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A MUSE study of NGC 7469: Spatially resolved star-formation and AGN-driven outflows

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Abstract. NGC 7469 is a well-known type 1 AGN with a cirumnuclear star formation ring. It has previous detections of X-rays warm absorbers and an infrared biconical outflow. We analysed archival MUSE/VLT observations of this galaxy in order to look for an optical counterpart of these outflows. We report spatially resolved winds in the [O III]λ5007 emission line in two regimes: a high velocity regime possibly associated with the AGN and a slower one associated with the massive star formation of the ring. This slower regime is also detected with Hβ.

Keywords. Galaxies: Seyfert, nuclei

1. Introduction

NGC 7469 is a luminous infrared galaxy (LIRG) hosting a Seyfert 1 active galactic nucleus (AGN). It shows a starburst, likely caused by interactions with galaxy IC 5283, concentrated in a circumnuclear star formation ring (hereafter: CSFR) between 0.4 and 1.6 kpc from the centre, producing 80% of the bolometric flux (Genzel *et al.* 1995). Stellar populations within the ring are very young with ages <20 Myr (Diaz-Santos *et al.* 2007).

Nuclear winds have been reported in X-rays (warm absorbers) and ultraviolet by Blustin *et al.* (2007), with line-of sight velocities (LoSV) from −500 to −2000 km s^{-1}, which have been associated with the AGN. A biconical outflow was reported by Müller-Sánchez *et al.* (2011), in scales of 10^2 pc, using infrared integral field spectroscopy (IFS). Here we present a search for optical counterparts of this outflow using archival IFS data of the Multi Unit Spectroscopic Explorer (MUSE) instrument at the Very Large Telescope (VLT, European Southern Observatory, Chile).

2. Methodology

We used archival data from August 19, 2014 from the MUSE science verification run. The data reduction followed the standard procedures, with the REFLEX software (Freudling *et al.* 2013) and MUSE pipelines (Weilbacher *et al.* 2014).

Correction for beam smearing was applied (to account for contamination by extended emission from the non-resolved AGN due to seeing) using QDEBLEND3D, described in Husemann *et al.* (2014). This yields a datacube containing stellar and nebular emission from the host galaxy, as well as the emission from the extended narrow line region (NLR), where evidence of outflows could be found. In this way, contamination by the broad line region (BLR), the inner NLR and the AGN continuum were subtracted.

A synthetic stellar continuum (obtained with STARLIGHT, Cid Fernandes *et al.* 2005) using the MILES spectral libraries (a 2016 update of the ones by Bruzual & Charlot 2003) was subtracted from each spaxel. Afterwards, three Gaussian components were fitted to the [O III]λ5007 and Hβ emission lines. Following the non-parametric approach (Harrison *et al.* 2014), we measured the full width at half maximum ($FWHM$) and the width at 80% of the flux (W_{80}), with the ratio $W_{80}/FWHM > 1.2$ criterion corresponding to a line profile so broadened at its base that it cannot be fitted with a single Gaussian. The velocity offset Δv (i.e. the mean of the velocities at the 5th and 95th percentiles) was estimated, which is related to the asymmetry of the line. Large values of these parameters are evidence of the presence of outflows.

3. Results

For the [O III]λ5007 line we found a broadening ($2 \leqslant W_{80}/FWHM \leqslant 4$) and blue-shifted asymmetry ($\Delta_v \sim -300$ km s^{-1}) at $\sim$200 pc in the north-west direction between the AGN and the CSFR. This is consistent with an extended outflow moving towards the observer. Lower velocity offsets ($\Delta v \sim -200$ to -100 km s^{-1}) extend across the north east, north west and south west regions, covering part of the CSFR. This lower velocity outflow is consistent with what we observe in Hβ, and we propose that it is associated with the massive star forming regions of the CSFR. Nevertheless, the higher velocity [O III]λ5007 outflow was not detected in Hβ, for which we propose and AGN origin. More details will be presented in Robleto-Orús *et al.* (in preparation).

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