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Final Report

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Title: Jet-Intracluster Medium Interactions of the Head Tail Radio Galaxy 3C 129
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Performed Research:
The 50 ksec XMM observations of the galaxy cluster 3C 129 were taken as scheduled, and the data are of good quality. We analyzed the data in the following way. After standard cleaning, we flat-fielded the XMM surface brightness maps. Combining the data from the EPIC MOS and PN Camera CCDs, we performed a cross-correlation analysis of the X-ray surface brightness distribution with the 1.4 GHz VLA radio map. We found evidence for cavities in the X-ray emitting Intra-Cluster Medium (ICM) associated with the radio tail of the head-tail radio galaxy 3C 129. This discovery is very interesting as it excludes the presence of a large fraction of thermal plasma in the radio tail. Together with the observation of an apparent pressure mismatch between the radio plasma and the ICM, and an upper limit on the magnetic field inside the radio tail (from the radio spectral indices map) the observation implies that the tail pressure is dominated either by low-energy electrons/positrons, or, by relativistic protons. Furthermore, we studied the energy spectrum of an X-ray "hot-spot" associated with the head of the radio galaxy 3C 129. It seems likely that the X-ray hot-spot originates from shocked gas in front of the radio galaxy.

The analysis turned out to be much more difficult than anticipated. The main reason is the lack of a comprehensive, publicly available background model that is key for the analysis of extended sources. Small groups like our do not have the man-power to come up with a background model themselves. We used the model from Read & Ponman (A&A 409, 395, 2003). However, the background subtracted X-ray surface brightness maps show a bright ring in the outer 20% of the camera. We tried to get rid of this ring and contacted the XMM helpdesk and Read & Ponman, the authors of the background paper. However, up to this day, we did not entirely succeed to remove the brightness enhancement at the outer parts of the camera. Unfortunately, our results are somewhat sensitive to the uncertainty, as the radio galaxy 3C 129 is very large and occupies a rather large fraction of the XMM field of view. We are now working on a paper describing the results. The paper will include a detailed discussion of the uncertainties associated with the non-perfect background subtraction.

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Conference Contributions:

- "Chandra and XMM-Newton Observations of the Galaxy Cluster 3C 129 and its Head-Tail Radio Galaxy 3C 129", Perkins, J. S.; Krawczynski, H.; Harris, D., 2004, American Astronomical Society, HEAD meeting #8, #36.02

Publications:

- "XMM-Newton Observations of the Galaxy Cluster 3C 129 and its Head-Tail Radio Galaxy 3C 129", Perkins, J. S.; Krawczynski, H., ApJ, in preparation. Anticipated submission date: Spring 2006.