

# On the importance of using appropriate spectral models to derive physical properties of galaxies

The Spectral Energy Distribution of high-redshift galaxies: Lessons learned and open questions 26.1.2015, Sexten Center for Astrophysics, Italy





Camilla Pacifici (Yonsei), Elisabete da Cunha (MPIA), Hans-Walter Rix (MPIA), Stephane Charlot (IAP), Sukyoung Yi (Yonsei)

### Outline

- Can we trust SED fitting?
- Observed sample a practical example
- Modeling approach the behaviour of different spectral libraries
- Extracting the physical parameters
  - Biases
  - Photometry alone VS Photometry + Spectroscopy
- More examples
- Conclusions

### SEL

### Many tools available

Photometric redshifts Best-fitting model Bayesian inference Inversion codes

FAST, MAGPHYS, CIGALE, SEABASs, EAZY, STECKMAP, and many others.

All have pro and cons because they rely on some assumptions

### SED fitting

### SED fitting relies on assumptions

- star formation and metal enrichment histories
  - stellar population models
    - gas models
    - dust models

Statistical treatment of the result

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### Statistical treatment of the result

build large library of "as realistic as possible" SEDs to estimate physical parameters from multi-wavelength observations

3D-HST photometry and grism spectroscopy

We select galaxies in the GOODS-South Field with accurate grism redshifts (H<23)

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9 broad bands: U, 4 ACS, 3 WFC3, IRAC 3.6μm

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to study the improvements given by adding spectroscopic information to photometry

### 3D-HST photometry and grism spectroscopy

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### Required detection of at least one emission line with S/N>5

3 different spectral libraries - same statistical approach

### CLASSICAL

- exponentially declining SFHs, fixed metallicity
- stellar emission from the latest version of BC03
- simple dust attenuation

Wavelength

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#### PI2 without emission lines

- physically motivated SF and ME histories
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3 different spectral libraries - same statistical approach

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### PI2 without emission lines

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### P12

- physically motivated SF and ME histories
- stellar emission from the latest version of BC03
- nebular emission lines included
- sophisticated dust attenuation

Encompared wavelength

### Convolve SEDs with the broad band filters and compare with observations



#### Convolve SEDs with the broad band filters and compare with observations



# Fitting procedure

#### Photometric fit to 9 broad bands



# Fitting procedure

#### Photometric fit to 9 broad bands



# Extracting the physical parameters

#### The impact of the different libraries on the fits





## Extracting the physical parameters

#### Photometry + Spectroscopy



### The star-formation main sequence



The star formation histories of blue star-forming galaxies

The star formation histories of blue star-forming galaxies

DEEP2 galaxies 0.2<z<1.4 photometry + spectroscopy



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The star formation histories of dwarf galaxies

Rodriguez-Munoz et al. (2014)

#### The star formation histories of dwarf galaxies



### Rainbow database + VIMOS 0.1<z<1.4 deep photometry + spectroscopy

Rodriguez-Munoz et al. (2014)

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### Rainbow database + VIMOS 0. | <z< |.4 deep photometry + spectroscopy



Rodriguez-Munoz et al. (2014)

The star formation histories of dwarf galaxies

Atek et al. (2014)

#### The star formation histories of dwarf galaxies

WISP + 3D-HST sample selected according to emission lines photometry + spectrsocopy 0.3<z<2.5



Atek et al. (2014)

The star formation histories of massive compact galaxies

The star formation histories of massive compact galaxies



CANDELS + 3D-HST compact galaxies photometry + spectrsocopy z~2

The star formation histories of massive compact galaxies



CANDELS + 3D-HST compact galaxies photometry + spectrsocopy z~2



The star formation histories of SDSS galaxies

Pacifici et al. (in prep)

#### The star formation histories of SDSS galaxies

### SDSS + GALEX + WISE all galaxies photometry + spectrsocopy z<0.14



Pacifici et al. (in prep)

### Take home messages

- SED fitting is a very powerful tool when the assumptions are under control
- It is important to make sure that the spectral models can reproduce the observations
- Uncertainties are useful if they are reliable
- Emission lines should not be forgotten •
- Interest in deriving constraints on the SFHs of galaxies

### Photometry from 3D-HST catalogue



The star formation histories of blue star-forming galaxies



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CANDELS + 3D-HST compact galaxies photometry + spectrsocopy z~2