SDSS-IV MaNGA:

DRIVERS OF STELLAR METALLICITY IN GALAXIES

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The distribution of stellar metallicities within and across galaxies is an excellent relic of the chemical evolution across cosmic time. We present a detailed analysis of spatially resolved stellar populations based on > 2.6 million spatial bins from 7439 nearby galaxies in the SDSS-IV MaNGA survey. Our study goes beyond the well-known global mass-metallicity relation and radial metallicity gradients by providing a statistically sound exploration of local relations between stellar metallicity [Z/H], stellar surface mass density Σ_* and galactocentric distance in the global mass-morphology plane. We find a significant resolved mass density-metallicity relation rΣ_*ZR for galaxies of all types and masses. The spread of the relation is mainly attributed to different radial distances. In particular, we find that at fixed Σ_* metallicity increases with radius. This result calls for a driver of metallicity, in addition to Σ_* that promotes chemical enrichment in the outer parts of galaxies more strongly than in the inner parts. We discuss gas accretion, outflows, recycling and radial migration as possible scenarios.

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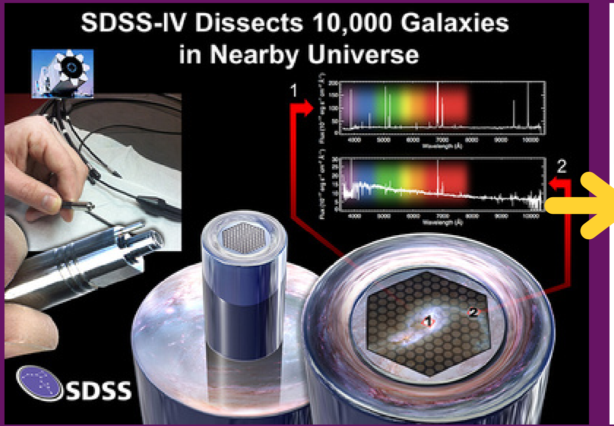
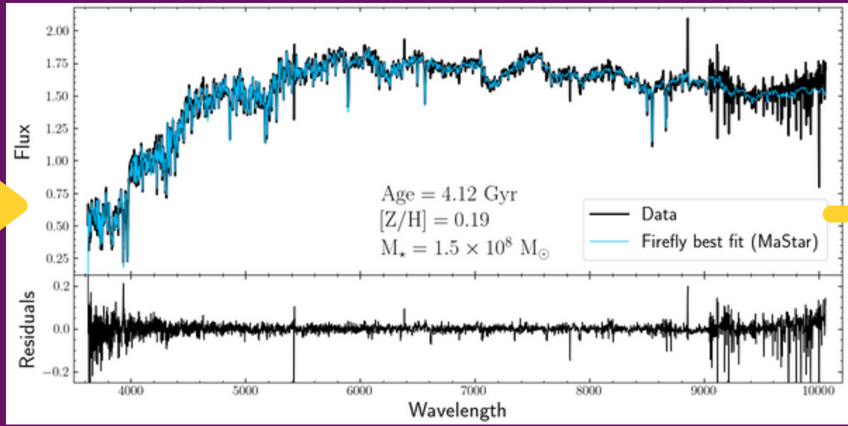
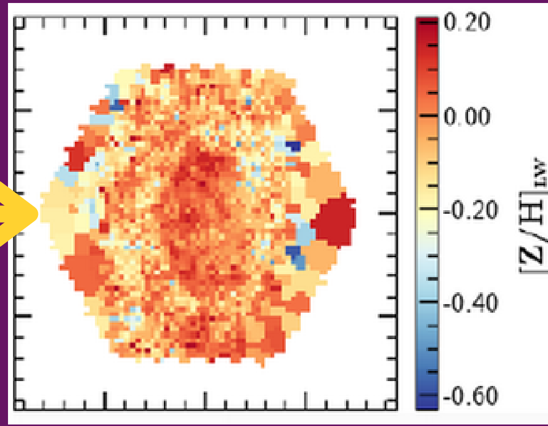
We analyse spatially resolved spectra of ~10,000 galaxies from the integral field unit survery of nearby galaxies MaNGA. We fit each spectrum with stellar population models employing the FIREFLY code. All results are stored in one big catalogue (see poster: 'MaNGA Firefly Catalogue').

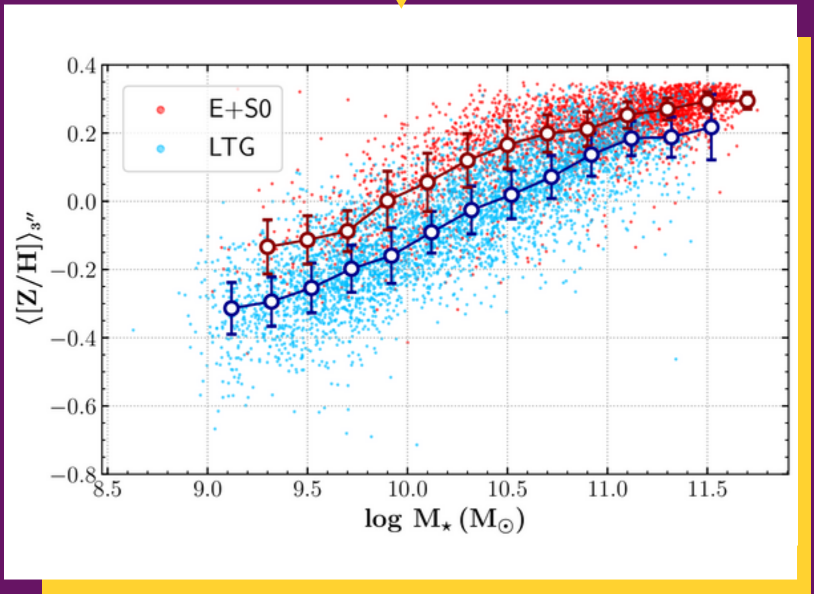






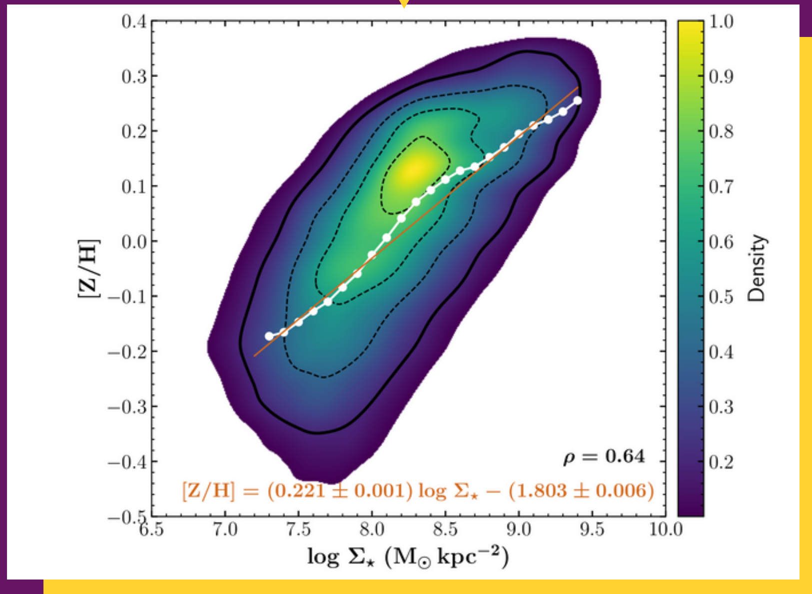
Global Mass-Metallicity Relation

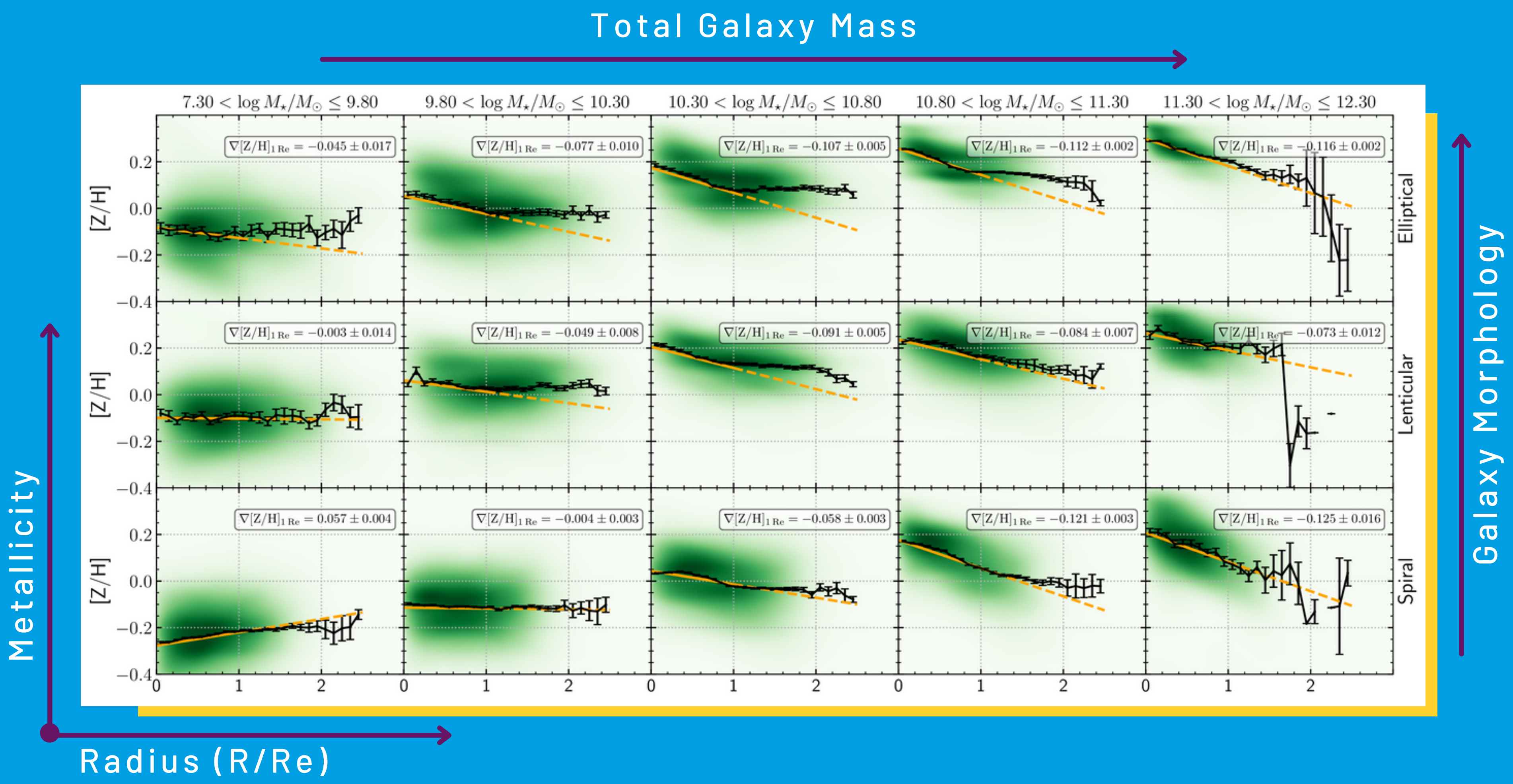
This is a well-known relation between the total stellar mass and the metallicity of a galaxy. It is usually understood as the consequence of the ability to retain and recycle enriched gas in more massive galaxies with a higher potential well. We nicely reproduce this relation with a systematic offset of passive galaxies having higher metallicities as compared to active galaxies.



Spatiall-Resolved Surface Mass Density-Metallicity Relation

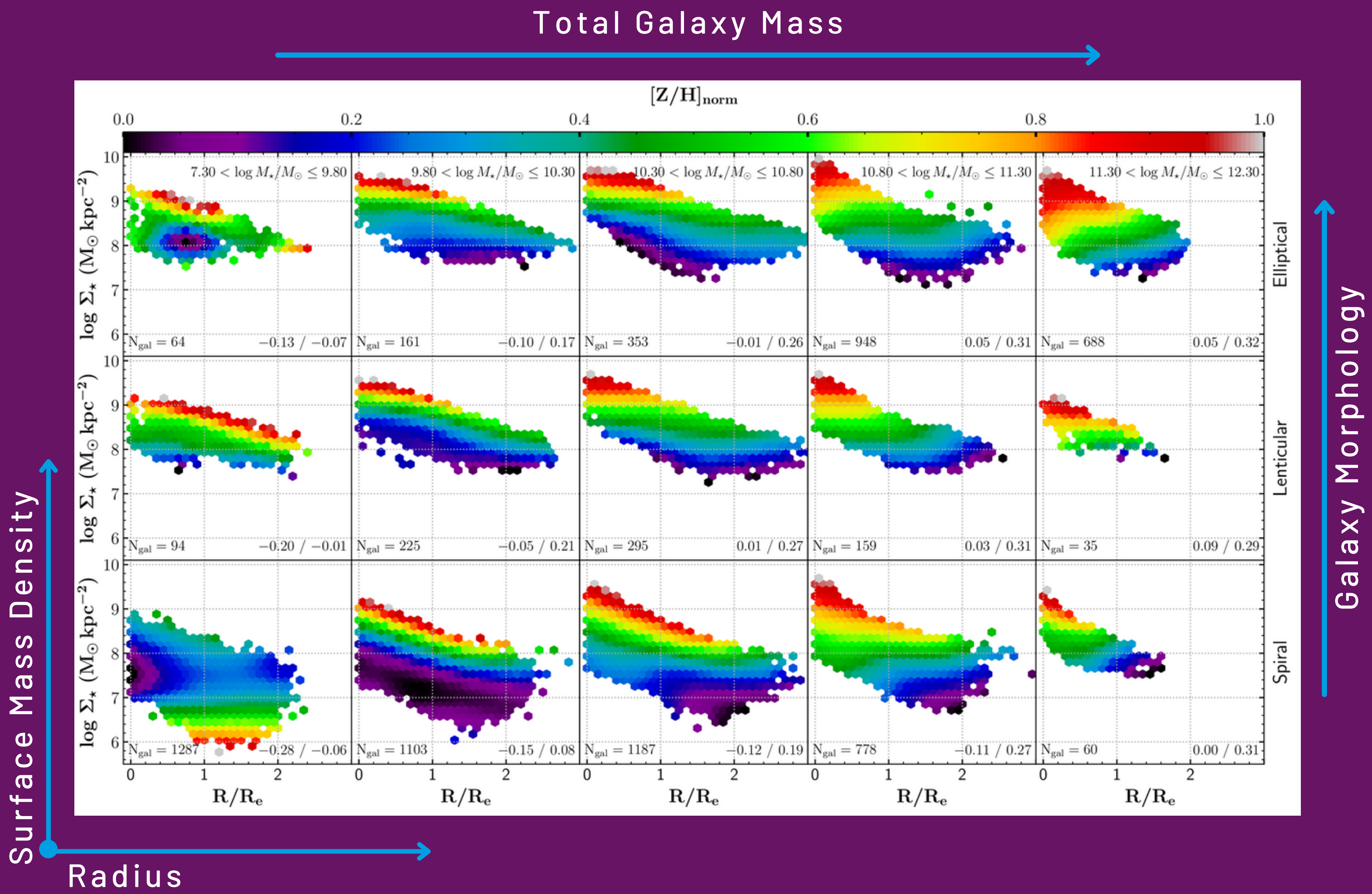
We find a significant r$\Sigma_{\star}$ZR - a spatially resolved counterpart to the MZR. This figure shows >2.6 million resolved regions across the galaxies. It demonstrates that metallicity is locally driven by surface mass density.





This figure shows the metallicity plotted against the galactocentric distance for individual resolved regions. Galaxies are grouped in different bins of mass and morphology. Gradients are fitted within the effective radius.

Metallicity gradients are clearly negative in massive galaxies yet become flatter with decreasing mass. This can be understood as a consequence of radially decreasing $\Sigma_{\star}$, which drives metallicity lcoally. However, the metallicity gradients are too flat to be purely $\Sigma_{\star}$-driven and become even positive at the lowest mass galaxies.



In this plot, we focus on how the metallicity changes as a function of radius at fixed surface mass density. At each x-y grid point the colour indicates the average metallicity for regions at the radius x with the mass density. First of all, at almost any radial location in any part of the grid, we clearly see increasing metallicity with increasing surface mass density, i.e. a rΣ_*ZR is found at any galactocentric distance. Additionally, if we look at these plots at fixed Σ_* instead of at fixed radius, we observe that [Z/H] is increasing with radius for almost all masses and morphologies.

This result requires an additional driver of stellar metallicity that promotes chemical enrichment in the outer parts of galaxies more strongly than in the inner parts. For example, gas accretion, outflows, quenching and stellar migration.