Evolution of AGN in cluster environment

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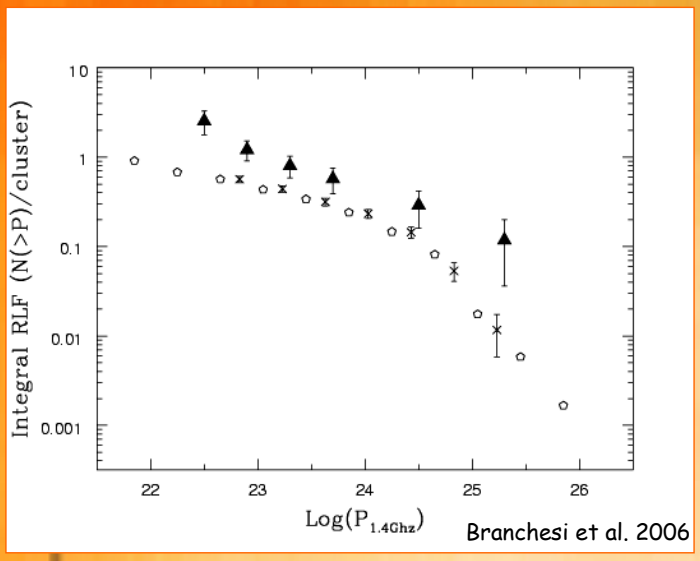
In recent years radio and X-ray studies found evidence for AGN evolution in cluster environment. The cluster AGN fraction seems to increase more rapidly with redshift than the field AGN (see Eastman et al. 2007 for the X-ray).



Branchesi et al. 2006

Fig. 1 presents the first evidence of evolution in the Radio Luminosity Function (RLF) of the distant cluster radio galaxies with respect to the local ones. The radio data come from a VLA 1.4 GHz survey (Branchesi et al. 2006) of 18 distant **(0.3<z<0.8)** clusters from the ROSAT NEP survey (Gioia et al. 2003).
The NEP RLF (solid triangles) lies above the two nearby cluster RLF (Fanti 1984, Ledlow & Owen 1996, open symbols), has a steeper slope and presents no evidence for a break at about 6×10^{24} W Hz^{-1} as observed in the local clusters RLFs.
The NEP X-ray selected sample at high-z is by selection overluminous in X-rays with respect to the local samples. However the higher amplitude of the NEP RLF could be only partially attributed to a higher central galaxy population density considering the uncertain correlation between Lx and galaxy density.

Different hypoteses that might explain the evolution are outlined below:

- The luminosity evolution of the type $(1+z)^2$ for the field radio galaxies (Sadler et al. 2007, in the luminosity range 10^{24}-10^{25} W Hz^{-1}) is not enough to explain the larger amplitude of NEP RLF;
- Since merging processes may be important in the triggering of radio emissions (Miller & Owen 2003), increased signs of activity are expected at earlier epochs when the clusters are assembled. The merging scenario could also explain the steeper slope at low luminosities as due to an enhanced star formation activity extending up to 10^{23} WHz^{-1};
- Different X-ray luminosities might be related to different shapes of the optical luminosity function of the distant cluster galaxies. A higher fraction of optically very bright galaxies could justify the apparent lack of the break, since the break seems to increase with optical luminosity.

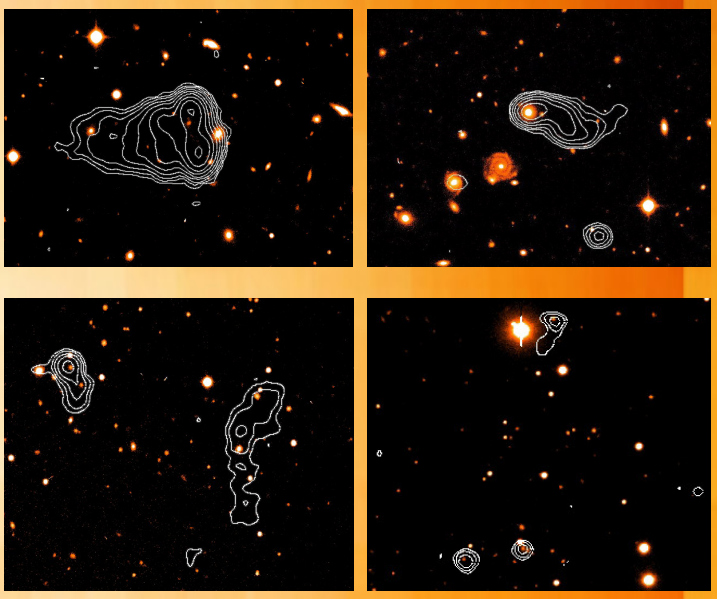


Fig. 2 above shows VLA radio contours overplotted on the optical red CFHT images.

To correctly quantify the possible selection effects and to understand the distant cluster radio galaxy evolution we are analyzing three colors CFHT images of the NEP clusters. The goal is to derive the optical luminosity function and the bivariate RLF.

The radio source surface density associated to the NEP radio galaxies is about 20 times higher than the X-ray point source surface density found within 0.5 Mpc by Branchesi et al. (2007) and Ruderman & Ebeling (2005). However the larger radio excess could be a selection effect due to the better sensitivity of the radio observations as compared to the X-ray sensitivity. Radio observations at the virial radius of a sample of high-z clusters are required to verify the possible presence of a similar radio excess as seen in X-rays by Cappelluti (2005) and Ruderman & Ebeling (2005). Combined radio, X-ray and optical data would shed light on the probability of a galaxy to become an AGN in cluster enviroment and could constrain different scenarios of AGN triggering occuring close to the cluster center and/or to the cluster-field interface.

The radio luminosity function of distant cluster radio galaxies is different in amplitude and shape with respect to the local clusters. The AGN evolution in the field is not enough to explain the evolution in cluster environment. The overdensity of AGN in high-z clusters could be an additional source of preheating of the ICM. Thus to correctly estimate the role that AGN play in thermodynamical history of clusters it is extremely useful to quantify the AGN population and its evolution.