QSFit

AUTOMATIC ANALYSIS OF OPTICAL AGN SPECTRA

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QSFit is a new software to automatically perform the analysis of Active Galactic Nuclei (AGN) optical/UV spectra. The software provides estimates of:

* AGN continuum luminosities and slopes at several rest frame wavelengths;
* host galaxy luminosities (for sources with z < 0.8);
* luminosities, widths and velocity offsets of 20 emission lines (Hα, Hβ, MgII, [OIII], CIV, etc...);
* luminosities of iron blended lines at optical and UV wavelengths;
* several "quality flags" to assess the reliability of the results.

QSFit fits all components simultaneously, using a smoothly broken power law to account for the **broad band AGN continuum**, which extends over the entire available spectrum.

QSFit aims to allow astronomers to run **standardized recipes** to analyze the AGN data, in a **simple, replicable and shareable way.**

QSFit is written in *IDL* and is released as **free software** (under the GPL license) on Github: **https://github.com/gcalderone/qsfit**

The **QSFit** model is built step by step, by iteratively adding a component and re-running the minimization procedure. The plots on the right show the comparison between the data and the model, as well as the individual components being added (left panels). The right panels shows the residuals (data - model) in units of 1 σ uncertainties in the data, and the red lines show the cumulative χ^2_{red} across the available wavelength range.

The fitting **process runs through the following steps**:

(i) we add the AGN continuum (a smoothly broken power law) and the host galaxy template and run the minimization procedure;

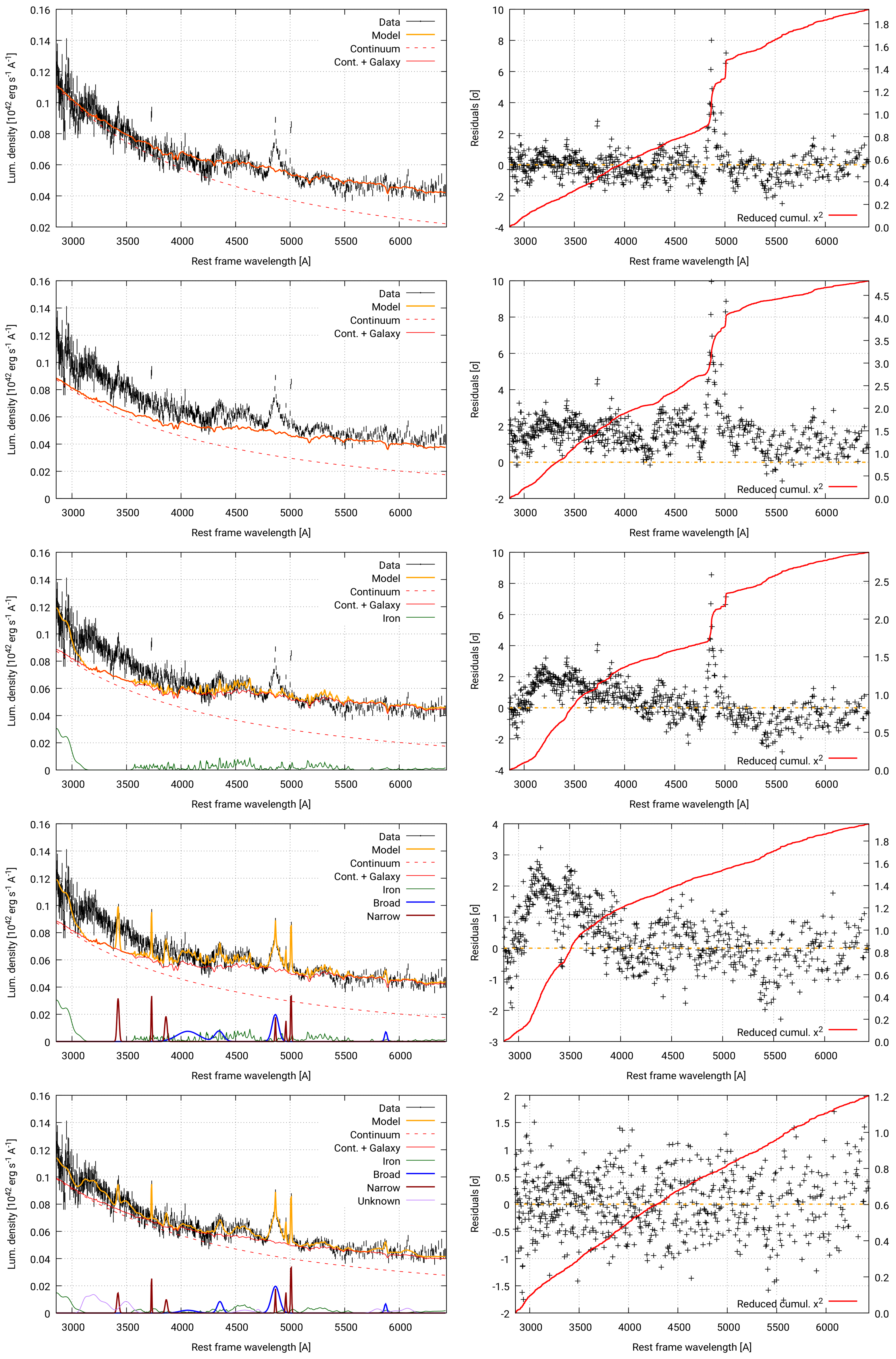
(ii) In order to provide room for further components (namely the emission lines) we lower the continuum normalization until the positive residuals reach ~ 90%, and fix all parameters for next iterations;

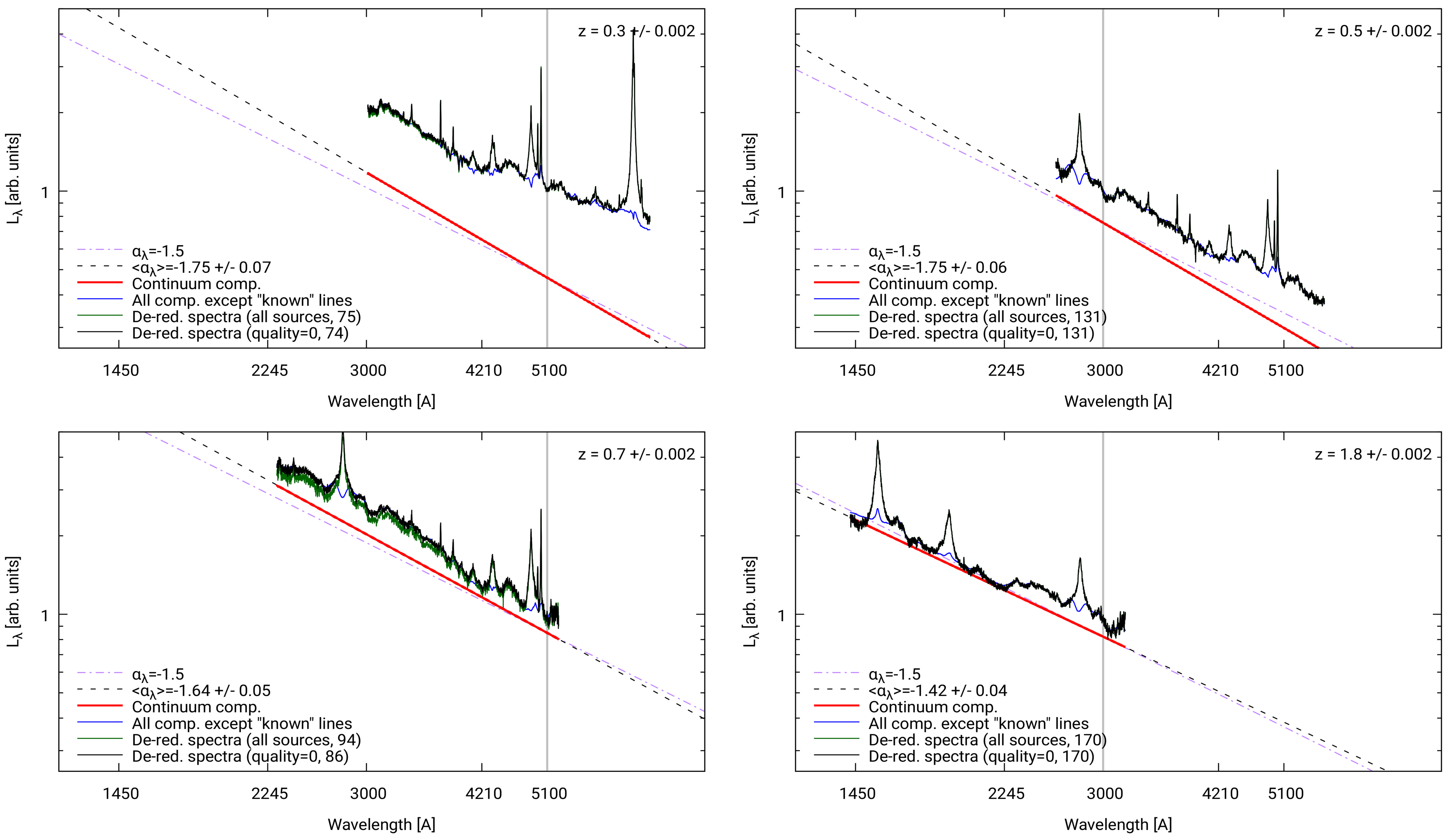
(iii) we add the components for the iron templates at UV and optical wavelength, run the minimization procedure, and fix the resulting parameters at their best fit values;

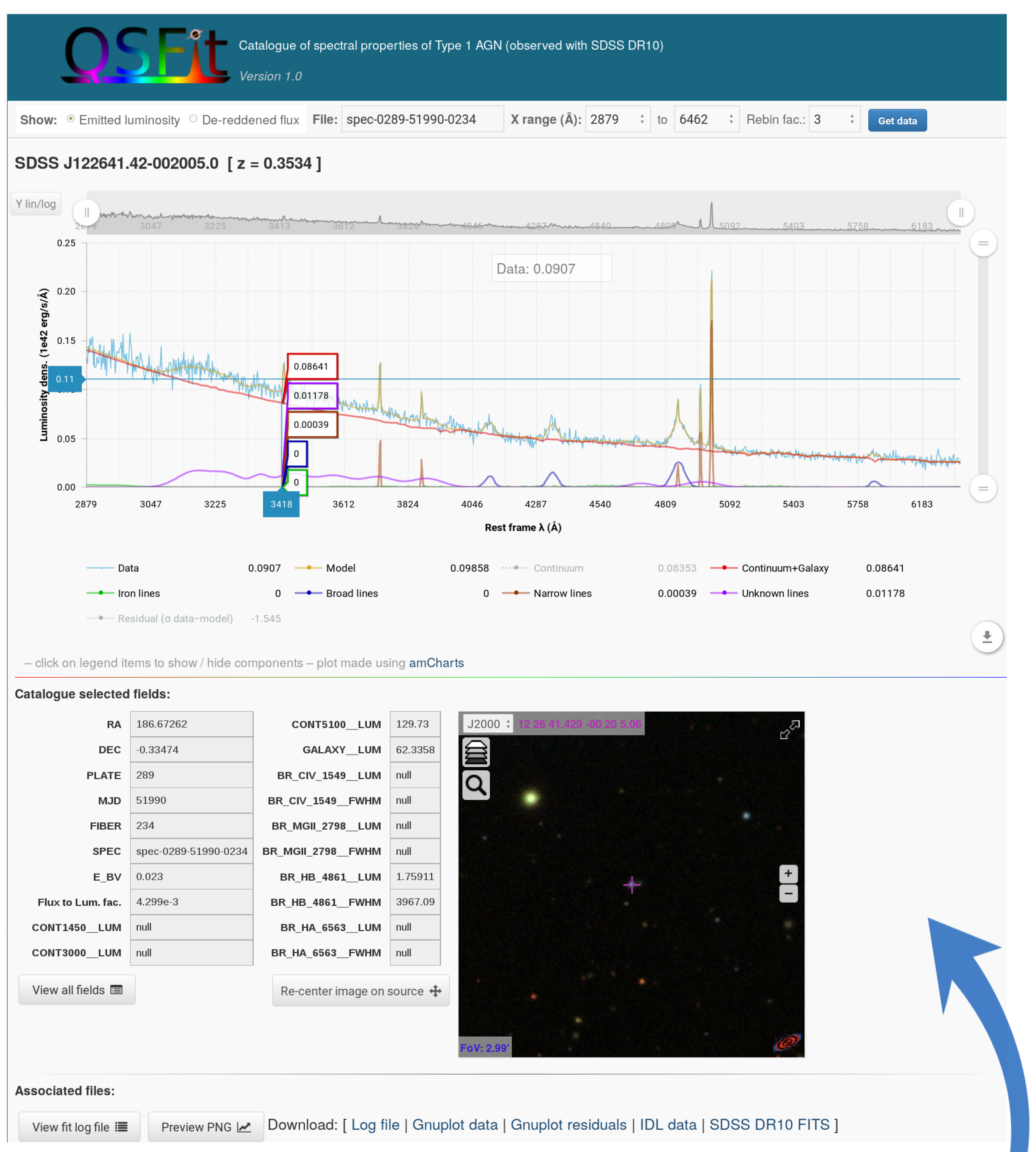
(iv) we add the broad and narrow emission line components, run the minimization procedure, and fix the resulting parameters at their best fit values;

(v) we iteratively add up to 10 "unknown" (i.e. not a priori associated) emission lines, to account for specific features in the spectrum (e.g. in the region 3100-3600A in the figure) and run the minimization procedure leaving all parameters free to vary.

The recipe outlined above allows to **drive the minimization procedure towards a physically acceptable solution**, without human intervention. The typical analysis time of a SDSS optical spectrum on a modern laptop is **~8 s**. Hence, **QSFit** can be used to **quickly analyze large samples.**







We used **QSFit** to analyze a sample of 71,251 spectra of Type 1 AGN with z<2 observed by SDSS. The procedure and results are discussed in a MNRAS-submitted paper (available at: **https://arxiv.org/abs/1612.01580**). The **whole catalog** with all the original spectra, the **QSFit** results, the analysis logs and plots of all components are available at: **http://qsfit.inaf.it**

The plots above show the reliability of **QSFit** in estimating the broad band AGN continuum:

* the black lines show the composite spectrum of a subsample of sources within a very narrow redshift range (shown in the upper right corner). The composite spectrum is calculated as the geometrical average of SDSS de-reddened spectra;
* the red lines are the composite **QSFit** continuum, while the blue line is the composite of the sum of all **QSFit** components (except the emission lines). The average continuum slopes at 5100A (left panels) and 3000A (right panels) are shown with a dashed black line. The slope average and the standard deviation of the mean are shown in the lower left corner;
* the purple line is the commonly assumed slope (-1.5) for the AGN continuum.

The plots show that **QSFit** provides (at least on average) a **good representation of the AGN continuum**, even if the host galaxy contribute significantly to the overall luminosity. Also, they show (for the very first time on a very large sample) that the **AGN continuum slopes** at optical/UV wavelengths **is constrained in the range -1.4 : -1.75** for all sources with z < 2.