X-ray Clusters

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Scientific Objective

Physics of the Intra Cluster Medium (ICM)

1. Analysis & interpretation of X-ray data from operating experiments:
    - detailed analysis of individual objects
    - analysis of samples
2. Design of future X-ray missions

Systematic search for Cold Fronts

Cold fronts are contact discontinuities discovered with Chandra (Markevitch et al. 2000). Have been observed both in more relaxed "Cool Core" and interacting clusters.

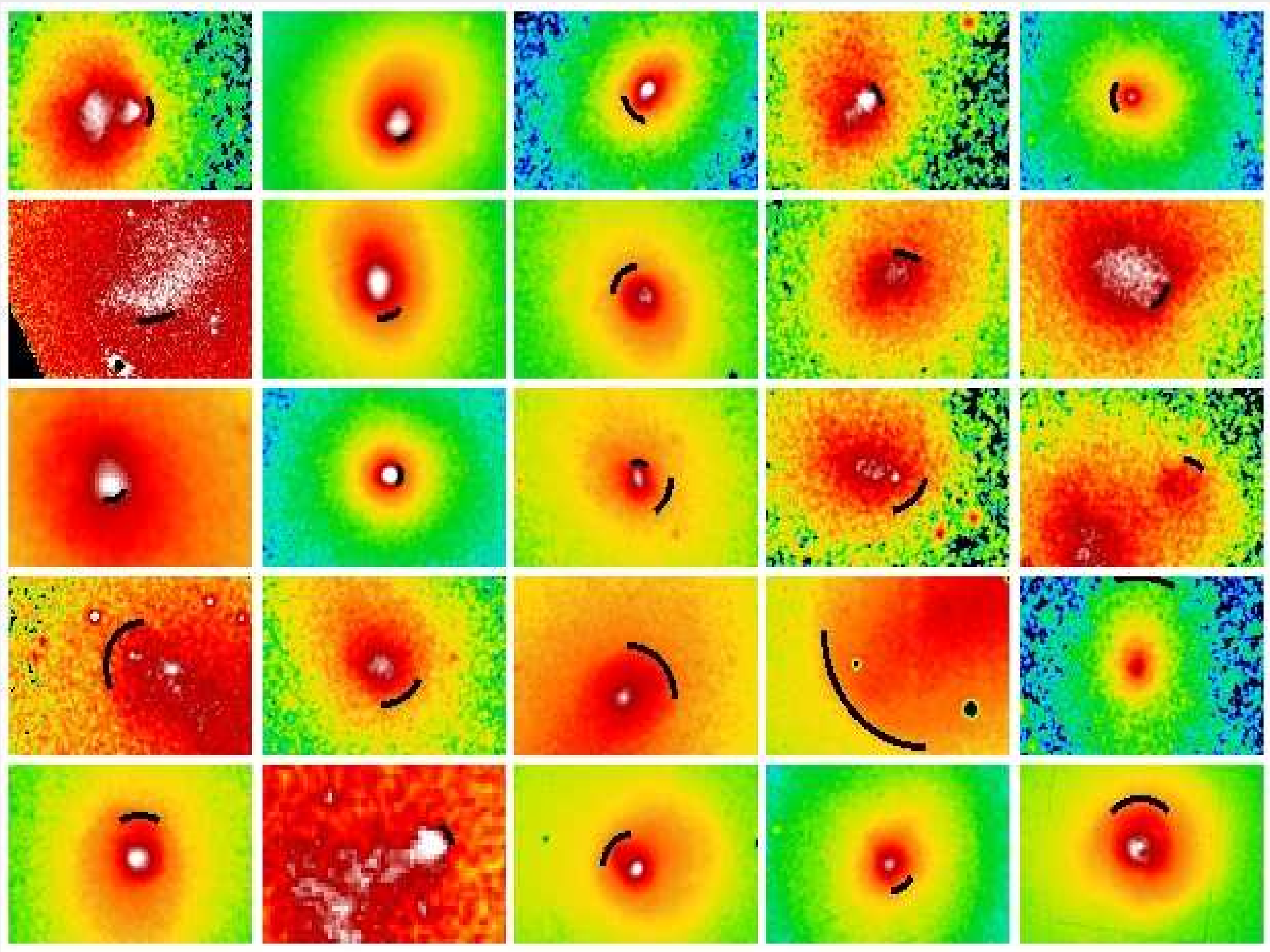
Ghizzardi et al. (2007),(2008)

Total of 84 objects

46 from local flux limited sample

38 intermediate redshift sample

Systematic search for Cold Fronts



CF are frequent, almost all nearby objects have 1 or more.
Typical velocities are in the order of 1/3 to 1/2 of c_s.
Gas motions with kinetic energy comparable to thermal energy.

A3558 A peculiar system

(Rossetti et al. 2007)

- SB peak at the center *
- Peak in metal abundance profiles
- Temperature drop at the center *
- Central BCG

- Deviations from spherical simmetry in thermo maps
- Anomalous SE regions: low temperature, low entropy tail, high pressure

* "Moderate", the temperature gradient and the SB excess are lower than in Cool core cluster

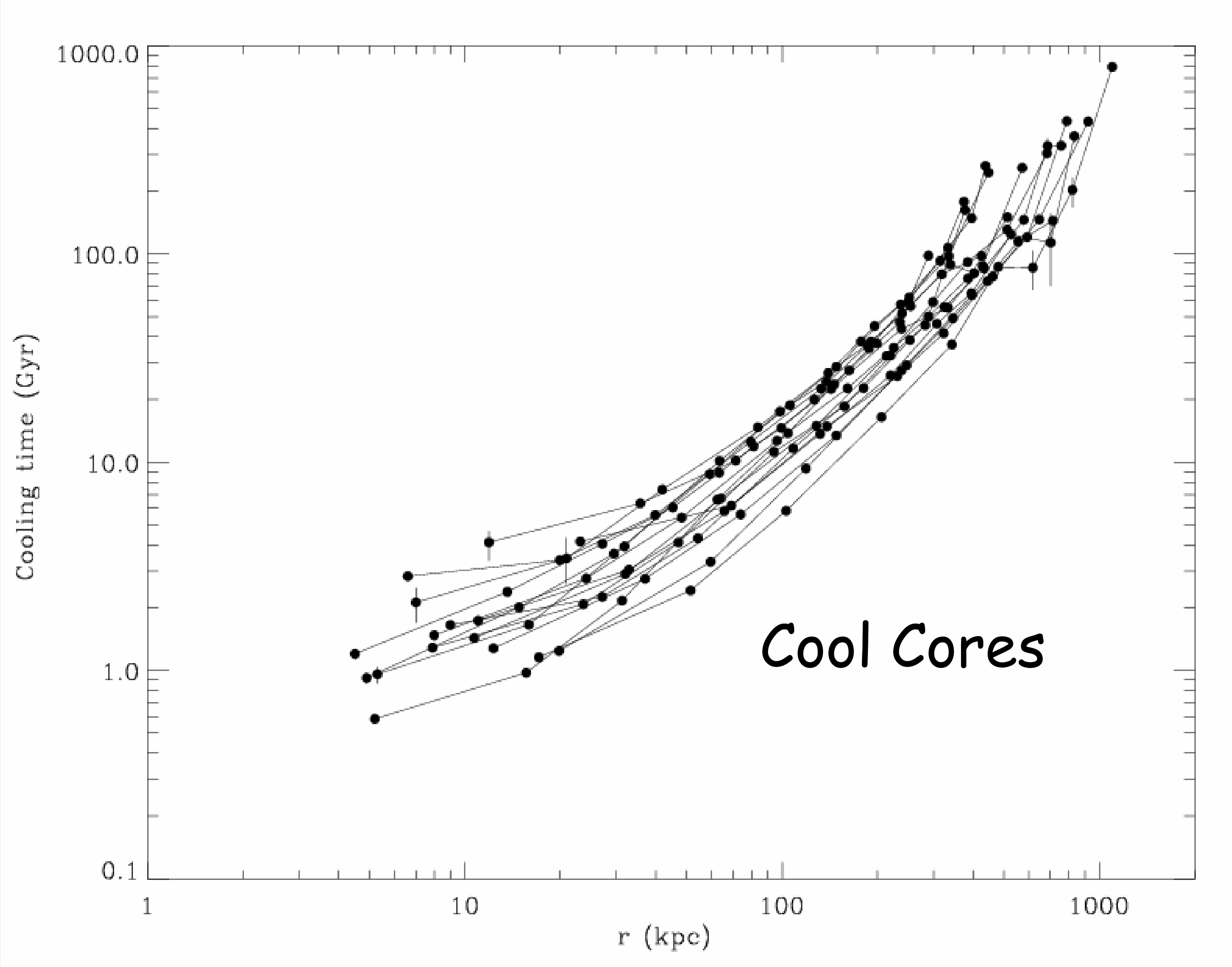
From our data we can exclude a recent major merger and a full blown cool core

A3558 is an intermediate system

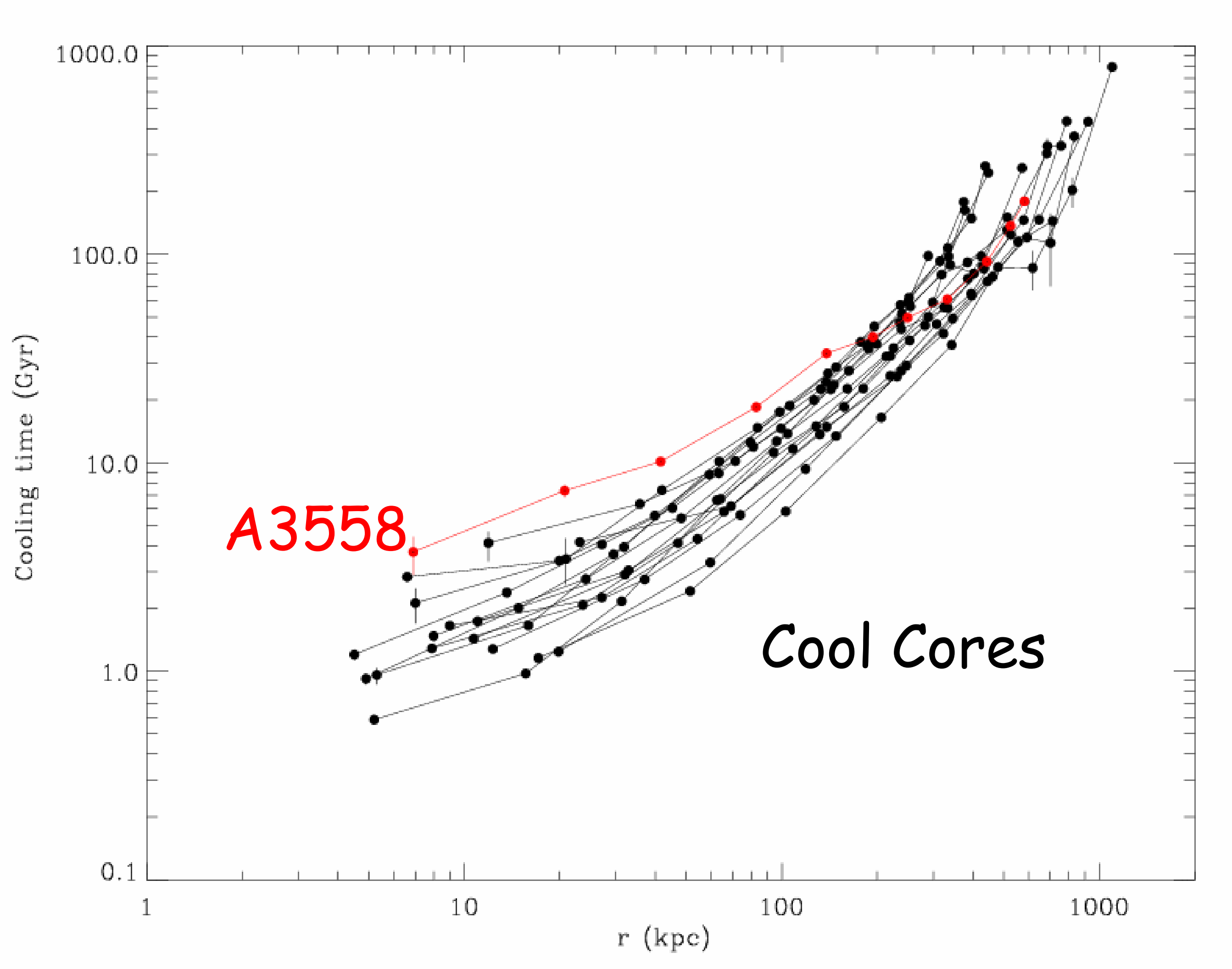
Cooling time profiles

One of the quantities used to characterize clusters is the cooling time profile

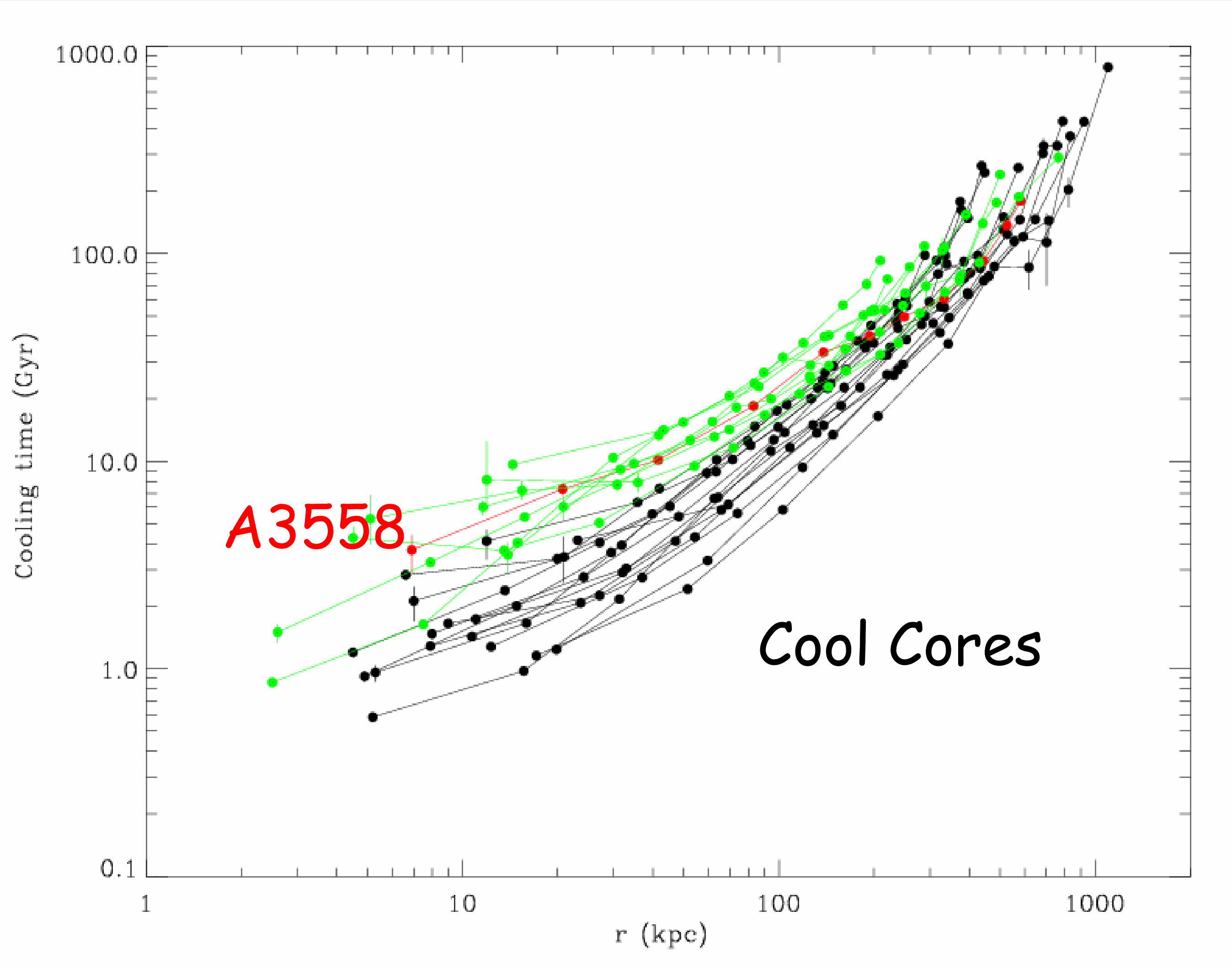
Cooling time profiles



Cooling time profiles



Cooling time profiles



Rossetti et al. in prep.

T profiles for mid z sample

Outer regions are important

1) This is where clusters form by accretion
2) Easier to compare simulations with observations, feedback effects are less important

Try measure properties as far as possible with current instrumentation

Specific to our approach:

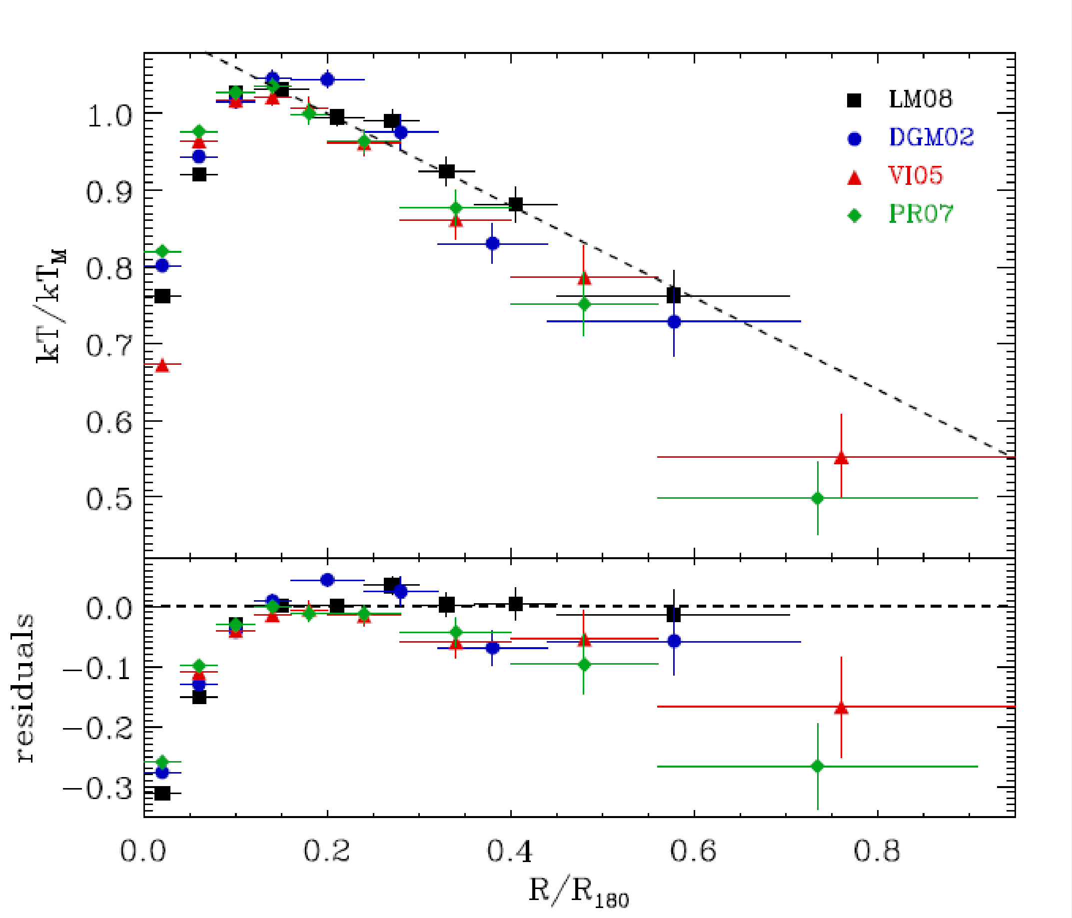
New analysis methods

bkg modelling rather than subtraction

ad-hoc statistical tools (Leccardi & Molendi 2007)

extensive simulations to asses systematic effects

Mean Temperature Profile



Leccardi & Molendi (2007),(2008)

Profile consitent with BeppoSAX (De Grandi & Molendi 2001) Chandra (Vikhlinin et al 2006) and revised XMM measurements (Pratt 2007)

Not just a confirmation

For the first time we believe we know where the systematics come from and how large they are.

This not only allows us to have confidence in our results but also to look forward to ambitious new measurements.

In XMM AO7 we proposed a long observation on A754 to look for a shock

We were awarded 230 ks (Pi A. Leccardi), one of the longest exposure times for an individual cluster

The Future

Making best possible use of Chandra or XMM data we cannot go further than $\sim\frac{1}{2}\ r_{180}$

To go beyond we need new missions

Observational Requirements

Detect and characterize emission from regions where SB is up to ~100x smaller than what is achievable today

Instrumental Requirements

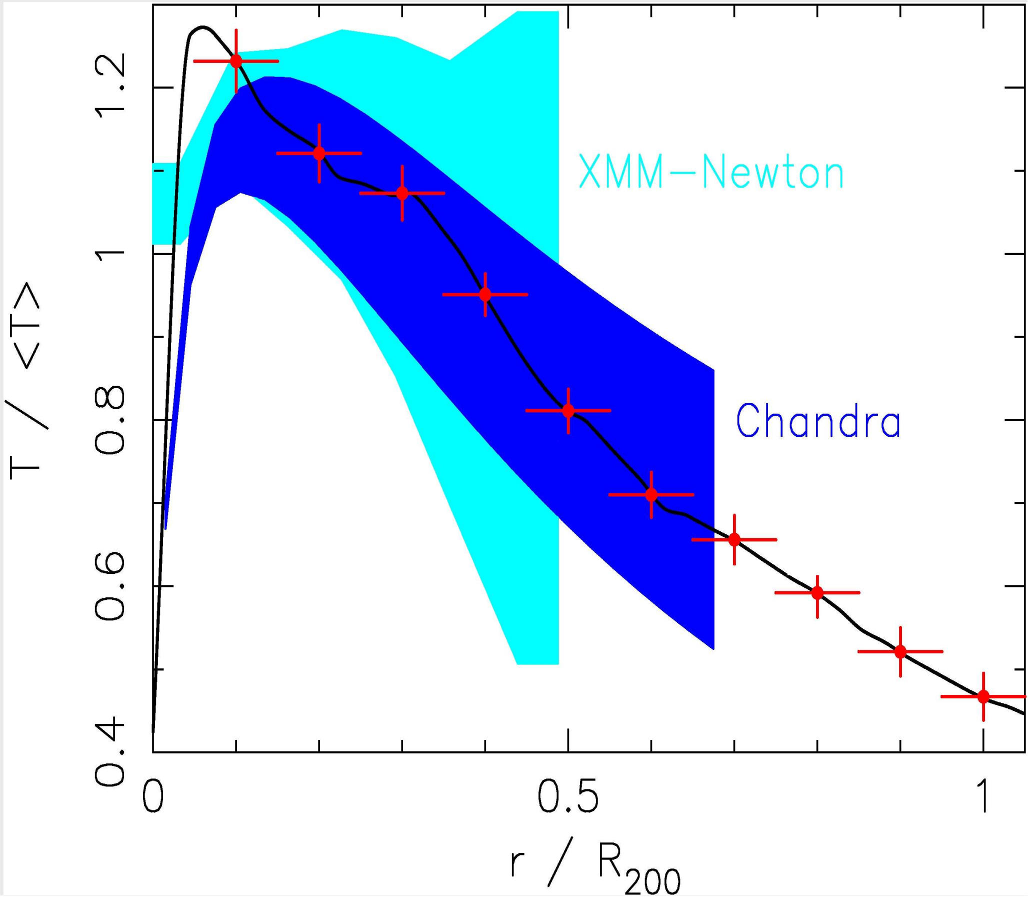
1. Large Grasp $A_{Eff}*\Omega \sim 700$ cm^2 deg^2
2. Adequate ang.res. ~15″ HPD across FOV
3. Low, well behaved background

SB, T & Z with WFI

Simulations show that:

with an texp=1 Ms and random fluctuations of 5% on bkg components, we reach typical uncertain. (90% c.l.) of <10% on K & T.

Constraints on Z, somewhat weaker 20-40%, based on Fe-L blend



EDGE and XENIA

- A mission designed along these lines was proposed to ESA for CV and it was turned down.
- A very similar mission has now been proposed to NASA.

Our work has clearly shown how instrumentation to study cluster outskirts should be designed.