The Santa Fe Light Cone Simulation Project: Predictions for SZ Observations of the WHIM and Galaxy Clusters
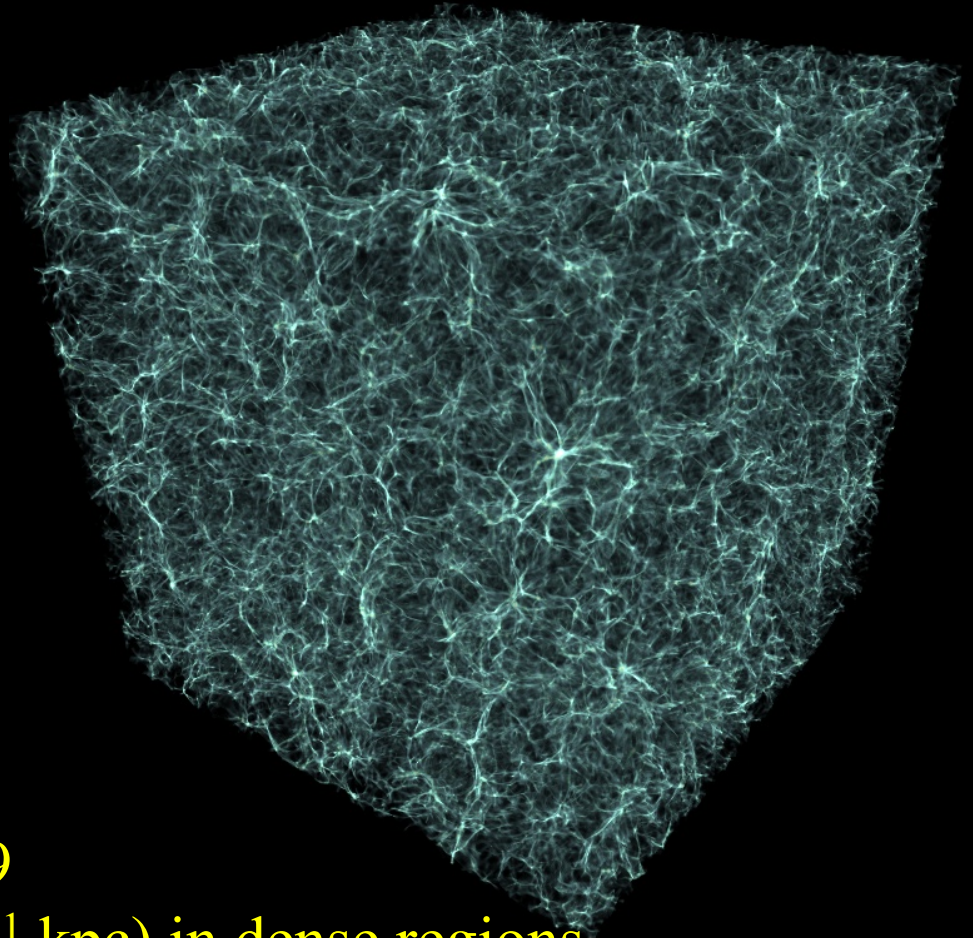
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Honolulu, HI

Adaptive Mesh Refinement (AMR) Light Cone Simulations (N-body + Hydro)

Enzo (O'Shea et al. 2005, http://cosmos.ucsd.edu/enzo)

- ΛCDM Ω_m=0.3, Ω_Λ=0.7, σ_8=0.9
- AMR gives high resolution (8 h^{-1} kpc) in dense regions
- 512 h^{-1} Mpc on a side, use 7 levels of refinement
- 100 square degrees; 27 z-intervals tiled from z = 3 to 0.1
- DM mass = $7.3 \times 10^{10} M_{solar}$, baryon mass = $1.1 \times 10^{10} M_{solar}$
- Initial run is adiabatic physics only

Goals for the Santa Fe Light Cone

- Complementary tool with new SZ telescopes to enable precision cosmology.

- Investigate effects of intrinsic cluster to cluster variations, geometric projections, baryonic physics, variation in cosmological parameters, and instrumental limitations on survey completeness & angular statistics.
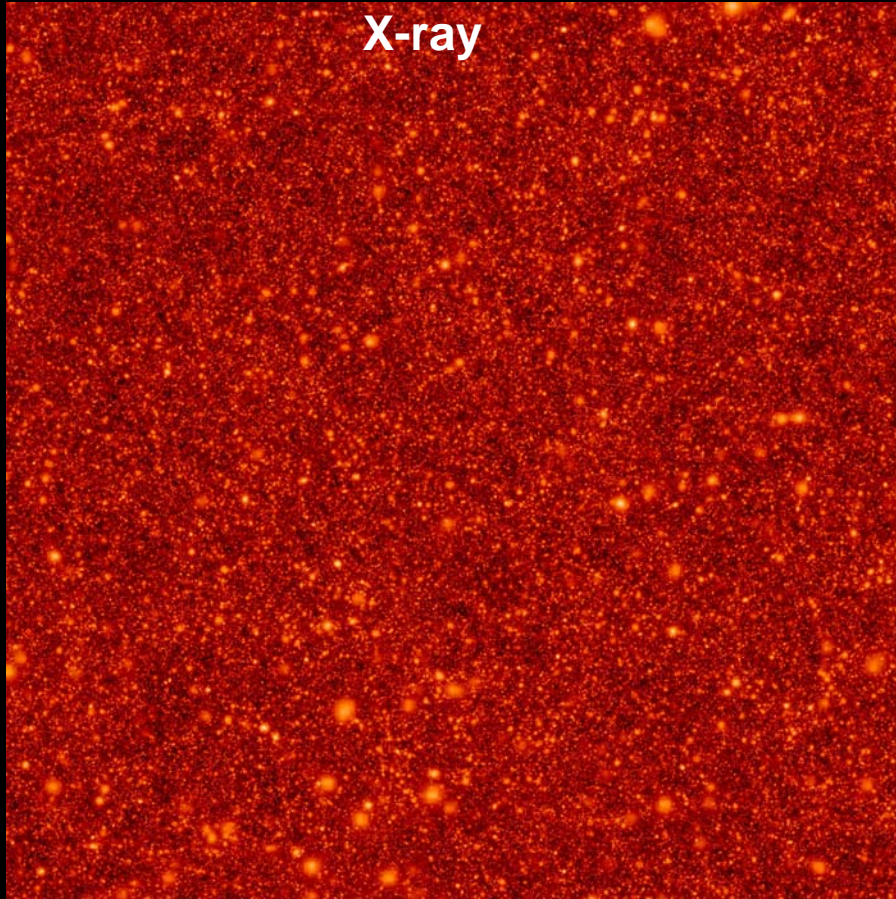

South Pole Telescope (SPT)
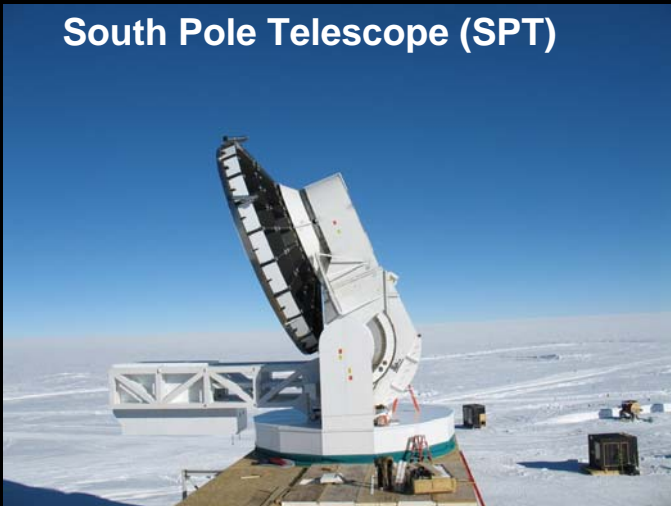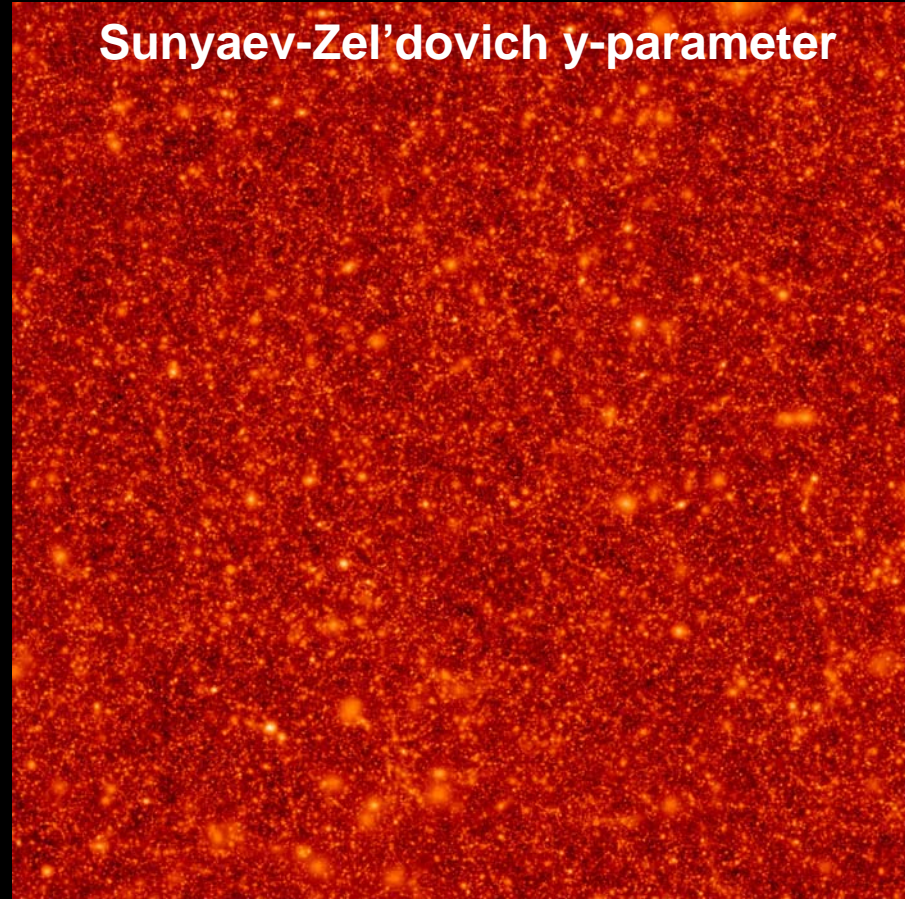

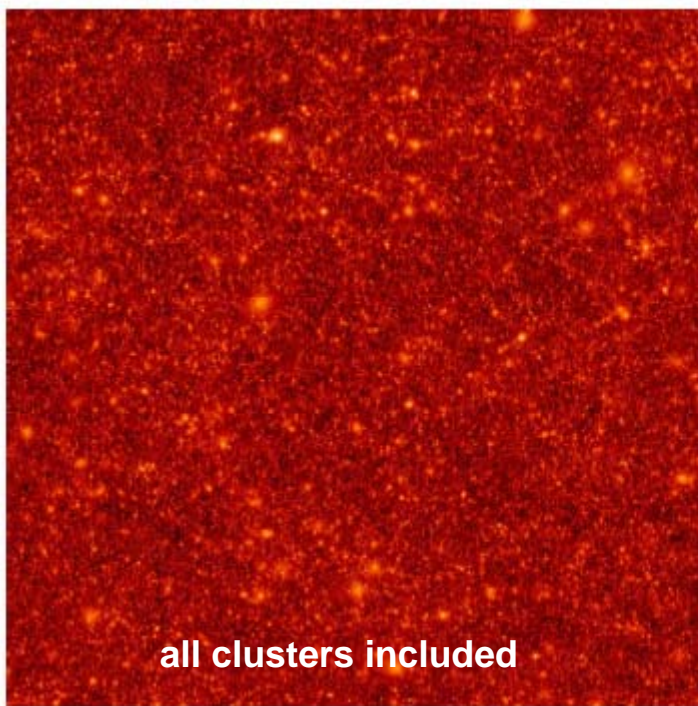Atacama Pathfinder Experiment (APEX)
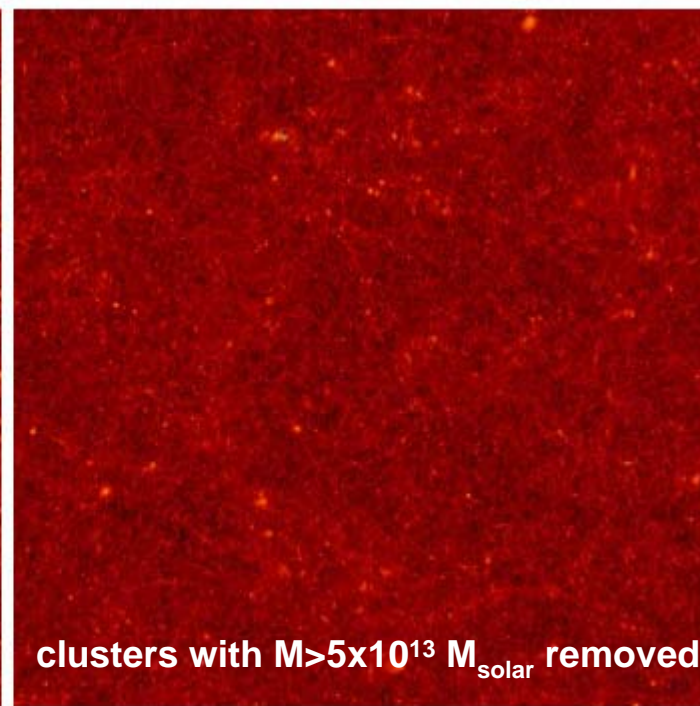
Sky Surveys

X-ray
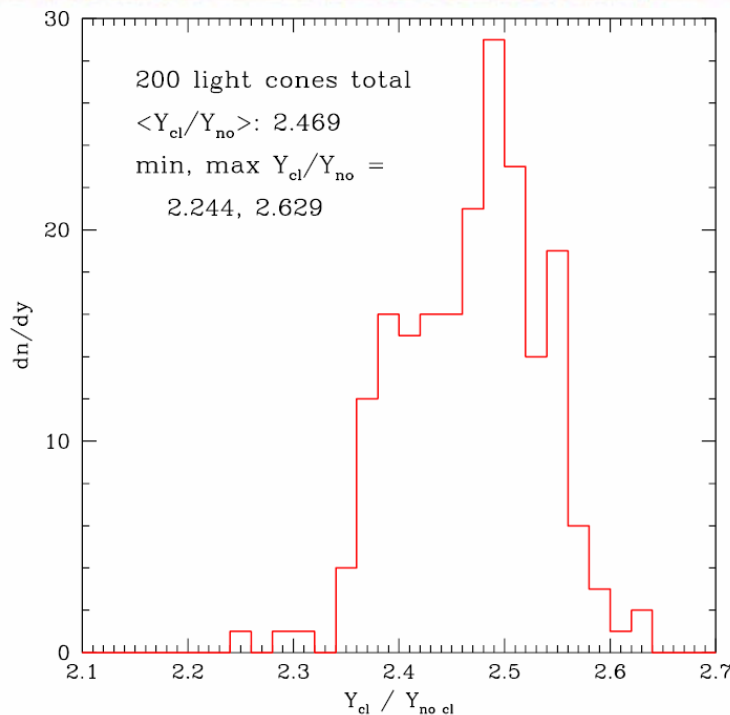
Sunyaev-Zel'dovich y-parameter

- **X-ray and SZE synthetic surveys**
- **5000+ Clusters above $1 \times 10^{14} M_{solar}$ in field out to z=3**
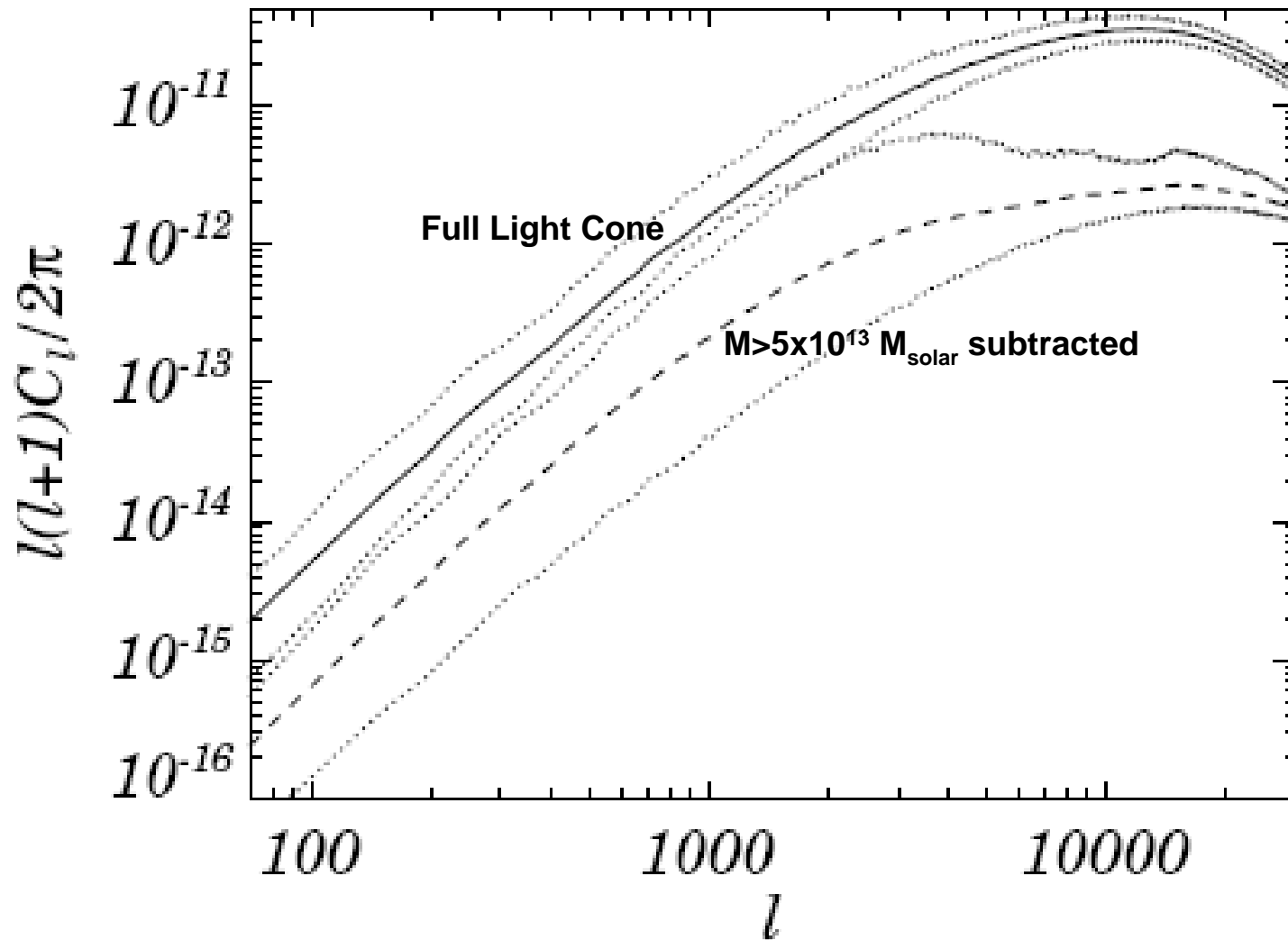- **2048x2048, 10x10 degrees, 17.6" / pixel**

all clusters included

clusters with M>5x10¹³ M$_{solar}$ removed

200 light cones total

$\langle Y_{cl}/Y_{no} \rangle$: 2.469

min, max Y_{cl}/Y_{no} = 2.244, 2.629

Histogram of ratio of total flux in SZ y-parameter from left over right images.

=>2/3^{rds} of flux from clusters with M>5x10^{13} M$_{solar}$ and 1/3rd from WHIM and poor groups.

Angular power spectrum from SZ image. Angular power from
cluster-subtracted field is nearly 10 times less than for full
Light Cone.
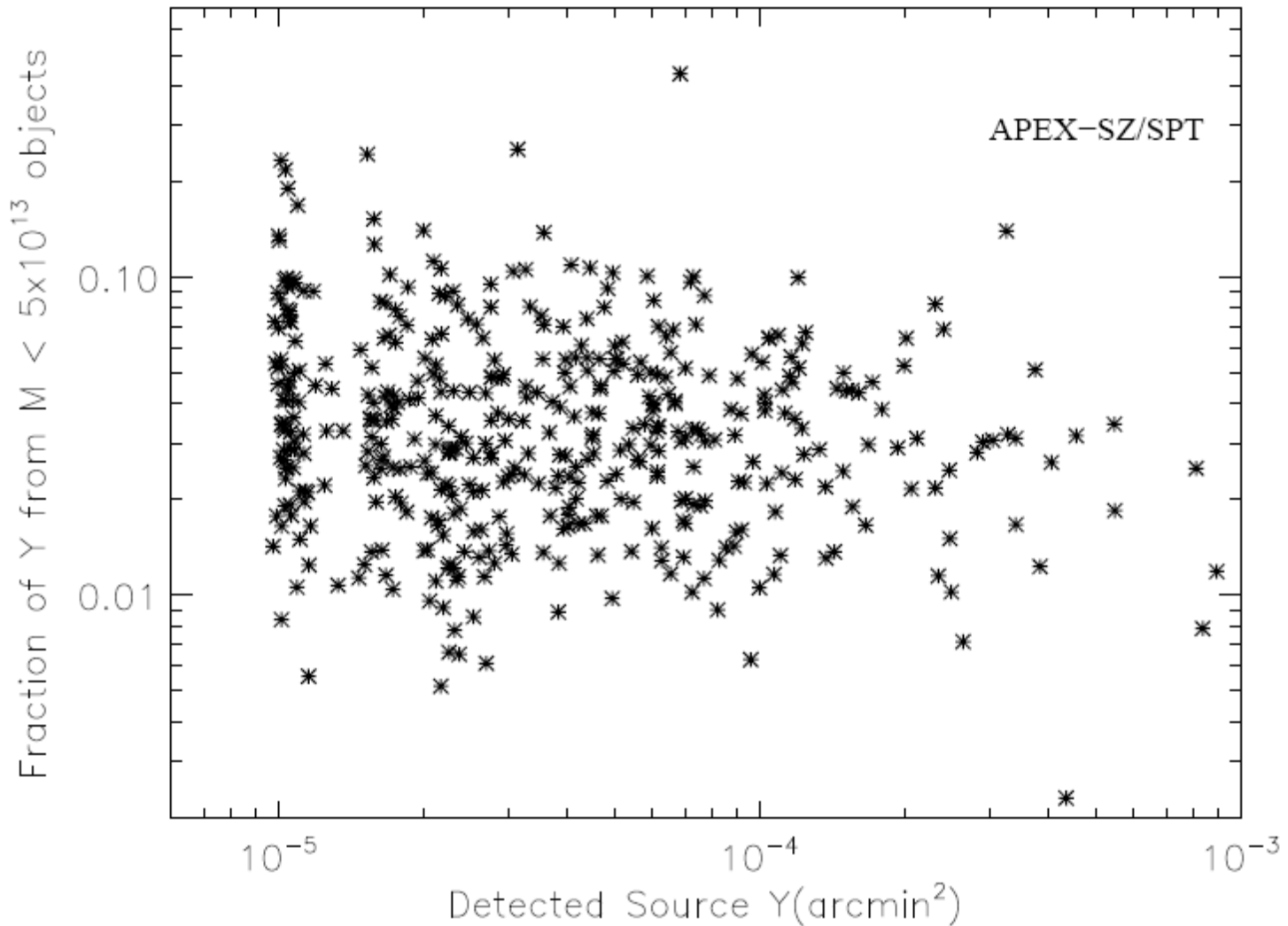
Unresolved halos and unbound gas (WHIM) create positive bias for flux measurements of individual clusters. For APEX/SPT, this extra flux is expected to be 1.6-5.9% (1-sigma). Will add scatter and bias to Y-M relationship.

Summary

- We have introduced a new generation of large-area, large volume synthetic cluster survey tools to use in conjunction with new SZ telescopic observations.

- There is a clear contribution to the SZ flux in surveys from gas outside clusters (from groups and WHIM).

- This flux adds both bias and scatter to the SZ y-parameter values in upcoming surveys.