CIGALE: Code Investigating GALaxy Emission

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Abstract

We present CIGALE (Burgarella et al., 2005; Noll et al., 2009), a SED fitting code developed especially to take into account both the dust UV-optical attenuation and the corresponding infra-red re-emission. From multi-wavelength observations of galaxies, CIGALE can derive some of their physical parameters. We also give some examples of scientific results obtained with CIGALE.

Aim of the software

The multi-wavelength observation of galaxies allows astrophysicists to derive some of their physical parameters from the comparison of their spectral energy distributions (SEDs) to computed SEDs based on models and templates (SED fitting). Scientists from the *Laboratoire d'Astrophysique de Marseille* developed CIGALE (/si.gal/), a Code Investigating Galaxy Emission that takes into account both the dust ultraviolet-optical attenuation and its corresponding infra-red re-emission. CIGALE is able to statistically derive reliable physical parameters from UV to IR observations.

How CIGALE works

As presented in figure 1, the user provides CIGALE with multi-λ fluxes and redshift for studied galaxies, as well as a list possible values for physical parameters. Those parameters are related to **star formation history** (τ and ages for young and old Stellar Populations (SP), mass fraction of young SP), **dust attenuation** (V-band attenuation, reduction factor of A_V for old SP) and **dust emission** (IR power law slope, AGN related fraction of L_{dust}). Using various models, libraries and templates (in blue in figure 2) CIGALE computes all the possible spectra and derives mean fluxes for the observed filter bands. Then a Bayesian-like statistical analysis permits to determine the best value for each parameter as well as the best computed model (see figures 3 and 4) for each galaxy.

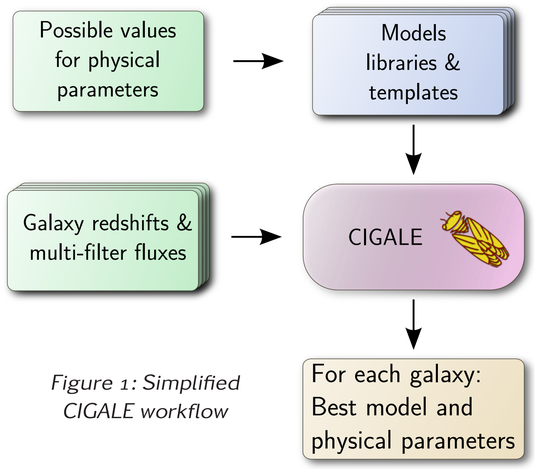

Figure 1: Simplified CIGALE workflow

Examples of scientific applications

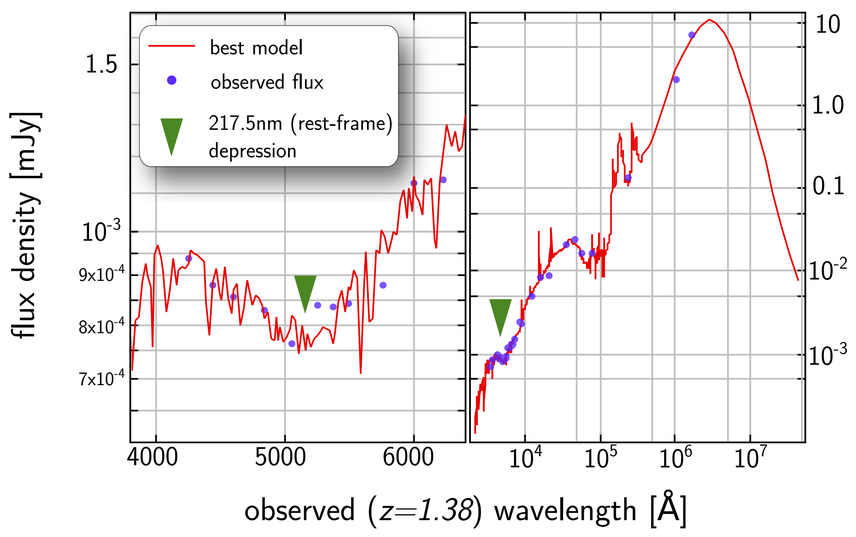

Figure 3: $z = 1.38$ galaxy SED showing 217.5nm depression (Buat et al., 2011)

Buat et al. (2011) used CIGALE to show a dust-related depression in flux density at 217.5*nm* (rest-frame) in high redshift sources (figure 3).

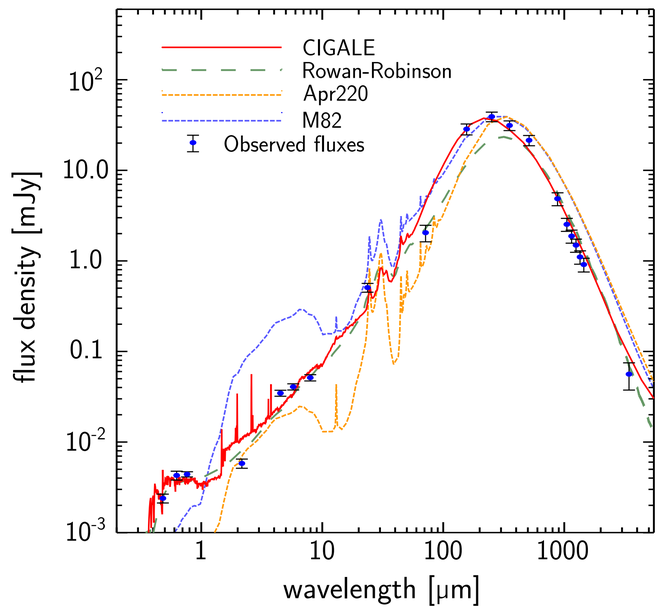

Figure 4: CIGALE fitting of HLSW-01 - adapted from Conley et al. (2011)

Conley et al. (2011) used CIGALE to study the multiply-lensed galaxy HLSW-01 and compute some of its physical properties.

CIGALE operation workflow

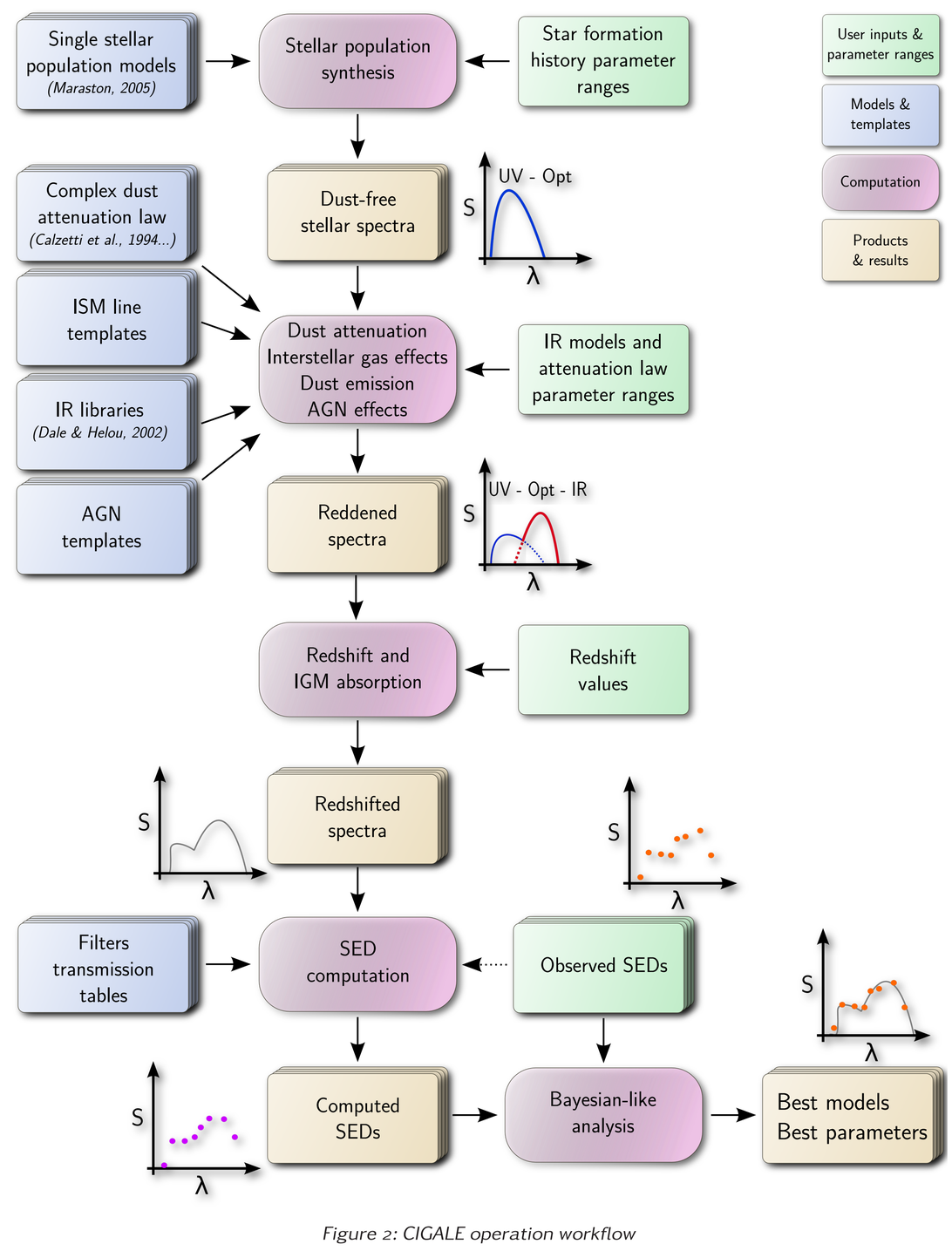

Figure 2: CIGALE operation workflow

CIGALEMC - Using Monte Carlo Markov Chain statistical method

From the CIGALE code base, Serra et al. (2011) developed CIGALEMC that uses a Monte Carlo Markov Chain method to find the best fit parameters. CIGALEMC was developed to be:

- **efficient**: needed CPU time grows linearly (not exponentially as with CIGALE) with the number of fitted parameters
- **accurate**: statistical quantities are robustly determined using Gelman & Rubin diagnostic as convergence criteria
- **user friendly**: *a priori* deciding the parameter density, to find a compromise between accuracy and speed, is not necessary

Future evolutions of CIGALE

- Use of alternative infra-red libraries and templates: Chary & Elbaz (2001), Siebenmorgen & Krügel (2007) and Draine & Li (2007). Use of CB07 stellar population model by Bruzual & Charlot (http://bruzual.org/cb07/).
- We are studying the port of CIGALE to Python for more modularity, more readability of the code and more evolution opportunities.

Contact and download

CIGALE is available for download on its web site (see footer), where you will also find an on-line, java applet based, version. For more information on CIGALE software, you can contact Denis Burgarella <denis.burgarella@oamp.fr>.
You can also talk to Yannick during ADASS conference.

http://cigale.oamp.fr/misc/adass2011poster

Yannick

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View this poster ↑ on the web.

References

Buat et al., 2011 A&A 533 93 / Burgarella et al., 2005 MNRAS 360 1413 / Calzetti et al., 1994 ApJ 429 582 / Chary & Elbaz, 2001 ApJ 556 562 / Conley et al., 2011 ApJ 732 35 / Dale & Helou, 2002 ApJ 576 159 / Draine & Li, 2007 ApJ 657 810 / Maraston, 2005 MNRAS 362 799 / Noll et al., 2009 A&A 507 1793 / Serra et al., 2011 ApJ 740 22 / Siebenmorgen & Krügel, 2007 A&A 461 445

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