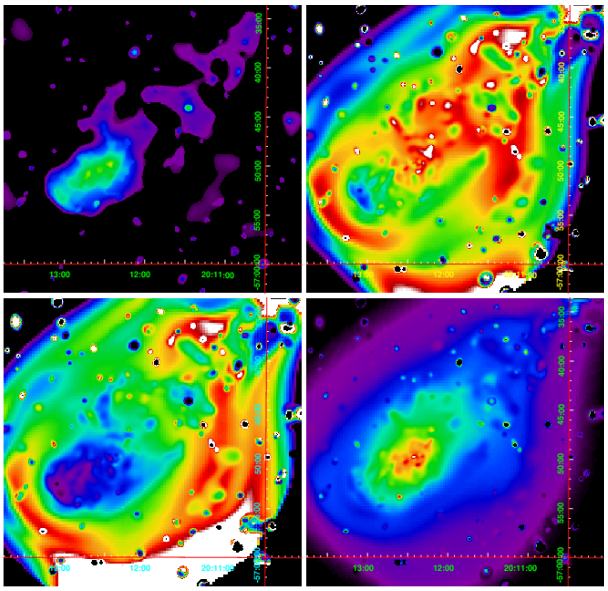
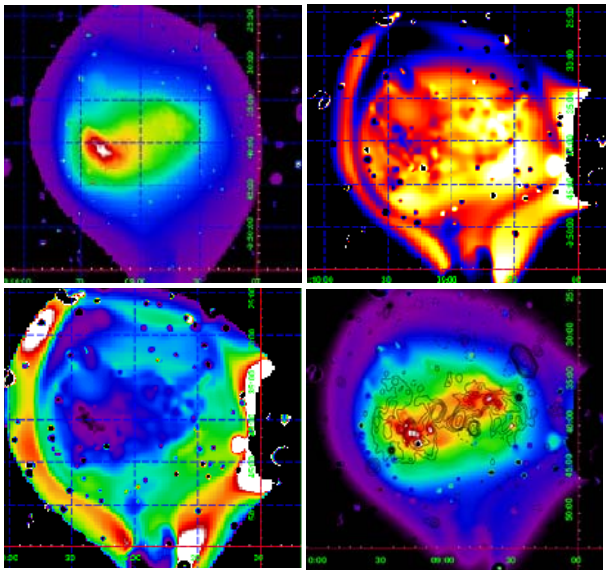
EPIC-XMM-Newton Observations of two nearby Galaxy Clusters

We observed the two nearby galaxy clusters A3667 and A754 with the XMM-Newton. To cover the large angular extent of the clusters, mosaics involving 4 to 6 observing fields have been performed. Images were produced in the energy bands from 0.5 to 2.0 keV and 2.0 to 7.0 keV. We used a wavelet-filtering method to show variations in the surface brightness distribution down to a 5-sigma significance. With those images we produced hardness ratio maps. Using the soft surface brightness maps and the hardness ratio maps, we produced pressure and entropy maps.



A3667: In the cluster A3667, Chandra detected a cold front with a very steep discontinuity in the X-ray surface brightness across it (Vikhlinin et al. 2001 and Mazzotta et al. 2002). With the EPIC data we clearly detect the very irregular shape of the cluster's surface brightness distribution and also the very steep drop around the cold front (see top-left figure, in which we show only the smallest wavelet scales). In addition to the three peaks in the center of the cluster we find striking evidence of turbulence down-stream of the cold front especially towards the north (confirming the findings of Chandra) and also towards the NW. This turbulence is even more evident in the hardness-ratio map (see top-right figure). This map shows hot gas flowing around the cold front probably developing Kelvin-Helmholtz instabilities. We observe structure in the cold front, resembling a mushroom head and stem. Such structure was found in simulations of cluster merger by Heinz et al. (2003). The intensity maximum is coincident with the lowest entropy (see bottom-left figure). We observe tails of low-entropy gas coming off the concave surface of the cold front. The pressure map (bottom-right figure) confirms that the cold front is not a shock front, there is no factor 4 increase of pressure accross the front. The pressure peak is not coincident with the cold front, rather with the brightest cluster galaxy. There is elongation in the pressure and in the entropy towards the north-west from the A3667 center.



A754: The Abell cluster A754 is an example of a cluster experiencing a major merger. This was found in the observations made with ROSAT, which resulted in the first temperature map of A754 (Henry & Briel 1995) and also in ASCA data (Henriksen & Markevitch 1996). In the EPIC image, we clearly detect the very irregular shape of the cluster's surface brightness distribution, especially the bright elongated bar with the maximum in the brightness (see top-left figure). Moreover, the surface brightness west of the bar also shows turbulent-like substructure. The hardness ratio map (see top-right figure) confirms the hotter region west of the bar (also seen in the ROSAT and ASCA maps) and it shows additional temperature variations across the face of the cluster. It shows that only the northern part of the bar is at a low temperature, found also recently by Chandra (Markevitch et al. 2000). In addition, we find a hot outer rim seen in spectroscopic fits of the outer region. Different from earler findings, we interpret our new observations as indicating the merging subcluster came from the north-west and has passed through the main cluster core. As expected, the peak of the pressure (bottom-right figure) is coincident with the peak of the surface brightness. We also find enhanced pressure in the NW region away from the highest X-ray intensity. These two high pressure regions seem to be associated with the diffuse radio emission, seen in observations at 20cm (Bacchi et al. 2003, contour lines in pressure map, bottom-right figure).

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