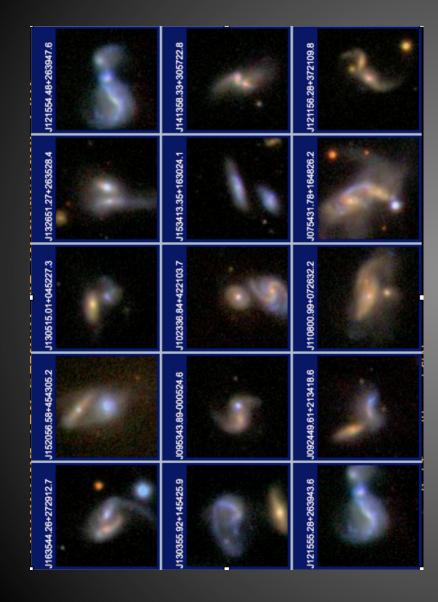
Triggering processes and star formation in AGN: Multi-wavelength matters. Sara Ellison (University of Victoria)



Shobita Satyapal (GMU), Ryan Hickox (Dartmouth), Dave Patton (Trent), Trevor Mendel (MPE), Jillian Scudder (Sussex), David Rosario (Durham), Hossen Teimoorinia (Uvic).

## Galaxy pairs in the SDSS



DR7 pairs sample: Projected separation <80 kpc  $\Delta V$  <300 km/s Mass ratio 0.1 - 10

Yields: ~14,000 galaxies in pairs.

Construct control samples that are matched in mass, redshift and environment: typically 100s control galaxies per pair.

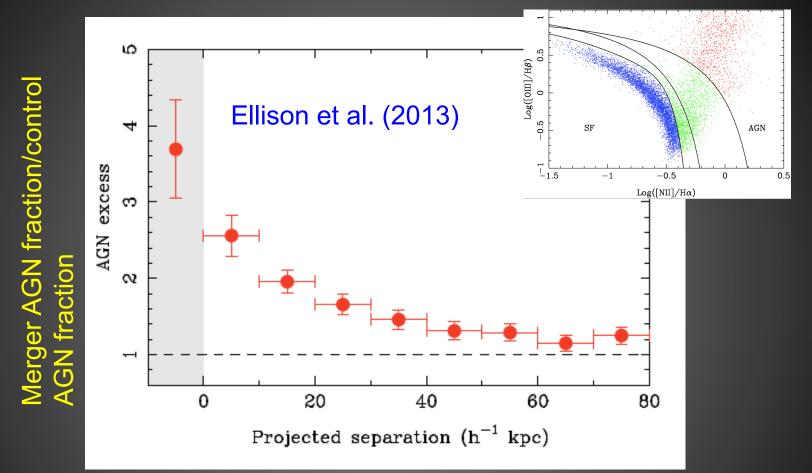
## Post-merger sample

587736947747053602	587732484342415393	598946900971898657	597725551741370430	587738406785557168
J101833.64+361326.6	J084344.98+354942	J094711.78+004209.6	J083551.6+612111.3	J083347.41+104842.3
		.7		
587736543096798321	587734948595236905	587732484897954080	587735666377949228	587741603112157297
J150517.88+080612.7	J104103.74+110546.2	J123040.3+510814.3	J134442 18+555313.5	J132505 73+273243.3
587725550135214103	587735667454247018	587726032776285850	587736586047014003	538017720630020337
J110213.01+645924.8	J142459.77+543106.2	J103831.87+022144	J155517.83+290621.2	J110554.44+404755
587726031175221366	587735349633351726	587739720296626334	587722983883407448	587732470387703859
J120359.57+012439	J095312.32+130603.4	J135831.05+272326.8	J112154.61+003344.8	J083818.43+333441.3
587732580077410186	688017605220171808	597739707051809602	598010890378404942	587741533323526200
J100048.35+534655.6	J120813.48+452001.3	J151151.35+230903.7	J131957.88+054828.3	J113507.51+295327.7

97 visually selected post-mergers from Galaxy Zoo.

Control matching and analysis done exactly same as for pairs.

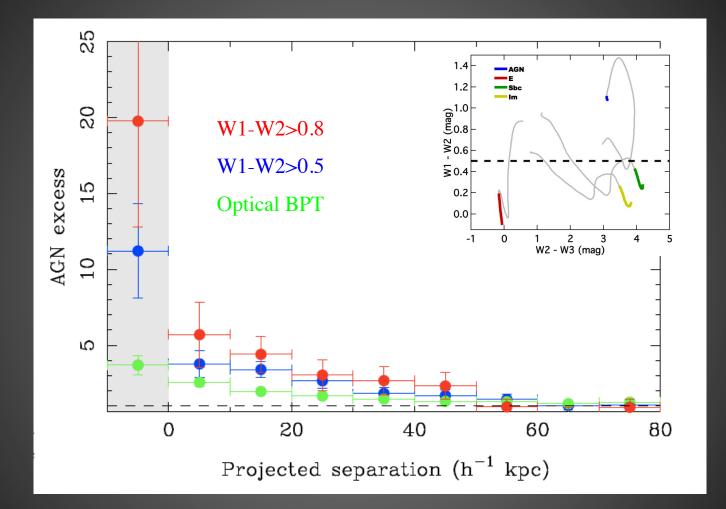
## AGN frequency: from optical emission lines



Although AGN *may* be triggered by first pass, fraction increases most strongly after coalescence

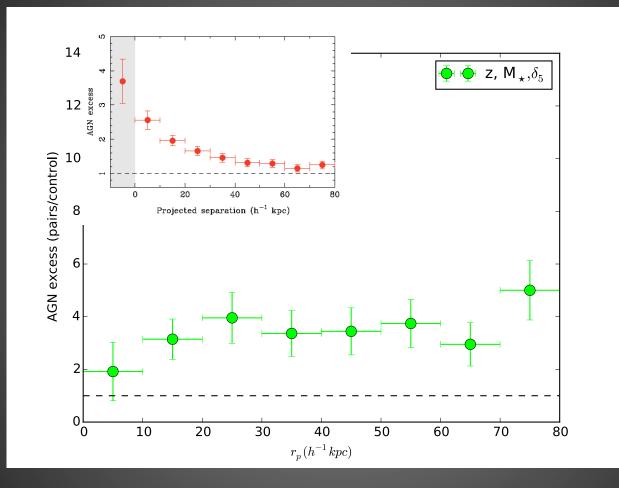
See also Ellison et al. (2011), Khabiboulline et al. (2014)

## AGN frequency: from mid-IR colours



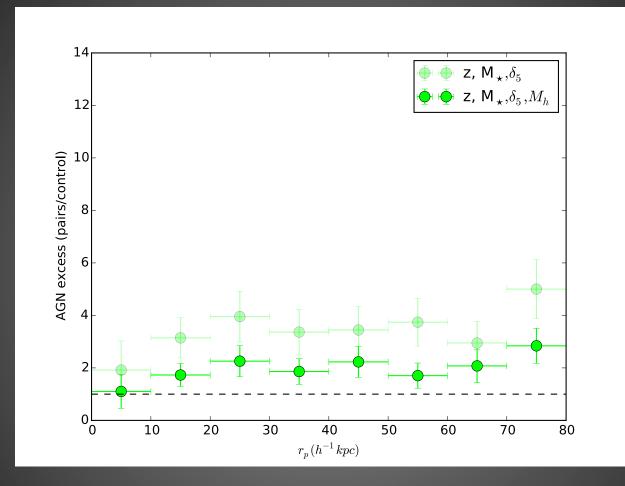
Significant fraction of merger triggered AGN are dust obscured and not seen as AGN in optical. Satyapal et al. (2014)

#### Radio-selected AGN (LERGs = radiatively inefficient/radio mode) Selected from Best & Heckman (2012)



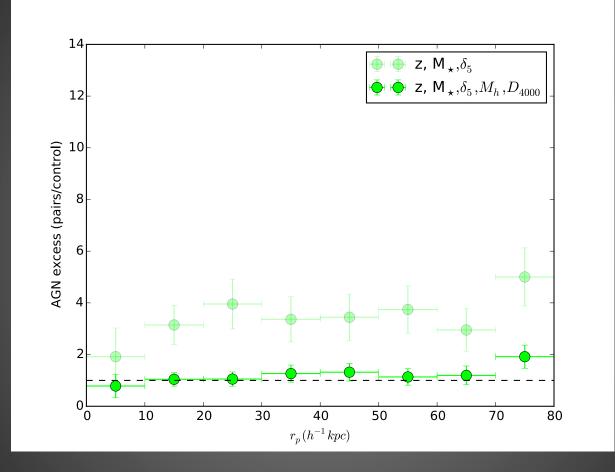
RL-AGN excess in pairs, but no trend with separation (and excess extends to 500 kpc). Non-merger origin?

#### Radio-selected AGN (LERGs)

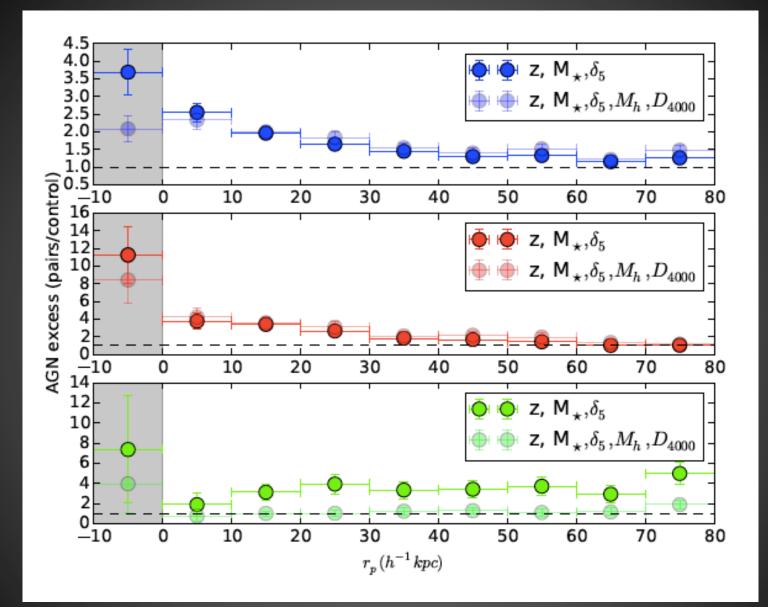


Matching in halo mass reduces the excess, but does not remove it: some dependence on external group gas, but not the whole story.

#### Radio-selected AGN (LERGs)

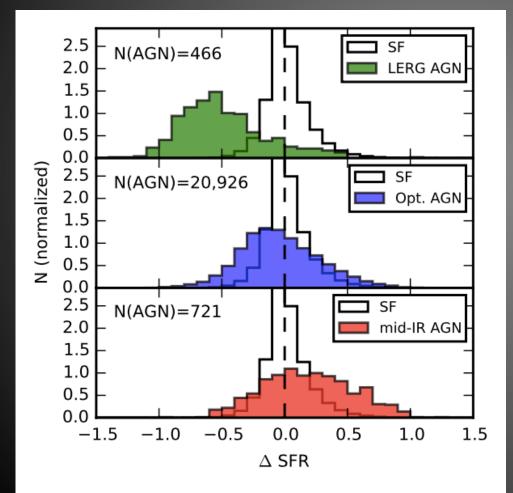


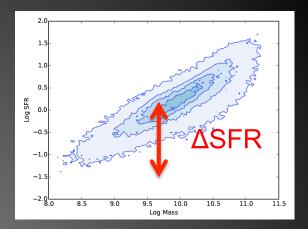
Matching in halo mass and D4000 removes the excess: Fuelling linked to both environmental and internal stellar sources



Ellison, Patton & Hickox 2015

SFRs of AGN hosts obtained from far-IR luminosities (catalog of SFRs from far-IR luminosities for SDSS galaxies: Ellison et al. 2016a).





Radio-selected AGN (LERGs) are strongly UNDER star forming

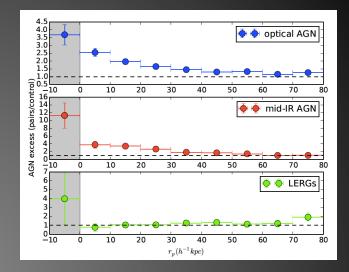
Optically-selected AGN are slightly UNDER star forming

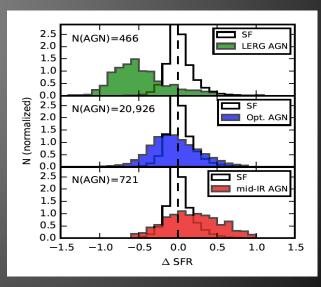
mid-IR-selected AGN are OVER star forming

Ellison et al. (2016b)

# Summary

- Mergers can trigger AGN, and enhance their accretion rate. Ellison et al. (2011, 2013).
- IR selected AGN more prevalent in mergers than optically selected AGN – mergers more frequently to lead to obscured AGN. Satyapal et al. (2014)
- Low excitation radio galaxy (LERG) AGN are not fuelled by mergers Ellison, Patton & Hickox (2015).
- SFRs of AGN depend on how AGN is selected. Ellison et al. (2016b).





#### Not all AGN are equal! Selection matters.