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STRATEGIES FOR AGN CHARACTERISATION IN THE OTELO SURVEY

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We present the current status of definition of the observational and analysis strategies for the study of Active Galactic Nuclei (AGN) in the OTELO survey. The main goal of this project is to determine the fraction of each species of AGN and their luminosity functions.

Introduction

The OTELO survey (Cepa et al. 2002) is the deepest Hα narrow-band imaging survey of ELGs using the OSIRIS Tuneable Filters (TF). Currently, two windows at z $\simeq$ 0.24 and z $\simeq$ 0.4 have been defined. The main drivers and objectives of the investigation of AGN in the OTELO survey have been described in Sánchez-Portal et al. (2002, hereafter Paper I). Our goal is to estimate, and to compare with local Universe measures, the following parameters:

(a) the fraction of AGN; (b) the fraction of Seyfert 1, Seyfert 2 and LINER, and (c) the luminosity function of each active galaxy type.

AGN characterization from OTELO data: capabilities and limitations

The OTELO strategy to discriminate among the different nuclear species at the nominal redshift windows is based on its ability to separate the Hα and [N II] lines. The techniques to accomplish this are briefly explained in Paper 1. The ratio between the two lines can be then used to separate AGN from starburst nuclei (if [N II] 6583Å/Hα > 0.6, the nucleus can be classified as AGN, otherwise as a nuclear starburst). Moreover, the Hα line width can be used to distinguish between broad-line AGN (either Seyfert 1.x or LINER 1.x) and narrow-band AGN (Seyert 2 or LINER 2). Unfortunately, the [N II]/Hα criterion cannot be used to separate between Seyfert and LINER galaxies. We have investigated additional parameters from the available lines that could potentially be used to separate between these two AGN types, namely:

(i) Hα equivalent width, and (ii) Hα luminosity.

To this end, we have gathered data from a large survey of ELGs in the local Universe (Ho et al. 1997). Figure 1 shows the diagnostics diagrams representing log([N II]/Hα) vs. log EW(Hα) (left) and vs. log L(Hα) (right). It is quite evident that the locii of Seyfert and LINER galaxies cannot be properly separated using these diagnostics. The situation is not improved by using [N II] parameters instead. It becomes clear, therefore, that additional data must be gathered in order to individuate each AGN species.

The most evident option is to observe with OSIRIS the strong lines [O III] 5007Å and Hβ in order to apply the [O III]/Hβ ratio criterion ([O III]/Hβ > 3 for AGN). While used alone it is not a robust indicator, since the AGN region is also occupied by low-metallicity H II regions, it can be combined with the [N II]/Hα ratio in order to produce BPT diagnostic diagrams where the locii of Seyfert, LINERs and H II galaxies are clearly separated. In order to obtain the spectrophotometric data, two competing techniques can be applied:

(a) OSIRIS standard MOS, or (b) TF line scanning.

The observation method adopted will depend on the number of objects detected in the nominal redshift windows. For $N \sim 100$ objects per OSIRIS field, MOS is the preferred choice. For larger numbers, TF becomes more efficient. Based on our broadband preliminary results shown in figure 2 (Pérez-García et al., 2004), we expect $\sim$ 1500 extragalactic objects per OSIRIS field (at any redshift). The final decission would depend on the number of objects detected in the z $\simeq$ 0.24 and 0.4 windows (as derived from photometric redshifts) and in the actual fraction of AGNs observed (our current assumption is around 10%).

A second option is to gather X-ray data. The separation technique can be implemented by means

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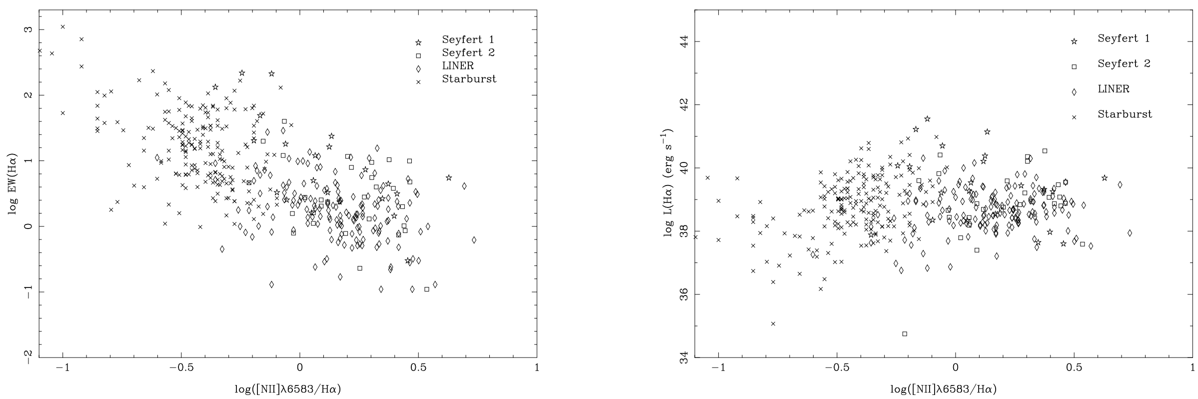

Fig. 1. Diagnostics diagrams from Hα and [N II] 6583Å lines.

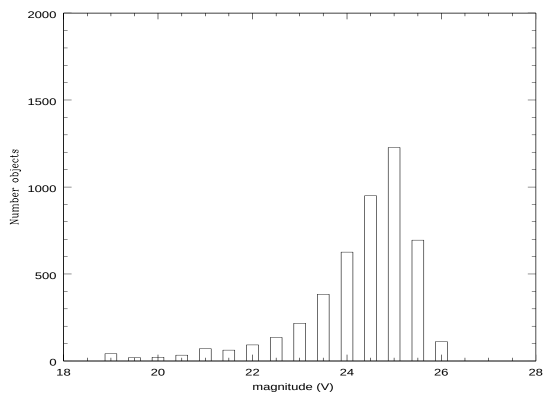

Fig. 2. Object count distribution derived from the OTELO broadband observations of the GROTH field.

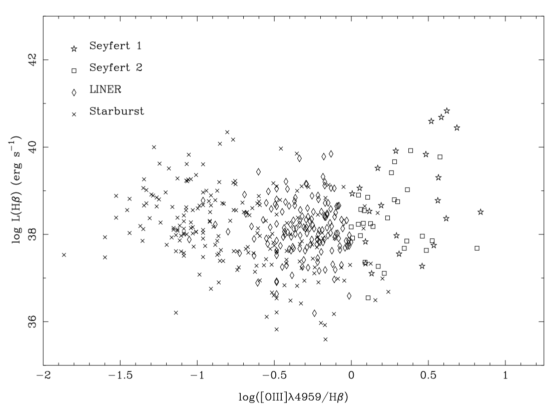

Fig. 3. Diagnostics from Hβ and [O III] 4959Å lines.

of colour-colour diagnostic diagrams. The X-ray colours are characterised by means of "hardness ratios", $HR = (H-S)/(H+S)$, where H and S correspond to the counts in the harder and softer energy bands, respectively. The selection of three statistically independent ratios plus comparison against a grid of power-law spectra and neutral hydrogen absorption models can be used to determine if spectrum hardening is intrinsical or due to absorption. Up to date, public data have been gathered from *XMM-Newton* for the VIRMOS and GROTH strips. It is envisaged to be able to detect bright LINERs up to z $\simeq$ 0.24, should they exist.

The OTELO survey can provide useful data at other redshift ranges. So far we have identified two windows at z $\simeq$ 0.7 and $\simeq$ 0.9, where the Hβ and [O III] 4959Å lines fall inside the 0.24 and 0.4 windows, respectively. The line ratio [O III] 4959Å/Hβ is equivalent (at least at low densities) to [O III] 5007Å/Hβ and can be then used as an estimator to separate AGN species (though not very robust, as explained above). Figure 3 shows a diagnostics diagram using the [O III] 4959Å/Hβ ratio vs. L(Hβ) (data from Ho et al. 1997)

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