Project 5.1 PACIS: Precision and Accuracy for Cosmological Imaging Surveys

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Background:

Cosmological measurements from new-era surveys of galaxies are expected to rigorously test the standard model of the Universe dominated by mysterious dark matter and dark energy. One of the most promising avenues towards this goal is to carefully study various physical aspects of matter distribution on the largest cosmic scales. This distribution is observationally traced by luminous beacons – galaxies, and new and better approaches to efficiently cataloging them and estimating their distances (via redshift) are necessary. The aim of the project is to harvest the newest imaging datasets and construct state-of-the-art galaxy catalogs with reliable redshift estimates, to be employed for precise and accurate cosmological tests using jointly weak lensing and galaxy clustering. For that purpose we are developing robust and self-contained methodologies based on recent advancements in machine learning and Bayesian inference. We will apply our novel framework to modern photometric data, with the aim of delivering new, enhanced galaxy datasets. We will start with the recently completed Kilo-Degree Survey and use it as a stepping stone towards the next-generation Legacy Survey of Space and Time. Following careful validation, the novel galaxy samples extracted from these deep wide-angle datasets will be used for cosmological multi-probe studies.

Aim:

We will work with cosmological imaging surveys and apply state-of-the-art computer techniques such as machine learning to select complete and pure galaxy samples with precise and accurate photometric redshifts. We will use tools such as artificial neural networks and the most novel deep learning. Post-processing steps will follow to employ the new datasets for cosmological analyses, in particular for the multi-probe approach with weak lensing and galaxy clustering within the KiDS and LSST teams.

Requirements:

- Master of Science (MSc) degree or equivalent in physical or computational sciences,
- documented experience with (astro)physical big data and/or machine learning in the (astro)physical context will be an additional asset,
- interest in the subject and motivation for scientific research,
- knowledge of spoken and written English at a level to efficiently communicate.