The mass-metallicity relation and its dependence on environment.

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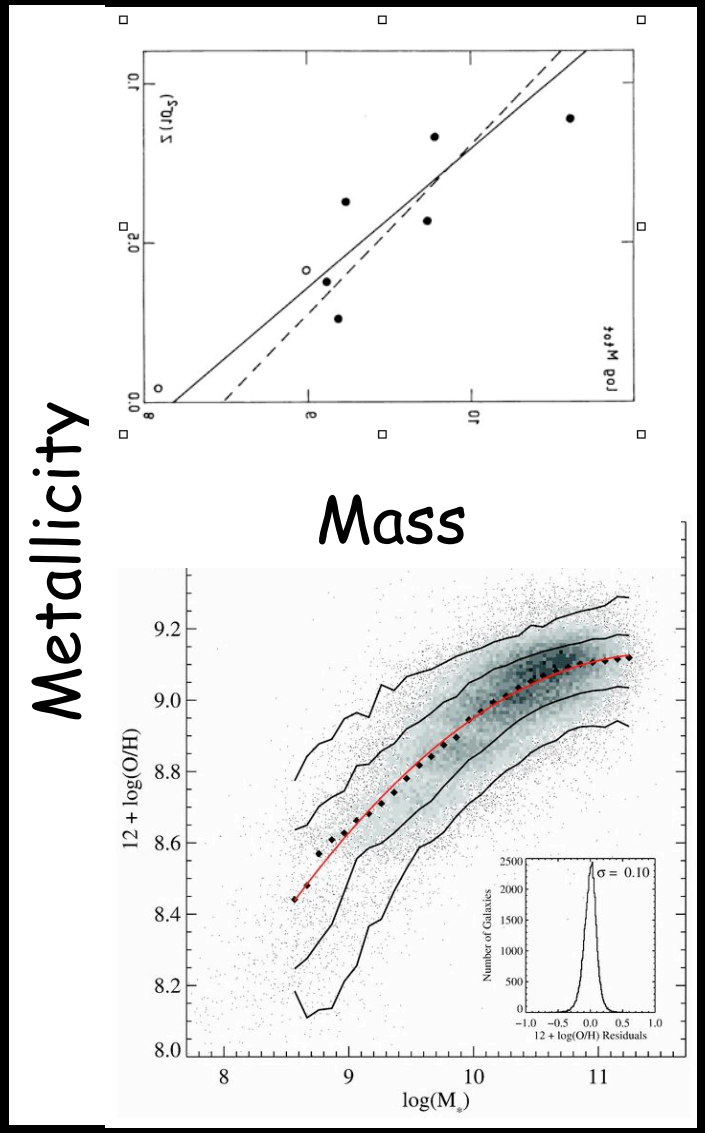
The mass- (gas) metallicity relation



1979: Lequeux et al. sample calculated total masses from HI rotation curves of 8 irregular and blue compact galaxies

2004: Tremonti et al used stellar masses from SED fits

Scatter in the MZR is ~0.1 dex, what is the cause of this scatter, and is some of it due to environment?

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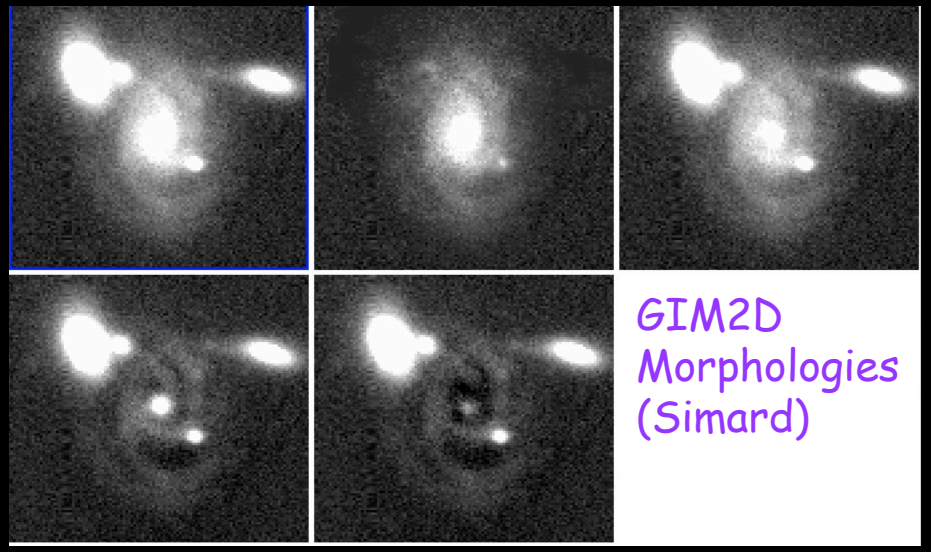
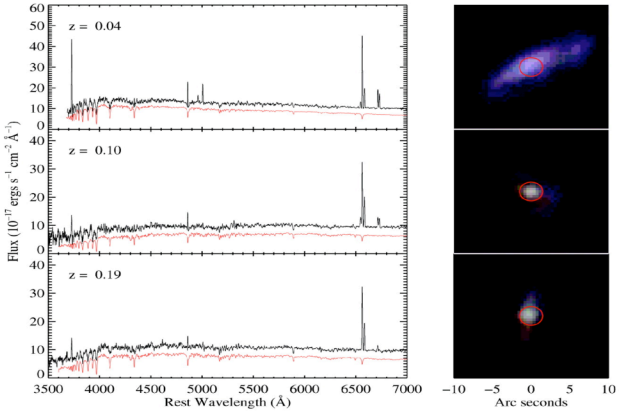
The dataset and tools of the trade

~ half a million galaxies in the SDSS DR4: stellar masses, metallicities, SFRs, colours, bulge fractions, asymmetries and local densities.

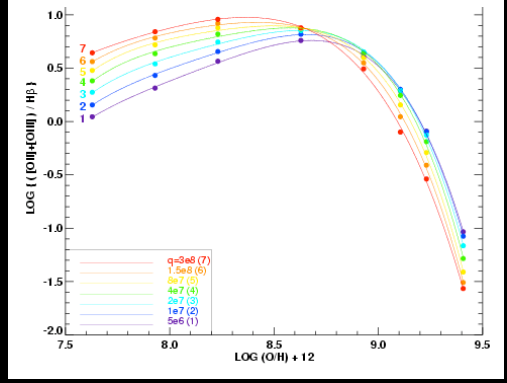


GIM2D Morphologies (Simard)

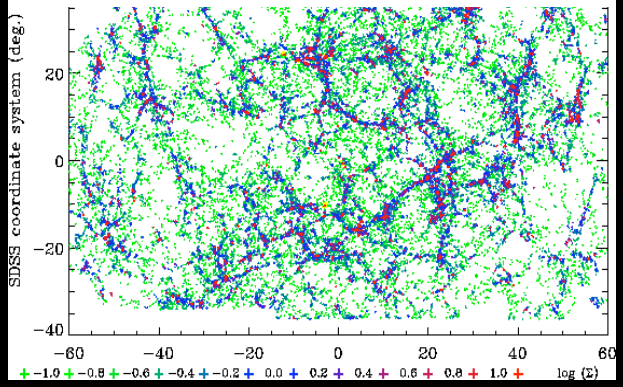
Masses: Munich/JHU website



Metallicities: Kewley/ Ellison



Environments: Patton/Baldry/Cowan



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The environment hierarchy

Galaxy pairs - probe effects of individual mergers

Local density - probe effects of high density

Galaxy clusters - probe effects of high density and presence of hot intra-cluster gas

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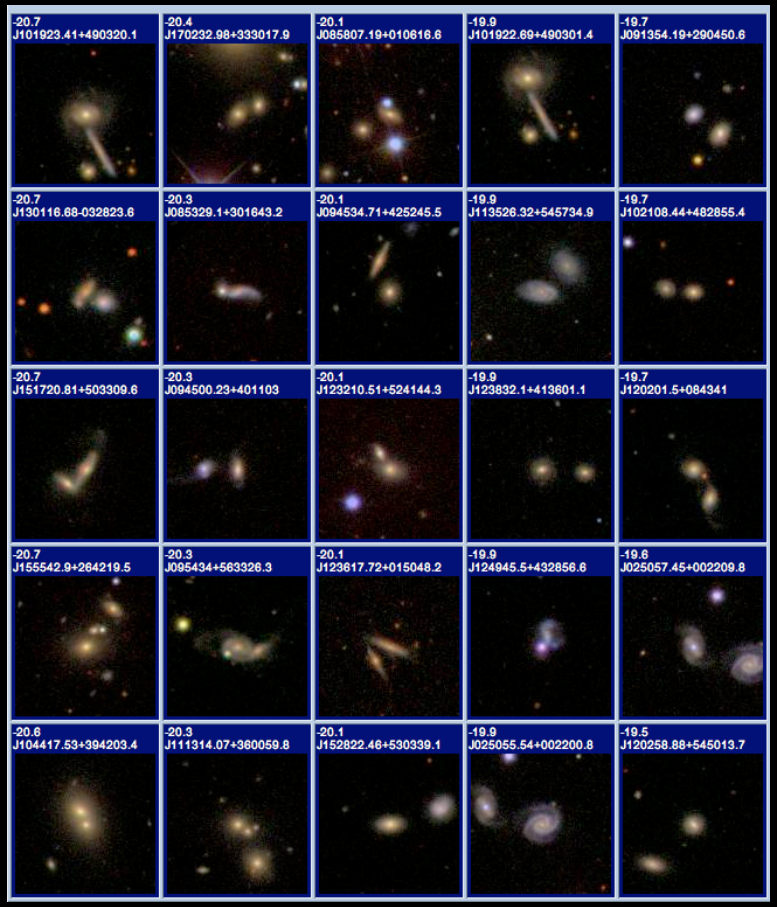
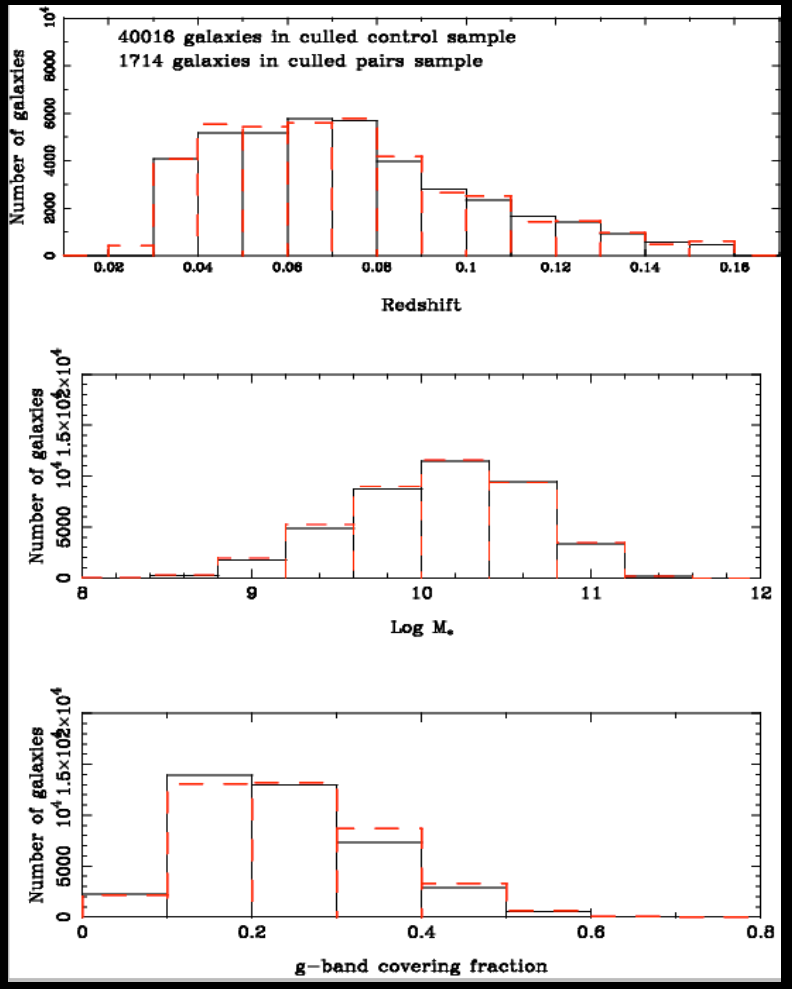
SDSS pairs: galaxies selected from main galaxy sample and having projected separation $r < 30\ h^{-1}_{70}$ kpc, velocity separation < 500 km/s, relative masses within 1:10. Control sample matched in mass, CF and z.





Ellison et al. (2008)

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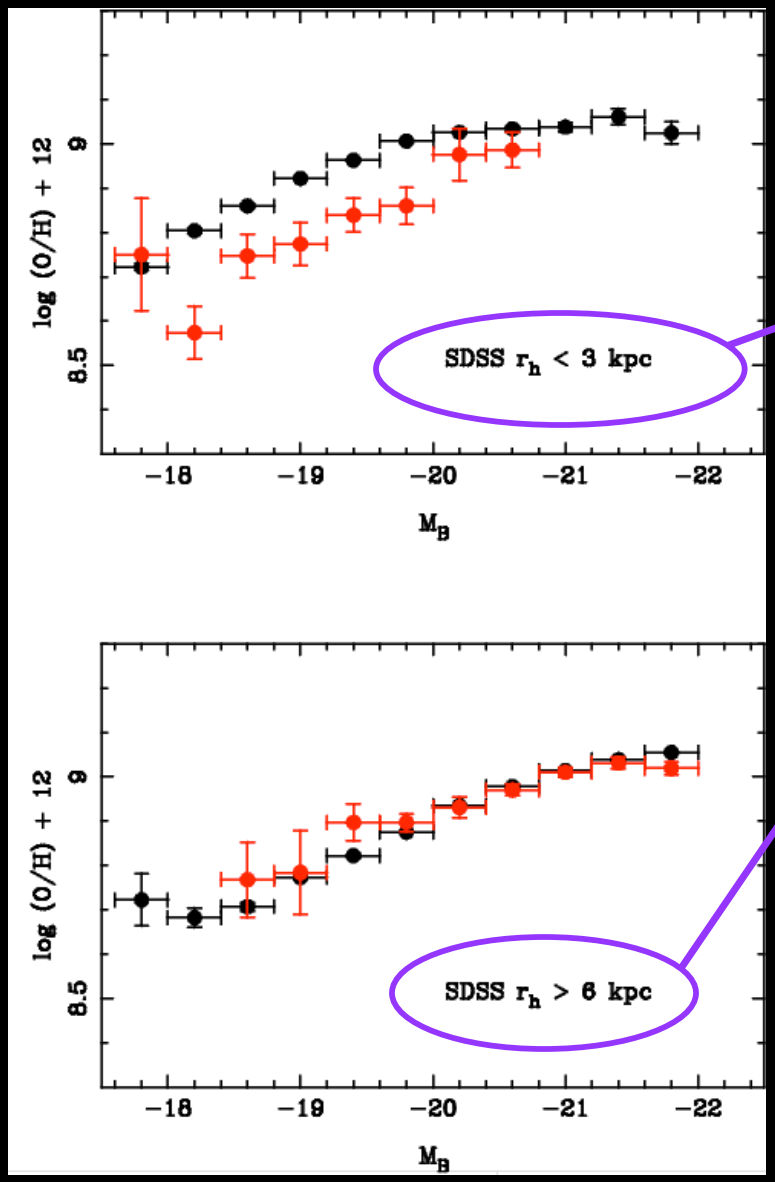

Small galaxies in pairs are typically more metal-poor than the control by 0.1 dex

Large galaxies in pairs are consistent with the control

Why are pairs metal-poor and why is this dependent on galaxy half light radius?

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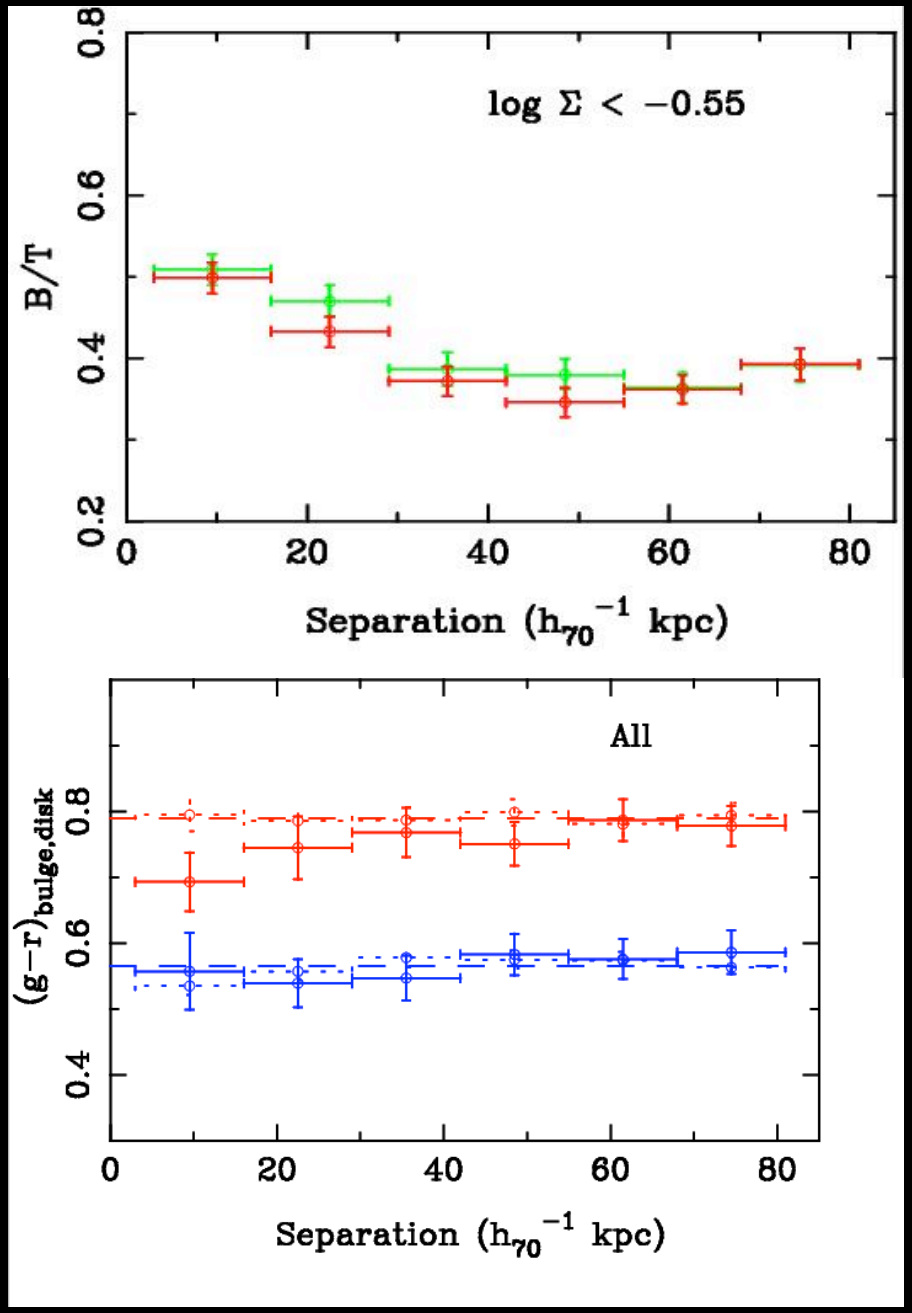

Metal-poor gas flows to galaxy center and triggers star formation. This increases the bulge fraction which decreases the half light radius.

Evidence for central star formation comes from higher bulge fractions and bluer bulge colours at small separations.

Ellison et al. in prep.

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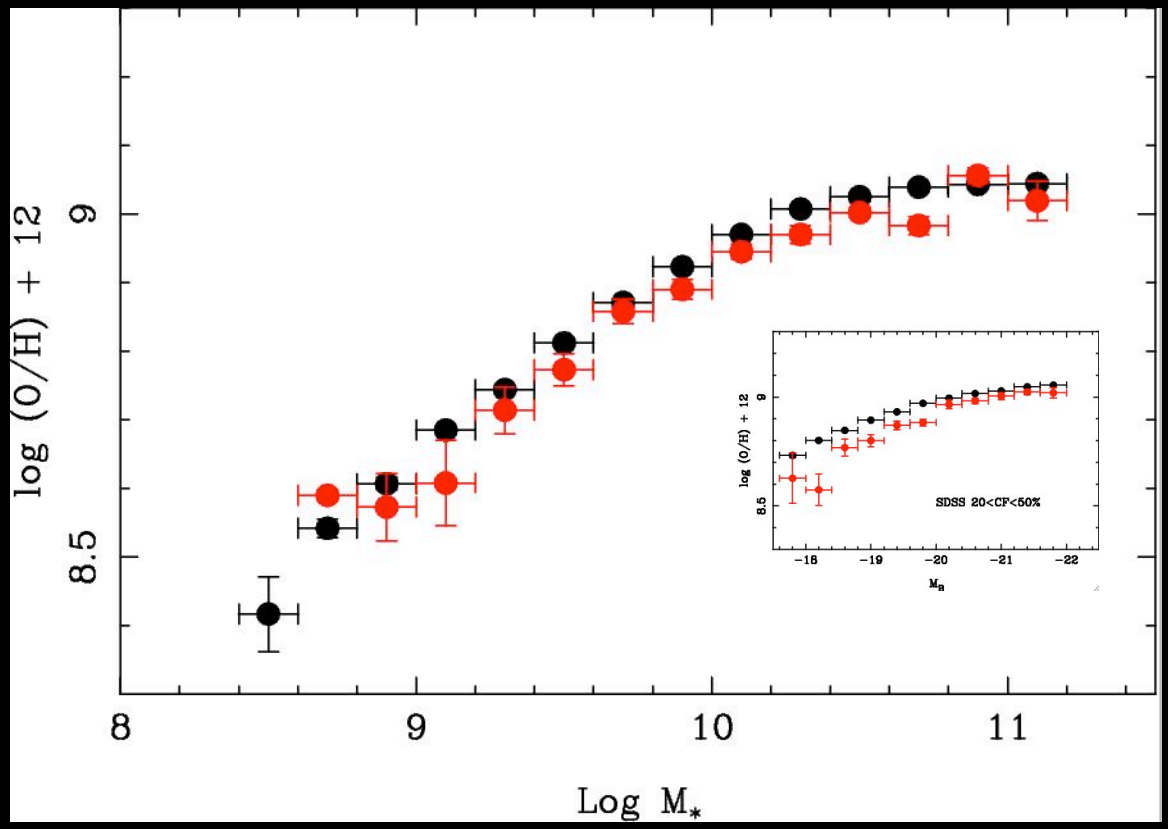
The mass-metallicity relation in pairs



The stellar-mass-metallicity relation shows a much smaller offset than the LZR, indicating that changes in metallicity only account for about 50% of the shift. I.e. the offset in the LZR is caused by both lower metallicities and brighter magnitudes.

Ellison et al. (2008)

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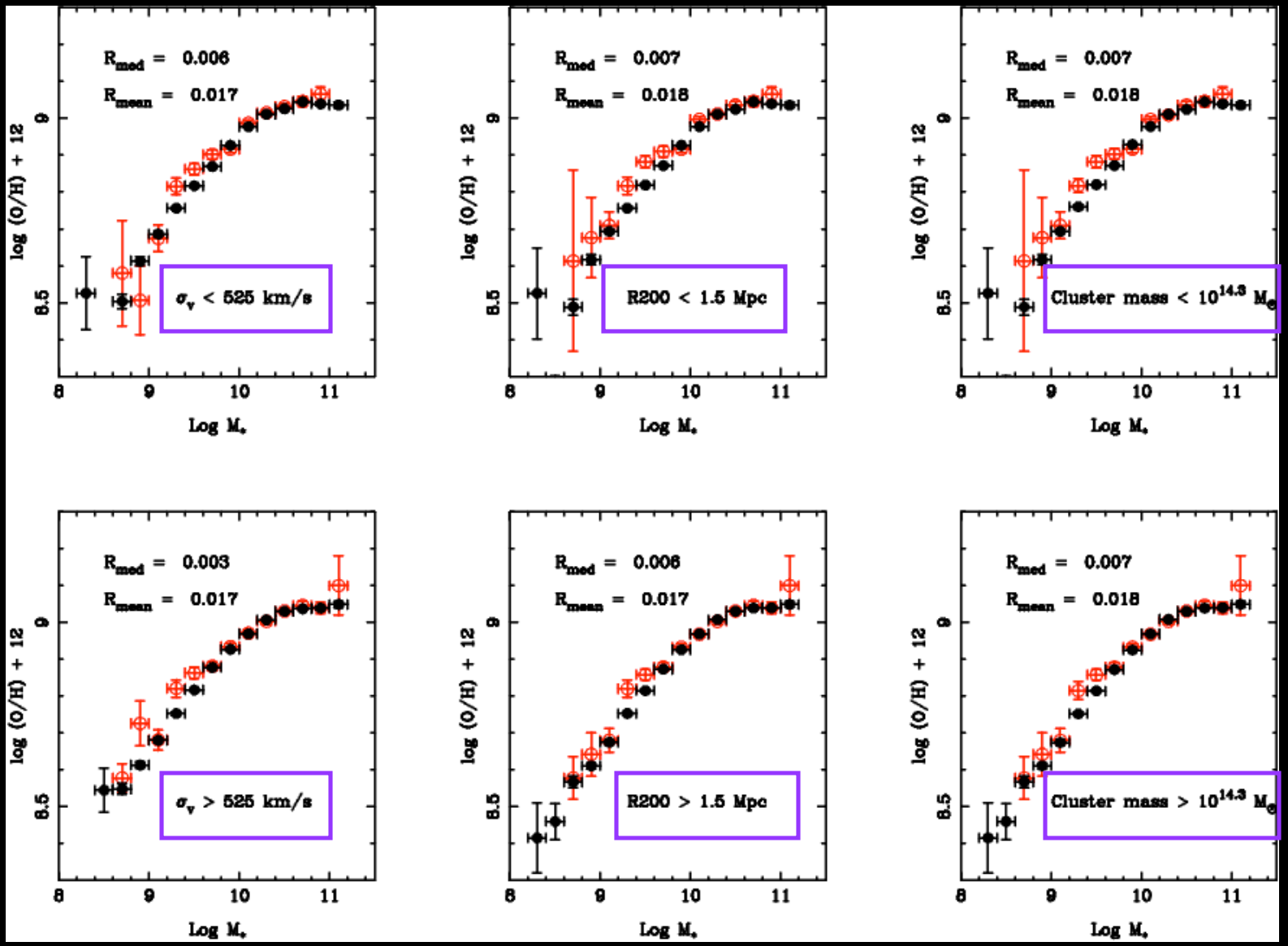
~ 1300 SDSS cluster galaxies from von der Linden et al. (2007). Although cluster galaxies are slightly more metal-rich than the `control', this does not appear to depend on cluster properties.

Low σ_v, R200, mass

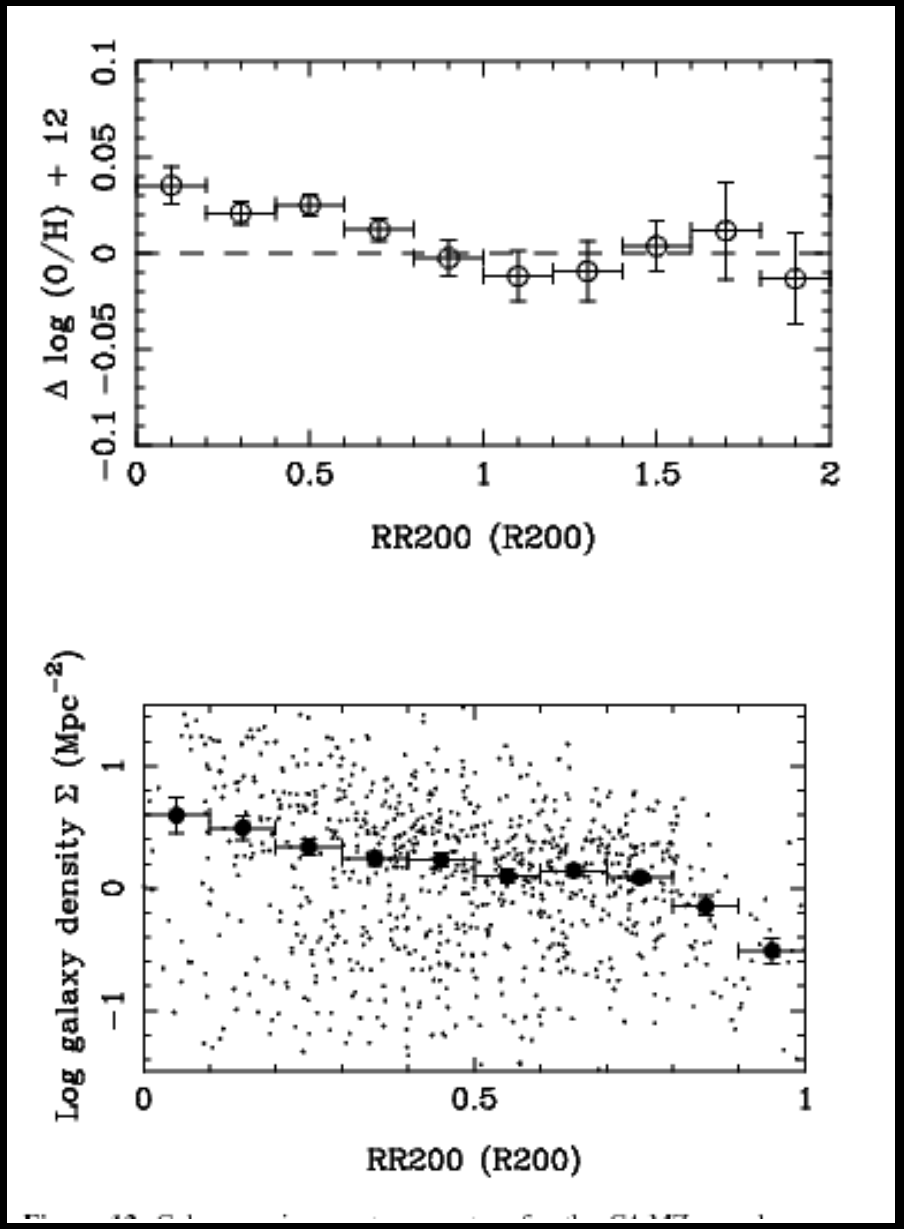
High σ_v, R200, mass



The only cluster-related property which affects the MZR is the clustercentric distance of a galaxy. However, this is driven by a dependence on local density.

At a given local density, non-cluster galaxies show a similar metallicity enhancement.

Ellison et al., (2009)



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Summary

- Galaxies in pairs are relatively metal poor for their stellar mass by ~ 0.05 dex. Larger offsets in the LZR are due to the combined effects of metallicity and luminosity.

- Galaxies in clusters are slightly metal-rich for their stellar mass by ~ 0.03 dex. The offset is independent of cluster properties, but is largest for galaxies at small clustercentric radii.

- Both cluster and field galaxies show enhanced metallicities when the local density is high, by up to ~ 0.05 dex.

Almost every galaxy property seems to depend on environment. However, the median MZR is very robust with changes < 0.05 dex at a given stellar mass.

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