

Research project and development plan

The Euclid space mission, managed by the European Space Agency (ESA), aims to study dark energy and dark matter by creating a three-dimensional map of the universe. A crucial component of the mission is the collection and analysis of spectroscopic data, which allows the measurement of the physical and chemical properties of the observed galaxies. The management of this data is assigned to the Organizational Unit Spectroscopy (OU-SPE), which is responsible for the development, validation, and testing of the spectroscopic measurement pipelines. These pipelines are essential to ensure the quality and accuracy of the measurements required for the mission's Key Projects.

This research project focuses on the development, validation, and optimization of these pipelines, with particular attention to the analysis of non-standard object populations and the robustness of the code. Dedicated simulations will be employed to test the performance of the pipelines and ensure that the spectroscopic data provided by Euclid are suitable for the mission's scientific goals.

Objectives:

- Improve the robustness and accuracy of the spectroscopic pipelines through the development of dedicated simulations.
- Optimize the pipeline for measuring key objects such as AGN (Active Galactic Nuclei) and passive galaxies, essential for Euclid's legacy science.
- Support the Euclid team in the operational phase, ensuring the validity of the data collected.
- Explore the scientific and cosmological constraints obtainable through spectroscopic data.

Activities:

- **Development and validation of simulations** for the analysis of non-standard object populations not included in Euclid's official simulations (AGN, passive galaxies) to test the robustness of the code.
- **Development and optimization of the pipeline** for measuring spectral features of AGN (essential for legacy science): broad lines, multi-component fitting.
- **Development and optimization of the pipeline** for measuring spectral features of passive galaxies (essential for legacy science): Lick indices, spectral discontinuities (e.g. D4000).
- **Study and implementation of methodologies** for the measurement and analysis of spectral features in Deep Field spectra, including the combination of Blue Grism and Red Grism.
- **Analysis and optimization of outputs**, in synergy with OU-LE3, to improve mission performance in terms of purity and completeness, including non-standard parameters (line width, various line flux measurement methods).
- **Analysis of E2E simulations** provided by different Science Working Groups, with outputs necessary for the completion of various Key Projects.
- **Validation and support of the code** during the mission, especially in the early phase, and support for Q1 and DR1 releases, with close and periodic testing phases to validate the performance of the SPE pipeline and the overall Euclid pipeline.
- **Exploitation of spectroscopic measurements** to explore additional scientific cases, such as gravitational waves, cosmic chronometers, and other emerging astrophysical phenomena.

The success of the Euclid mission heavily depends on the quality and precision of the collected and analyzed spectroscopic data. The work of developing, validating, and optimizing the OU-SPE pipelines will play an essential role in ensuring that these data meet the scientific goals of the mission, opening new paths for understanding the universe and its evolution.