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NIR–IFU observations of the merger remnant NGC 34

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Abstract. Understanding the interplay between the phenomena of active galactic nuclei (AGN) and starbursts remains an open issue in studies of galaxy evolution. The galaxy NGC 34 is the remnant of the merger of two former gas-rich disc galaxies and it also hosts a strong nuclear starburst. In this work, we map the ionized and molecular gas present in the nuclear regions of the galaxy NGC 34 using adaptive optics (AO) assisted near infrared (NIR) integral field unity (IFU) observations. Our main goals are to better constrain the energy source of this object and to use NGC 34 as a laboratory to probe the AGN-starburst connection in the context of galaxy evolution and AGN feeding and feedback processes.

Keywords. galaxies: interactions, galaxies: active, galaxies: starburst, infrared: galaxies

1. Introduction

The phenomenon of active galactic nuclei (AGN) represents a critical phase in galaxy evolution, since AGN feedback may impact star formation (SF) over galactic scales (Storchi-Bergmann & Schnorr-Muller 2019). However, understanding the feeding and feedback of AGN becomes a challenging task for objects that seem to host not only an AGN but also a nuclear starburst. Another problem involves quantifying feedback effects in high redshift objects, which can be addressed through studies of Local Universe analogs.

In this context, the galaxy NGC 34, $z = 0.01962$ (Rothberg & Joseph 2006), a local luminous infrared galaxy (LIRG), is an ideal laboratory for such studies. It hosts a strong nuclear starburst and tidal tails indicative of the merger of two former gas-rich disc galaxies (Schweizer & Seitzer 2007). Although X-ray observations provide compelling evidence for the presence of an AGN in its central regions (Esquej *et al.* 2012), the

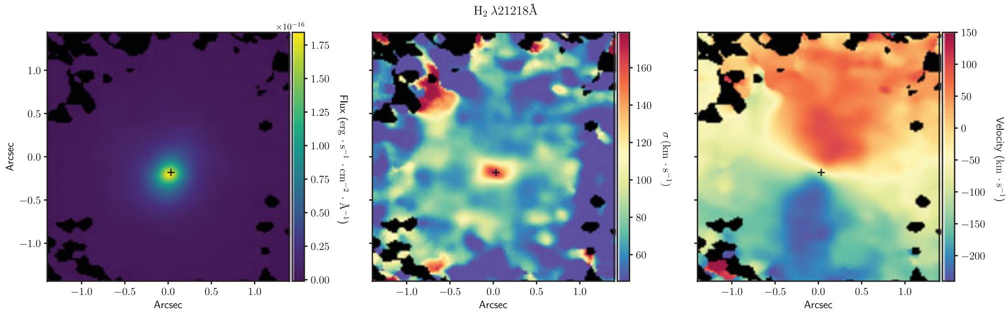

Figure 1. Flux, velocity dispersion σ and centroid velocity maps for the H_2 λ21218Å emission line. The black cross indicates the galaxy center. Black pixels were not considered in the fit.

nature of its nuclear emission line spectrum is still highly controversial. In this work, we use near infrared (NIR) integral field unity (IFU) observations to map the distribution of the ionized and molecular gas present in the central regions of NGC 34 in order to better constrain the energy source powering this object and to use NGC 34 as a local laboratory to probe the AGN-starburst connection in the context of galaxy evolution.

2. Observations and Data analysis

We have taken adaptive optics (AO) assisted Gemini North Near-Infrared Integral Field Spectrograph (NIFS) data cubes in September 2011 in the J and K_l bands. The data were reduced using IRAF and standard reduction scripts made available by the Gemini team. We applied the treatment techniques suggested by Menezes *et al.* (2014). Our final data cubes have fields–of–view (FoV) of ≈3.0 arcsec × 3.0 arcsec, corresponding to 1.2 kpc × 1.2 kpc at the galaxy, and the spatial resolution is 0.17 arcsec (≈70 pc) for both bands. We subtracted the stellar component from the observed spectra of the galaxy using the IRTF Spectral Library (Cushing *et al.* 2005; Rayner *et al.* 2009) and the Penalized Pixel-Fitting (PPXF) code (Cappellari 2017). The fitting of the profiles of the emission lines is being carried out using the package IFSCUBE.

3. Preliminary results and Ongoing analysis

The main NIR emission lines that can be seen in our spectra are [P II] λ11470Å, [P II] λ11886Å, [Fe II] λ12570Å and Paβ in the J band, and H_2 λ21218Å, Brγ, H_2 λ22230Å and H_2 λ22470Å in the K band. The flux distribution and velocity field maps for H_2 λ21218Å are shown in Fig. 1. The map of velocities shows a rotation signature that resembles a disc with a northern receding and a southern approaching side. Our next steps include obtaining spatially resolved maps of the emission line ratios H_2 $\lambda 2.121\mu$m/Brγ and [FeII]$\lambda 1.257\mu$m/Paβ to be used in NIR diagnostic diagrams that will allow us to better constrain the excitation mechanisms of the multi–phase gas in NGC 34.

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