Evolution of Entropy Profiles in Simulated Clusters

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Cosmological simulations as asset for Athena Collaboration & scientific definition of Key Science Project

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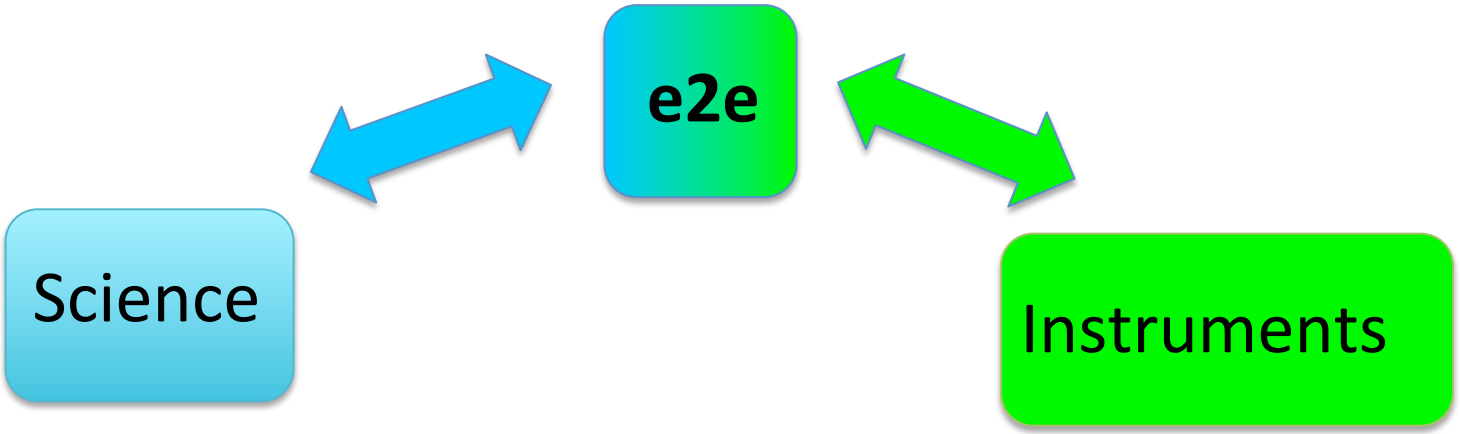

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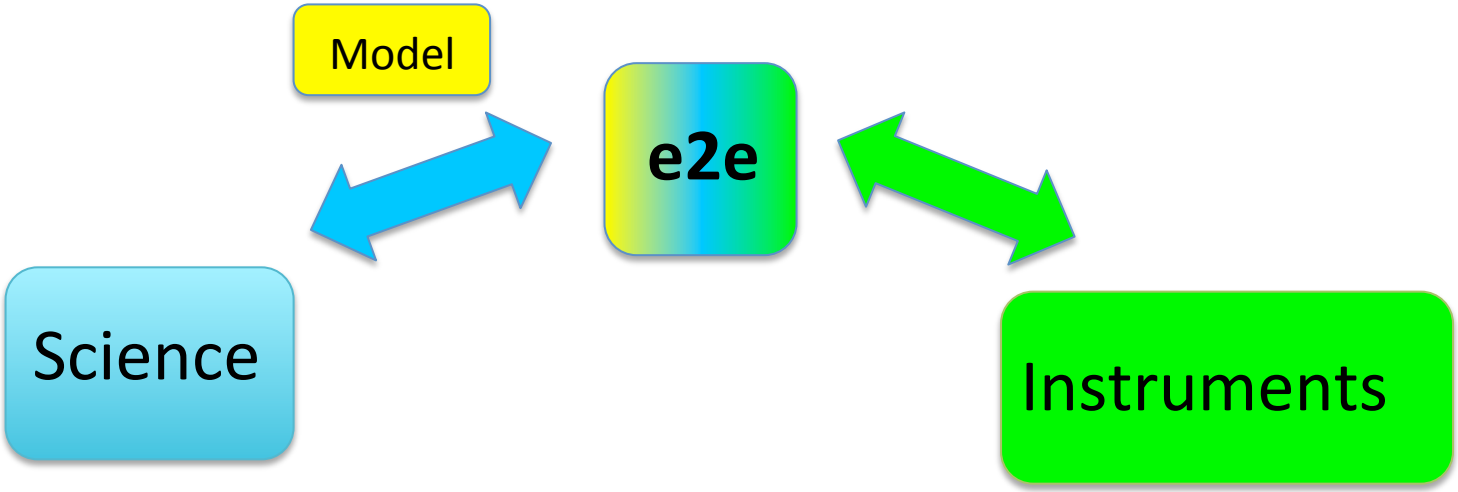


Athena swg1.1 & swg1.2
[121- Evolution of Entropy Profiles
122 Evolution of metal production]

Entropy @ z~0

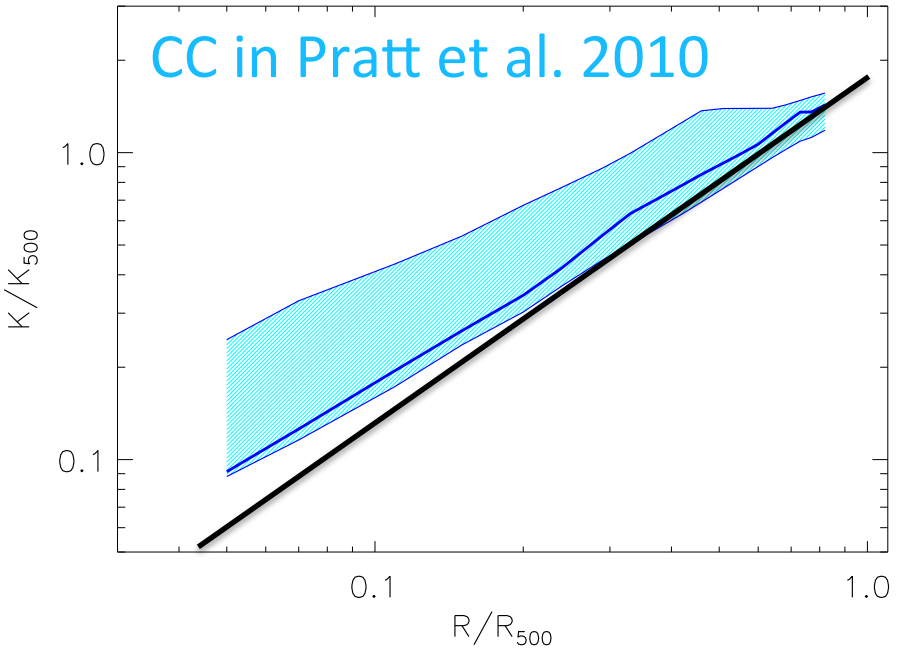
$K=kT/n_e^{2/3}$

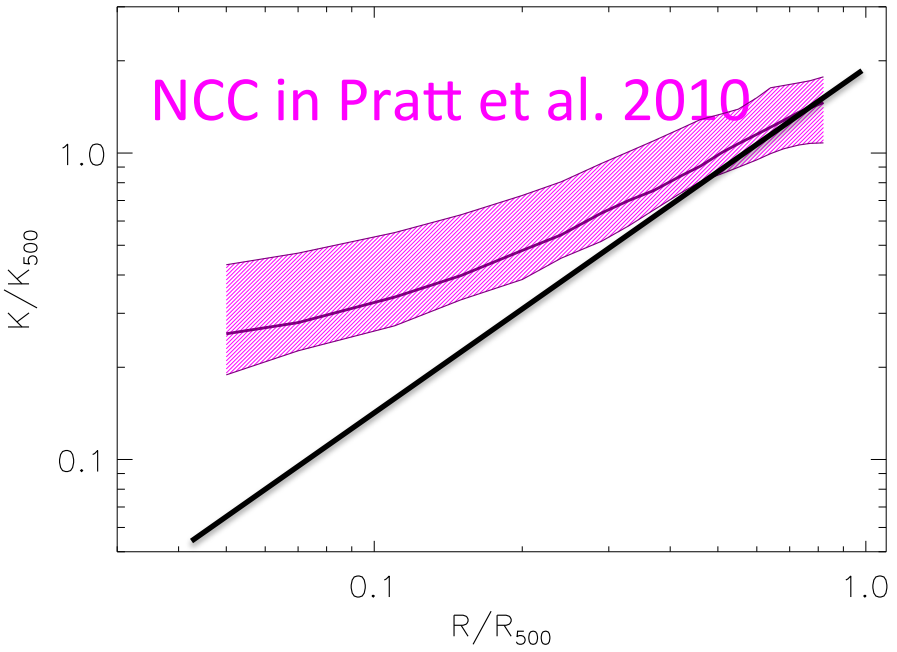
Gravity drives structure formation.

Simply gravity-only models do not explain the observed gas profiles from the core to the outskirts.

Delicate balance between heating and cooling is in place.

Entropy quantifies the history of the energy deposited in the intra-cluster medium.





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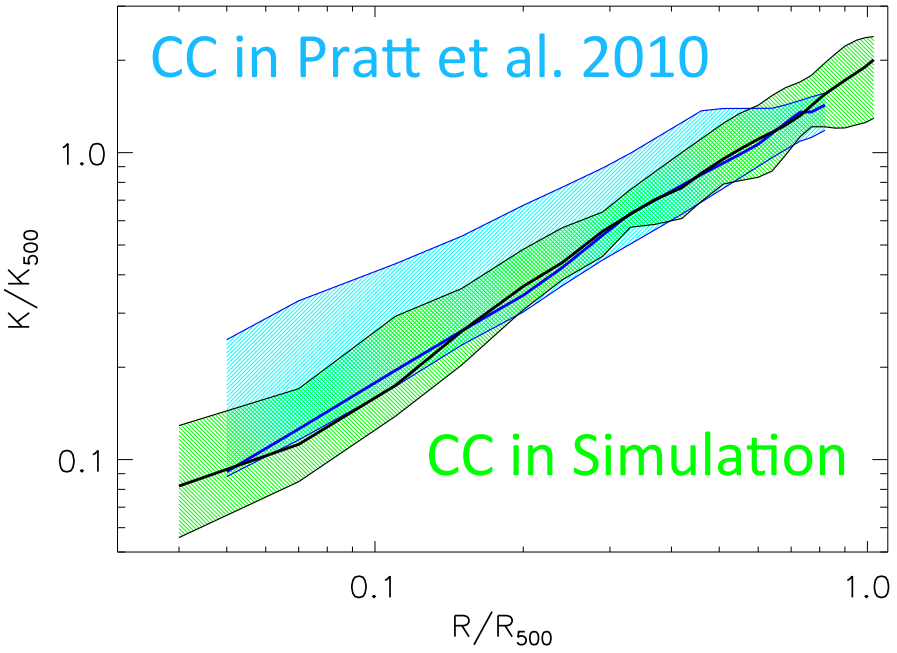

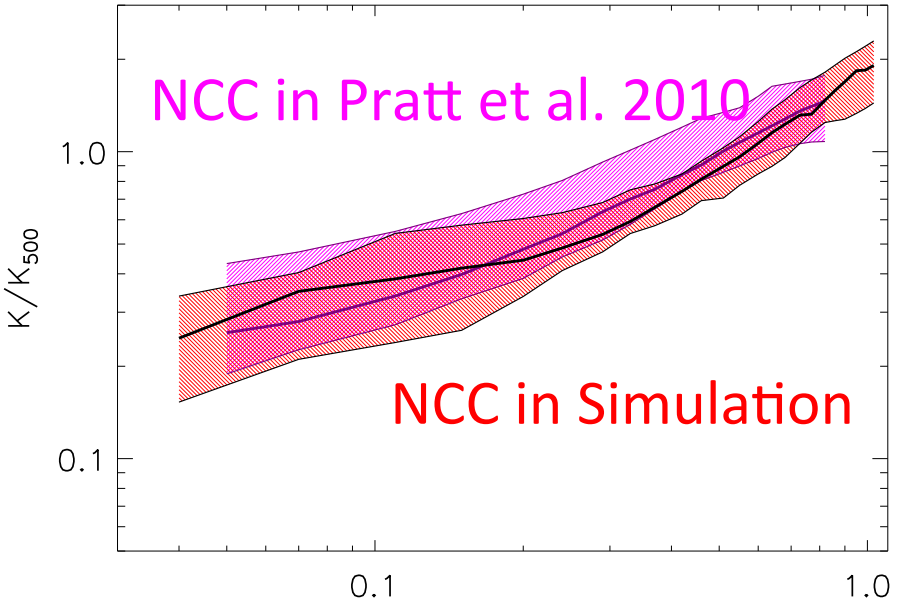

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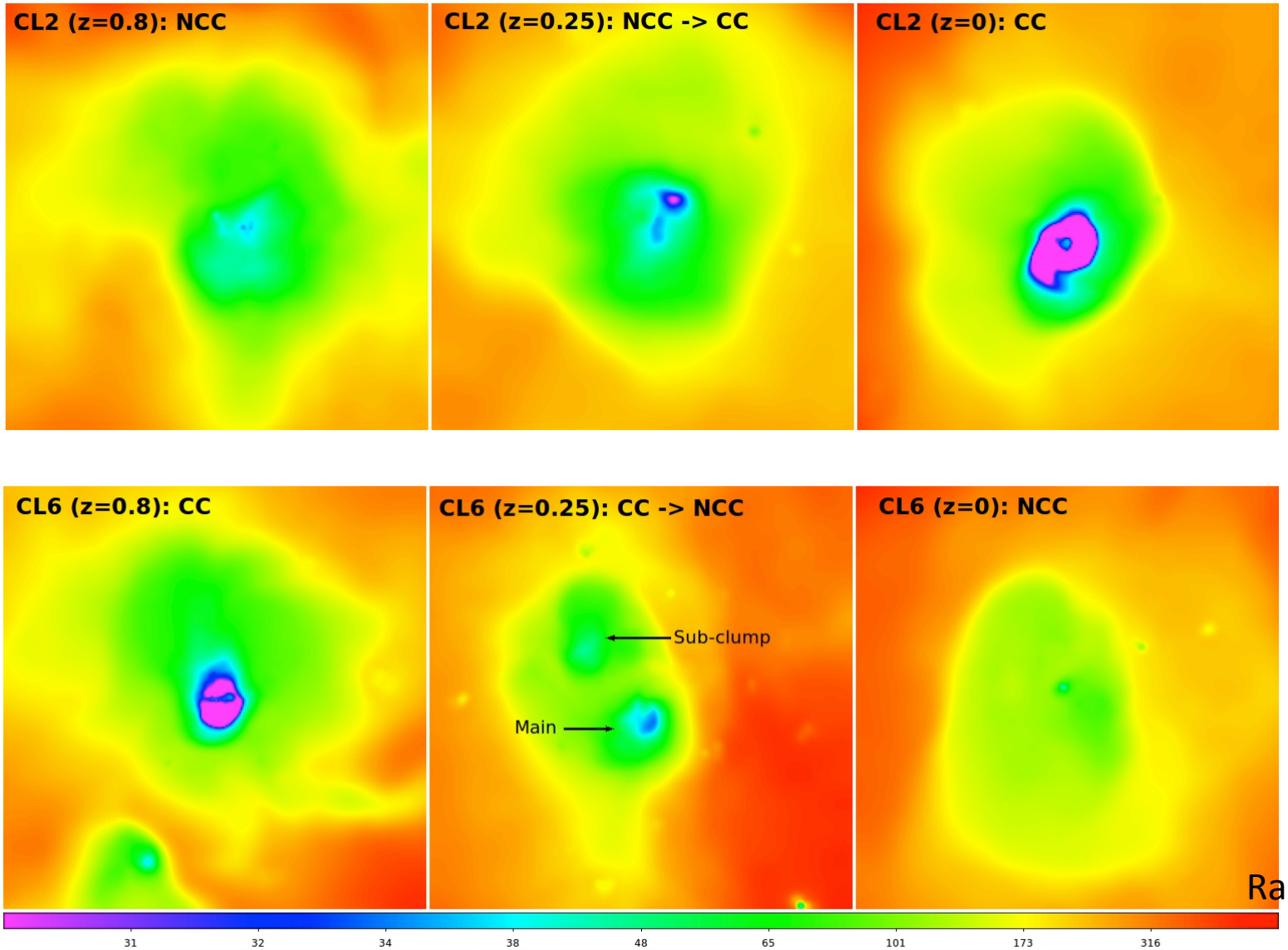
CC-> NCC-> CC

Pseudo-Entropy Maps



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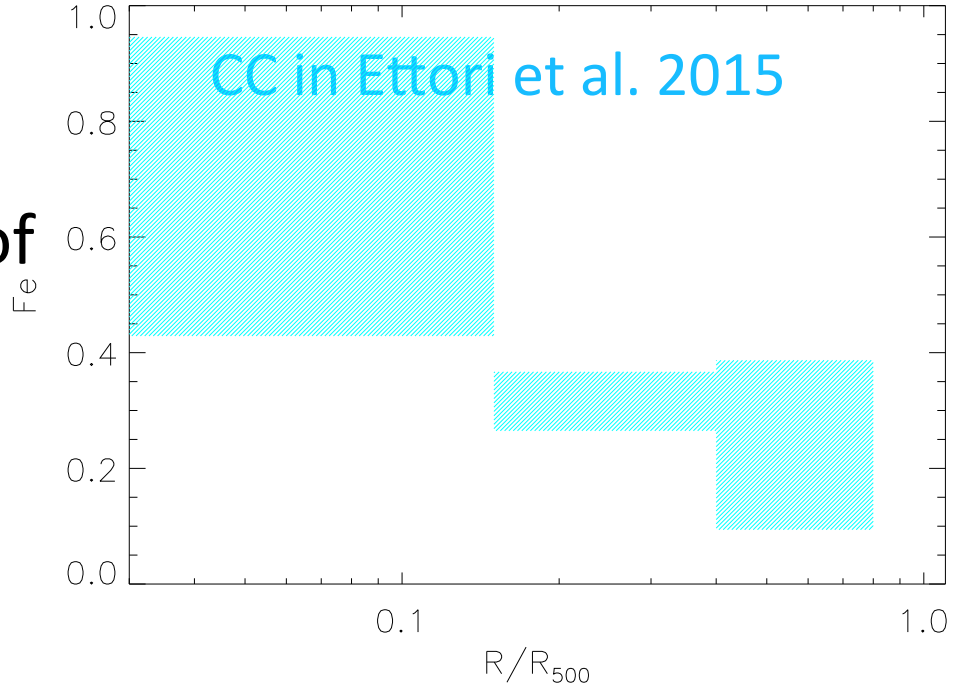
Iron Abundance at z~0

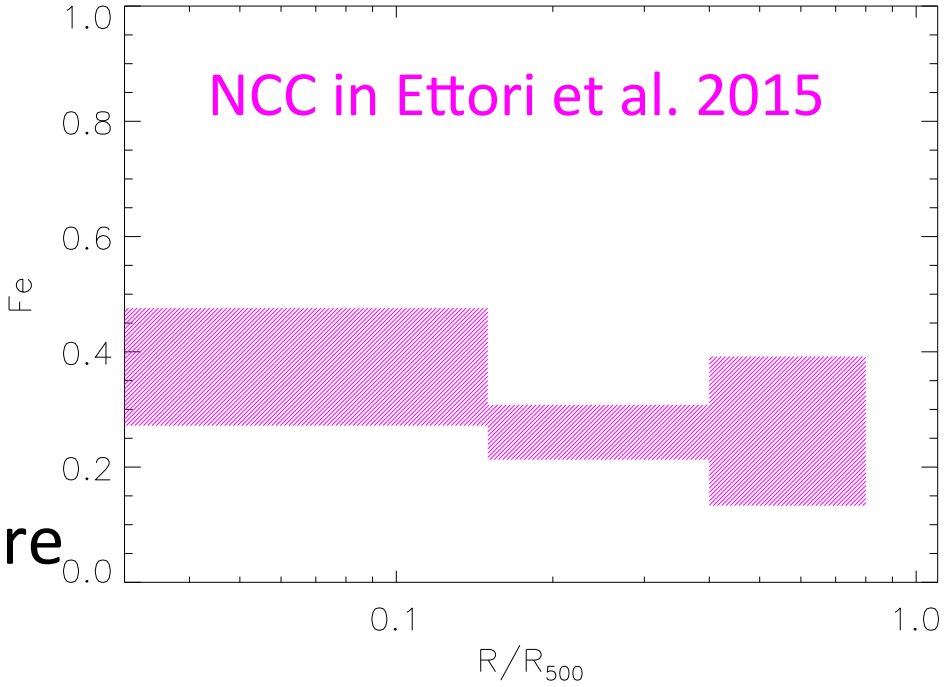
Process driving evolution of chemical enrichment:

- Initial Mass Function
- SNIa, SNcc, AGB yields (and evolution)

Metal diffusion into the intra-cluster medium:

- Early superwinds
- Late ram pressure stripping
- Minor mergers in the core
- Uplift by AGN bubbles





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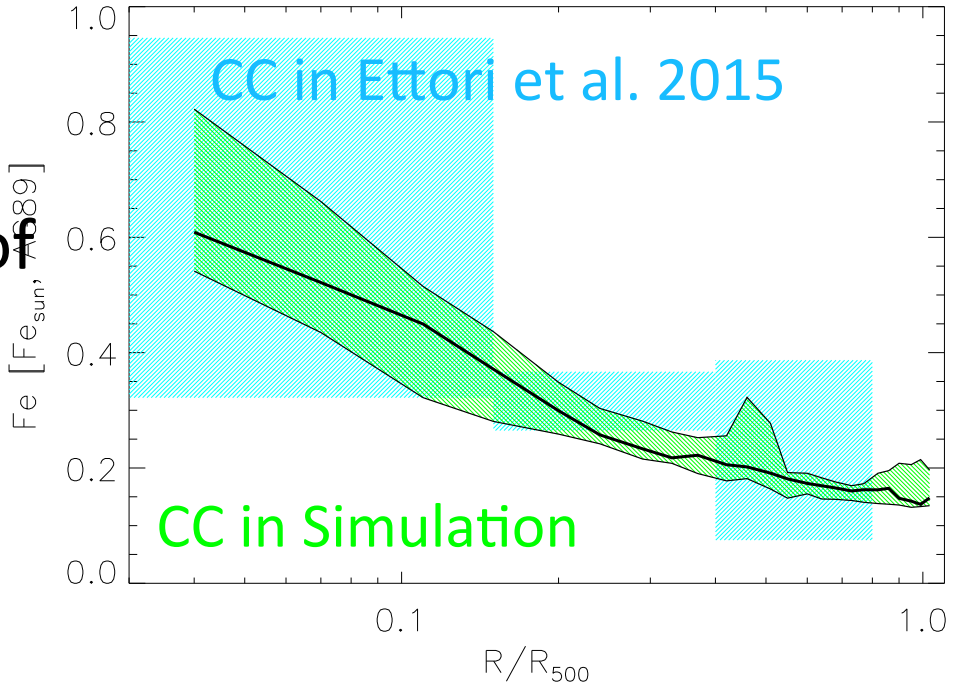

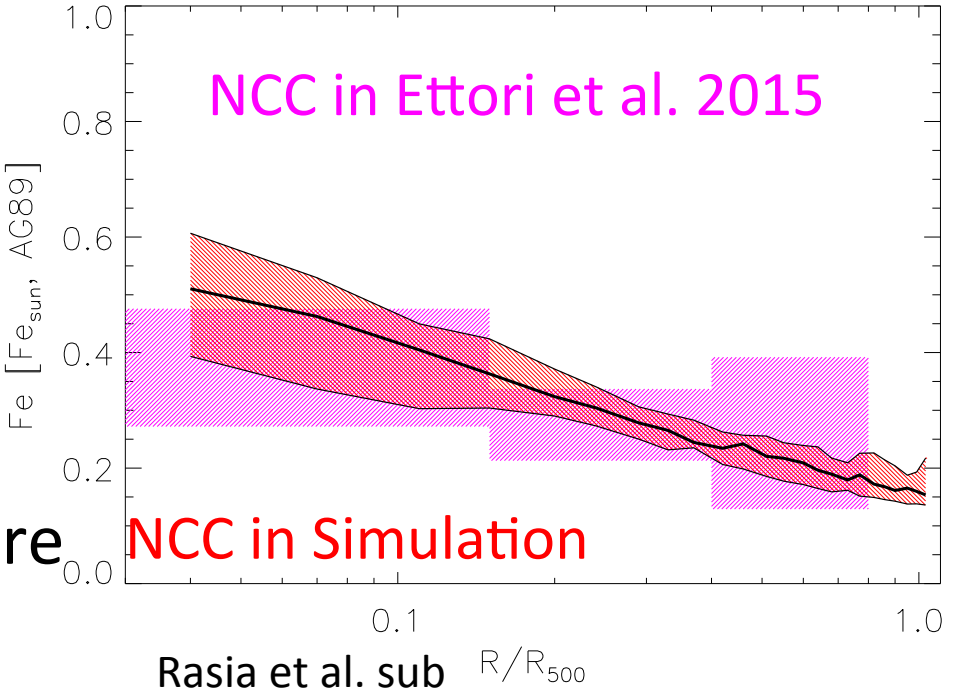

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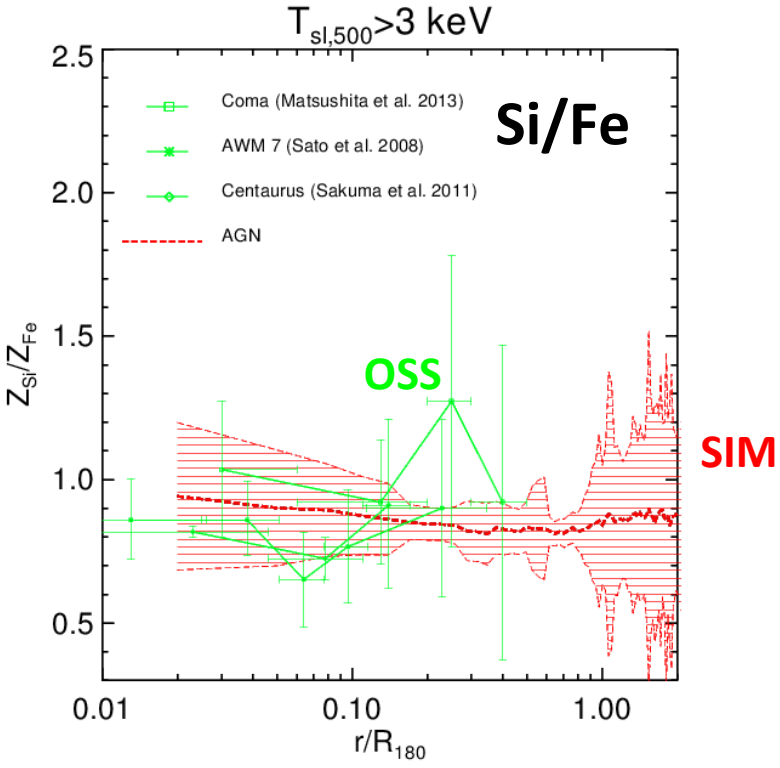
Few z=0 comparisons

ICM enrichment

Not only Iron and Silicon individual profiles profiles but also their ratio



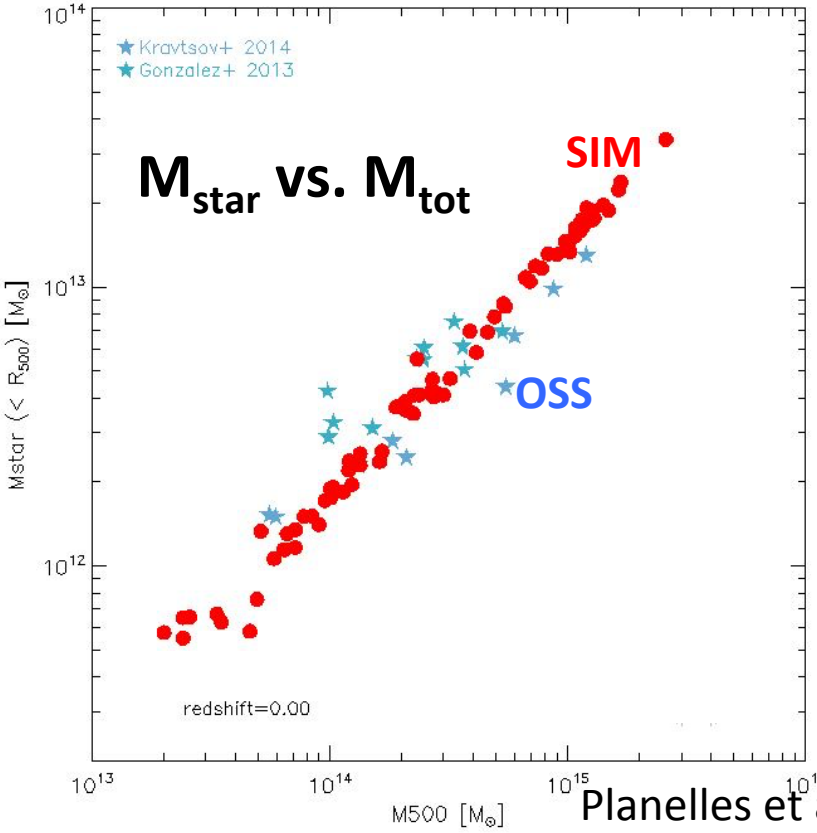
Biffi et al. in prep

Stellar Scaling Relation

M_{BH}-M_* relation to calibrate feedback parameters:
v_w=350 km s^{-1} & ε_f=0.05
Observations from McConnell & Ma 2013

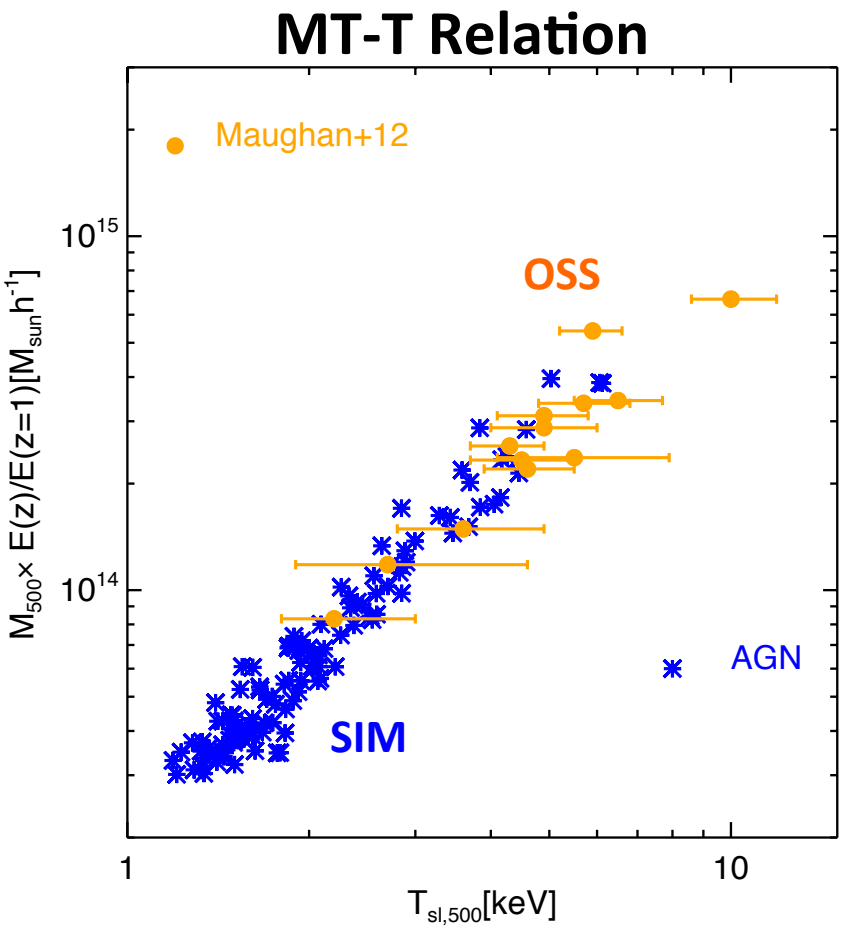
M_{*BCG}-M_{500} in agreement with observations (Kravtsov+14)

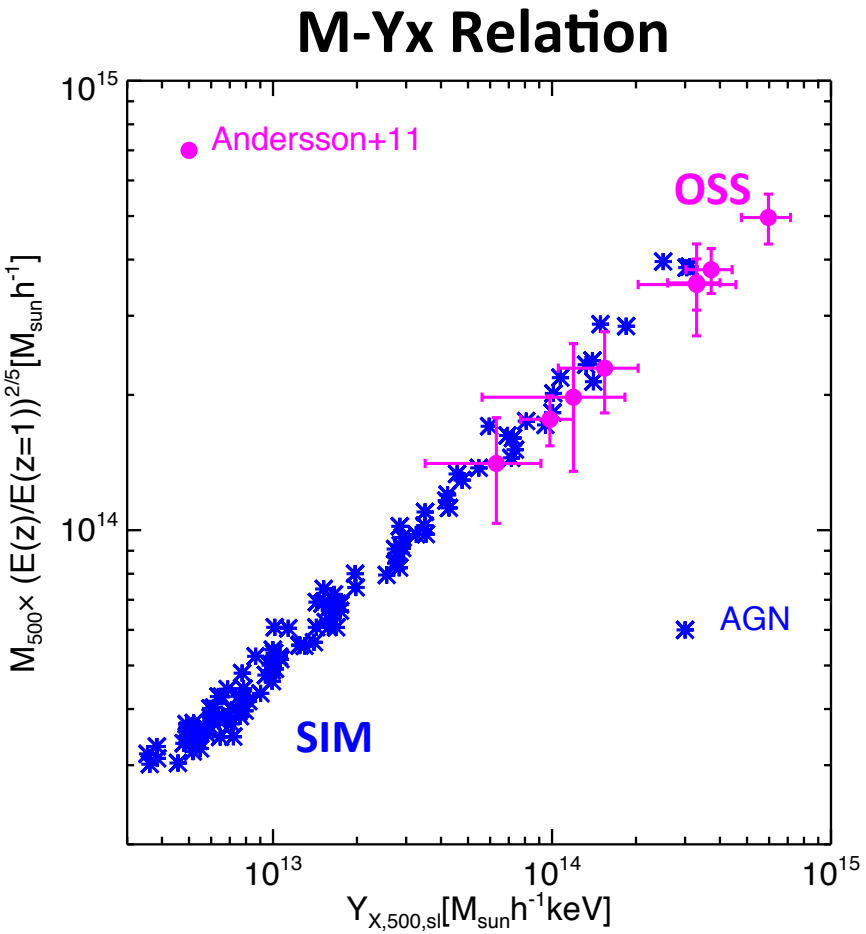
Total stellar mass also close to observations (Gonzalez+13, Kravtsov+14)



Planelles et al. in prep

Few Scaling Relation at z~1



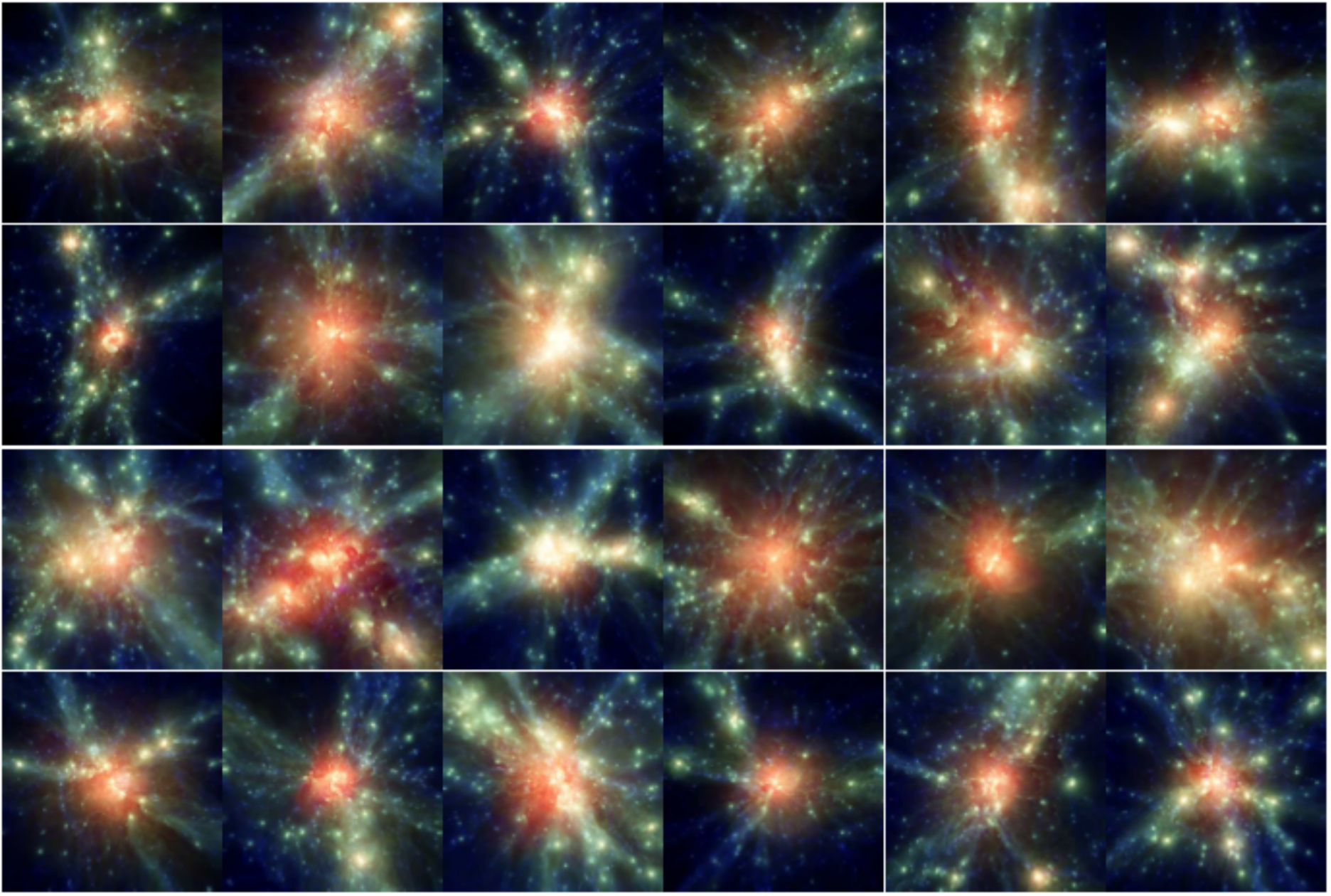


Truong et al. in preparation

$Y_x = T\ M_{gas}$

Zoom-in simulations

Bonafede+12



Bonafede+12

24 massive clusters + 5 groups

GADGET3 with modifications: ✔

- *Artificial conduction term*
- A high-order interpolating kernel
- A time-dependent artificial viscosity

Metal-dependent radiative cooling

Kinetic feedback from SN (v=350 km/s)

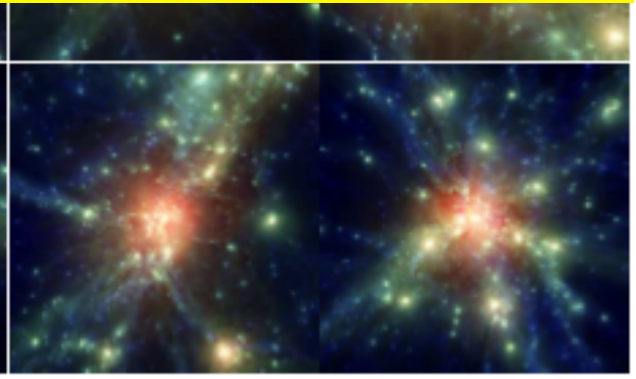
Metal production from SNII, SNIa, AGB:

C, Ca, O, N, Ne, Mg, S, Si, Fe, Na, Al, Ar, Ni

AGN feedback with cold and hot accretion

NOT INCLUDED ✖

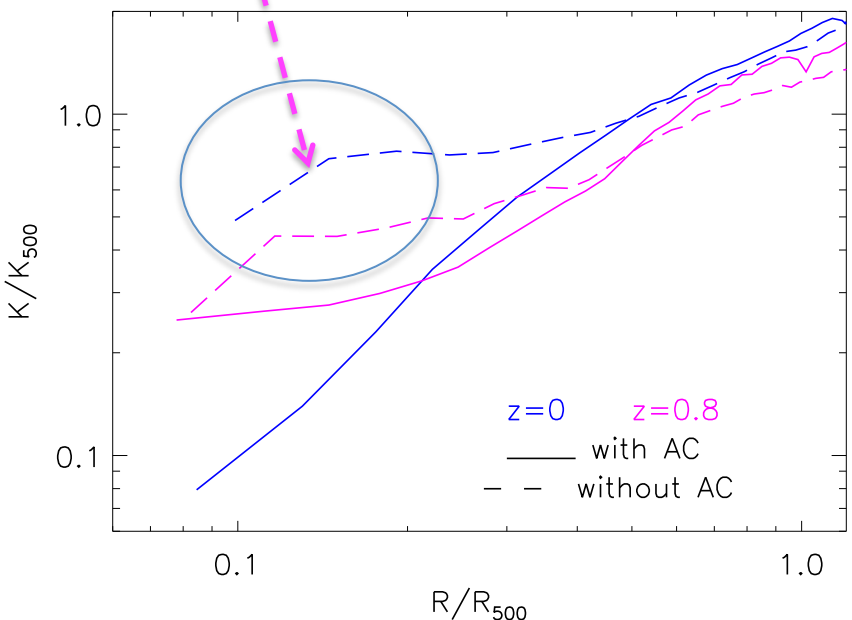
- Inflation of bubbles of high-entropy gas from the shocks of sub-relativistic jets
- Gas circulation and turbulence triggered by the bubbles
- Magnetic field
- Thermal Conduction
- Cosmic ray

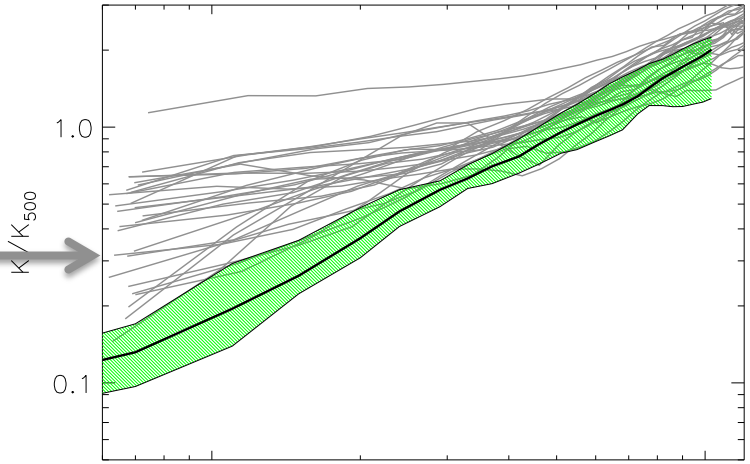


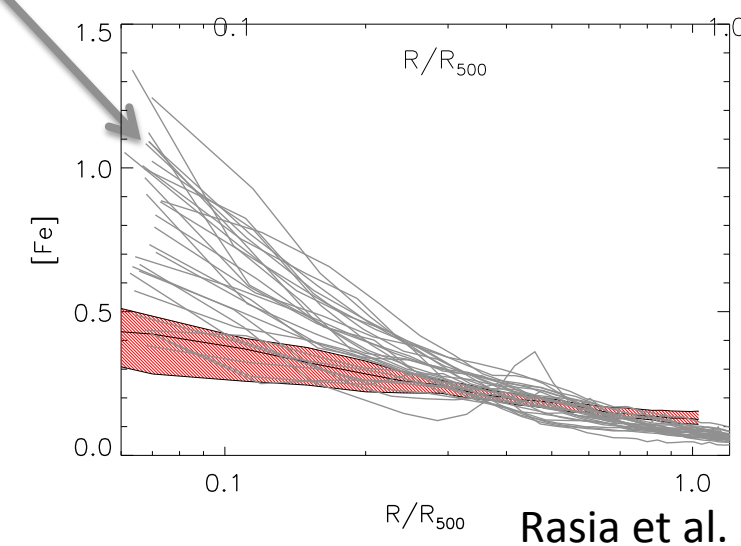
The capability of generating a realistic CC population is due to *combined* action of AGN feedback and the artificial conduction term in SPH equation.

Without AC -> no dichotomy

Without AGN ->
No CC in entropy
No NCC in Iron







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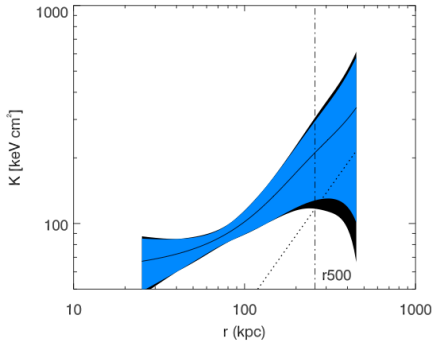
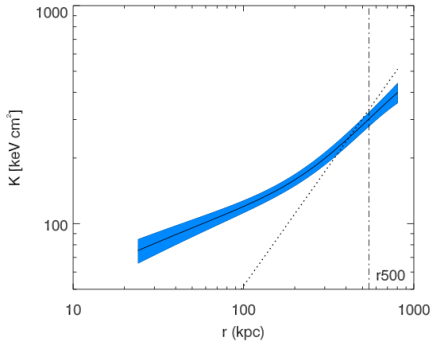
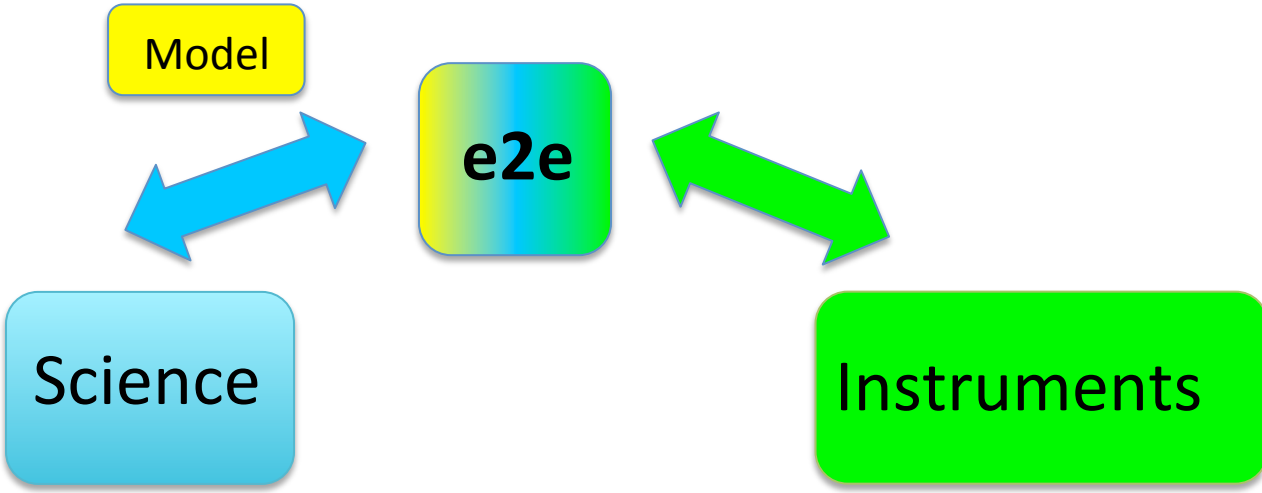




Pointecouteau, Reiprich+2013



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