Dark matter and gas entropy in poor clusters

We present an XMM-Newton analysis of the total mass and entropy profiles of a small sample of poor galaxy clusters, and compare to those of one hot cluster. The scaled mass profiles are found to be remarkably similar, and the dispersion in their NFW parameterisations are found to be consistent with the results from numerical simulations. The entropy profiles are similar beyond ~0.1 r200, but require non-standard scaling with temperature, indicating the strong effect of non-gravitational gas physics on the X-ray properites.

The distribution of mass M(r) and the entropy S(r) reflect respectively the physics of the gravitational collapse and the thermodynamic history of the gas. We calculate mass profiles from the spatially resolved gas temperature and density information assuming spherical symmetry and hydrostatic equilibrium. We then fit these profiles with the NFW mass model. We calculate the entropy from the same density and temperature profiles using the equation S = kT ne-2/3. The key characteristics of the clusters under consideration are summarised in Table 1. Note that four of these clusters have very similar temperatures.

Table 1. Cluster sample.

Name	z	kT
A1983	0.044	2.20
A2717	0.050	2.53
MKW9	0.038	2.58
A1991	0.056	2.65
A1413	0.141	6.51

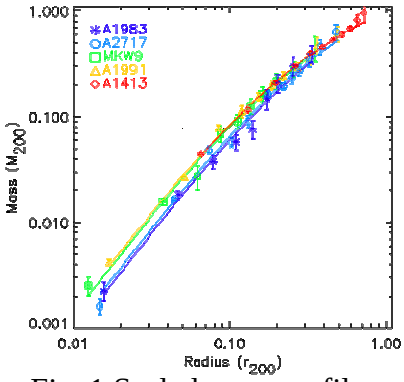

Fig. 1 Scaled mass profiles.

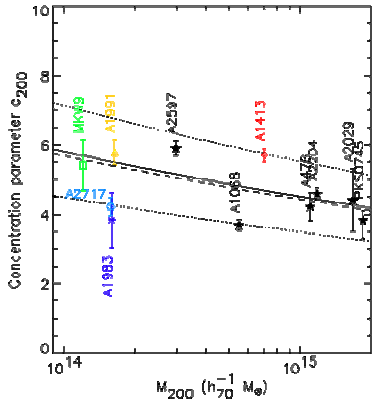

Fig. 2 NFW concentration parameter vs mass

Results

Thescaled mass profiles show ~20 per cent scatter. The concentration parameters are consistent with the expected dpendence with mass. The scatter in the entropy profiles is reducd by ~40 per cent, to ~22 per cent, if they are scaled as $S \propto T^{0.65.}$ Note the remarkable difference in entropy properties at small radius.

The dark matter collapse seems well understood, but non-gravitational processes have a marked effect on the gas physics. More details in Pratt & Arnaud (2004).

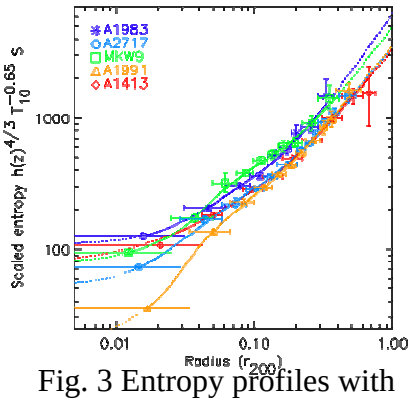

Fig. 3 Entropy profiles with $S \propto T^{0.65}$ scaling

References:
• Pratt & Arnaud, 2004, astroph/0406366

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