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Photospectral synthesis of galaxies in the middle age of the Universe

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Detailed full spectral synthesis studies of the stellar populations in galaxies are usually restricted to the local Universe ($z \leq 0.1$), where data is more abundant. Spectroscopic observations of galaxies at redshift's 0.6–1.0 by the Large Early Galaxy Astrophysics Census (LEGA-C) survey (van der Wel et al., 2016) allow spectral synthesis studies similar to those performed in the Local Universe, but for systems half as old. These spectra are complemented with photometry from a wealth of sources from the COSMOS survey (Scoville et al., 2007). These pan-spectral data allow more reliable stellar populations fits than those based only on optical spectra. Photometric and spectroscopic data are fitted simultaneously with the latest version of the STARLIGHT (Cid Fernandes et al., 2005) code. The photo-spectral fits obtained are excellent. The intrinsic properties (masses, average age and metallicity, extinction, star formation history) derived from these fits allow detailed studies of these objects.

STARLIGHT fits the observed data by combining stellar population models and taking into account kinematics and dust attenuation, creating a synthetic model whose fluxes for each population reflect a non-parametric star formation history. We used 98 base models, assuming constant star formation rate in each time interval, built from 2019 Bruzual and Charlot Models covering 7 metallicities and 14 age bins, from zero to 8.5 Gyr ($z \leq 1$). The VLT spectra are scaled to match the overlapping photometry to ensure consistent fluxes. A typical result from the photospectral synthesis is exemplified in Fig. 1.

The bottom panel in Fig. 1 shows the UVJ diagram for 3558 LEGA-C galaxies, with regions corresponding to Quiescent, Starforming and Redenned–Starforming galaxies indicated. Points are colour-coded by the flux-weighted mean (log) age of the stellar populations derived from our photospectral fits. These results illustrate the potential of this new tool to map galaxy properties across cosmic times.

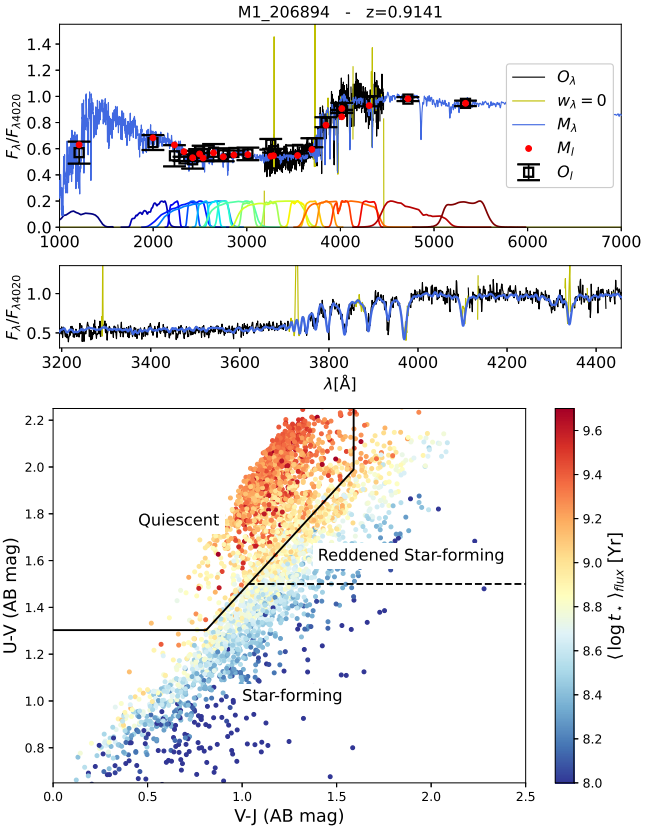

Figure 1. Top: Example photospectral fit of a LEGA-C galaxy. Black and blue lines, black boxes with errorbars and red dots are the observed and synthetic spectra, observed and synthetic photometry, respectively. Transmission curves for the different filters used are also shown. Middle: Zoom on the spectral fit. Bottom: UVJ diagram for LEGA-C galaxies, colour-coded by the mean log stellar age derived from our STARLIGHT fits.

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