SFR & Metallicity Offsets in Interacting Galaxy Pairs

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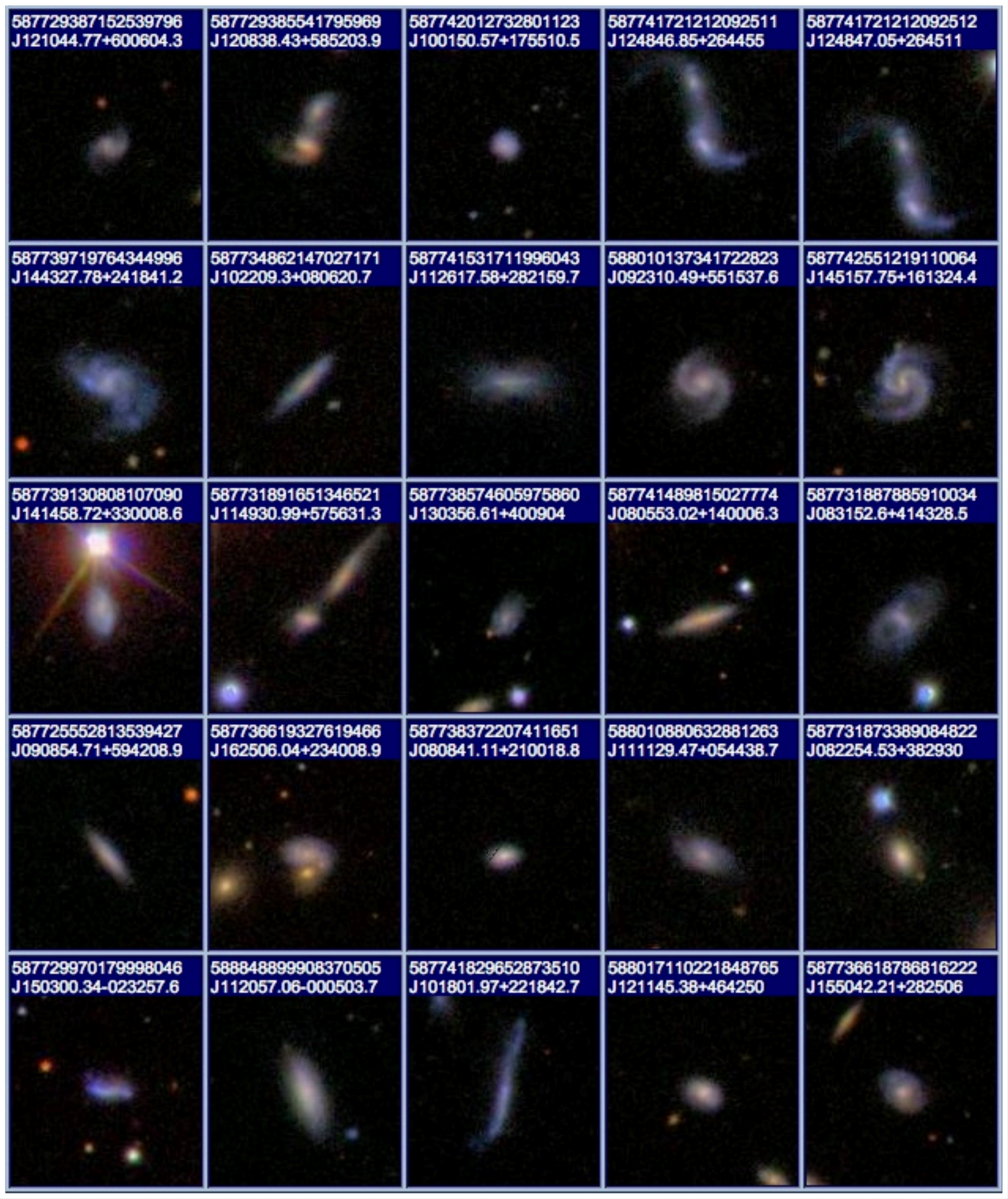


25 random galaxies in our sample

Abstract

We probe the range of projected separations over which the effects of an interaction can have an effect upon a galaxy. We present a sample of 1828 galaxies with near neighbours from the SDSS DR7 with robustly calculated SFRs & metallicities to investigate changes from a control pool of non-interacting galaxies, as a function of projected separation, and find that galaxies can be influenced by interactions at separations of 80 kpc.

Introduction

Galaxy interactions induce significant changes in the spectroscopic properties of the galaxies involved. Specifically, merging galaxies show lowered metallicities and higher SFR at fixed mass. This is understood theoretically as the result of low-metallicity gas flowing to the central regions of a galaxy, thus lowering the central metallicity, and inducing a nuclear starburst.

We avail ourselves of the statistics of the SDSS DR7 to probe these effects; our pairs sample is taken from the spectroscopic galaxy pairs sample defined by Patton et al (2011). We require stellar masses, metallicities, and SFRs to be present for all galaxies in the pair and control samples.

Sample definition

The pairs catalogue has a maximum projected separation of $r_p < 80$ kpc/h_{70}, and requires the mass ratio of the pair and its companion to be within 10:1. We also impose a velocity difference cut of $\Delta v < 300$ km/s to minimize the interloper fraction. This leaves a final sample of **1828** pair galaxies.

Each pair is matched to a non-pair control sample in mass, redshift & local density; the final control sample has **10** control galaxies per galaxy in a pair.

Offset methodology

To find the offset from the control at fixed mass, we find the median value for the 10 control galaxies in SFR & log(O/H)+ 12.

We then subtract the control value from the pair.

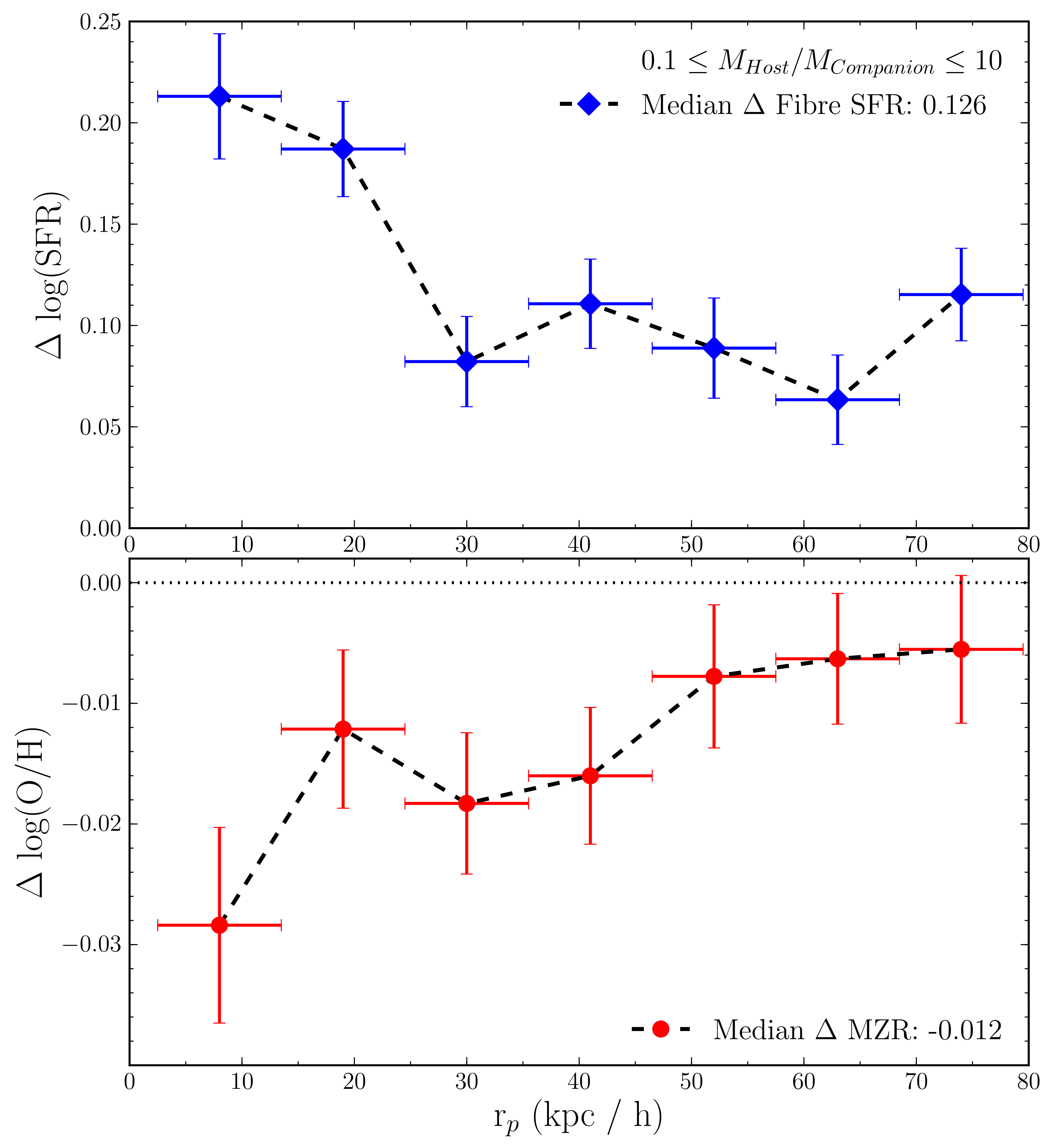
Positive offset values indicate *enhancements* over the control (i.e., SFR enhancement or metallicity enrichment), whereas negative offsets indicate *suppressions* relative to the control (i.e., SFR suppression, metallicity dilution).

Results & Comparison

Our offsets show the signature of metal poor gas inflows to the centre of a galaxy as a result of an interaction, which then sparks nuclear star formation. The strongest offsets are preferentially found at small projected separations.

The decline back towards control values as separation increases is not smooth for either parameter. The SFR offsets plateau at ~0.1 dex at separations of $r_p > 30$ kpc, and are still offset from the control at 80 kpc, the maximal separation in the sample. The nuclear metallicity offset trends are similar in form, although by 70 kpc, the offsets have reached values consistent with the control.

Ellison et al (2008) found significant SFR offsets out to only ~30 kpc when looking at a DR4 sample of pairs. However, Patton et al (2011) showed that the fibre colours of galaxy pairs in the DR7 remain bluer than the control out to 80 kpc, with a trend very similar in form to those presented here.



Offsets from the control for SFR (top panel) & metallicity (lower panel), as a function of projected separation. Points are median values for that bin, and error bars are standard error on the median.

Conclusions

Galaxies show enhanced SFRs and suppressed metallicities out to much wider separations than previously observed. The effects of a close passage can still be seen at 80 kpc/h_{70}.

References

Ellison et al. 2008, AJ, 135, 1877
Patton et al. 2011, MNRAS, 412, 591

Background image credit: NASA, ESA, & the Hubble Heritage team (STScI/AURA)