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NGC 1052: a LINER with strong stellar Mg/Fe gradient

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Abstract. We analyze long slit spectroscopy of NGC 1052, the third brightest member of a group of eleven galaxies. This elliptical is a typical LINER with a stellar rotating disk. We have found a strong negative radial gradient of the abundance ratio Mg/Fe, which suggests an enhancement of α-elements particulary towards the nuclear region, and higher metallicity and age at the galactic nucleus too. We have measured the Lick line-strength indices along the major axis of the galaxy. This information, together with single-aged stellar population models of Thomas *et al.* (2003), was used to determine the star formation history of NGC 1052.

1. Observations and spectra extraction

The long slit spectroscopic observation of NGC 1052, oriented along the major photometric axis (PA=120°), and covering the wavelength range $\lambda\lambda$4320-6360Å, was carried out in 1999 with the Boller & Chivens spectrograph at the Cassegrain focus of the 1.60m telescope of the *Observatório do Pico dos Dias* (OPD) operated by the *Laboratório Nacional de Astrofísica* (LNA). The slit width was 2.08″ and its length was 230″. The spatial scale is 1.092″ pixel^{-1} (100 pc pixel^{-1} for h_0=0.75 and cz=1470 km s^{-1}). The seeing was FWHM$_{seeing}$=2.0″. The spectral resolution has FWHM=7.1 Å (σ_v=168±10 km s^{-1}) with 2.01 Åpixel^{-1}. The aperture spectra of the brightness profile were extracted for the radial distances of 0.00, 1.10, 3.56, 6.84, 11.80 and 20.21″ presenting (S/N)/Å from 40 (more externals) up to 83 (the central one).

2. Radial profiles of Lick indices

We have measured several Lick indices (Fe4383, Ca4455, Fe4531, Fe4668, Mg b, Fe5270, Fe5335, Fe5406, Fe5709, Fe5782 and Na D) for the eleven spectra of NGC 1052, corresponding to equivalent widths (EW) of absorption line-strength blendings. The radial gradient of the majority of Fe lines is quite null (the exceptions are Fe4383 and Fe4668) while the Mg b gradient is very deep. The Ca4455 radial gradient is null. The Na D radial gradient is very deep too, more than the Mg b one. Na D index is probably contimated by the intrinsic interstelar absorption of NGC 1052 and its deep gradient is due to this extinction that is greater in the inner regions. If the indices Fe4383 and Fe4668 are actually contaminated by CH and CN lines, respectively, we can propose that there must exist some radial gradient of carbon stellar abundance. Figure 1 shows the radial profiles of Fe5270 and Mg b indices.

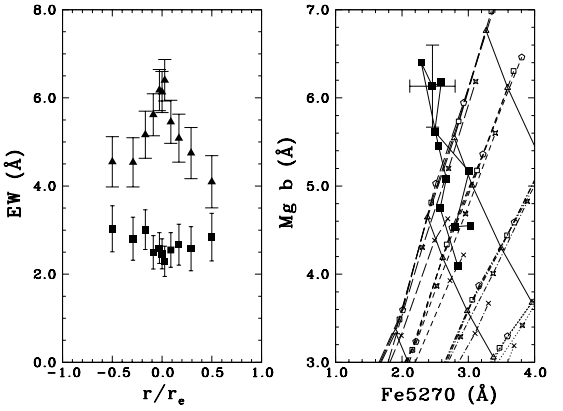

Figure 1. Left: the radial profiles of the indices Mg b (triangles) and Fe5270 (squares) along the major axis of NGC 1052. Right: the Mg b *vs.* Fe5270 plot is presented showing the observed indices (connected solid squares) against the theoretical ones of Thomas *et al.* (2003) models (curve families for [α/Fe] and different simbols for age); see Sec. 3 for details. The solid lines connect the predicted indices of the SSPs with 10 Gyrs (open triangles) and $Z_{\odot}$.

3. Comparison against stellar populations models

We have adopted the single-aged stellar population (SSPs) models of Thomas *et al.* (2003) with Salpeter's IMF, whose principal characteristic is to consider non-solar stellar abundance ratios for the α-elements. We have used the SSPs models with five ages (2, 6, 10, 12 and 15 Gyrs), six global metallicities ([$Z/Z_{\odot}$]= -2.25, -1.35, -0.33, 0.00, +0.35, +0.67 dex) and four α-elements/Fe ratios ([α/Fe]= -0.3, 0.0, +0.3, +0.5 dex). We have compared the Lick indices of NGC 1052 against the theoretical ones of SSPs models. In the plots Mg b *vs.* iron index (e.g. Fig. 1), the predicted Lick indices of the SSPs are distributed about four curve families, each one with a different α-element/Fe ratio. Each curve family presents Lick indices of SSPs with five ages and six metallicities.

Figure 1 shows the Mg b *vs.* Fe5270 plot as an example; that presents the Lick indices of all spectra with distribution between the curves of the SSPs with [α/Fe]=+0.3 and +0.5 dex (or higher!) at the region of [$Z/Z_{\odot}$]= 0.00 and +0.35 dex.

The stellar populations inside the observed region of NGC 1052 have heterogeneous high overabundance of α-elements relative to iron ($0.0 \leqslant$ [α/Fe] $\leqslant +0.5$ dex). The global metallicity seems to change in some interval from [$Z/Z_{\odot}$]=0.0 up to +0.67 dex. Moreover, in other plots as Mg b *vs.* iron index, both Lick indices of more central spectra are higher than the ones of the more externals (a good correlation between both indices!). The strong radial gradient of Mg/Fe explains the radial gradient of Z and the stellar age radial gradient too. It is an indicative of an unique formation and evolution process for the stars of NGC 1052 (from the nucleus up to 0.5 r_e along the rotating disky component).

We found that the stars of NGC 1052 are α-element richer and older at the nucleus than outside. This suggests the star formation at the nucleus happened in a rapid ancient episode and it has been prolonged outwards.

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References

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