X-Ray—Optical (Radio) Scaling Relations of a Complete X-Ray Flux-

Thomas Reiprich

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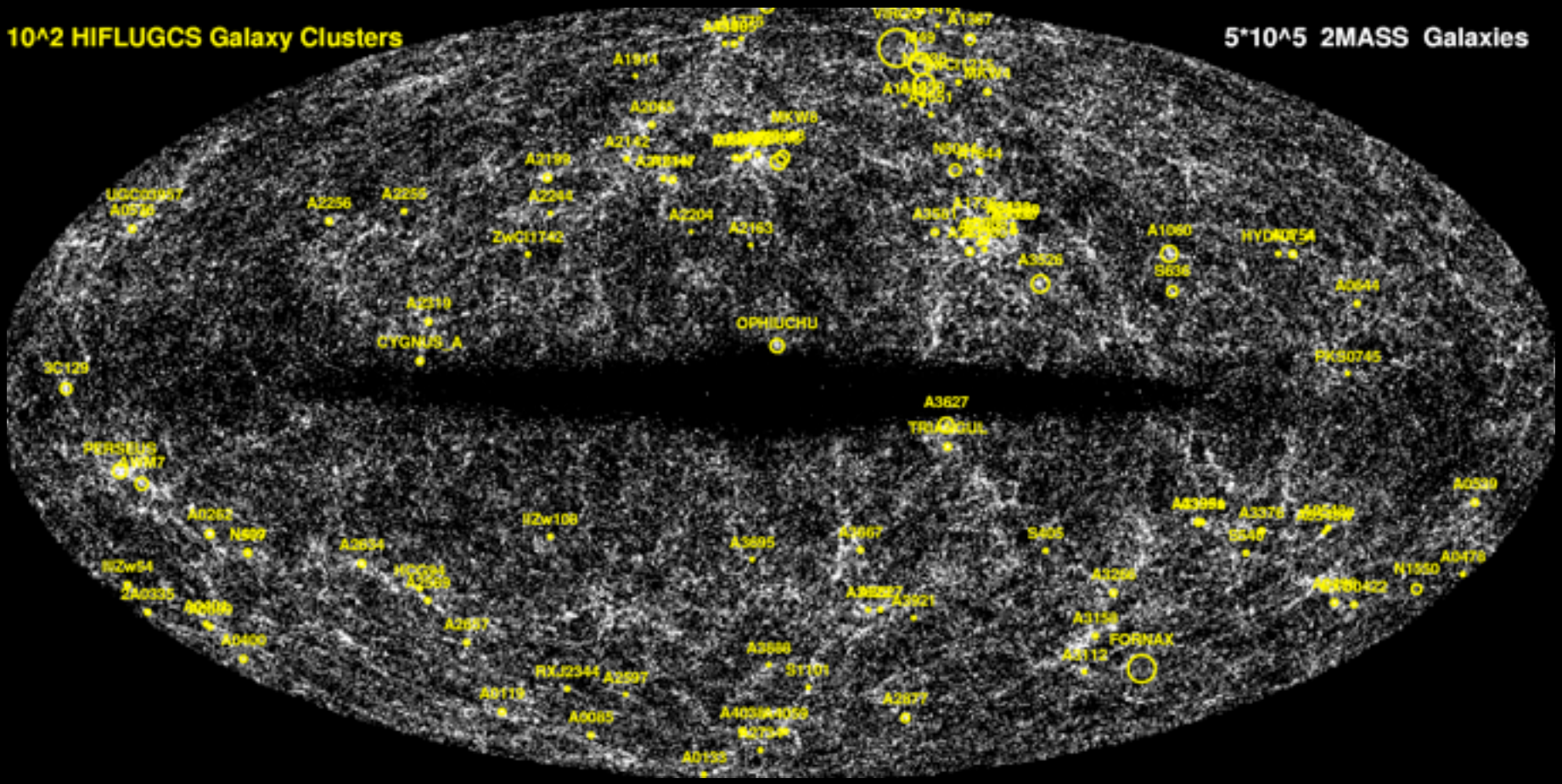
HIFLUGCS

- 64 X-ray brightest clusters in sky (Reiprich & Böhringer 2002, Chen et al. 2007, Mittal et al. 2009, Hudson et al. 2010, Zhang et al. 2011).



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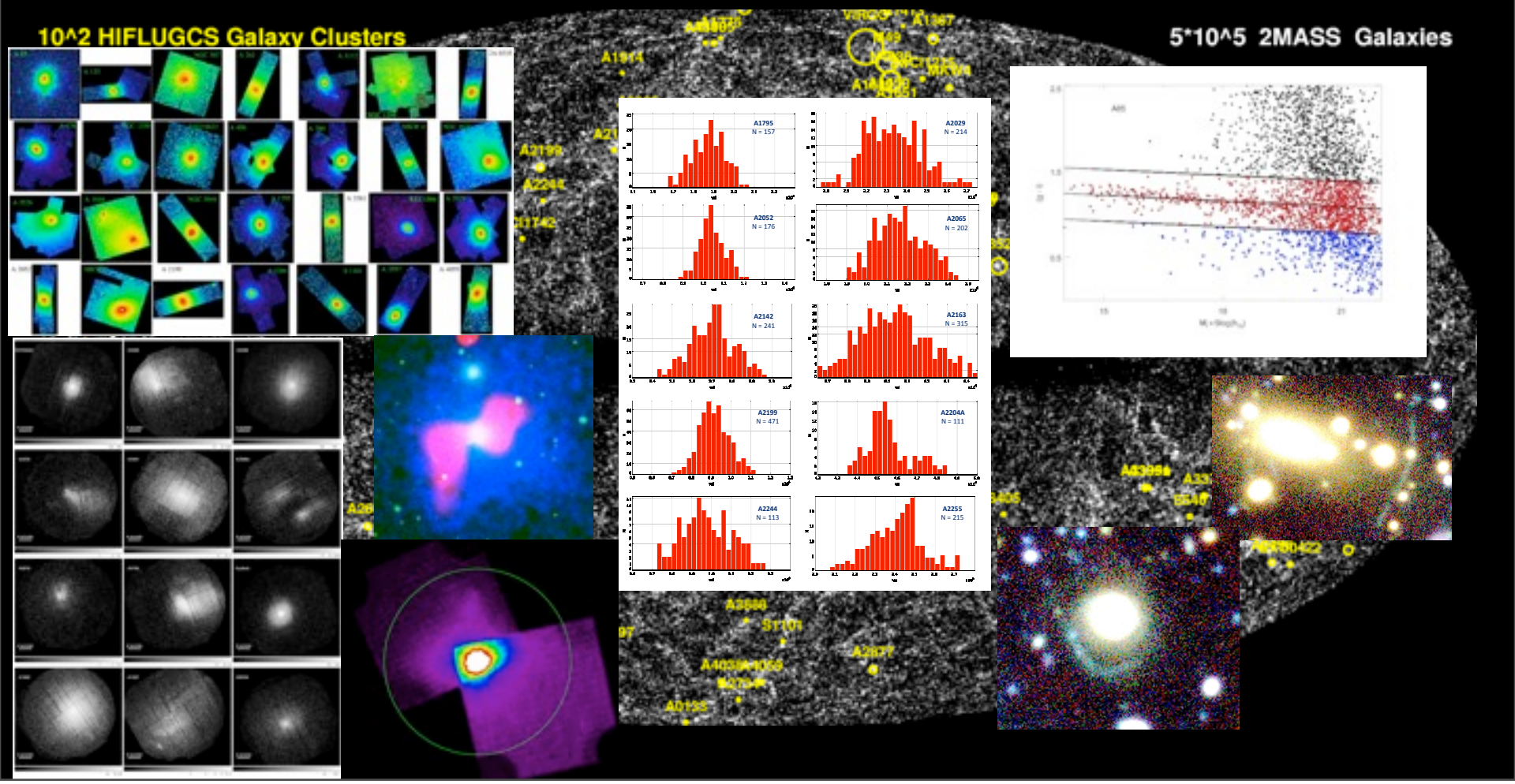

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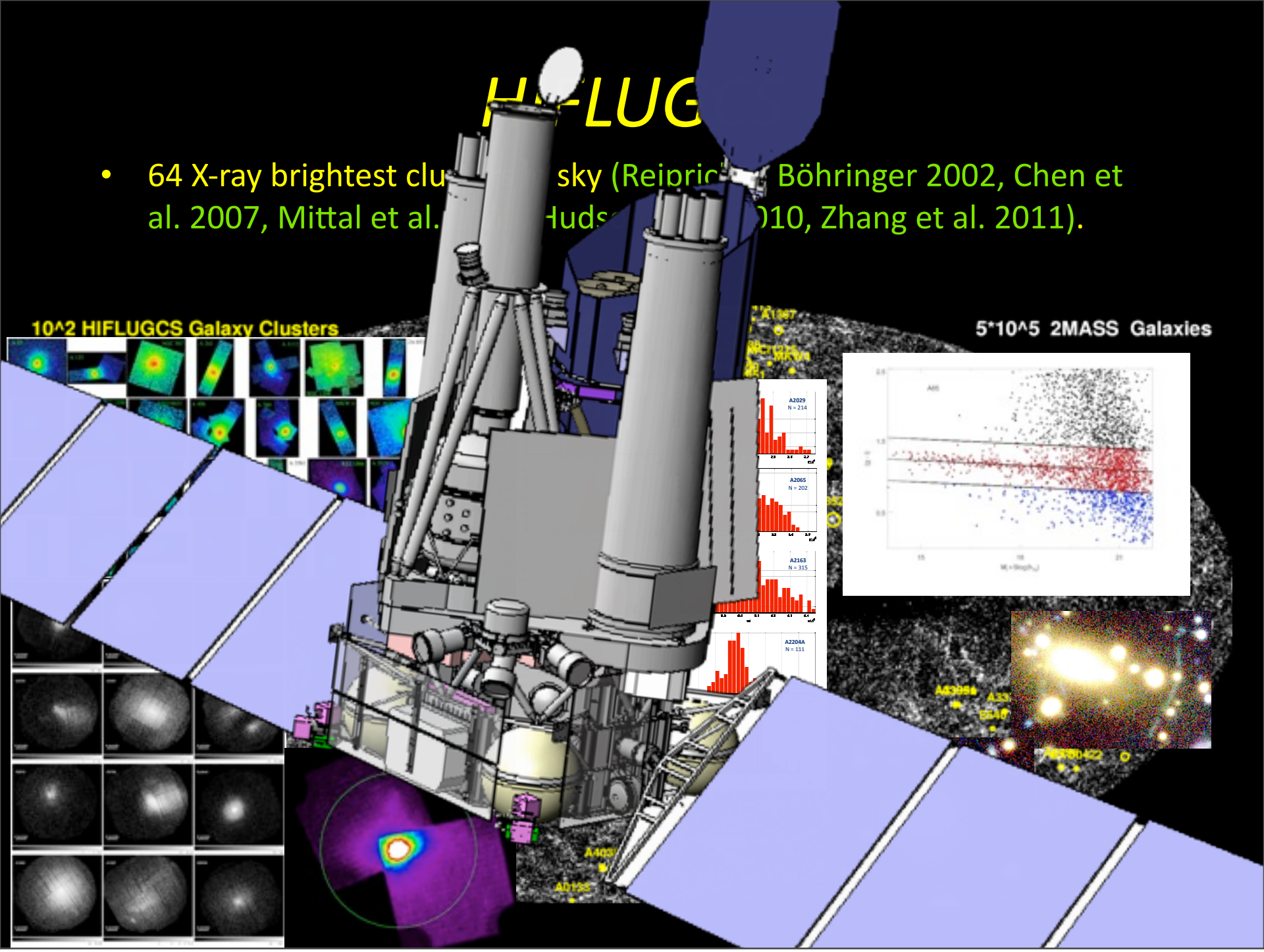
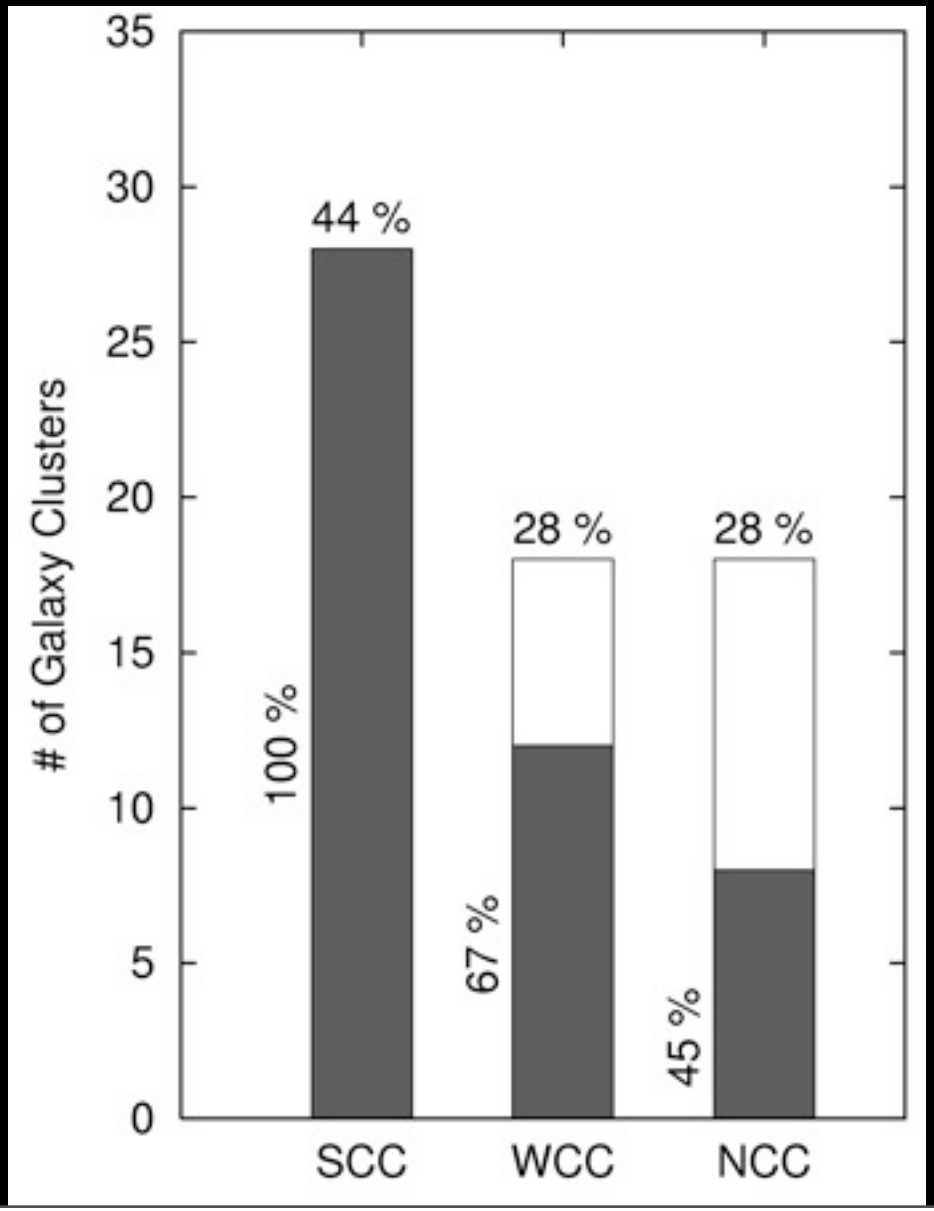


Cool Core Fraction: Selection Effects

Mittal et al. (2009), Hudson et al. (2010, Sect. 3.2.2). See also Eckert et al. (2011).



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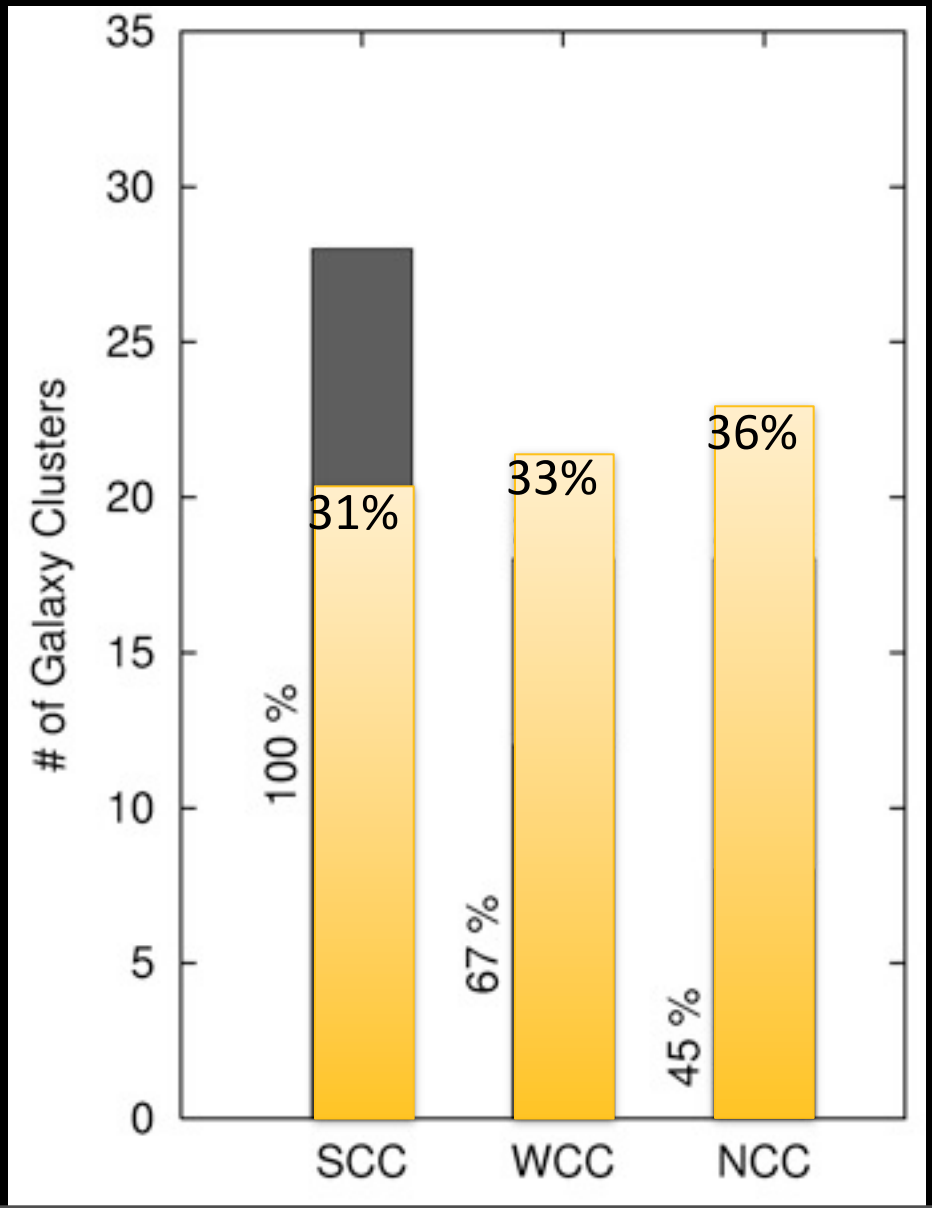


"True" underlying fractions.

Correction can only be done with *complete* sample.

Used L_X–T relations from Mittal & Reiprich (subm.), and T-function from Ikebe et al. (2002).

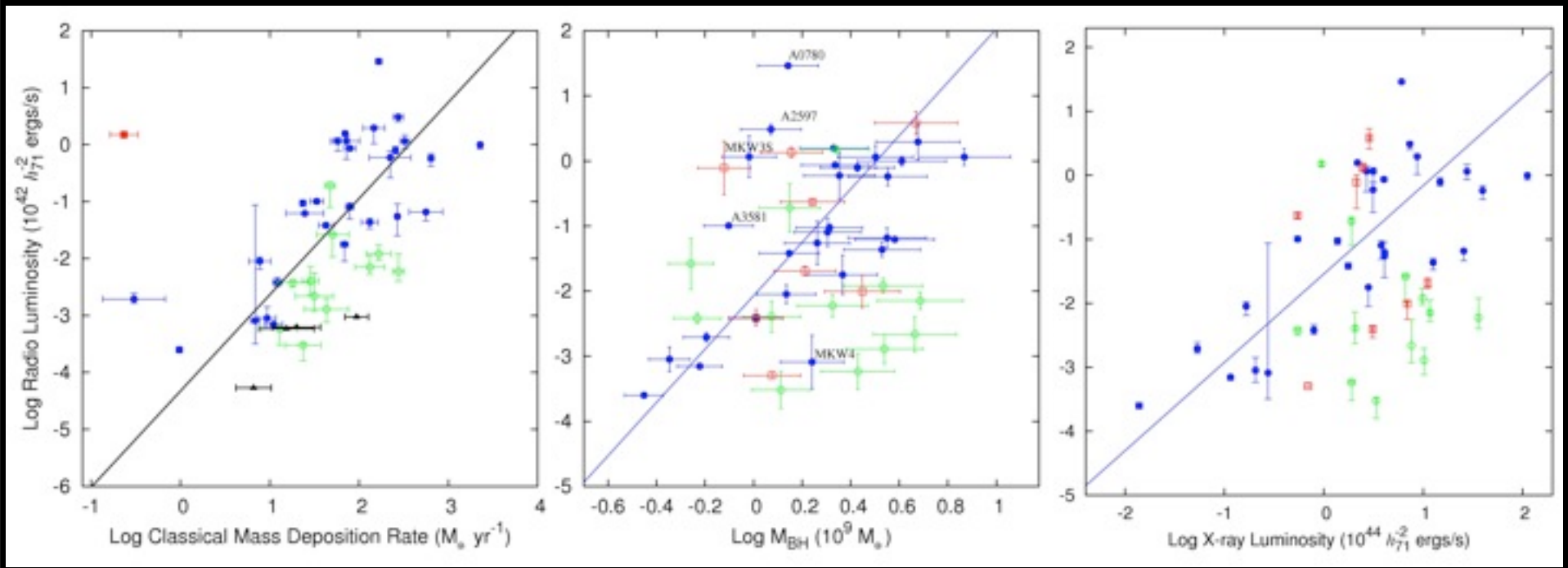
Supermassive Black Holes, AGN–Cooling Core Connection

Mittal et al. (2009). See also, e.g., Peres et al. (1998).

Used 2MASS ESC (Jarrett et al. 2000) and Marconi & Hunt (2003).
See also, e.g., Franchesini et al. (1998), Laor (2000), Lacy et al. (2001), Liu et al (2006).

Supermassive Black Holes, AGN–Cooling Core Connection

$L_{radio} \sim \dot{M}_{class}^{1.7}$ $L_{radio} \sim M_{BH}^{4.1}$ (SCCs)



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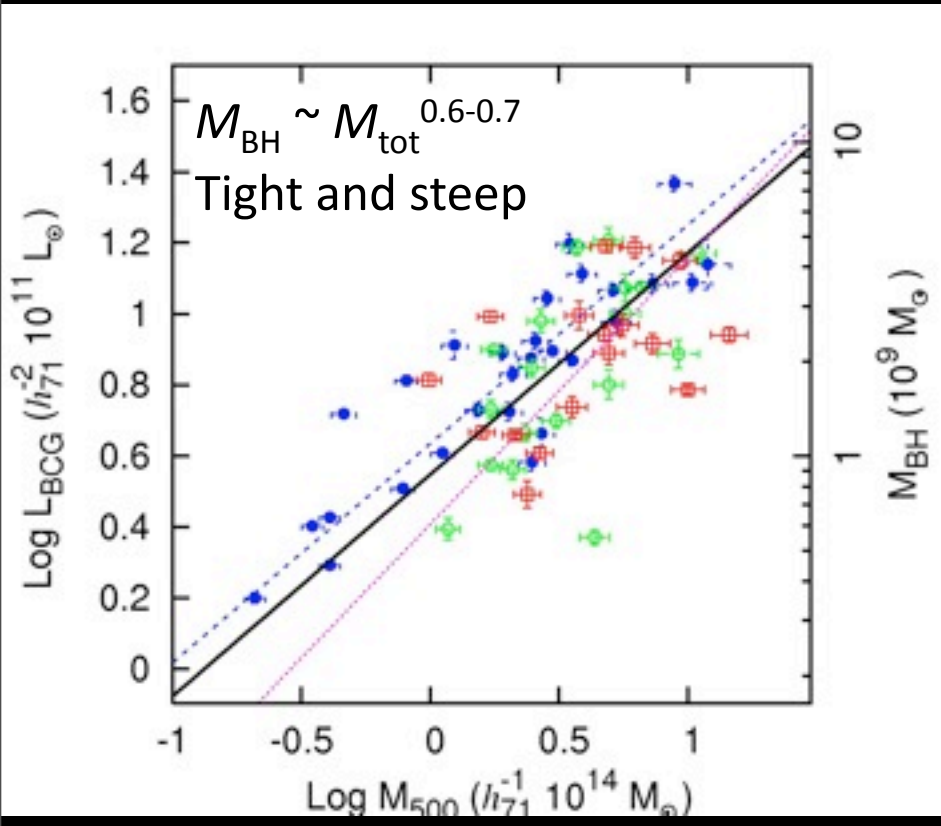
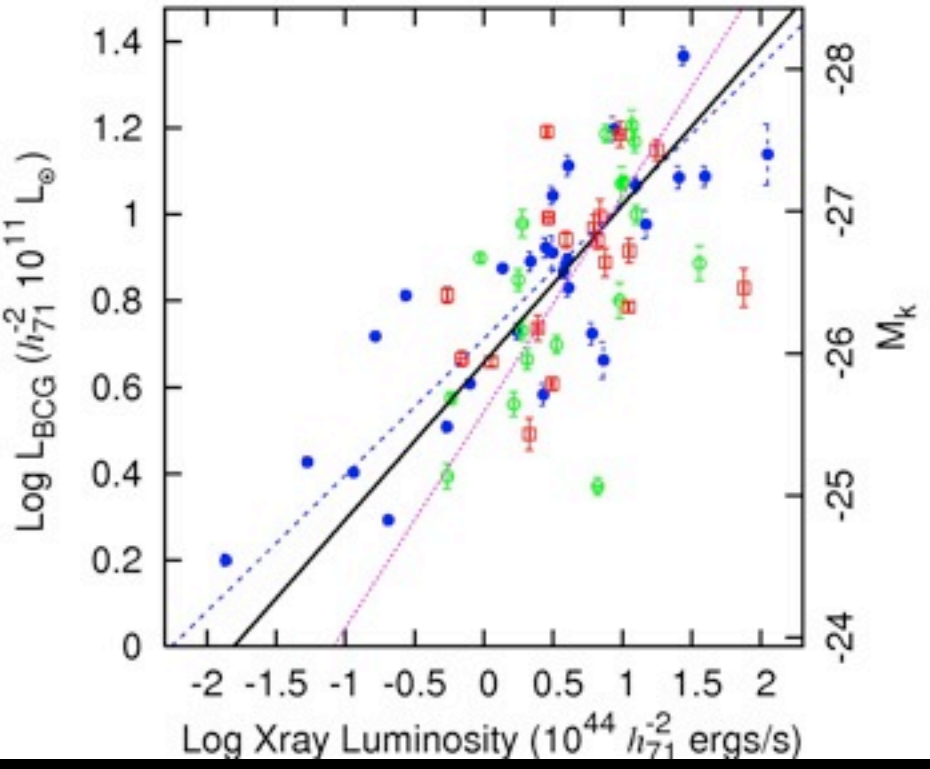
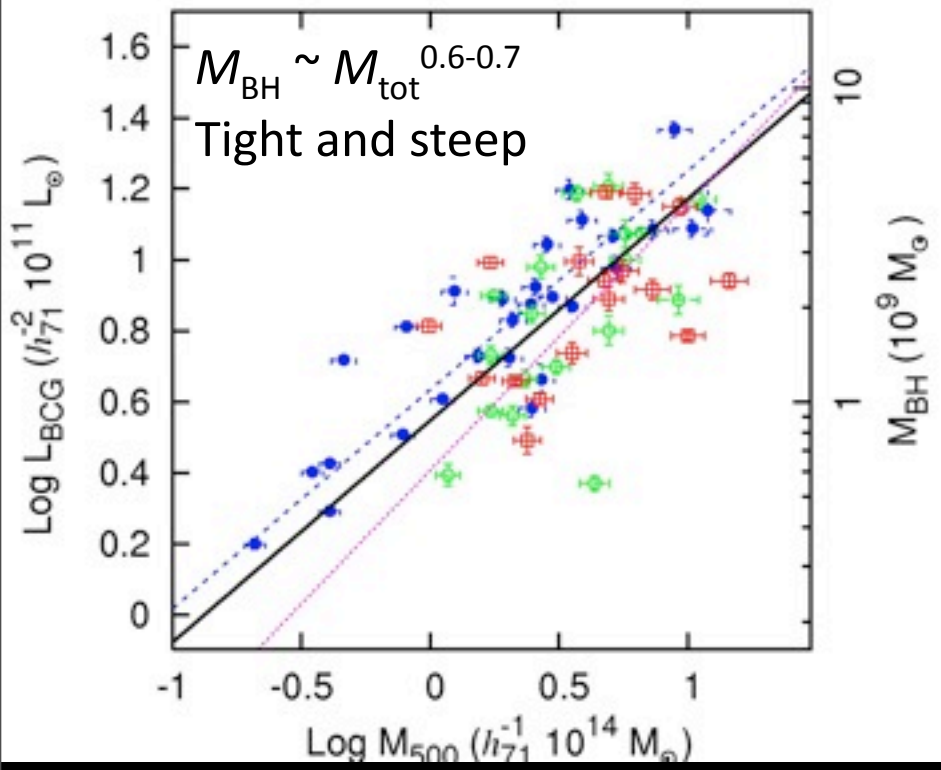


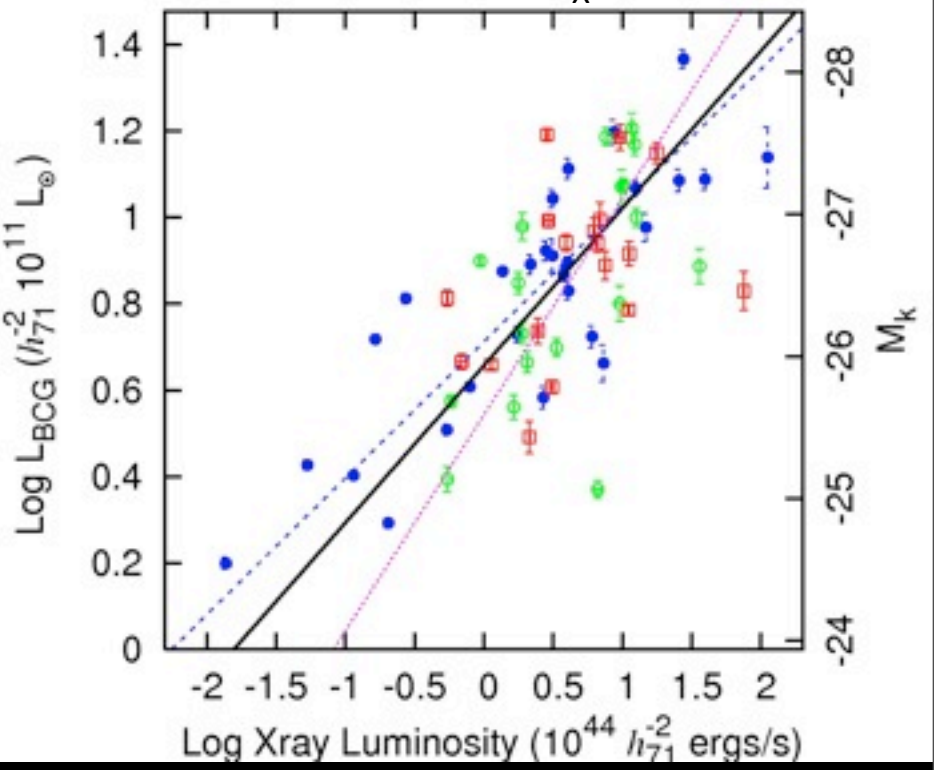


Mittal et al. (2009);
see also, e.g., Edge (1991), Katayama et al. (2003), Fujita & Reiprich (2004), Lin & Mohr (2004), Popesso et al. (2007), Hansen et al. (2007), Brough et al. (2008).

Supermassive Black Holes, AGN–Cooling Core Connection

Segregation vanishes when using L_X as mass proxy.





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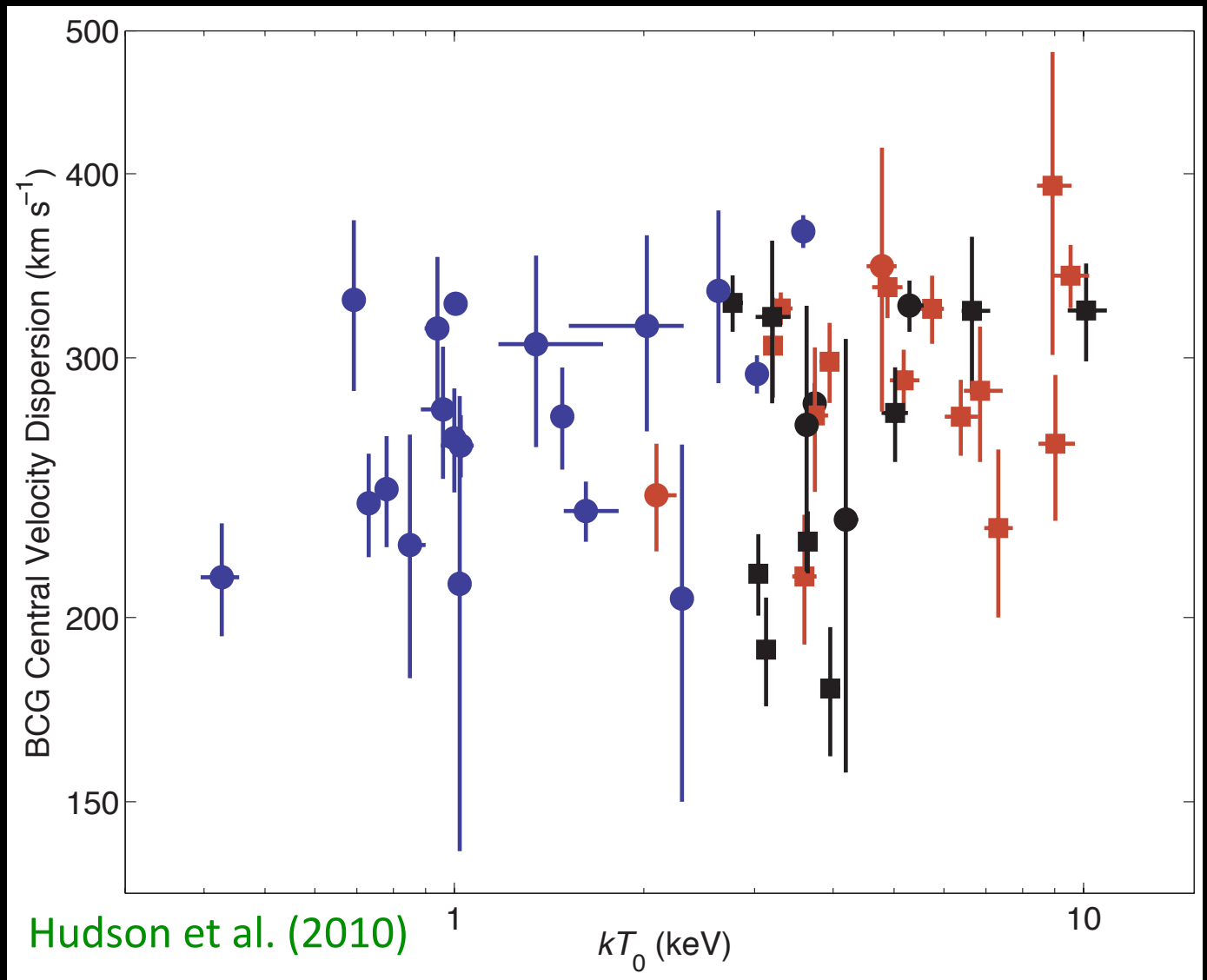
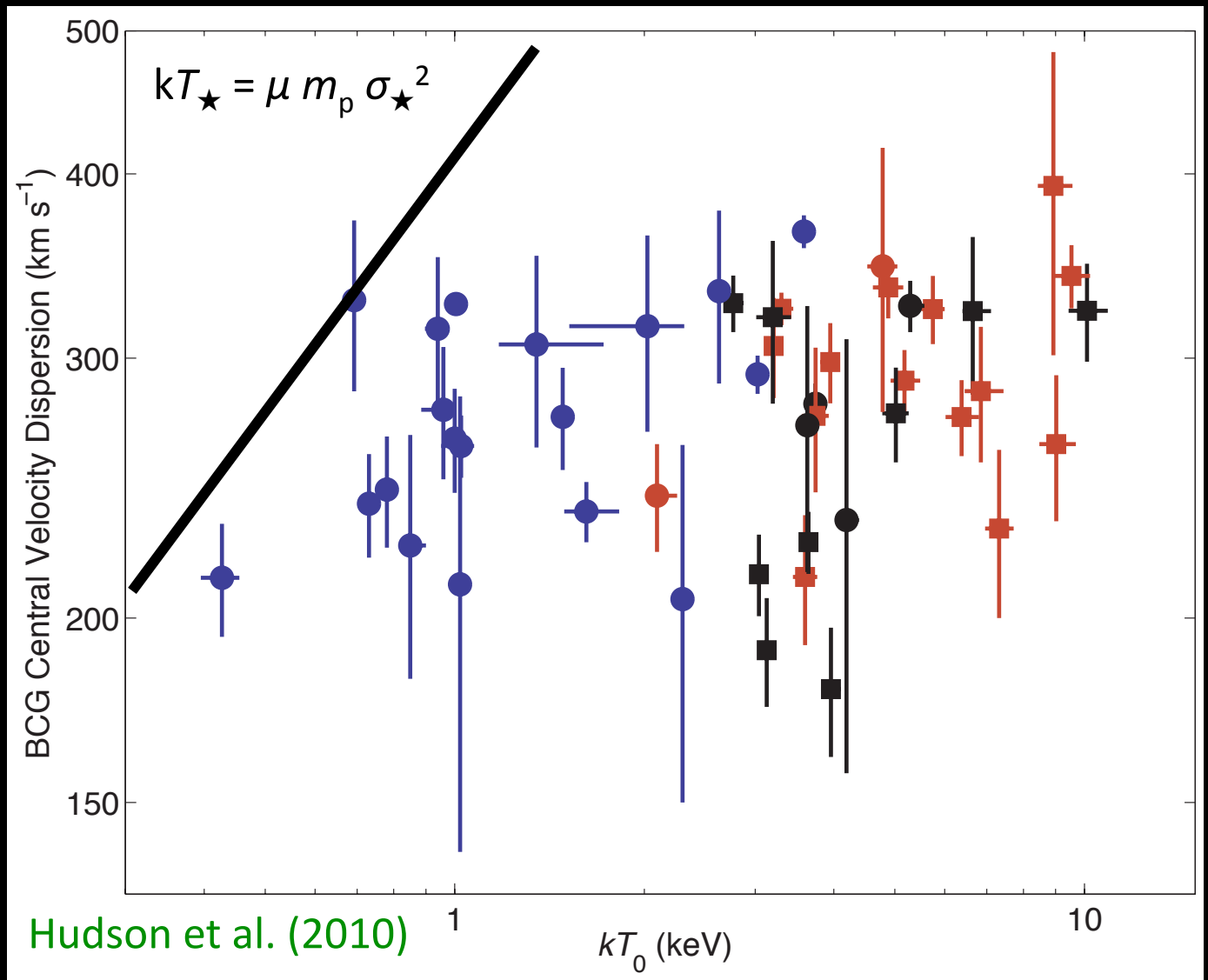
BCG Stellar Velocity Dispersion



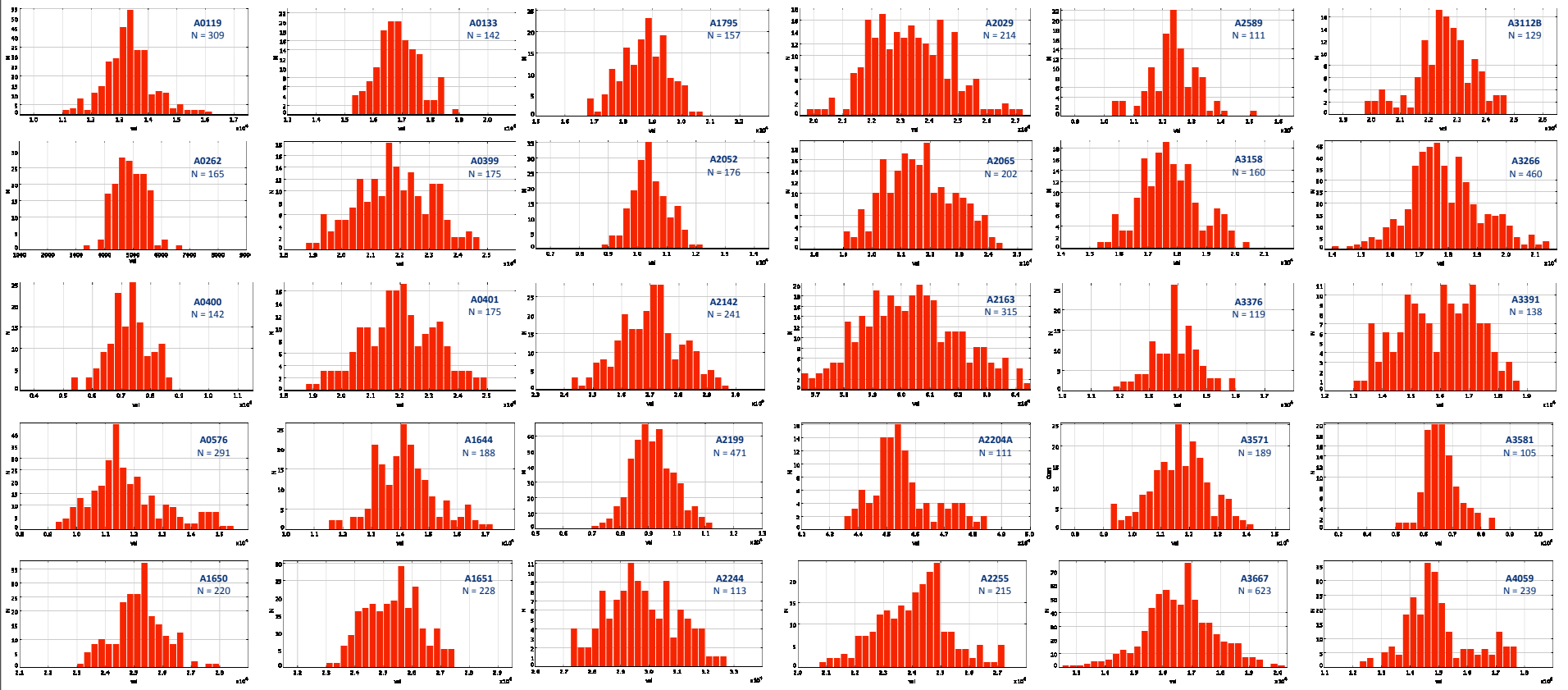
Hudson et al. (2010)

BCG Stellar Velocity Dispersion

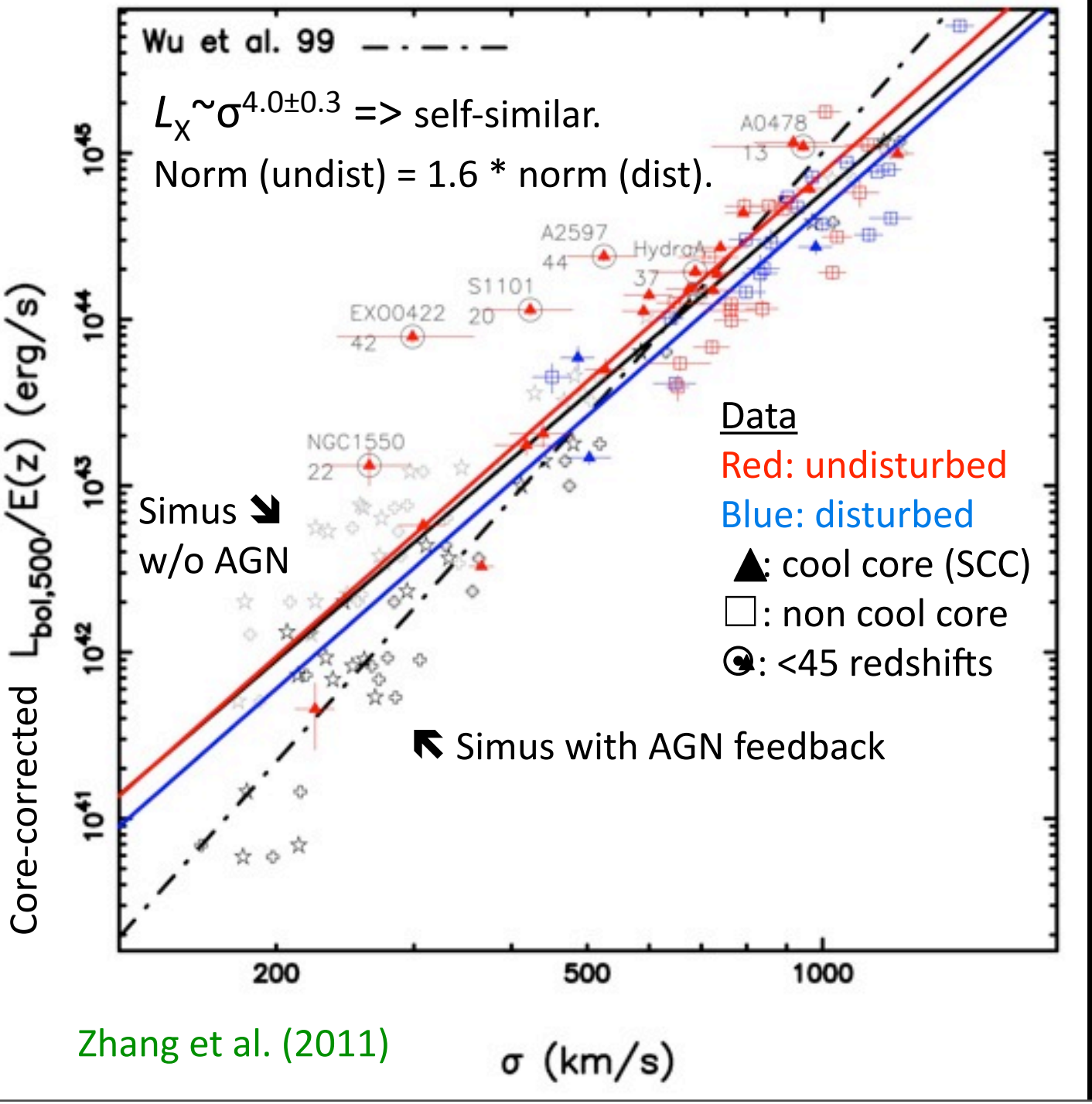


Hudson et al. (2010)

Velocity Dispersion and Mass With >13,000 Galaxy Velocities (Median: 185/Cluster)

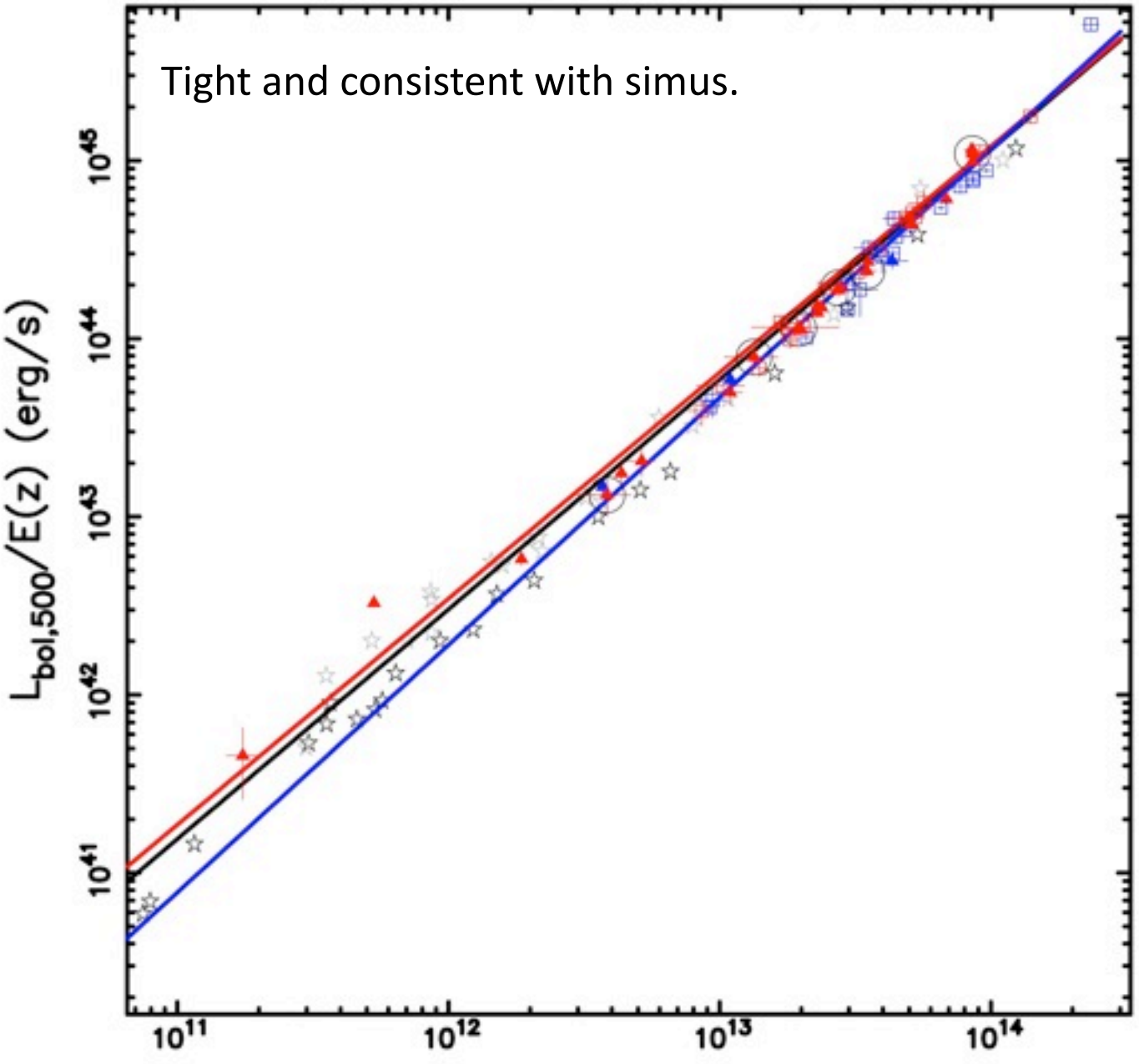


From H. Andernach



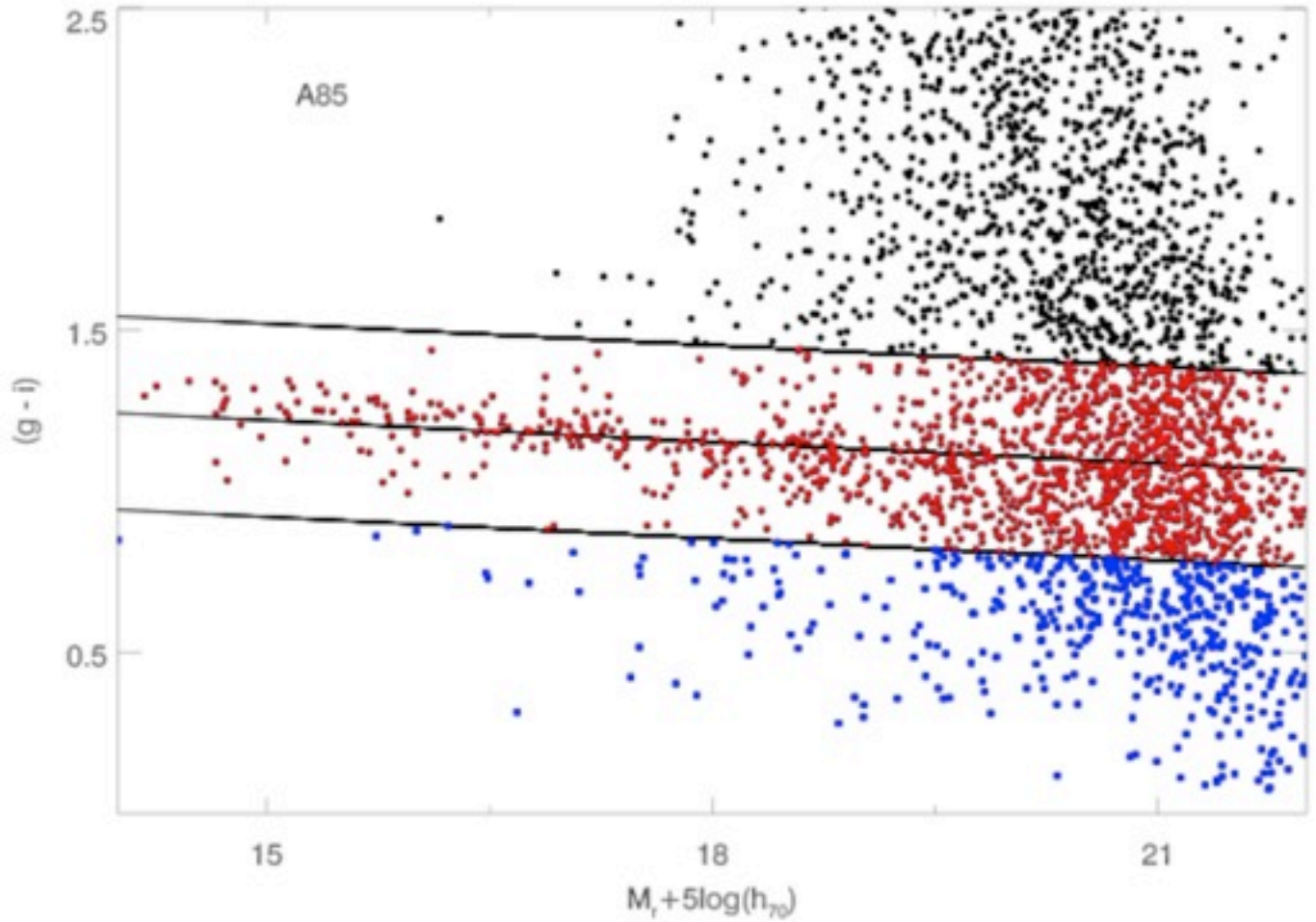
Zhang et al. (2011)

Tight and consistent with simus.



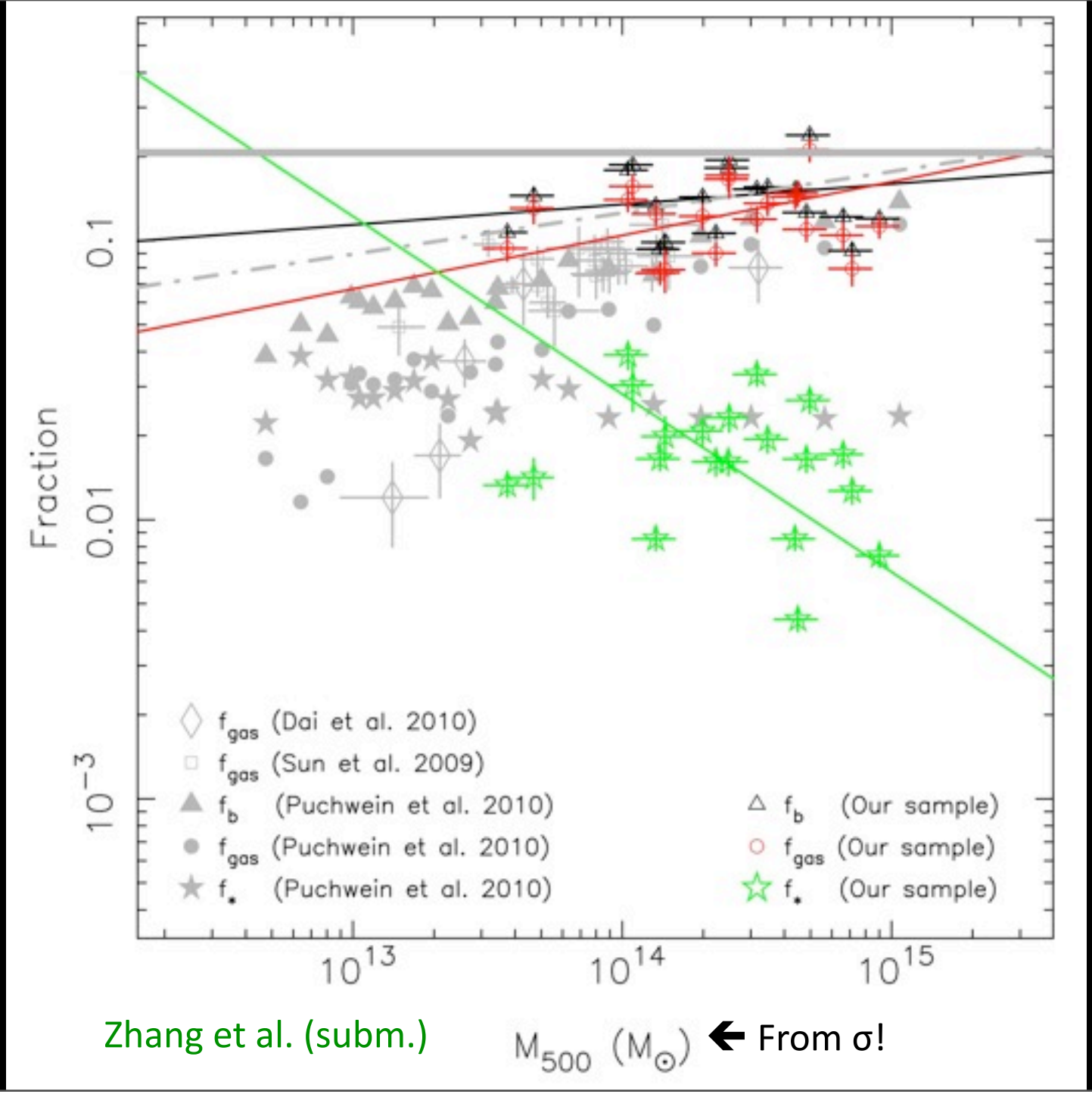
Zhang et al. (2011)

HIFLUGCS: XMM-Newton/SDSS



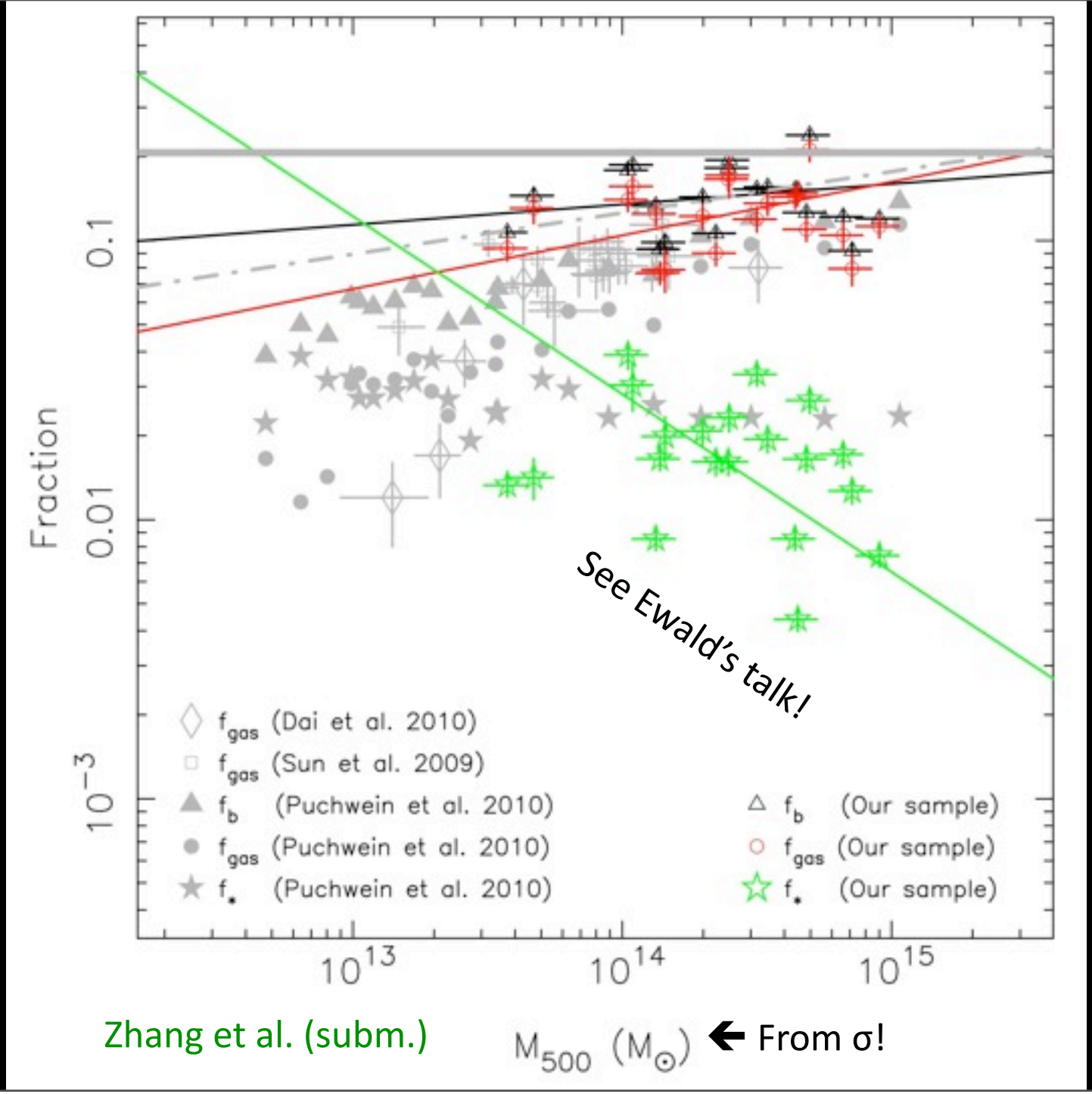
Lagana et al. (to be subm.)

Zhang et al. (subm.)



Zhang et al. (subm.)

← From σ!

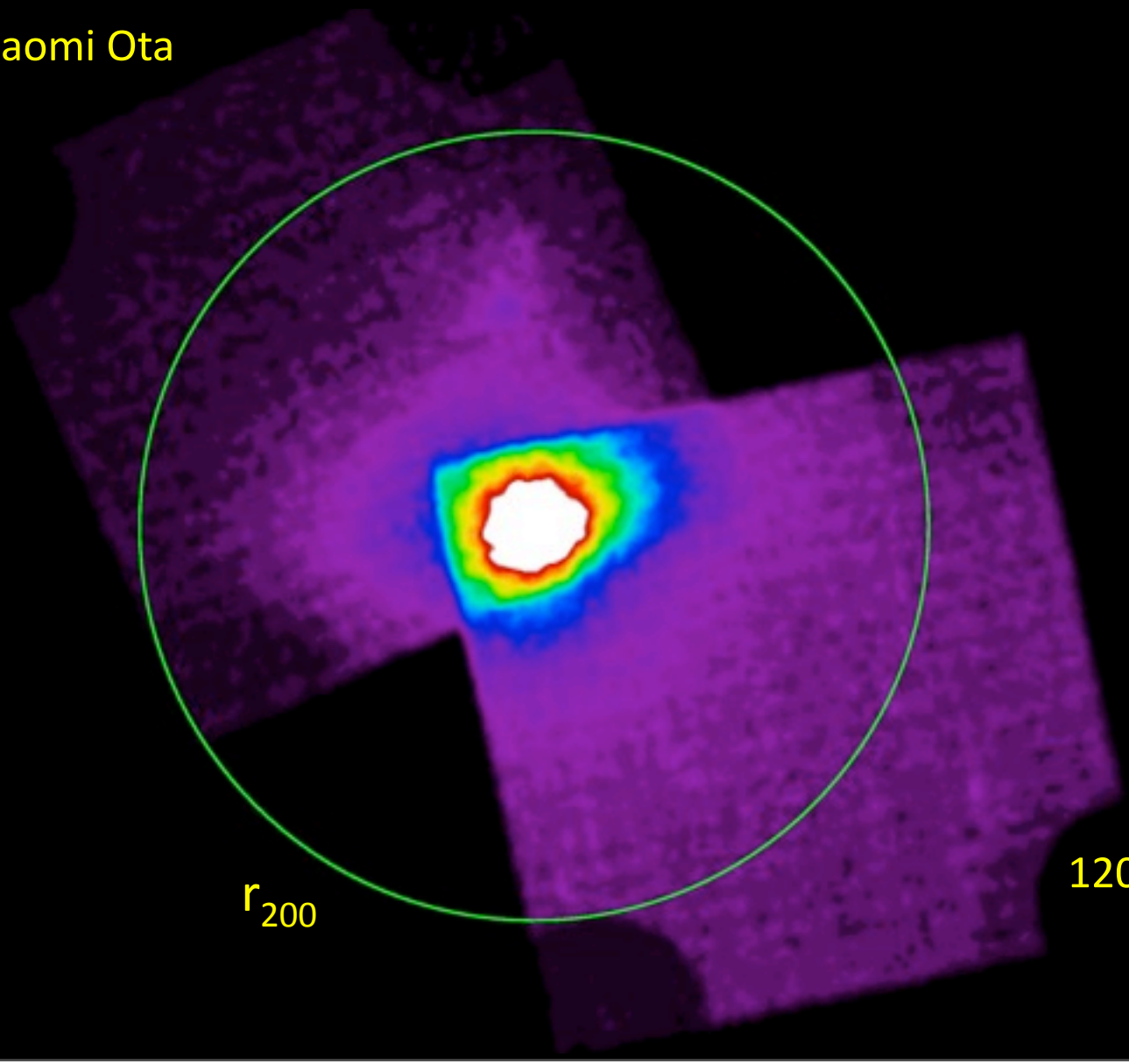


Zhang et al. (subm.)

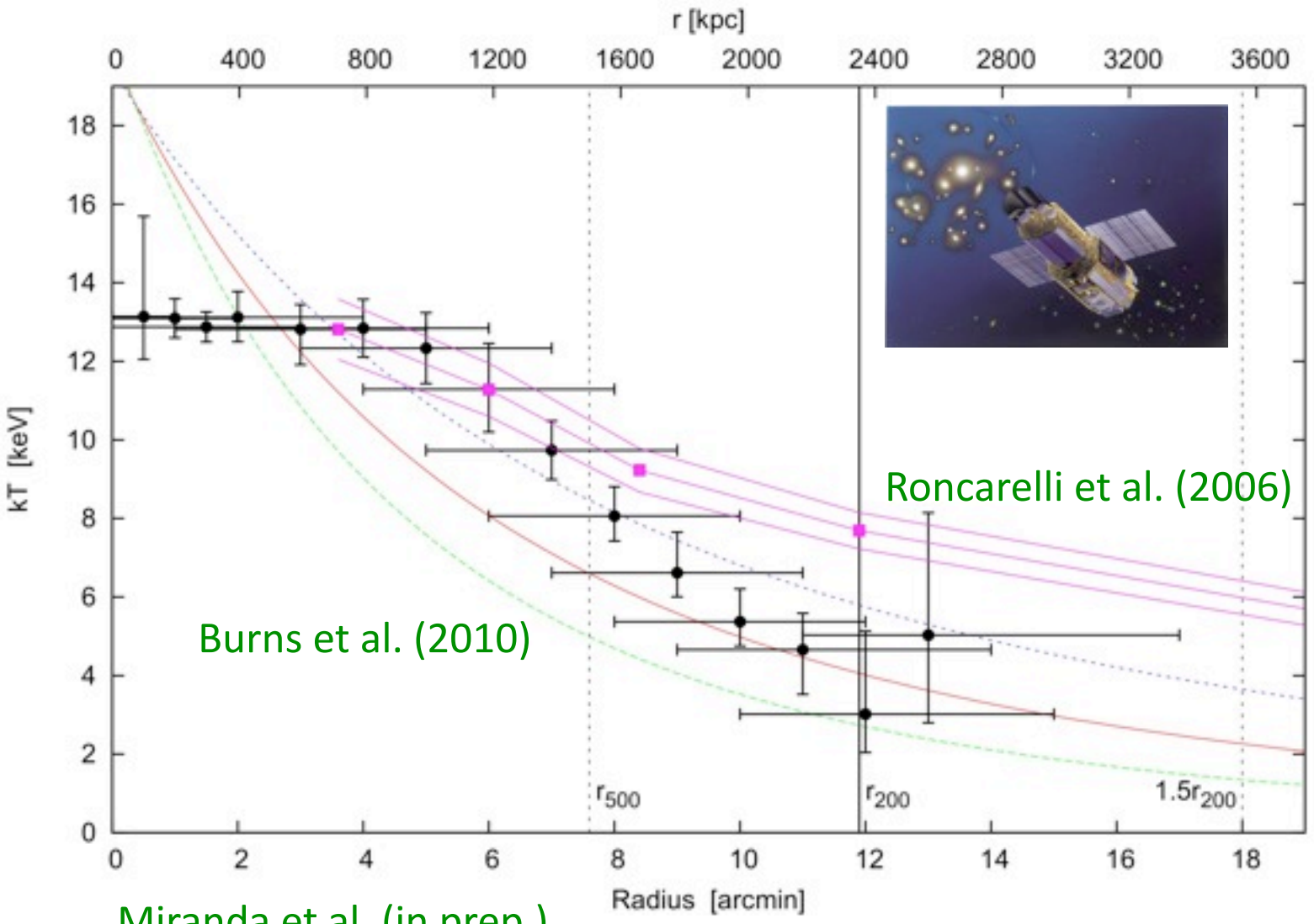
← From σ!

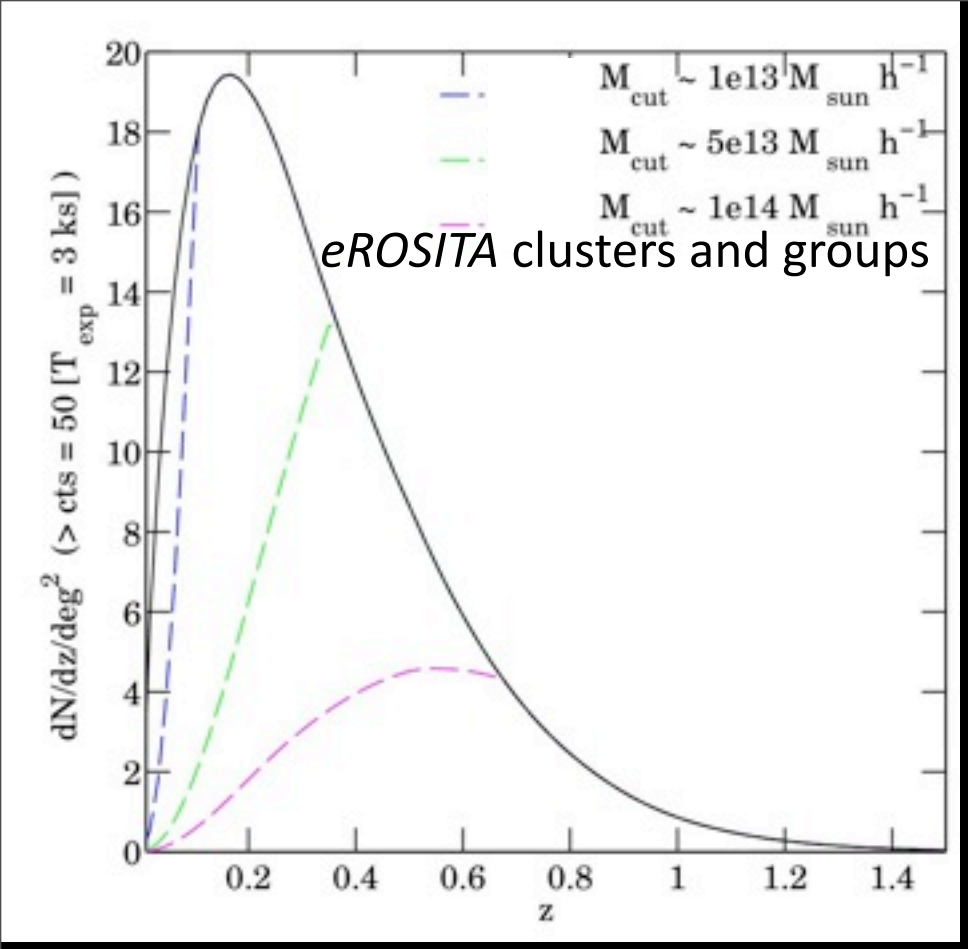
A2163 Suzaku (raw)

40 ks, PI: Naomi Ota

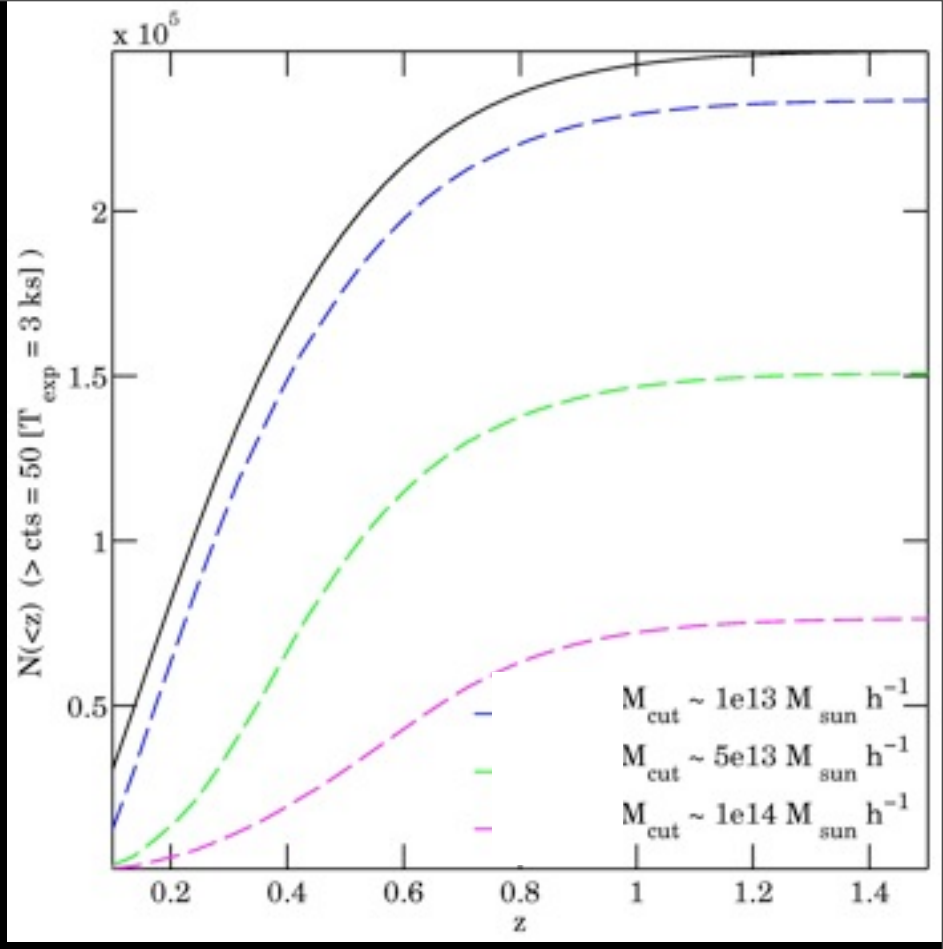


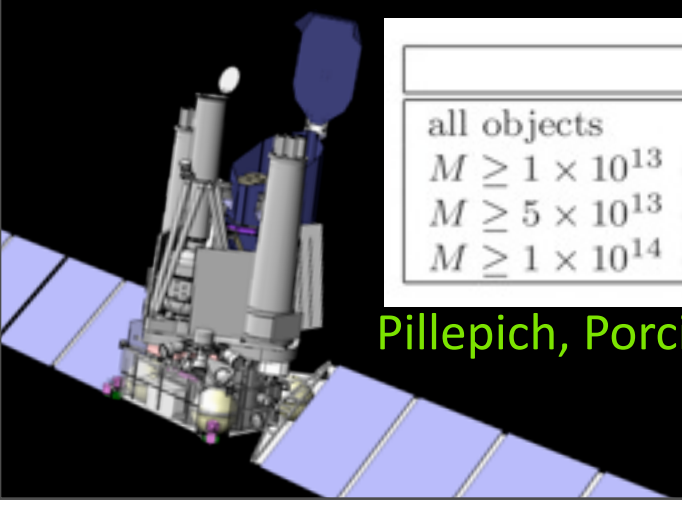
~160 ks Abell 2163 projected temperature profile (NE-S joint analysis) PSF-corrected





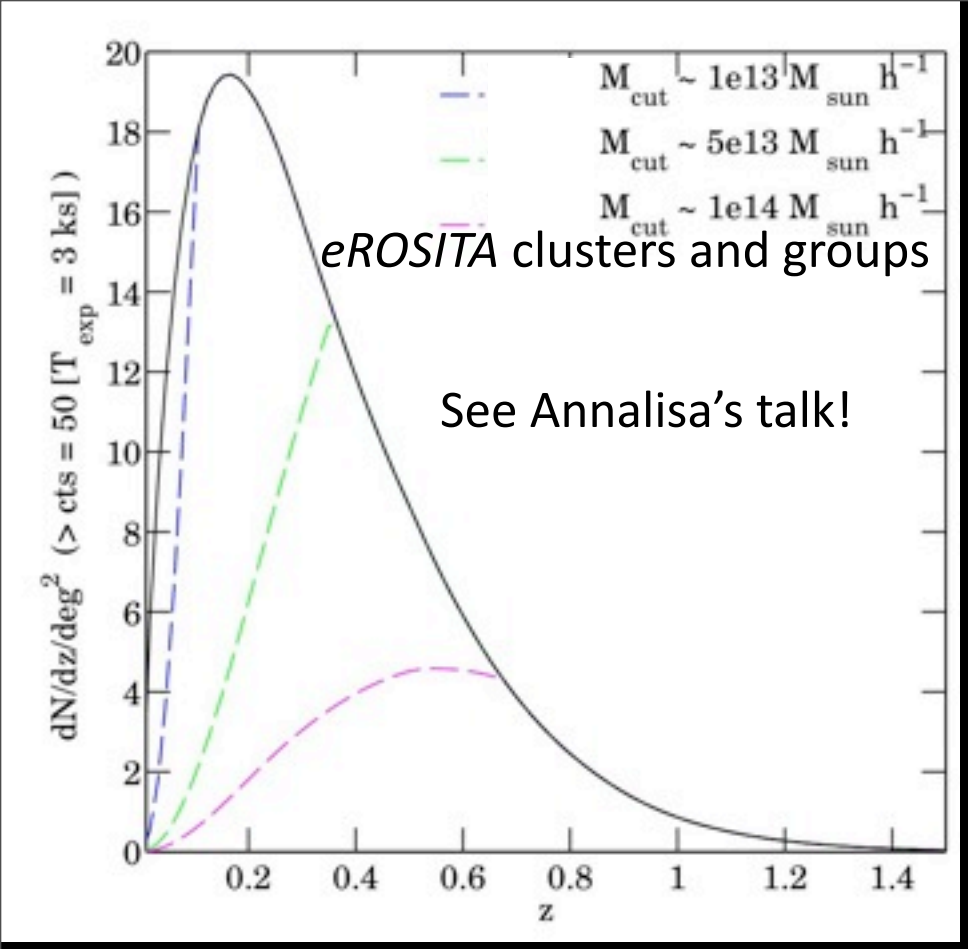
eROSITA clusters and groups





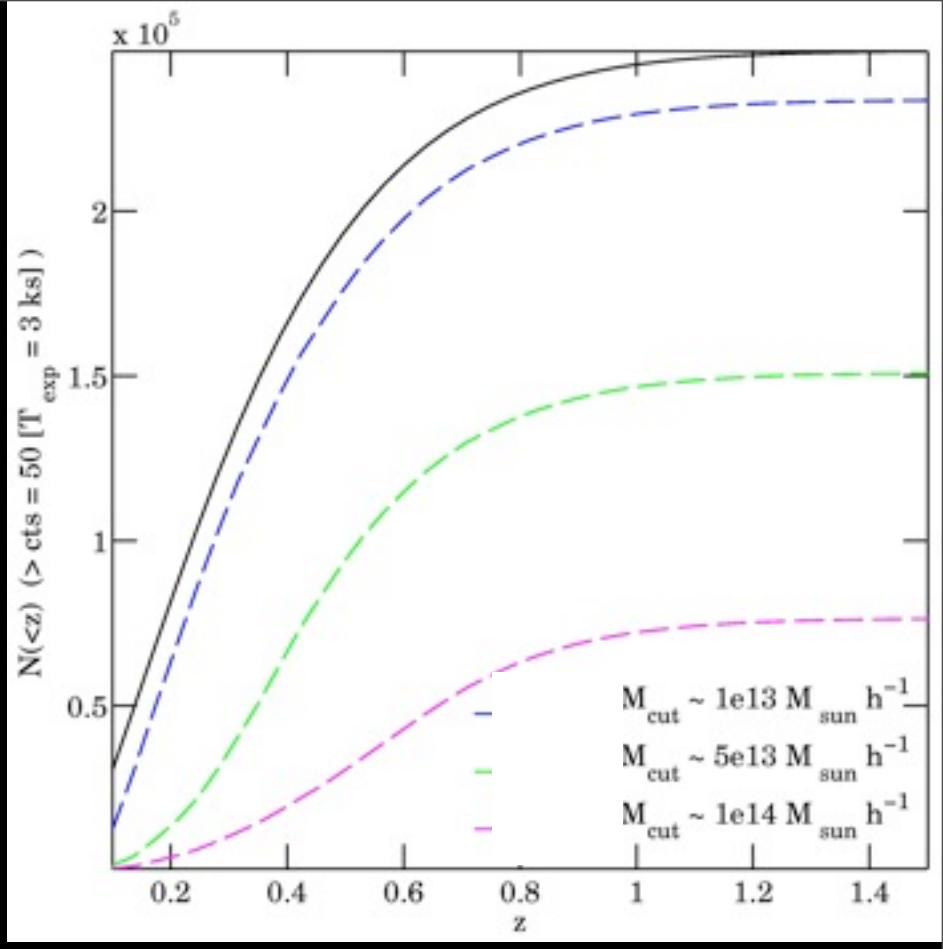
	$N_{\rm clusters}$ $(cts \geq 50$ (3 ks))	$z_{\rm median}$
all objects	$2.64\ (2.49) \times 10^5$	0.30
$M \geq 1 \times 10^{13}\ (M_\odot h^{-1})$	$2.48\ (2.34) \times 10^5$	0.31
$M \geq 5 \times 10^{13}\ (M_\odot h^{-1})$	$1.61\ (1.51) \times 10^5$	0.42
$M \geq 1 \times 10^{14}\ (M_\odot h^{-1})$	$8.13\ (7.63) \times 10^4$	0.56

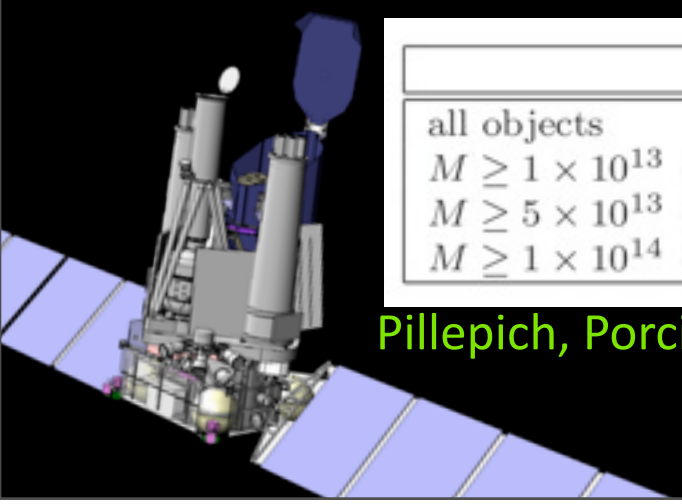
Pillepich, Porciani, Reiprich (to be subm.)



eROSITA clusters and groups

See Annalisa's talk!





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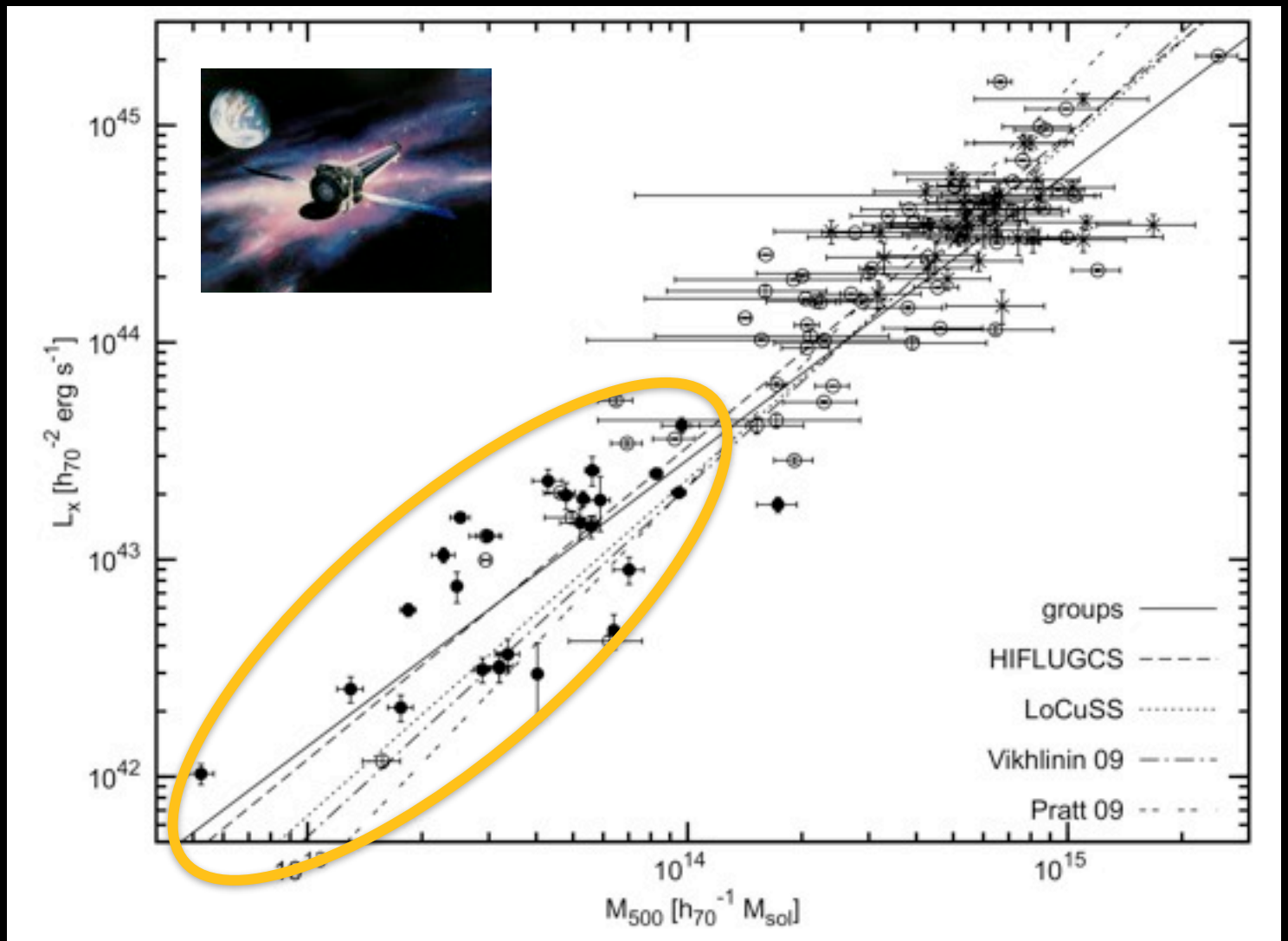
L_x–M Relation for Groups



Eckmiller, Hudson, Reiprich (subm.)

10

1

$M^{wl}_{500}\ (r^{wl}_{500})\ [10^{14}\ M_{sol}]$

1

10

$M^{hyd}_{500}\ (r^{wl}_{500})\ [10^{14}\ M_{sol}]$

400d, *z*~0.5, Israel (in prep.)

Summary of Conclusions

- *All* SCC clusters host a central AGN, only *half* of the NCC clusters host one.
- Observed SCC fraction is higher than "true" fraction.
- $L_{\rm radio}$ of central AGN is correlated with $\dot{M}_{\rm class}$.
- $M_{\rm BH}$ is weakly correlated with $L_{\rm radio}$, for SCCs.
- $M_{\rm BH}$ is tightly correlated with $M_{\rm tot}$, especially for SCCs.
- $\sigma_\star$ of BCGs is *not* correlated with T_0.
- Self-similar correlation of $L_{\rm X}$ and $\sigma_{\rm gal}$.
- ….
- High quality benchmark sample, to be reproduced by future cosmological simulations (start with mass function then gauge physics input until all properties