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3D Spectroscopy of the Nuclear Environment of a Selected Sample of Nearby Active Galactic Nuclei: NGC 7319

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Abstract. We report some results of a spectrophotometric study of the Seyfert 2 galaxy NGC 7319 extracted from a sample of nearby active galactic nuclei observed using integral field spectroscopy. The Multi Pupil Fiber Spectrograph (MPFS) mounted at the Russian 6-m telescope, which takes simultaneously 240 spectra at low or intermediate spectral resolution of a $16'' \times 15''$ field, has been used for the observations. Two-dimensional maps of diagnostic emission line ratios have allowed to investigate in detail the nature of the ionization processes acting in these regions.

NGC 7319 is a SB(pec) Seyfert 2 galaxy belonging to the compact group of galaxies known as Stephan Quintet. It was observed with the Multi Pupil Fiber Spectrograph (MPFS, Afanasiev et al. 2001) through which it was possible to measure the fluxes of the brightest emission lines. All emission line maps present an elongated shape with a bright center slightly shifted ($\sim 1.5''$) toward the N with respect to the center of the continuum map, and a position angle PA $\sim 200°$ misaligned of about 65° with respect to the major axis of the continuum. The size of this extended emission line region (EELR) is $\simeq 10''$ ($\simeq 4.3$ kpc). These values agree with the results obtained by means of longslit scanning by Aoki et al. (1996). Although the spatial distribution of the ionized gas shows a similar morphology at different emission lines, the maps of the emission line ratios reveal interesting features. In particular the [O III]/Hβ and the reddening corrected [O III]/Hα show a high degree of ionization with sharp edges that strongly resemble an ionization cone. On the contrary, the maps of [O I]/Hα, [N II]/Hα and [S II]/Hα ratios reveal a completely different and asymmetric structure with a well defined line of demarcation between lower values, which belong to the region corresponding to the maximum extent of the emission lines distribution (region C), and the higher ratios located at the nucleus and at North of it (region A). To investigate the physical conditions of the emitting gas we built the classical diagnostic diagrams (Fig. 1).

In all of these diagrams the line ratios fall within the limits that characterize Seyfert galaxies, but with a spread indicating that the EELR of NGC 7319 is characterized by a wide range of physical parameters. It is also evident that the ionization of the region C can be easily explained with a simple AGN model, but the same model fails to explain the data belonging to region A. For the first time we also recovered the stellar kinematics of the galaxy which shows quite ordered rotation with a minor kinematic axis approximately aligned with the minor photometric axis. We measured an heliocentric velocity of 6770 ± 50 km s^{-1} at the continuum peak in good agreement with 6740 ± 50 km s^{-1} as found by

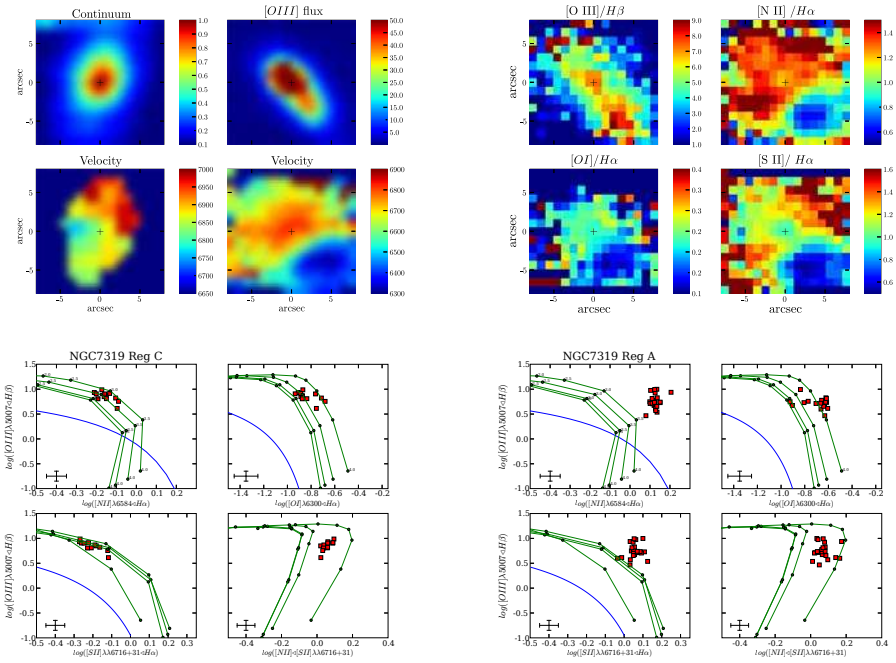

Figure 1. Upper left panel: Flux maps and kinematics of the stellar and gaseous component. Upper right panel: Emission line ratios. Lower left panel: Diagnostic diagram of region A. Lower right panel: The same for region C. The solid blue lines divide the theoretical starburst region from other types of excitation as computed by Kewley et al. (2001). A grid of photoionization models calculated with Cloudy using a single power law with $\alpha = -1.3$, ionization parameters $10^{-0.5} \leq U \leq 10^{-4}$ and $1 \leq \log N_{\rm H} \leq 4$, are also overlaid.

Aoki et al. (1996). The gaseous component instead shows a completely different behavior: at a distance of about 5″ in the south-west direction, the ionized gas shows a blueshift from the systemic velocity by more than 300 km s^{-1}. well separated from the northern regions, which have a radial velocity more close to the systemic velocity. This blueshifted region corresponds to the region that we named region C and it was interpreted by Aoki et al. (1996) as an high velocity and large scale outflow in the EELR of NGC 7319.

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