The Star Formation History of Galaxies
(as revealed by spectral synthesis)

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1 Spectral Synthesis - STARLIGHT

How many $M_\odot$/yr was SDSS J1119+5130 converting into stars 2 Gyr ago? And yesterday? What was the metallicity of its stars at these times? How do its SFR and $Z_\star$ evolve?

Galaxy spectra help answering these and other questions. Our code STARLIGHT fits a galaxy spectrum by combining Simple Stellar Populations of different ages and metallicities, reconstructing the full **Star-Formation History** from the strength of each component. But does it work? See our papers on the *Semi-Empirical Analysis of Galaxies (SEAGal)* or **Fig 1**. Despite the numerous degeneracies which plague population synthesis studies, one can derive meaningful SFHs through such fits.

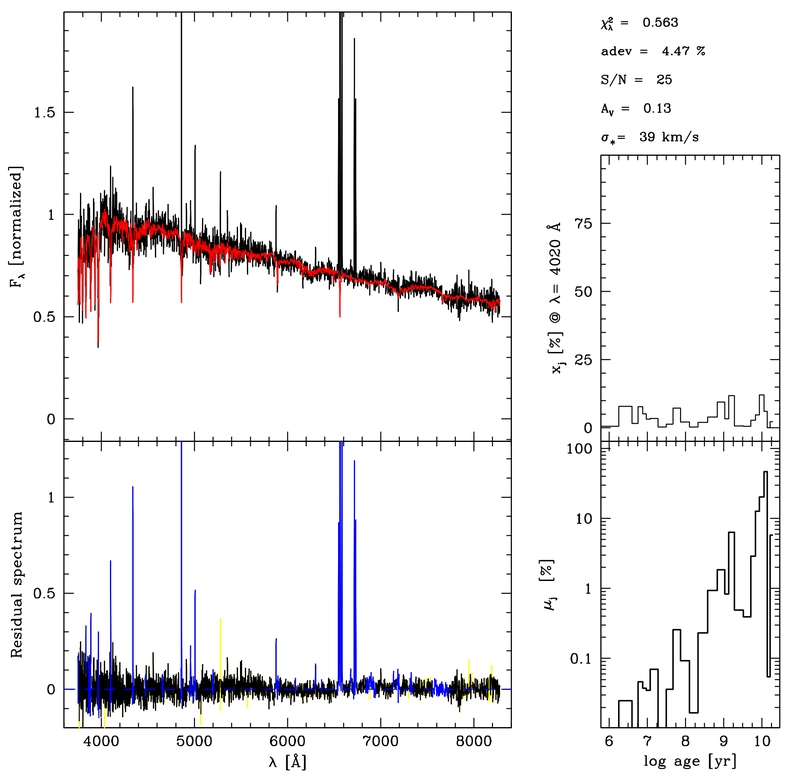

Figure 1: Examples of STARLIGHT fits using the SSPs of Bruzual & Charlot (2003). Panels on the right show the light (x) and mass (μ) fractions associated with populations of different ages. Details in Cid Fernandes et al. (2005) & Mateus et al. (2006). STARLIGHT and its fits for $\sim$ 500k SDSS galaxies will be made available in a VO environment in Dec/2006.

2 Star Forming Galaxies - SDSS

We have synthesized **497676** SDSS galaxies with STARLIGHT, producing a huge catalog of physical properties such as stellar mass, mean age and metallicity, velocity dispersions, extinctions, α-enhancement and emission line properties. Here we present a short study of the SFHs of **Star-Forming** galaxies only, defined by their location in the BPT diagram (**Fig 2**).

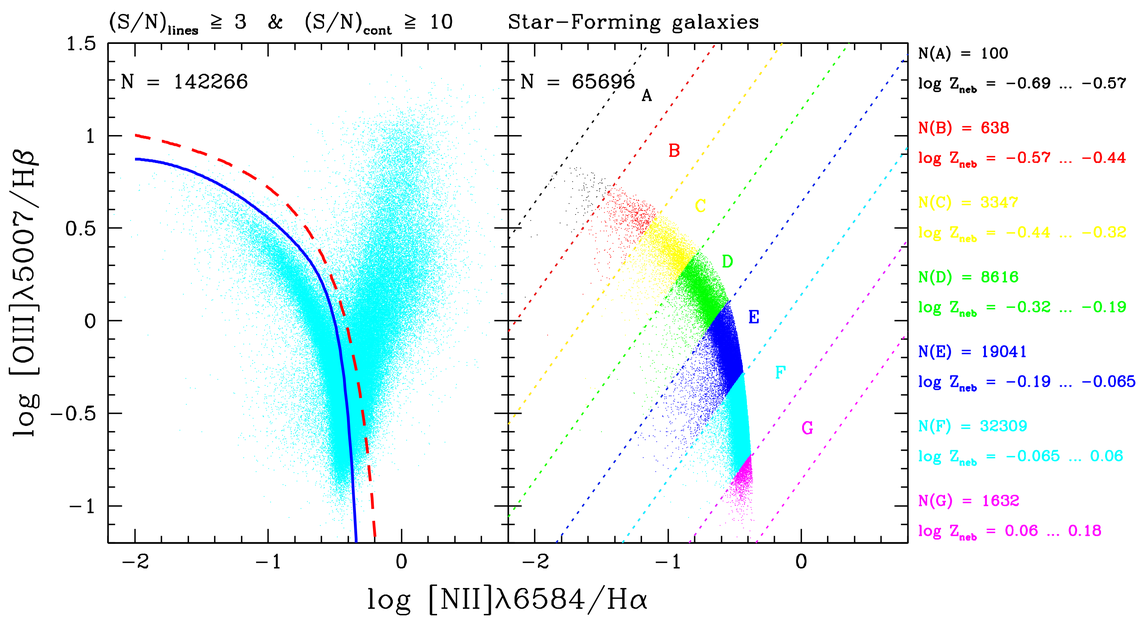

Figure 2: (a) 142286 SDSS galaxies in the BPT diagram. The solid (blue) line (Stasińska et al 2006) divides Star-Forming galaxies from AGN, while the dashed (red) line is the one used by Kauffmann et al. (2003). (b) The SF sample, chopped into bins of nebular abundance $Z_{\rm neb} = \frac{(O/H)}{(O/H)_\odot}$.

• **Physical properties** $\times$ $Z_{\rm neb}$**:** The left/star-forming wing of the "seagull" in the BPT diagram is essentially a sequence in **nebular metallicity** ($Z_{\rm neb}$), computed from [OIII]/[NII] (Stasińska 2006). **Fig 3** shows how global properties like stellar mass, mean-stellar age, stellar-metallicity and nebular (Hα/Hβ) extinction correlate with $Z_{\rm neb}$. All these plots strongly suggest that galaxies in different loci in the BPT diagram evolved differently.

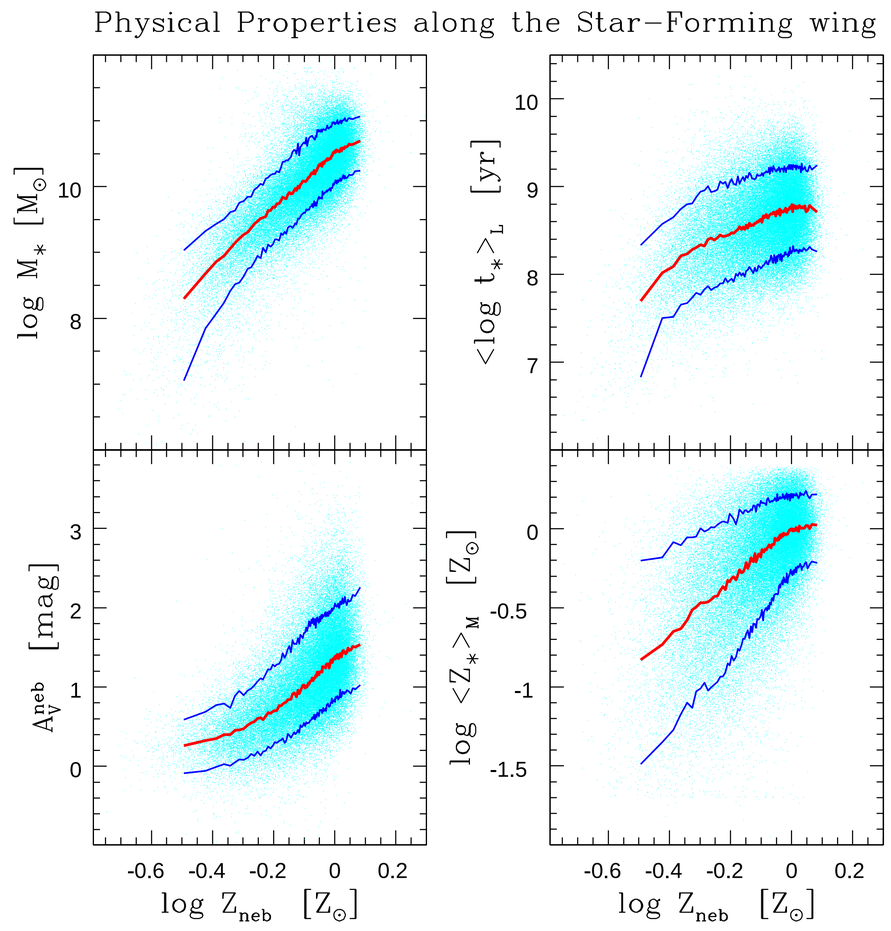

Figure 3: Correlations of $Z_{\rm neb}$ with physical properties. Red lines represent the median, while blue lines show the 10 and 90% percentiles.

• **Star formation history and chemical enrichment:** To have a closer look at galaxy **evolution** itself, we chop the SF-wing into $Z_{\rm neb}$ bins and compute the mean time dependent star-formation rate and stellar metallicity build up for each bin. **Fig 4** shows how the **specific SFR** and **stellar metallicity** varied from $\sim$ 10 Gyr ago till $z \sim 0$. Notice how spectral synthesis recovers not only the SFHs, but also very sensible chemical enrichment histories *without* imposing any *a priori* constraints on neither.

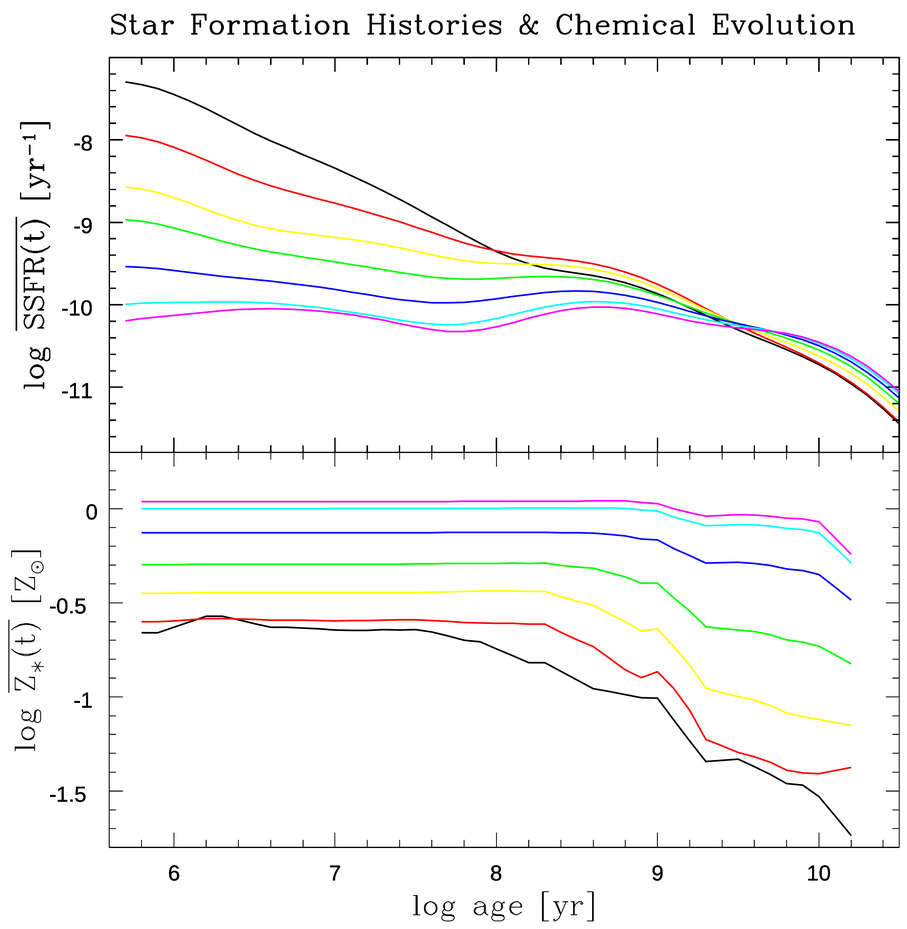

Figure 4: Evolution of the SFR (expressed in specific terms) and **stellar** metallicity. Colored lines represent the different $Z_{\rm neb}$ bins in Fig 2, going from $Z_{\rm neb} = 0.2$ (black) to 1.3 (magenta) $Z_\odot$.

3 Conclusions

Quite obviously, big, massive and metal-rich SF galaxies have undergone most of their mass build up and chemical evolution long ago. Smaller and less metal-rich systems, on the other hand, are slower in their mass and chemical evolution. More details in Asari et al (in prep).

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