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THE DETECTION OF EXTREME LOW-LUMINOSITY AGNS

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RESUMEN

Exploramos el diagrama de diagnóstico que utiliza la razón de líneas de emisión ([NII]λ6584 Å/Hα) frente al ancho equivalente de [NII]λ6584 Å, propuesto por Coziol et al. (1998) a una muestra obtenida del SDSS DR5 para separar las galaxias dominadas por formación estelar y galaxias con núcleo activo (AGNs) de baja luminosidad. Este diagrama de diagnóstico no necesita las líneas clasicas de emisión como [OIII]λ5007 Å, o Hβ para clasificar el tipo de actividad. Se demuestra empíricamente que esta combinación de líneas de emisión se puede utilizar para buscar en los llamados AGN de baja luminosidad.

ABSTRACT

We explore the diagnostic diagram that uses the ratio of emission lines ([NII]λ6584 Å/Hα) versus equivalent width of [NII]λ6584 Å, proposed by Coziol et al. (1998) to a sample obtained from Sloan Digital Sky Survey Data Release 5 to separate star-forming and active galaxies from low-luminosity AGNs. This diagnostic diagram does not need the classical emission lines like [OIII]λ5007 Å, or Hβ to classify activity type. We show empirically that this combination of emission lines can be used to search the called Low-Luminosity AGN.

Key Words: galaxies: active — galaxies: evolution

1. INTRODUCTION

The most common activity diagnostic diagrams are those that compare the line ratio [OIII]λ5007/Hβ with [NII]λ6584/Hα (Baldwin, Phillips, & Terlevich 1981), with [OI]λ6300/Hα, or with [SII]$\lambda\lambda$6717,6731/Hα (Veilleux & Osterbrock 1987). Applying different empirical separation sequences in these diagrams (Kewley at al. 2001; Kauffmann et al. 2003) allow to distinguish between two main ionization mechanisms: thermal photo-ionization by massive OB stars for Star Forming Galaxies (SFGs), and non thermal photo-ionization related to AGNs (Seyfert 2 or LINER). Although extremely useful, the standard diagnostic diagrams become unhelpful in cases where some emission lines are missing. Coziol et al. (1998) and Martínez et al. (2008, 2010) have found many examples of galaxies where the only clear emission transitions are the two nitrogen lines [NII]$\lambda\lambda$6548,6584. Coziol et al. (1998) have demonstrated that the ratio [NII]λ6584/Hα in these galaxies is consistent with what is observed in typical AGNs. To compare these galaxies with those observed by Phillips et al. (1986), these authors have used a different "diagnostic diagram" which compares the equivalent width (EW) of [NII]λ6584 with the ratio of [NII]λ6584/Hα (NII diagram). This diagram place such objects in a regime of Low-Luminosity AGNs (LLAGNs).

2. SAMPLE DATA

The data used come from main catalog of the Sloan Digital Sky Survey Data Release 5 (Adelman-McCarthy et al. 2007). Using the Virtual Observatory service[2], we have downloaded the spectra of 476931 objects spectroscopically classified as narrow line emission galaxies. The spectra were processed using the spectral synthesis code STARLIGHT (Cid Fernandes at al. 2005). One of the main advantages of using STARLIGHT is that it produces synthetic spectral models, which are built by summing simple stellar populations from a standard library, and from the residual spectrum we obtain a good measure of the emission line characteristics such as fluxes and EWs for the most important lines. In our original sample we have identified three different cases of missing emission lines: (1) either Hβ is missing, (2) or [OIII]λ5007 is missing, (3) or both lines are missing. We account for 68491 galaxies without Hβ, 27985 without [OIII] and 10926 without both lines. In total, this represents 22% of the whole sample. If we consider only those galaxies that have emission lines with signal to noise ratios, S/N, greater or equal to 3 (S/N>10 in the continuum), we are left with 224846 galaxies (47% from the original sample). From these, we account 34307 galaxies without Hβ, 12455 without [OIII], and 2840 without both lines. Again this represents 22% of the sample.

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[2]Available at `http://www.starlight.ufsc.br`.

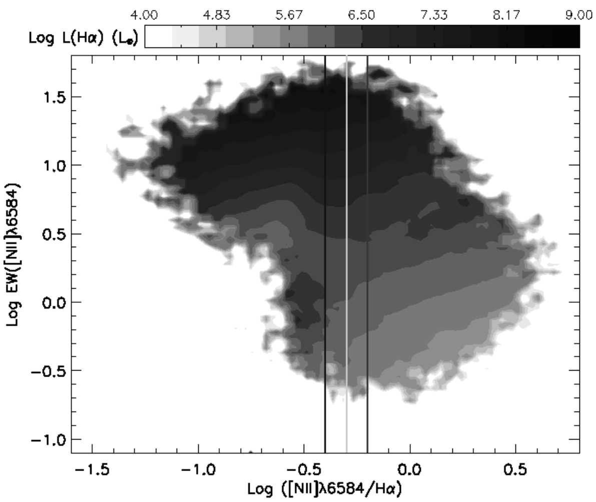

Fig. 1. Contour of luminosity of Hα, the solid line at -0.3 separate SFGs from TO, and -0.4 and -0.1 define de buffer zone where find the TO's.

3. LUMINOSITY

A very high fraction (62.3%) of the galaxies without [OIII] fall on the AGN side of the NII diagram (to the right of continuous line at -0.3 in [NII]/Hα). The galaxies without Hβ fall mostly (93%) on the AGN side. The distribution of the galaxies without both lines seems similar to that of the galaxies without Hβ: 91% are on the AGN side. Most of the galaxies with some emission lines missing fall below log(EW[NII]) = 0.6: 77% without [OIII], 94% without Hβ and 98% without both lines. Their median luminosity on this region in Hα is 5.6×10^{39} erg s^{-1}, which justify the LLAGNs classification. In Figure 1 we can see this decrease in luminosity.

4. FWHM OF Hα

These galaxies show broad FWHM typical of AGNs plus extra nuclear excitation compared to SFGs. Another characteristics of AGNs is their relatively broad line profiles compared to SFGs. Typical FWHM in AGNs range between 170 and 700 km s^{-1}. Such broad lines cannot be explained by thermal motion. It suggests the gas producing the emission is moving at high speed. The values were quadratically corrected for the resolution of the telescope (follow Greene & Ho 2006). One can see how the FWHM increases from the SFGs to the TOs to the AGNs. In Figure 2 we can see the histogram of FWHM of Hα.

5. DISCUSSION

Based on a large sample of emission line galaxies from SDSS, we have shown that the galaxies

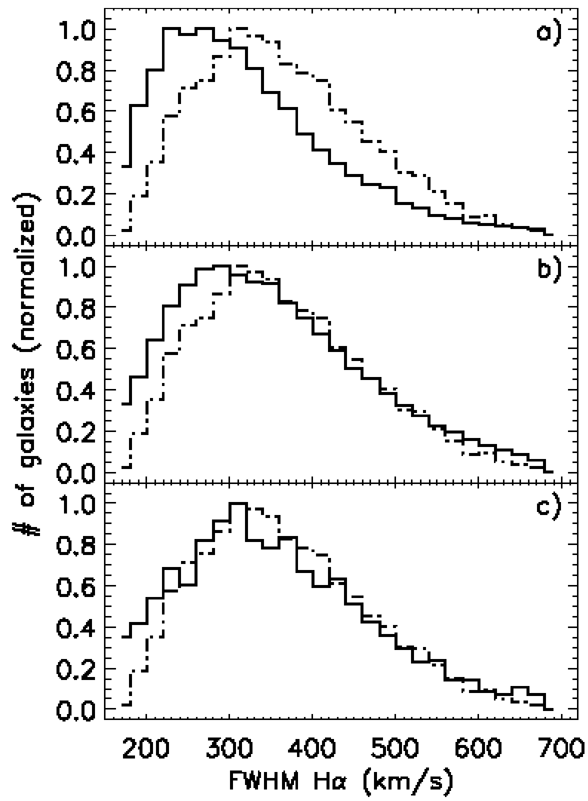

Fig. 2. Distributions of the FWHM of Hα: (a) galaxies without [OIII]; (b) galaxies without Hβ; (c) galaxies with both lines missing. The point dashed line corresponds to the standard AGNs.

that cannot be classified because some important emission lines are missing are in majority LLAGNs. Therefore this characteristics seems to be the signature of LLAGNs in the nearby universe (Coziol et al. 1998).

REFERENCES

Adelman-McCarthy, J. K., et al. 2007, ApJS, 172, 634
Baldwin, J. A., Phillips, M. M., & Terlevich, R. 1981, PASP, 93, 5
Cid Fernandes, R., Mateus, A., Sodré, L., Stasińska, G., & Gomes, J. M. 2005, MNRAS, 348, 363
Coziol, R., Ribeiro, A. L. B., de Carvalho, R. R., & Capelato, H. V. 1998, ApJ, 493, 563
Greene, J. E., & Ho, L. C. 2006, ApJ, 641, 117
Kauffmann, G., et al. 2003, MNRAS, 346, 1055
Kewley, L. J., et al. 2001, ApJ, 556, 121
Martínez, M.A., del Olmo, A., Coziol, R., & Focardi, P. 2008, ApJ, 678, L9
Martínez, M. A., del Olmo, A., Coziol, R., & Perea, J. 2010, AJ, 139, 1199
Phillips, M. M., Jenkins, C. R., Dopita, M. A., Sadler, E. M., & Binette, L. 1986, AJ, 91, 1062
Veilleux, S., & Osterbrock, D. E. 1987, ApJS, 63, 295