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The DIVING^{3D} Project: Analysis of the nuclear region of Early-type Galaxies

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Abstract. In this work, we present preliminary results regarding the nuclear emission lines of a statistically complete sample of 56 early-type galaxies that are part of the Deep Integral Field Spectroscopy View of Nuclei of Galaxies (DIVING^{3D}) Project. All early type galaxies (ETGs) were observed with the Gemini Multi-Object Spectrograph Integral Field Unit (GMOS-IFU) installed on the Gemini South Telescope. We detected emission lines in 93% of the sample, mostly low-ionization nuclear emission-line region galaxies (LINERs). We did not find Transition Objects nor H II regions in the sample. Type 1 objects are seen in ∼23% of the galaxies.

Keywords. galaxies: active – galaxies: elliptical and lenticular, cD – galaxies: nuclei – galaxies: statistics

1. Introduction

Statistical studies of the central regions of galaxies allow one to understand the main properties of active galactic nuclei (AGNs) in a given sample of objects. In the local Universe, the Palomar Survey (Filippenko & Sargent 1985; Ho *et al.* 1997a) is an example of such an analysis. If only the Early-type galaxies (ETGs, elliptical and lenticular galaxies) from this survey are considered, emission lines are seen in half of the objects, mostly LINERs (Ho *et al.* 1997b; Ho 2008).

The DIVING^{3D} Project (Deep IFS View of Nuclei of Galaxies) is a statistically complete sample of objects that contains all 170 galaxies of the Southern Hemisphere with $B < 12.0$ mag and galactic latitude $|b| < 15°$ from the RSA and the RC 3. All objects were observed with the Gemini South Telescope using the Gemini Multi-Object Spectrograph (GMOS) under the Integral Field Unit (IFU) mode (Allington-Smith *et al.* 2002) and with the SOAR Integral Field Spectrograph (SIFS). One of the main advantages of the DIVING^{3D} Project, when compared to the Palomar Survey, is the use of seeing-limited IFU data to analyse the very central region of galaxies.

The goal of this work is to present preliminary results of the nuclear region of a statistically complete sample of all 56 ETGs that belong to the DIVING^{3D} Project.

2. Results

Emission lines were detected in ∼93% of the nuclei of the sample ETGs after subtracting their stellar component with the PPXF technique (Cappellari & Emsellem 2004) and using the simple stellar population models described in Vazdekis *et al.* (2015). However,

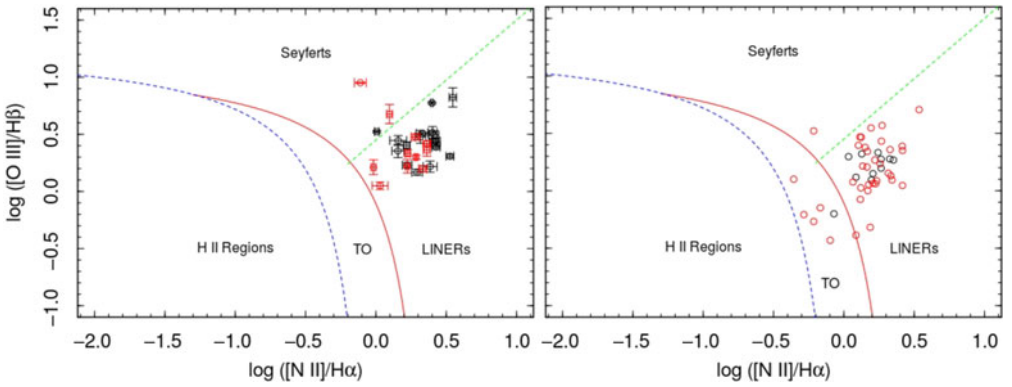

Figure 1. Diagnostic diagram containing only nuclei of ETGs. Left: data from the DIVING^{3D} Project. Right: data from the Palomar Survey (Ho *et al.* 1997a). The black circles correspond to Type 1 AGNs, while the red circles are related to objects with no broad component detected in the permitted lines. The dashed blue line is for the maximum starburst line (Kewley *et al.* 2001), the full red line is for the empirical division between H II regions and AGNs (Kauffmann *et al.* 2003), and the dashed green line is for the LINER/Seyfert division (Schawinski *et al.* 2007). TOs are Transition Objects, which correspond to LINER/H II region composite spectra.

for only half of the sample we were able to accurately measure the flux of the Hα, Hβ, [O III]λ5007 and [N II]λ6583 lines. For these objects, we used a BPT diagnostic diagram, shown in Fig. 1, to classify their nuclear emission.

3. Conclusions

• We detected emission lines in ∼93% of the ETGs from the DIVING^{3D} Project, which is higher than the fraction seen in the Palomar sample (∼ 60%).

• Also, the number of ETGs with a broad Hα component is higher in the objects from the DIVING^{3D} Project (∼23%) than in the Palomar sample (∼15%).

• Both the above results reflect the fact that the ETGs from the DIVING^{3D} Project were observed with a more modern instrument and a better spatial resolution than the Palomar Survey observations.

• Transition Objects are seen in the ETGs from the Palomar survey (9%), but not in the galaxies from the DIVING^{3D} Project. This is also a consequence of the better spatial resolution of the DIVING^{3D} observations, since the use of seeing limited IFU data allows one to isolate the nuclear region, thus avoiding contamination from H II regions.

• The fraction of ETG nuclei containing Seyferts + LINERs is the same in both samples (∼50%).

• When only highly accurate measurements are used in BPT diagrams to determine an emission line nuclei, we noticed that all ETGs are consistent as being classified as LINERs with exception of only one coronal line Seyfert 2 galaxy.

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