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Mapping the inner kpc of the interacting Seyfert galaxy NGC 2992: Stellar populations and gas kinematics

Muryel Guolo-Pereira and Daniel Ruschel-Dutra

Universidade Federal de Santa Catarina, 88040-900 Florianópolis, SC, Brazil
email: muryel@astro.ufsc.br

Abstract. We present Gemini Multi-Object Spectrograph Integral Field Unit (GMOS-IFU) observations of the inner 1.1 kpc of the interacting Seyfert galaxy NGC 2992. From full spectral synthesis we found that the stellar population is mainly (up to 80 per cent of the total light) composed by an old ($t \geqslant 1.4$ Gyr) metal-rich ($Z \geqslant 2.0$ $Z_\odot$) populations with a smaller but considerable contribution (up to 30 per cent) from young ($t \leqslant 100$ Myr) metal-poor ($Z \leqslant 1.0$ $Z_\odot$) populations. The gas kinematics presents two main components: one from gas in orbit in the galaxy disk and an outflow with mass outflow rate of ~ 2 $M_\odot$ yr^{-1} and a kinematic power of $\sim 2 \times 10^{40}$ erg s^{-1}.

Keywords. galaxies: individual (NGC2992, Arp 245), galaxies: active, galaxies: interactions

1. Introduction and Observations

NGC2992 is a nearby (z = 0.0077) interacting Seyfert galaxy, that together with NGC 2993 forms the system Arp 245. The pericentre passage between NGC2992 and NGC2993 is predicted to have occurred ∼100 Myr ago (Duc *et al.* 2000). In order to investigate the role the active galaxy nucleus (AGN) and the interaction in both circumnuclear stellar and gaseous content, we obtained IFU observations of the inner 1.1 kpc of the galaxy, with the Gemini instrument GMOS-IFU. The final reduced data cube has a field-of-view (FoV) of $6.0'' \times 6.1''$, with ∼2500 spaxels, and wavelength range ∼4400−6800Å. The spatial resolution is $\sim 0.8''$(120 pc) and the spectral is ∼45 km s^{-1}.

2. Stellar populations

We performed stellar population synthesis using the STARLIGHT code (Cid Fernandes *et al.* 2005). We use Bruzual & Charlot (2003) simple stellar populations (SSP) models. The base consists of 45 SSPs with 15 ages and 3 metallicities (0.2 $Z_\odot$, 1.0 $Z_\odot$, 2.5 $Z_\odot$) in addition to a power law featureless continuum (FC) with the form of $\mathrm{Flux}(\lambda) \propto \lambda^{-1.7}$. We applied Cappellari & Copin (2003) Voronoi binning technique with a target S/N of 20. We also divided the SSPs in 3 age groups: a young one (x_y) with age range from 1 Myr to 100 Myr, an intermediate one (x_I) with age from 0.1 Gyr to 1.4 Gyr and a old one (x_O) with age from 1.5 to 13 Gyr, where the quantities x_y, x_I and x_O are respectively the percentage contribution to the total light from young, intermediaries and old SSPs.

The stellar population synthesis shows that the stellar population in the inner 1.1 kpc of NGC 2992 is mainly composed (60 percent $\leqslant x_O \leqslant$ 80 per cent) by old ($t \geqslant 1.4$ Gyr) metal rich ($\langle Z \rangle_O \geqslant 2.0 Z_\odot$) populations with a smaller, but considerable, contribution (10 per cent $\leqslant x_Y \leqslant$ 30 percent) by young ($t \leqslant 100$ Myr) metal poor ($\langle Z \rangle_Y \leqslant 1.0 Z_\odot$)

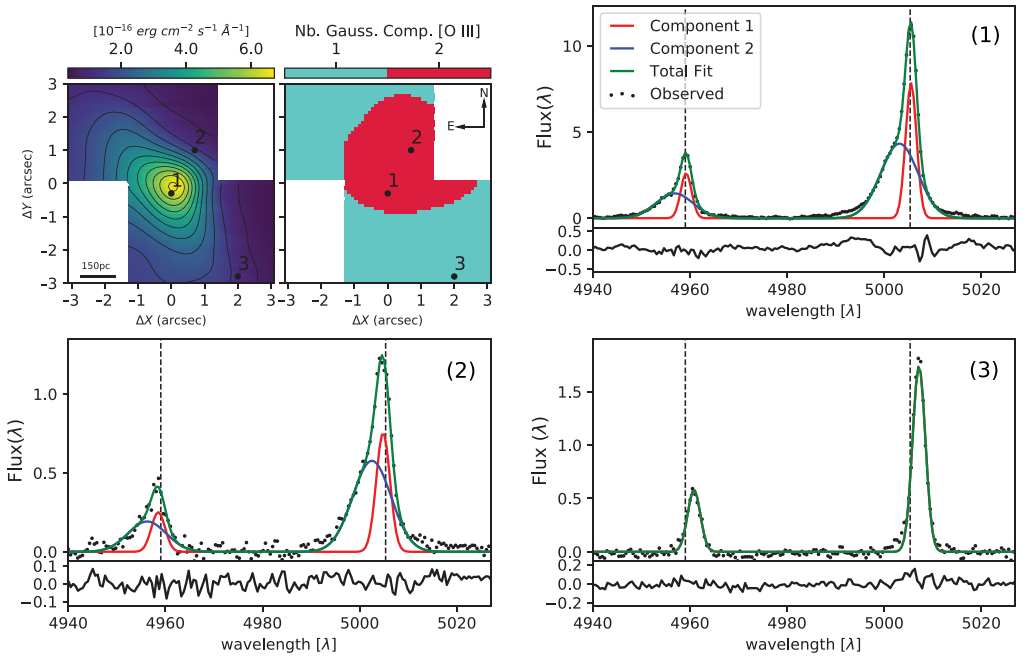

Figure 1. Top Left: Continuum map alongside with the map with the number of Gaussian component fitted to the [O III] emission lines. Other panel: Examples of fits profiles in three distinct regions of the FoV. Vertical axis units in the panels showing the emission-line profiles are 10^{-16}erg cm^{-2} s^{-1}.

populations, trough the entire FoV. A contribution up to 20 per cent of the total light from the FC component is also found in the innermost spaxels.

The pericentre passage of the galaxies is estimated to have occurred ∼100 Myr ago (Duc *et al.* 2000), thus a possible scenario is that metal-poor gas inflow has let to interaction-driven circumnuclear star formation which can explain the presence of such young metal-poor stellar population in the nucleus. Such inflows could also be responsible to trigger the nuclear activity. For numerical simulations on the AGN-merger link in Arp 245 see abstract by Lösch & Ruschel-Dutra in this same IAU Proceeding Volume.

3. Gas kinematics

We use gaussian profiles to fit the ionized gas emission lines spaxel by spaxel, performed using the IFSCUBE code (https://github.com/danielrd6/ifscube). Examples of the fits in distinct portions of the FoV can be seen in Figure 1. Two main kinematic components were adjusted to [O III]λ5007. The first one was present in the entire FoV, showing a clear rotation pattern, interpreted as originating in the galaxy disk in rotation. The second one was present from the central to the NW region, blueshifted by ∼150−250 km s$_{-1}$ and interpreted as due to a nuclear outflow. For the outflow component we estimated both its mass outflow rate and kinetic power, combining the velocities from [O III]λ5007, the luminosity from H $\alpha$and the electron density from the [S II]λ6717/λ6731 ratio. The values found were $\dot{M}_{out} \approx 1.6 \pm 0.6$ M$_\odot$ yr^{-1} and $\dot{E}_{out} = 2.2 \pm 0.3 \times 10^{40}$ erg s^{-1}. We do not find any clear evidence of direct influence of the interaction in the kinematics of the circumnuclear region of NGC 2992.

More details of this study can be found in the paper Guolo-Pereira *et al.* (2020).

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