Astronomy in Focus - XXX
Proceedings IAU Symposium No. XXX, 2018
M. T. Lago, ed.

doi:10.1017/S1743921319004356

Metallicity gradients in high-z galaxies: insights from the KLEVER Survey

Mirko Curti[1,2]

[1]Cavendish Laboratory

[2]Kavli Institute for Cosmology, University of Cambridge, Madingley Road CB3 0HA, Cambridge, United Kingdom

Abstract. We present reconstructed source plane metallicity maps for a sample of ~ 30 gravitationally lensed galaxies between $1.2 < z < 2.5$, observed in the framework of the KLEVER Survey. Oxygen abundance is derived exploiting a variety of different emission line diagnostics, as provided by the full coverage of the near-infrared bands. The majority of galaxies in our sample present flat radial metallicity gradients, in agreement with galaxy evolution models predicting strong feedback mechanisms in place at these epochs. However, complex patterns as seen in some of our metallicity maps warn against the use of azimuthally-averaged radial gradients as the only observable to constrain chemical evolution models.

Keywords. galaxies: high-redshift galaxies: abundances galaxies: evolution

Studying the spatial distribution of heavy elements within galaxies represents a powerful tool to constrain their baryonic and chemical assembly history, including the effects of gas flows. In the local Universe, galaxies are generally characterised by negative gradients (e.g., Sanchez *et al.* 2014), which are generally interpreted as indicative of an "inside-out" scenario of galaxy formation. On the contrary, the situation at higher redshifts is instead much more complicated: the growing number of observational efforts in the last years produced sometimes conflicting results (e.g., Cresci *et al.* 2010; Wang *et al.* 2017), whose interpretation in terms of galaxy evolution proves indeed to be rather difficult.

In this work, we have analysed a sample of gravitationally lensed galaxies at $1.2 < z < 2.5$, observed with the SINFONI and KMOS near-infrared integral field spectrographs on the VLT as part of the KLEVER Survey. Our data provides spatially resolved information in the Y, J, H and K bands, enabling us to map the full suite of rest-frame optical emission lines, which can be used to robustly infer the chemical properties of the ISM in our galaxies from a combination of complementary diagnostics. Thanks to a careful de-lensing procedure, we could reconstruct source-plane metallicity maps with a typical resolution of 2-3 kpc and investigate the presence of radial gradients. Almost the entirety of our sample is characterised by flat metallicity gradients (albeit with large dispersion), similarly to what previously reported in the literature (e.g., Wuyts *et al.* 2016). Comparison with cosmological simulations that explore the effect of stellar feedback, suggests a scenario where efficient mixing processes are active in redistributing a significant amount of gas over large scales. However, despite the apparent homogeneity, many of our galaxies exhibit clumpy and irregular patterns in the metallicity maps, suggesting to move beyond radial gradients as the main constraints for galaxy evolution models. We also find tentative evidence of a spatial anti-correlation between metallicity and the star formation rate surface density (Σ_{SFR}), in particular for high Σ_{SFR}. This may be driven by the infall of pristine gas which locally dilutes the metal content whilst it is triggering new star formation.

References

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