Non-parametric Decomposition of Morphological Structures in Disc Galaxies

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Abstract

Morphological decomposition in galaxies involves separating different structural components (like bulges, disks, bars, and spiral arms) to understand their individual properties and contributions to the galaxy's total light distribution. This technique, typically performed by fitting mathematical functions to galaxy images, is pivotal in understanding galaxy formation and evolution since different components form through distinct physical processes and at different cosmic epochs. The goal of this project is to deploy a framework to perform a non-parametric decomposition of disc galaxies in modern photometric surveys and use it to analyse a sample of nearby massive disc galaxies. A non-parametric approach makes fewer assumptions about component shapes compared to traditional parametric methods, potentially revealing more complex or unexpected structures. We will make use of Capivara, a segmentation code based solely on spectral similarity, tested on an IFU-based survey. Initially we will search J-PAS, PHANGS and S4G photometric surveys for a sample of nearby disc galaxies and transform the data into hyperspectral data cube to be fed to Capivara for decomposition. After that, a stellar population analysis will be made for each similarity group in each galaxy, using SED fitting techniques. These results will be evaluated to extract insights about the disc galaxies defined as samples and compare our results to those obtained from IFU studies such as TIMER. Migrating from IFU to photometry will imply a loss of spectral resolution but a marked increase in spatial resolution and volume. Given the multitude of large photometric surveys currently under operation, this exploration is timely.