Black Holes from Stars to Galaxies – Across the Range of Masses
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Near-IR integral field spectroscopy of the NLR of ESO428-G14: the role of the radio jet

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Abstract. We present two-dimensional (2D) gas kinematics and excitation of the inner 300 pc of the Seyfert galaxy ESO428-G14 at a sampling of 14 pc^2, from near-infrared spectroscopic observations at R=5900 obtained with the Integral Field Unit of the Gemini Near-Infrared Spectrograph. Blue-shifts of up to $400\,km\,s^{-1}$ and velocity dispersions of up to $150\,km\,s^{-1}$, are observed in association with the radio jet running from SE to NW along position angle 129°. Both X-rays emitted by the active galactic nucleus and shocks produced by the radio jet can excite the H_2 and [Fe II] emission lines. We use the 2D velocity dispersion maps we estimate upper limits of 90% to the contribution of the radio jet to the excitation of [Fe II]$\lambda1.257\mu$m, and of 80% to the excitation of $H_2\lambda2.121\mu$m in the jet region.

Keywords. Galaxies: individual (ESO 428-G14) – galaxies, active – galaxies: nuclei – galaxies: ISM – galaxies: kinematics and dynamics – galaxies: jets

1. Introduction

The Narrow-Line Region (NLR) of Seyfert galaxies is one of the best probes of the mechanisms in operation in the surrounding of accreting supermassive black holes in galaxies. The excitation and dynamics of the inner NLR gas can reveal how radiation and mass outflows from the nucleus interact with circumnuclear gas. In this work we use the IFU of the Gemini Near-Infrared Spectrograph which provides two dimensional (hereafter 2D) mapping in the near-IR (thus minimizing the effect of reddening) to study the circumnuclear emitting gas of the Seyfert galaxy ESO 428-G14. Further results of this study can be found in Riffel *et al.* (2006).

2. Results and conclusions

In Fig. 1 we present 2D maps for the flux distribution and kinematics of the H_2, H I and [Fe II] emitting gas. The intensity maps show that all emission lines are most extended along the position angle PA∼129°, which is the orientation of the radio jet and approximately coincides with the photometric major axis of the galaxy. The line emission distributions present a bibolar structure extended to both sides of the nucleus and show a detailed correspondence between with the radio map: the strongest line-emission is observed to the NW, and approximately coincides with the strongest emission in radio; the emission-line distribution to the SE bends to NE, as also observed in the radio contours. The strong influence of the radio jet is also observed in the gas kinematics. In particular, the location of a radio hot spot at $\approx 0.8''$ NW from the nucleus corresponds

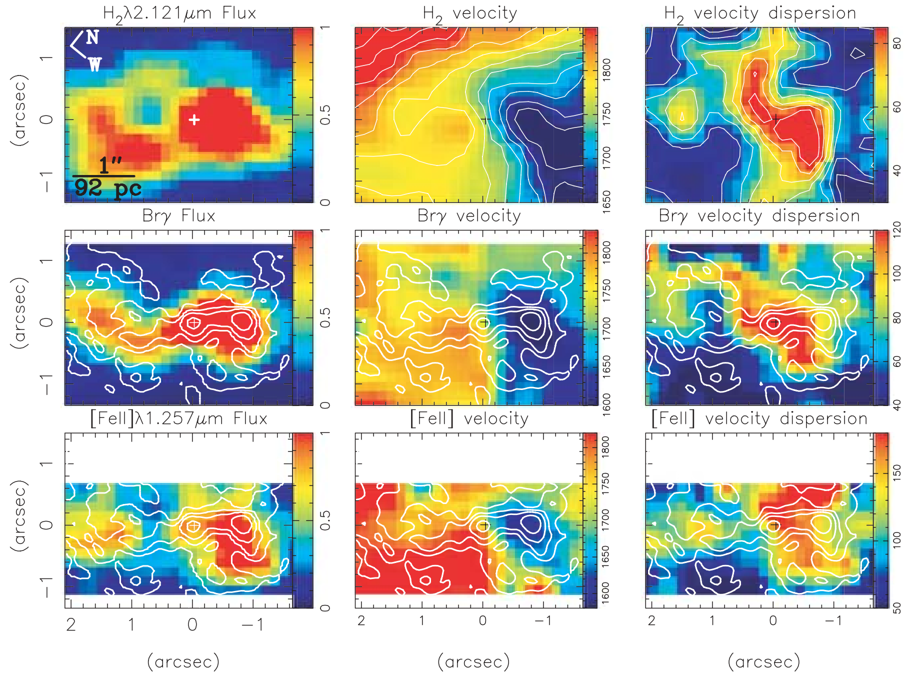

Figure 1. 2D maps for the flux distribution and kinematics of the $H_2\lambda2.121$, Brγ and [Fe II] emission lines. Left panels: intensity maps in arbitrary units; middle: radial velocity fields; right: velocity dispersions. Radio contours at wavelength 2 cm (heavy white lines) from Falcke, Wilson & Simpson (1998) are overlaid on the Brγ and [Fe II] maps. The cross marks the position of the nucleus, defined as the peak of the K band continuum emission.

to the highest blueshifts observed in the gas. The highest velocity dispersion (σ) values are observed between the nucleus and the radio hot spot, and do not coincide with the emission line flux and velocity peaks, being shifted towards the nucleus. We interpret this result as due to the kinetic energy deposited by the radio jet in the circumnuclear ISM, producing a compression in the gas and emission enhancement just beyond this compressed region. Velocities slices along each emission line profile are presented in Riffel *et al.* (2006). Blueshifts of up to 400 km s^{-1} and velocity dispersions of up to 150 km s^{-1}, are observed in association with the radio jet.

From the observed kinematics, we conclude that the radio jet has a fundamental role in shaping the emission line region as it interacts with the galaxy ISM surrounding the galaxy nucleus. We have used the 2D velocity dispersion maps to estimate the kinetic energy deposited in the circumnuclear ISM by the radio jet relative to regions away from the jet. Assuming that the H_2 and [Fe II] excitation in the latter regions is dominated by X-rays, and that the X-rays excitation is the same in the jet region, we obtain contributions by shocks of up to 80 - 90% for the [Fe II] and up to 70 - 80% for H_2 in the jet region. These are however, upper limits due to the fact that the X-rays contribution along the jet axis may be larger than away from it. The stronger association of the [Fe II] emission and kinematics with the radio structure supports a larger contribution of the radio jet to the excitation of [Fe II] than to that of H_2.

References

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