The dwarf irregular galaxy candidate next to Mrk 1172

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Introduction

Dwarf galaxies are the most abundant class of galaxies in the Universe, and play a fundamental role in models of galaxy formation and evolution. Understanding the chemical evolution of dwarf galaxies is essential to constrain models of galaxy formation and evolution, since the fraction of heavy elements within a galaxy is not only related to secular processes, but can also carry imprints of past merging episodes In this work we analyse a galaxy in the vicinity of the massive Early-Type Galaxy (ETG) Mrk 1172. This object has available photometric data in the optical (Sloan Digital Sky Survey, SDSS) and in the NUV and FUV (Galaxy Evolution Explorer, GALEX), but, to the best of our knowledge, has no previous detailed analysis on the literature using spectroscopic data.

Data

In this work we present integral field spectroscopy (IFS) of the Mrk 1172 region (J020536.18-081443.23). The data were obtained using the Multi-Unit Spectroscopic Explorer in the wide-field mode (WFM), covering the nominal wavelength range of 4650 - 9300 Å with spectral resolution of 1.25 Å, a FoV of 1x1 arcmin^2, angular sampling of 0.2 arcsec and seeing of ~1.4 arcsec. Mrk 1172 has a measured z = 0.04115, while the dwarf galaxy has z ~ 0.04.

Spatially resolved diagnostic diagram

In order to determine the source of photoionization, we performed a spatially resolved map of the indicated emission line ratios over the dI to build the BPT diagnostic diagrams . We used the flux subtracting the synthetic flux given by stellar population contributions measured using STARLIGHT to quantify the emission lines ratio for each spaxel in the defined region. In Fig. 2 we present spatially resolved diagnostic diagrams for the gas within the dI.

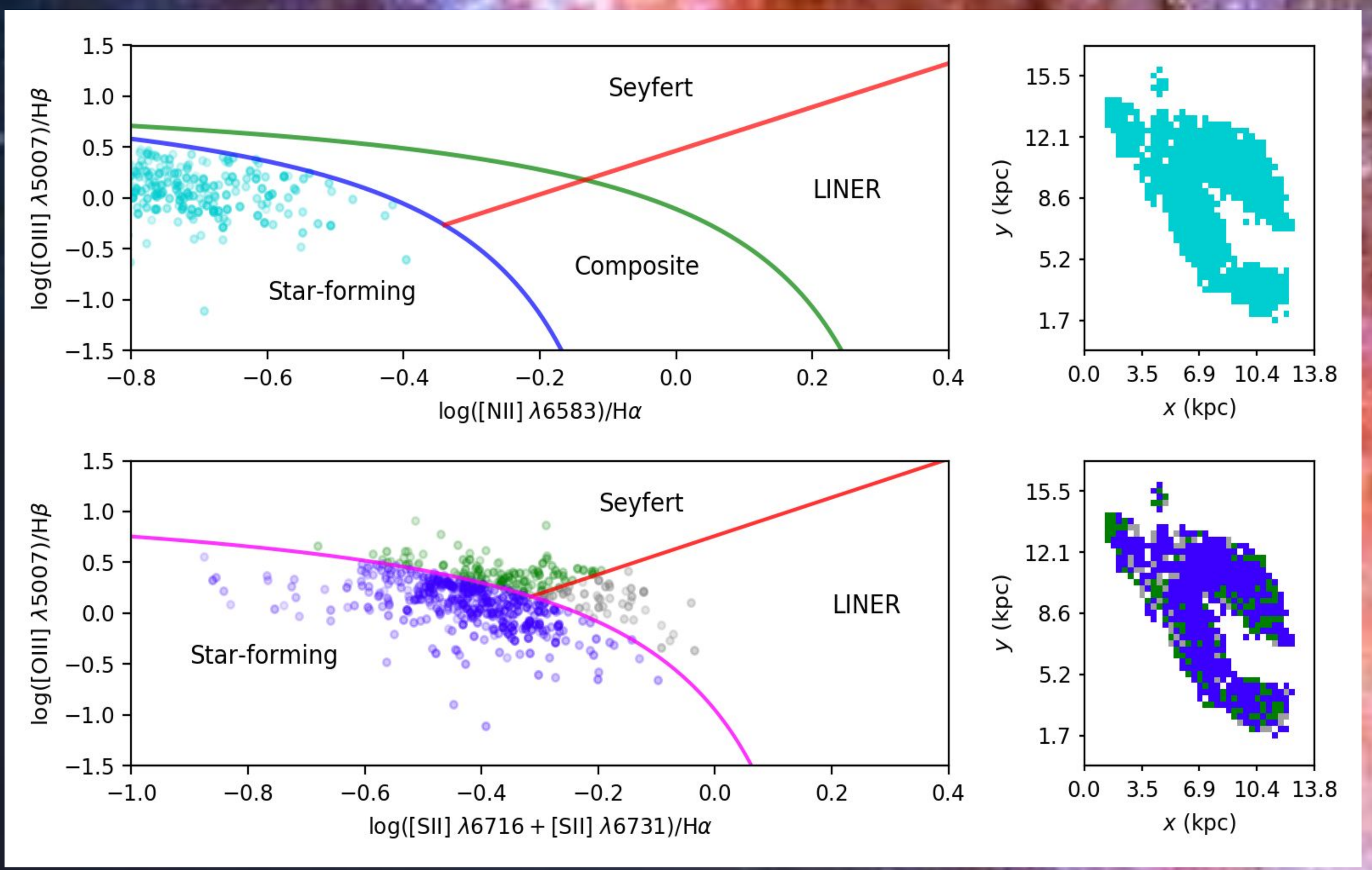

Figure 2: Spatially resolved diagnostic diagram for the dI. *Left top panel:* The circles represent the position of individual spaxels in the diagnostic diagram. The transparency of the circles is related to the SNR measured for that spectrum, i.e., fainter circles have lower SNR. The green, red and blue lines are the delimiting lines given by (Kewley+2001, Kauffmann+2003), respectively. *Left bottom panel:* Same as left top panel, now using different emission line ratio for the diagram. The red and magenta solid lines are given by (Kewley+2006, Kewley+2001), respectively. *Right top/bottom panel:* The dI with each spaxel colored corresponding to its position in the diagnostic diagram.

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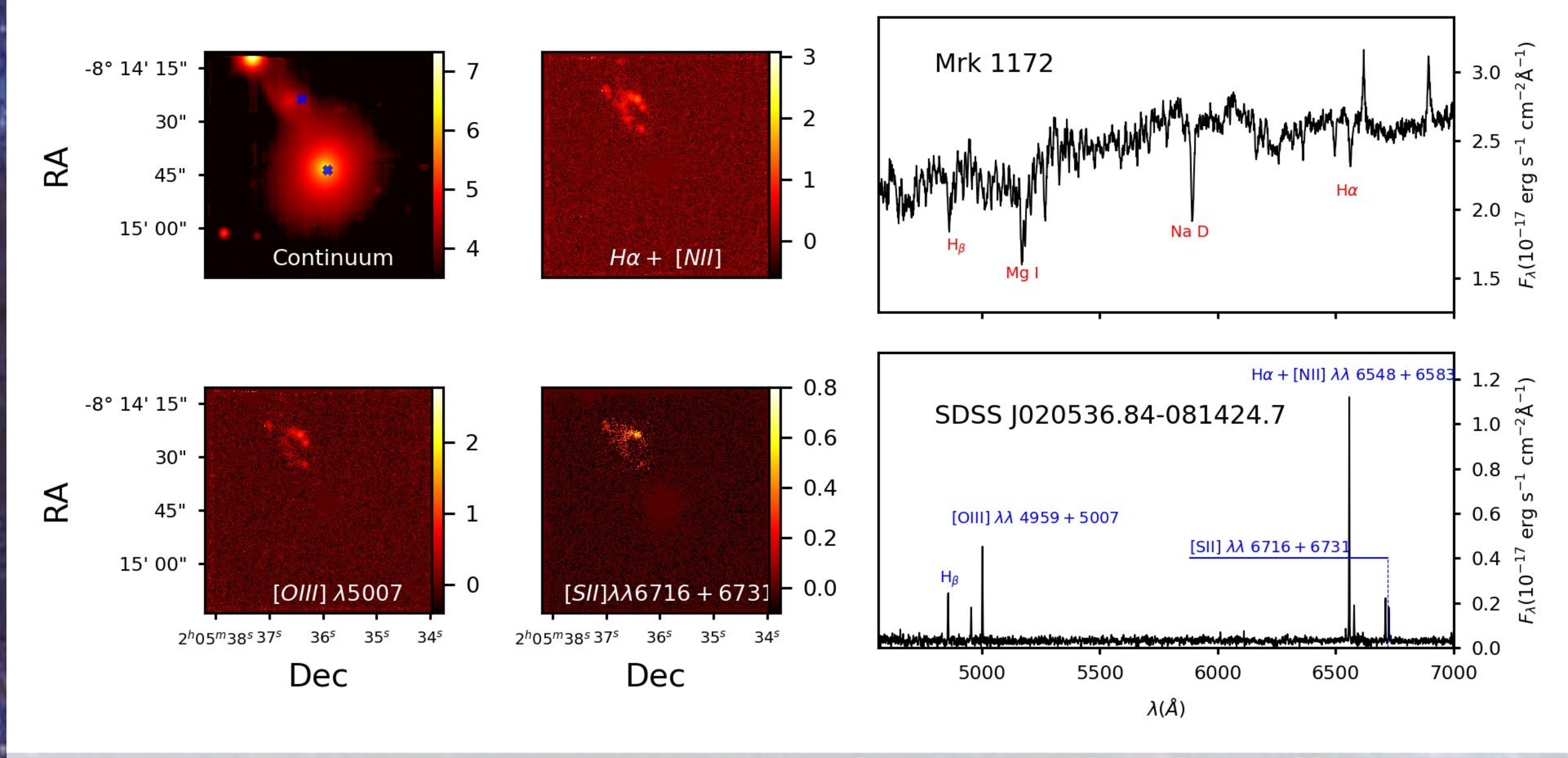

Figure 1: *Left panels:* MUSE FoV of the analysed system, where the images are centered in different wavelength ranges, as indicated. The blue crosses represent the highest SNR spaxel of each galaxy. *Right panel:* The spectrum of the highest SNR spaxel of each galaxy, where the main absorption/emission lines are indicated. The colorbar presents the flux in units of 10^{-20} erg s^{-1}.

Abundance

The relations from Marino+13 (indirect method) were applied for each spaxel of the dI, producing two Oxygen abundance maps, shown in Fig. 3. Both maps show values in the range of 8.0 < log (O/H) + 12 < 8.6, which represents a range of approximately 0.2 $Z_{\odot}$ < Z < 0.7 $Z_{\odot}$. To have a representative value of metallicity for this galaxy, we calculated the average value for the spaxels in the maps of Fig. 3. We have obtained log (O/H) + 12 = 8.28 ± 0.03 for the O3N2 index and log (O/H) + 12 = 8.296 ± 0.004 for the N2 index. As a sanity check we have calculated the abundance derived from the emission lines measured in an integrated spectra of the dI. These values are low, thus we say that this galaxy has a metal-poor environment.

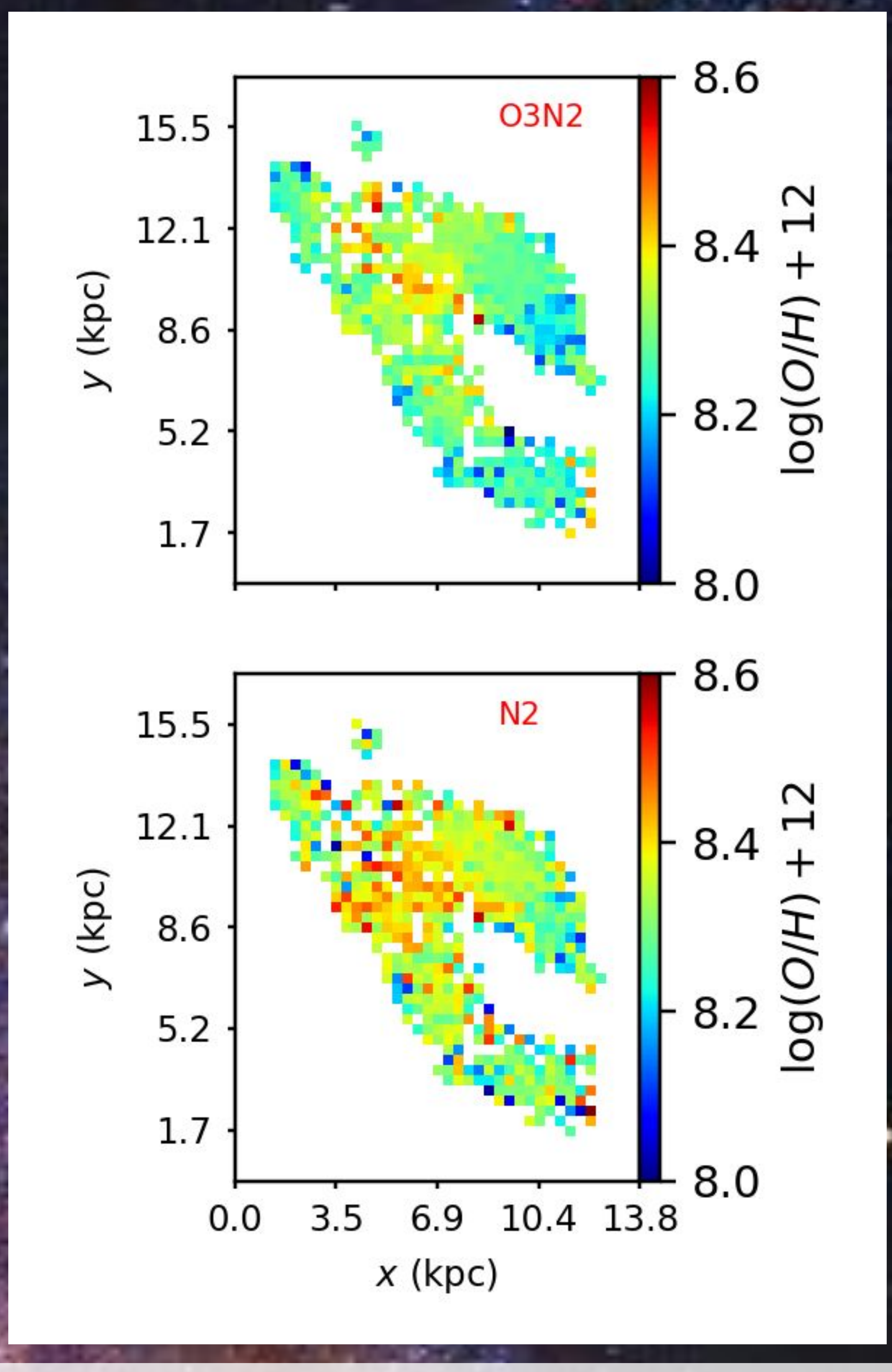

Figure 3: Oxygen abundance maps obtained using the indirect method, once T_e could not be determined. The relations used are from Marino+13. *Upper panel:* Oxygen abundance map considering the O3N2 index. *Lower panel:* Oxygen abundance map considering the N2 index.

Final Remarks

The diagnostic diagram shows that the dwar irregular candidate is photoionized rather by hot stars than by a hard radiation field, although the emission lines ratio may be affected by its metal-poor environment. Besides, the region shows strong and evident emission lines clumpy knots where the star formation is taking place and the SFR reaches higher values, presenting also a surprisingly low density. An analysis of the stellar populations of the dI indicates that it is young (~1 Gyr), with a different star formation history in comparison to Mrk 1172. Using the indirect method we estimated the Oxygen abundance of the galaxy, used as a tracer of the metallicity of the gas phase. The galaxy is considered to be metal-poor, thus the processes in its ISM may resemble those in the primeval galaxies, providing a laboratory of such objects in the Local universe. The nature of this galaxy remains unrevealed, and now dynamical models are being used to better understand how it is interacting with Mrk 1172.

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