Project Title: The impact of a variable Initial Mass Function on galaxy evolution

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Project Description:

The stellar initial mass function (IMF) describes the number of stars formed per stellar mass bin in a given star formation episode and represents one of the fundamental assumption for any theory of galaxy evolution. Recently, different lines of evidence have challenged the long-standing assumption of the universality of the IMF, based on local observations. The strongest deviations from this hypothesis have been found in the most massive early type galaxies (e.g. La Barbera et al. 2013, Cappellari et al. 2012), using a combination of dynamical and spectroscopic diagnostics. Nonetheless, some inconsistencies between the different evidences have been also reported, and the subject remain heavily debated in the community. The increase of available resolved dynamical information and high resolution spectroscopy is also making the subject of a variable IMF a popular one. It is therefore timely to assess the theoretical expectations of such scenarios.

This PhD project is aimed at a detailed characterization of the impact of a variable stellar Initial Mass Function (IMF) on the chemical and physical properties of galaxies. The successful candidate is supposed to work mainly with the semi-analytic GAEA model (Hirschmann, De Lucia & Fontanot 2016). This code represents an ideal tool to carry out this investigation, thanks to its improved modeling of chemical enrichment (which explicitly includes the differential contribution of SNeII, SNeIa and AGB stars) and stellar feedback (which allows us to reproduce the differential assembly of galaxy populations over cosmic epochs). Moreover, GAEA already features module variants that deal with IMF variability and link the IMF shape to

the physical properties of the star-forming galaxies, such as their SFR and SFR density.

We expect the student to work on the extensive comparison between model predictions and observational constraints. His/her involvement will be twofold. From the numerical point of view he/she will work directly on the code structure and implementation, with particular emphasis on the coupling of model outputs with the latest generation population synthesis models, in order to predict the shape and properties of spectral features sensitive to IMF variations. Moreover, from the observational side, she/he will work alongside with INAF experts (e.g. La Barbera et al., 2013) on the characterization of the same spectral features on observed high-resolution spectra with the aim to provide a quantitative comparison with model predictions. Model results will also be used to formulate predictions for future observational programs.