



Weighing in Dwarf Galaxies

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Motivation

As telescopes like the Rubin Observatory and Euclid Space Telescope discover more low-mass galaxies, understanding how their light translates into stellar mass remains unclear, especially for small dwarf galaxies. A recent study by Mithi A. C. de los Reyes highlights how stellar mass can vary depending on a galaxy's star formation history. This project aims to compare mass-estimates of small dwarf galaxies from the Galaxy And Mass Assembly (GAMA) survey using four different methods to determine whether they agree, particularly for galaxies with only a few million stars. The goal is to explore whether we are missing stars in these small galaxies. Using Jupyter notebooks and Python, the project will analyze and visualize the data to answer these questions.



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Methodology

Using Jupyter and Python, we import Matplotlib for graph plotting and Astropy for handling astronomical data. Our primary model, MAGPHYS, uses spectral energy distributions to estimate parameters like stellar mass. We compare MAGPHYS with four different Bagpipes models. Python codes that generate galaxy spectra and fit them to observational data. The data from both models, containing stellar mass information, are merged into a single table, and a logarithmic transformation is applied to scale the large values into a comprehensible range. A scatter plot is created to compare the values of MAGPHYS and the Bagpipes models on a log10 scale, followed by categorizing the data into low-mass ($<10^{8.5}$) and high-mass ($>10^{8.5}$) galaxies. Histograms are plotted to visualize the distribution of differences, and mean and standard deviation are calculated to compare the datasets.



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Logarithmic Stellar Mass Value Comparison

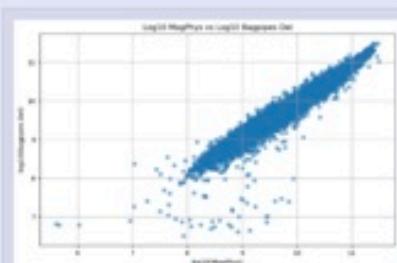


Figure 3. MAGPHYS vs Bagpipes DEL

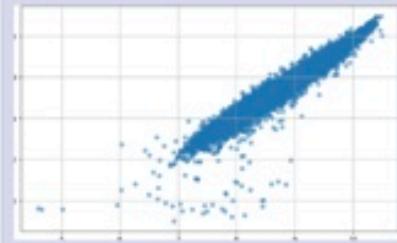


Figure 4. MAGPHYS vs Bagpipes DEL, -1 shift

Distribution of Logarithmic Stellar Mass Differences



Figure 5. MAGPHYS vs Bagpipes DEL

Our histograms show a fairly large gap in distribution between high and low mass galaxies. Standard Deviation for both high and low mass galaxies across all four models are in a consistent value. We found that there is bias in our results, illustrated by the differences in the mean values. Big galaxies agree, smaller galaxies do not.

Conclusions and Future Work

Conclusions

- This study analyzed the comparison and contrast to model MAGPHYS and Python code Bagpipes on a logarithmic scale.
- In obtaining the histograms, there is bias in our results due to conflicting mean values.

Future Work

- In the future, we can study bias by performing a KS test on all four histograms, allowing for comparison to analyze consistency between the two models.
- Another thing to take into future account is limiting x -values for redshift (Z).

References

- Bellstedt, Sabine, et al. Galaxy And Mass Assembly (GAMA): A forensic SED reconstruction of the cosmic star formation history and metallicity evolution by galaxy type, 2020.
- Carnall, Adam, et al. How to measure galaxy star formation histories I: Parametric models, 2019.
- Paspalas, E.-D, et al. Star-forming early- and quiescent late-type galaxies in the local Universe, 2022.

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