

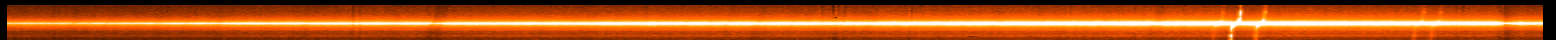
From mergers to post-mergers: a complete view of the galaxy interaction sequence.



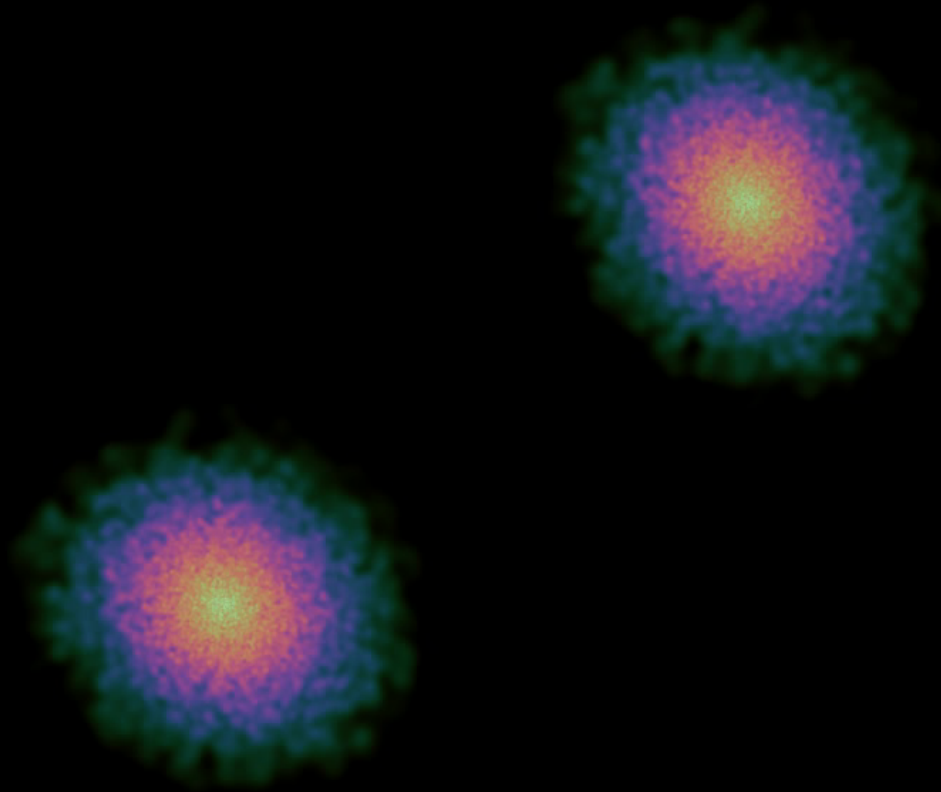
Sara L. Ellison: University of Victoria

Dave Patton (Trent U.), Jillian Scudder (Uvic), Trevor Mendel (MPE)

Results published in Ellison et al. (2013)

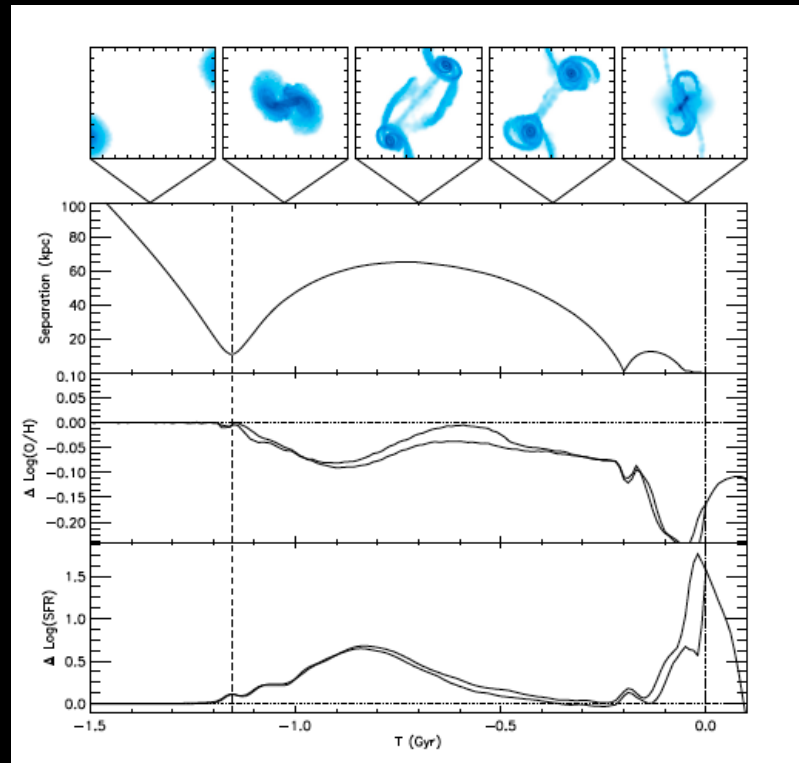


What leads to the merger spectacle?

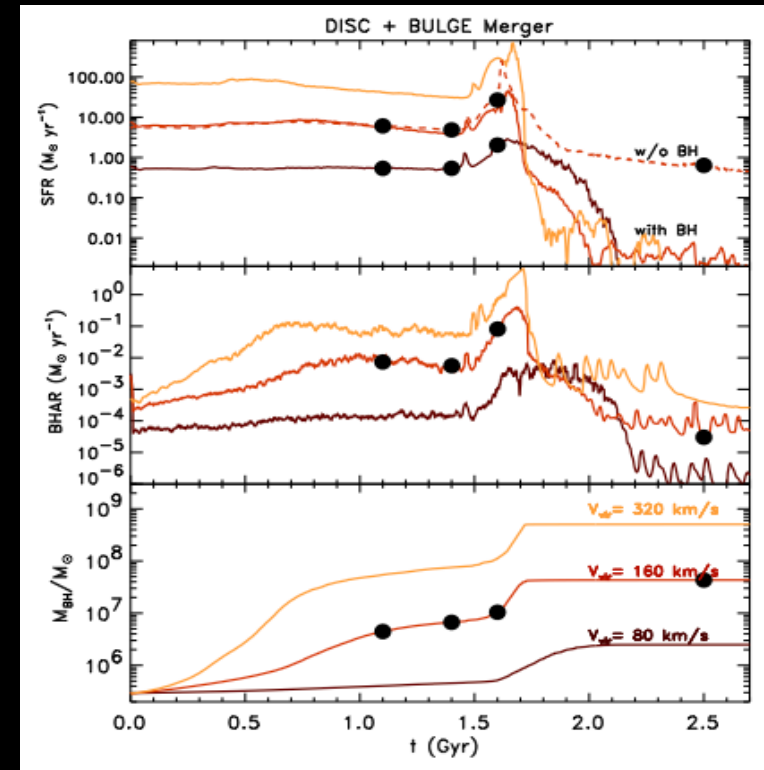


Credit: Paul Torrey

The effects of gas flows in mergers:



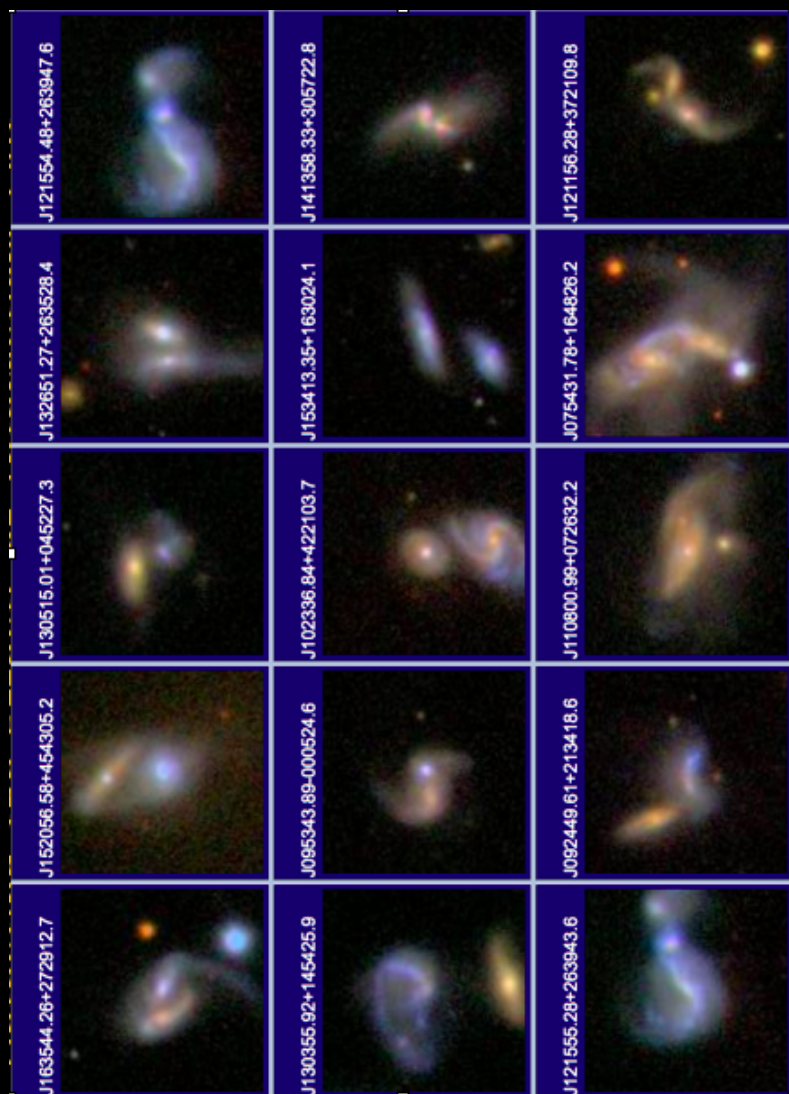
Torrey et al. (2012)



Di Matteo et al (2005)

Predicted changes in SFR, O/H and black hole accretion.
Most dramatic effects are seen at, or near, coalescence.

Galaxy pairs in the SDSS



DR7 pairs sample (24,000 gals):

Projected separation < 80 kpc

$\Delta V < 10,000$ km/s

Mass ratio within 1:10

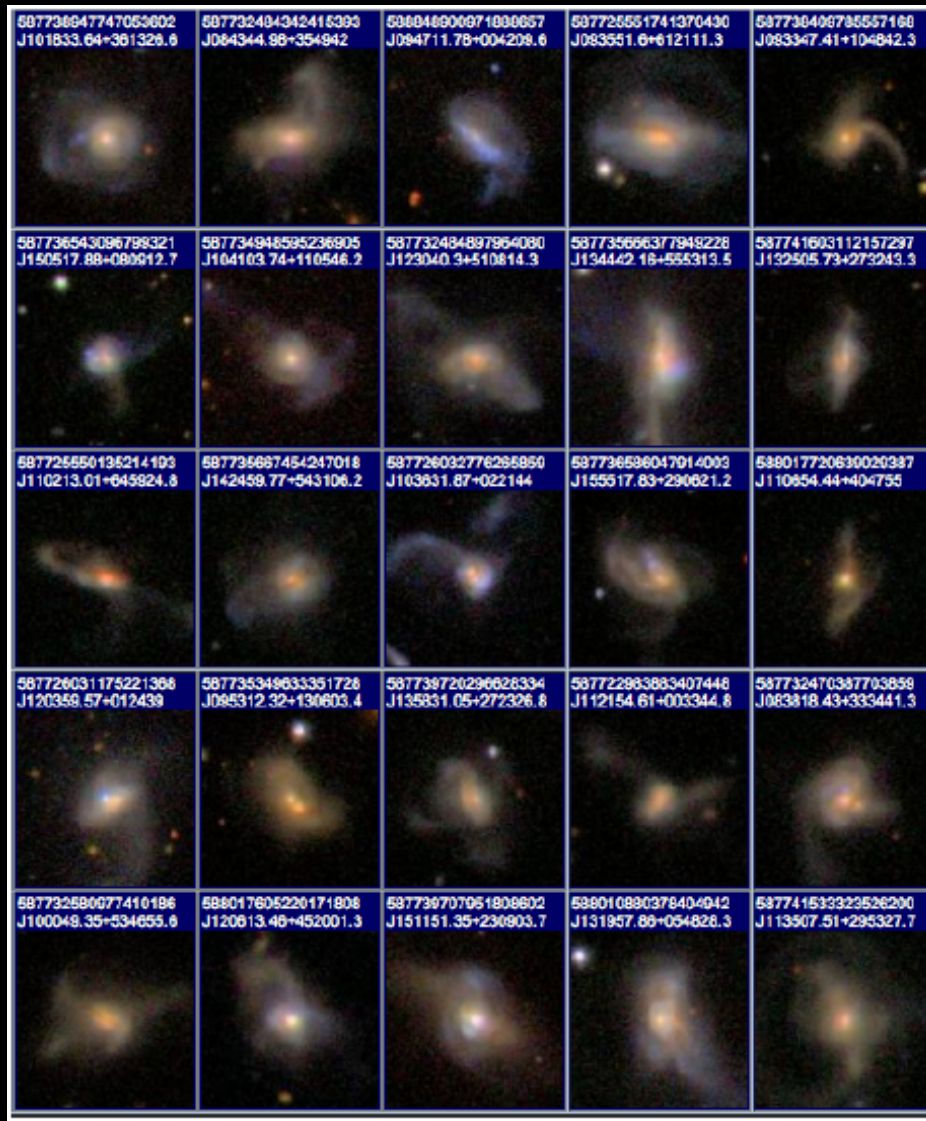
Subset: $\Delta V < 300$ km/s

Mass ratio within 1:4

Yields 10,800 pair galaxies.

Construct control samples that are matched in mass, redshift and environment; typically 100s control galaxies per pair. Measure changes differentially (Δ).

Post-merger sample

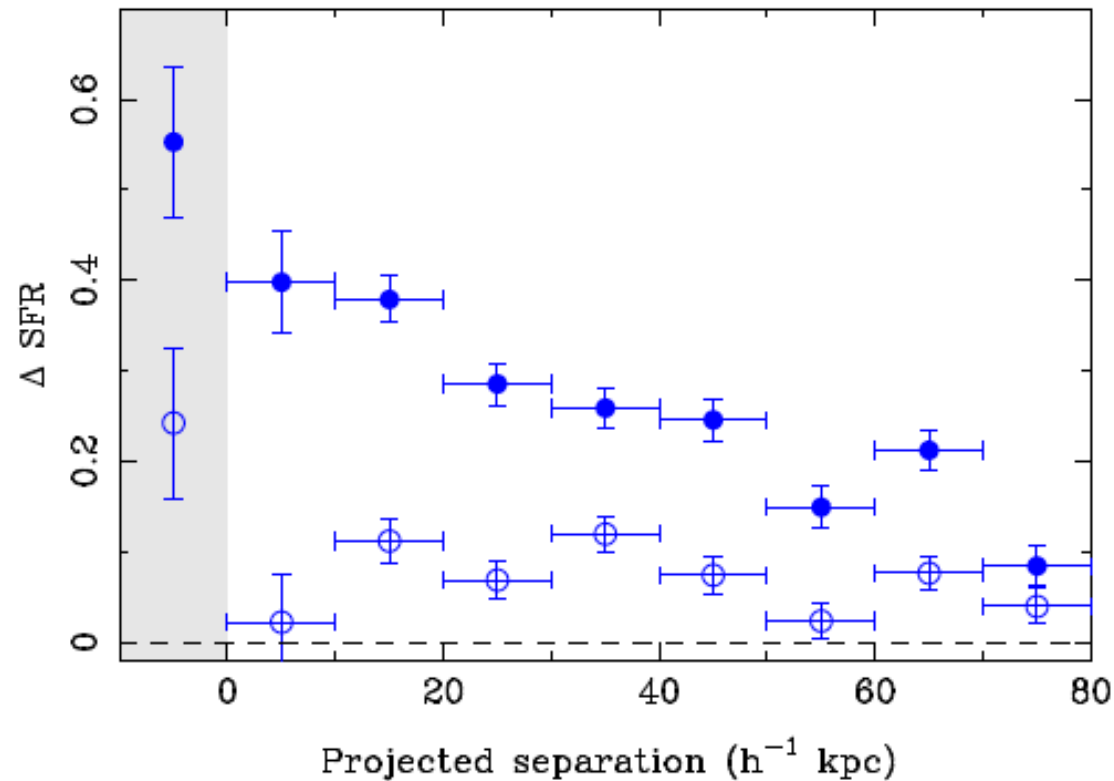


97 visually selected post-mergers from Galaxy Zoo, based on catalog by Darg et al. (2010).

Control matching and analysis done exactly same as for pairs.

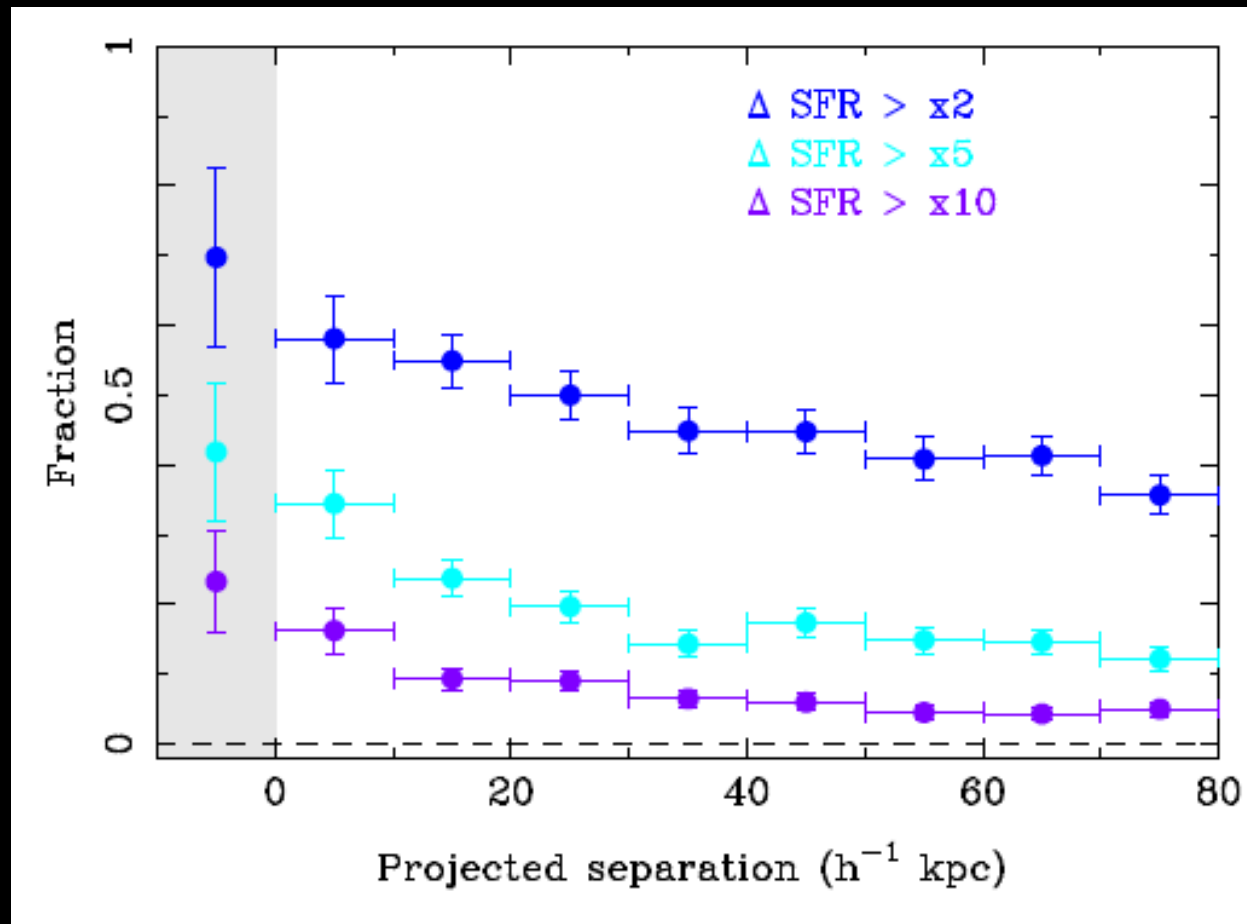
Star formation rates

$$\Delta \text{SFR} = \log (\text{SFR}_{\text{pair}} / \langle \text{SFR} \rangle_{\text{control}})$$



Star formation rates gradually increase towards closer separations, peaking in post-mergers. SFR enhanced both centrally and (less so) globally).

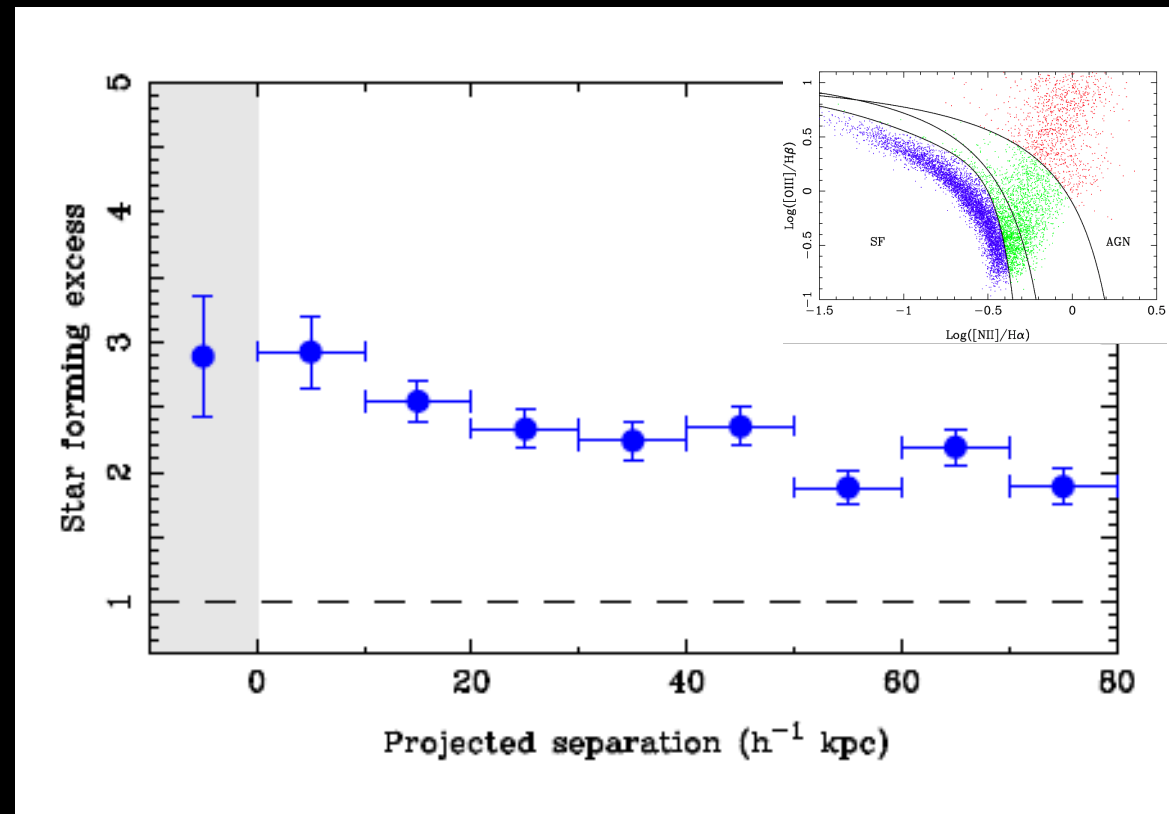
Star burst frequency



Starbursts are rare, or short-lived.

The frequency of star forming galaxies

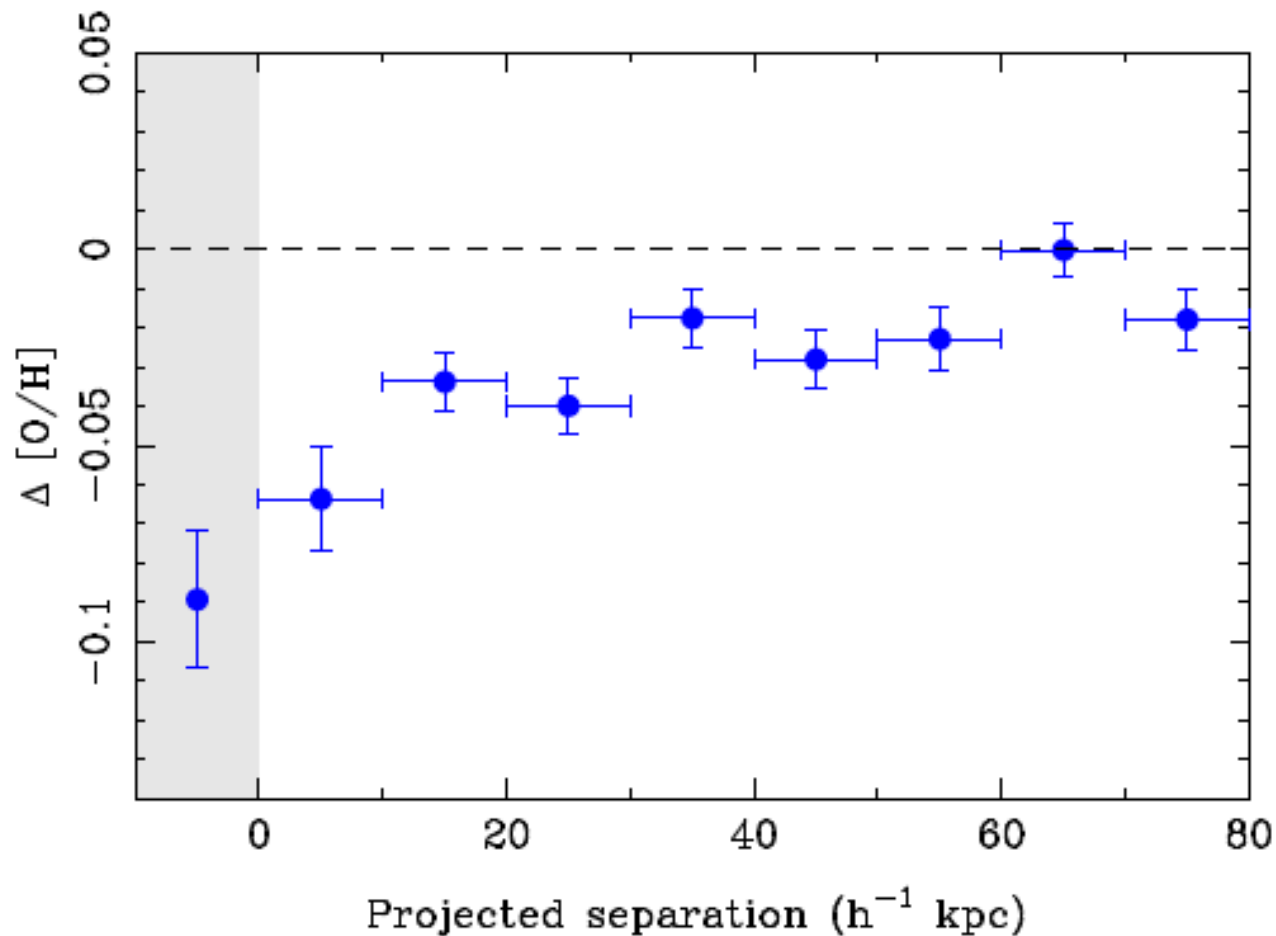
galaxies
classified as
star-forming
in pairs,
relative to
control



The absolute *number* of star forming galaxies is largely independent of separation: star formation triggered early on in interaction.

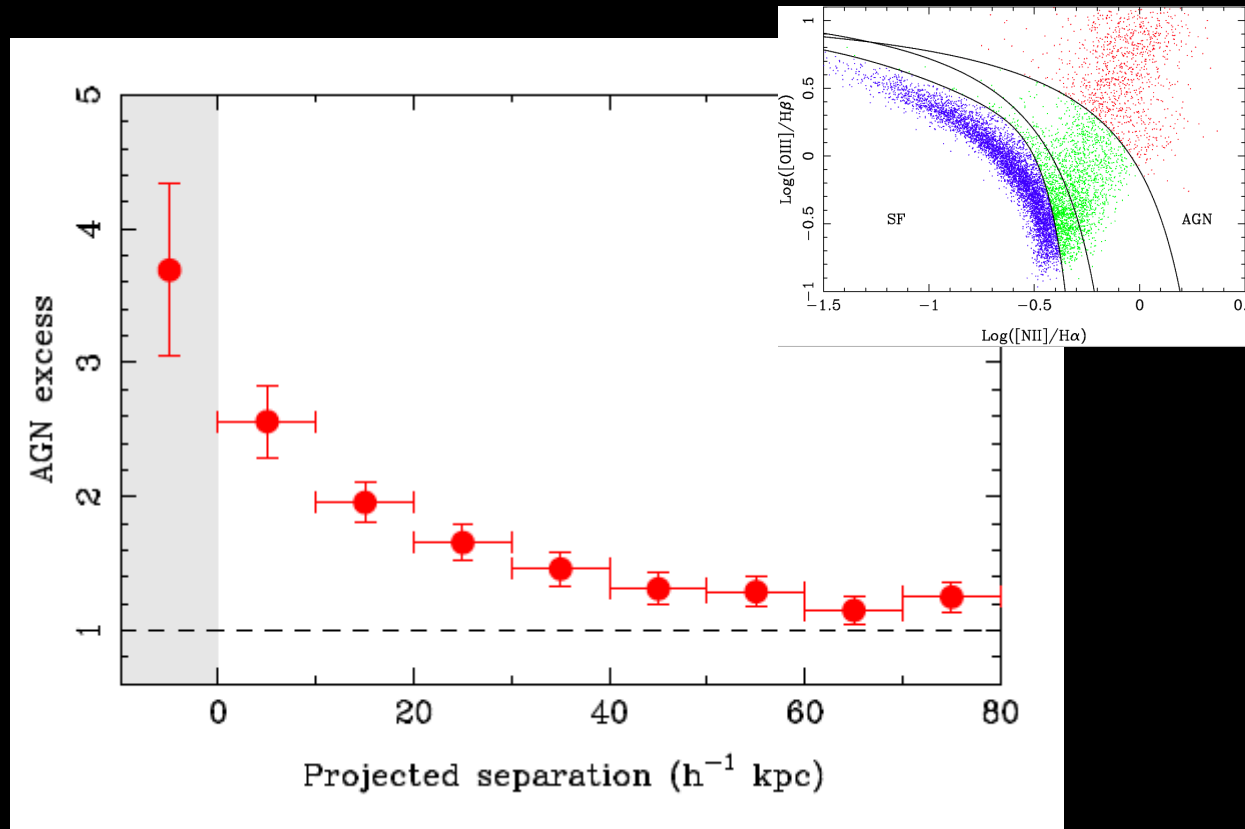
Gas phase metallicities

$$\Delta O/H = \log(O/H_{\text{pair}} / O/H_{\text{control}})$$



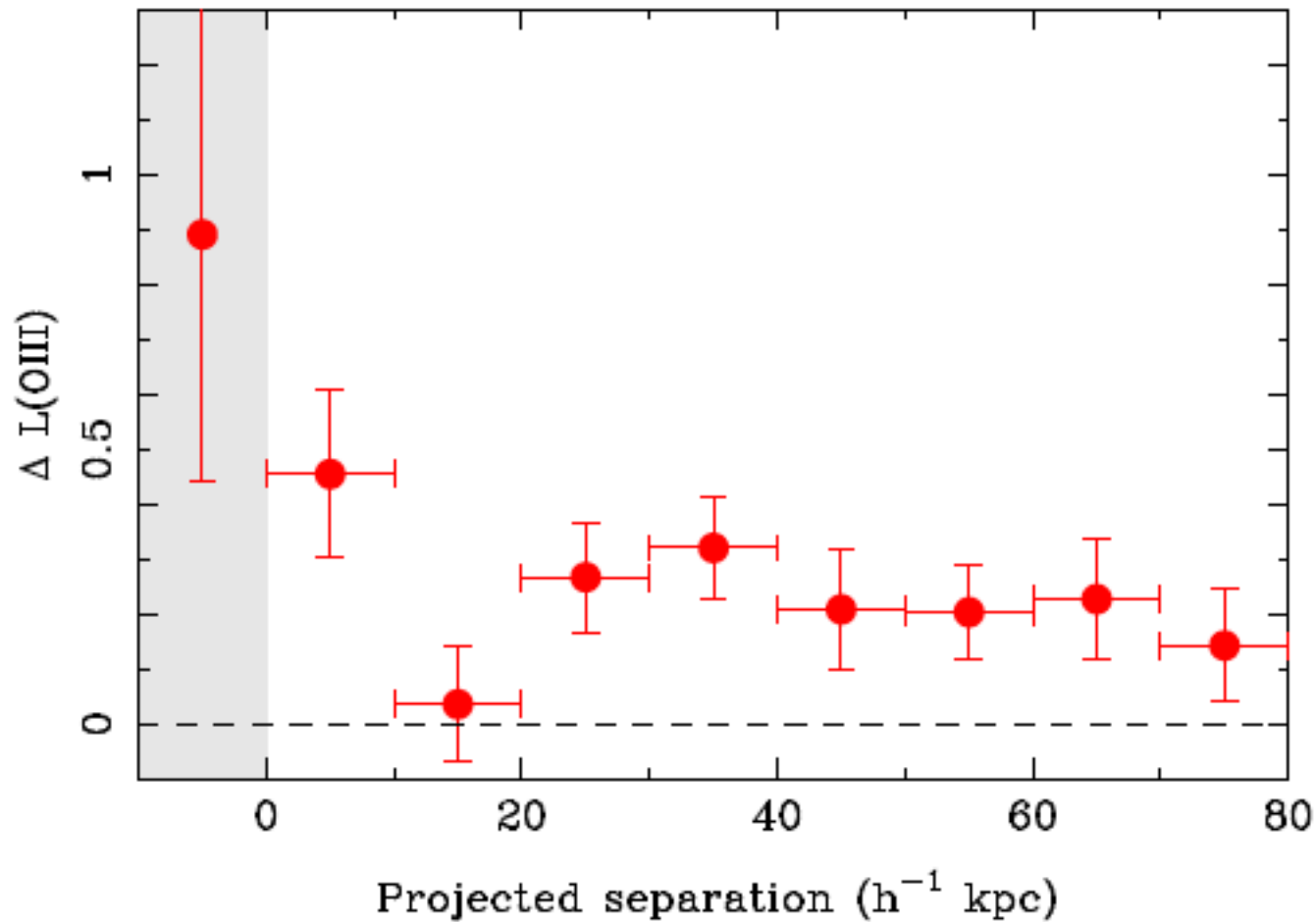
Central gas flows dilute the metallicity. Lowest O/H in post-mergers: age < few hundred Myr.

AGN frequency



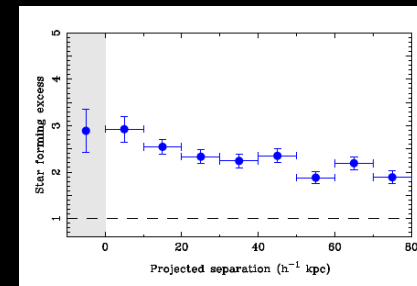
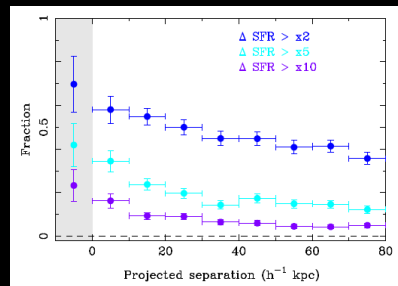
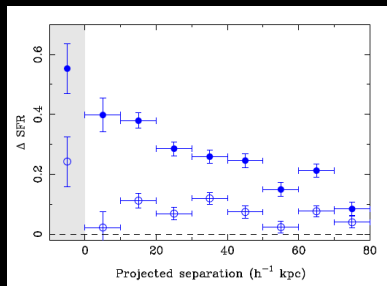
Steady increase towards smaller separations, peaking in post-mergers: AGN triggering may occur before coalescence, but it is largely a late stage phenomenon.

AGN accretion rates



Increase in luminosity is modest in most merger AGN.

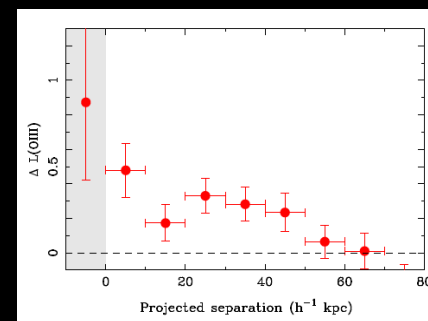
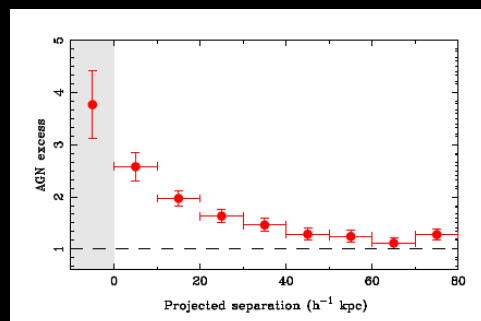
Summary - galaxy mergers across the full sequence



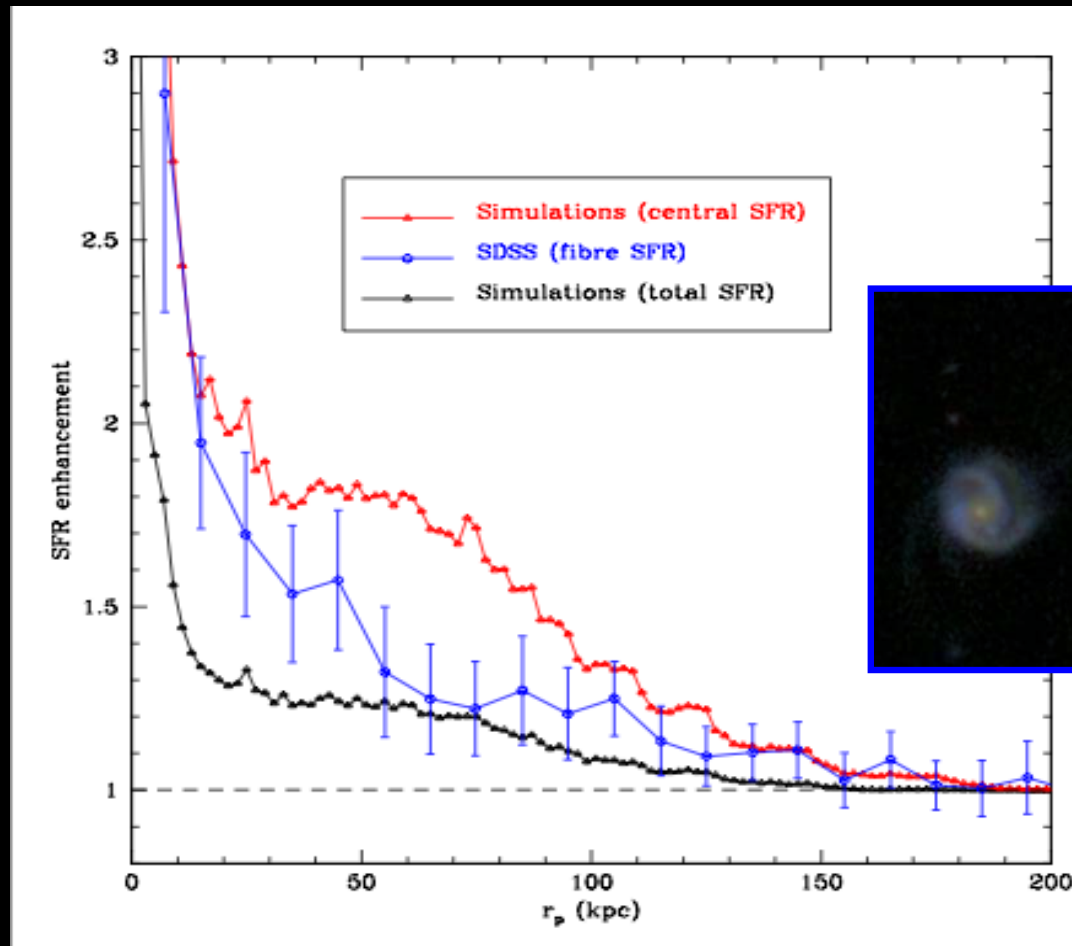
Star formation: happens centrally & globally, triggered early. Starbursts are rare.



AGN: Predominantly associated with coalescence, not all merger trigger luminous AGN



Extending observational pairs samples to wide separations.

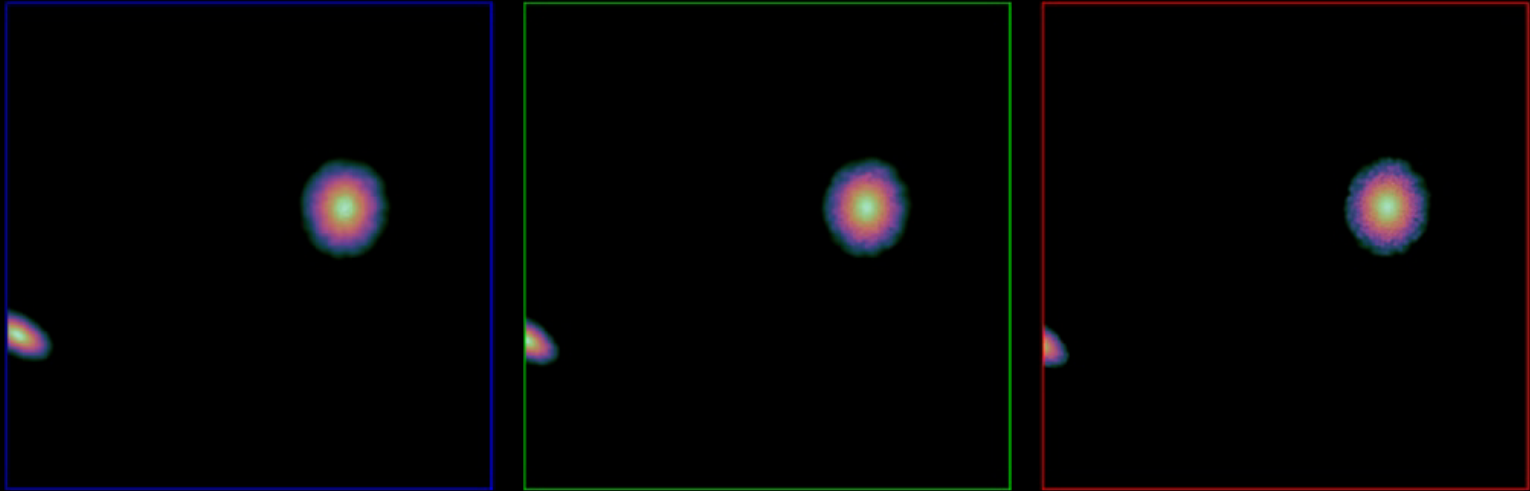


Enhanced SFRs out to 150 kpc:

Patton et al. (2013)

2/3 of merger-induced star formation occurs at $r_p > 30$ kpc

Interpreting the SFR enhancement plateau.



Paul Torrey
Dave Patton
Sara Ellison
Trevor Mendel
Jillian Scudder



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UNIVERSITY

Photometry of close pairs



Several improvements made to SDSS photometry, which tends to give colours that are too red in crowded environments.

Improvements:

- Bulge+disk decomposition
- SExtractor deblending
- Local sky determination
- Simultaneous g+r fits

Public catalogs available:

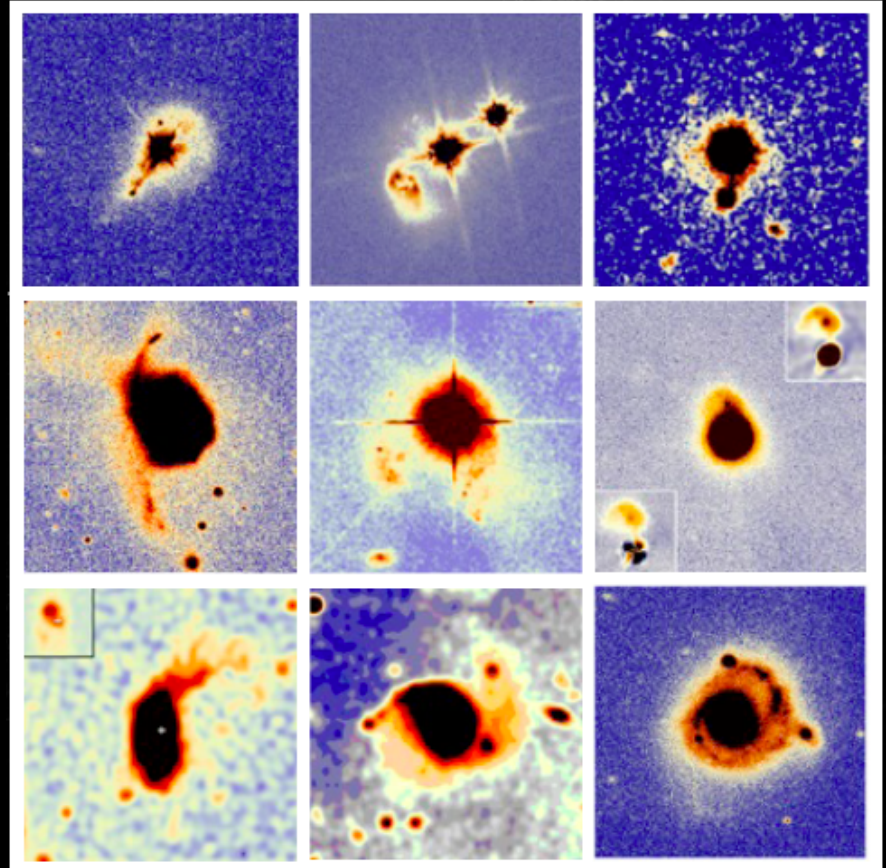
Photometry: Simard et al. (2011)

Masses: Mendel et al. (2013)

About 1% of nearby galaxies are experiencing mergers and they seem to lead to some of the most spectacular cosmic events.



Ultraluminous Infrared Galaxies HST • WFPC2
NASA and K. Borne (Raytheon ITSS and NASA Goddard Space Flight Center), H. Bushouse (STScI), L. Colina (Instituto de Física de Cantabria, Spain) and R. Lucas (STScI)



QSO host galaxies from Canalizo & Stockton (2001)