Galaxy Evolution and Feedback across Different Environments
Proceedings IAU Symposium No. 359, 2020
T. Storchi-Bergmann, W. Forman, R. Overzier & R. Riffel, eds.
doi:10.1017/S1743921320004299

An Extended Emission Line Region around Mrk 1172

Augusto Lassen[1], Rogério Riffel[1], Ana L. Chies-Santos[1], Evelyn Johnston[2], Boris Haeussler[3], Daniel R. Dutra[4] and Gabriel M. Azevedo[1]

[1]Instituto de Física, Universidade Federal do Rio Grande do Sul, Brazil
[2]Instituto de astrofísica, Pontificia Universidad Católica de Chile
[3]European Southern Observatory, Chile
[4]Departamento de Física, Universidade Federal de Santa Catarina

Abstract. We serendipitously found an intriguing Extended Emission Line Region (EELR) near the quiescent and massive early-type Mrk 1172, with a projected extension of approximately 14×14 kpc. Its irregular shape, high gas content, strong emission lines and proximity to an isolated possible faded quasar raise questions about the ionization of this gas and the nature of this object. Analyzing the stellar population in both objects we observe that the EELR has a dominance of young-intermediate and intermediate stellar populations (200 Myr $< t <$ 1 Gyr) with significant star formation activity, while Mrk 1172 is dominated by old stellar population ($t > 5$ Gyr). BPT diagnostic diagrams indicate that the gas in the EELR is photoionized by hot massive stars rather than by a hard radiation field or by shocks. Further analysis on abundances of the gas and its kinematics shall be performed to better comprehend the nature of this object and how it is interacting with Mrk 1172.

Keywords. ISM: structure, Galaxy: stellar content, Galaxy: evolution

1. A new extended emission line region

During the inspection of public data from the Multi Unit Spectroscopic Explorer (MUSE), we have serendipitously found an Extended Emission Line Region (EELR) near the Early-Type Galaxy (ETG) Mrk 1172 with similar redshift ($z = 0.04115$ for Mrk 1172 and $z \sim 0.0403$ for the EELR). In figure 1 we show the MUSE Field-of-View (FoV) for the system in the continuum and in H_α,[OIII]λ5007 and [SII] λ6716 + [SII] λ6731 wavelength range, where the red bars and the yellow parts of spectra represent the slices taken to produce the images. Spectra shown are from spaxels in Mrk 1172 (top right) and in the EELR (bottom right), showing that the EELR is very faint in the continuum, despite its emission lines luminosity, and was never reported in the literature, to the best of our knowledge. To estimate the projected extension of the EELR we used a square box of $\sim$14 kpc $\times$ 14 kpc that contains this region.

We performed a spatially resolved stellar population synthesis analysis on the system. This allowed us to remove the stellar contribution from the gas emission lines. To perform the stellar population synthesis we used MEGACUBE (Mallmann *et al.* 2018) with the templates of "GM base" introduced in Fernandes *et al.* (2014). The fit was performed in the 4800 $\sim$ 6900 Å range with normalization at $\lambda_0 = 5600$ Å. The analysis reveals that the EELR has a dominant stellar population with ages in the range of 0.2 $\sim$ 1.0 Gyr. Mrk 1172 is dominated by an old stellar population ($t > 5$ Gyr).

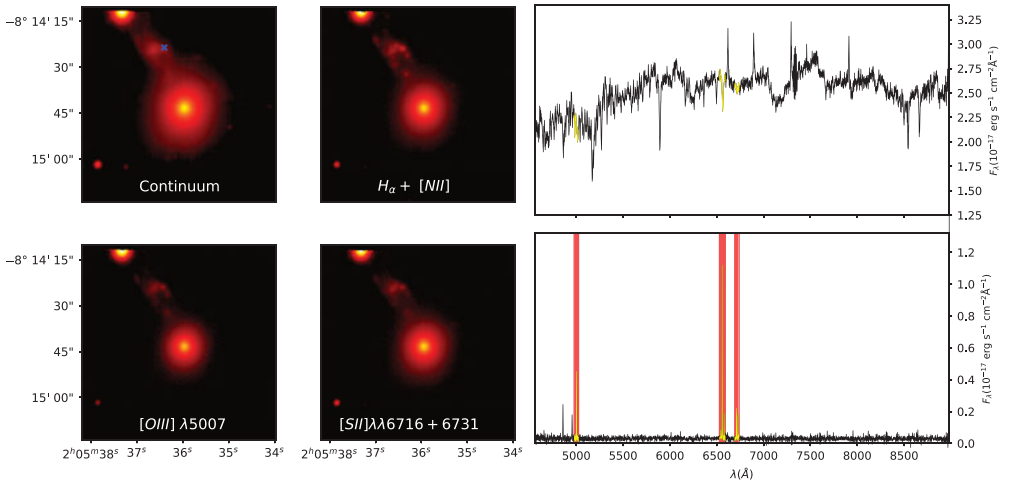

Figure 1. Mrk 1172 FoV in the continuum (top left) and H_α+[NII]$\lambda\lambda$6550 + 6585 (top central), [OIII]λ5007 (bottom left) and [SII]$\lambda\lambda$6716 + 6731 (bottom central) wavelength ranges. The wavelength windows used to produce these images is highlighted in yellow in top and bottom right panels. In right (top) the rest-frame spectrum of Mrk 1172 and (bottom) the rest-frame EELR spectrum. The bright object in the top of the figure is a star.

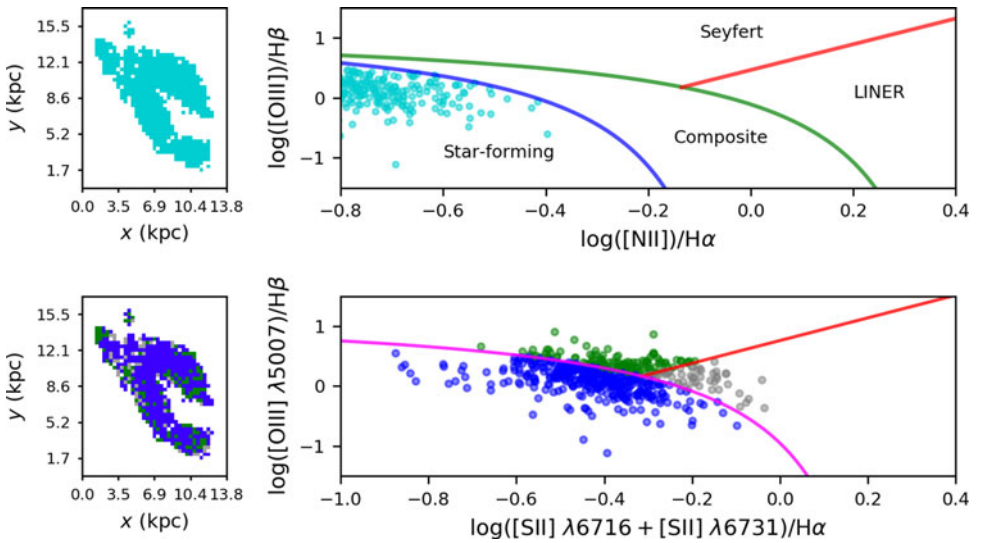

Figure 2. Spatially resolved diagnostic diagram for the EELR. *Right top/bottom panel:* The dots represent the position of each single spaxel in the diagnostic diagram, where the solid lines represent the curves that define the excitation regions. *Left top/bottom panel*: The EELR with each spaxel coloured corresponding to its position in the diagnostic diagram.

In figure 2 we present the spatially resolved diagnostic diagrams for the EELR (Baldwin, Phillips & Terlevich 1981). Both diagrams indicate that the gas seems to be ionized by young massive stars rather than by an Active Galactic Nuclei (AGN). Ionization by shocks was investigated using the fast radiative shock models adopting solar metallicity, $n_e = 1.0$ cm^{-3} and varying the values of magnetic field Allen *et al.* (2008). In any of these cases the curve of emission line ratio vs. shock velocity was able

https://doi.org/10.1017/S1743921320004299 Published online by Cambridge University Press

to approach the low observed value of [NII]/$H_\beta \sim 0.56$, indicating that shock ionization is unlikely in this EELR.

2. Conclusion

The diagnostic diagram shows that the EELR is an active star-forming region. The stellar population synthesis shows that the EELR has younger dominant stellar population in comparison to the old, massive and quiescent ETG Mrk 1172.

References

Allen, M. G., Groves, B. A., Dopita, M. A., *et al.* 2008, *ApJS*(Supplement Series) 178
Baldwin, J. A., Phillips, M. M., & Terlevich, R. 1981, *PASP* 93, 551
Fernandes, R. C., Delgado, R. G., Benito, R. G., *et al.* 2014, *A&A* 561, A130
Nicolas, N. D., Riffel, R., Storchi-Bergmann, T., *et al.* 2018, *MNRAS* 478, 4

https://doi.org/10.1017/S1743921320004299 Published online by Cambridge University Press