

Using Constrained Hydro Simulations to Explore the Gas Component of the Cosmic Web

Renjie Li 2023.06

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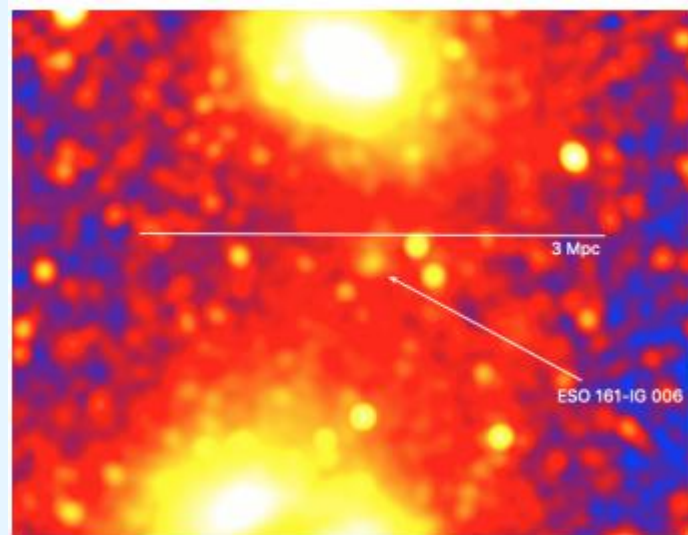
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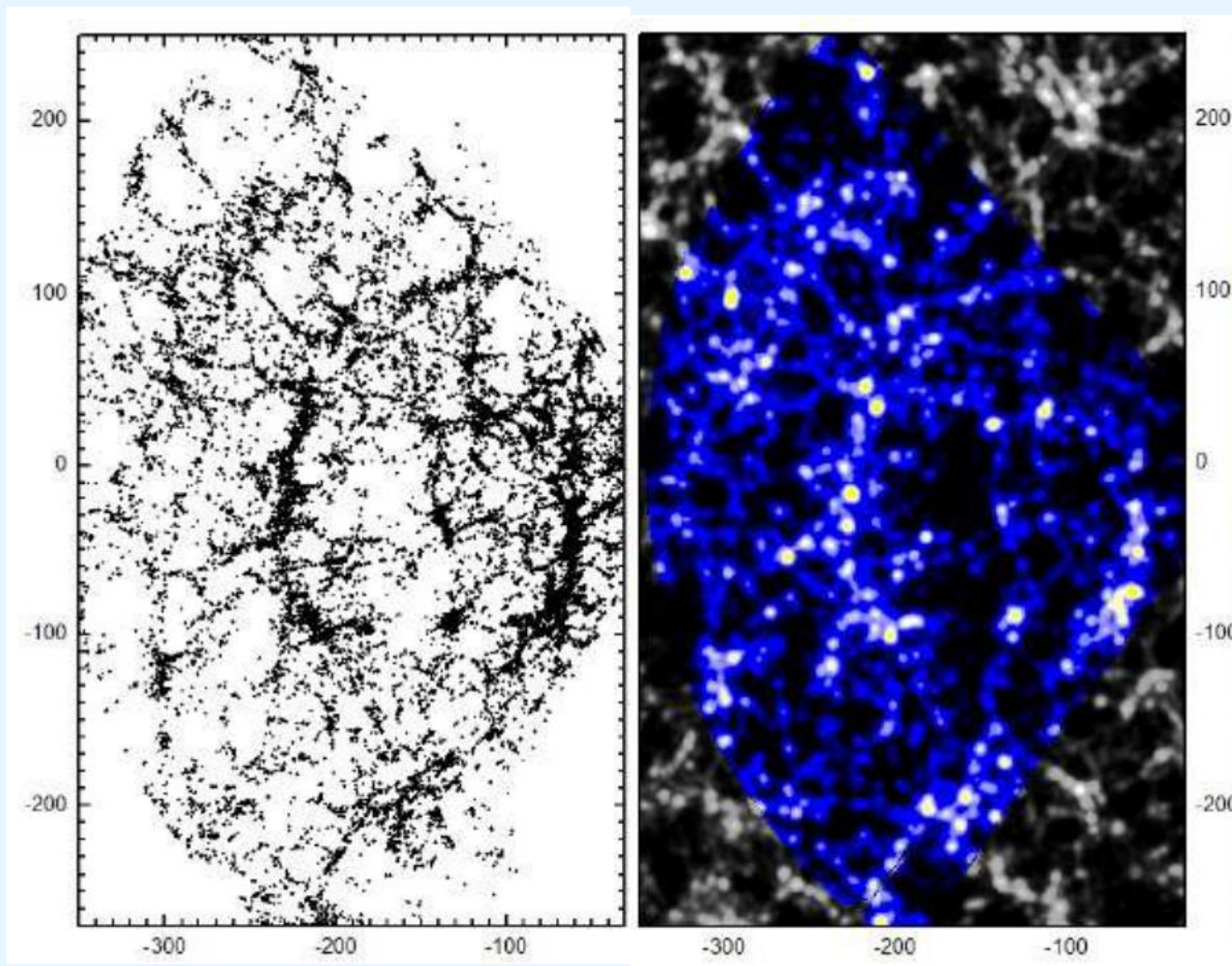
Missing baryon and observation

- Missing baryon problem
- Observation
 - X-ray, SZ effect, absorption line, etc.
 - Gas in filaments
 - Massive filaments between pairs of massive merging clusters (e.g. [Planck Collaboration et al. 2013b](#); [Sugawara et al. 2017](#); [Reiprich et al. 2021](#))
 - Stacking a large number of galaxy pairs ([de Graaff et al. 2019](#))

Reiprich 2021, eROSITA

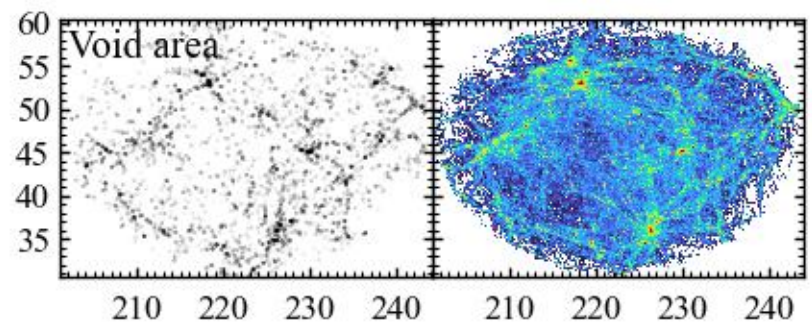
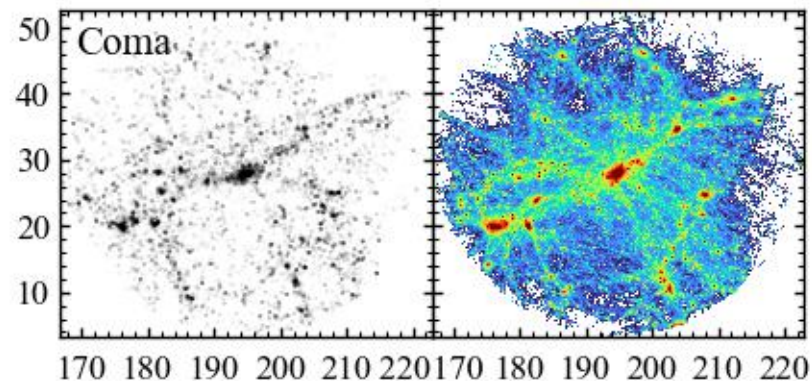
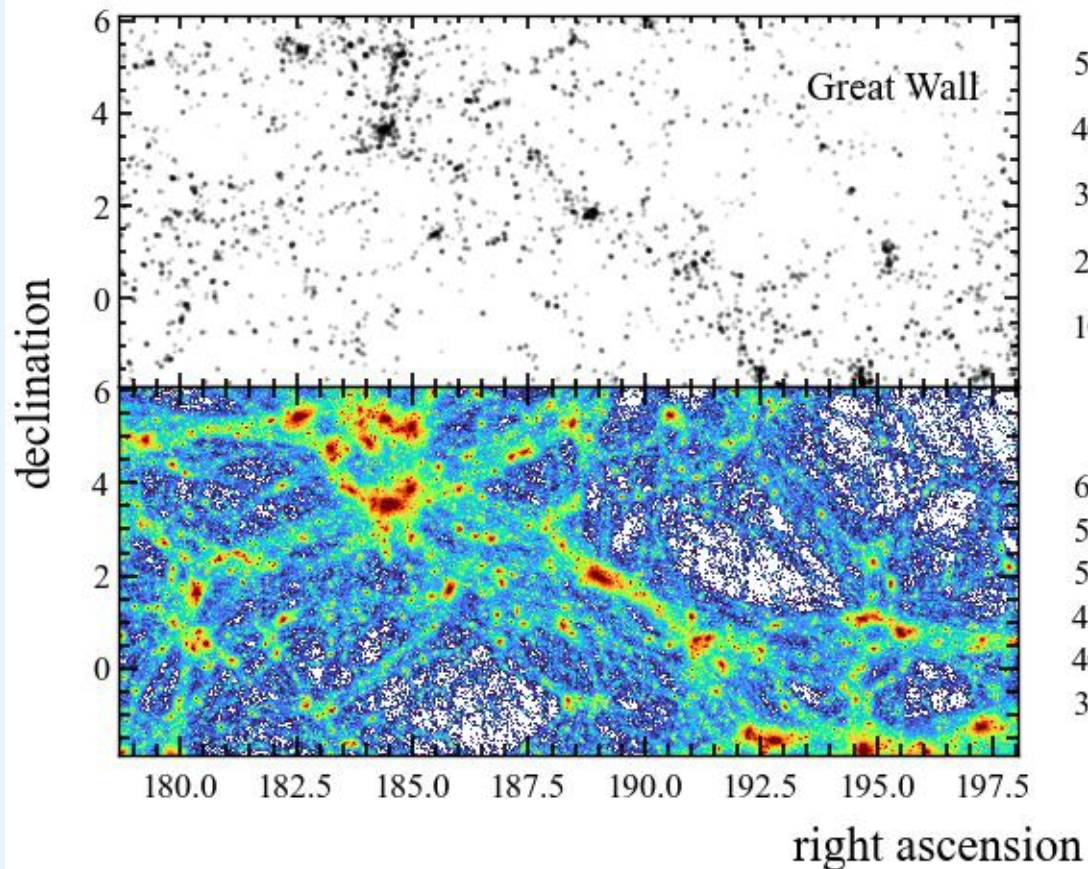


Constrained simulation and observation



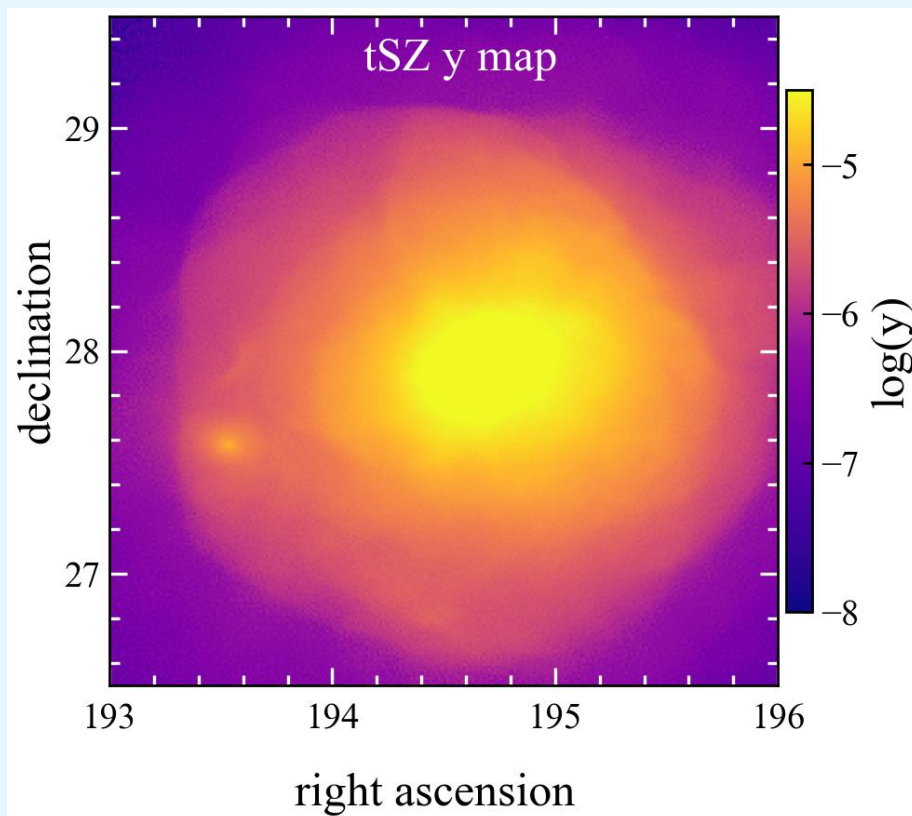
Wang et al. 2016, ELUCID

Constrained simulation and observation

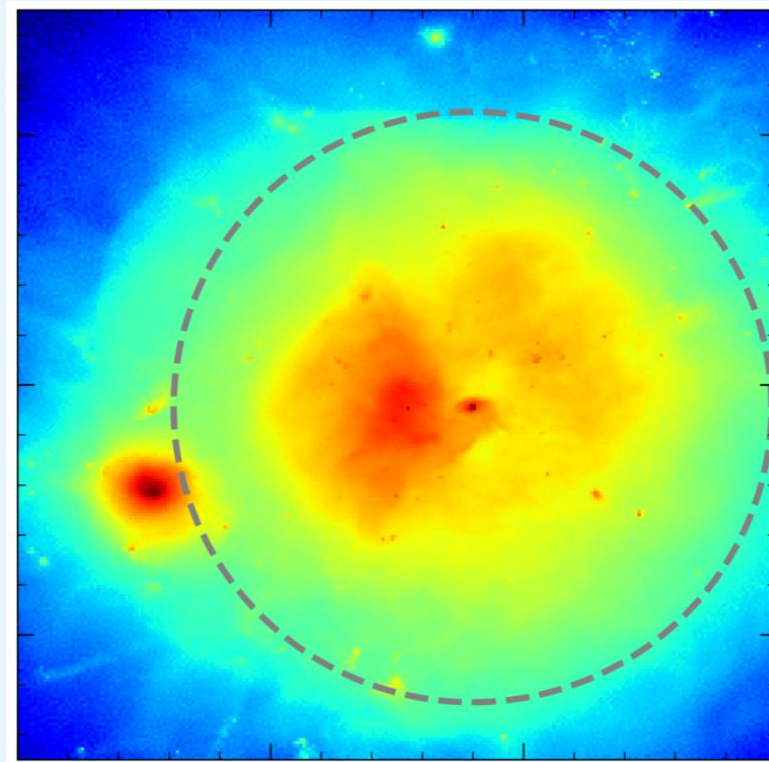


- Gadget-3 code as described in [Huang et al. \(2019, 2020\)](#).
- Feedback from active galactic nuclei is NOT included in our simulations.

Constrained simulation and observation



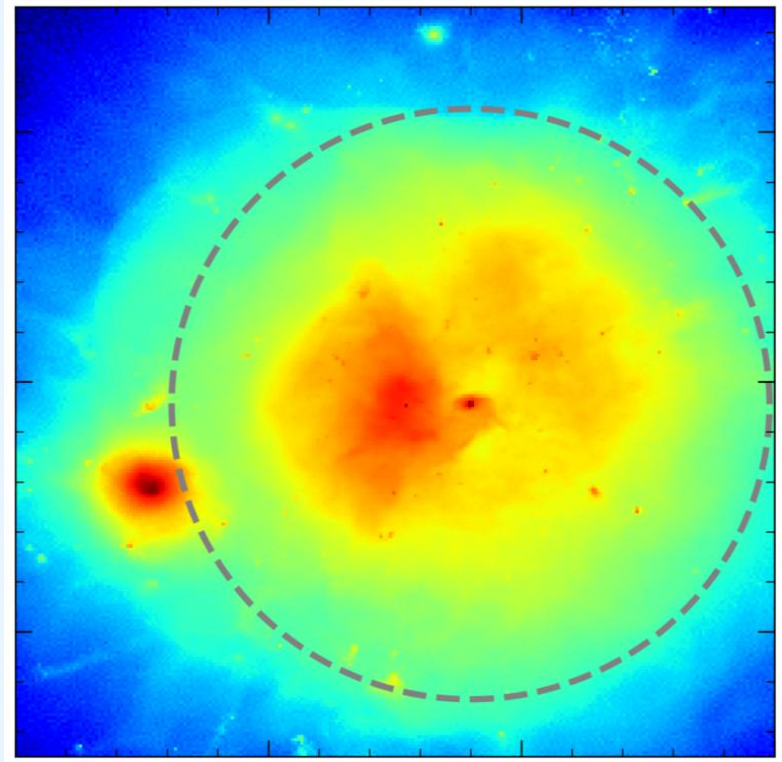
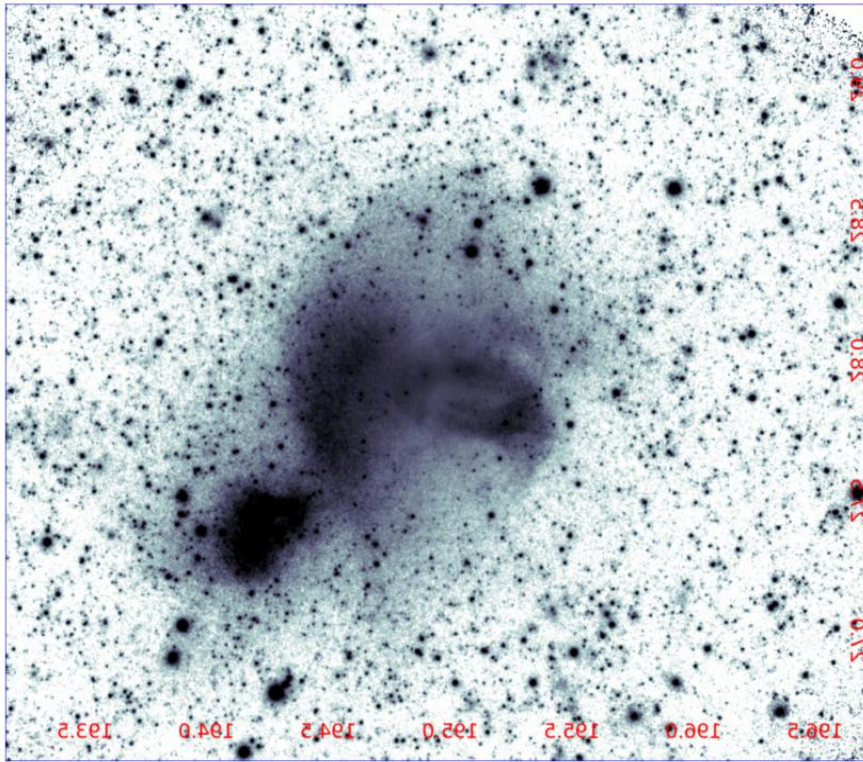
tSZ y map



X-ray map

$$y = \frac{\sigma_T}{m_e c^2} \int P(l) dl,$$

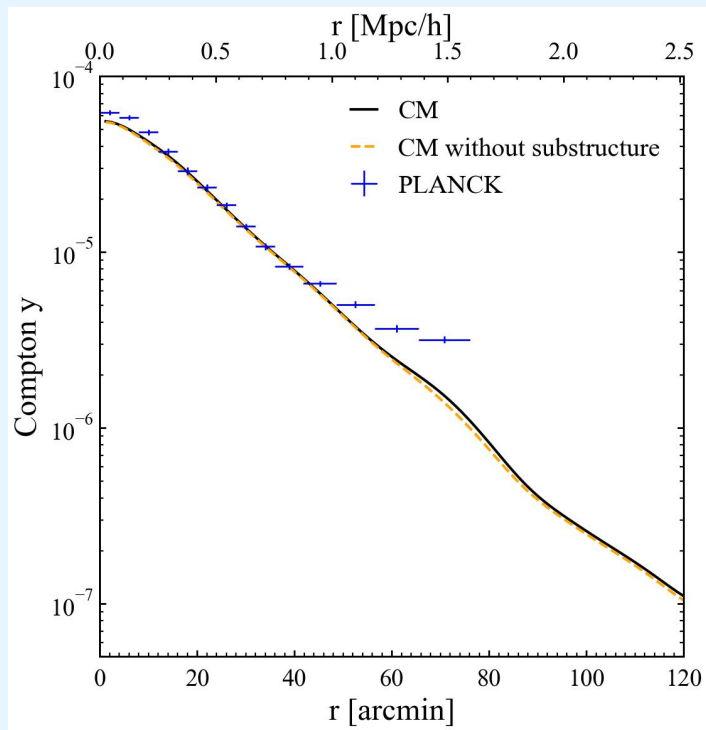
Constrained simulation and observation



Churazov et al. 2021, eROSITA

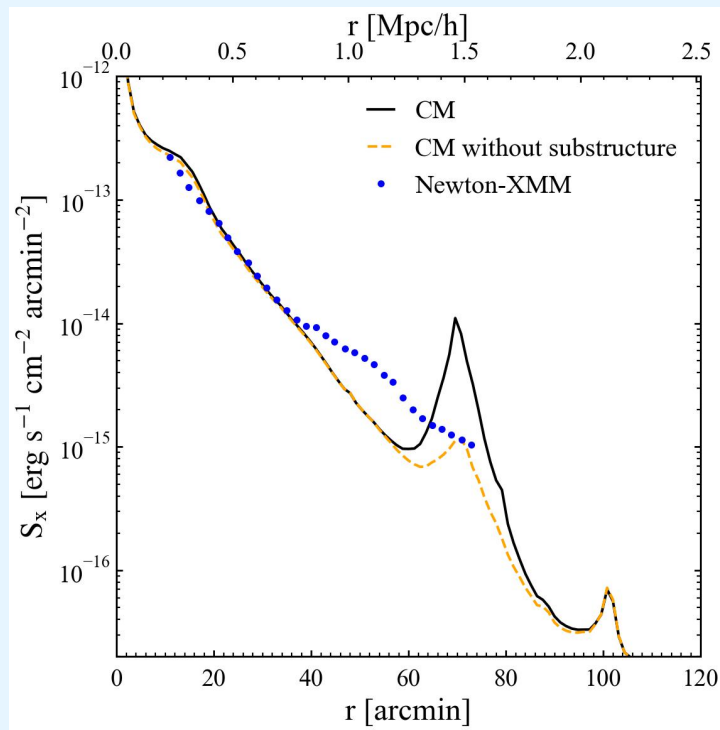
Constrained simulation and observation

- The tSZ effect



- The data points, taken from (Mirakhor & Walker 2020, private communication)

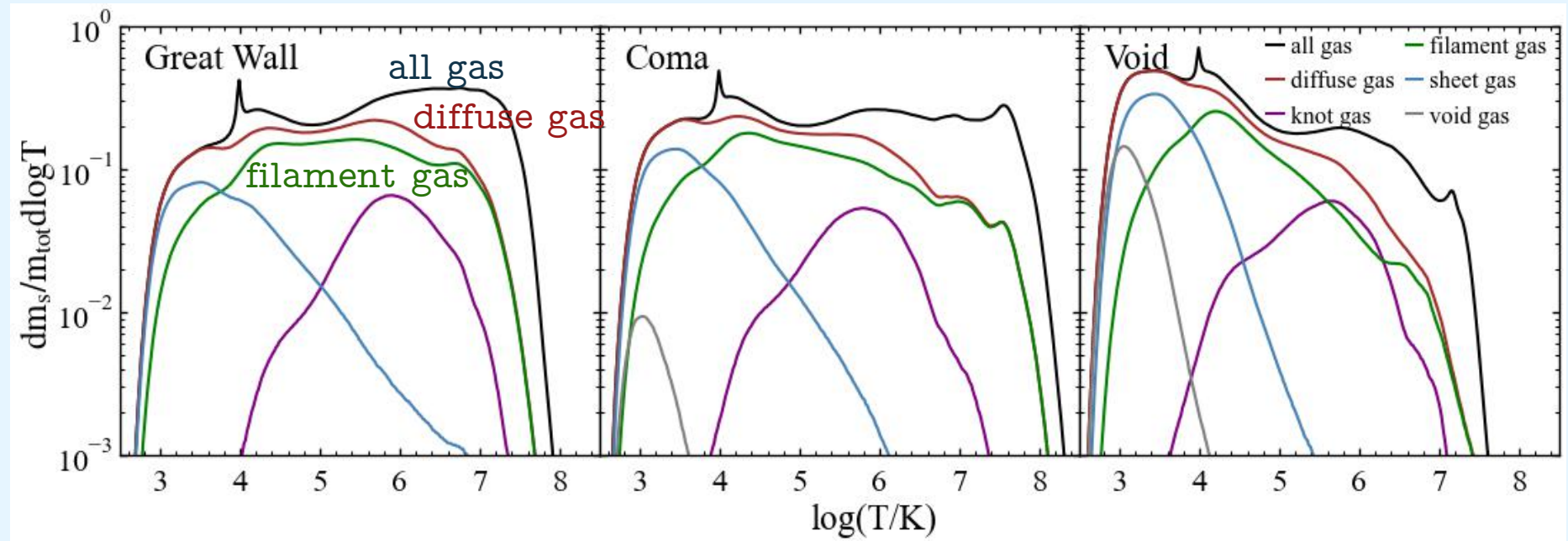
- X-ray



- The data points are based on Newton-XMM observation (Mirakhor & Walker 2020, private communication)

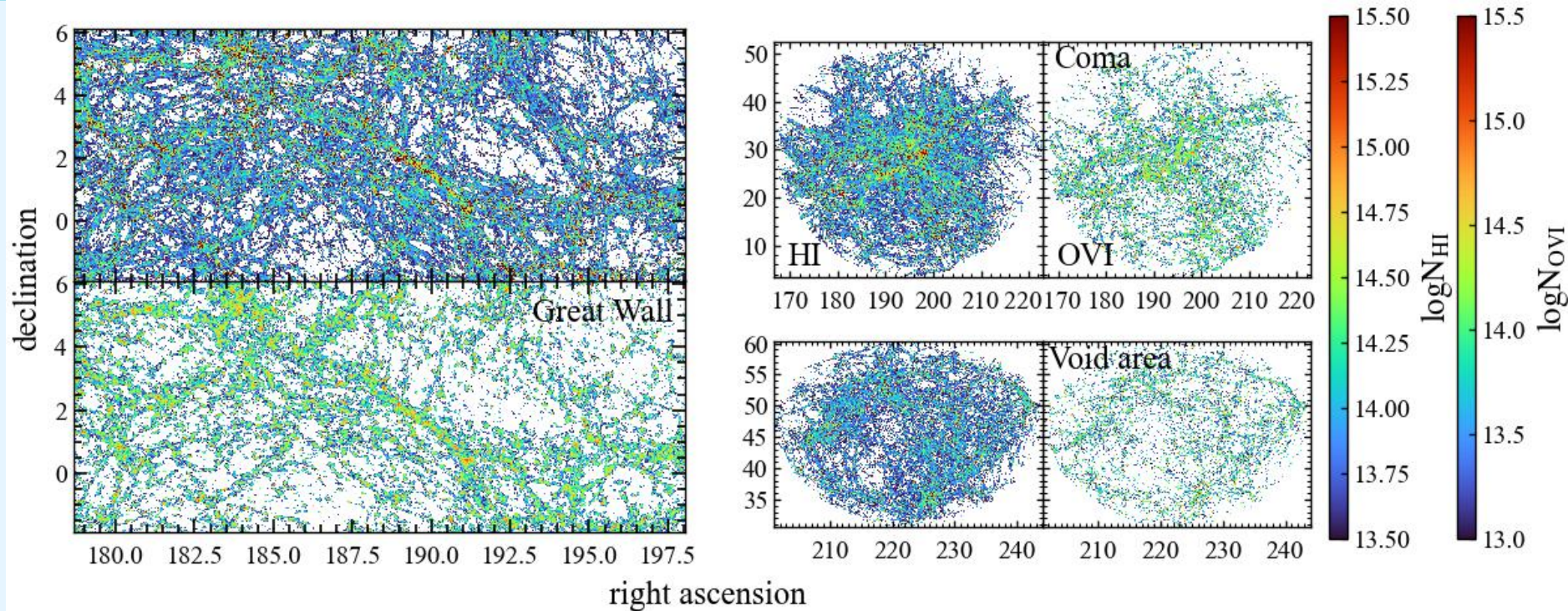
Warm-hot gas in filaments

- The temperature distribution



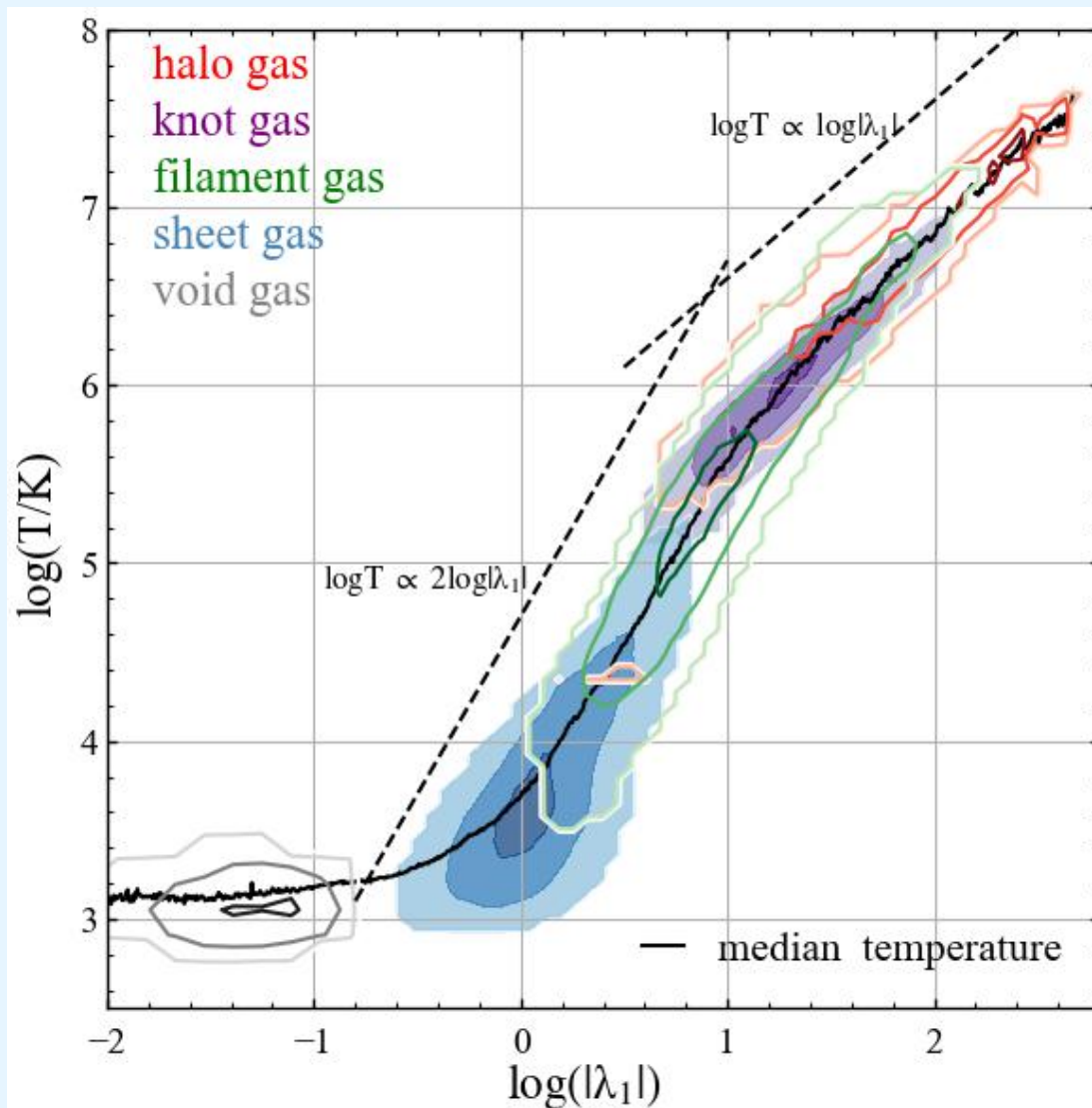
- Most of the warm-hot diffuse gas resides in filaments.

Detect gas in filaments

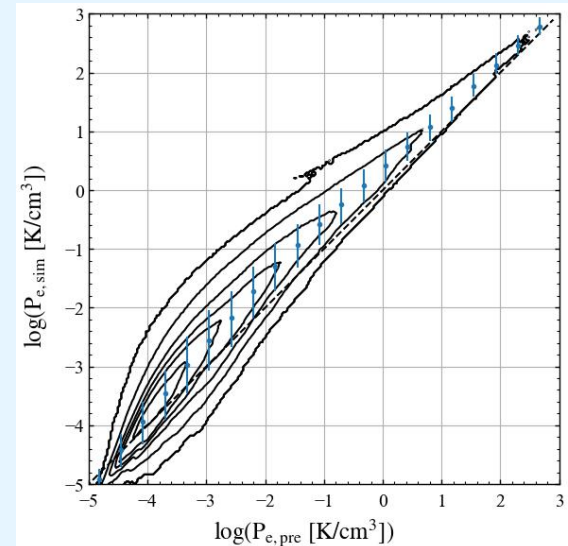
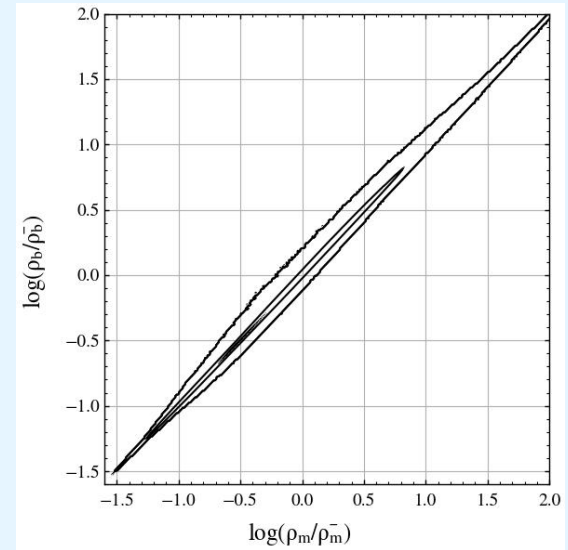
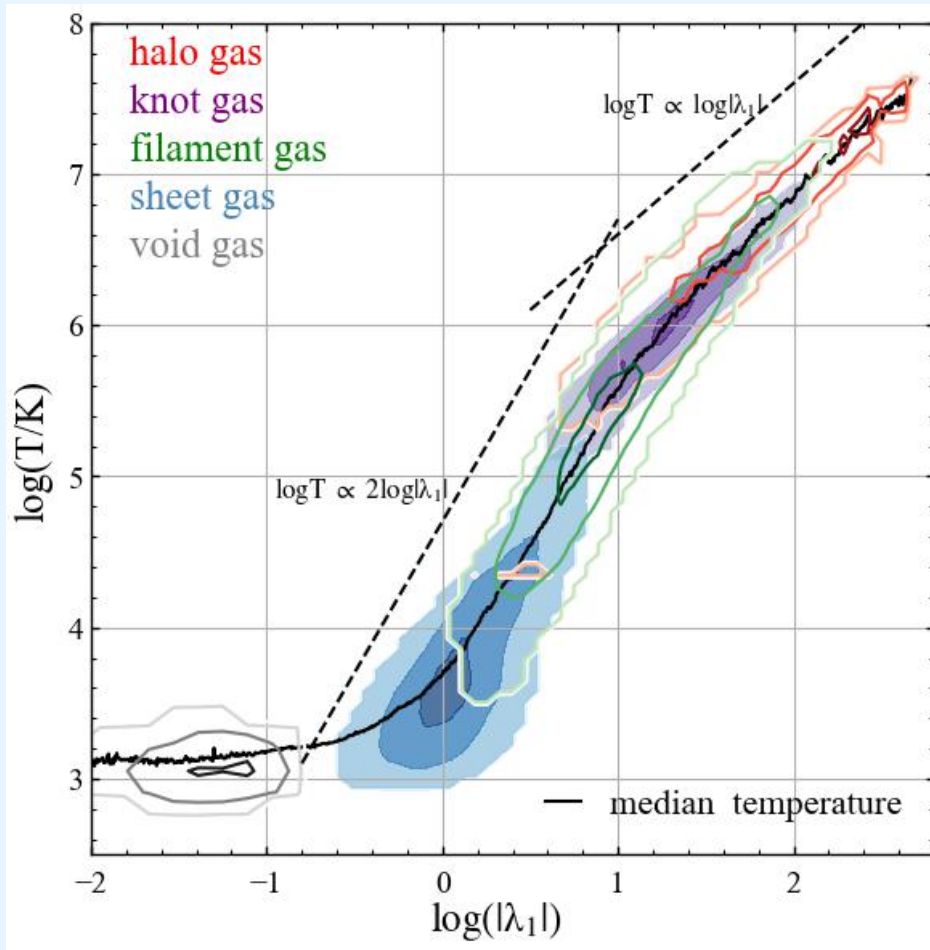


Low N_{HI} Ly α absorption and most of the OVI absorption with $\log N_{\text{OVI}} > 13$ are good tracers of the diffuse gas in filaments. (Bradley et al. 2022)

T- λ correlation



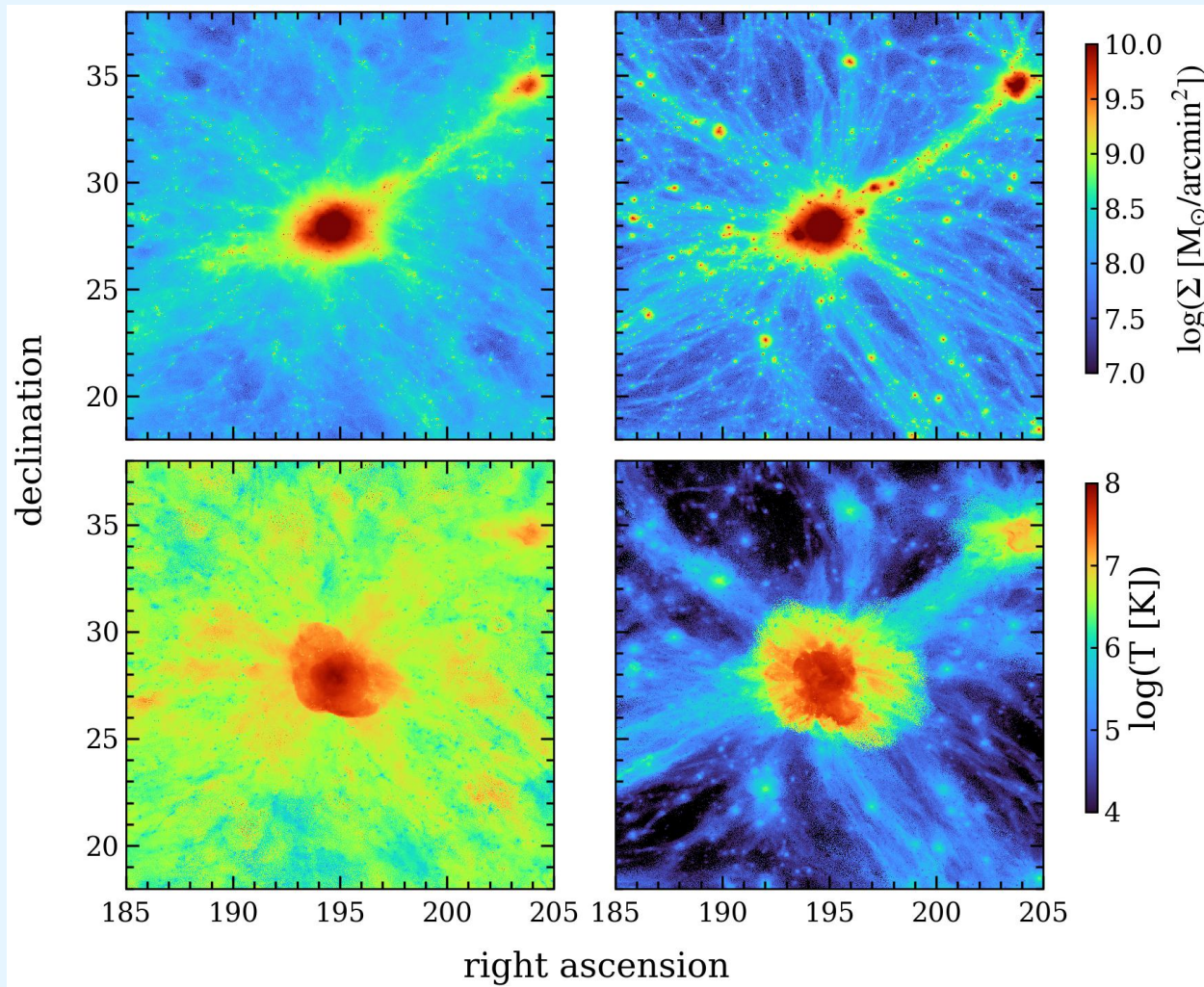
T- λ correlation



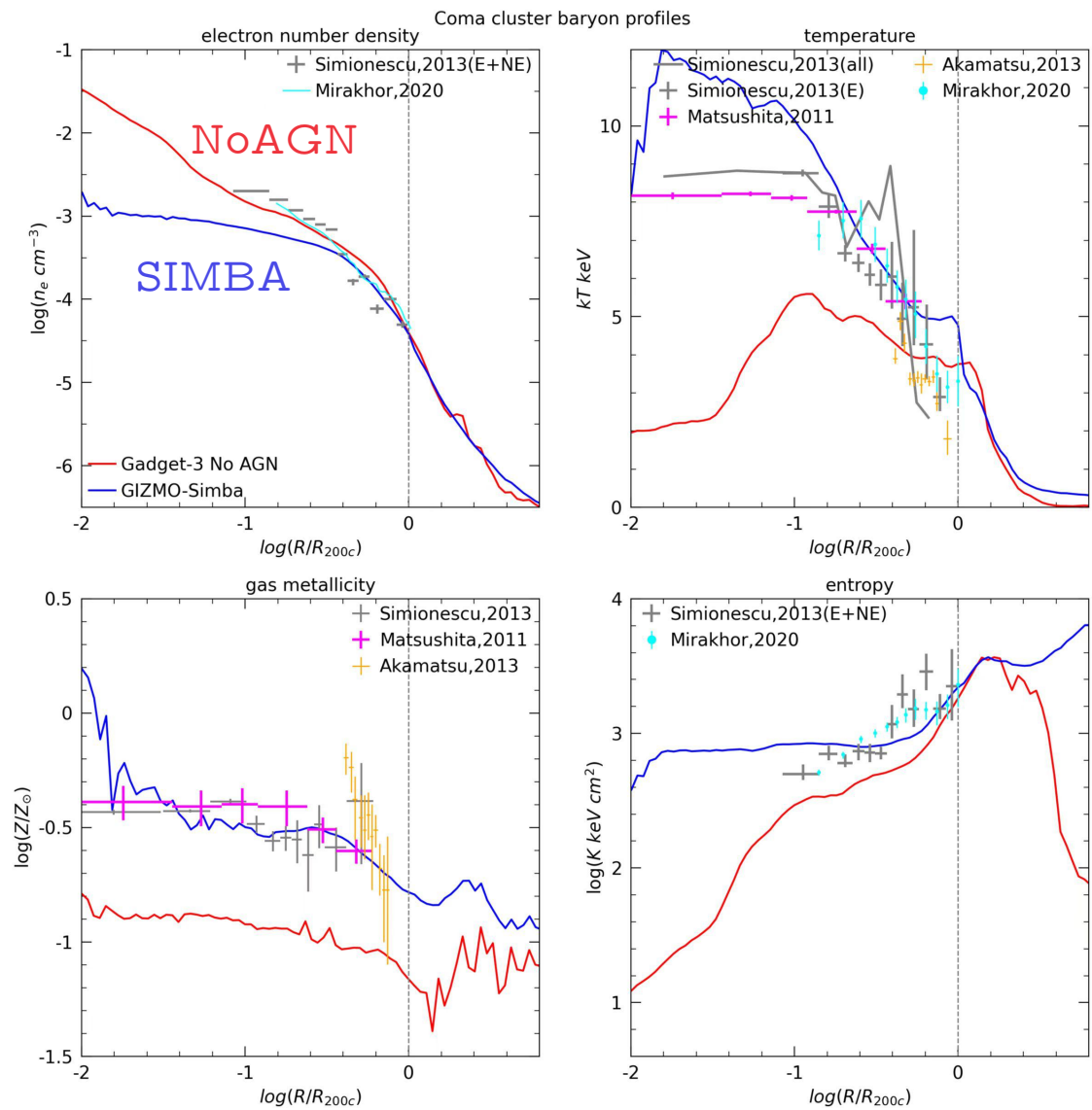
GIZMO-SIMBA

GIZMO-SIMBA

GADGET-3

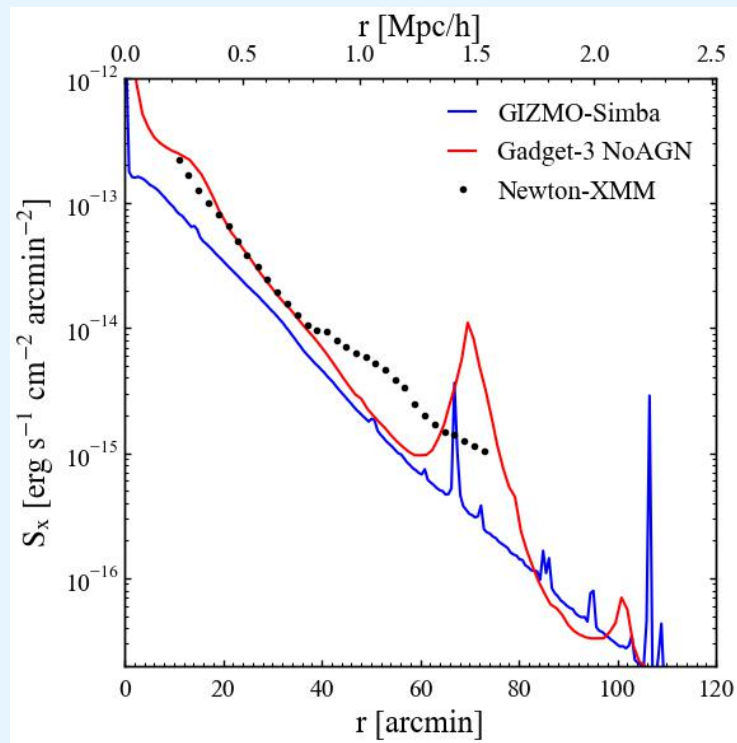
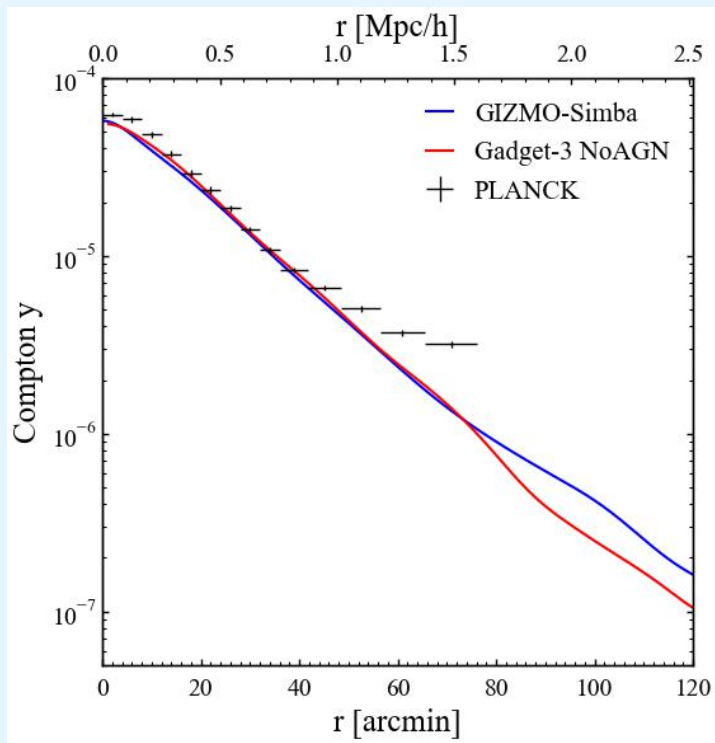


GIZMO-SIMBA



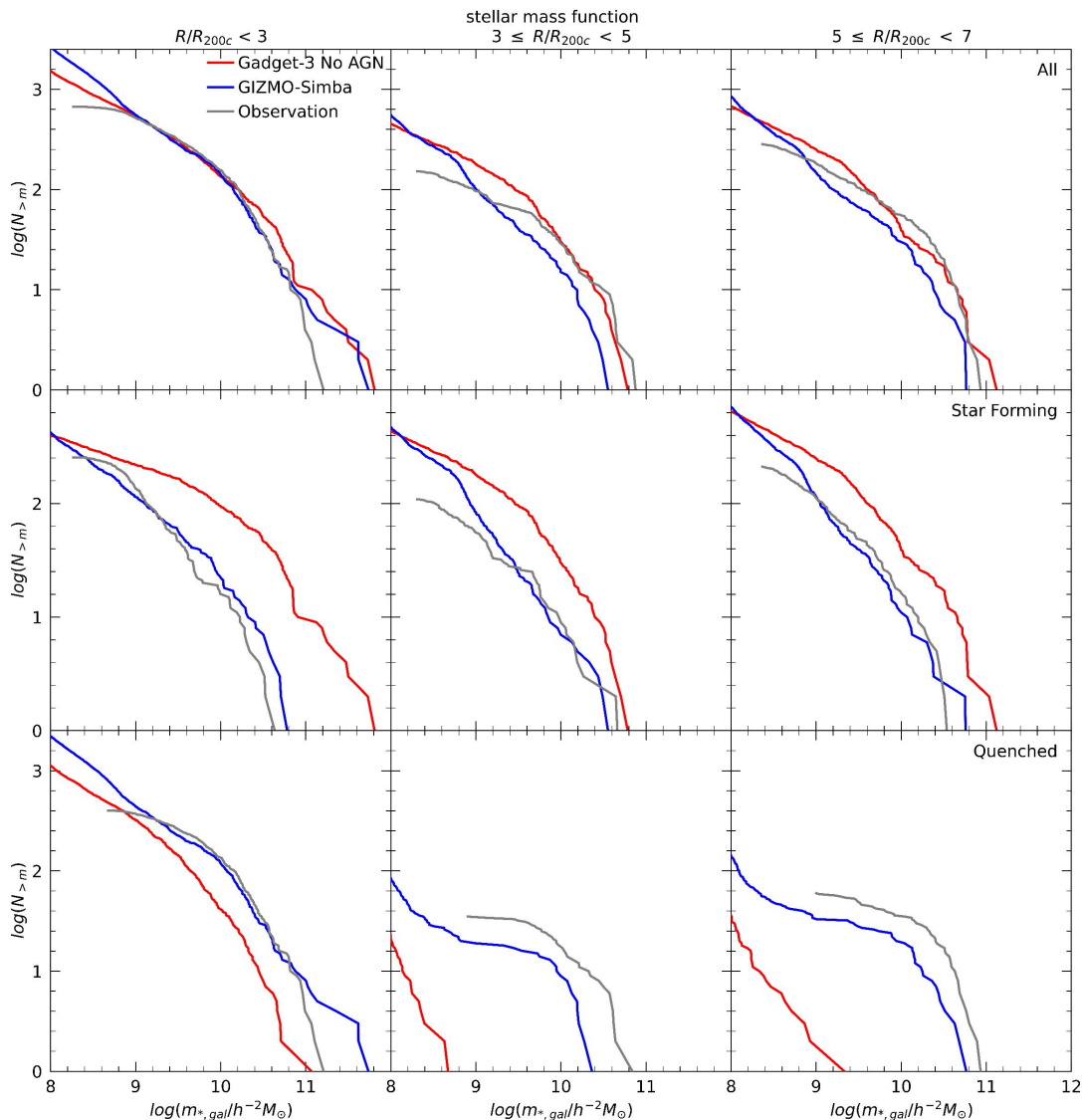
Luo et al. in prep.

GIZMO-SIMBA



Luo et al. in prep.

How AGN affects Coma cluster



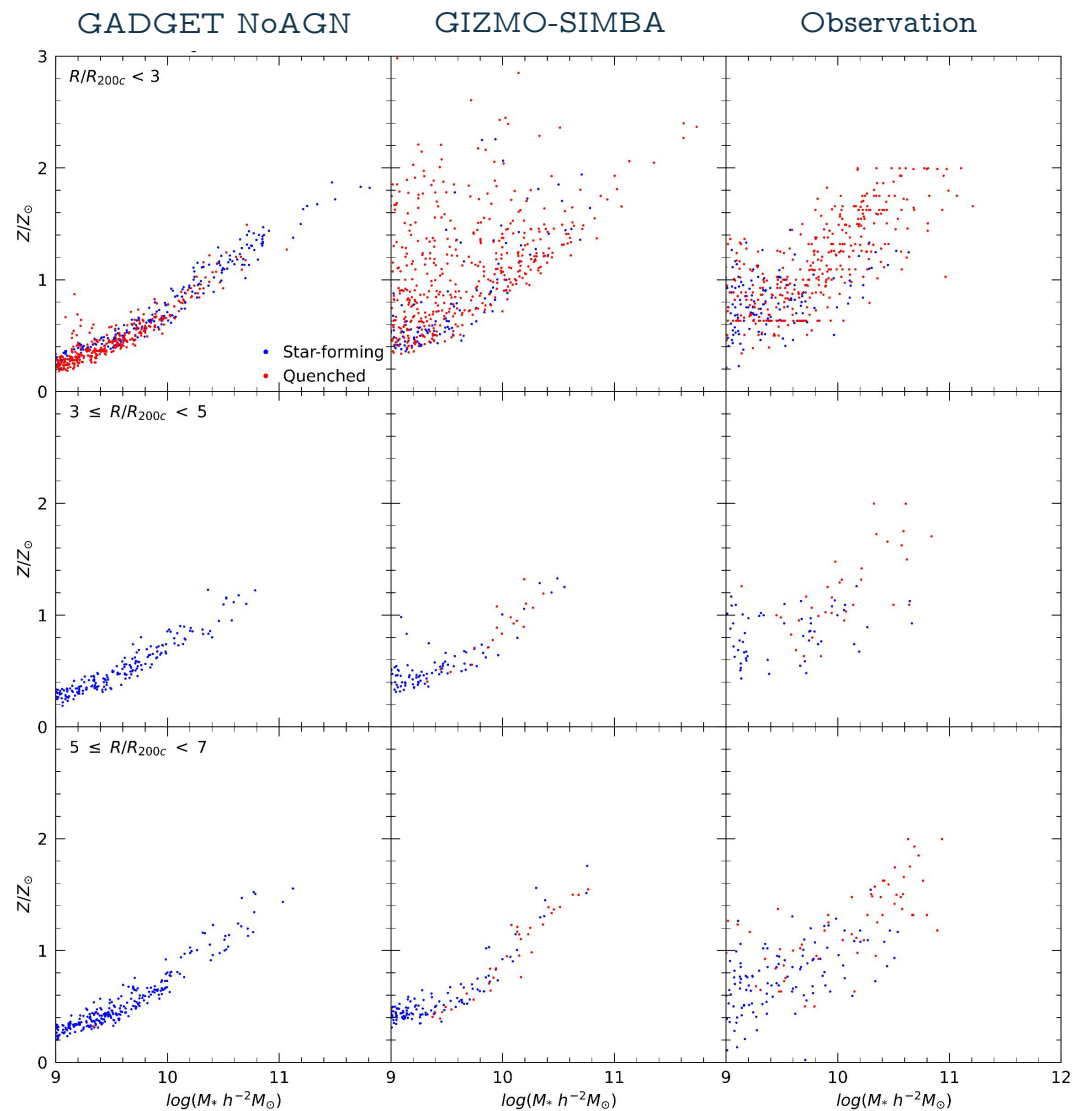
All

Star-Forming

Quenched

Luo et al. in prep.

How AGN affects Coma cluster



Luo et al. in prep.

Thanks

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