Inter-Lagrangian Baryon Transfer in the SIMBA Simulations

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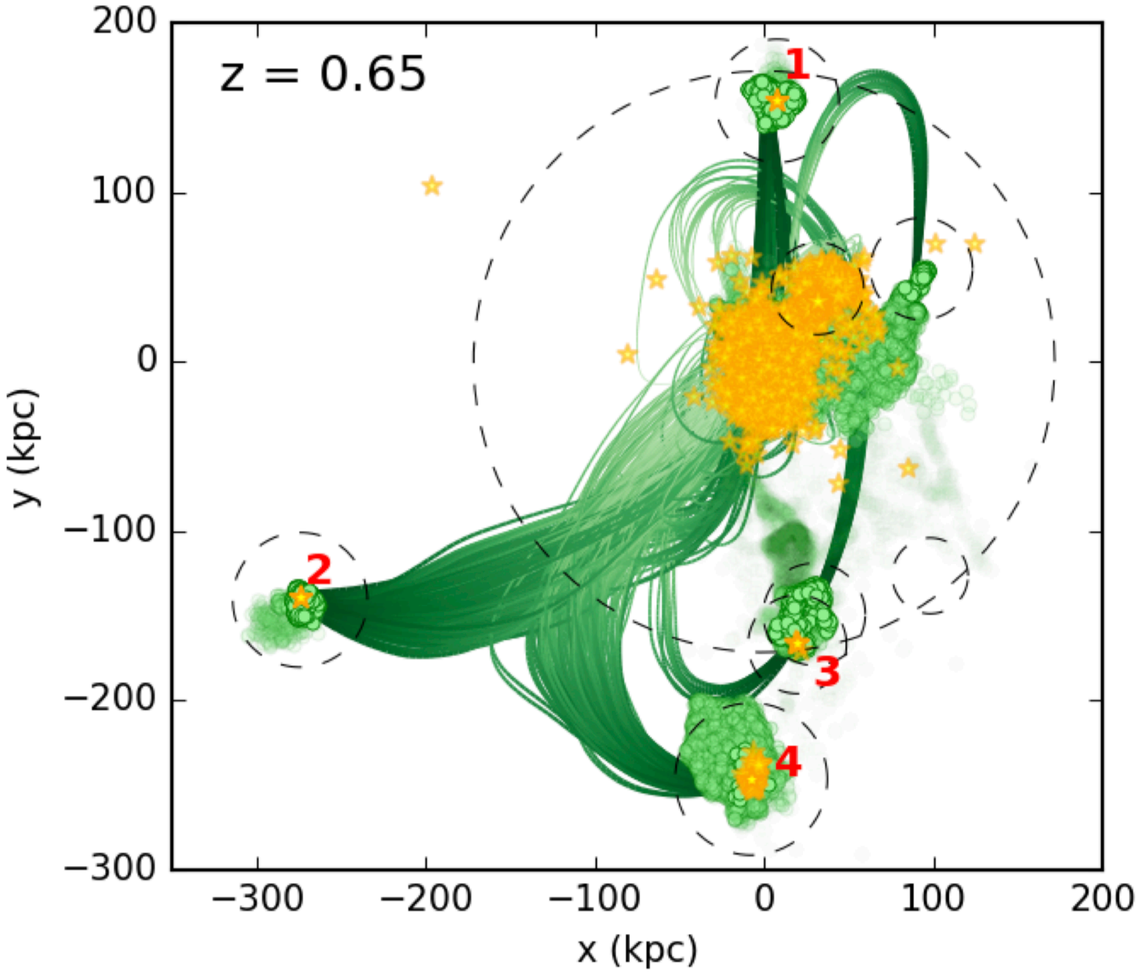
DEX XV, Edinburgh | 8th January 2019

Physical Motivation

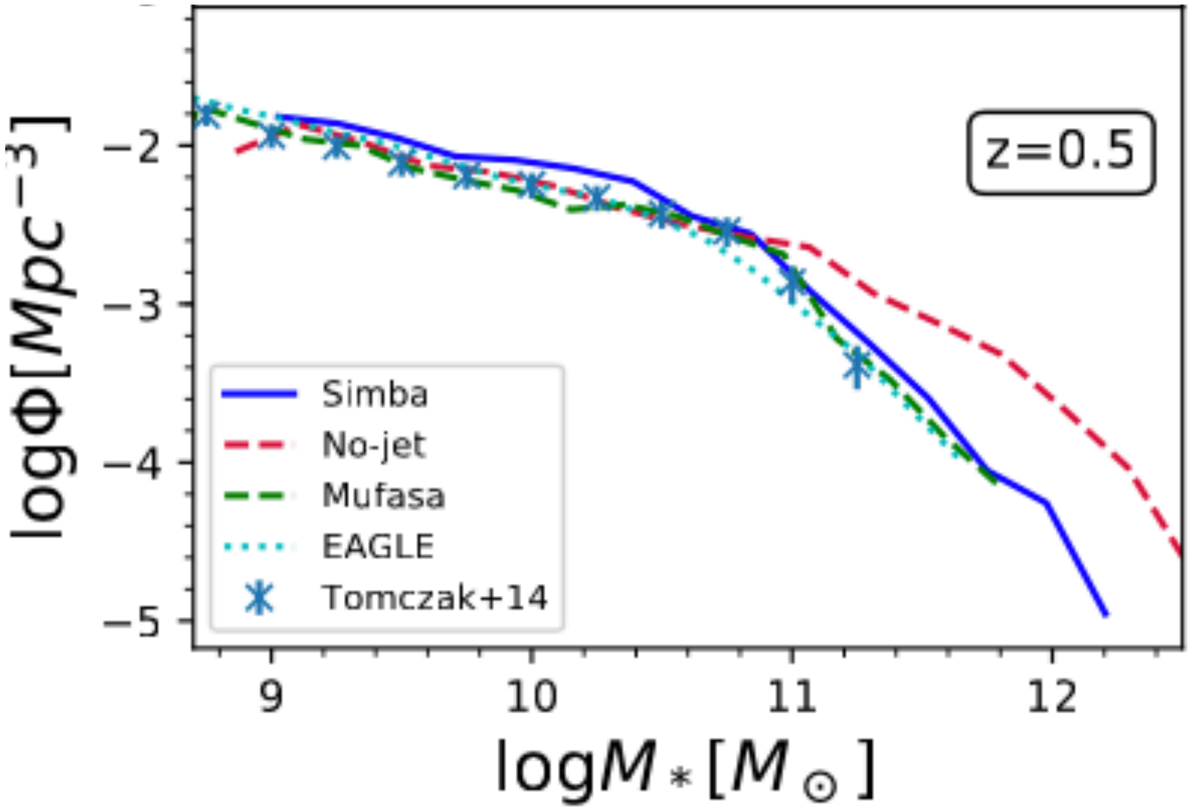
- Feedback causes gas to be blown out of galaxies
- This is especially true in simulations that include AGN feedback
- Where does that gas go?



Angles-Alcazar+, Baryon Cycling and Galaxy Assembly on FIRE, 2017

SIMBA

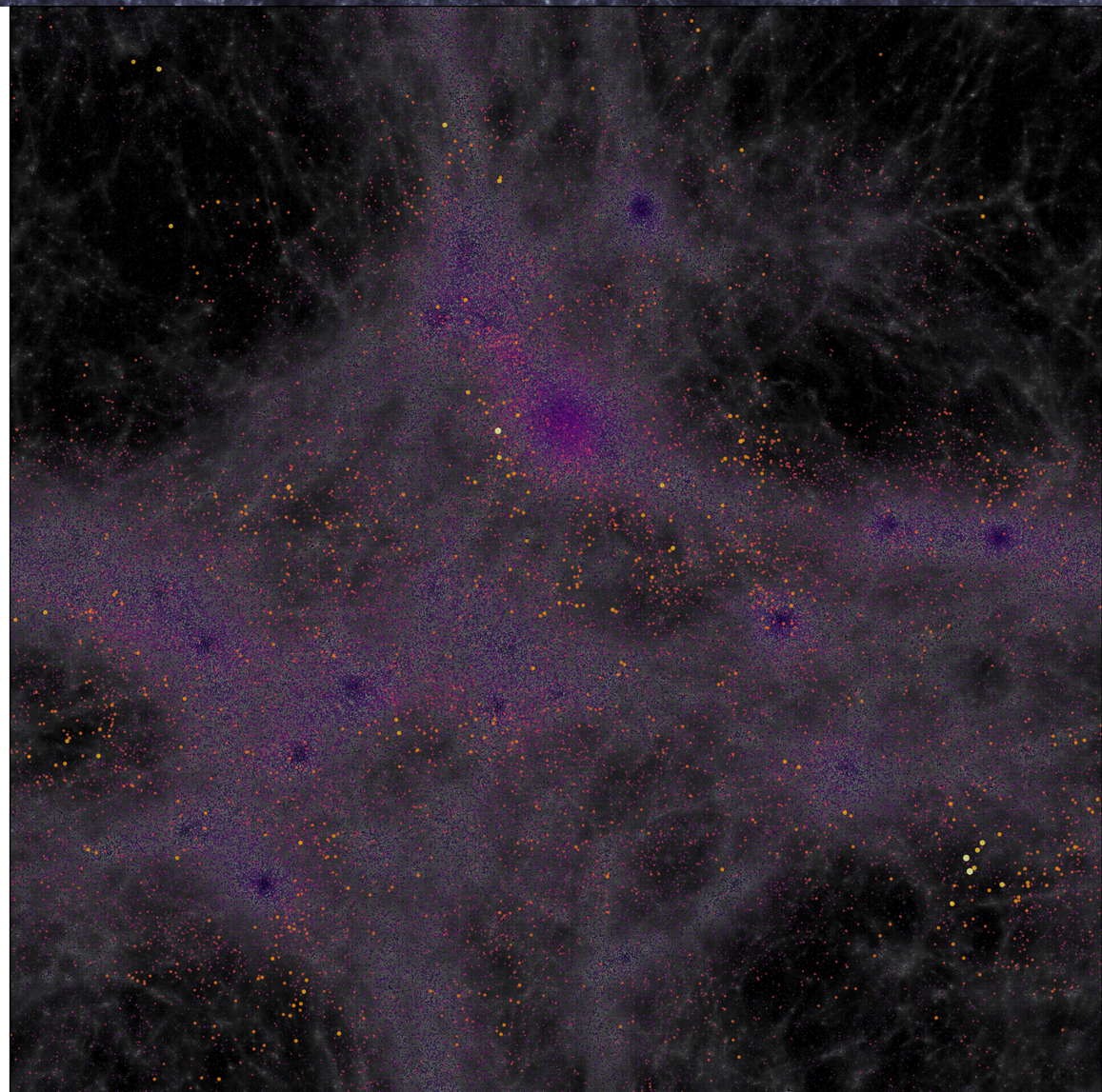
- New cosmological simulation suite
- Sub-grid parameters based on scalings from FIRE (Hopkins+ 2018)
- Includes a sophisticated AGN feedback model



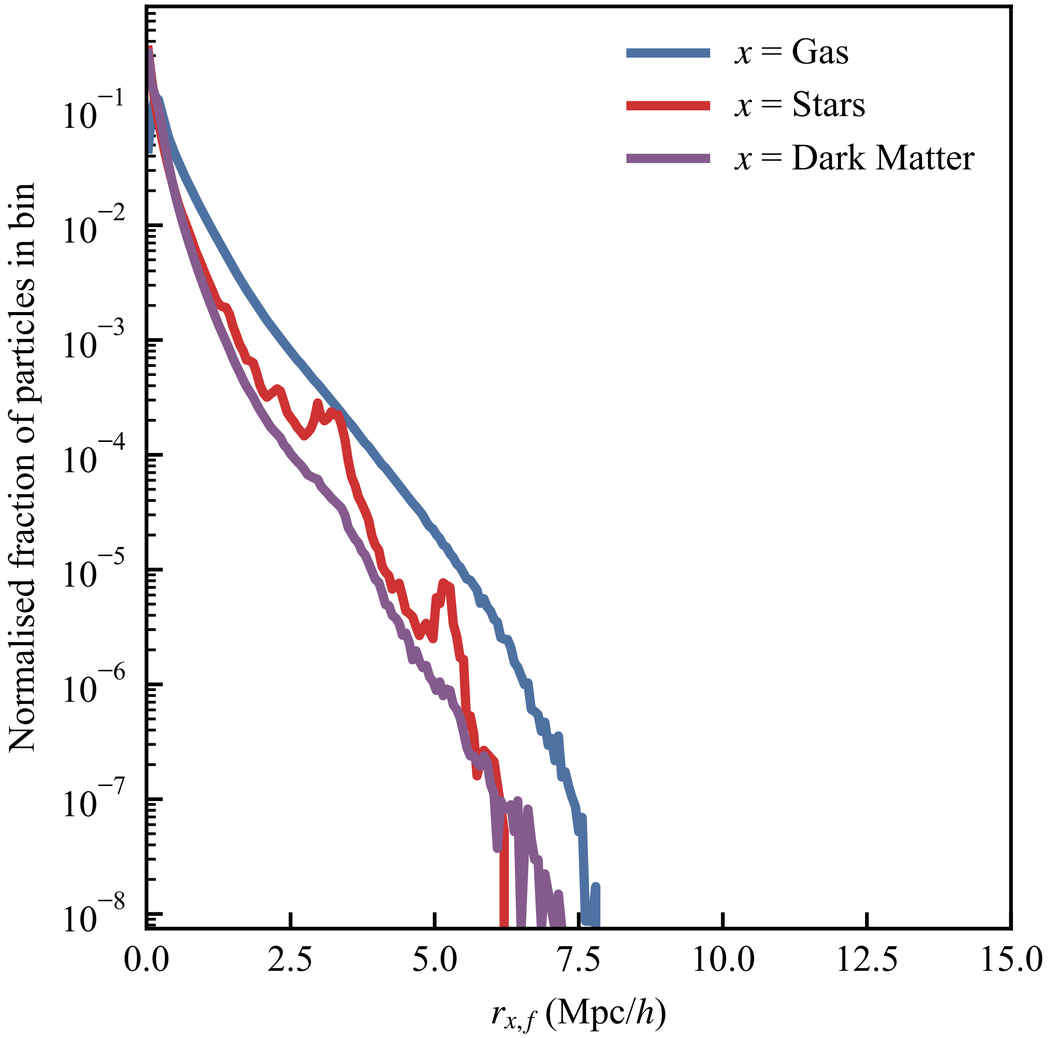
GSMF for the 50 Mpc/h SIMBA volume (Dave+ 2019)

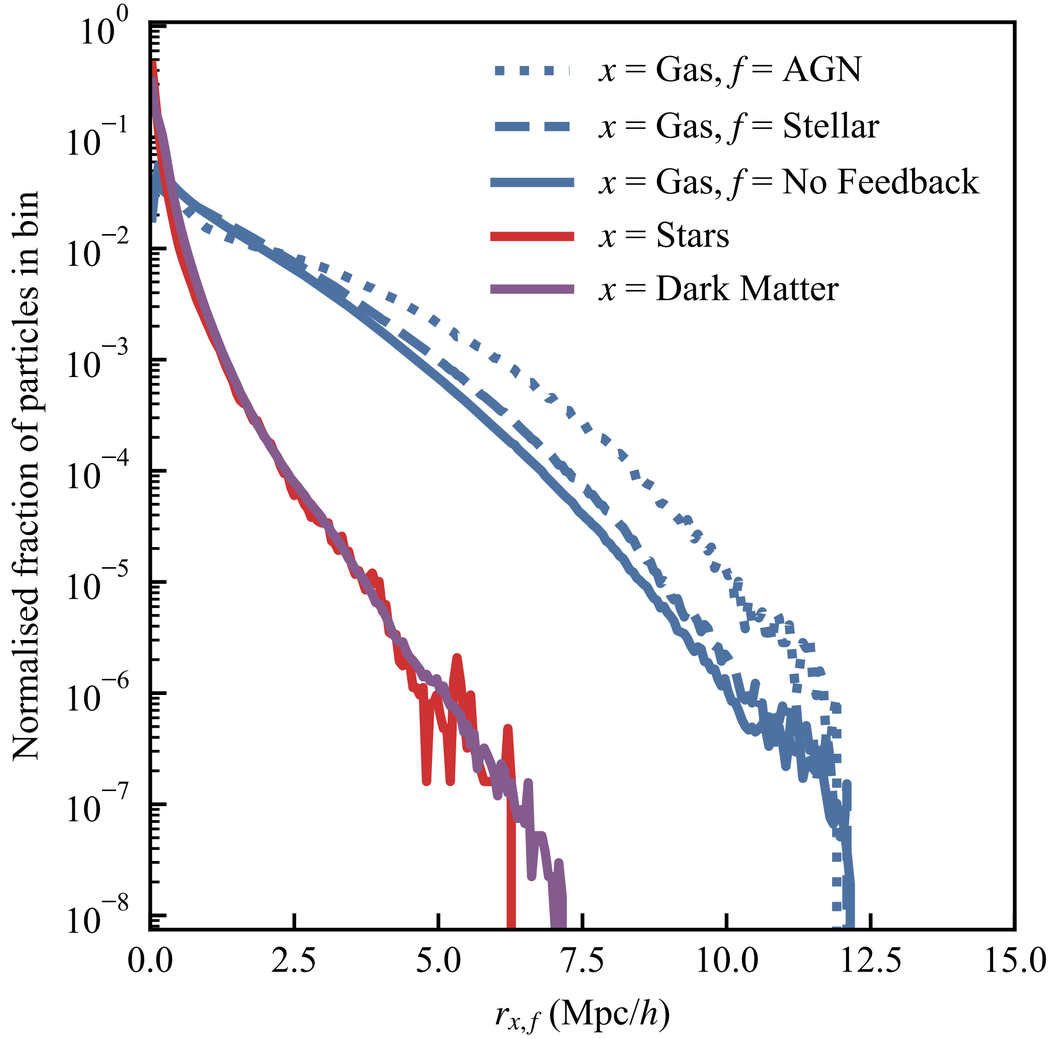
Let’s talk about metrics

- The effect of feedback itself is hard to quantify
- Can see effect on GSMF, etc. indirectly
- Very few direct metrics exist
- Have to run simulations with/out; these are usually invalid because of calibration.



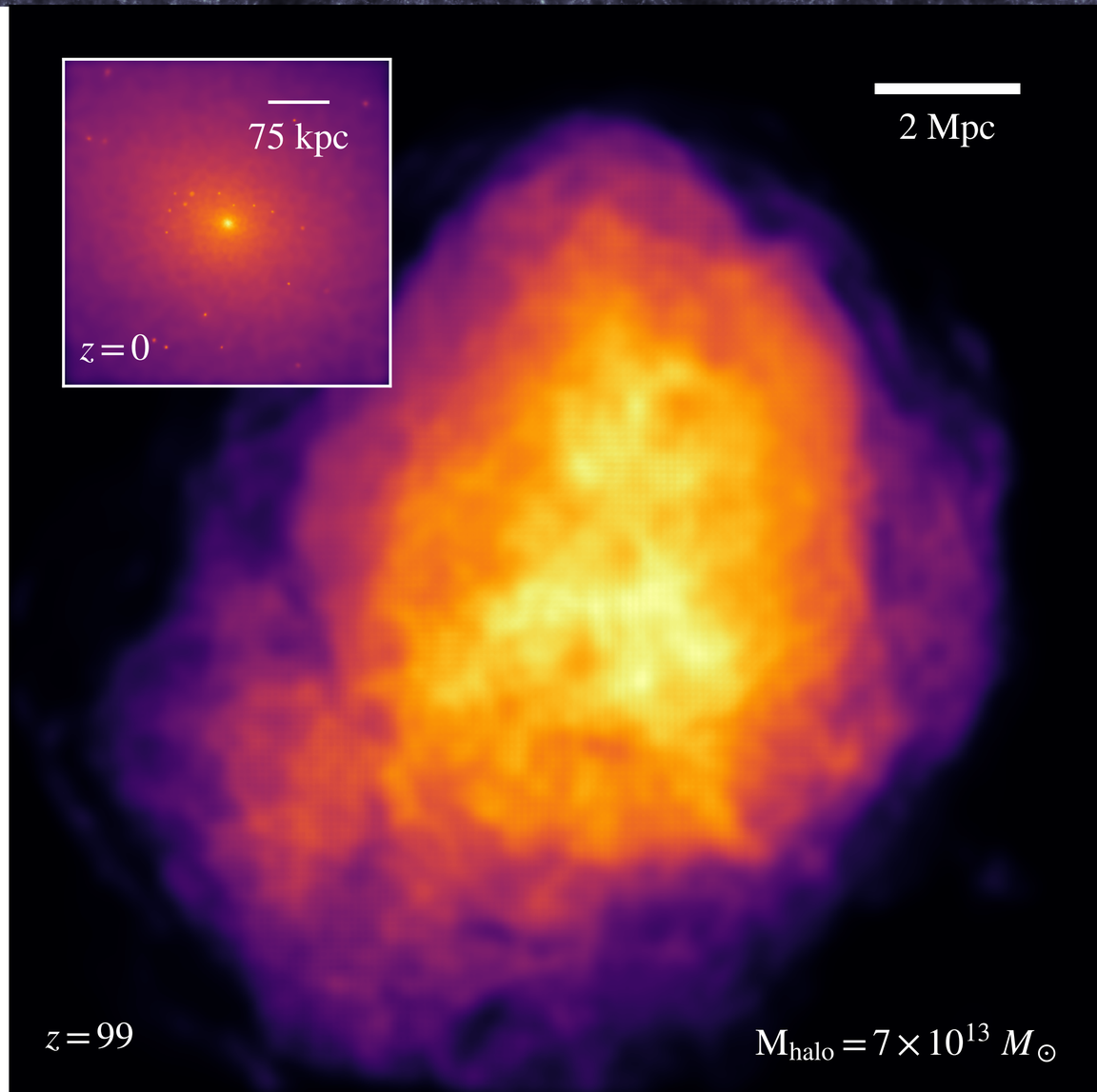
NoJet (L) v.s. full model (R)



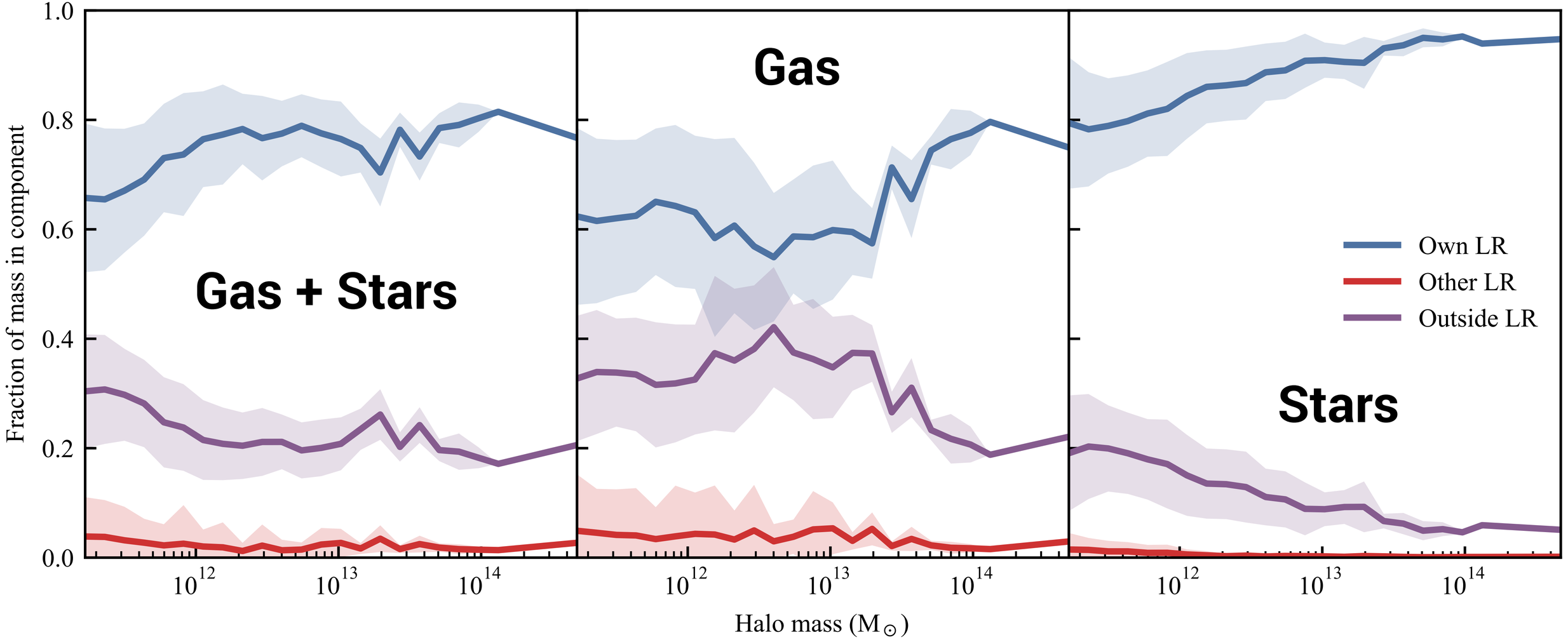


Lagrangian regions

- Define the “Lagrangian region” by the dark matter of a collapsed object at z=0
- Look at the spatial region those particles are spread over in the ICs
- Extend to gas using nearest neighbour searching



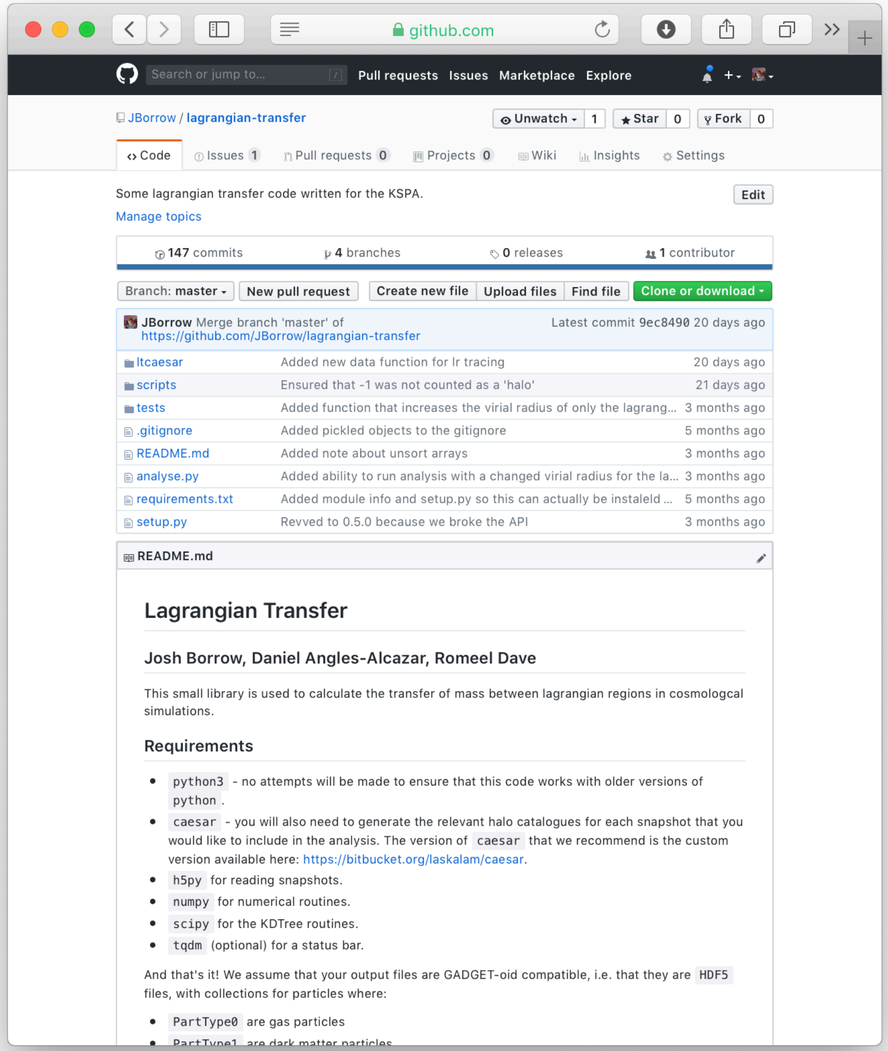
BTMF (Baryon Transfer Mass Functions)



LTCaesar

- LTCaesar, the code that does this matching, is fully open source and available

- We want to apply this to other simulation suites (next up EAGLE, Illustris, and maybe TNG?) so get in touch if you are interested!



Conclusions

- New feedback models include jet modes
- The impact these jet modes have is clear visually, but hard to quantify; can use the spread metric to visualise.
- Feedback drives gas flow between halos; ~5-10% of the mass of a MW-like galaxy originates from another galaxy

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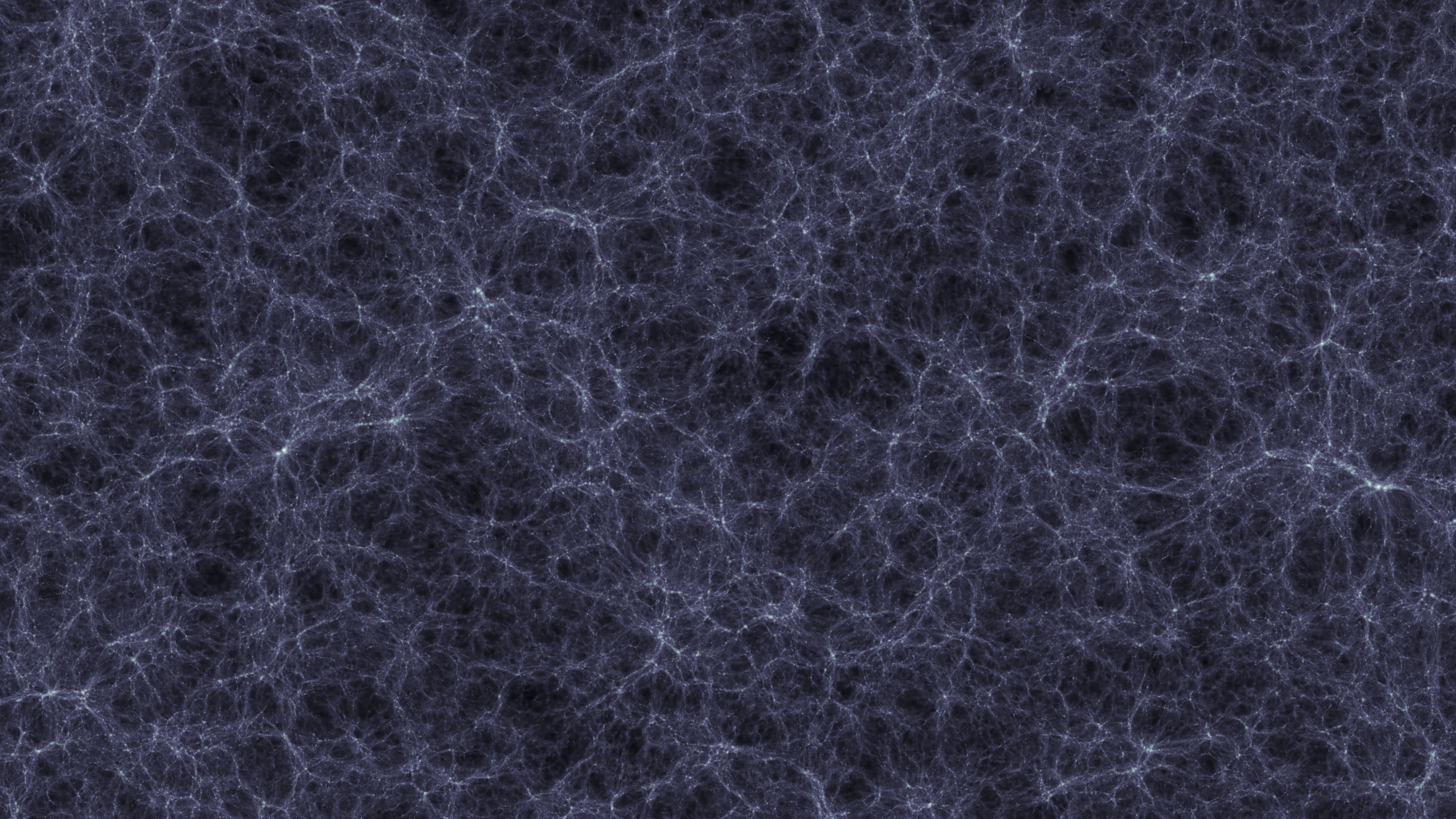
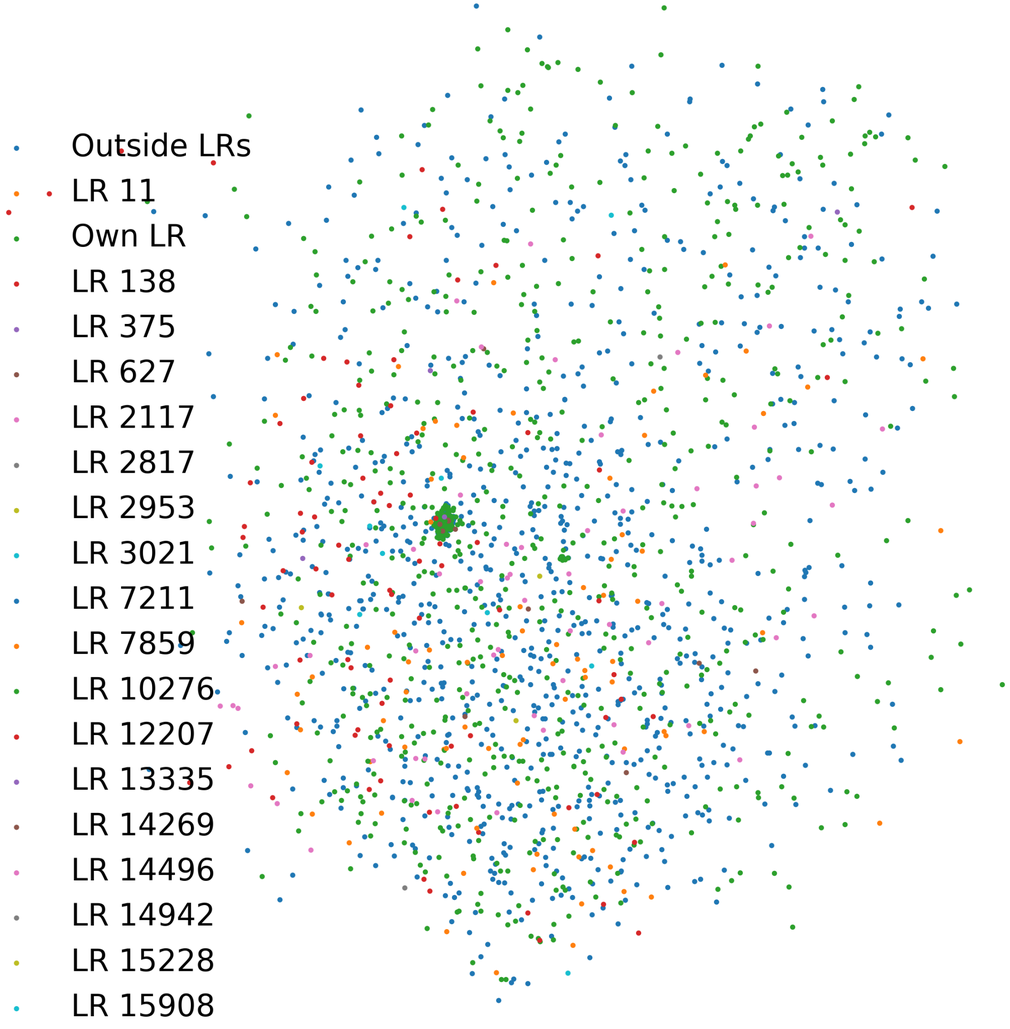


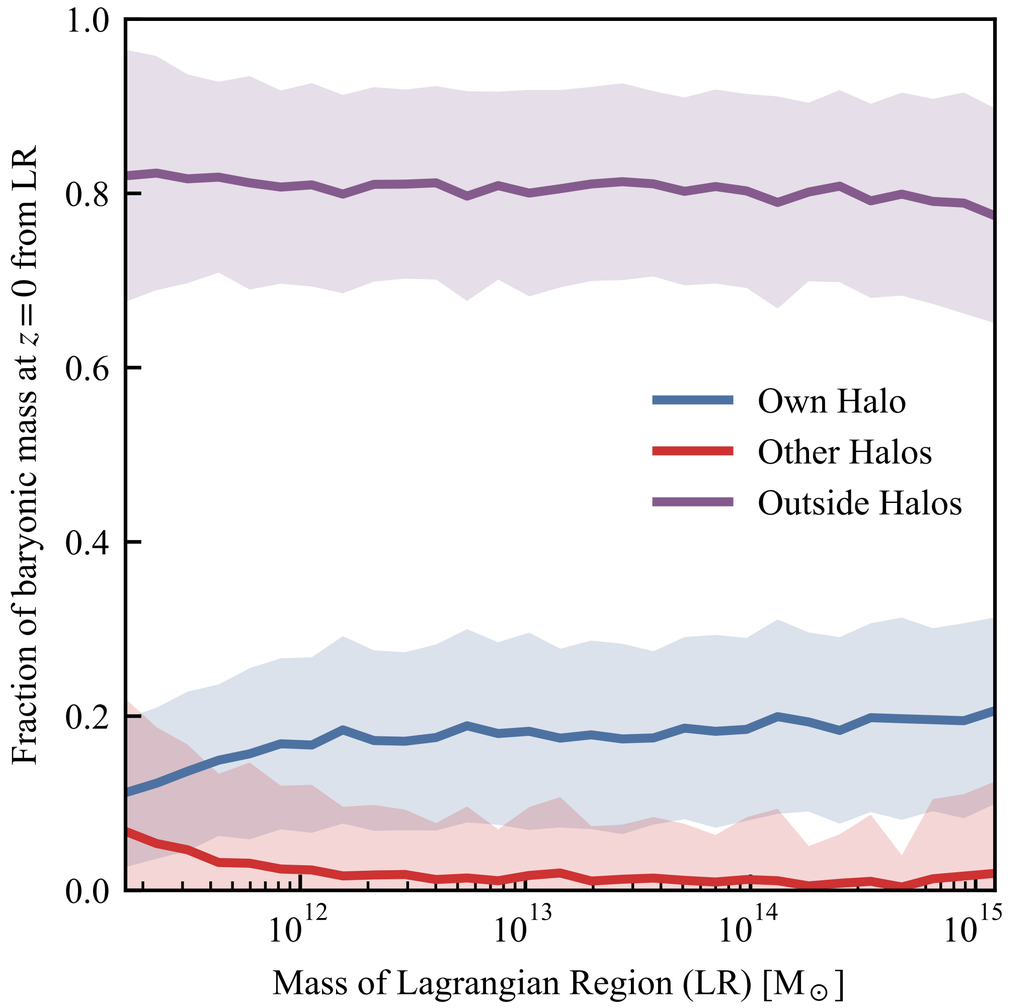
Where to go with this?

- Can use these metrics to put constraints on feedback models
- Of course, this is very difficult to measure in observations
- Can tie into metallicity measurements, etc.



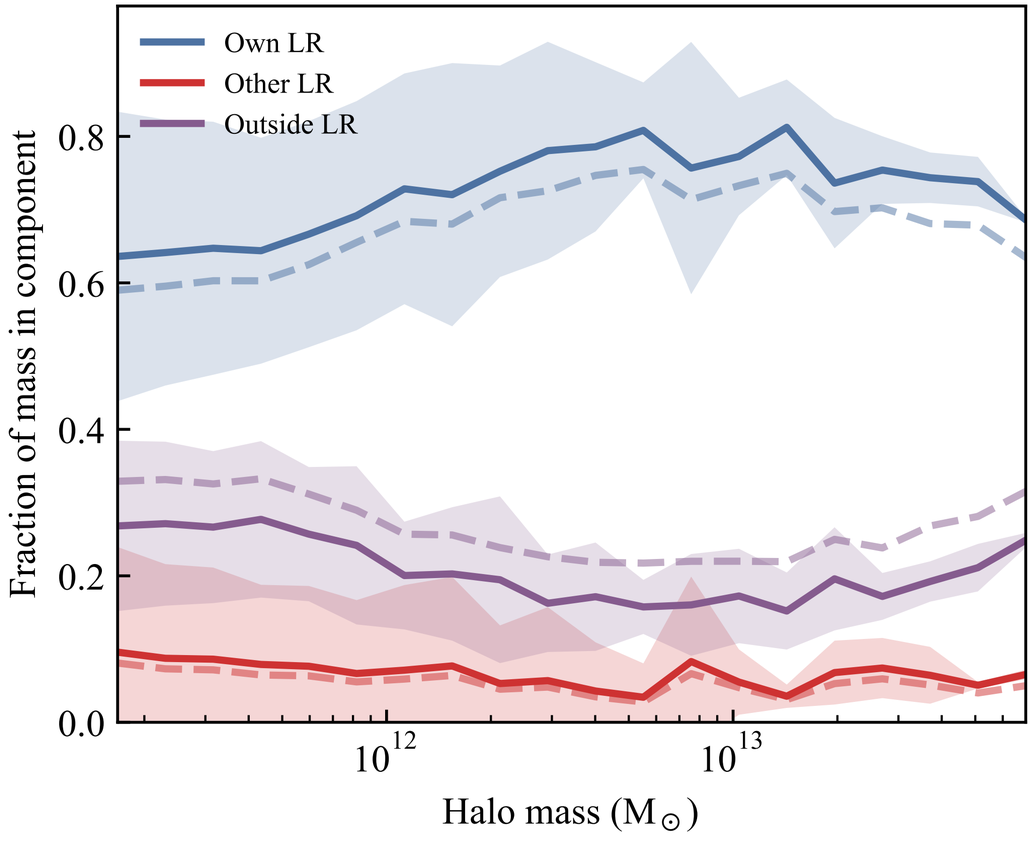
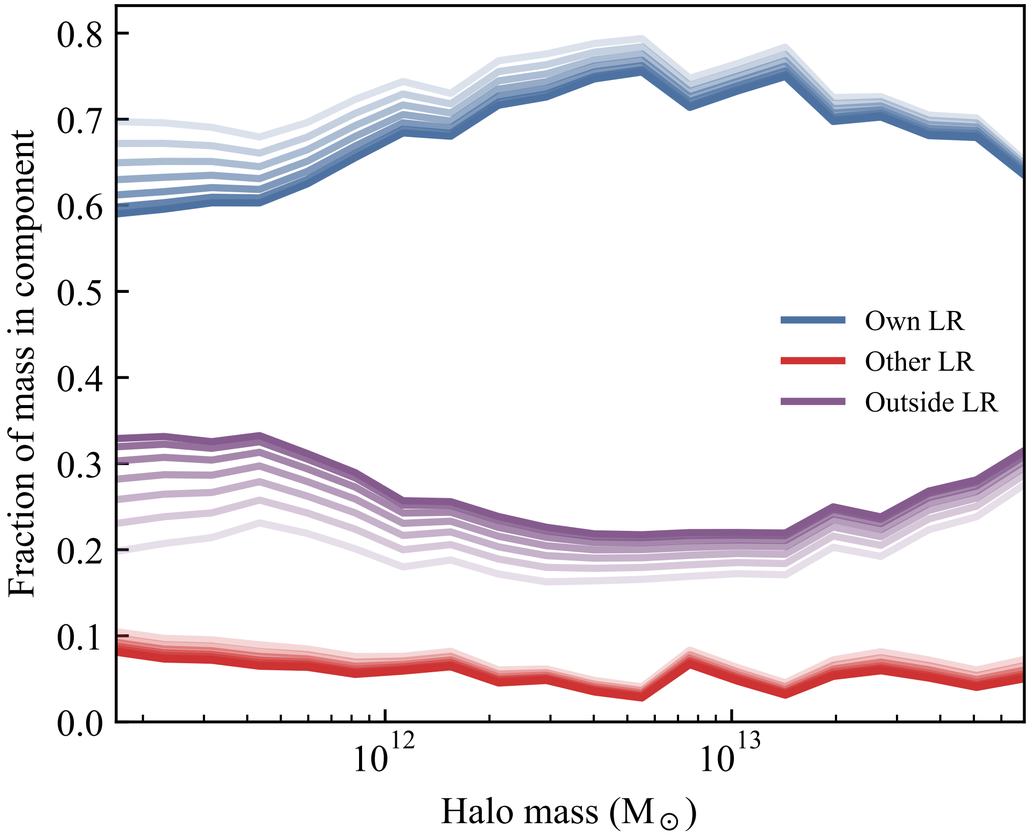
But where does it go?

- Only 20% of the baryonic mass of a given Lagrangian region ends up in the final halo
- The rest ends up outside any LR: delayed infall and feedback out of galaxies.



Validation

Expanded r_{vir}



Smoothing LRs