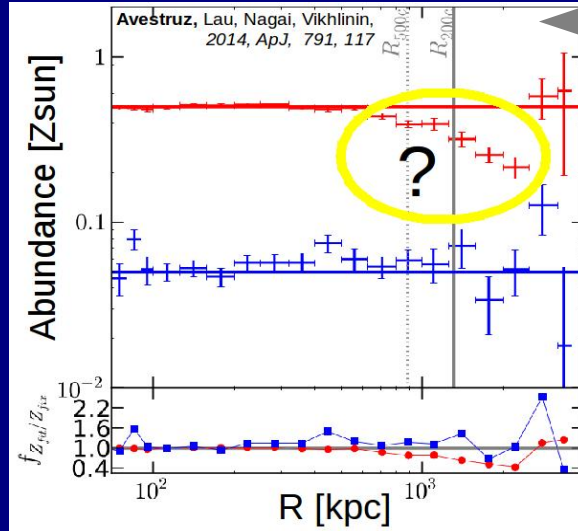


Modeling Galaxy Cluster Outskirts with Cosmological Simulations

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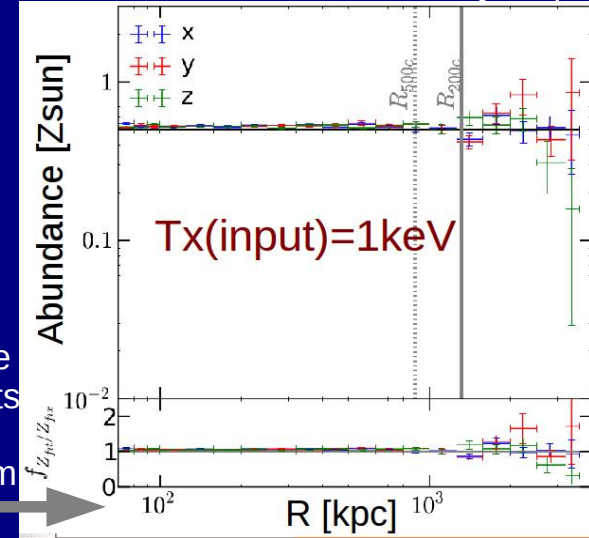
Abstract: The observational study of galaxy cluster outskirts is a new territory to probe the thermodynamic and chemical structure of the X-ray emitting intracluster medium (ICM). Motivated by recent ultra-deep Chandra observations of Abell 133, we perform a similar X-ray analysis on clusters simulated using the Adaptive Refinement Tree code. We use a sample of hydrodynamical cosmologically simulated galaxy clusters to assess the effects of inhomogeneities and non-equilibrium physics on X-ray observations of ICM properties in cluster outskirts. We show (1) a multi-temperature medium can systematically bias measured metal abundance measurements low, and (2) non-equilibrium electrons can bias X-ray temperature measurements low.

Biased Metal Abundance in Cluster Outskirts

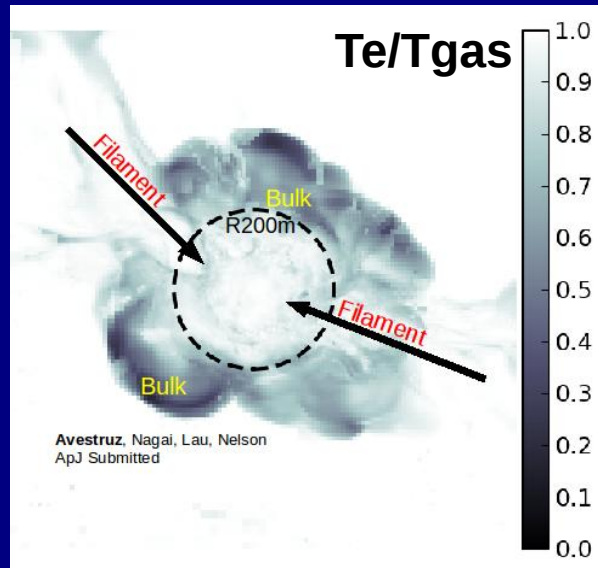


The bias is due to a wider temperature distribution in the outskirts. Spectral fits assume a single temperature. The bias disappears in measurements from a map generated with a constant T_x .

In a numerical experiment, we test X-ray measurements of metal abundance for $Z=0.05$ and $Z=0.5$ input metallicity. We find a systematic bias measured from the $Z=0.5$ X-ray map.



Non-Equilibrium Electron Temperatures



X-ray measurements are sensitive to the electron temperature. We show the bias in X-ray temperature for two sample clusters.

The accretion shock generates non-equilibrium electrons, which can result in electron temperatures colder than the mean gas temperature.

