GALEV evolutionary synthesis models
current status and future plans

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Introduction and scientific context

Stellar population models are one of the workhorses of current galactic and extra-galactic research. Based on few assumptions such as the stellar initial mass function, models for stellar evolution and atmospheres they allow to trace the evolution of physical properties as well as the integrated light of a given stellar population over time and redshift.

In combination with dedicated analysis tools, models like GALEV enable us to extract physical parameters from observations, either spectroscopic or photometric, of star clusters in the Milky Way out to galaxies in the early universe at high redshift, allowing to study to physical processes governing the evolution of the universe.

Here we present our GALEV evolutionary synthesis model, its parameters as well as the resulting output data, and encourage researchers to try and use its interactive web-interface, available at

http://www.galev.org.

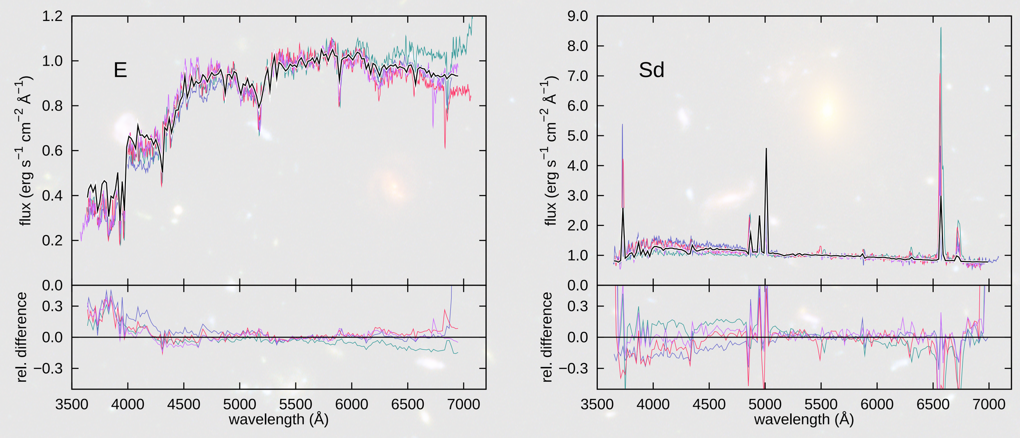
For more details, read Kotulla et al, MNRAS 396, 462 (2009)

GALEV in a nutshell

GALEV evolutionary synthesis models aim at describing the spectral and chemical evolution of stellar populations. Using only a minimum of input parameters (Star Formation History and Initial Mass Function) we are able to reproduce a wealth of physical parameters such as spectra, colors, star formation rates, stellar and gaseous masses, mass-to-light ratios and metallicities for a wide range of galaxy types. This holds true not only for local galaxies, but also for younger galaxies at high redshifts.

Model calibration

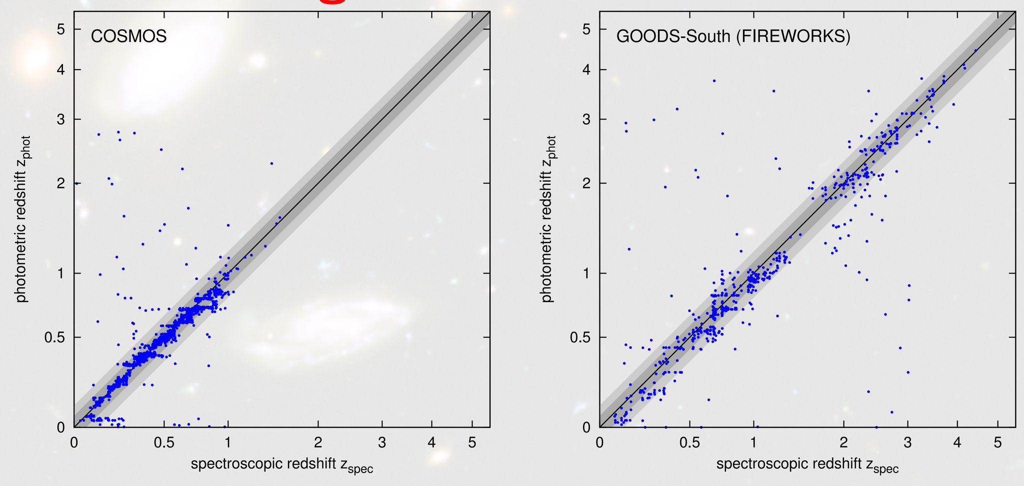
Tuning only the local gas fraction, we successfully reproduce spectra and physical parameters across all Hubble types at z=0:



Comparison of our calibrated models (black line) to integrated light spectroscopy of nearby galaxies (colored lines) for two Hubble types E (left panel) and Sd (right panel); Kotulla et al. (2009)

Post-processing and analysis tools

We also offer a variety of tools to help you get the most out of your data, e.g. **SED fitting** codes to derive masses, ages and metallicities for star clusters, or a **photometric redshift** code that also computes **physical parameters including uncertainties**.



Comparison of photometric and spectroscopic redshifts for two galaxy samples from the COSMOS (left panel) and GOODS-South (right panel) fields. The shaded areas outline the $\sigma_z = |z_{spec} - z_{phot}| \times (1 + z_{spec})^{-1} = 0.1$ (light grey) and $\sigma_z = 0.05$ (darker grey) accuracy regions.

GALEV reference paper

Kotulla et al, MNRAS 396, 462 (2009)

Available parameters to specify your galaxy

- We offer a selection of the most frequently used **Initial Mass Functions** (IMFs): Salpeter and Kroupa (more in the works)
- **Gaseous emission** can be switched off or on, and contains line and/or continuum emission.
- The **metallicity** can be fixed or set to chemically consistent.

To describe galaxies you specify:

- **Galaxy mass**
- **Galaxy type**: We offer
  - Simple Stellar Populations (SSPs)
  - standard spectral types E . . . Sd,
  - exponentially declining SFRs,
  - SFRs proportional to the gas-mass,
  - constant SFRs, and
  - user-defined SFHs for which the user specifies the SFR at each time.
- **Starbursts** or **Truncation of star formation** scenarios can be added to all galaxy types.

To describe observations you can specify:

- **Extinction** We offer the following extinction-laws:
  - Calzetti for starburst galaxies
  - Cardelli for more quiescent galaxies
- **Cosmological models** can be specified via:
  - Hubble constant H_0
  - Energy density Ω_M and Ω_Λ
  - Formation redshift
- **Filter sets** are required to compute magnitudes in the Vega-, AB- or ST-system; most common filters are readily available, further filters can easily be added upon request.

For large(r) model grids:
GALEV offers a **batch-mode**, allowing you to run a large number of models in one go.

Output options

Direct output from GALEV

- Integrated **spectra and magnitudes** as function of time
- **Stellar and gaseous masses**
- **Star formation rates** and
- ISM **metallicities**
- Luminosity- and mass-weighted ages and stellar metallicities

Combined with a cosmological model:
All outputs by default include attenuation due to intergalactic hydrogen (can be turned off)

- **Redshifted spectra**
- Absolute and apparent **magnitudes**
- **Rest-frame magnitudes** and colors
- Cosmological **k-corrections**
- Evolutionary **e-corrections**

If extinction was specified:

- All above parameters for each extinction step

The next-generation of GALEV models

New input physics

- Extended isochrone sets, including effects of binary evolution and stellar rotation
- Further and/or higher resolution spectral libraries, both observed and theoretical
- User-defined IMF shapes (only for SSPs), stochastically sampled / time-variable IMFs
- Detailed treatment of the stochastic nature of intergalactic attenuation.

New output options

- Stellar absorption features, e.g. Lick indices
- Color magnitude diagrams
- Detailed chemical abundances

These will be continually updated and upgraded, so **stay tuned!**

Community input and collaborations

You calculate your own stellar evolution or stellar library, or need some other input/output that is not (yet) available? Then let us know, we are happy to collaborate.