The Environments of Hot and Cold Accretors

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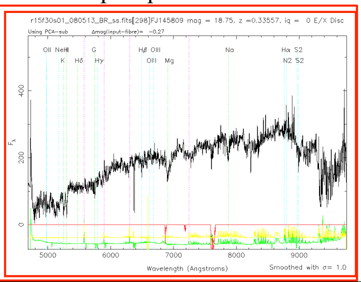
What are hot and cold mode accretors?

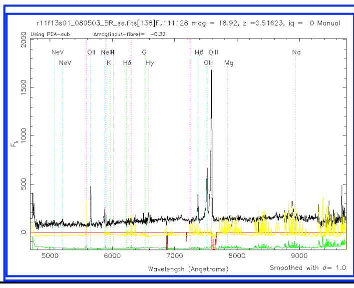
Current observations (Best el al, 2005; Hardcastle et al. 2007) suggest that there are two different modes by which radio-loud AGNs accrete material into their central black hole, a hot and a cold mode. See Figure 1 for example of spectra of hot and cold mode accretors.

Figure 1 Example spectra from visual classification of different radio-loud AGN.

Hot Mode

- slow accretion of gas.
- not able to form an efficient accretion disk.
- no high-excitation emission lines.





Cold Mode

- accretes gas rapidly.
- forms a radiatively efficient accretion disk.
- presence of high-excitation emission.

Q: Do hot and cold mode accretors live in different environments?

It is believed that hot mode accretors are commonly found in dense environments, because the virial temperature of the group is sufficiently high such that the cooling times of gas is quite large (Croton et al. 2006; Bower 2006), **whereas cold mode accretors are believed to lie in lower density environments**. **To test this we compare the environments of hot and cold mode radio galaxies in the GAMA and WiggleZ redshift survey.**

A: YES! The FoF and D_5 both show that:

- **hot mode objects are largely found in groups that tend to have high surface densities.**
- **cold mode objects live in low density environments similar to their non-radio counterparts.**

FoF: Friends-of-Friends

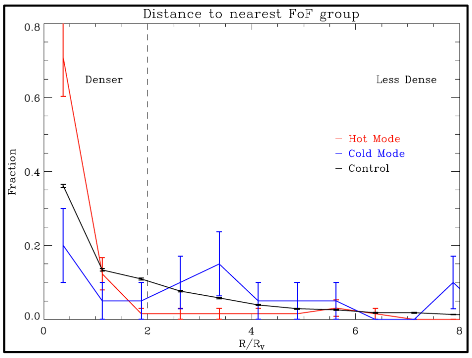


Figure 2 Distribution of distances to the closest GAMA FoF group (in units of the virial radius R_V for that group) for hot mode, cold mode and control in red, blue and black respectively.

Friends-of-Friends (FoF) group finding algorithm robustly locates groups and clusters by linking GAMA galaxies and finding common links. Figure 2 shows the comoving distances to the nearest GAMA galaxy group (Robotham et al 2011) for hot and cold mode radio galaxies, and a control non-radio sample, all within $0.25<z<0.30$ and $10 < \log(M/M_{\odot}) <11$. **Almost all of the hot mode objects in Figure 2 lie within 2 virial radius (R_V) of their nearest group (i.e. likely association to the group), with only a small fraction outside $2R_V$. The cold mode objects and the control sample both have a much lower fraction within $2R_V$, suggesting that they either lie in void environments or dwarf group systems not detected by the GAMA survey.**

D_5: 5th Nearest Neighbour density

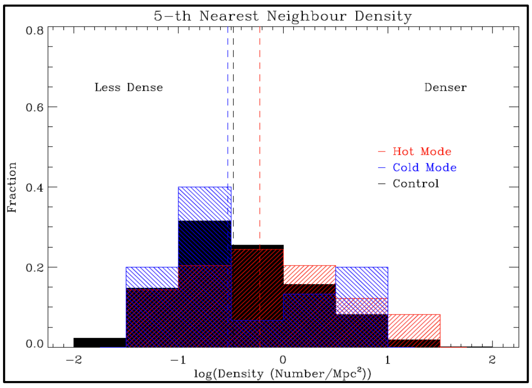


Figure 3 Distribution of the 5-th nearest neighbour density for hot mode, cold mode and control in blue, red and black respectively.

The Fifth Nearest Neighbour Density (D_5) provides a rough estimate of the projected local density out to the 5-th nearest main GAMA (Brough et al. (in prep)). Figure 3 shows the D_5 for the hot and cold mode radio galaxies, and a control non-radio sample all within $0.09<z<0.20$ and $10.7<\log(M/M_{\odot}) <11.3$. **Clearly the median surface density of the cold mode sample and the control sample are very similar, and very different from the hot mode which prefer denser environments.**

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References: Best P. et al., 2005, MNRAS, 362, 25; Bower R. et al., 2006, MNRAS, 370, 645, Brough S. et al., in prep; Croton D. et al., 2006, MNRAS, 367, 864; Hardcastle M. et al., 2007, MNRAS, 376, 1849; Robotham A. et al., 2011, arXiv, 1106.1994