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Metallicity gradients in nearby star forming galaxies

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Abstract. I study the gas phase metallicity (O/H) radial profiles in a representative sample of 550 nearby star forming galaxies with resolved spectroscopic data from the SDSS-IV MaNGA survey. Using strong-line ratio diagnostics (R23 and O3N2) and referencing to the effective (half-light) radius (R_e), I find that the metallicity gradient steepens with stellar mass going from $\log(M_\star/M_\odot) = 9.0$ to $\log(M_\star/M_\odot) = 10.5$. At higher masses a flattening of the metallicity radial profile is observed in the central regions ($R < 1\ R_e$). These findings are in agreement with recent independent analysis of other large samples of nearby galaxies.

Keywords. galaxies: abundances, galaxies: ISM, galaxies: evolution

1. Introduction

Metals are direct products of stellar nucleosynthesis, making chemical abundances ideal tracers of the integrated history of star formation and gas flows in and out of galaxies. In particular, metallicity radial gradients in galaxies have long been a source of considerable interest, as they are directly related to the process of disc assembly (Larson 1976; Matteucci & François 1989; Pezzulli & Fraternali 2016)

Observationally, it is well known that in the local Universe disc galaxies present a negative metallicity gradient (e.g. Vila-Costas & Edmunds 1992; Van Zee *et al.* 1998). Only recently, however, integral field spectroscopy (IFS) surveys of nearby galaxies have provided large data sets suitable for systematically studying the shape of the gas phase metallicity gradients in the nearby Universe. In particular the recent CALIFA (Sánchez *et al.* 2012), SAMI (Croom *et al.* 2012) and SDSS IV MaNGA (Bundy *et al.* 2015) surveys aim to observe $\sim$ 700, 3000 and 10000 galaxies respectively at $\sim$kpc resolution.

2. Metallicity gradients in the local Universe

In Belfiore *et al.* (2017) I make use of data from the MaNGA survey to derive gas-phase metallicity radial profiles for a sample of 550 local star forming galaxies. The uniformity of the dataset over the stellar mass range $9.0 < \log(M_\star/M_\odot) < 11.0$, where the MaNGA sample is fully representative of the local galaxy population, makes this study the most comprehensive analysis of metallicity radial profiles in galaxies to date. Star forming regions are selected from the [SII]-BPT diagram (Baldwin, Phillips & Terlevich 1981, also Belfiore *et al.* 2016), since at the resolution of the MaNGA survey ($\sim$2 kpc) one cannot identify individual HII regions. Gas-phase metallicity is derived with two complementary strong line calibrations, that of Maiolino *et al.* (2008) based on the $R23 = ([OIII]\lambda\lambda4959, 5007 + [OII]\lambda\lambda3727, 29)/H\beta$ index, and that of Pettini & Pagel (2004) based on the $O3N2 = ([OIII]\lambda5007/H\beta)/([NII]\lambda6584/H\alpha)$ index. Metallicity radial profiles for different mass bins are shown in Fig. 1. Using either metallicity calibration,

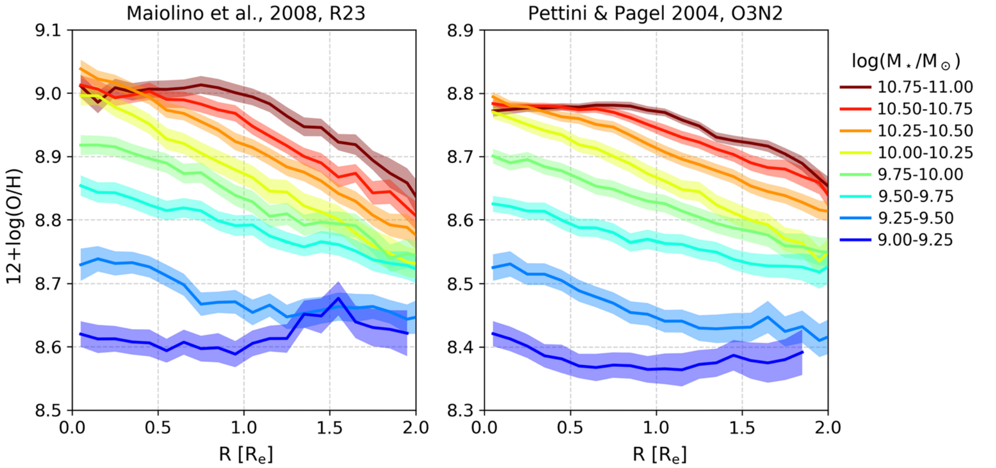

Figure 1. *Adapted from Belfiore et al. (2017).* Gas-phase metallicity radial profiles gradients for 550 star forming galaxies from the MaNGA survey. Radial metallicity profiles are shown in 0.25 dex mass bins and for two different strong line metallicity calibrators (the Maiolino *et al.* 2008 calibration on the R23 on the left and the Pettini & Pagel 2004 metallicity calibration based on O3N2 on the right).

the shape of the metallicity gradient changes as a function of stellar mass, lying roughly flat among galaxies with $\log(M_\star/M_\odot) = 9.0$ but exhibiting slopes as steep as -0.14 dex R_e^{-1} at $\log(M_\star/M_\odot) = 10.5$ (using R23, but equivalent results are obtained using O3N2). Galaxies of higher stellar mass, on the other hand, show a flattening in the regions $<1.0\ R_e$. Interestingly, these features have also been described in the most recent analysis of the CALIFA data (Sánchez-Menguiano *et al.* 2016) and in a study based on higher-resolution MUSE data (see these proceedings and Sánchez-Menguiano *et al.* 2017). In light of these recent results it appears that the change in shape of the metallicity radial profiles as a function of stellar mass is now a robust observational result, borne out in independent analysis of different datasets. Future theoretical work will need to address the origin of these trends.

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