Panchromatic SED modelling with CIGALE: Technical report

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1. Introduction

The aim of this work is to study the evolution of (U)LIRGs (Ultra Luminous Infrared Galaxies – L_{IR} (8-1000 μm) > 10^{11} $L_{\odot}$) by deriving various of their physical properties with high reliability. In order to achieve that we compared modelled galaxy Spectral Energy Distributions (SEDs) with observed ones in a wide range of wavelengths (from the far ultraviolet to the submm), using the CIGALE (Code Investigating GALaxy Emission; Burgarella et al. 2005; Noll et al. 2009) code. This code was developed to fit the attenuated emission and the related dust emission at the same time while estimating galaxy parameters like, for instance, stellar mass, age, luminosity, dust attenuation and star formation history.

2. The sample

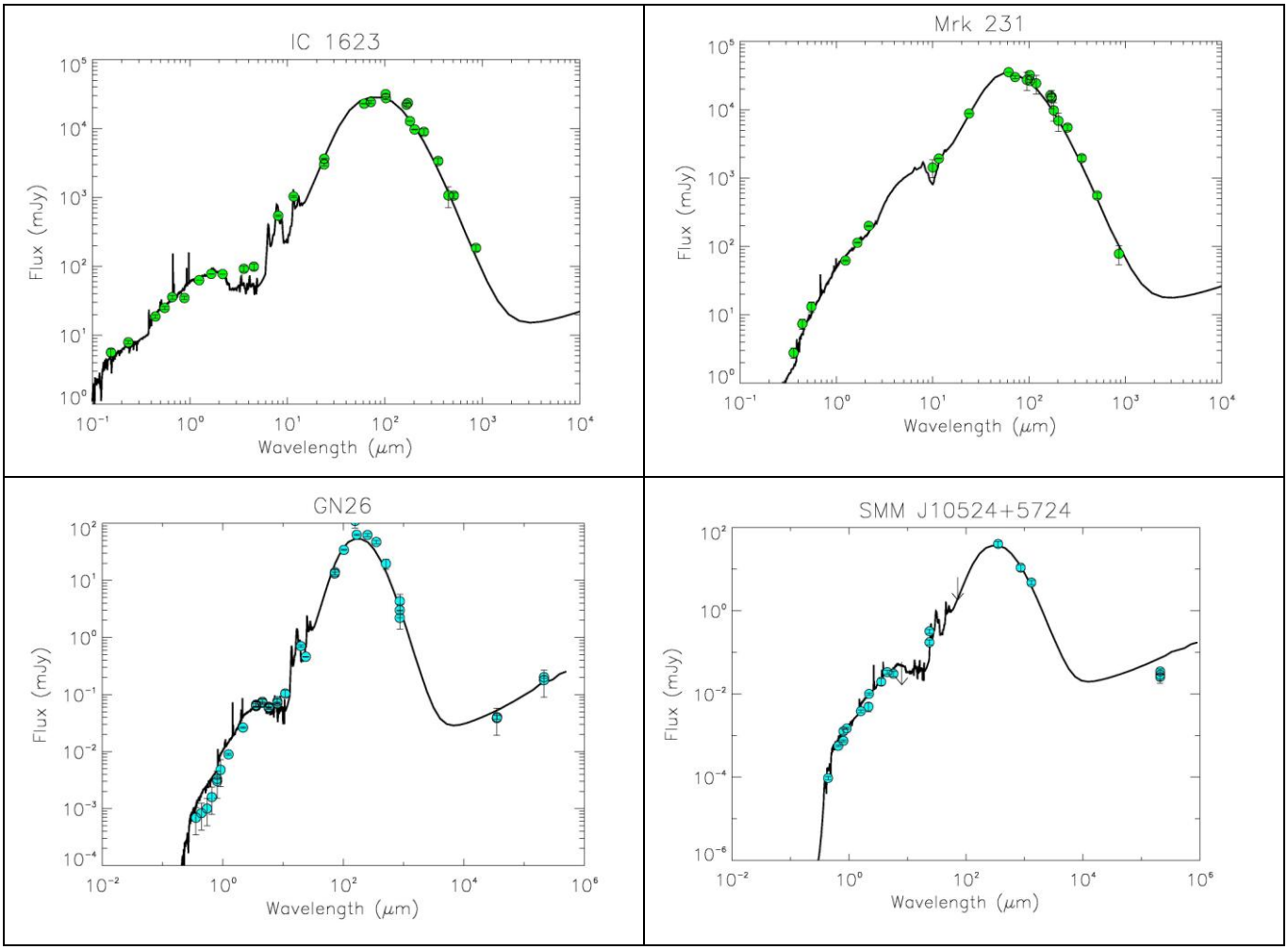
We used a sample of 76 local (U)LIRGs (combining galaxies from the Herschel Comprehensive (U)LIRG Emission Survey (HerCULES) as well as sources from the IRAS Revised Bright Galaxy Sample (RBGS); Papadopoulos et al. 2012) with $z < 0.1$. Our sample was expanded to high redshifts ($z > 1$) by including 42 (sub)-millimeter selected dusty star forming galaxies. The FUV/FIR/submm photometric data were extracted from a meticulous compilation from the literature as well as from the NASA/IPAC Extragalactic Database (NED) while most of the FIR photometric data for the Hercules sample were deduced by our team from PACS/SPIRE Herschel imaging data (see also demogas.astro.noa.gr/PACS_SPIRE_report.pdf).

3. CIGALE

Panchromatic (FUV/optical to radio) spectral energy distributions (SEDs) of our sample galaxies were modeled using CIGALE. CIGALE employs dust-attenuated stellar population models to fit the FUV/optical SED, while at the same time ensuring that the dust-absorbed UV photons are re-emitted in the FIR, thus maintaining energy-balance between the FUV and FIR. The FIR/submm continuum is modeled using the templates by Dale & Helou (2002) and Chary & Elbaz (2001). For the stellar emission population synthesis models from Maraston (2005) with a Salpeter initial mass function were used, and for the reddening we used attenuation curves from Calzetti et al. (1994) with a wide range of V-band attenuation values for young stellar populations. We allowed for the possibility of additional dust emission from deeply buried AGN by including in our SED fits the 32 AGN models from the Fritz, Franceschini & Hatziminaoglou (2006) library. Four representative SEDs are shown in the Figure below.

4. SED modelling

From our well-sampled SED fits we were able to derive various accurate galaxy physical parameters such as stellar mass, age, luminosity, dust attenuation, star formation history, etc.



All SED fits can be found at http://demogas.astro.noa.gr/hercules_seds.htm and at http://demogas.astro.noa.gr/DSFGs_seds.htm.