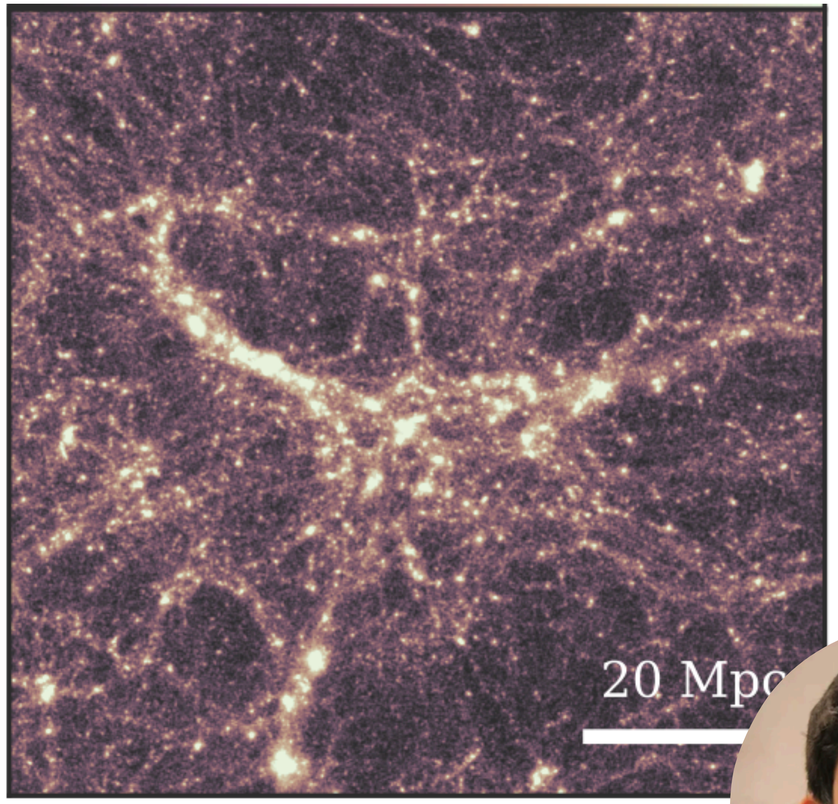
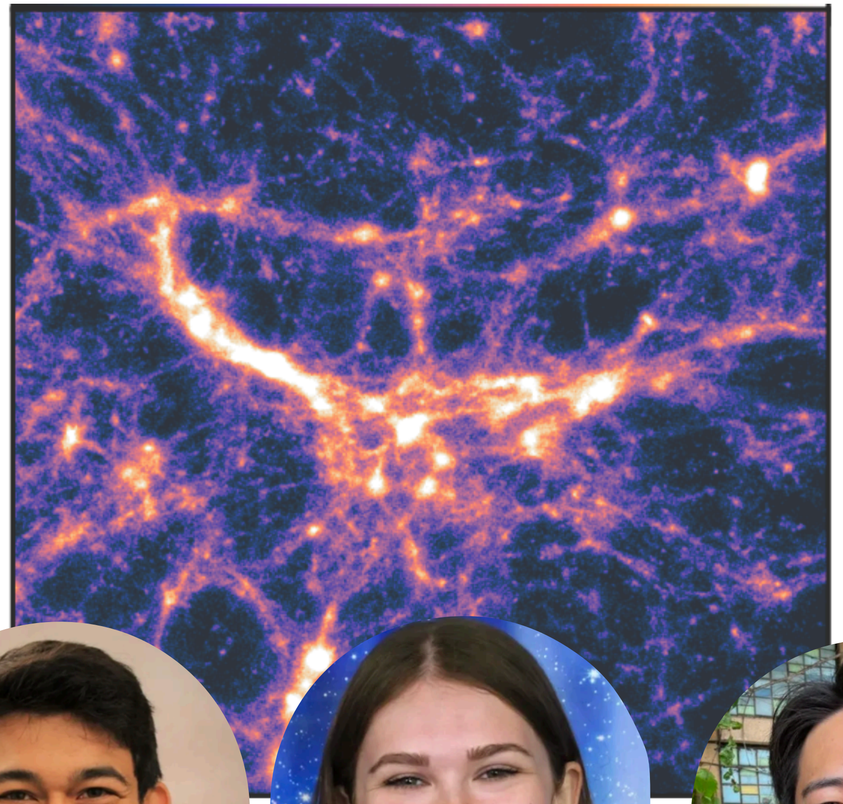
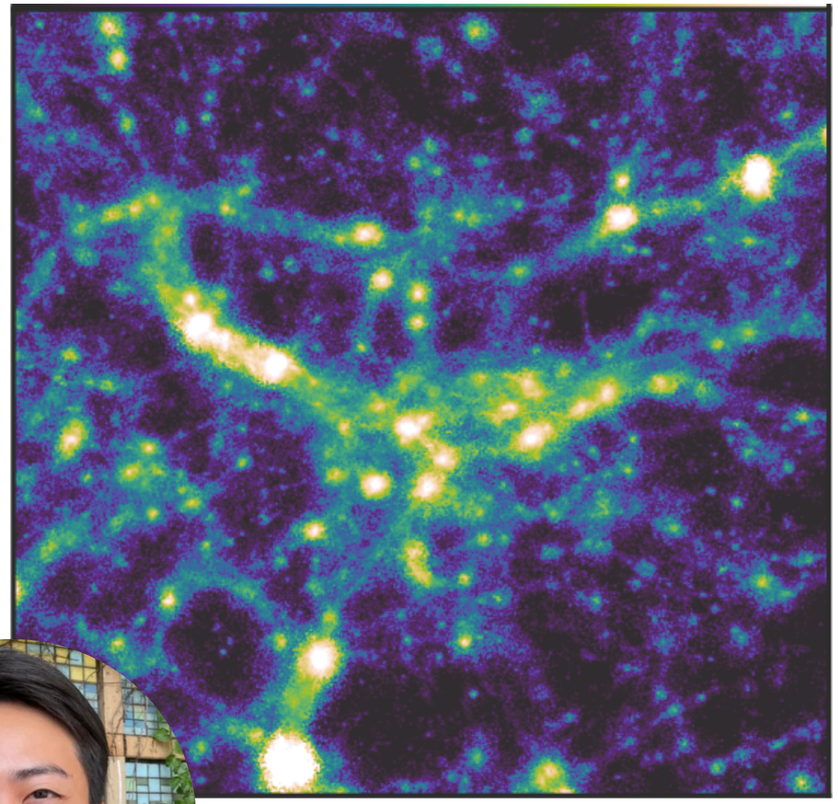
Building a complete picture of feedback: How extreme is too extreme?

Alexandra Amon, Princeton University

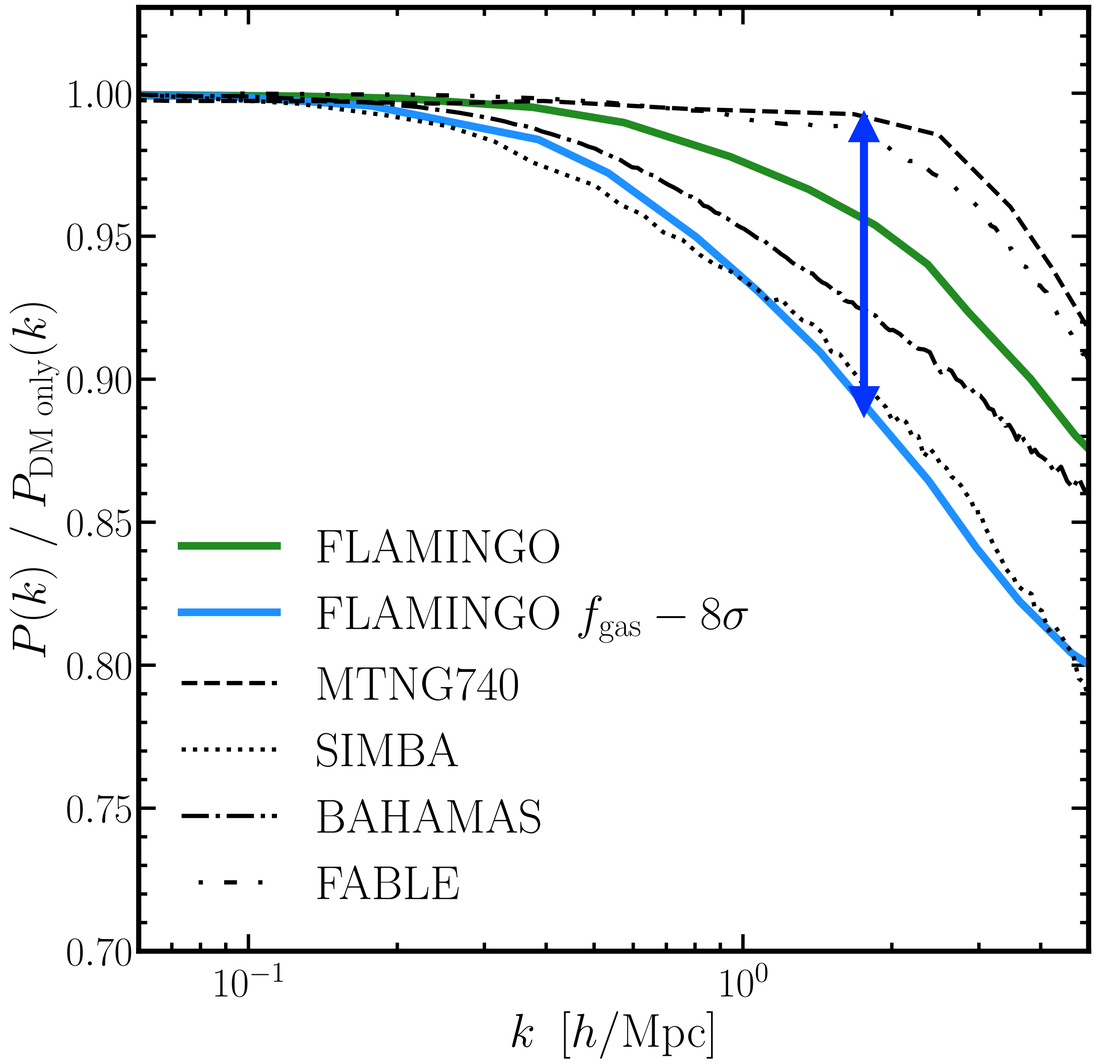




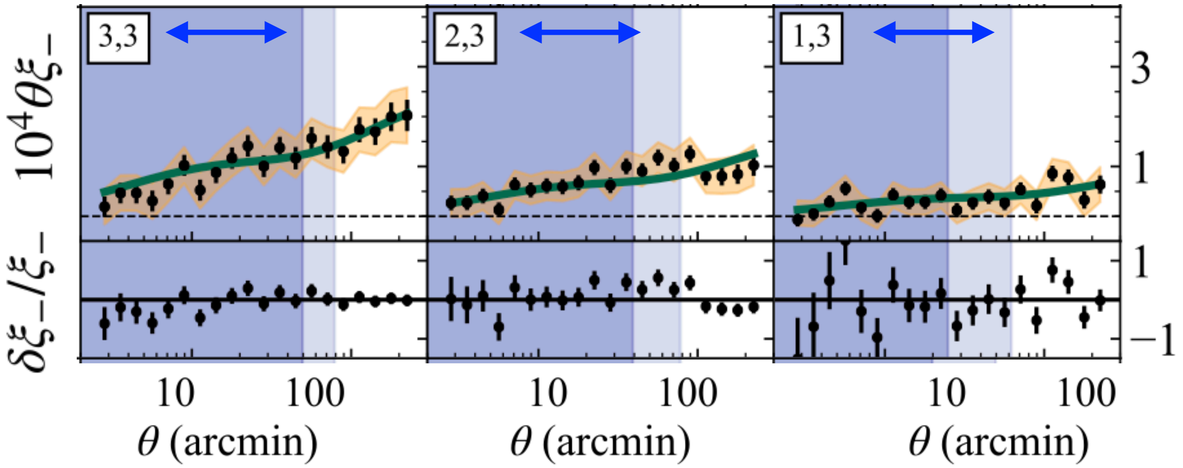


Jared Siegel, Leah Bigwood, Masaya Yamamoto & Ian McCarthy

Cosmic shear challenges: modelling baryon feedback



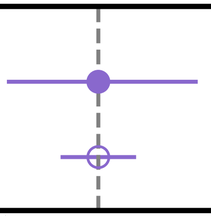
DES Y3 cosmic shear measurements



[adapted from DES Y3, Amon+ 21]

DES data: Fiducial anaylsis

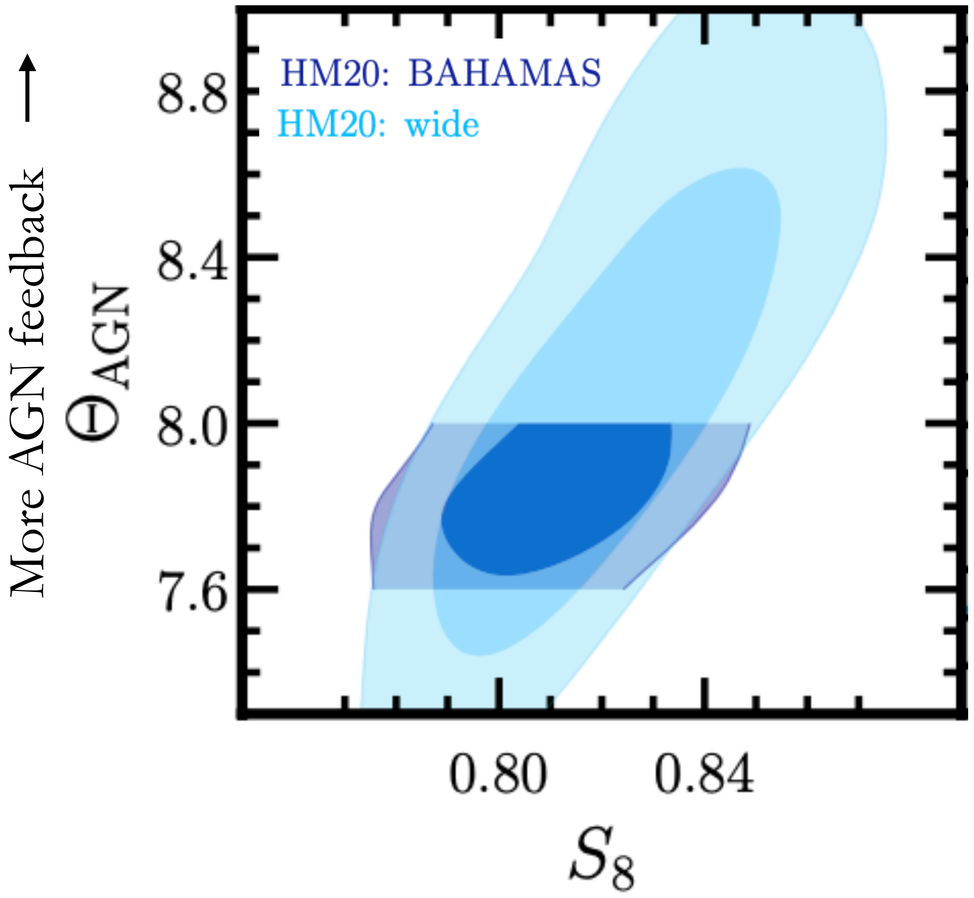
DES data: No astrophysical uncertainties

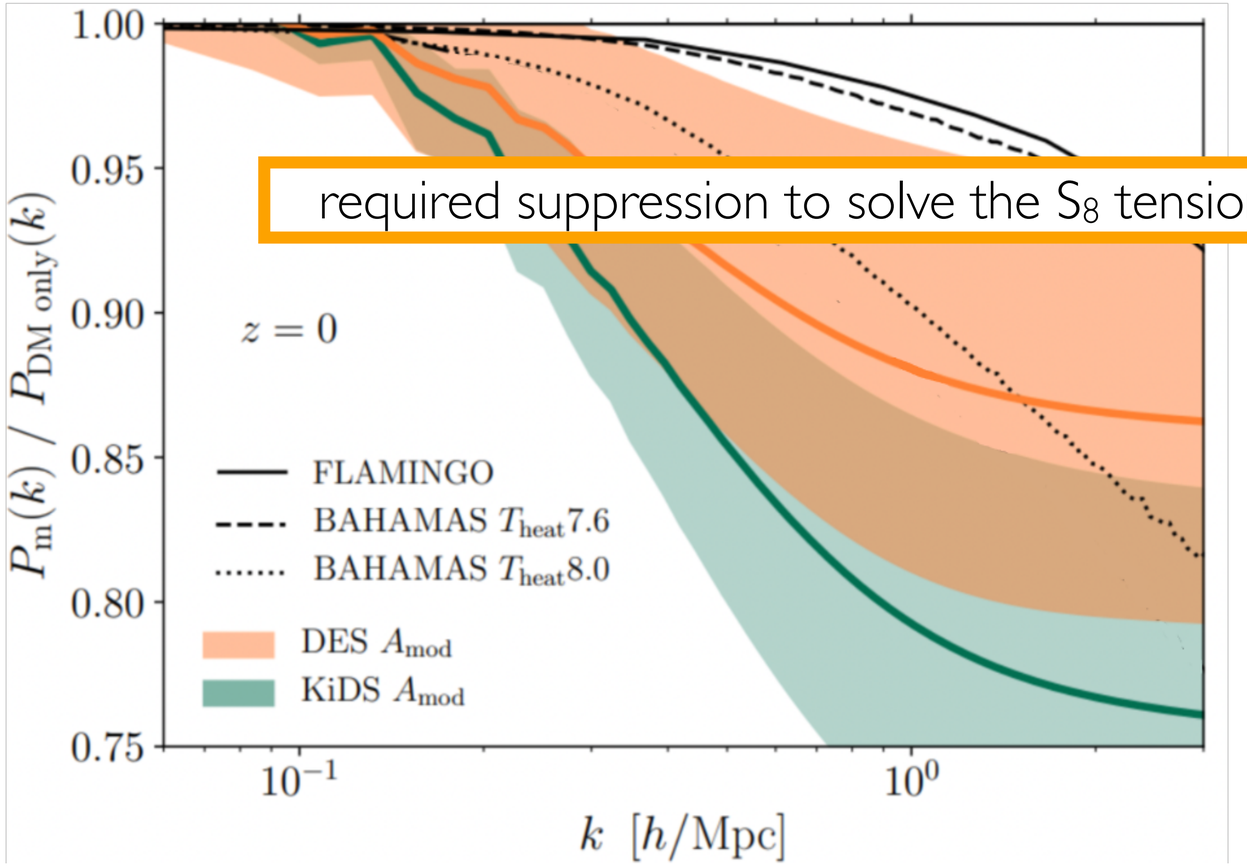


Clustering Amplitude, $S_8 = \sigma_8(\Omega_{\rm m}/0.3)^{0.5}$

Cosmic shear challenges: modelling baryon feedback

Halo model approach calibrated on BAHAMAS hydro-simulations



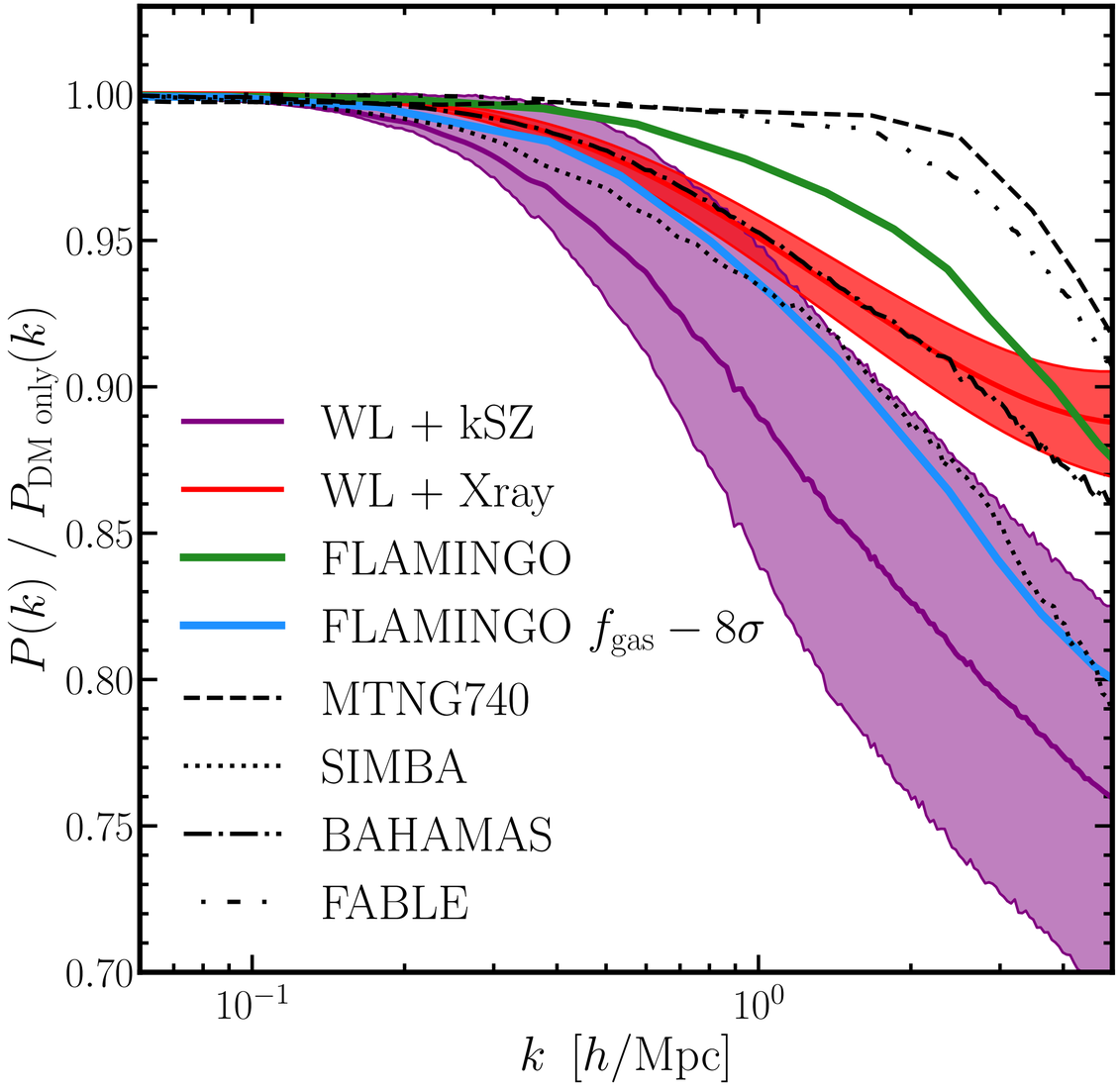


[*Amon & Efstathiou 22*]
[*Preston, Amon & Efstathiou 23*]


Rubin is here

kSZ + X-ray predict different feedback strengths?

Leah Bigwood



DES Y3 cosmic shear
+ Akino X-ray gas fractions

DES Y3 cosmic shear
+ ACT-BOSS kSZ

[*Bigwood, Amon+ 24*]

kSZ + X-ray predict different feedback strengths? Towards a complete picture of feedback

- Results unphysical due to baryonification over-flexibility?

  —> *test with FLAMINGO*

- kSZ probe <u>different halo masses</u> to X-ray gas fractions?

  —> *analyze kSZ(mass)*

- kSZ probe <u>different redshifts</u> to X-ray gas fractions?

—> *analyze kSZ(z)*

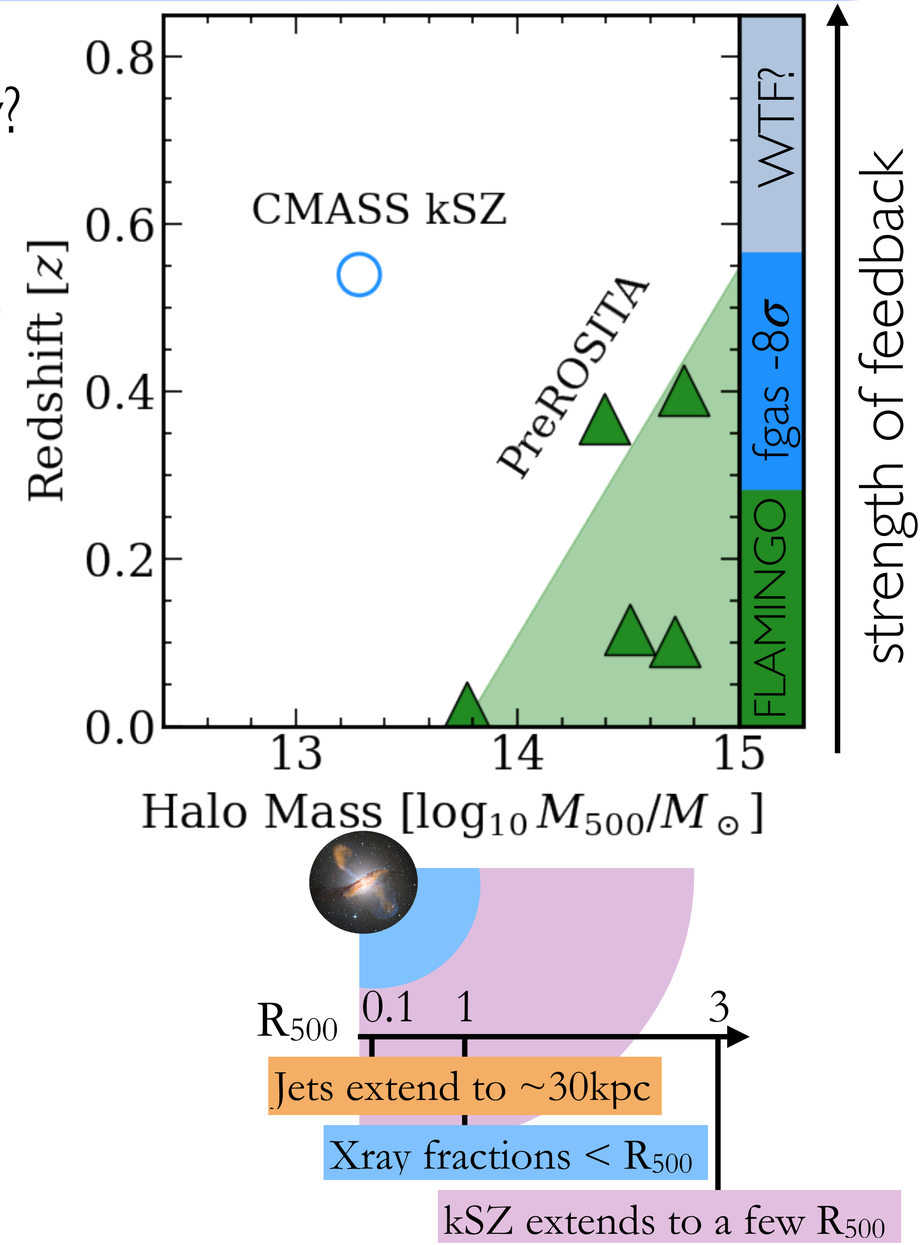
- kSZ <u>scale extent</u> not captured by simulations?

—> *jointly model X-ray & kSZ*

- Systematics in X-ray measurements and/or kSZ?

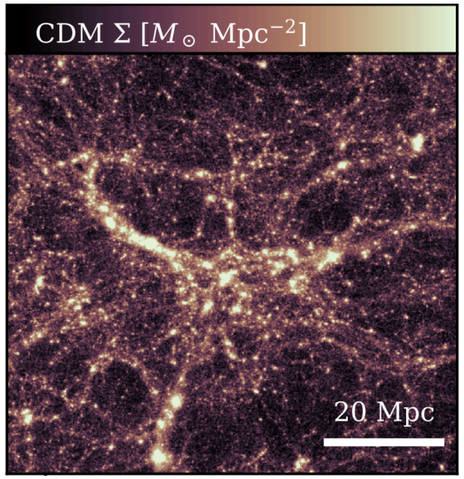
—> *well characterized samples*

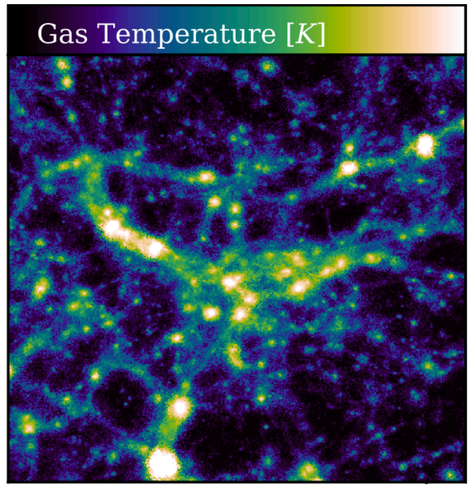
- FLAMINGO odd? —> *test with other sims*

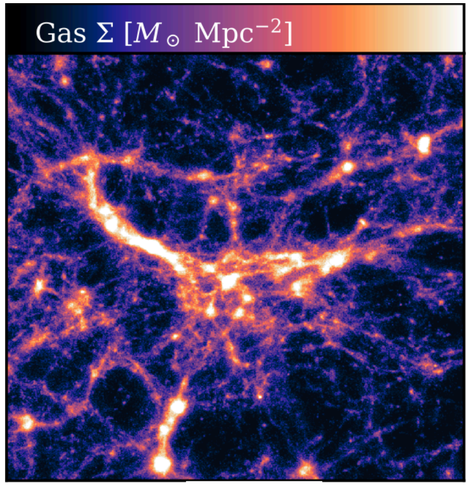


Towards a complete picture of feedback :
kSZ profiles + X-ray gas fractions + galaxy-galaxy lensing

Jared Siegel





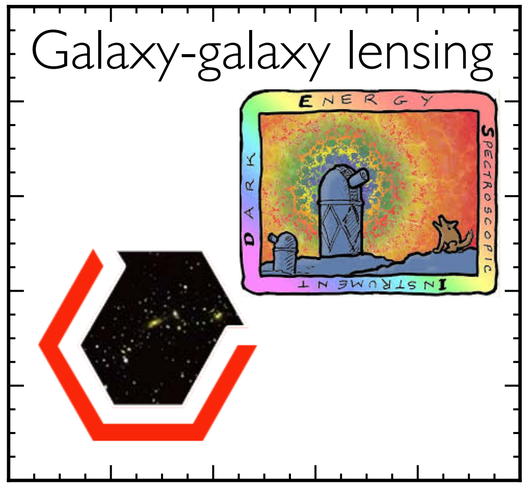


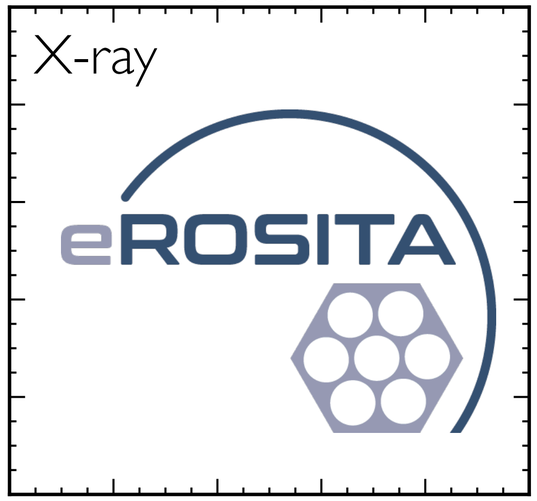
Analyzed with: +Ian McCarthy

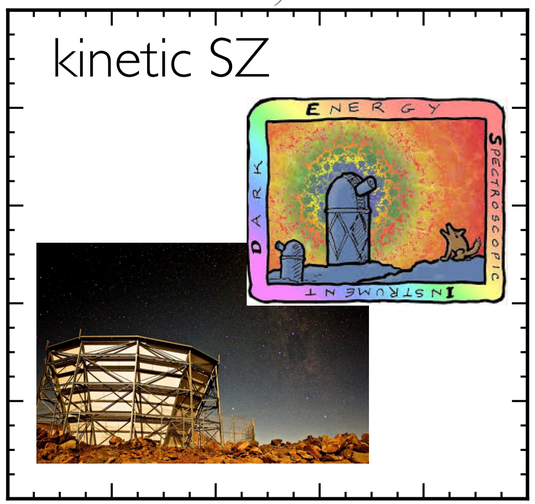
1. *FLAMINGO* simulations
2. flexible *baryonification* model

+ Esra Bulbul

Ried Guachalla, Schaan +25

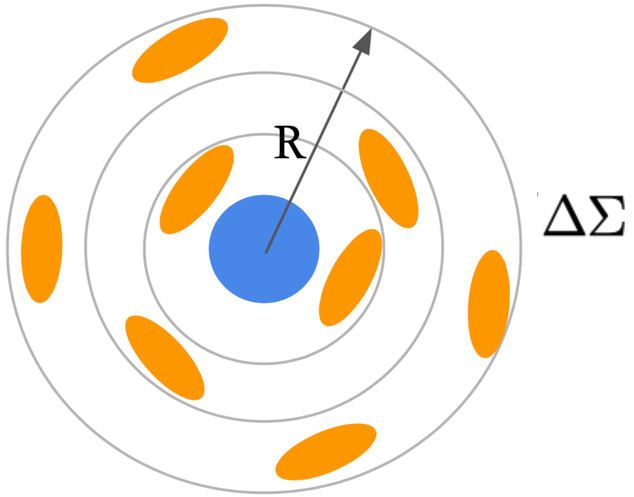




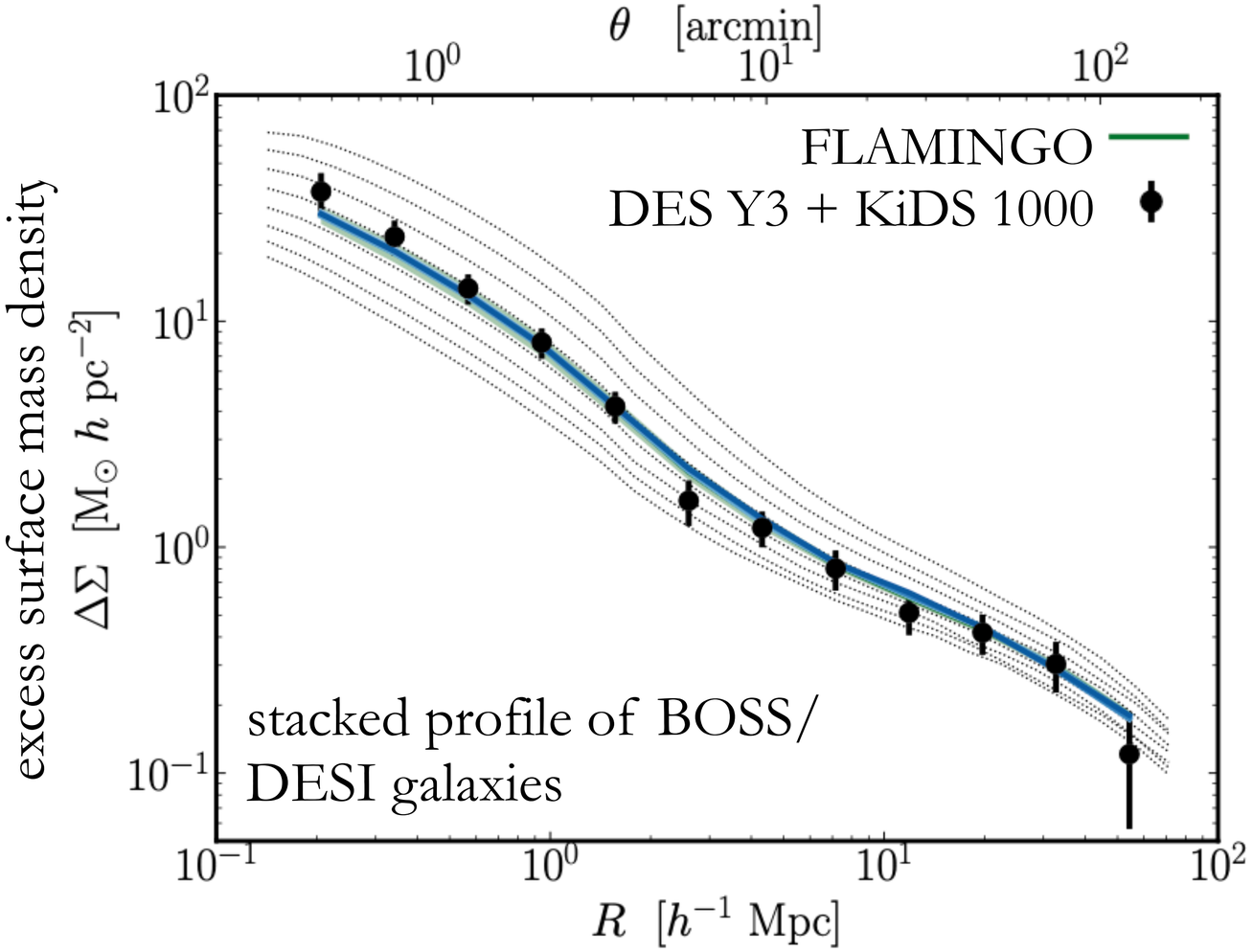


Galaxy-galaxy weak lensing: for accurate halo mass selection

foreground lens (BOSS / DESI)

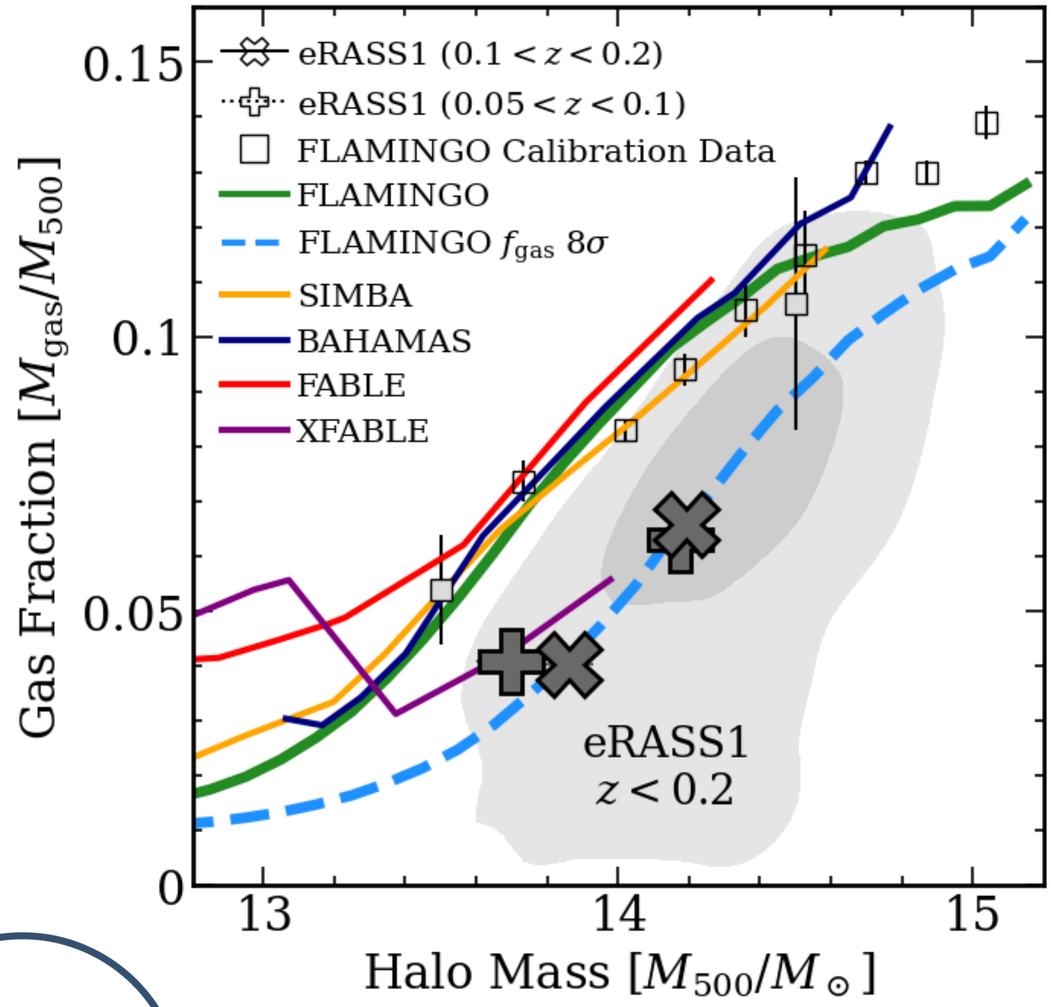


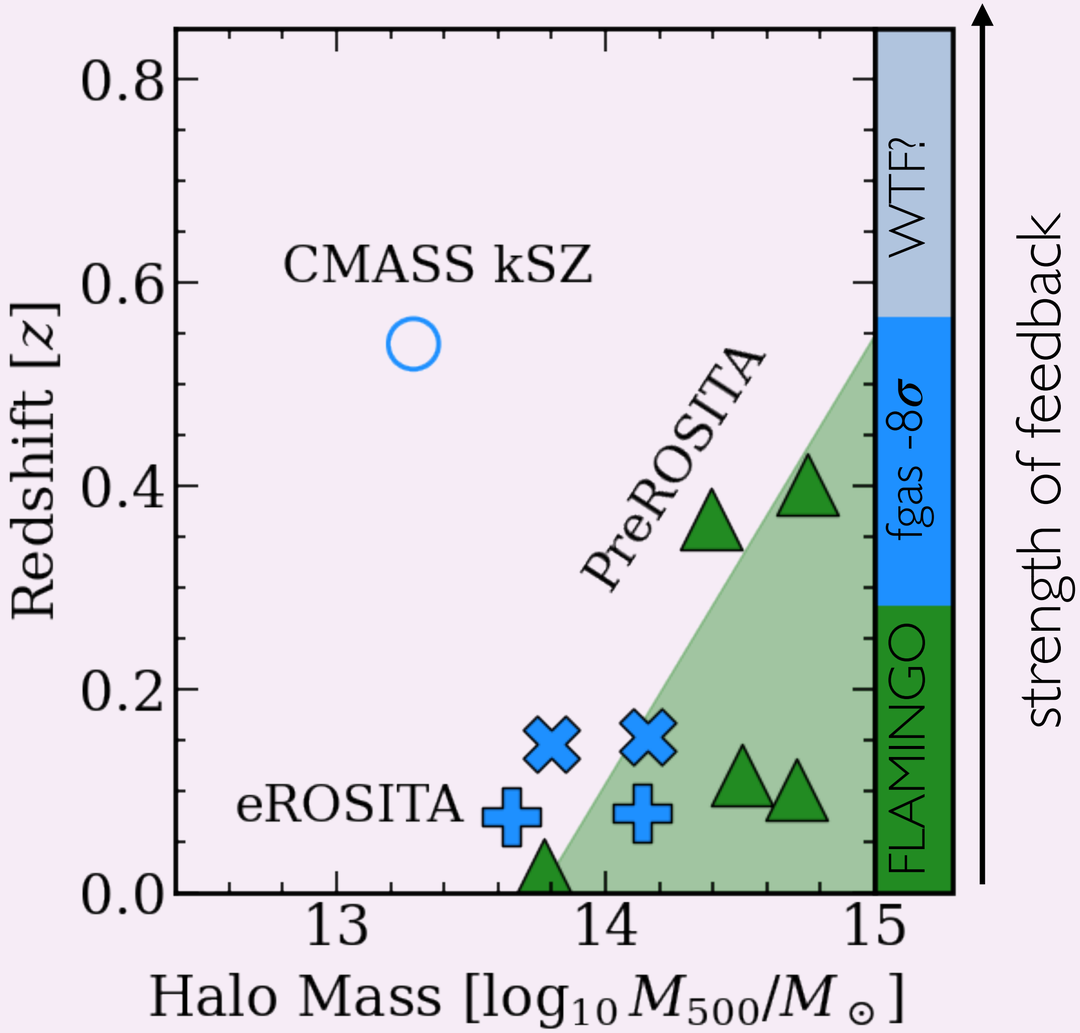
lensed background source galaxies (DES + KiDS + HSC)



[*McCarthy, Amon, FLAMINGO+ 24*]

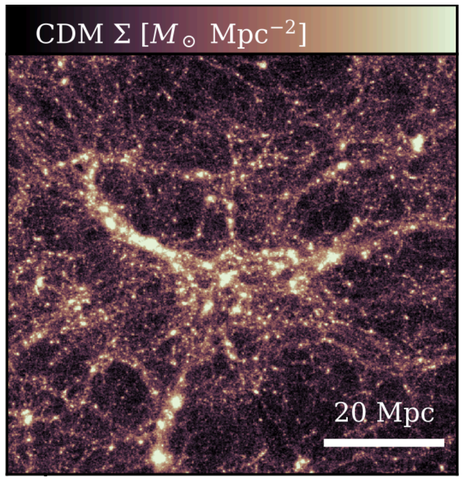
eROSITA X-ray gas fractions: extreme feedback

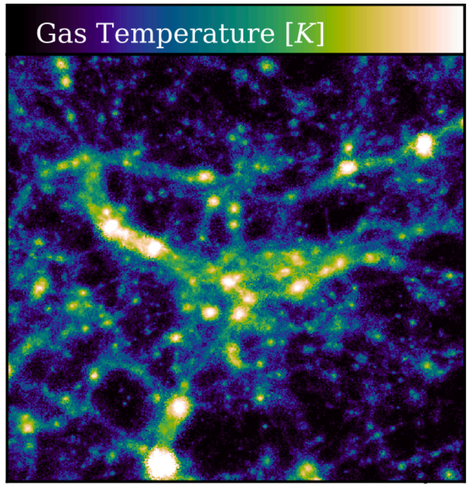


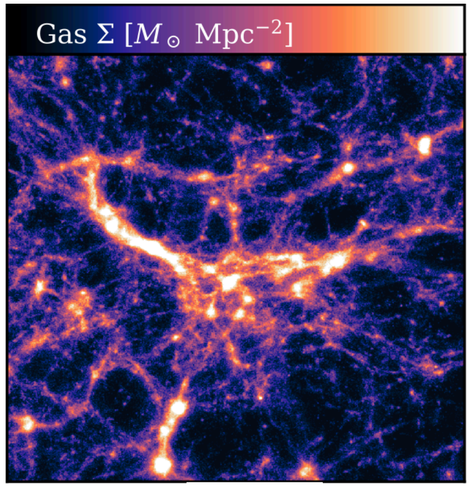


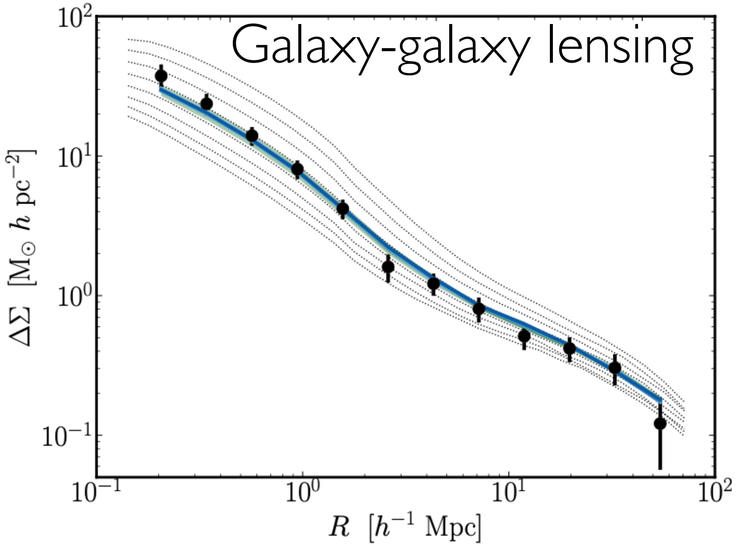
[*Siegel+ (in prep.)*]

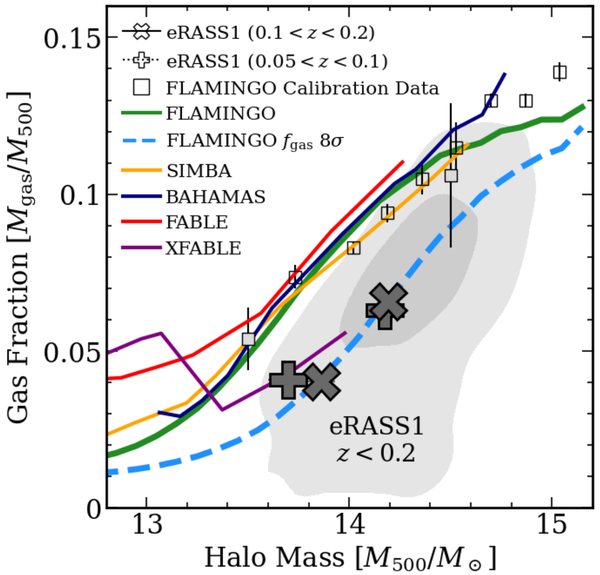
Towards a complete picture of feedback :
kSZ profiles + X-ray gas fractions + galaxy-galaxy lensing



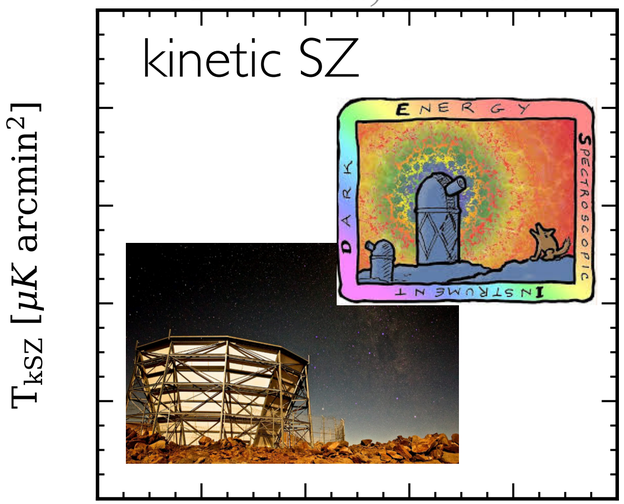




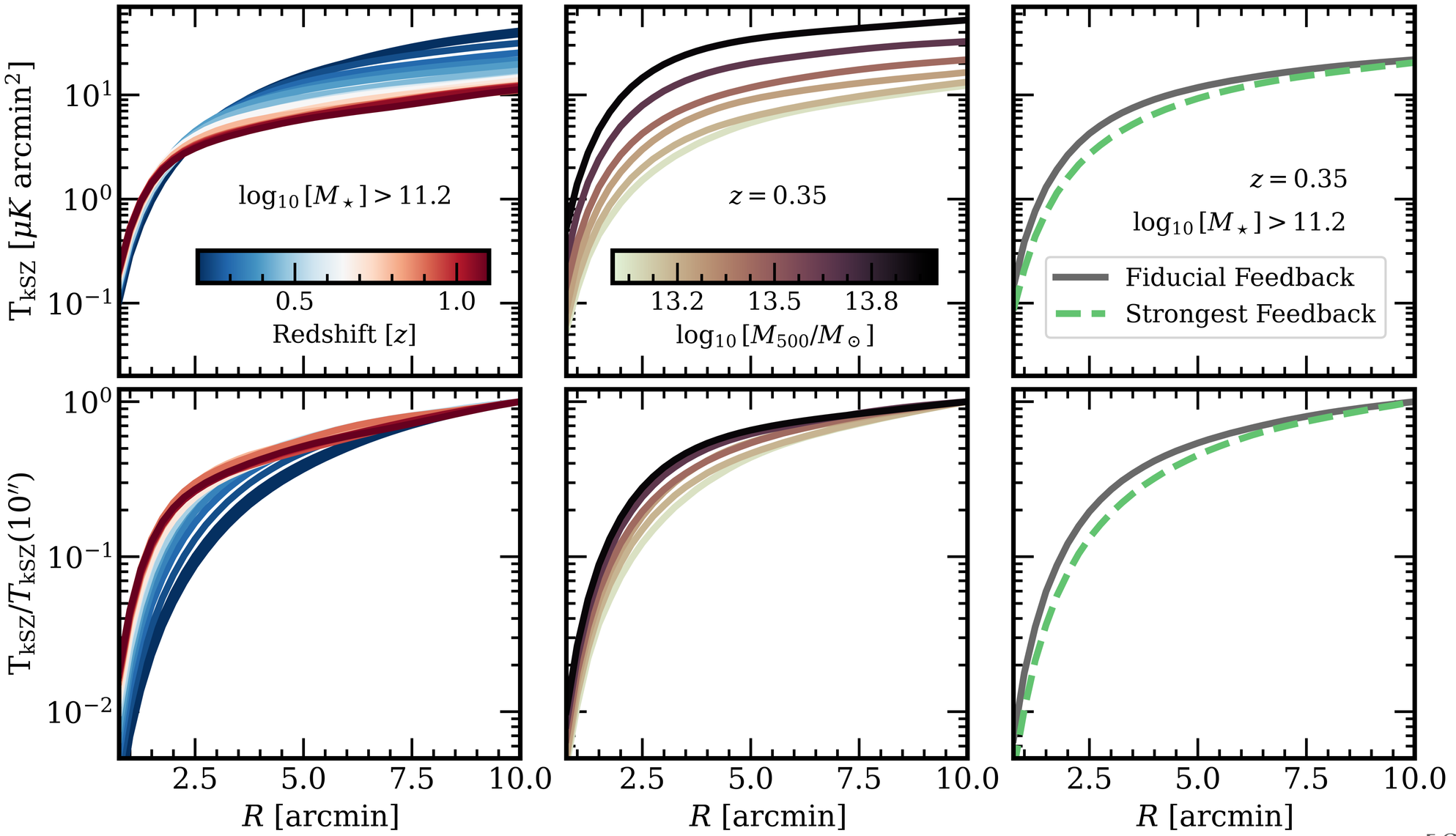




Ried Guachalla, Schaan +25

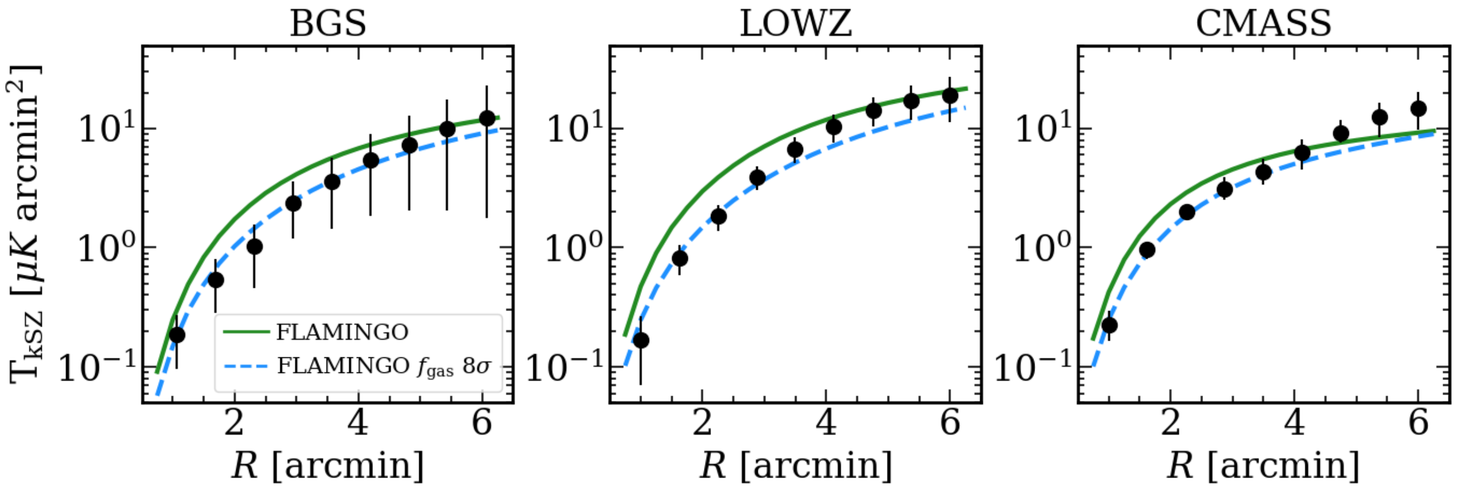


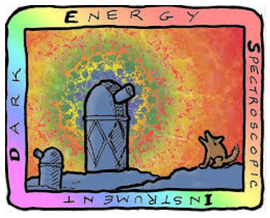
The importance of sample selection for studying kSZ in simulations



[*Siegel+ (in prep.)*]

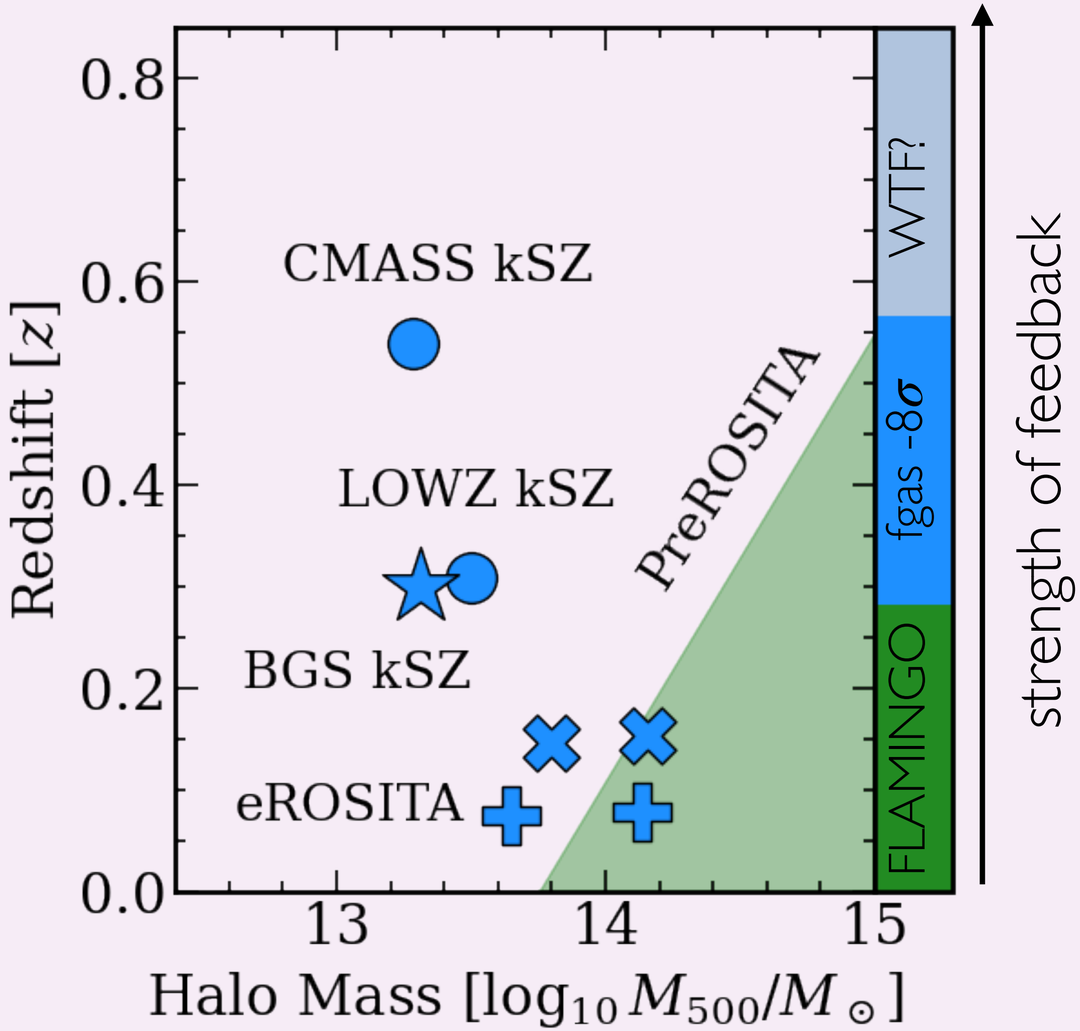
ACT + DESI kSZ: Consistent with extreme feedback



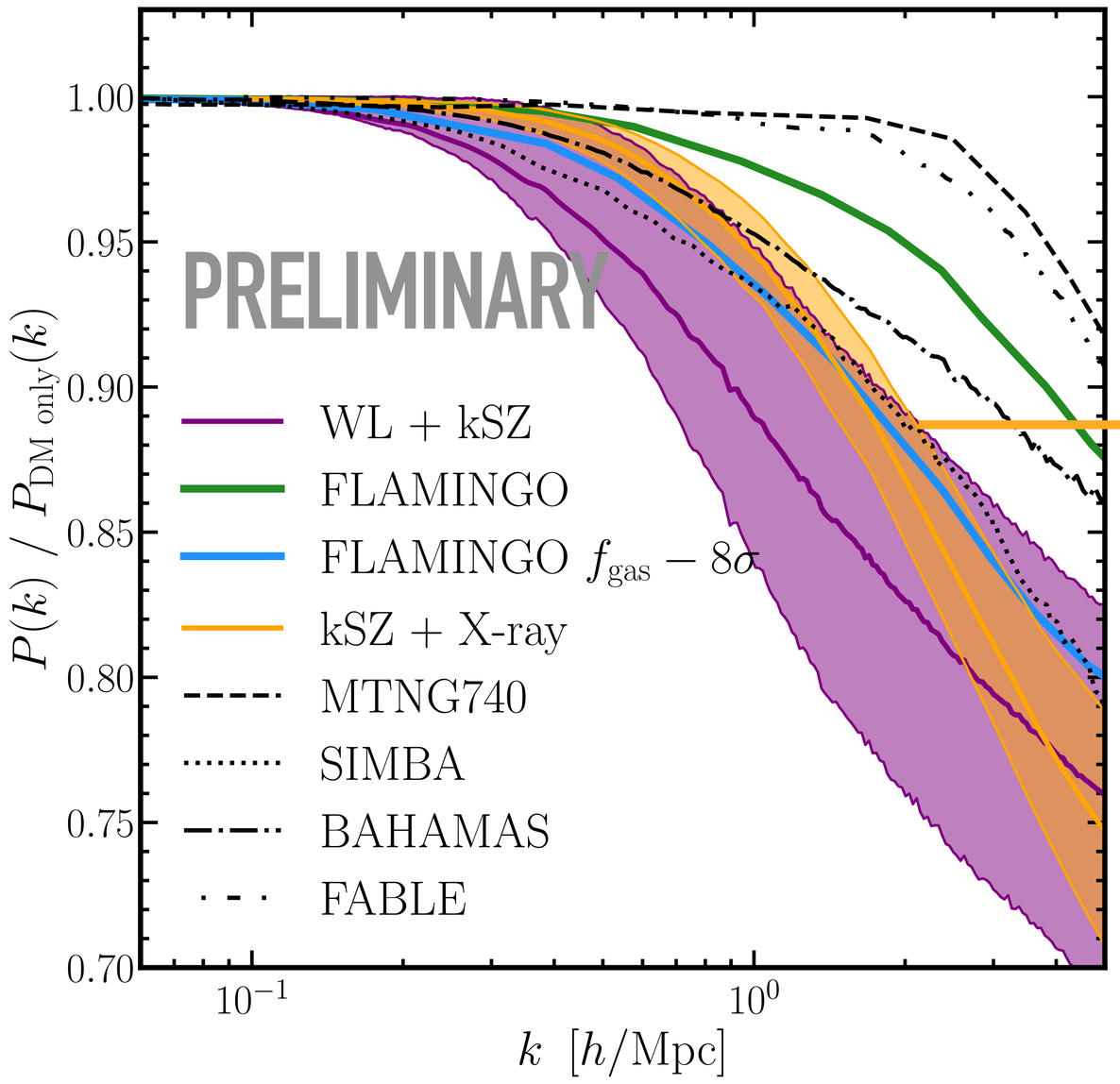


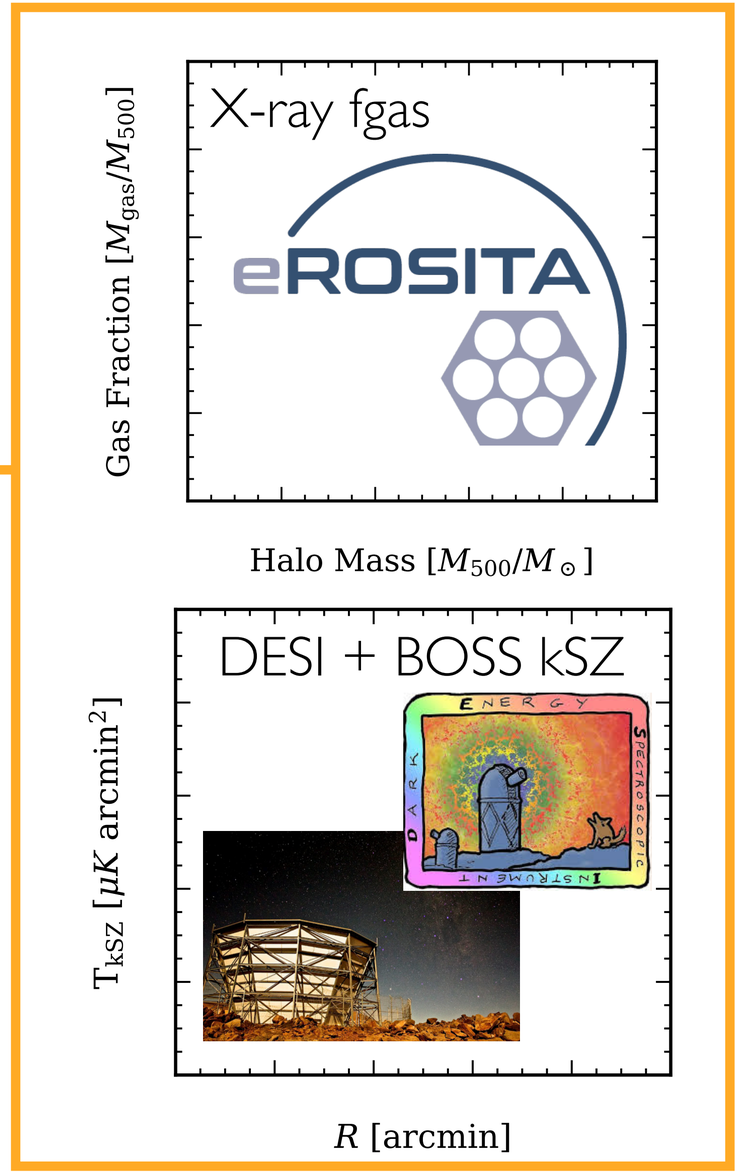
[*Siegel+ (in prep.)*]

[*McCarthy, Amon, FLAMINGO+ 24*]

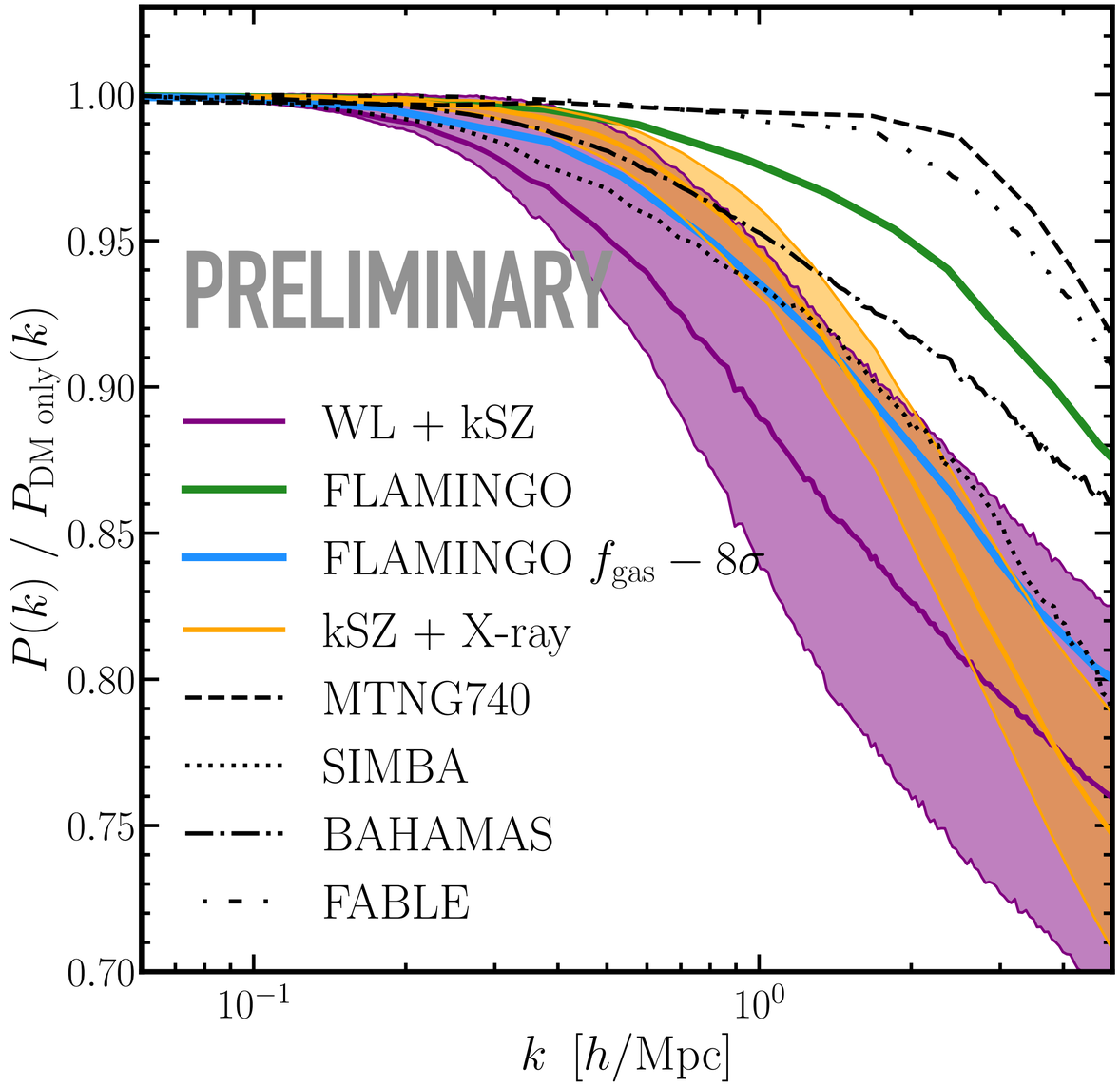


eROSITA gas fractions + kSZ: Consistent with extreme feedback





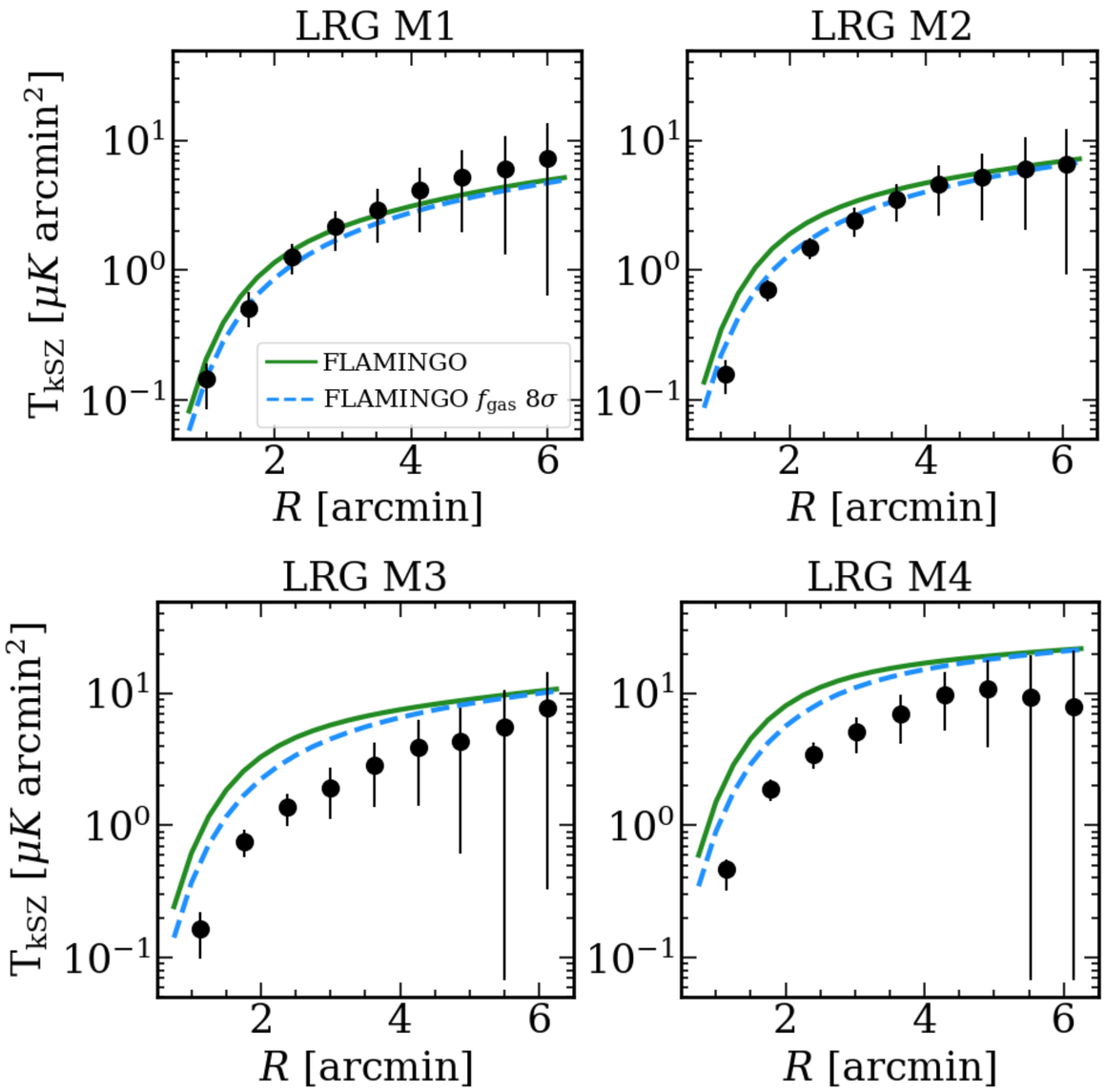
eROSITA gas fractions + kSZ: Consistent with extreme feedback

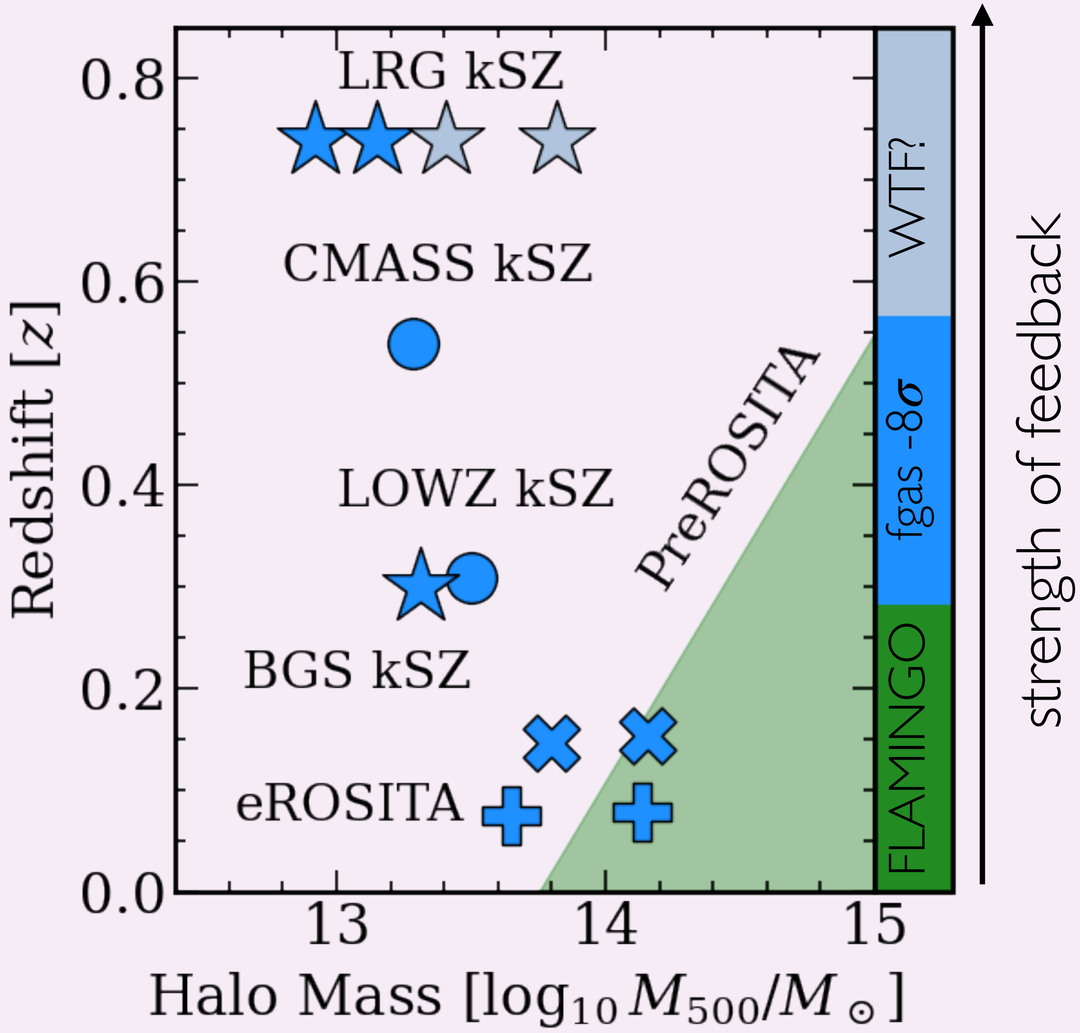


At Rubin-relevant redshifts (z<0.7), across a range of masses, the kSZ & X-ray fgas tell a consistent story: well described by FLAMINGO's extreme feedback variant.

- How do simulations produce this without breaking other observations?
- Selection effects in older X-ray gas fractions?

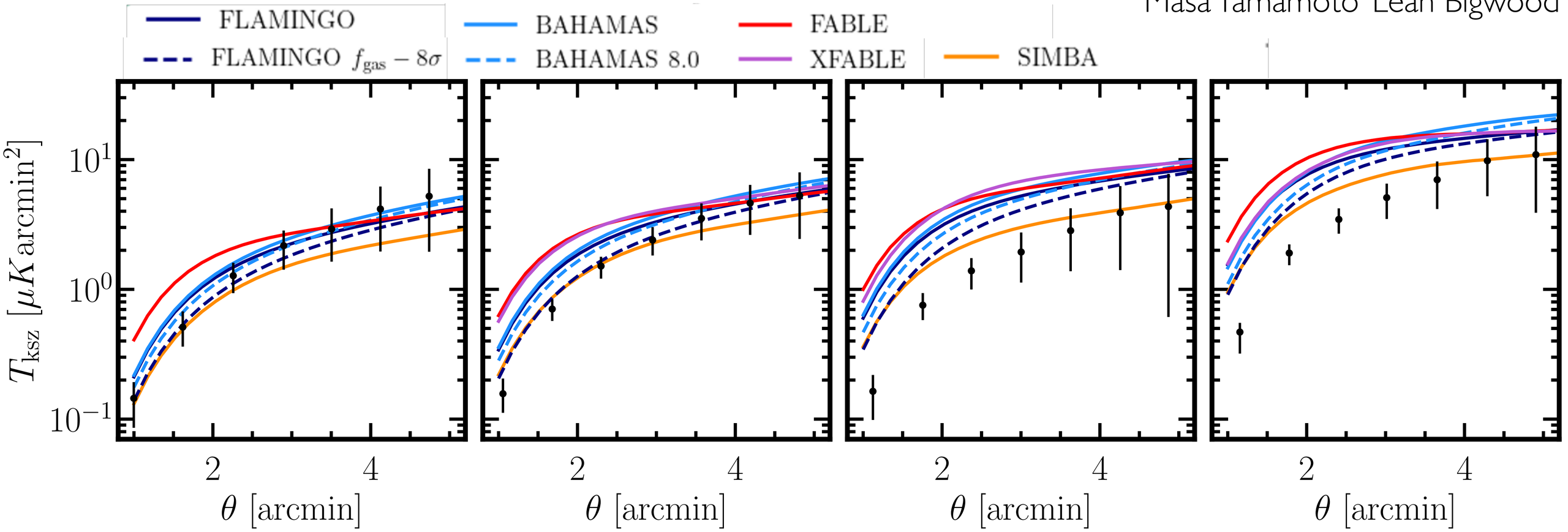
ACT + DESI kSZ at higher-z: unexplored territory





ACT + DESI kSZ at higher redshift: what about other hydro-sims?

Masa Yamamoto Leah Bigwood



ACT + DESI kSZ at higher redshift: what about other hydro-sims?

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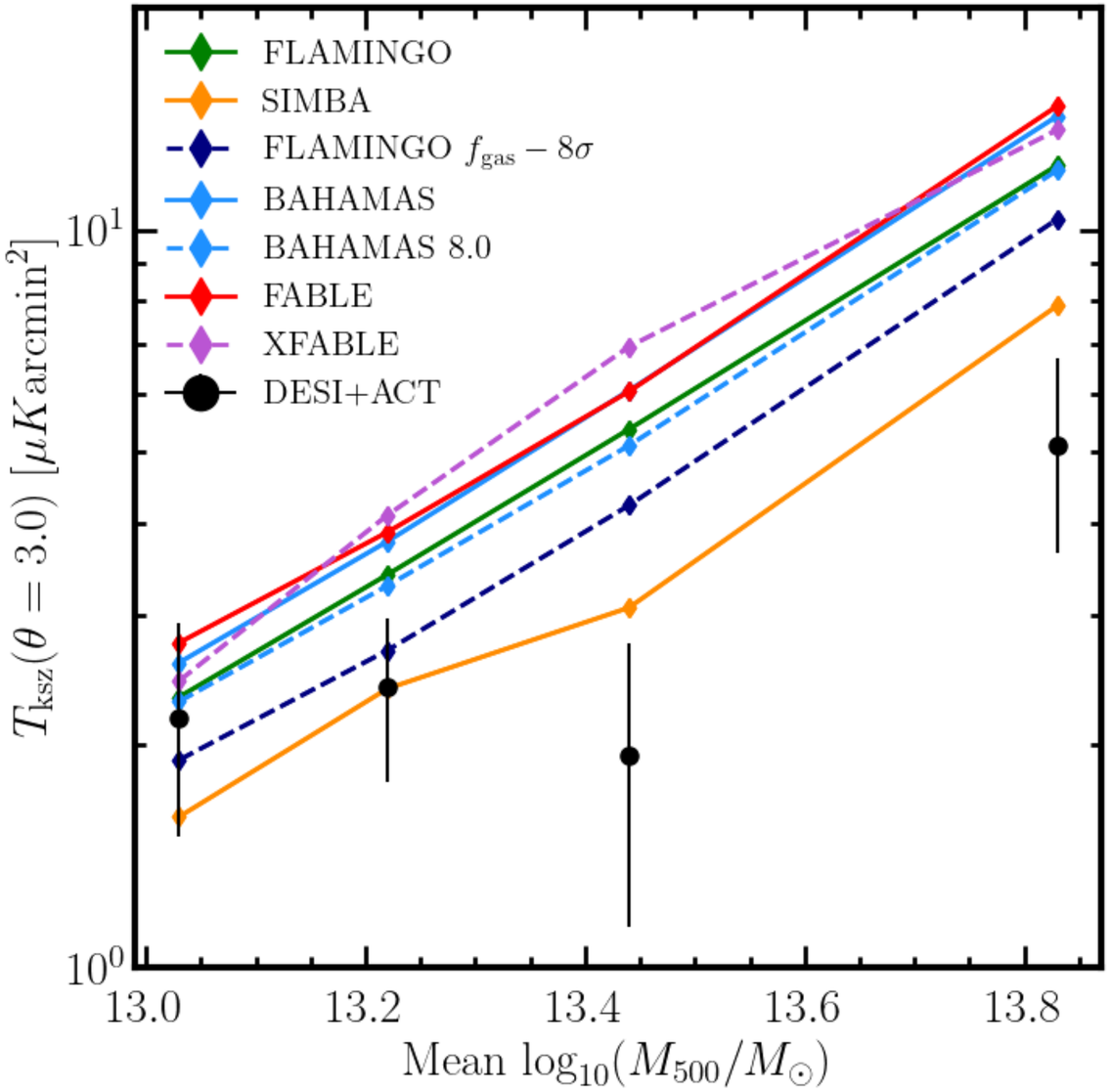
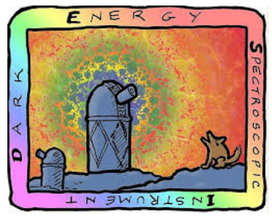


We are establishing a consistent picture of feedback with joint kSZ + X-ray gas fractions + GGL masses

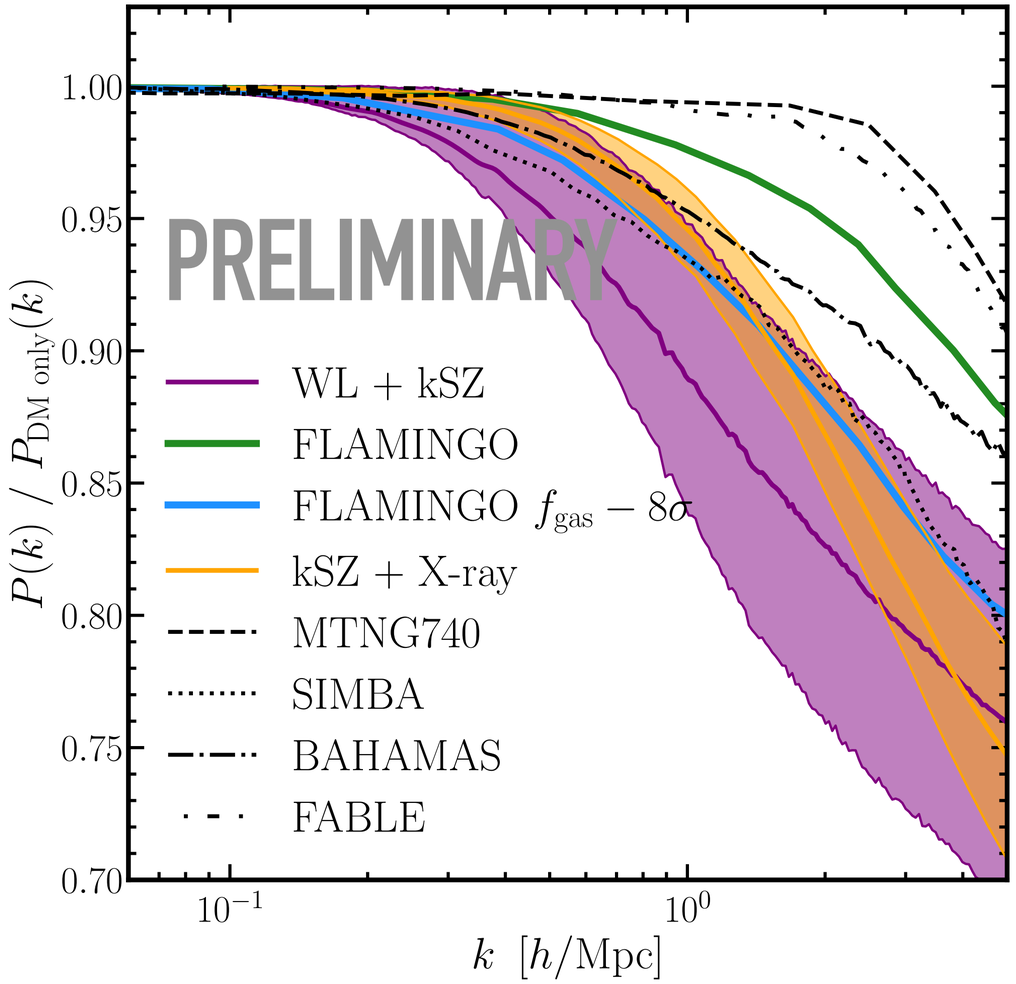



Ian McCarthy Masa Yamamoto Leah Bigwood Jared Siegel

There is mounting evidence that feedback is 'extreme'



eROSITA



Test models of baryon feedback: *Joint analysis of weak lensing + kSZ*

Methods informed by X-ray gas fractions

Discard measurements on scales impacted by feedback (acc. to OWLS AGN hydro-sim)

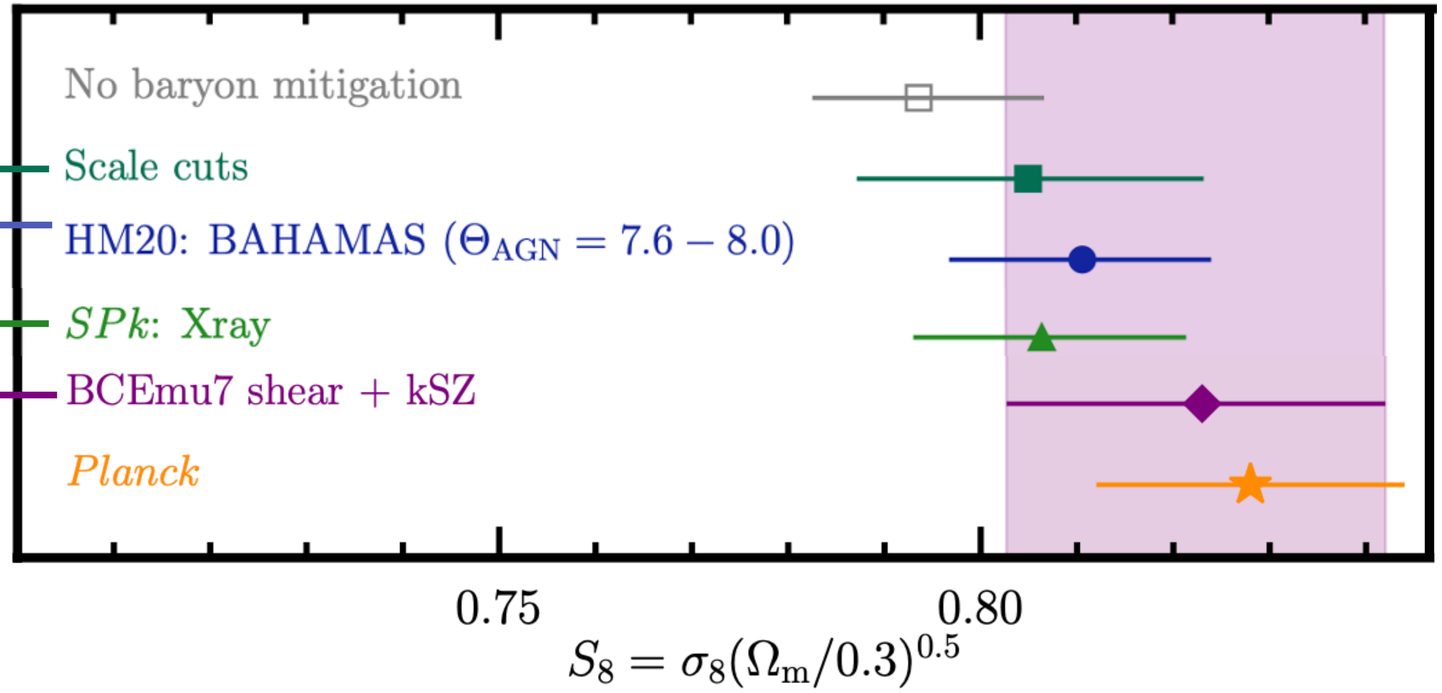
Halo model approach (calibrated to BAHAMAS hydro-sim)

Emulator built from ANTILLES hydro-sims, with X-ray prior

Analytic model based on N-body simulations, flexible to reproduce a range of hydro-simulations

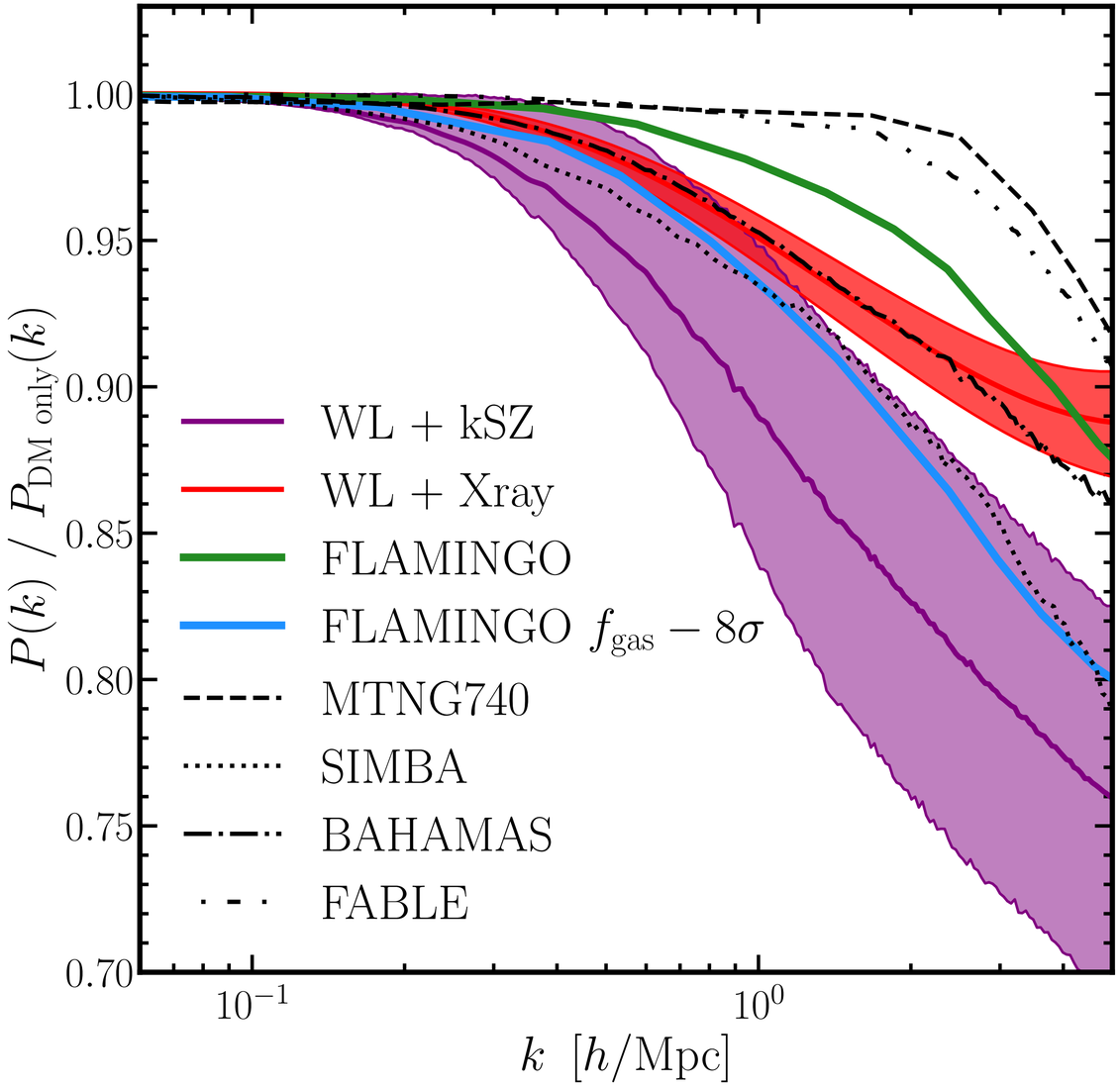
+ **kSZ** to constrain model parameters

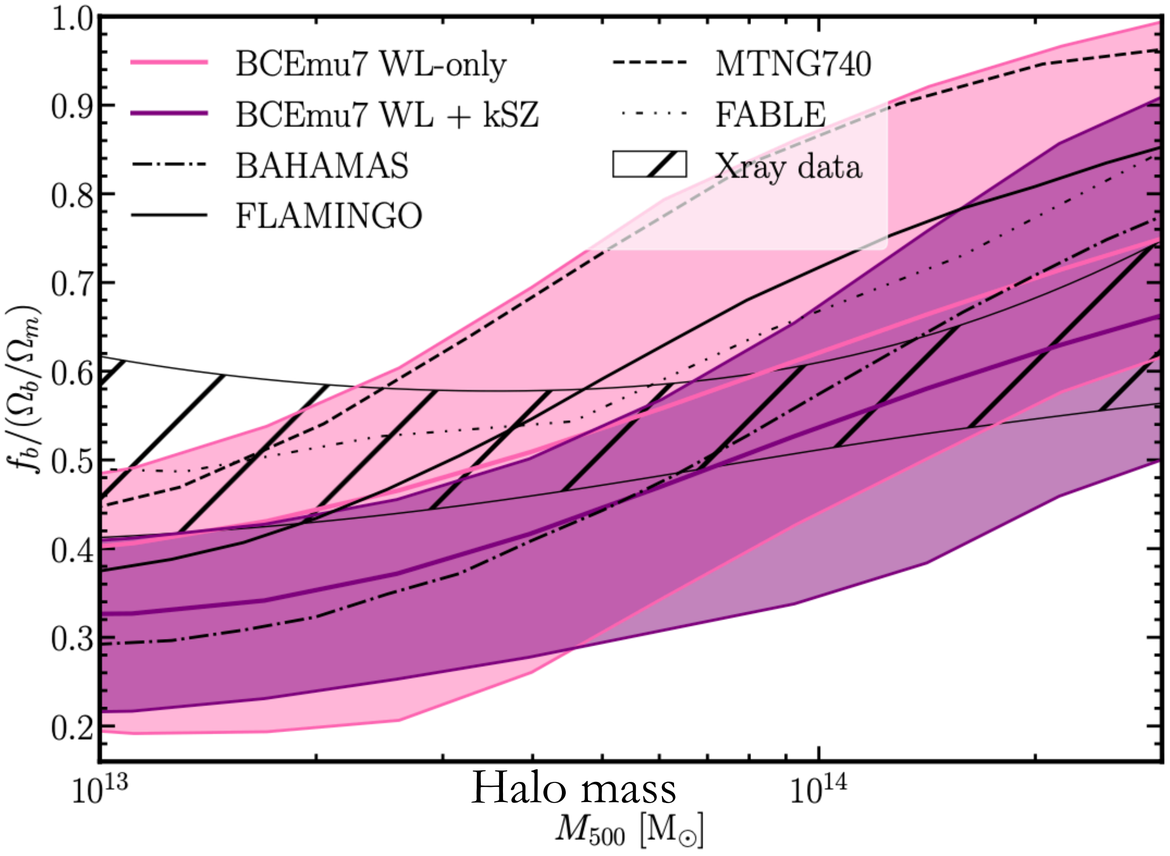
Gas priors are important!
Do X-ray and kSZ give a consistent view of feedback?



[*Bigwood, Amon+ 24*]

kSZ + X-ray predict different feedback strengths?





[*Bigwood, Amon+ 24*]