GALFITools: A Python library to enhance GALFIT usage in galaxy image modeling

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Summary

Understanding how galaxies form and evolve requires measuring their light distributions in images taken by telescopes. This process often involves fitting mathematical models to galaxy images to extract properties such as size, brightness, components, and shape. GALFIT is a widely used tool for this purpose, but it requires careful preparation of input files and interpretation of results, which can be a barrier to efficient use.

GALFITools is a Python library that streamlines this workflow by automating many of the tasks surrounding the use of GALFIT. These include generating image masks, estimating sky background, modeling the telescope's point spread function, and extracting physical parameters from GALFIT outputs. The software is designed for researchers and students who work with galaxy image modeling and aims to make the process more reproducible, accessible, and scalable.

Statement of need

The analysis of galaxy morphology through image fitting is a fundamental task in extragalactic astronomy. GALFIT (C. Y. Peng et al., 2002; Chien Y. Peng et al., 2010) is a well-established tool that performs parametric two-dimensional modeling of galaxy surface brightness profiles. However, GALFIT does not provide utilities for related tasks such as generating mask images, selecting stars for PSF modeling, estimating initial fit parameters, or interpreting its output formats in a structured way. These tasks are typically handled manually or with ad hoc scripts, which reduces reproducibility, becomes time-consuming and error-prone, raises the barrier for new users, and makes the application to large surveys difficult.

GALFITools (Añorve, 2024) addresses this gap by offering a cohesive suite of Python-based tools that extend the functionality of GALFIT. It facilitates the full modeling pipeline, from input preparation to result interpretation. This includes routines to construct PSFs, galaxy modeling via Multi-Gaussian Expansion (MGE, Cappellari, 2002), estimate sky backgrounds, simulate galaxies, estimate initial parameters, generate diagnostic plots, model visualization, and compute photometric parameters from multiple Sérsic components such as effective radius, bar size, Sérsic index, (among others). These functionalities are available as command-line tools, in line with GALFIT's command-line interface, but can also be imported as Python modules.

GALFITools lowers the technical barriers for new users and increases efficiency for experienced researchers. The package is designed for astronomers who analyze galaxy images and require flexible, scriptable tools that complement GALFIT analysis. While other packages such as `IMFIT` (Erwin, 2015) and `ProFit` (Robotham et al., 2016) provide similar modeling capabilities, GALFIT remains one of the most widely used tools in the astronomical community for galaxy image modeling, supported by an extensive user base and numerous legacy workflows. GALFITools is not a replacement for GALFIT, but a complementary toolset specifically tailored to its ecosystem. By reducing the technical overhead and providing automation, GALFITools supports researchers in conducting large-scale studies of galaxy structure and photometry with improved efficiency and reproducibility.

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