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Kinematics and stellar populations of the double-barred early-type galaxy NGC357

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Abstract. We have carried out a kinematical and stellar population analysis of the double-barred galaxy NGC357 to provide a more complete characterization of these systems and their role in the formation of galaxy bulges. We clearly identify the presence of the inner bar in the radial velocity and velocity dispersion profiles. The age, metallicity and [Mg/Fe] abundance ratio estimates are very similar to those of ellipticals of equivalent central σ. The [Mg/Fe] value for the bulge of this galaxy suggests formation timescales shorter than 1Gyr.

Keywords. galaxies: bulges, galaxies: evolution, galaxies: formation, galaxies: kinematics and dynamics

1. Introduction

The formation of bulges is still an open question. A common view is that they form after discs via bars that transport gas to the central regions and trigger an intense star formation there. However, as the material may not reach the center it has been suggested an inner bar to play this role (Shlosman *et al.* 1990). We carry out a kinematical and stellar population analysis of the double-barred S0 galaxy NGC357 to provide a more completed characterization of these systems.

2. Kinematics

Long-slit deep spectra were obtained along the inner and outer bars and the semi-major axis with the NTT telescope (La Silla). The radial velocity and the velocity dispersion of NGC357 have been obtained by performing the cross-correlation between our spectra and one star spectrum of similar spectral type. Figure 1 shows the kinematics along the nuclear bar of this galaxy: both plots reveal the presence of the bar at a radius of $\sim$4 arcsec. Note the two σ hollows matching the position of the inner bar.

3. Stellar populations

We have analyzed the stellar populations of the bulge of this galaxy, for which we obtained very high S/N. Figure 2 shows the Vazdekis (1999) model grids for three pair of indices which break the age-metallicity degeneracy: the $H\gamma_{\sigma=200}$ of Vazdekis & Arimoto 1999 for the age and the [MgFe], Mgb and <Fe> for the metallicity. We include in these plots the index measurements for NGC4473 (Yamada *et al.* 2006), a Virgo elliptical galaxy of similar central σ. We see that the estimated metallicity values are nearly the same for the two galaxies, whereas NGC357 is slightly younger as expected for field galaxies (Kuntschner *et al.* 2002). We also obtain a similar [Mg/Fe] overabundance indicating that the bulk of the stellar population of the bulge has been formed in less than $\sim$1 Gyr.

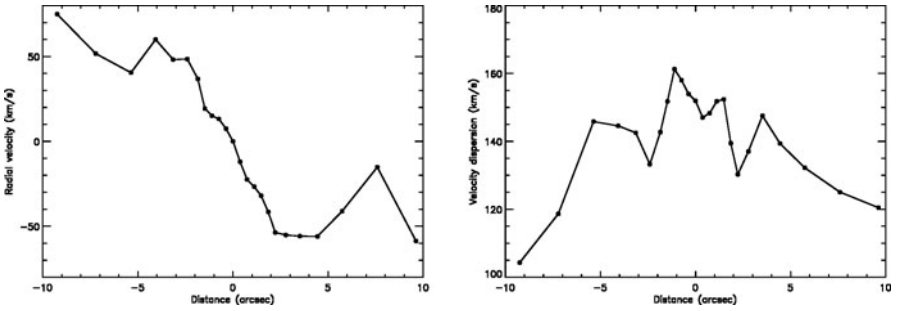

Figure 1. Velocity and velocity dispersion profiles along the nuclear bar of NGC357. We notice the position of the bar at ±4 arcsec approximately.

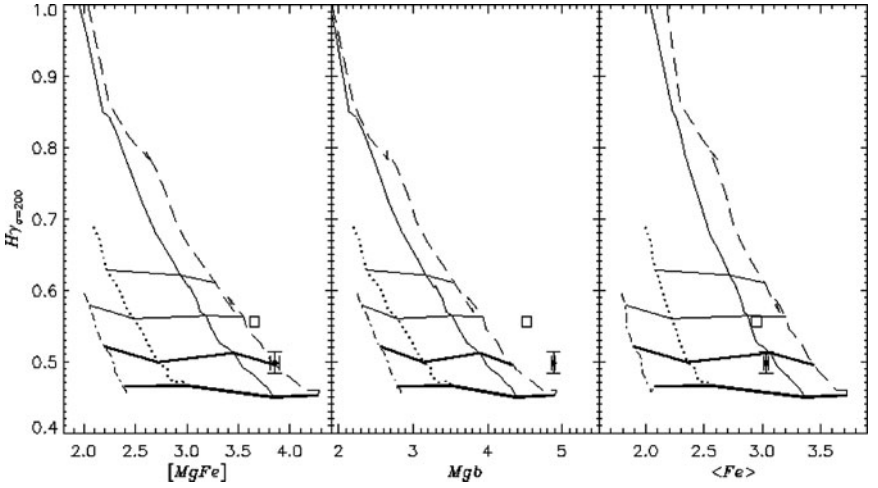

Figure 2. The age indicator $H\gamma_{\sigma=200}$ (Vazdekis & Arimoto 1999) vs. the metallicity indicators [MgFe], Mg*b* and <Fe>. The grids were obtained from the Vazdekis (1999) stellar population synthesis models, previously smoothed to match the central velocity dispersion of NGC357 (i.e., 180 km s^{-1}). The age (solid lines) increases from top to bottom (4, 6, 10 and 18 Gyr) whereas the metallicity increases from left to right ([Fe/H] -0.7, -0.4, 0.0, 0.2). The square is the bulge of NGC357 and the filled dot is a reference Virgo elliptical galaxy of similar central σ (NGC4473; Yamada *et al.* 2006).

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