POPULATION SYNTHESIS MODELLING OF LUMINOUS INFRARED GALAXIES AT INTERMEDIATE REDSHIFT

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Abstract. Luminous InfraRed Galaxies (LIRGs) are particularly important for studying the build-up of the stellar mass from z=1 to z=0, and for determining physical properties of these objects at redshift 0.7. The global star formation rate (SFR) at $z \sim 0.7$ is mainly produced by LIRGs. We perform a multiwavelength study of an LIRGs sample in the Extended Chandra Deep Field South at z=0.7, selected at 24 μm by MIPS onboard $Spitzer\ Space\ Telescope$ and detected in 17 filters. Data go from the near-ultraviolet to the mid-infrared. We distinguish a subsample of galaxies detected at 70 μm, which we compare to the rest of the sample to investigate the relative importance of this wavelength in determining of the physical parameters.

Keywords: galaxies evolution, infrared, Bayesian analysis, stellar content, SED-fitting

1 Introduction

Luminous InfraRed Galaxies (LIRGs) are commonly defined as galaxies whose infrared (IR, 8-1000 μm) emission is higher than 10^{11}L$_\odot$ and lower than 10^{12}L$_\odot$. A z ∼1 only 30% of LIRGs exhibit features linked to violent merging (Bell et al. 2007), (Zheng et al. 2007) : most of them look like bright spirals that experience a secular evolution without violent events. This morphological difference between local and distant LIRGs is corroborated by the analysis of their star formation rate (SFR). Whereas local LIRGs are experiencing a strong starburst, distant LIRGs do not seem to strongly depart from the mean SFR - stellar mass ($M_\star$) relation found at z=1 (Elbaz et al. 2007).

2 Analysis of a LIRGs sample

We apply a multiwavelength analysis from the far-ultraviolet (FUV) to the IR, based on SED (Spectral Energy Distribution)-fitting, on a sample of z=0.7 LIRGs selected at 24 μm (Giovannoli et al., 2010). Our aim is to study this galaxy sample, representative of LIRGs at intermediate redshift, in a very homogeneous and systematic way to determine the main characteristics of their stellar populations and dust emission. We study LIRGs with the SED-fitting code CIGALE (Code Investigating GALaxy Emission * : Noll et al. 2009b, Burgarella et al. 2005), which provides an estimation of physical parameters of galaxies thanks to a Bayesian-like analysis. The stellar populations synthesis code of Maraston et al. (2005) is adopted to model the stellar emission (UV, optical, and NIR wavelengths). The created stellar population spectra are then attenuated by using a synthetic Calzetti-based attenuation law (Calzetti et al. 2000) before adding the dust emission as given by the infrared SED library (semi-empirical one-parameter models of Dale & Helou (2002)).

Figure 1 shows distributions for the parameters related to the star formation history and the attenuation ($M_\star$, infrared luminosity L_{dust}, SFR, attenuation in the V-band A_V, fraction in mass of the young stellar population f_{ySP}, and fraction of AGN f_{AGN}) calculated with the Bayesian-like analysis in CIGALE, for the subsample detected at 70 μm and for the whole sample. The masses found for the 70 μm sample are shifted towards higher masses then in the total sample. We observe a similiar situation for L_{dust} and the SFR; the values are in the range [10^{11} ; 10^{12}] L$_\odot$ and [10 ; 92] M$_\odot$.yr^{-1}, respectively, with mean values higher than ones found for the total sample. This shift is expected because of the 70 μm detection limit

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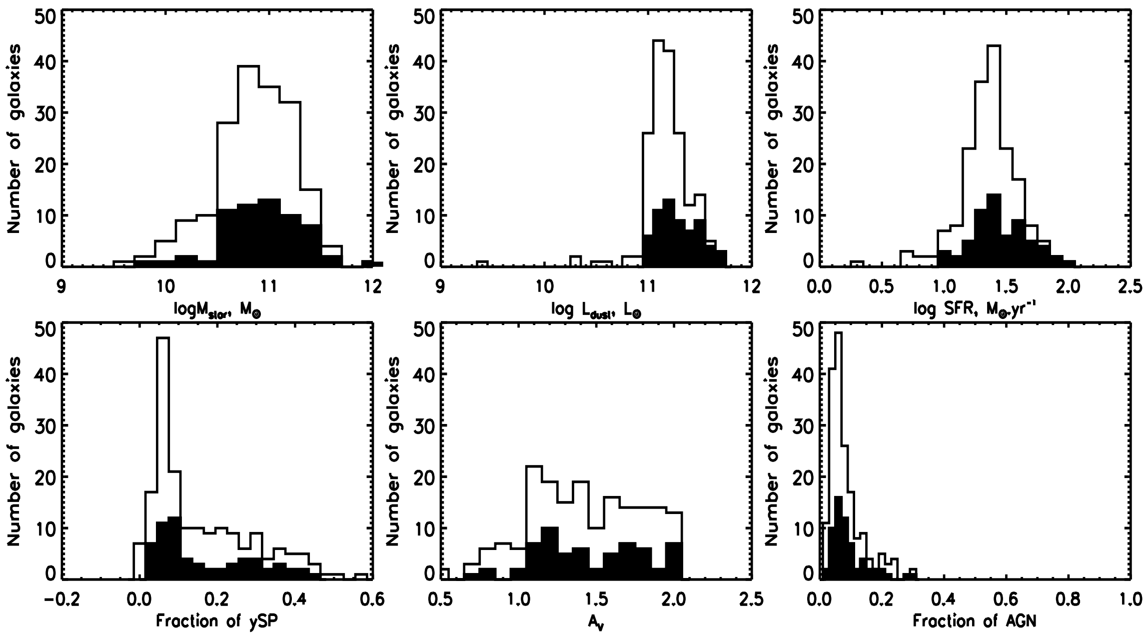

Fig. 1. Bayesian results of the code for the following parameters : $M_{\star}$, L_{dust}, SFR, A_V, f_{ySP}, f_{AGN}. The empty histogram represents the total sample and the full one represents the 70 μm sample.

(2.7 mJy at 5σ): at this wavelength, we only detect luminous and massive galaxies. The distribution of f_{ySP} is broad with a long tail towards high values, and A_V lies between 0.5 and 2.1 mag with very few objects under 1.0 mag and quite a homogeneous distribution between 1.0 and 2.0.

Galaxies in the total sample have $M_{\star}$ between 10^{10} and 10^{12} $M_{\odot}$ with a peak at $10^{10.8}M_{\odot}$. We find the SFR between 3 and 92 $M_{\odot}yr^{-1}$ with a peak at 23 $M_{\odot}yr^{-1}$. For f_{ySP} and A_V, we observe the same distribution as for the 70 μm sample. For both samples, f_{AGN} is relatively low, between 0.0 and 0.3 with the majority of the objects in the interval [0;0.1]. We consider that there is a definite contamination of L_{dust} by an AGN when $f_{AGN} > 15\%$, because a contamination lower than15% does not significantly modify the total IR emission.

3 Conclusions

We fit the SEDs of our sample of LIRGs with the CIGALE code, which combines stellar and dust emissions in a physical way. This study is the first use of CIGALE at a redshift higher than 0. The multiwavelength data analysis performed in this study provides reliable estimates of several physical parameters based on a Bayesian-like analysis.

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