probes is important because, when taken into account, enhances the constraining power of a galaxy survey and hence the measurements of cosmological parameters will be more precise.

List of given exams during my PhD

- Simulation methods applied to Physics (R. Ferrando)
- Very High Energy Astrophysics (F. Tavecchio)
- Summer School of Cosmology, International Center of Theoretical Physics, Trieste
June 2018
- Computational Methods in Cosmology, Cargese, August 2018,
- Cosmology (N. Maggiore)
- Gravitational Waves (G. Gemme, A. Chincarini, F. Sorrentino)

Attended Conferences and Meetings during last year

- Euclid Science Meeting, Paris, 3/02/2019-7/02/2020 (oral contribution)
- Euclid Workshop INAF, Bologna, 11/02/2019-14/02/2020: Annual collaboration meeting for the Italian Euclid community (oral contribution)
- Euclid Annual Meeting, online, 04/05/2019-08/05/2020: Annual collaboration meeting for the ESA Euclid Mission

Published Papers

- "Towards a New Proposal for the Time Delay in Gravitational Lensing"; Nicola Alchera, Marco Bonici, Nicola Maggiore; Symmetry 2017, 9(10), 202;
<https://doi.org/10.3390/sym9100202>
- Analysis of the Angular Dependence of Time Delay in Gravitational Lensing"; Nicola Alchera, Marco Bonici, Roberta Cardinale, Alba Domi, Nicola Maggiore, Chiara Righi, Silvano Tosi; Symmetry 2018, 10(7), 246,
<https://doi.org/10.3390/sym10070246>
- "Constraints on Interacting Dynamical Dark Energy and a new test for Λ CDM"; Marco Bonici, Nicola Maggiore; Eur.Phys.J. C79 (2019) no.8, 672;
<https://doi.org/10.1140/epjc/s10052-019-7198-1>