

RECONCILING *PLANCK* CLUSTER COUNTS AND COSMOLOGY?

Chandra/XMM instrumental calibration
and hydrostatic mass bias

Holger Israel

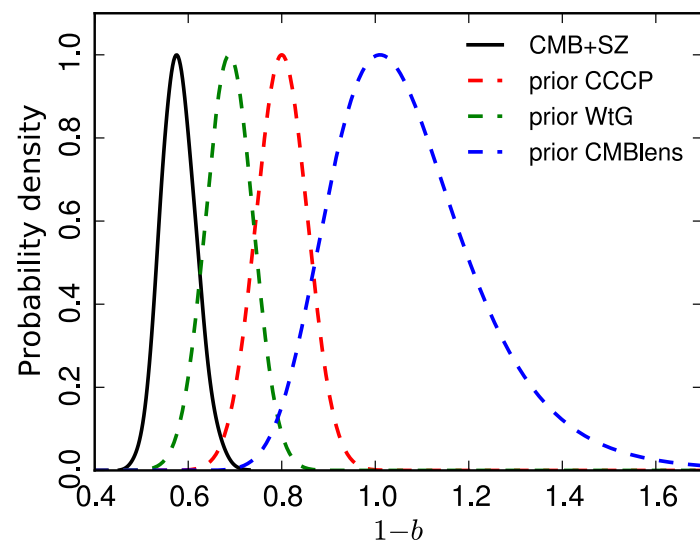
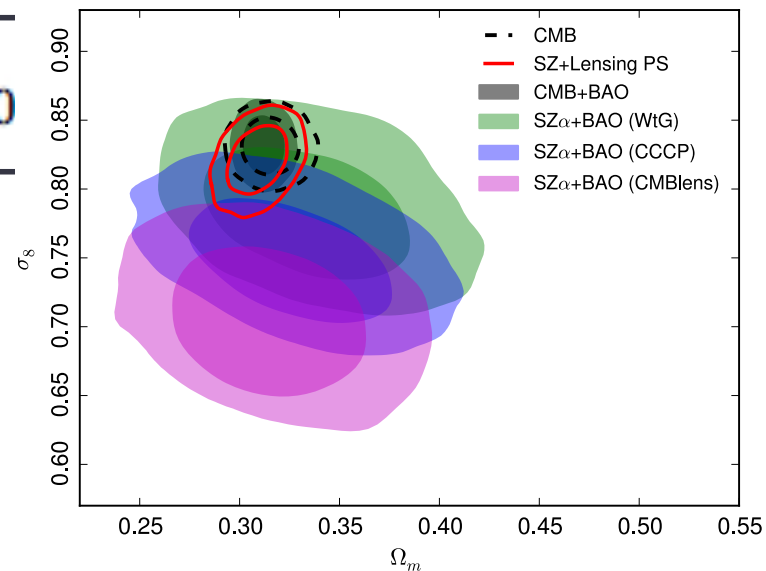
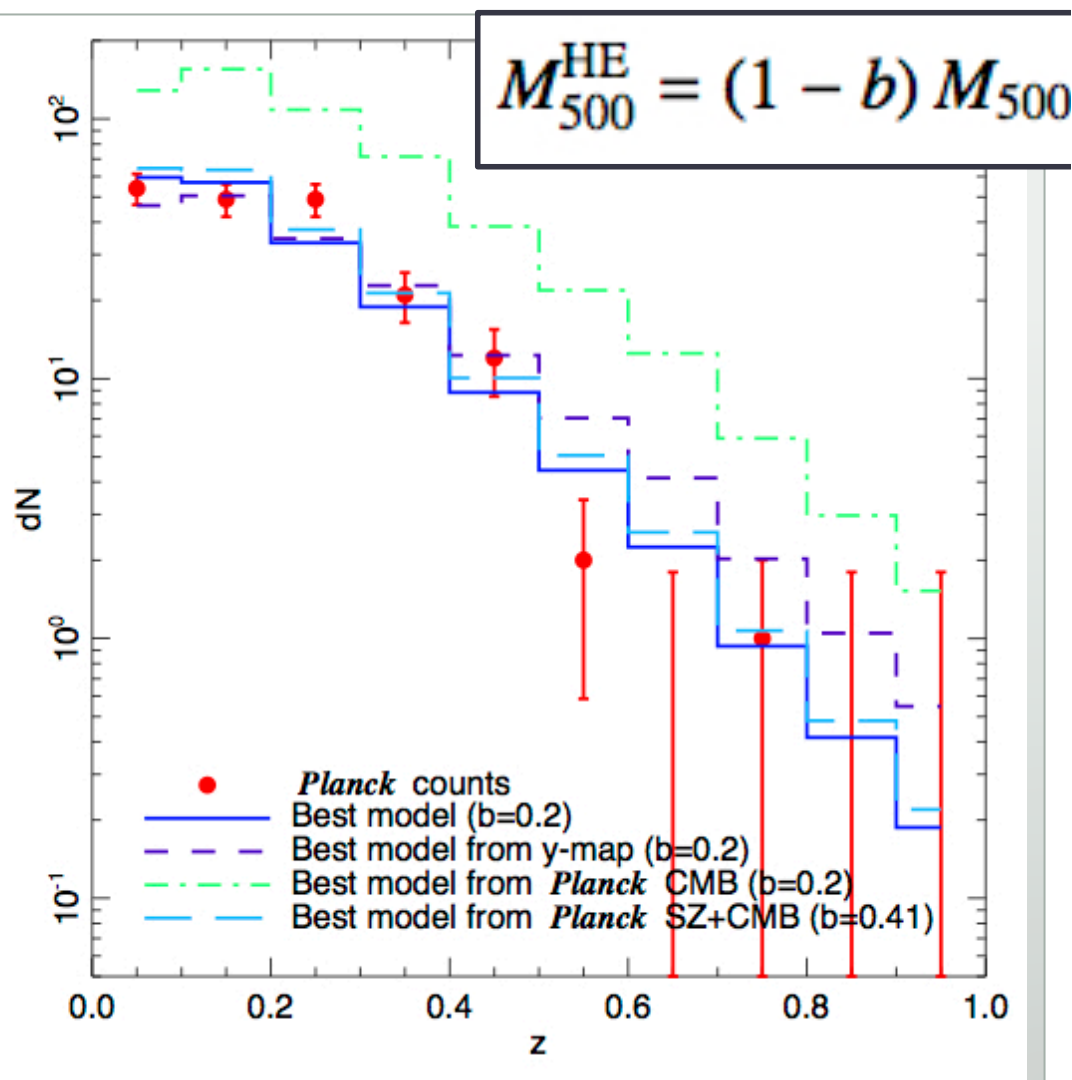
Durham University

Birmingham Extragalactic Workshop

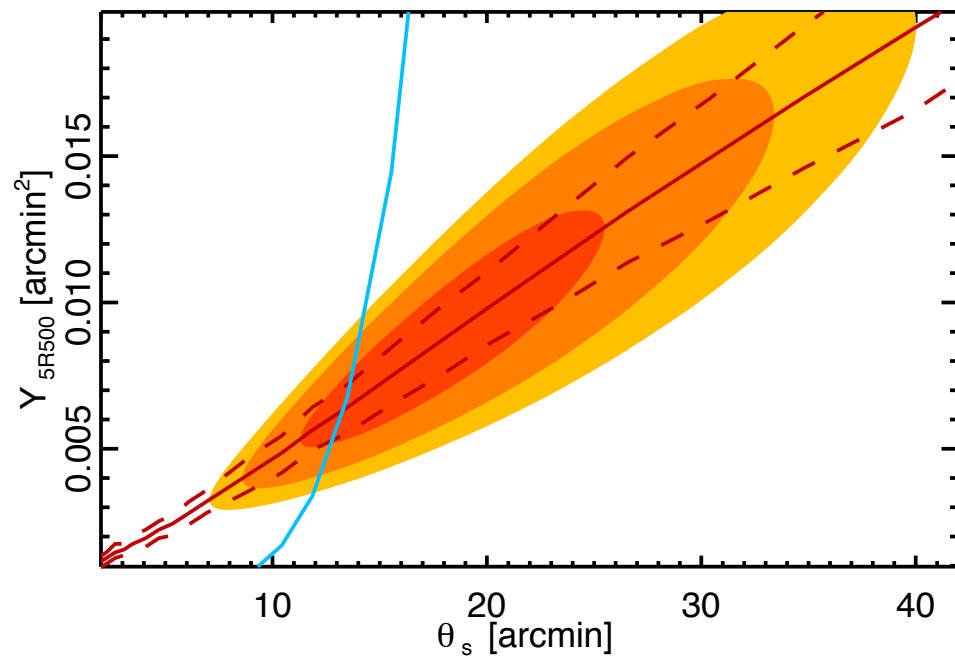
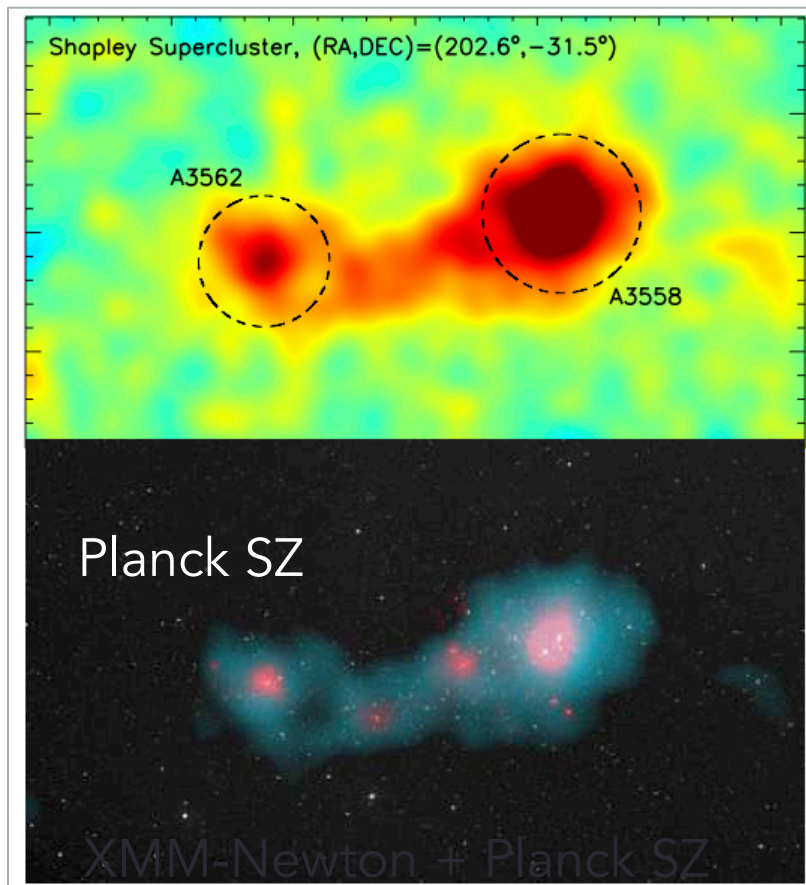
2015-02-17

HI, G. Schellenberger, J. Nevalainen, R. Massey, T. Reiprich:
MNRAS 448, 814 (2015); arXiv/1408.4578v2

The *Planck* cluster counts – CMB discrepancy



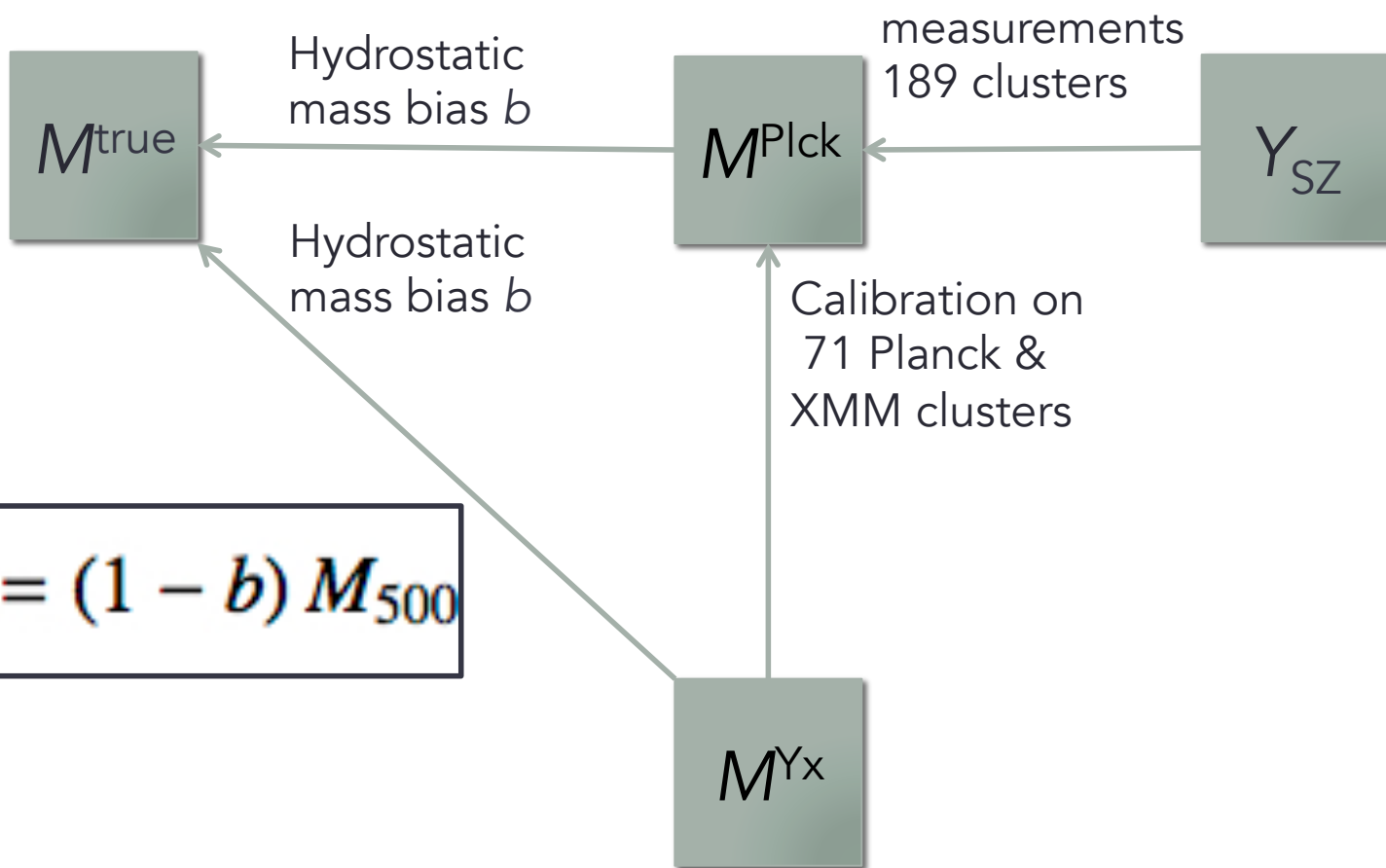
How to measure cluster masses with *Planck*?



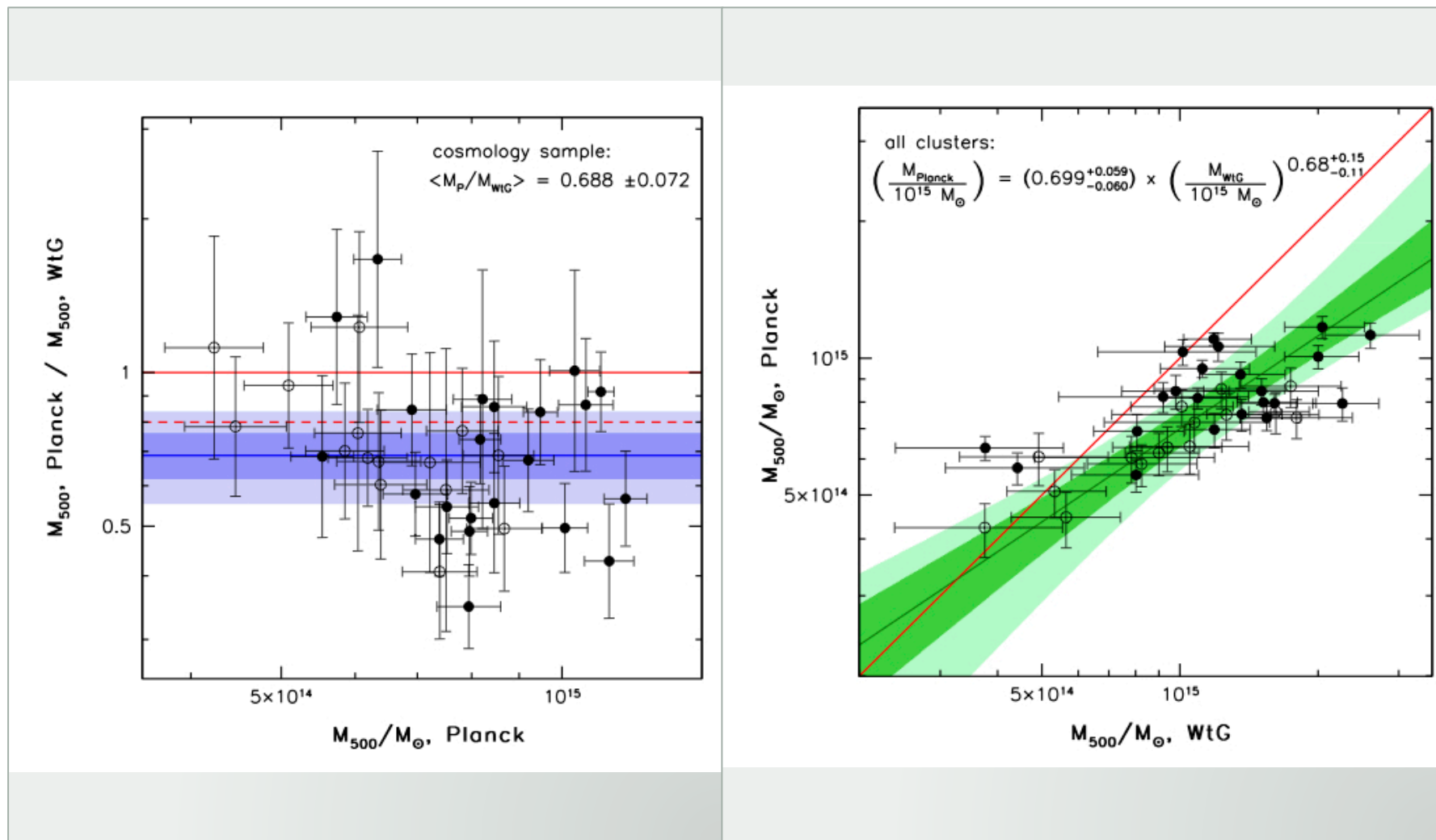
189 confirmed clusters at SZ $S/N > 7$; 184 with spectroscopic redshifts.

Enter hydrostatic mass bias

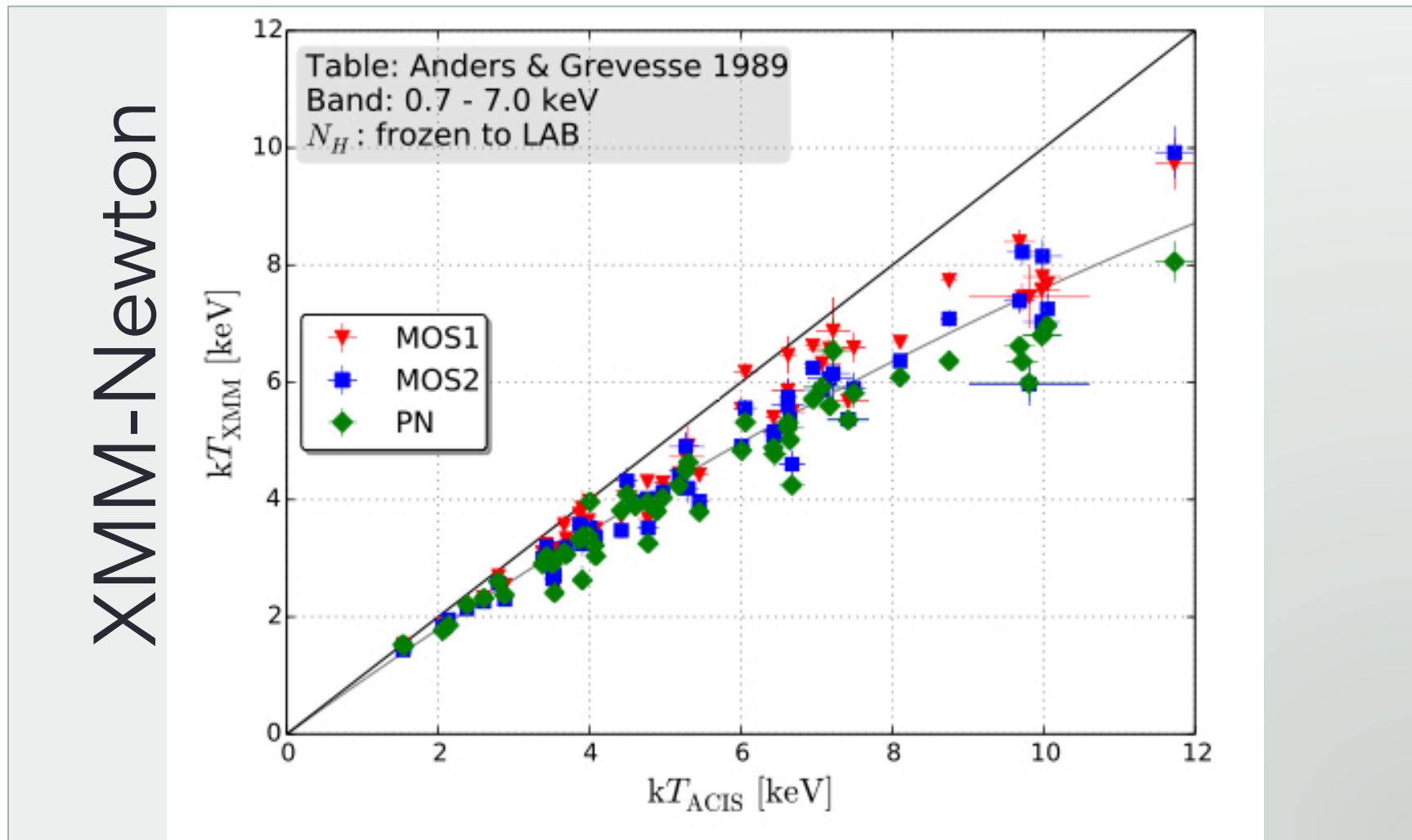
Arnaud et al., in prep.



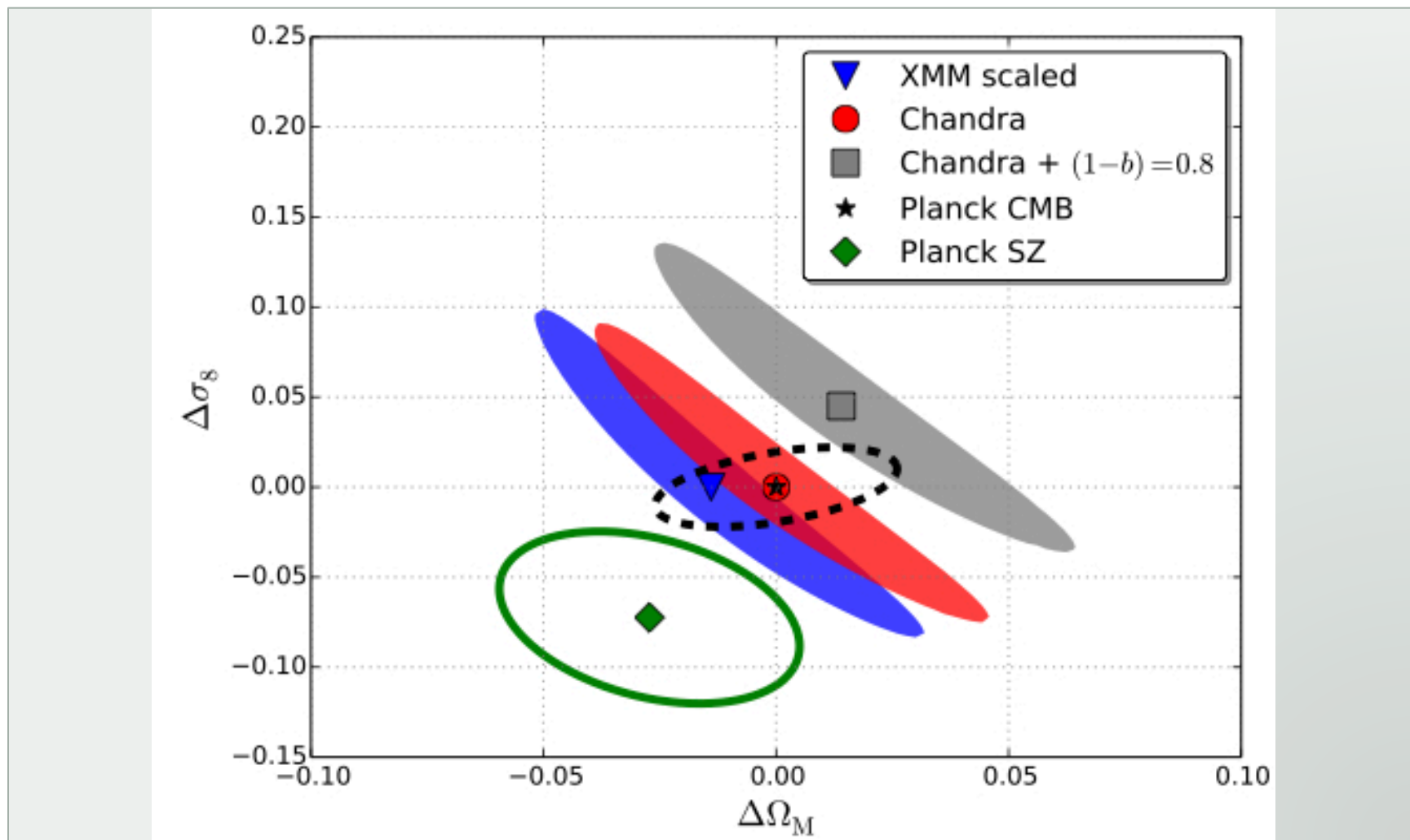
Weak Lensing may hint at large hydrostatic bias



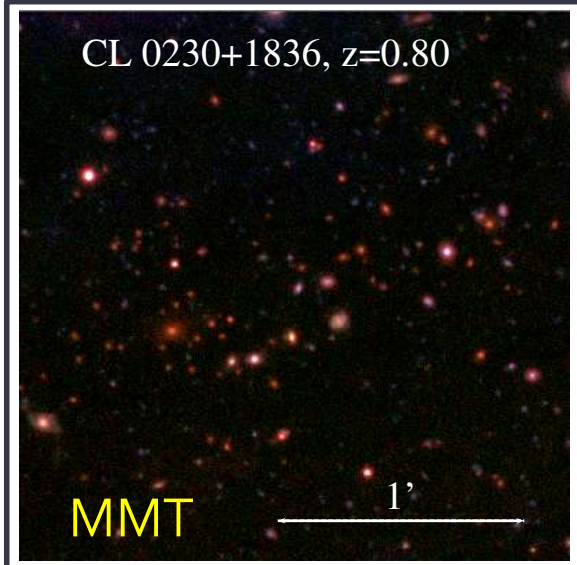
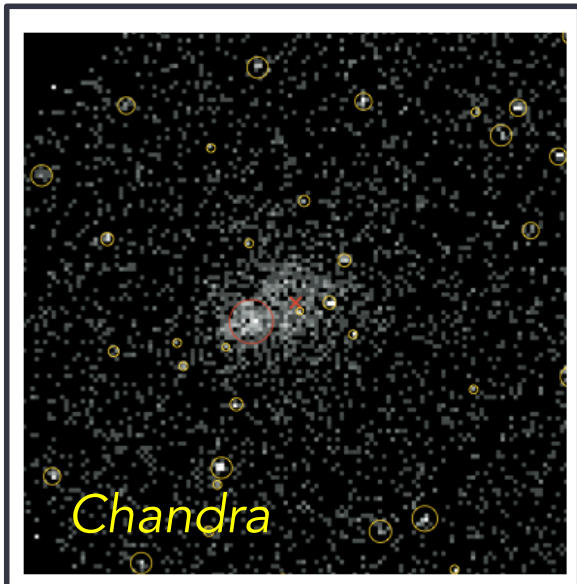
Chandra and XMM temperatures disagree



Chandra vs. XMM: effect on cosmology



The 400d X-ray cluster survey



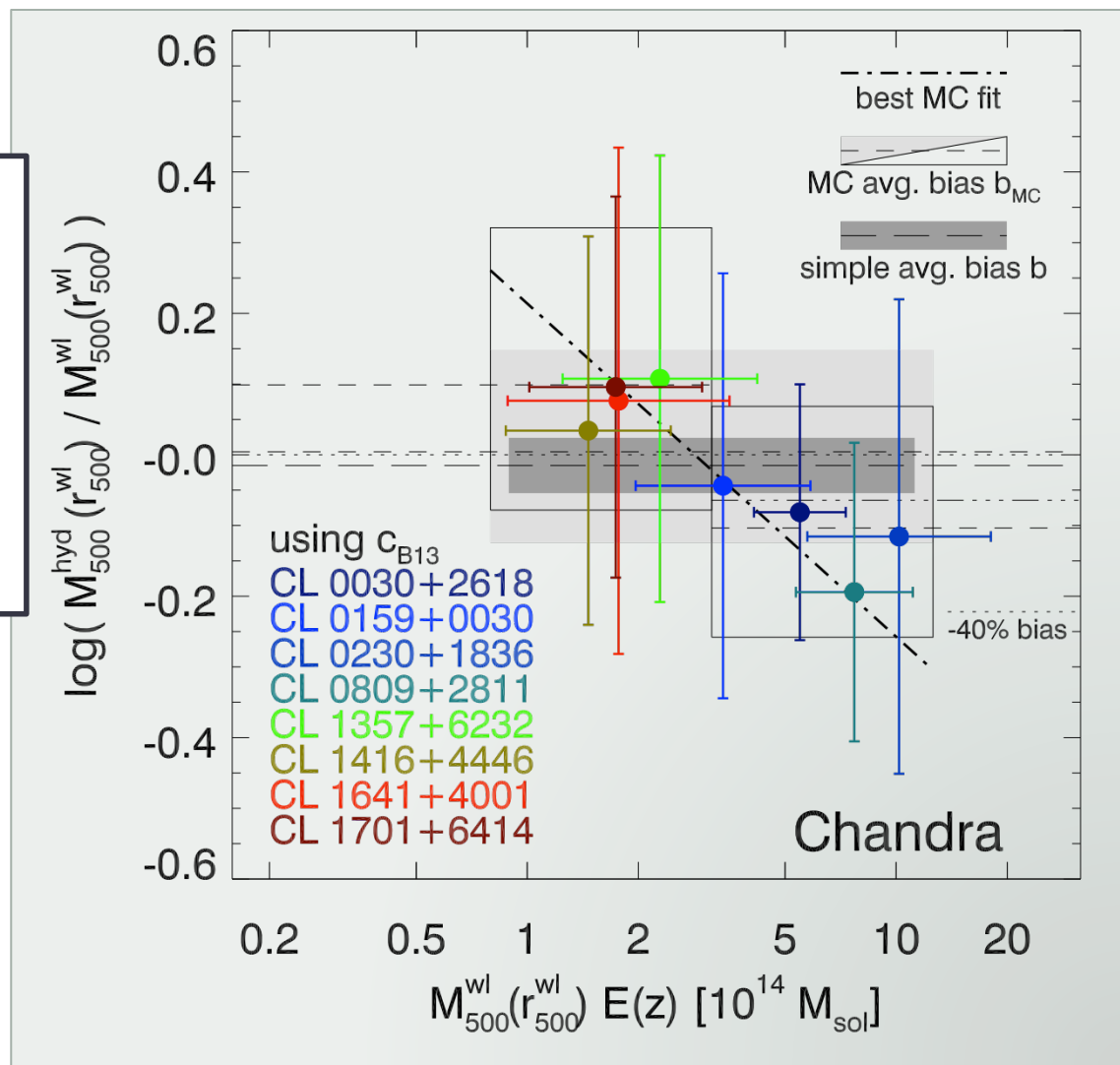
- Serendipitous cluster detections in all suited Rosat/PSPC pointings ($\sim 400 \text{ deg}^2$): Burenin+07
- Chandra analysis, mass determination for cosmo-subsample of 36 X-ray luminous clusters $z > 0.35$: Vikhlinin+09a
- Constraints of cosmological parameters comparing cosmo-subsample mass function to local clusters: Vikhlinin+09b

WL follow-up programme:

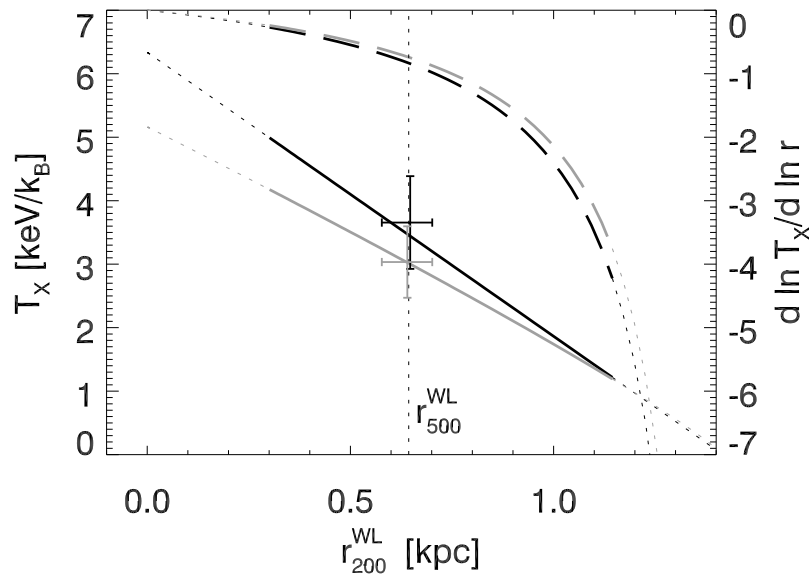
- Weak lensing masses for first 8 clusters (MMT): HI+10,12.
- Doria+15, Shafiee in prep. will add further 14 clusters to WL sample.

Hydrostatic mass bias in the 400d clusters

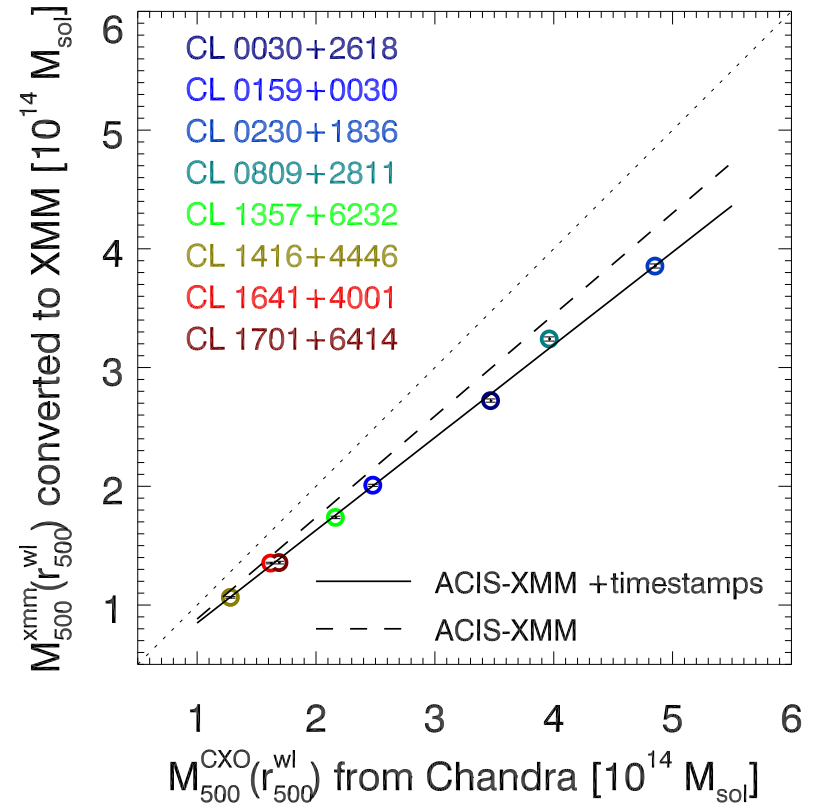
Direct calculation of hydrostatic mass profile
 Vikhlinin+09a *Chandra*
 T_x and density profiles,
 assuming Reiprich+13
 temperature profile



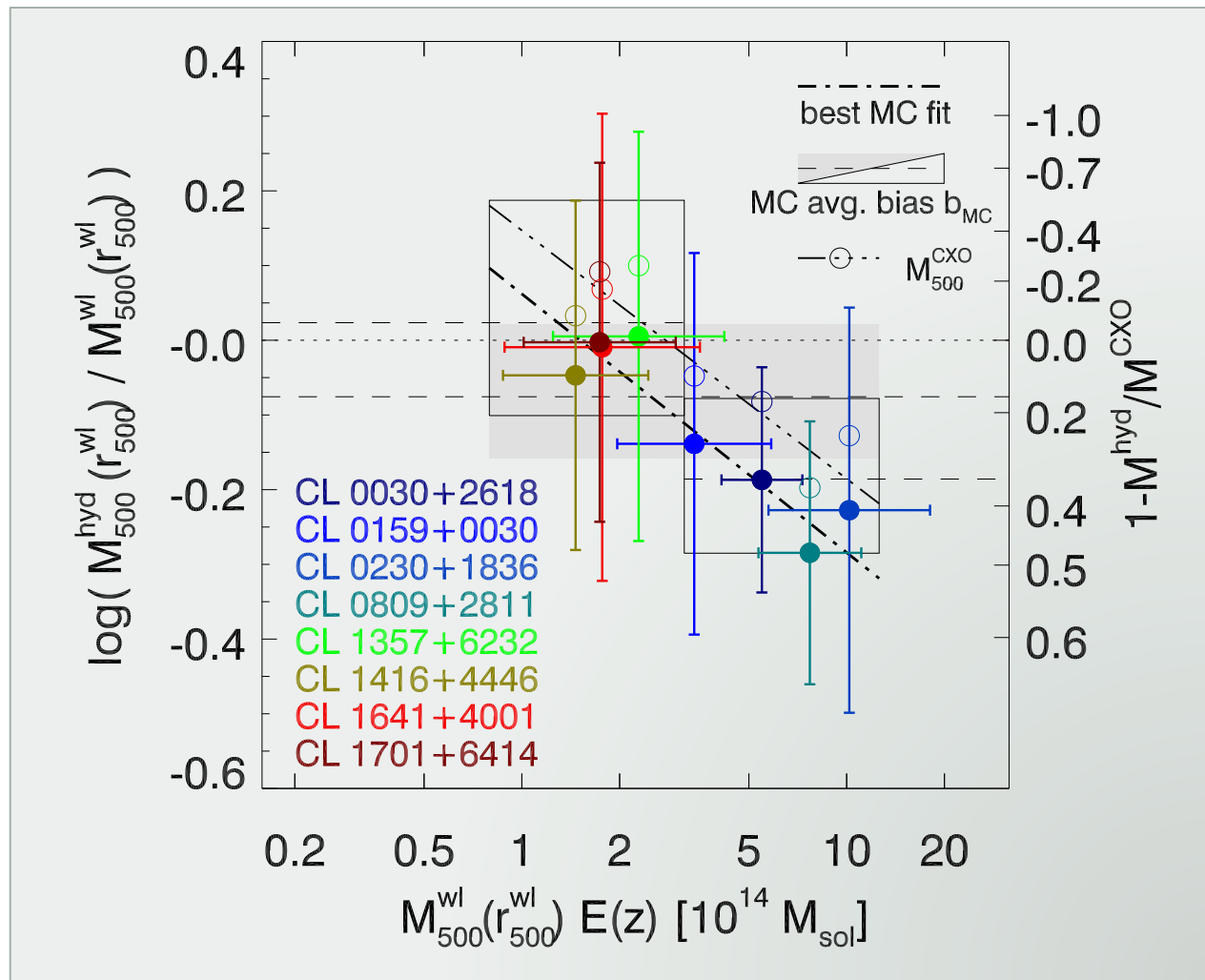
Pseudo-XMM hydro masses $\sim 20\%$ lower



HI +14b, assuming
Schellenberger+14 conversion

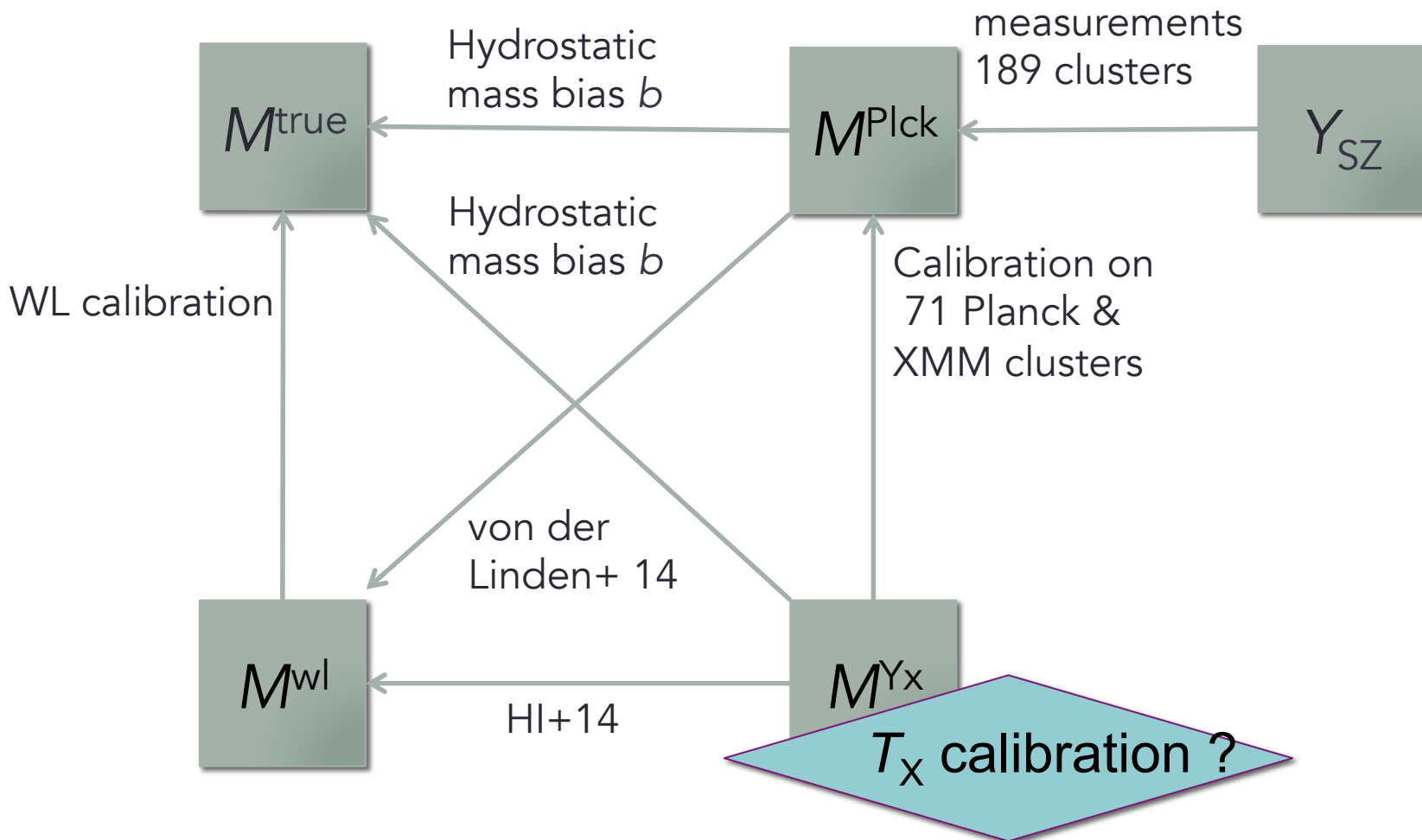


A larger hydro mass bias after conversion

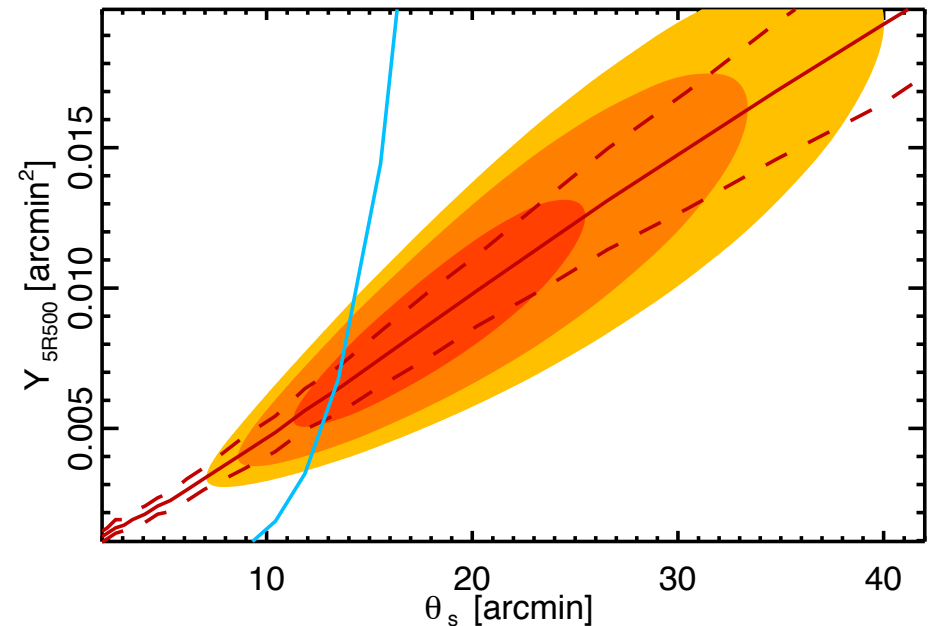
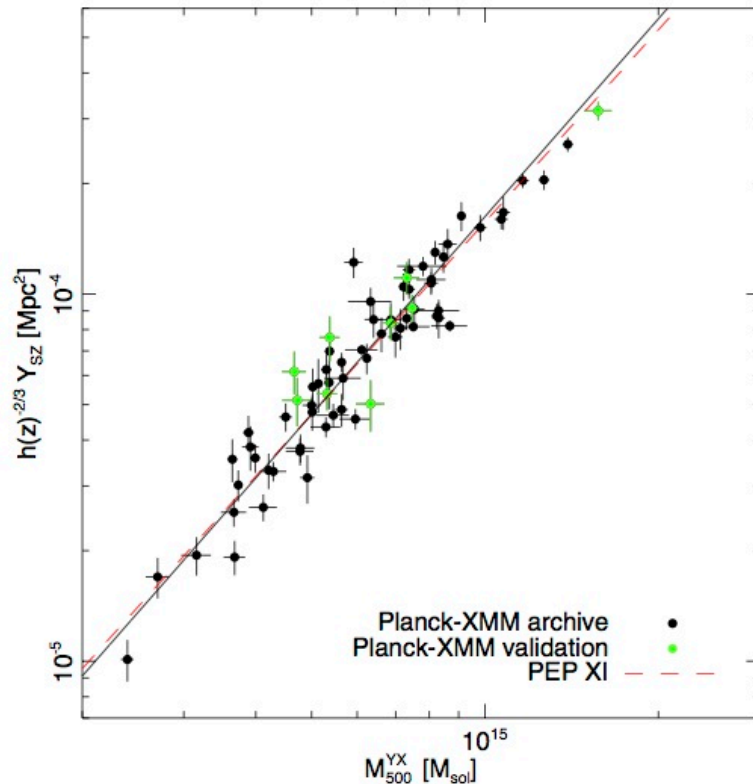


Which role does X-ray calibration play?

Arnaud et al., in prep.

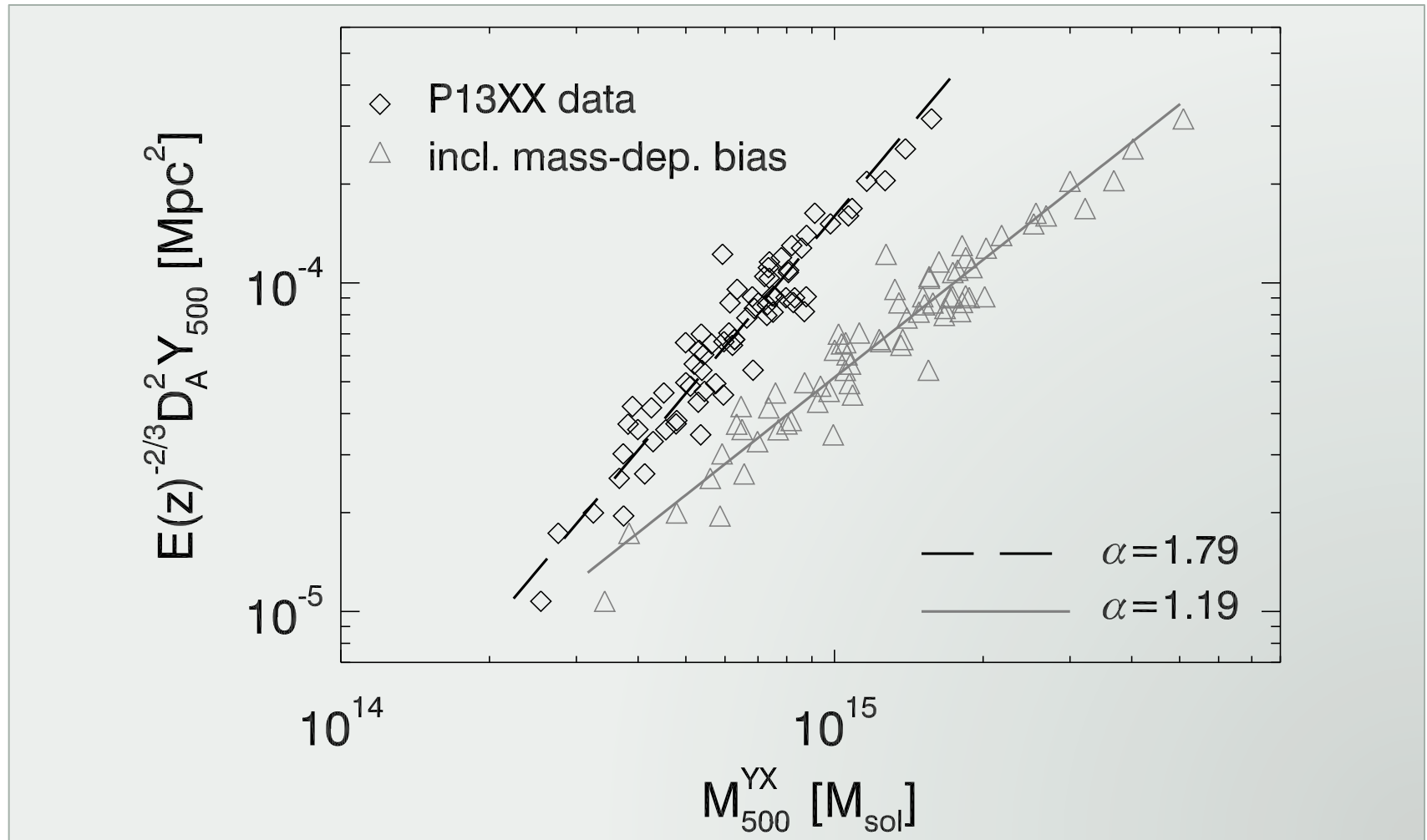


Amplification of (residual) calibration bias

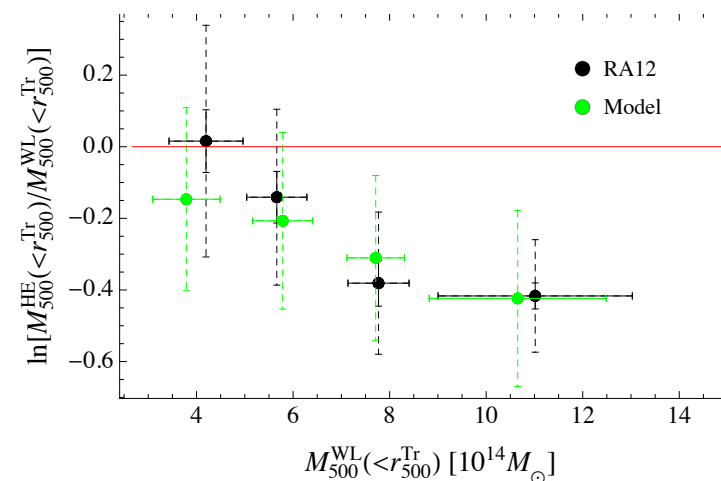
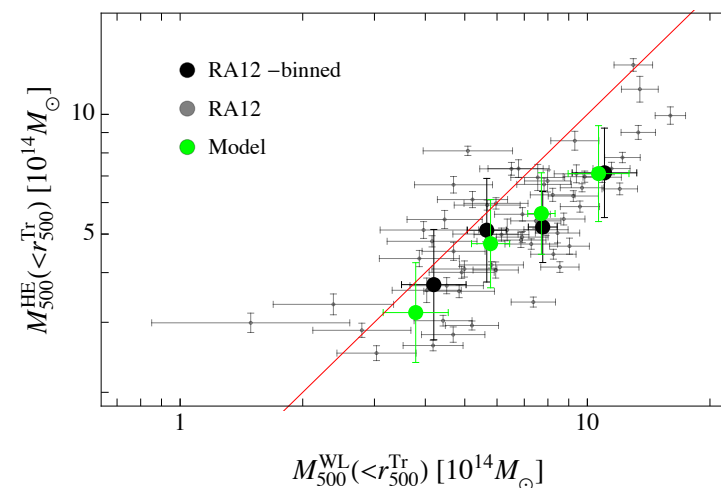
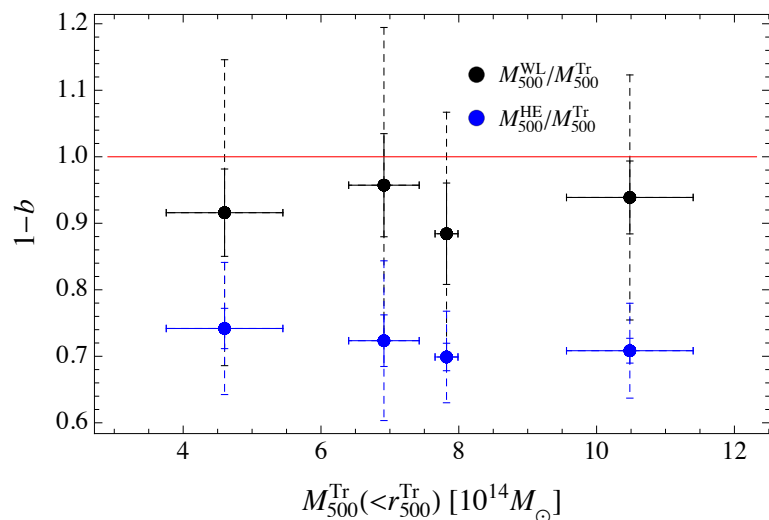


$$E^{-2/3}(z) \left[\frac{Y_X}{2 \cdot 10^{14} M_{\odot} \text{ keV}} \right] = 10^B \cdot \left[\frac{M_{500}^{\text{HE}}}{6 \cdot 10^{14} M_{\odot}} \right]^{\beta} \quad (5)$$

Effect of the mass-dependent mass bias



Eddington bias and large scatter in WL masses



Compilation of literature results on WL and X-ray cluster masses by Sereno & Ettori (2014).

Conclusions

- Hydrostatic mass bias of $\sim 40\%$ instead of $\sim 20\%$ (simulations) suggested to reconcile *Planck* cluster number counts and CMB.
- HI+14 find no $>20\%$ mass bias, using *Chandra*, less massive clusters.
- Schellenberger+14 confirm strong instrument-dependence of measured ICM temperatures.
- Converting *Chandra* masses to *XMM*, HSE masses decrease by $\sim 20\%$.
- Comparing WL and pseudo-*XMM* hydro masses for the *400d* clusters, we find $\sim -5\%$ for low mass clusters, $\sim 35\%$ for high-mass clusters.
- A combination of slightly higher mass bias than expected and X-ray calibration issues might contribute to *Planck* discrepancy.
- An increase of b_{hyd} with mass counteracts the calibration effect.