Longslit spectroscopy of the peculiar Seyfert 2 galaxy HRG 10103

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I - INTRODUCTION

There are some galaxies whose structure or emission is different from normal elliptical, spiral, or lenticular galaxies but is also not irregular in the sense of types Im and Irr II; they are referred to as ``peculiar'' galaxies. Sometimes their peculiar morphologies are the result of interactions with neighboring galaxies. Some galaxies are distinguished by their strong radio and nonthermal emission and optical emission lines; these are called “active” galaxies.

In this work, we present the first longslit spectroscopy for the galaxy HRG 10103, an Sa(r) type peculiar galaxy seen face-on with an asymmetrical elliptical structure. The aim of the current study is to describe the main physical properties of this object and also discuss possible evidences of gravitational interaction.

The spectra obtained in two observatories (Gemini South and OPD-LNA/MCT) shows a variety of interesting features and we have used diagnostic diagrams to classify this object as a Seyfert 2 galaxy, at a redshift of 11791± 14, corresponding to a distance of 158.36 Mpc (H_0 =73 km s^{-1} Mpc^{-1}). Table 1 gives the journal of some parameters.

Table 1. Basic parameters

	Exp. Time (s)	PA (°)	Seeing (arcsec)	Airmass	S/N	Window centre
OPD/LNA	1200	6	1.5	1.332	18	Nucleus
Gemini South	1200	6	1.5	1.348	22	Nucleus

	α (h m s)	δ (° ′ ″)	v (km s^{-1})	D, d (arcmin)	Mag (Filter)	Type
NASA/IPAC	16 58 20.9	–63 26 04	11779 ± 45	–	15.4 (R)	Sa(r)

II – SPECTROSCOPIC OBSERVATIONS

Longslit spectroscopy were obtained using the Boller and Chivens spectrograph attached on the 1.6-m OPD Telescope. The configuration was a 3.0-arcsec-wide longslit centred on the optical peak and oriented at position angle 6^0 (see Fig. 1). The detector used was CCD 101 with 1024x1024 pixels, and a 600 lines mm^{-1} grating, blazed at 6081Å, which provides a dispersion of 88.23 Åmm^{-1}. The scale of the frames on the spatial direction was 1.0 arcsec pixel^{-1}. The spectral resolution was matched to the 2.12 Å pixel^{-1}, yielding an effective resolution of about 4.0 Å (FWHM) and covering the 4979-7030 Å.

The obervation was also carried out with the Gemini Multi-Object Spectrograph at Gemini South, as part of poor weather program GS-2007A-Q-72. The grating B600+G5323 centered at 501.1 nm was used with a long-slit 1.0 arcsec wide by 375 arcsec long. The data were binned by 4 in the spatial dimension and 2 in the spectral dimension producing a spectral resolution of ±4.3 Å (FWHM) sampled at 0.68 Å pix^{-1}. The seeing throughout the observations was 1.5 arcsec and the binned pixel scale was 0.145 arcsec pix^{-1}. The wavelength range was 3560–5650 Å. A phtometric standard LTT 4816 was also observed using the same experimental set up.

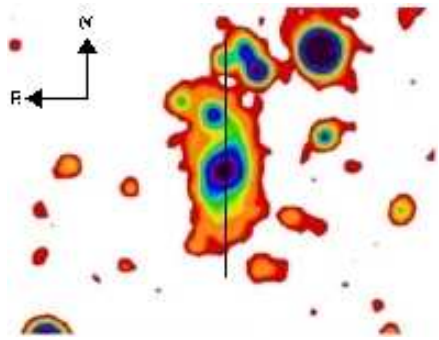

Fig. 1. Optical image taken from DSS with the slit position overlaid (very similar for both observational runs). The original image has been enhanced to highlight some substructures.

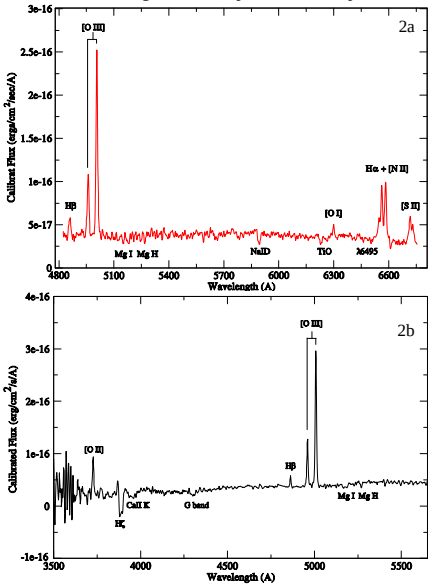

Fig. 2. Nuclear spectrum: OPD/LNA (2a) and GMOS Gemini (2b).

III – SPECTRAL ANALYSIS

This galaxy includes some of the most important emission lines for ionization diagnostics: Hβ, [O III]λ5007, [O I]λ6300, Hα, [NII]λ6583, [S II]λλ6716,6731. The strengths of the detectable emission lines after appropriate dereddening, as well as their equivalent widths, are presented in Table 2. These lines intensities and positions were determined by fitting Gaussians to observed profiles. Stellar absorption features are presented as well.

We have used the Balmer decrement (Hα/Hβ) to derive the reddening correction. We consider na intrinsic ratio of I(Hα)/I(Hβ) of 3.1 for AGN. The observed F(Hα)/F(Hβ) was 5.20; thus, the extinction E(B–V) was estimated to be 0.485 mag.

To map the gas kinematics, we have averaged together the central wavelength of Gaussians which we had fitted the emission lines Hβ, [OIII]λ5007, [OI]λ6300, Hα, [NII]λ6583, [SII]λλ6716,6731. Figure 3 gives the heliocentric velocities. Figure 4 gives a distribution of the observed flux for emission-line ratios.

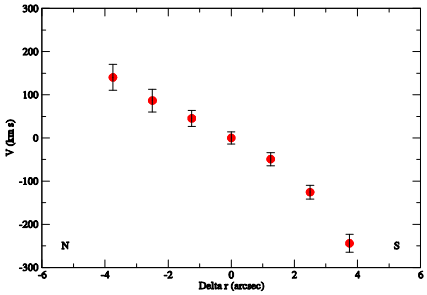

Fig. 3. Heliocentric velocities from OPD/LNA.

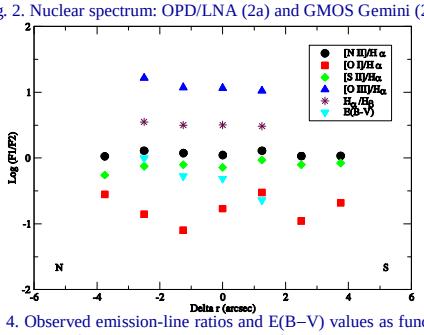

Fig. 4. Observed emission-line ratios and E(B–V) values as function of the distance from the nucleus. Calibrated flux: OPD/LNA.

Table 2. Emission-lines intensities. Observed and reddening-corrected fluxes in units of 10^{-16} erg cm^{-2} s^{-1} Å^{-1}.

Ion	OPD-obs (EW Å)	OPD-corr (EW Å)	Gem-obs (EW Å)	Gem-corr (EW Å)
[H II] λ3727	–	–	6.58±0.88 (12.54)	21.9±0.53 (13.48)
Hβ λ4861	1.19±0.68 (6.27)	2.40±0.81 (6.20)	2.06±0.51 (1.27)	9.15±1.11 (1.35)
[O III] λ4959	3.86±0.96 (18.39)	8.67±1.12 (24.06)	7.77±1.03 (17.06)	34.86±1.37 (18.02)
[O III] λ5007	11.90±2.54 (55.6)	25.15±2.69 (65.48)	23.38±1.89 (40.66)	102.51±5.63 (47.49)
[O I] λ6300	0.35±0.09 (1.46)	0.95±0.26 (2.52)	–	–
[N II] λ6548	1.89±0.42 (13.19)	3.24±0.74 (13.14)	–	–
Hα λ6563	4.36±0.87 (22.64)	7.31±0.81 (22.96)	–	–
[N II] λ6583	5.68±1.08 (30.01)	9.41±0.95 (30.09)	–	–
[S II] λ6716	2.75±0.95 (15.07)	4.45±1.91 (14.99)	–	–
[S II] λ6731	1.40±0.78 (7.69)	2.32±1.02 (7.88)	–	–

Table 3. Emission-lines ratios.

	Hα / Hβ	[O III] / Hβ	[N II] / Hα	[O I] / Hα	[S II] / Hα	[O II] / Hβ	R_{23}
OPD/LNA	3.05	10.48	1.29	0.13	0.93	–	–
Gemini South	–	11.20	–	–	–	2.39	1.24

V – DISCUSSION AND CONCLUSION

The nuclear spectrum for both observatories are presented in the Figs. 2a (OPD/LNA) and 2b (GMOS Gemini South). This object was classified as a Seyfert 2 galaxy, with narrow emission lines and λ6583/Hα = 1.29. A λ6300 emission line is observed with λ6300/Hα = 0.13.

* The emission-line intensity ratio R_{23} = ([O II]λ3727 + [O III]λ4959 + [O III]λ5007)/Hβ seems effectively to be a very interesting criterion allowing to make a better discrimination between the Seyfert 2 and both the H II galaxies and the LINERs, relatively to the intensity ratio [O III]λ5007/Hβ used in the diagnostic diagrams of Veilleux & Osterbrock (1987).

Figure 4 shows the variation of emission-line rations as a function of distance from the nucleus. All the emission-line ratios show na approximately symmetric behavior on both sides of the nucleus up to ±4 arcsec. [N II]/Hα seems not to vary much, while [S II]/Hα and Ha/Hb show a similar trend. On the other hand, [O III]/Hβ decrease, indicating a higher excitation, also revelead and consistent with the E(B–V) values. [O I]/Hα show an symmetric behavior on both sides of the nucleus.