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BAYESIAN ANALYSIS OF GALAXY SEDS FROM FUV TO FIR

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Abstract. Photometric data of galaxies ranging from rest-frame far-UV to far-IR allow to derive galaxy properties in a robust way by fitting the attenuated stellar emission and the related dust emission at the same time. For this purpose we have written a code which uses model spectra composed of the Maraston stellar population models, synthetic attenuation functions based on a modified Calzetti law, spectral line templates, and the Dale & Helou dust emission models. Depending on the input redshifts filter fluxes are computed for the model set and compared to the galaxy photometry by carrying out a Bayesian analysis. The code is tested by analysing a subset of the SINGS sample of nearby galaxies. We illustrate the quality of the results by comparing them to literature data and discuss the importance of IR data for the reliability of the fitting.

1 Project

Rest-frame UV-to-IR spectral energy distributions (SEDs) of star-forming galaxies at given redshifts enable us to derive physical galaxy properties with a high reliability, since dust extinction and dust emission can be studied at the same time. For this reason, we have developed the observer-friendly programme package *CIGALE* (*C*ode *I*nvestigating *GA*L*a*xy *E*mission) following a Bayesian approach (cf. Burgarella et al. 2005).

2 Procedure

CIGALE uses a grid of model templates based on one or two stellar population models of Maraston (2005) or PEGASE (Fioc & Rocca-Volmerange 1997) with different ages and exponentially decreasing star-formation rates (SFRs) characterised by the e-folding time τ. The use of Maraston (2005) models is preferred, since thermally pulsating asymptotic giant branch stars are considered. The stellar spectra are extinguished by Calzetti et al. (2000) dust attenuation curves modified by multiplying a power law (allowing for different slopes) and adding an optional Gaussian 2175 Å bump. The latter is suggested by the frequent detection of UV bumps in distant, UV-luminous galaxies (Noll et al. 2007). The re-emission of the dust-absorbed energy in the IR is considered by consistently adding dust emission templates of Dale & Helou (2002), which are parameterised by the slope of the power-law distribution of dust mass over heating intensity. Finally, the UV-to-IR spectra are corrected by empirical interstellar emission and absorption templates based on spectra of Kinney et al. (1996) and Noll et al. (2004).

For the redshifts of the objects under investigation filter fluxes are derived for each model and compared to the observed data by computing χ^2. Then, *CIGALE* performs a Bayesian analysis by using the distribution of χ^2-selected 'good' models in the parameter space in order to derive expectation values and standard deviations for the galaxy properties describing the models used.

3 Results from a SINGS test sample

We test the quality of the code by using a sample of 52 local SINGS galaxies (Kennicutt et al. 2003) for which photometry of Dale et al. (2007) in 16 filters between GALEX FUV and MIPS 160 μm is available. Combining

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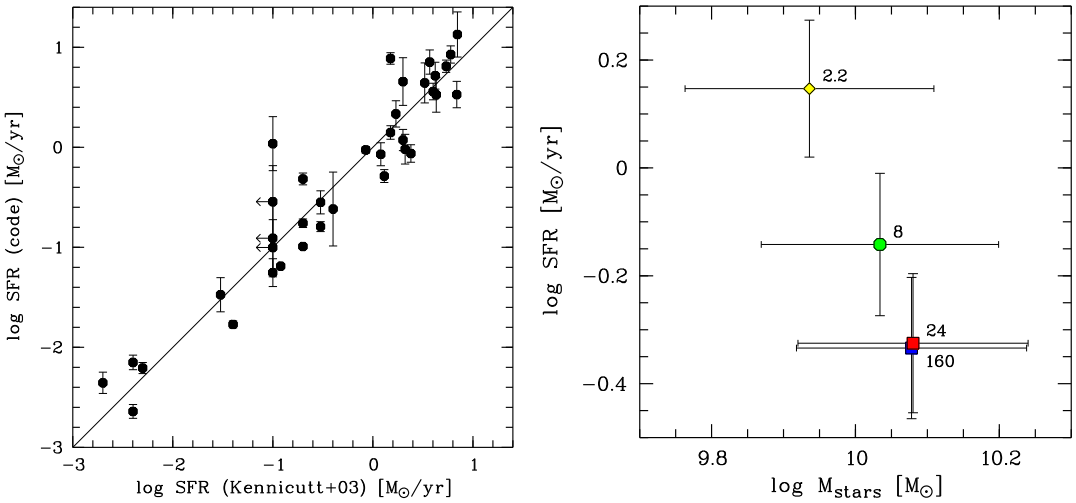

Fig. 1. *Left:* Comparison of the SFRs of our SINGS subsample derived from the code and those of Kennicutt et al. (2003) based on Hα emission. *Right:* Sample means and mean errors for the total stellar mass and SFR of our SINGS subsample for different filter combinations. The wavelength in μm of the last filter in the filter set is indicated near the symbols.

a 10 Gyr and a $\leq$ 0.2 Gyr-old model with different τ and mass ratios for solar metallicity, and a large set of attenuation curves (allowing for different $E(B-V)$ in both model components) and dust emission templates, we find good agreement between the measured and best-model filter fluxes. Typical systematic deviations are about 0.1 mag only.

The *CIGALE* results show good agreement with literature data derived in a different way. For example, our SFRs and the Hα-based ones in Kennicutt et al. (2003) differ by marginal 0.02 ± 0.04 dex on average only. Reducing the number of filters in the IR causes a significant deterioration of the fitting results, in particular, for the SFR, if no filter is available which traces the dust emission.

4 Conclusions

The new SED-fitting code *CIGALE* works and is ready for use at higher redshifts. Photometric data from rest-frame UV to IR are essential to obtain reliable galaxy properties.

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