Temperature maps of Clusters from ROSAT PSPC observations

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The ROSAT observatory with its high spatial resolution telescope in combination with the position sensitive proportional counter (PSPC) is an ideal instrument to study extended sources like clusters of galaxies. Very deep ROSAT observations of galaxy clusters reveal substructure on different levels: structure associated with bright galaxies, faint galaxies, or structure consistent with the merger of groups with the main cluster. As an example of a deep PSPC observation we show in the left figure the surface brightness of Coma (from White, Briel and Henry, 1993). An other indication of substructure is the deviation of the temperature of the intra-cluster gas from isothermality. Although the ROSAT PSPC only has a moderate spectral resolution and a small photon energy band pass, observations with a resulting high counting-statistic enabled us to determine two-dimensional temperature distributions of several galaxy clusters. So far we have analysed pointed PSPC observations of 5 X-ray bright Abell clusters: A2256, A754, A2142, A1795 and A1656 (Coma).

These clusters are good representatives of the different evolution stages that probably all clusters experience as they grow from mergers of smaller groups. We might have caught A2256 at an early stage and A745 at a somewhat later stage of merging with a group. Both clusters show considerable variation in their temperature maps. Coma seems to have experienced a complete crossing of a group, which is now visible outside the main cluster. The temperature map of Coma, which is shown in the right figure, is confirming this scenario. A2142 and even more A1795 are in very late stages. Both show significant cooler centers, coincident with the brightest, sharply peaked X-ray emission, the typical indication of cooling flow clusters. A1795, the cluster with one of the the strongest cooling flows, is essentially isothermal outside the flow region.

References:

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