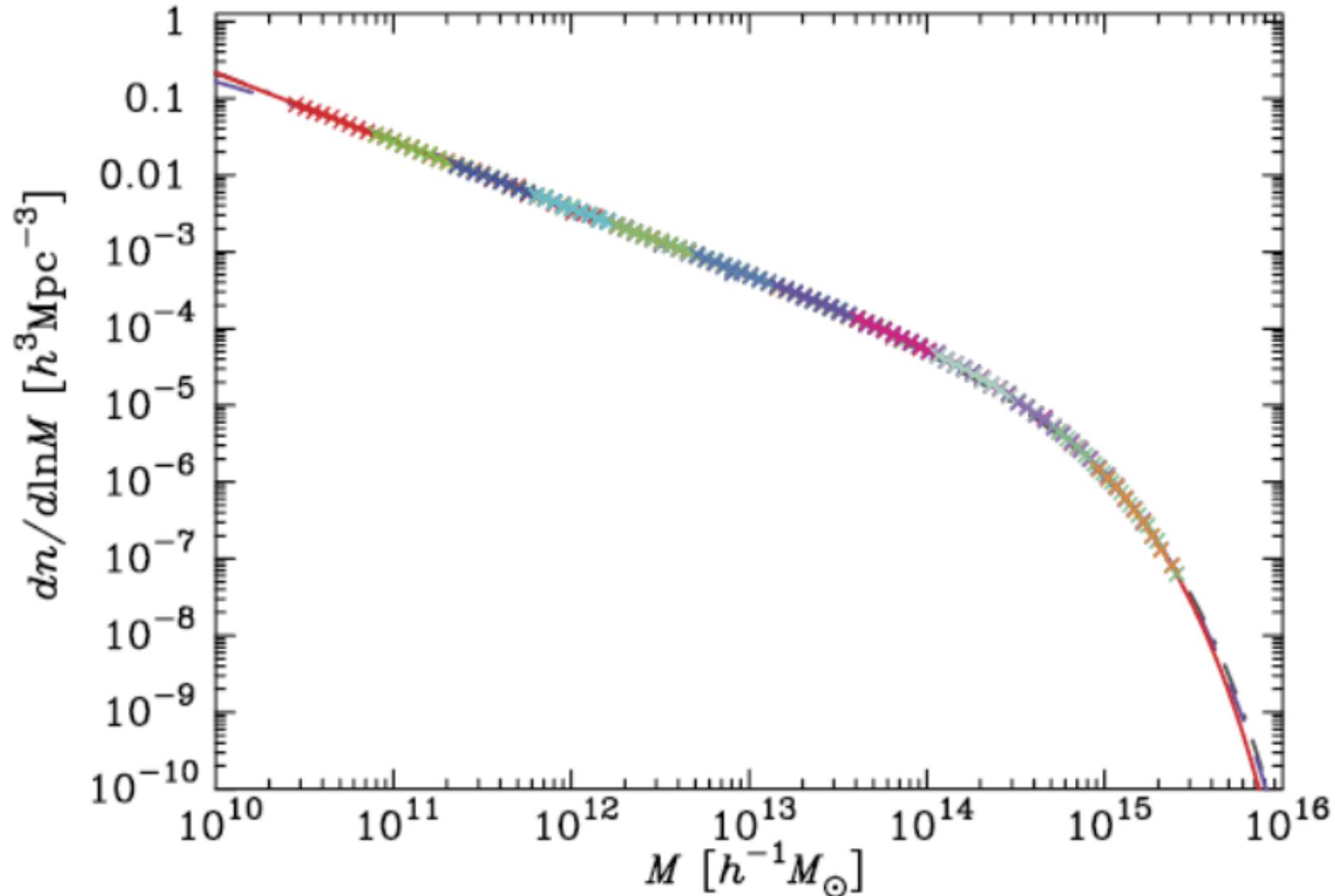


# Large Scale Structure

Silvano Molendi  
IASF-Milano/INAF

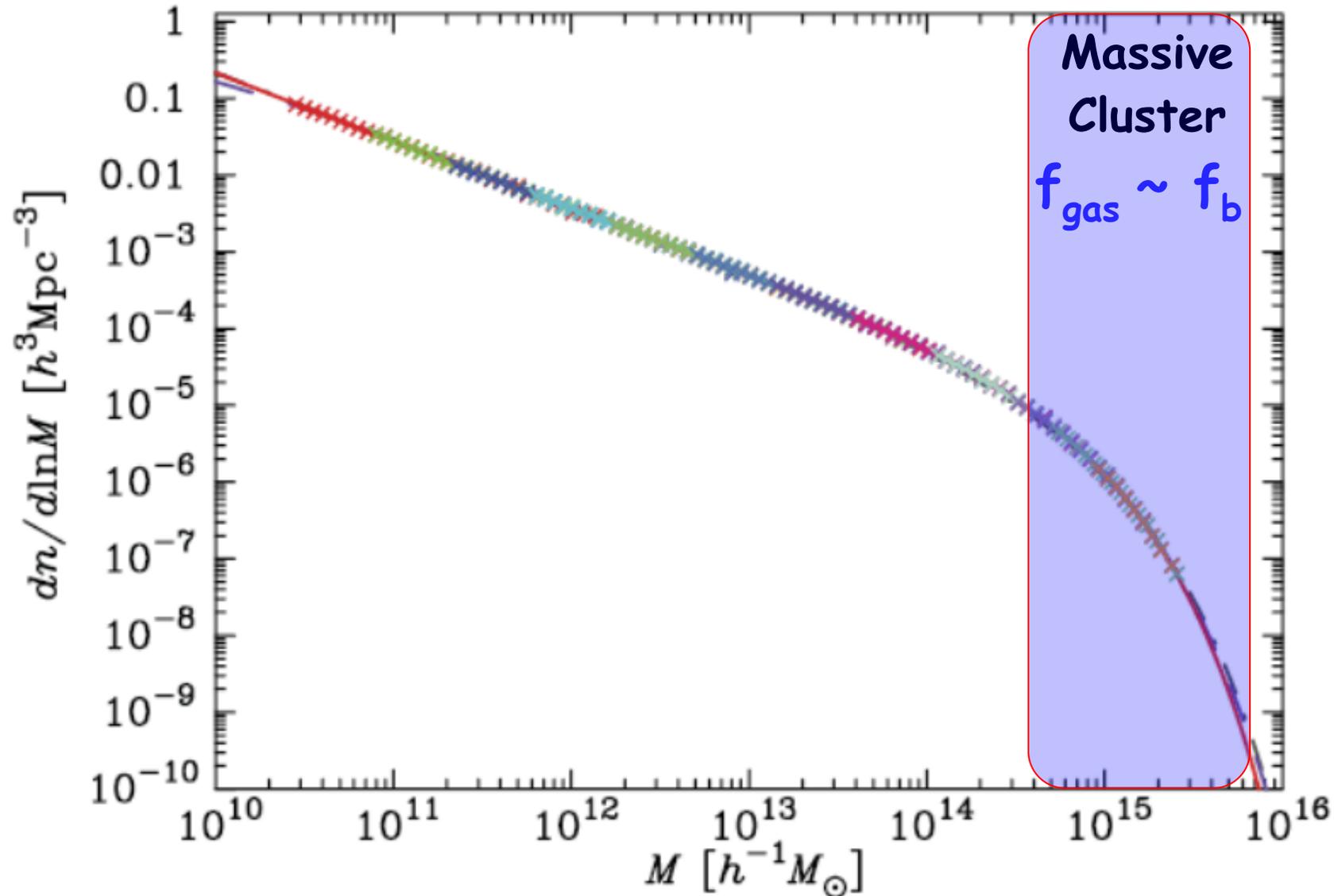
# Dark Matter vs. Baryon Distribution

Warren+06



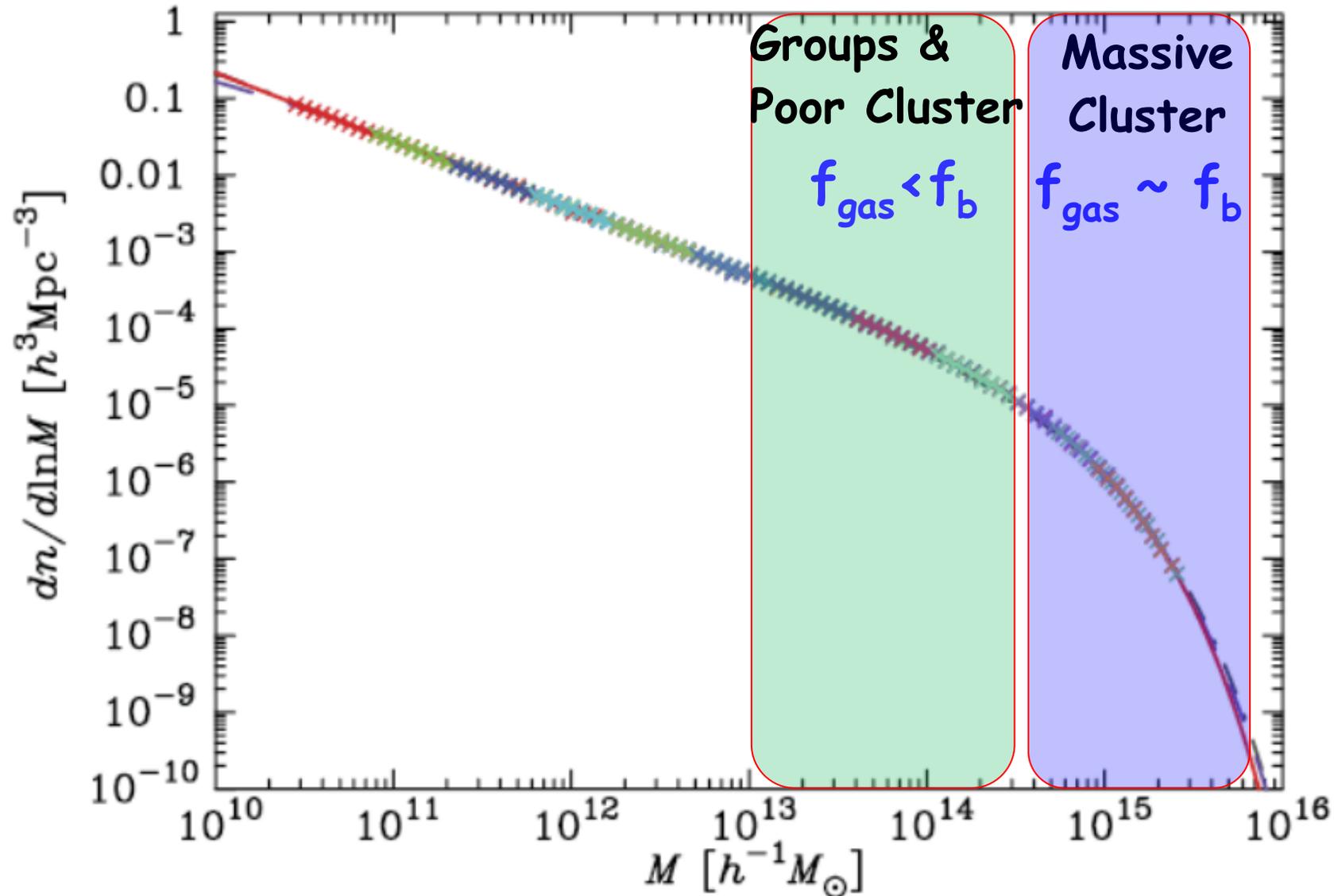
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Warren+06



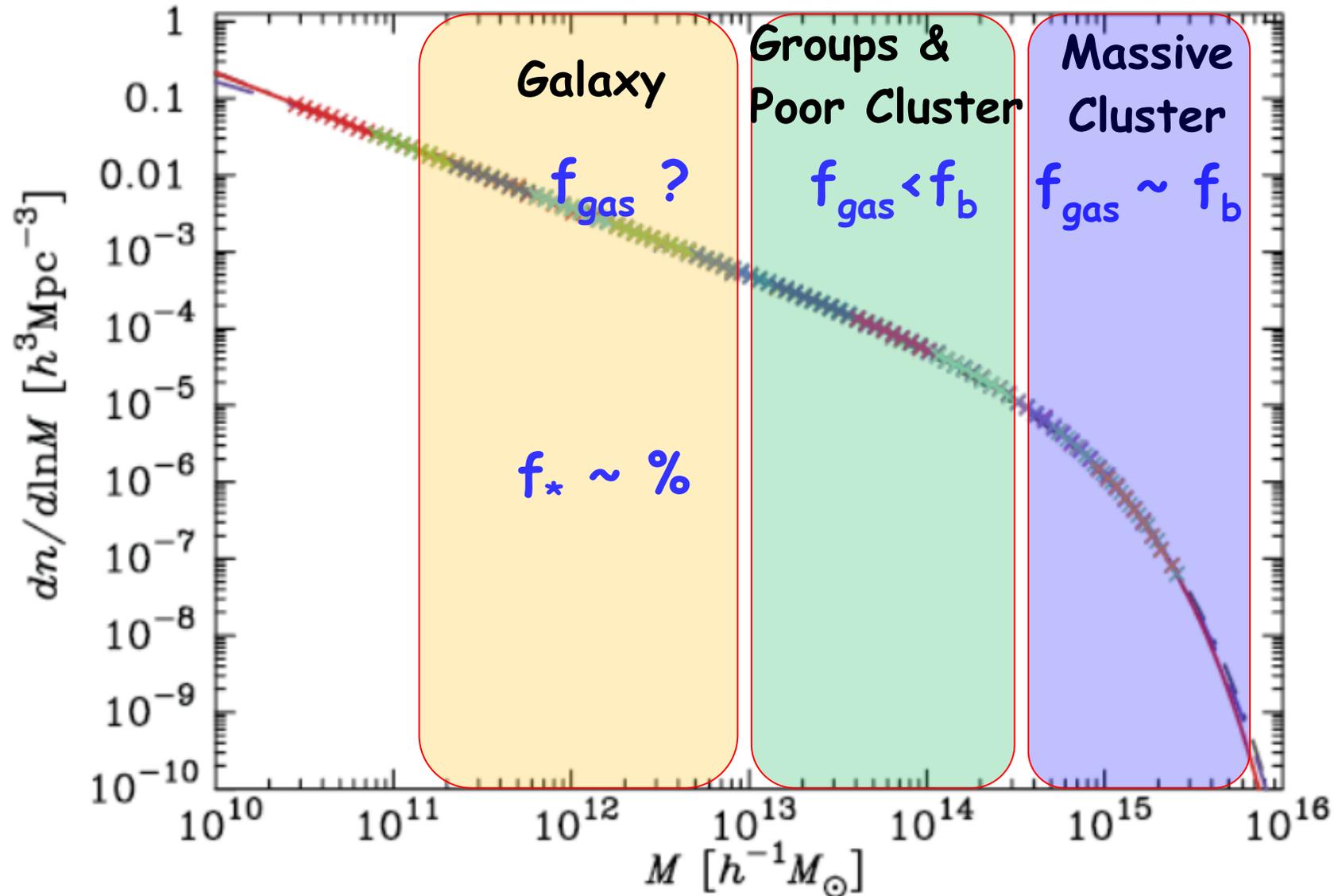
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Warren+06



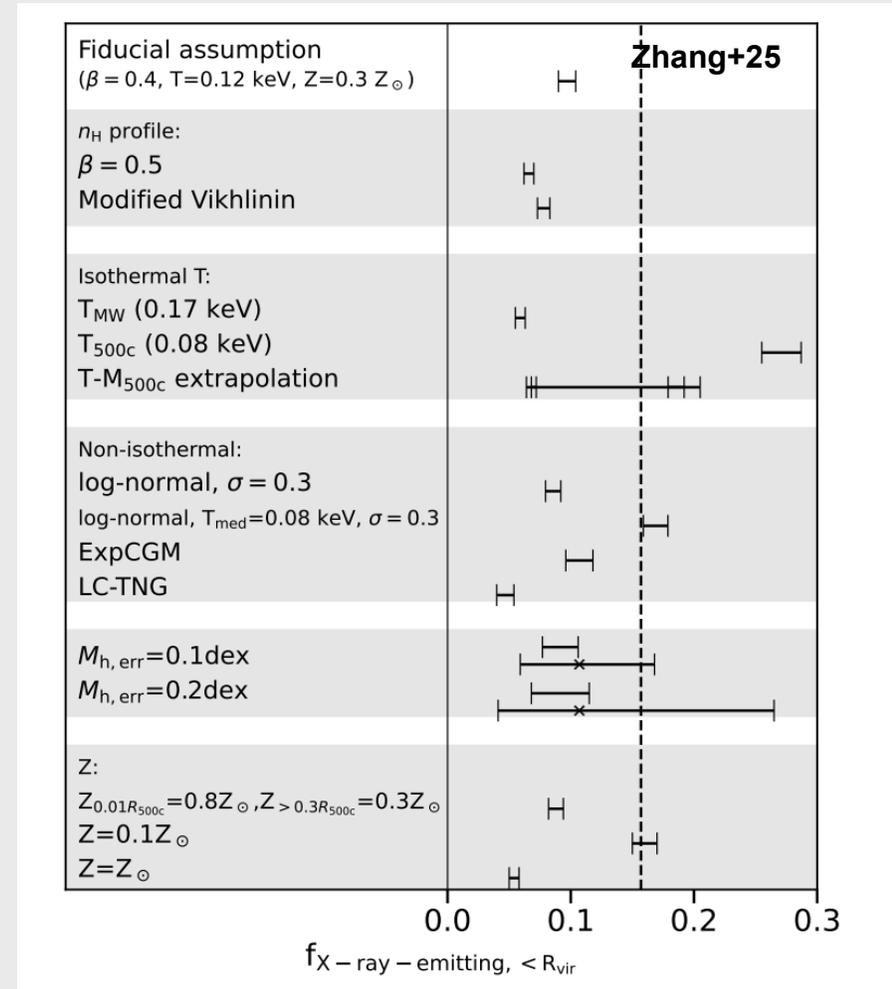
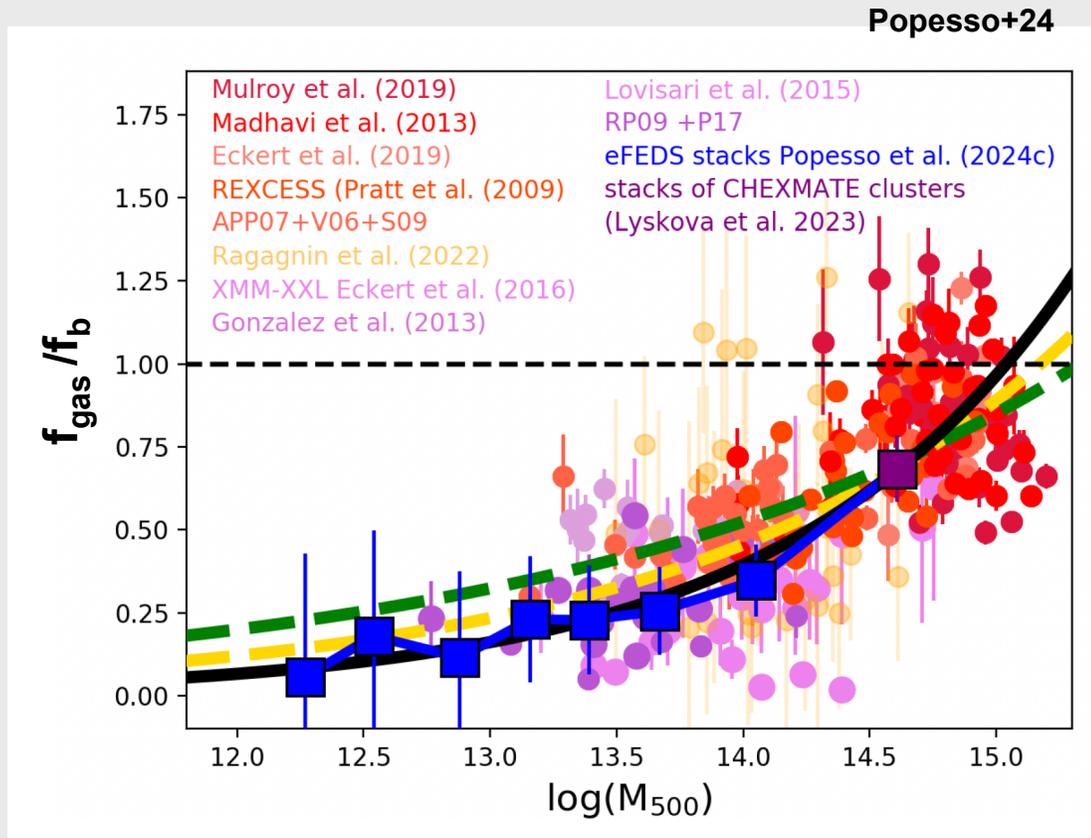
# Dark Matter vs. Baryon Distribution

Warren+06



# Baryons in halos

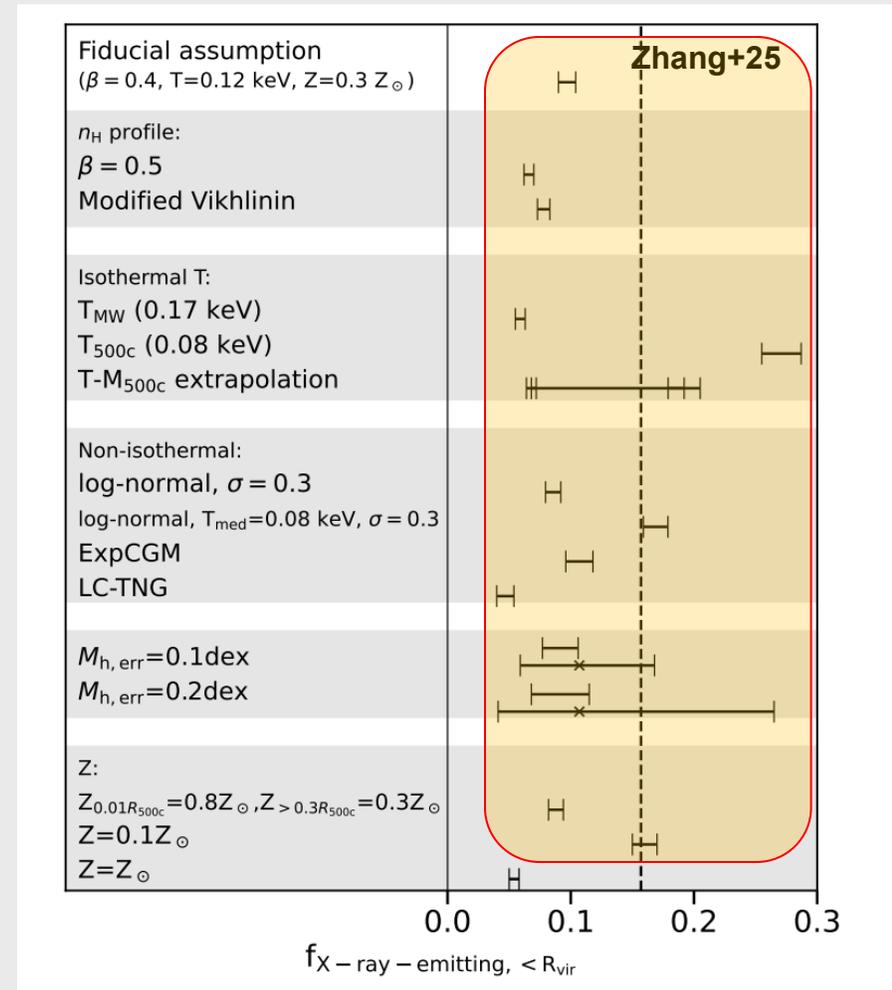
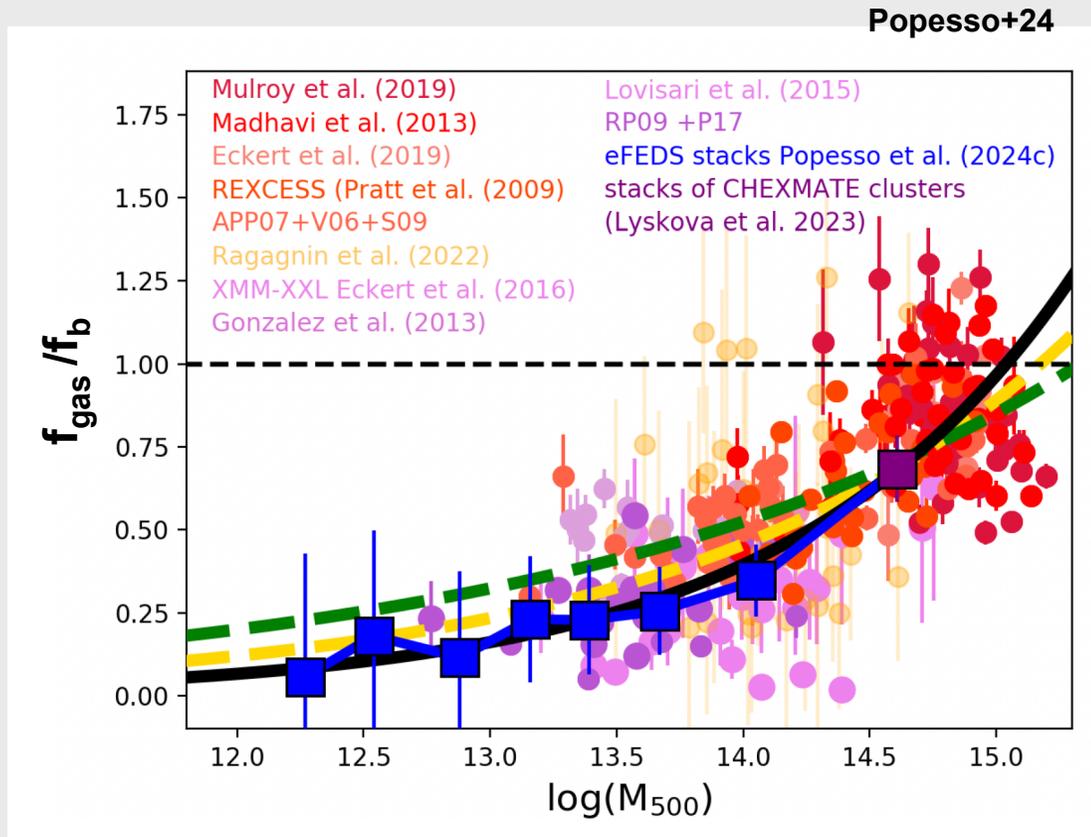
Attempts at estimating gas fraction on group and galaxy scales



Stacking of eROSITA data

# Baryons in halos

Attempts at estimating gas fraction on group and galaxy scales



Stacking of eROSITA data

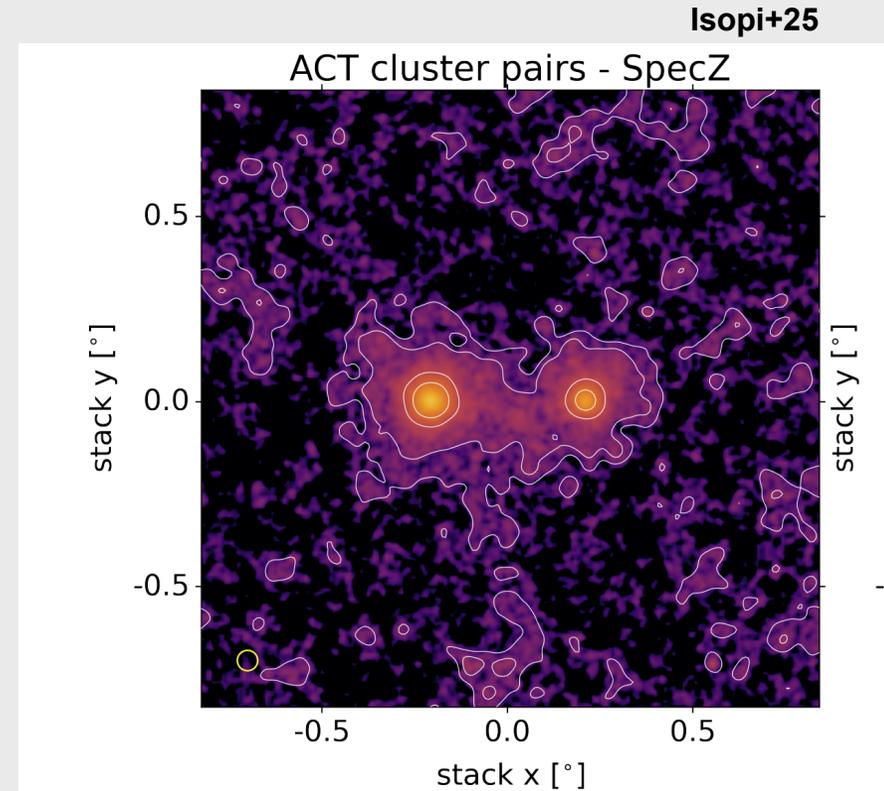
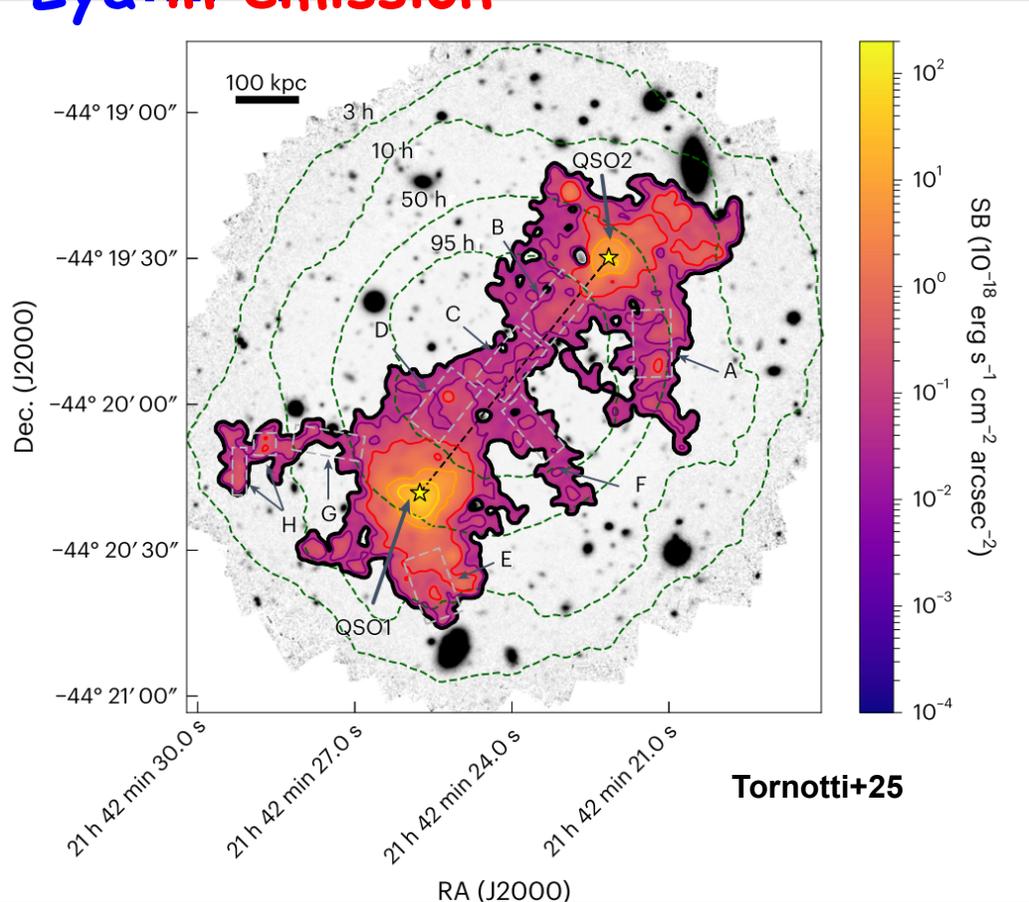
$$0.25 < f_{\text{gas}}/f_b < 2$$

# Baryons outside halos

filament @  $z \sim 3$  observed via

**$\text{Ly}\alpha$  in emission**

At lower redshift gas is hotter



**Filaments between clusters**

# Direct detection of missing baryons

Detection of warm/hot low density baryons in X-rays is based on absorption lines. (e.g. Nicastro+23)

Detection of these lines has been controversial

# Direct detection of missing baryons

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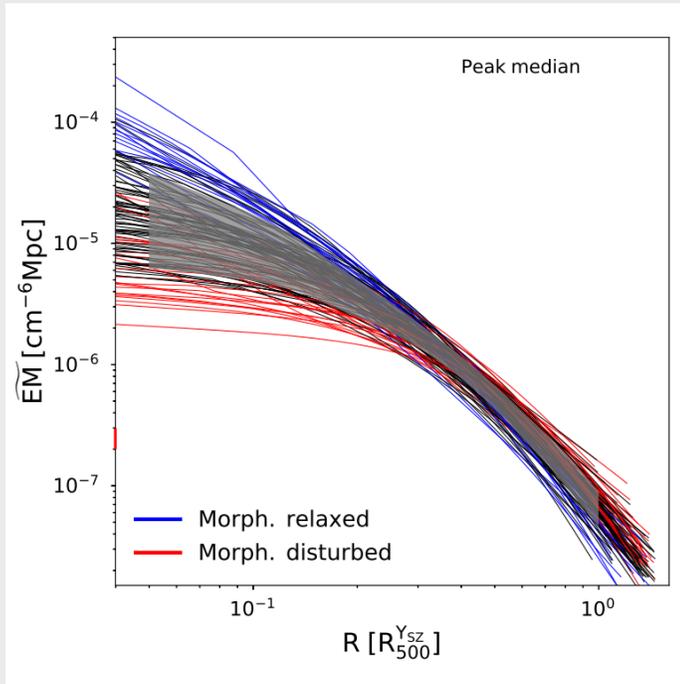
Detection of these lines has been controversial

Lots of gas not sure exactly how much and where it is

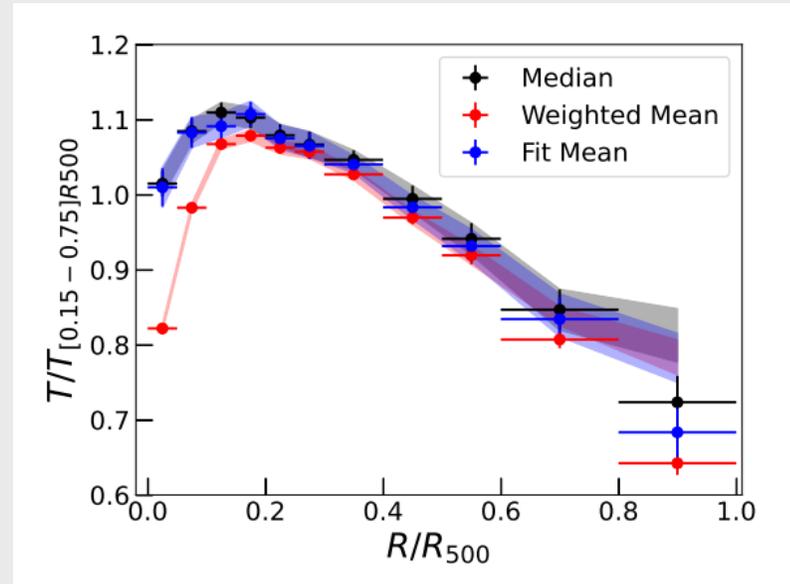
# ICM Thermodynamics

CHEX-MATE (XMM-Newton heritage program CoPIs Ettori, Pratt)

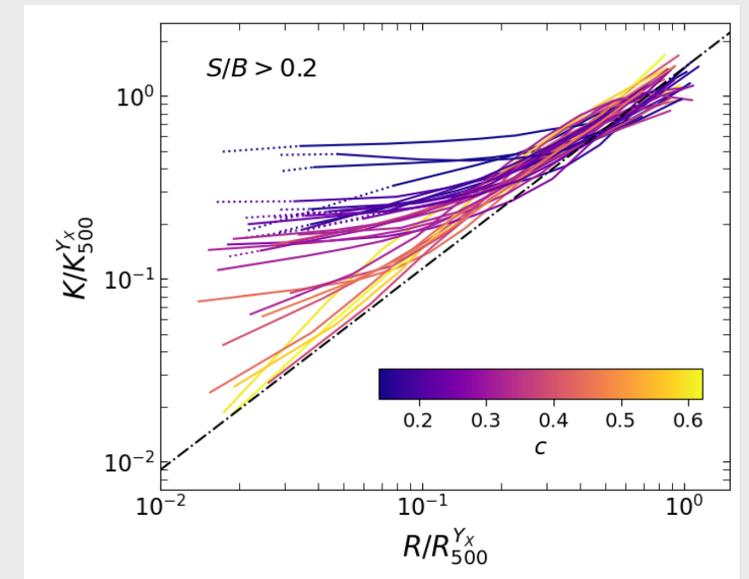
Batalucci+23



Rossetti+24



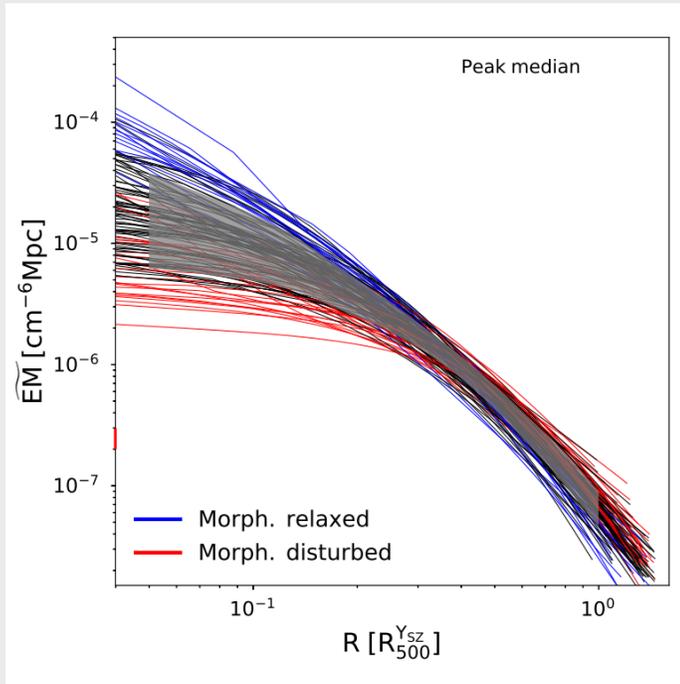
Riva+24



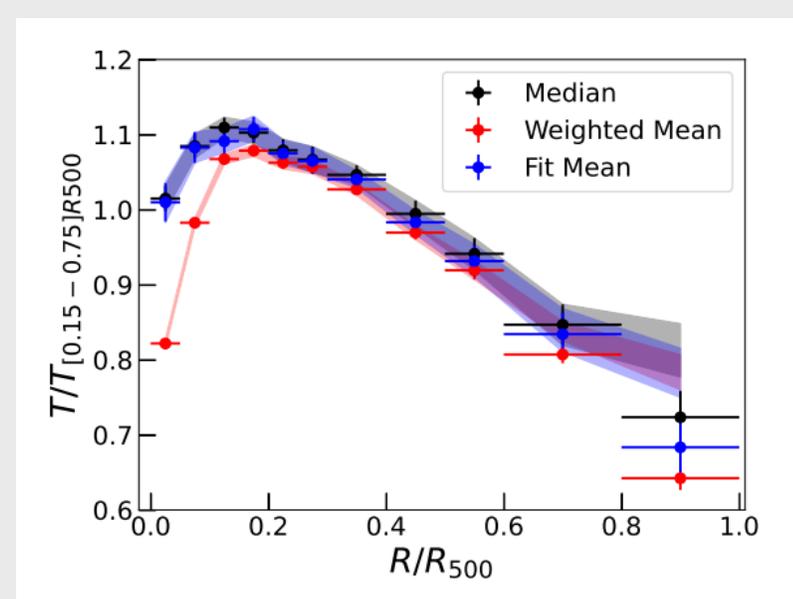
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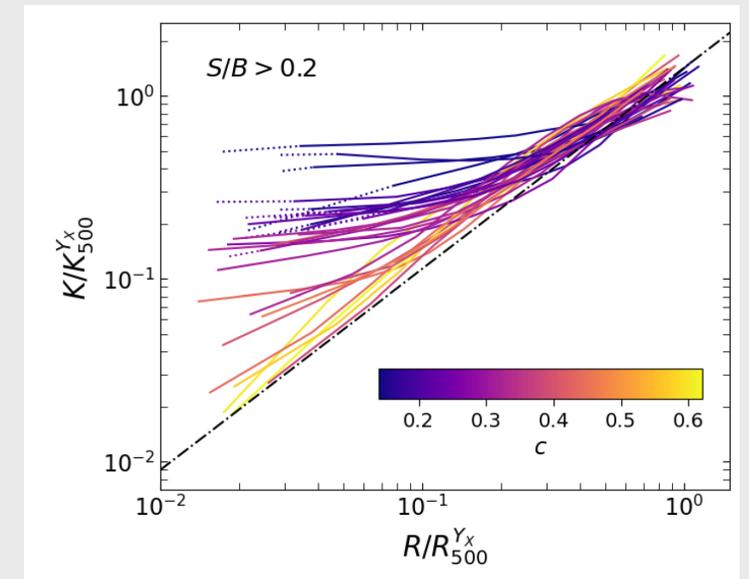
Batalucci+23



Rossetti+24

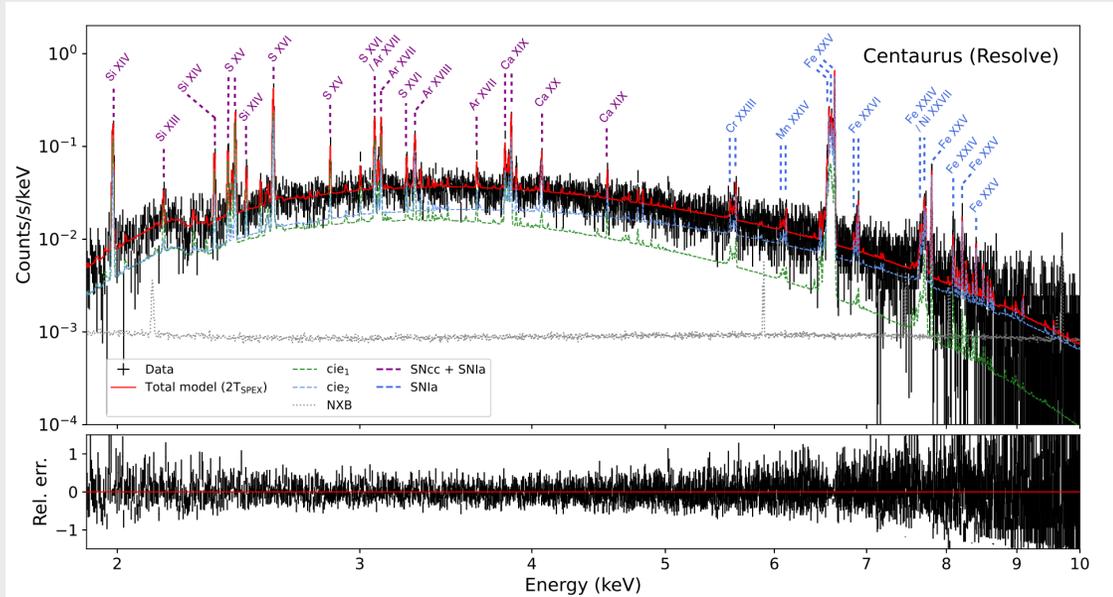


Riva+24

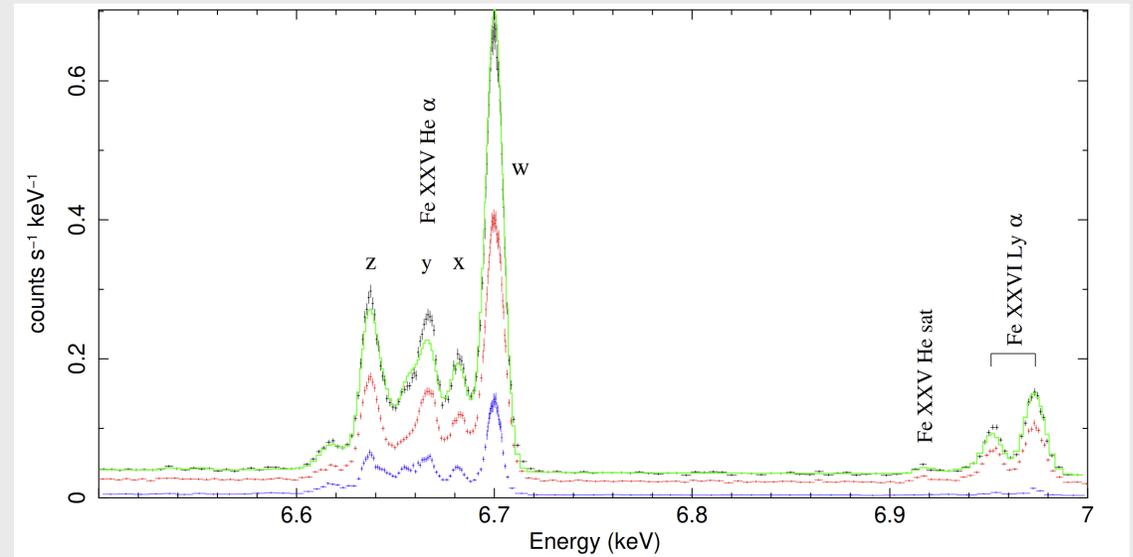


# ICM Dynamics / XRISM

Mernier+25



XRISM Collaboration a+25

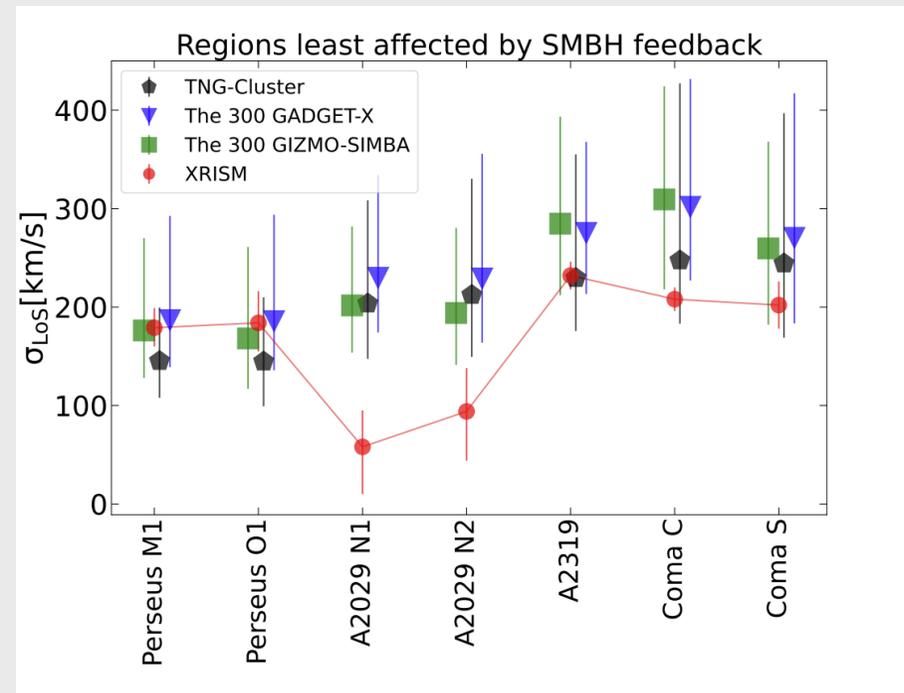
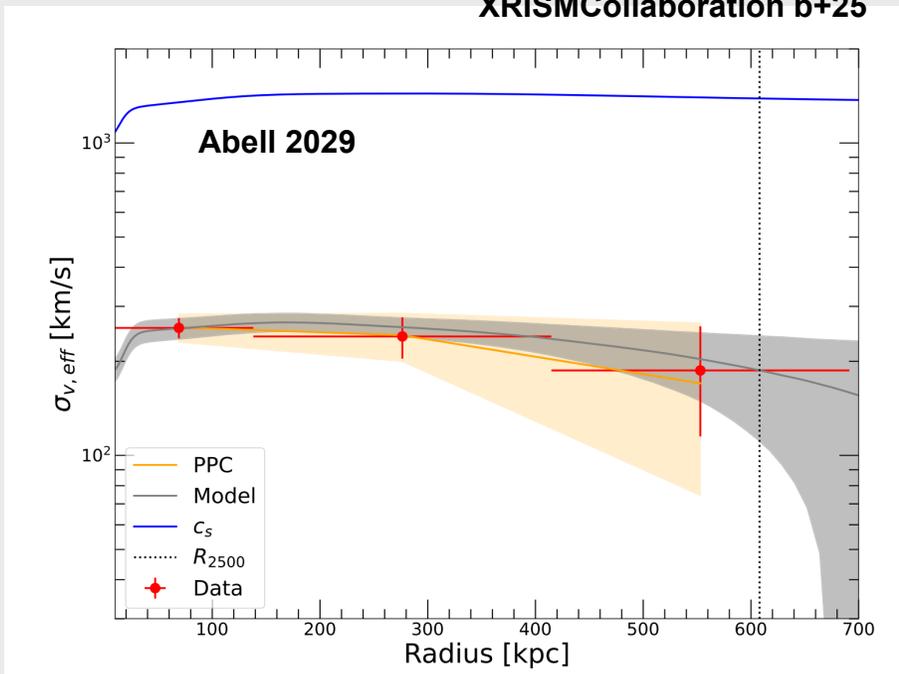


Jump in spectral resolution

# ICM Dynamics

XRISM Collaboration c+25

XRISM Collaboration b+25



Velocity dispersion lower than expected

# Overview

Non-Thermal Processes (103 papers/316)

literature, international collaboration, future facilities, integration with numerical simulations.

Environment (67 papers/316)

strong groups using MUSE, optical spectroscopy, radio, submm, mostly at low, but also high-z.

Cosmology and Early Universe (60 papers/316)

Clusters as cosmic telescopes for early universe (HST/JWST+MUSE).

Cosmotest with SZ, Xray survey

Baryon Distribution (55 papers/316)

Important role of observations & hydrodynamics simulations.

Dynamics (25 papers/316)

New: ICM dynamics. Role of numerical simulations. Hydrostatic mass bias

Future and Discussion (21 papers/316)

# Crossroads

Different themes are connected

Cosmology / Baryon Distribution



Tuning of sub-grid parameters in hydro simulation to reproduce observed properties

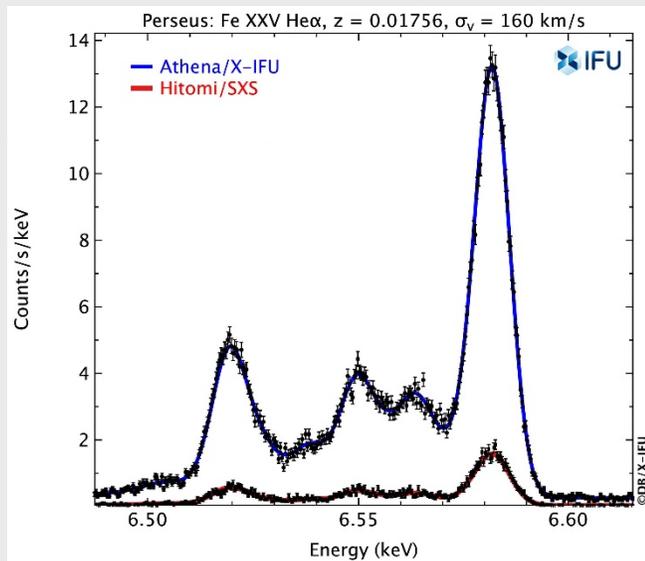
- Galaxy SMF
  - Gas content of massive halos
- Major Goal is to investigate cosmological model

Limits the predictive power of simulations

# New ATHENA

Most baryons in the local Universe are in the form of warm/hot gas

Detection and characterization in Xrays through wide field imaging and high resolution spectroscopy.



- Higher throughput
- Better Angular resolution
- Sensitivity below 2 keV

# New ATHENA Statuts



- ESA Positive Ministerial November 25
- NASA budget approved
- MAR (Mission Adoption Review) 26
- Adoption first half of 27
- Launch 37

# Funding

Stable funding of technological and scientific activities over the next decade

Connection is important for New-ATHENA and in general

Funding of space related activities is changing

# Summary

Within INAF much activity over a broad range of themes

Connection between Cosmology and Astrophysics is complex

New ATHENA is on its way to being adopted

Regular funding is important not just for ATHENA