Feedback from Active Galactic Nuclei (AGN) is required to explain the galaxy stellar mass function and star formation histories (e.g. Crotto et al. 2006; Shabala & Alexander 2009). The power and frequency of AGN outbursts is intimately linked to black hole environment (Shabala et al. 2008; Best et al. 2005), and it is unclear whether mechanical or radiative processes drive the feedback. Powerful, rare AGN outbursts associated with lobe-dominated (Fanaroff-Riley Type II) radio sources and their more frequent, less energetic, core-dominated (FR-I) counterparts can both in principle play important roles in regulating the star formation history of galaxies.

We compare the effects of both types of radio sources on galaxies near the AGN host by looking at galaxy colours. Photometry is used to reconstruct star formation histories (e.g. Kaviraj 2009; Kaviraj et al. 2011) and thus quantify the effects of feedback from different types of AGN on star formation.

1. Radio sources

Radio AGN with spectroscopic redshifts < 0.2 were selected from the 3CR, NVSS and FIRST surveys. The sample spans a large range of sizes (few kpc to Mpc) and radio source ages (few to few hundred Myrs).

2. Galaxies

S0/S is selected for galaxies within radius 1.5 < R200 of the AGN host, where R200 is the angular size of the radio source. Objects with photometric redshifts matching the AGN host redshift were retained for analysis. Photometric redshift selection enables us to study AGN effects on the smallest galaxies with shallow potential wells—precisely the objects in which gas is expected to be affected by kinetic and radiative AGN feedback.

3. Projection effects

For each radio source, galaxies were split into three groups:

(i) Galaxies lying outside the radio source contours. There are definitely not affected by the passage of the expanding radio source.

(ii) Galaxies lying within the innermost part of radio source contours. For lobe-dominated FR-2s these were galaxies within the radius defined by the minor axis of the radio source. For core-dominated FR-I the radius was taken as half the outermost contour. Such samples are unlikely to be affected significantly by projection effects (see Shabala, Kaviraj & Silk 2011), and thus represent galaxies genuinely overrun by radio sources.

(iii) Galaxies within the radio source contours, but outside the inner region. Some of these will be genuinely overrun by radio sources, others will falsely appear to be associated with radio sources due to projection effects.

The analysis below compares the colours of innermost (i.e. ‘definitely overrun’) and outer (‘definitely unaffected’) groups.

4. Mass corrections

Massive galaxies are known to be preferentially redder. We correct for the differing mass distributions in our samples in two ways. First, we exclude all galaxies outside the 10<sup>10</sup>–10<sup>10.5</sup> M⊙ mass range. Secondly, we weight the counts of overrun (innermost) galaxies to match the mass distribution of unaffected ones.

Model colours

We test whether observed galaxy colours are consistent with truncation of star formation by a shock associated with an expanding FR-2 radio source. Star formation in local galaxies is well described by a superposition of an old instantaneous burst of star formation and a recent burst described by the Schmidt-Kennicutt law (e.g. Kaviraj 2009). Parameters for star formation efficiency and old burst ages were adopted from Kaviraj et al. 2011 and Kaviraj 2009. Galaxy colours predicted by population synthesis models (Bruzual & Charlot 2003) then contain information on the time at which the recent burst of star formation was truncated.

**References**

Bruzual & Charlot 2003, MNRAS 344, 1000
Dunlop & Fabricant 2008
Dunlop et al. 2005. These clusters are split up into regions including the radial distribution of galaxies in the inner and outer regions of groups/clusters with FR-2 radio sources. The resulting samples were again mass corrected.

**Conclusions**

Rare, powerful lobe-dominated (FR-2) radio sources profoundly affect group/cluster galaxies outside AGN hosts, regulating star formation on Gyr timescales. Less powerful FR-1 sources can only regulate star formation in the host galaxy, and on much shorter timescales. Both mechanisms therefore play key roles in galaxy evolution, through the clean-up and maintenance mode respectively.