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# Molecular and ionised gas kinematics in a sample of nearby active galaxies

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**Abstract.** We used Gemini NIFS integral field spectroscopy to analyse the molecular and ionised gas kinematics of six nearby ($z \leqslant 0.015$) Seyfert galaxies with a spatial coverage of $0.1-0.6\,\mathrm{kpc}^2$. By fitting the emission-line profiles using multiple Gaussian components we determined that the ionised and hot molecular gas kinematics are dominated by gas outflows and rotation, respectively, even though three objects also present molecular outflows.

**Keywords.** galaxies: Seyfert, galaxies: kinematics and dynamics, galaxies: nuclei

## 1. Introduction

Feeding and feedback processes in active galaxies are one of the keys to constrain galaxy evolution models. Only in the local Universe it is possible to achieve spatial resolutions of tens of parsecs allowing us to resolve the gas kinematics in the vicinity of supermassive black holes. The gas distribution and kinematics in the inner kpc of the host galaxies of Active Galactic Nuclei (AGN) can provide insightful information about the physical processes involved in AGN feeding and feedback. The feeding, that occurs through gas accretion, is the source of the AGN power, while the feedback is required to constrain galaxy evolution models. Understanding these physical processes in high spatial and spectral resolution is important to such theoretical studies.

In this work we studied the gas kinematics of six nearby Seyfert galaxies observed with integral field spectroscopy in the near-infrared. These galaxies have been previously studied by Schönell *et al.* (2019), who mapped the gas and mass distribution concluding that the molecular and ionised gas present distinct flux distributions and kinematics. They estimated the mass of the former to be $10^{3-4}$ times smaller than that of the latter.

## 2. The data and measurements

Our sample is composed of six nearby Seyfert galaxies that are part of the AGNIFS sample (Riffel *et al.* 2018). This set of galaxies was built according to the following criteria: (i) $\mathrm{L_X} \geqslant 10^{41.5}\mathrm{L_\odot erg\,s^{-1}}$ in the 105 month 14-195 keV Swift catalogue; (ii) $z \leqslant 0.015$; (iii) $-30^\circ < \delta < 73^\circ$ and (iv) extended [OIII] emission. The total sample is composed of 24 galaxies, but here we studied: NGC 5899, Mrk 607, NGC 788, NGC 3227, NGC 3516 and NGC 5506 Schönell *et al.* (2019).

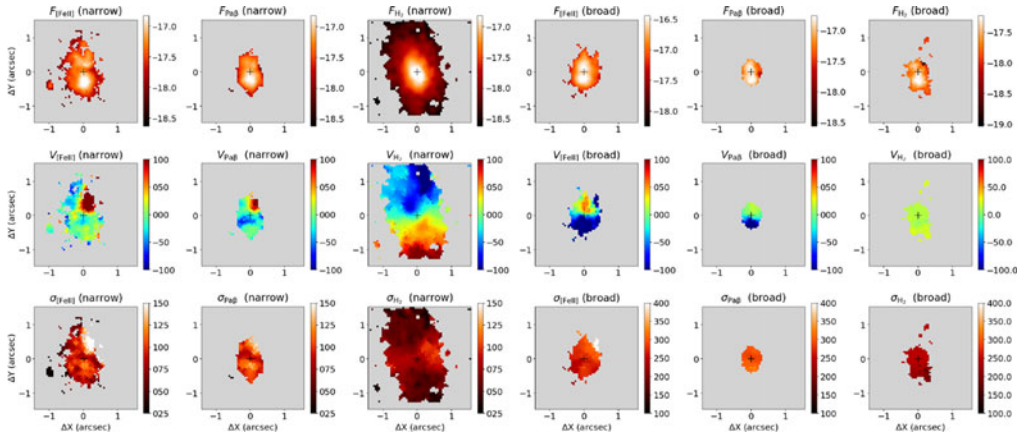

**Figure 1.** 2D maps for NGC 5899. Top: the flux (F) distribution for the narrow and broad components of the [FeII], Pa$\beta$ and $H_2\lambda2.12\mu$m. Middle and bottom: velocity (V) and velocity dispersion ($\sigma$) in the same order as the top panels. The $H_2$ narrow component is dominated by emission of gas in the disk, while the ionised gas emission is possibly dominated by outflows.

We used Gemini NIFS (Near-intrared Integral Field Spectrograph) to map the gas and stellar kinematics in the inner kpc of the galaxies of our sample, at a velocity resolution of $\sim$25 km s$^{-1}$ and a spatial resolution of 12–35 pc at the distance of the galaxies. Details about the data reduction can be found in Schönell *et al.* (2019).

In order to measure the fluxes, velocities and velocity dispersions ($\sigma$) of the J and K band emission lines, we used the IFSCUBE code† to fit each line profile with up to three Gaussian functions. The broad components ($\sigma \gtrsim 150$ km s$^{-1}$) are usually associated with gas outflows and the narrow components ($\sigma \lesssim 150$ km s$^{-1}$) with the gas rotating in a disk, the details will be analysed for each individual galaxy.

## 3. Results

We constructed flux, velocity and velocity dispersion maps for [Fe II]$\lambda1.2570\,\mu$m, Pa$\beta$ and $H_2\lambda2.1218\,\mu$m for all galaxies of our sample. As an example, Figure 1 shows the corresponding maps for NGC 5899. To represent the line profiles observed in this galaxy two-Gaussian components are required. A clear rotation pattern is observed for the narrow component of $H_2\lambda2.1218\,\mu$m, while for the ionised gas, the narrow component seems to be tracing a more disturbed kinematics, besides the emission from the disk. The broad components are interpreted as being due to emission within a bicone, with the near side of the cone seen to the south of the nucleus and its far side to the north of it. The broad component for the molecular gas seems to be tracing the interaction of the outflows with the gas of the disk of the galaxy, as indicated by the low velocities.

All galaxies of our sample present outflows in ionised gas, and at least three of them also show molecular outflows. Although for some galaxies (such as NGC 5899 and NGC 5506) the outflows seem to be observed within conical structures, the geometry of the outflows must be further constrained by modeling the gas kinematics. This will be presented in Bianchin *et al.* (in preparation).

## References

Riffel, R. A., *et al.* 2018, *MNRAS*, 474, 1373
Schönell, A. J., *et al.* 2019, *MNRAS*, 485, 2054

† https://github.com/danielrd6/ifscube

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