The Spectral Energy Distribution of Galaxies
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Stellar populations in the centers of nearby galaxies

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Abstract. The great amount of data observed in recent years coupled with modelling using evolutionary synthesis codes (BPASS, COELHO, GALAXEV, GALEV, MILES, PÉGASE, etc...) to compute Single Stellar Populations (SSPs) and the availability of fast and ingenious spectral synthesis codes such as STARLIGHT, ULySS and VESPA, have significantly shed light on our knowledge about the formation and evolution of galaxies. However, there are still open issues concerning the stellar populations in nearby galaxies, particularly those harbouring Active Galactic Nuclei (AGN): can stellar populations mimic nuclear activity, leading to a misclassification based on optical emission line ratios (Stasińska *et al.* 2008)? We have applied the STARLIGHT code (Cid Fernandes *et al.* 2005) to a well studied sample of nearby galaxies' nuclear spectra (r $<\sim$ 200 pc), observed with the Hale 5 m telescope at Palomar Observatory in two different regions: $\sim 4230 - 5110$ Å and $\sim 6210 - 6860$ Å (Ho *et al.* 1995), with spectral resolutions of approximately 4 Å and 2.5 Å. The aim is to properly derive the star-formation history (SFH), mean stellar age and metallicity and total stellar mass. Our results show that the star-formation history of Seyfert galaxies are very heterogeneous, i.e. these are composed of young, intermediate and old stellar populations, while the SFH of Low-Ionization Nuclear Emission-Line Regions (LINERs) are basically composed of old stellar populations. The absence of young stars in LINERs indicates that these are not responsible for the observed low-ionization emission lines. Furthermore, although a significant fraction of AGN spectra require a featureless continuum in their Spectral Energy Distribution (SED) modelling, this is not an indicative of the presence of an AGN, instead the continuum may simulate the presence of young stellar populations. The main objective of this research is to complement the study of spectroscopic parameters from 486 galaxies analyzed by Ho *et al.* (1995) that are public available in the VizieR catalog (Ho *et al.* 1997, 2009) and provide information about their stellar population content by means of the STARLIGHT. The base of Simple Stellar Populations used here was taken from Bruzual & Charlot (2003) and spans 25 ages (from 1 Myr to 18 Gyr) and 6 metallicities (Z = 0.005, 0.02, 0.2, 0.4, 1 & 2.5 $Z_{\odot}$).

Keywords. galaxies: evolution, galaxies: formation, galaxies: nuclei, galaxies: active, galaxies: stellar content, galaxies: Seyfert

1. Introduction

We have applied STARLIGHT to the entire sample of galaxies analyzed by Ho *et al.* (1995), which comprises 486 spectra observed with the Hale 5 m telescope at Palomar Observatory in two different regions: $\sim 4230 - 5110$ Å (BLUE) and $\sim 6210 - 6860$ Å (RED). After a series of tests, we decided to only model the BLUE part of the spectrum to derive the star-formation histories, mean stellar ages and metallicities, because the spectral information concerning young stellar populations is located mostly in the BLUE range. However, emission lines from both parts of the spectrum have been used in order to

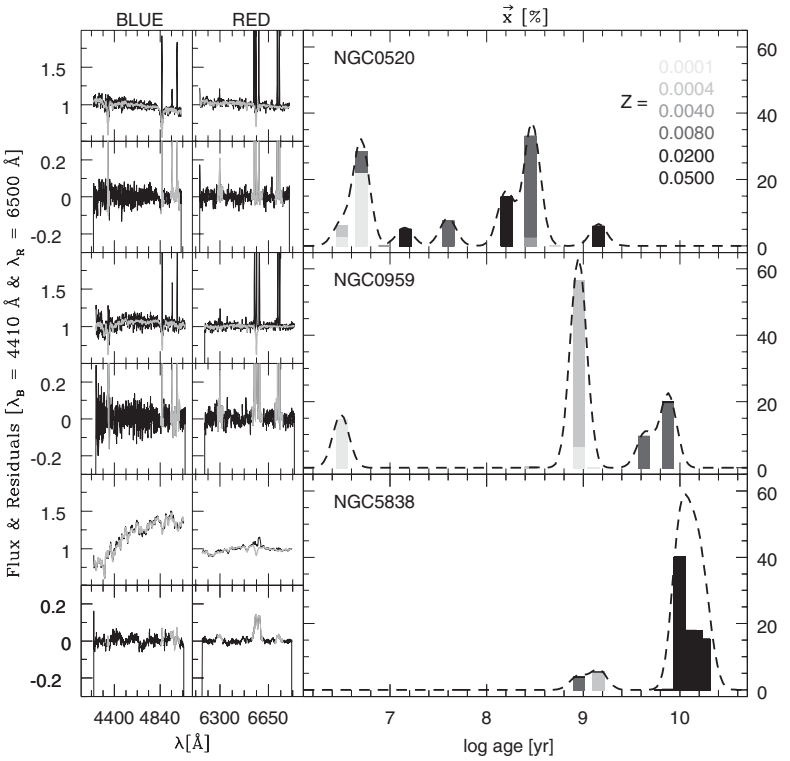

Figure 1. STARLIGHT spectral analysis of NGC 520 (Star-Forming), NGC 959 (Composite), NGC 5838 (AGN/LINER) from top to bottom. Left panels: we show the blue and red parts of spectrum in black and the best fit in grey colour. For clarity, residuals (observed – modeled) are shown bellow each spectrum window with emission lines in grey colour. The Star Formation History (SFH), characterized by the population vector $\vec{x}$ (i.e. the fractional contribution of each SSP), is shown as a function of log age in the right panels. The greyscale stands for distinct metallicities (see label). The black dashed lines are the corresponding smoothed SFHs (re-scaled) with a Gaussian FWHM of 0.2 dex to better show the trends for the different galaxies. Star-Forming galaxies tend to have younger stellar populations, Composites seem to have intermediate ones and AGN galaxies harbour older stellar populations.

distinguish between star-forming galaxies and AGN, based on the diagnostic emission-line ratios: [OIII]λ 5007/Hβ and [NII]λ 6583/Hα in BPT diagrams (Baldwin, Phillips & Terlevich 1981). In Fig. 1, we show three examples of spectral fitting, the respective residuals and SFHs for a Star-Forming, Composite and AGN/LINER.

2. Main result: Age and Metallicity distributions

The principal result retrieved by the STARLIGHT is depicted in Fig. 2. The histograms correspond to the fractional contribution of Young ($\vec{x}_{\rm Young}$, $< 9 \times 10^7$ years), Intermediate ($\vec{x}_{\rm Intermediate}$, between 9×10^7 and 10^9 years) and Old ($\vec{x}_{\rm Old}$, $> 10^9$ years) stellar populations. The histograms stand for Star-Forming (shaded histogram; light grey), Composites (solid line; medium grey) and AGN (dashed line; black) galaxies, classified according to the classical BPT diagram. For clarity, the mean stellar age and metallicity are also shown for the whole sample. We can see that Star-Forming galaxies tend to harbour younger stellar populations, Composites seem to have intermediate ones and AGN galaxies have older stellar populations in the centers of galaxies.

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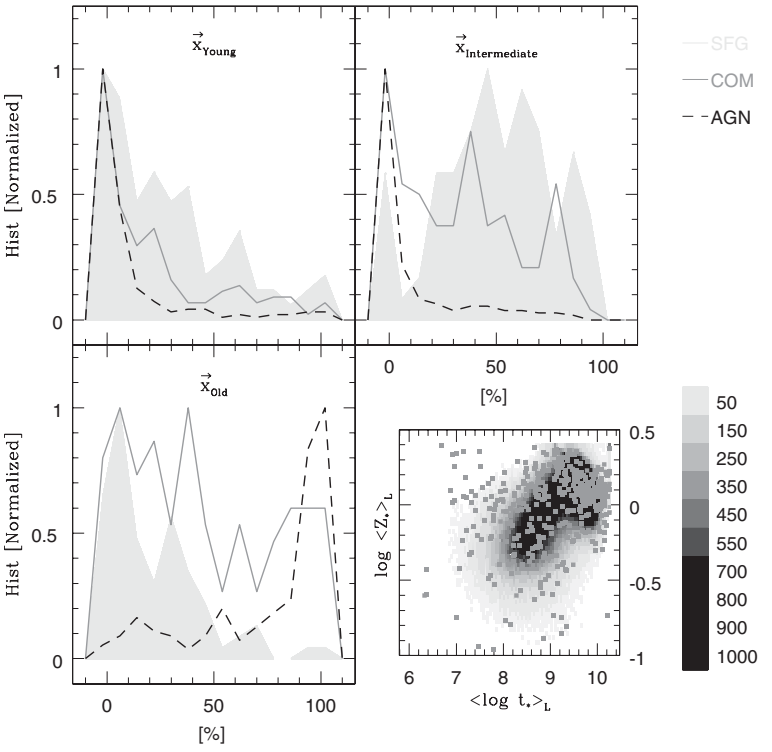

Figure 2. The histograms are the fractional contribution of **Young**, **Intermediate** and **Old** stellar populations, as explained in the text for three distinct galaxies of the sample: Star-Forming (shaded histogram; light grey), Composites (solid line; medium grey) and AGN (dashed line; black) galaxies, classified according to the classical BPT diagram. We also show the mean stellar age and metallicity distributions for the Palomar sample using grey squares. For comparison, the greyscale depicts the number of SDSS galaxies in each bin. We can reach the same conclusions as Fig. 1, where statistically star-forming galaxies tend to have younger stellar populations, while Composites seem to have intermediate ones and AGN galaxies harbour older stellar populations.

Acknowledgements

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