The Interplay among Black Holes, Stars and ISM in Galactic Nuclei
Proceedings IAU Symposium No. 222, 2004
T. Storchi-Bergmann, L. C. Ho & H. R. Schmitt, eds.

DOI: 10.1017/S1743921304002856

Does interaction induce activity in Seyfert galaxies? The case of Mrk 315.

S. Ciroi[1], P. Rafanelli[1], V. L. Afanasiev[2], S. N. Dodonov[2], V. Botte[1] and F. Di Mille[1]

[1]Padova Astronomical Department, Vicolo dell'Osservatorio, 2, I-35122 Padova, Italy

[2]Special Astrophysical Observatory, Nizhnij Arkhyz, Zelenchukskaya, Karachaevo-Cherkesia, Russia 369167

Abstract. During the last decades many authors have concentrated their efforts on understanding what are the most efficient mechanisms to feed an AGN. Several solutions have been proposed, as the presence of circumnuclear star clusters, nuclear bars/disks/spirals, and the interaction between galaxies, in form of close encounters and mergers. Here we present new results about an isolated, intermediate-type Seyfert galaxy, Mrk315. The analysis of broad- and narrow-band images, and integral field spectra revealed a spiral-like structure hidden under the E/S0 morphology of the galaxy, and confirmed the presence of a nuclear jet-like feature, forming a sort of very extended "hook". Moreover, our data confirmed the supposed nature of the already known knot, located at 2" from the active nucleus, as a secondary nucleus, residual of a minor merger bewteen the galaxy and a small nucleated companion.

1. Introduction

Until now, no unquestionable proofs have been found that AGN activity is "synonimous" of interaction, since for example numerous active galaxies appear isolated, with no evident companions within a projected distance of several diameters, and nuclear bars/spirals seem not to be more common among AGN than non-active galaxies. Nevertheless numerical simulations have shown that galaxy interactions can bring gas from the disk toward the nuclear regions, and statistical studies of their surrounding environment found an excess of companions around Seyfert galaxies relative to non-active galaxies. Therefore, one of the most natural approaches toward this topic is looking for effects of interaction in isolated nearby Seyfert galaxies. Here we present preliminary results about a photometric and spectroscopic study of an intermediate-type Seyfert galaxy: Mrk315 (Ciroi et al. 2004).

2. Preliminary Results

B, R, and Hα images obtained at the VAT telescope (Vatican Observatory, Arizona, USA) and processed with an adaptive filter (Richter et al. 1991), revealed a spiral-like structure, hidden under the E/S0 morphology of the galaxy, surrounding the nucleus and having a maximum projected radial extent of $\sim$ 4.5 kpc (Fig.1, *left*). This structure was already observed by MacKenty et al. (1994) and Nonino et al. (1998). The "pure" Hα image shows a smooth extended emission which corresponds exactly to the above mentioned spiral-like structure, suggesting that star formation is widespread in this structure.

SCORPIO [O III]5007 images and MPFS integral-field spectra were obtained at the 6-m telescope (SAO RAS, Russia). The "pure" [O III] image shows that the highly ionized gas has a distribution, which does not match the shape of the inner spiral-like structure, confirming the prevailing thermal origin of the ionization in this region of the galaxy.

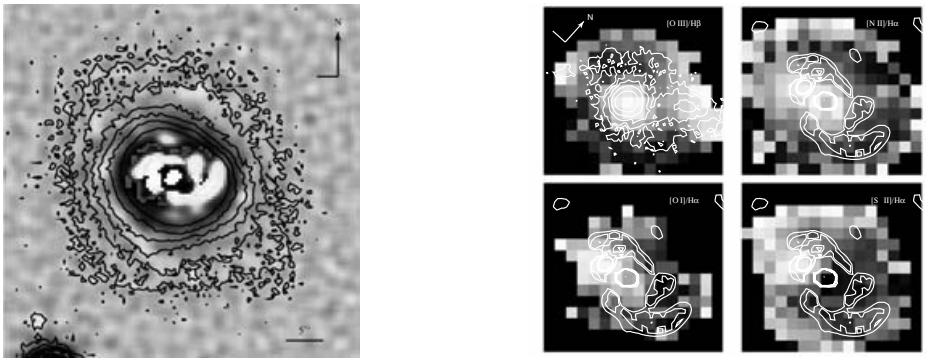

Figure 1. *Left*: R-band filtered image of Mrk315. *Right*: Maps of the emission line ratios [O III]/Hβ, [N II]/Hα, [S II]/Hα, and [O I]/Hα (clockwise from the up-left corner) plus contours of the "pure "[O III] emission (up-left) and the R-band filtered image.

A strong feature extended up to 7 kpc N−W to the nucleus suggests the presence of collimated radiation from the active nucleus. This feature, but extremely weaker, seems to continue from the outskirts of the galaxy up to $\sim$ 50 kpc, and then turns back for other $\sim$ 45 kpc, forming a sort of very extended "hook".

Both Hα and [O III]5007 velocity fields of the galaxy (f.o.v=16$''$ $\times$ 15$''$) were also obtained. While the first one shows a mostly regular "spider diagram" typical of pure rotation, the same does not hold for the second one: the nucleus has $\Delta V \sim -100$ km s^{-1} with respect to V$_{nuc}$(Hα) ($\sim$ 11770 km s^{-1}) indicating the presence of outflowing gas; in addition, two regions at N−W and S−E to the nucleus, have V $\sim$ 12000 km s^{-1}, not connected to the global rotation of the galaxy. In particular, the N−W region is the above mentioned strong feature likely ionized by the AGN, and connected to the "hook". Therefore, we suggest that this could be a nuclear jet-like structure.

Embedded in the inner spiral-like structure there is a bright knot located $\sim$ 2 kpc East to the nucleus, which does not appear so well defined in the Hα image, and shows a relatively weak [O III] emission. This knot has an evident stellar nature, since it is clearly visible in a I-band HST image, published by MacKenty et al. (1994), who made the hypothesis that this knot could be reasonably a secondary nucleus, debris of a merger between Mrk315 and a smaller nucleated companion.

Using our integral field spectra, we could create the maps of each emission line in the f.o.v of the instrument, and then the emission line ratio maps, which are useful to study the physical properties of the gaseous components. In particular we have obtained the maps of [N II]6583/Hα, [O I]6300/Hα, [S II]6716+6731/Hα, and [O III]5007/Hβ. These maps confirm the thermal ionization in the spiral-like structure, and the AGN ionization in the nuclear region, and more interestingly in the outer part of the strong N-W feature identified in the [O III] image. Moreover, at the location of the eastern knot, we observe high values of the first three listed emission line ratios, which suggest that the gas is compressed and characterized by shock ionization.

References

Ciroi, S., et al. 2004, MNRAS, in preparation
MacKenty, J. W., Simkin, S. M., Griffiths, R. E., Ulvestad, J. S., & Wilson, A. S. 1994, ApJ, 435, 71
Nonino, M., Henry, J. P., Fanti, C., Fanti, R., & Davies, J. 1998, MNRAS, 299, 332
Richter, G. M., Lorenz, H., Bohm, P., & Priebe, A. 1991, AN, 312, 345

https://doi.org/10.1017/S1743921304002856 Published online by Cambridge University Press