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# A Study of the X-ray Environment of Radio Galaxies

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We are currently working on a program to use extensive X-ray and radio databases to investigate the relationship between extended radio emission and environment in clusters of galaxies. The radio galaxy morphology is determined using VLA imaging and the X-ray properties are determined from EINSTEIN IPC images.

This study is motivated by the hypothesis that the key to understanding radio galaxies lies in the local environment. This hypothesis is suggested by three observations;

1) The radio luminosity function for galaxies in the central 0.3 Abell radii is identical with functions derived for radio galaxies not selected on cluster membership.

2) The radio sources are not primarily identified with the brightest cluster member but seem to be associated with a range of galaxy luminosities.The number of sources detected as a function of richness class is proportional to Abell's number count of galaxies. The probability of radio emission from a galaxy does not depend directly on cluster galaxy density.

3) The distribution of projected distances from the cluster center is very peaked on Abell's position for the cluster. The cluster radio galaxies are more centrally condensed than either the optical or X-ray emission.

To test this hypothesis we have studied the detailed relationship between galaxy radio emission and the X-ray morphology of their parent clusters. In this pilot study we have used 35 radio sources found in 27 clusters. We have determined the position angle of the X-ray and radio emission, and X-ray and radio luminosities. The X-ray position was taken to be the position of peak flux of the subclump containing the radio galaxy. The radio position was taken to be the position of the optical galaxy.

We do not find a correlation between the X-ray and radio source position angle. This remains true when the sample is divided into subsamples according to radio morphology (wide angle tail, twin jet, narrow angle tail galaxies). We find a weak correlation between the radio source luminosity and the X-ray luminosity.

We have computed the distance from the radio galaxy position to the center of the X-ray clump. We find a mean distance from the X-ray clump center of 0.16 Mpc for the radio galaxies in this sample. The mean distance to the nearest clump of X-ray emission is typically half the distance to the optical cluster center. *We thus find strong evidence that radio galaxies are located very clcse to clumps of X-ray emission* (see Fig. 1). These subclumps are not always affiliated with the central cluster X-ray emission. This supports our hypothesis that X-ray emission may provide a key to understanding radio galaxy morphology. We find evidence that radio galaxies occur in clusters that contain prominent substructures. Radio galaxies may thus provide an added diagnostic of the cluster dynamical state.

Figure 1. X-ray and radio emission for two clusters in our sample. The contours show the X-ray emission (EINSTEIN IPC), the greyscale shows the radio emission (VLA). The upper figure shows Abell 400 and the lower figure A1569.