

Title: Measuring the cosmic ecosystem with weak gravitational lensing

Speakers: Mike Hudson

Collection/Series: Cosmic Ecosystems

Subject: Cosmology

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Abstract:

Weak gravitational lensing is the only way to probe the total matter distribution on the scales of galaxies and the surrounding cosmic web. Understanding the dark matter distribution and its link to galaxies is critical not only galaxy formation and evolution, but also to correctly extract the cosmological parameters from weak lensing surveys. I will highlight recent results from the Ultraviolet Near Infrared Optical Northern Survey (UNIONS), a major weak lensing survey of 6000 square degrees of the northern sky, that probe the dark matter distribution around luminous red galaxies, allowing us to see the feedback-affected matter profiles, around galaxy mergers and in filaments of the cosmic web. If time permits, I will discuss prospect for future weak lensing surveys such as Euclid.

MEASURING THE COSMIC ECOSYSTEM WITH WEAK LENSING

Mike Hudson



UNIVERSITY OF
WATERLOO





Canada-France-Hawaii Telescope



Pan-STARRS

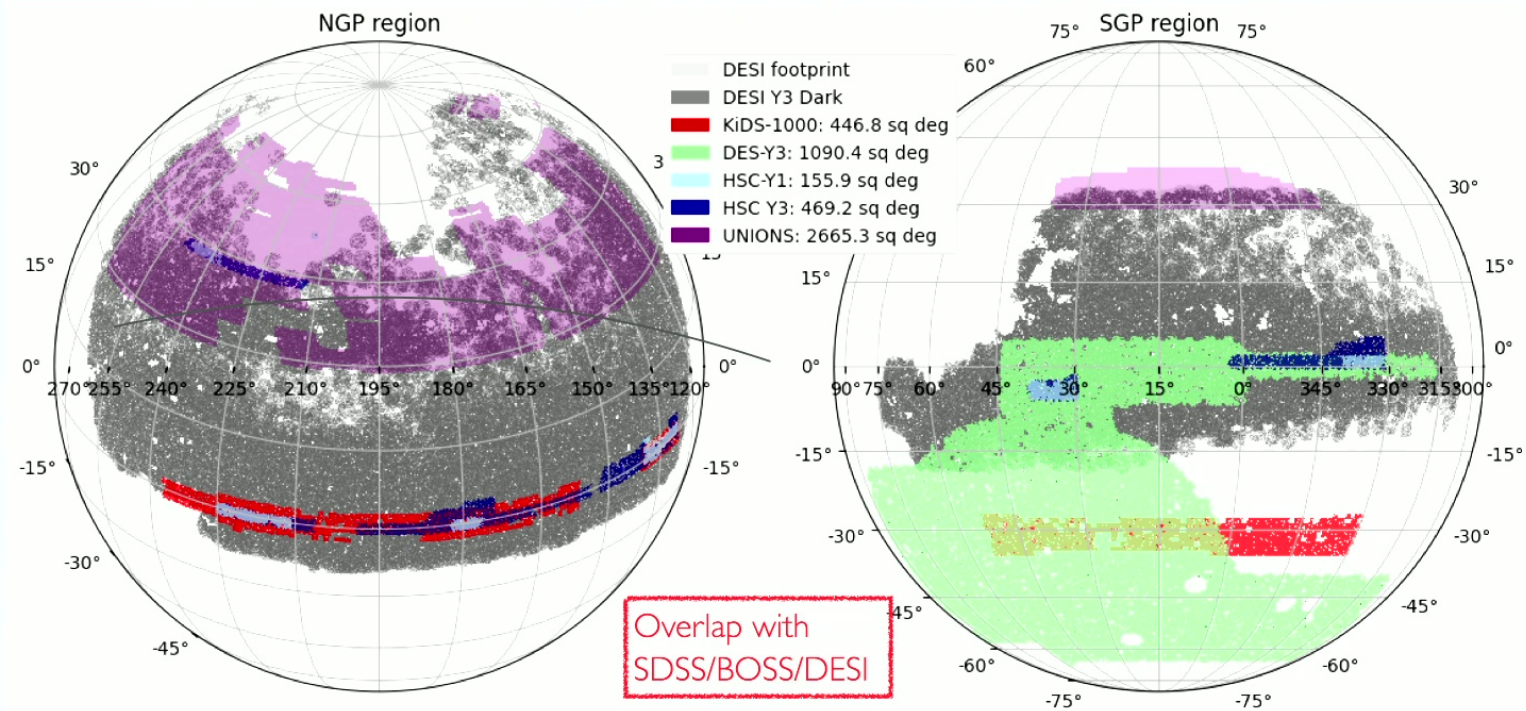


Subaru Telescope

UNIONS Weak Lensing Team: L. Baumont, **P. Burger**, M. Campbell, **I. Cheng**, A. Corinaldi, C. Dailey, J. Elvin-Poole, S. Fabbro, S. Farrens, R. Gavazzi, L. Goh, S. Gu, S. Guerrini, A. Guinot, H. Hildebrandt, F. Hervas-Peters, M. Kilbinger, H. Martin, C. Murray, D. Patel, B. Robison, I. Spitzer, L. van Waerbeke, A. Wittje, Z. Yan, **J. Zhang**

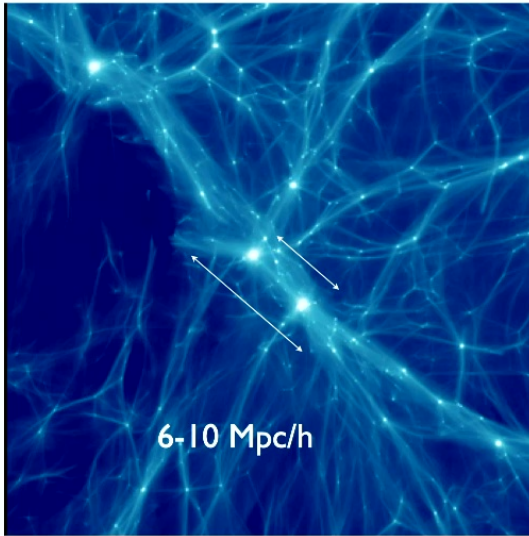
UNIONS Steering Group: A. McConnachie, J.-C. Cuillandre, M. Balogh, R. Carlberg, K. Chambers, T. de Boer, H. Furusawa, S. Gwyn, G. Magnier, M. Oguri, K. Osato

ULTRAVIOLET NEAR-INFRARED OPTICAL NORTHERN SURVEY

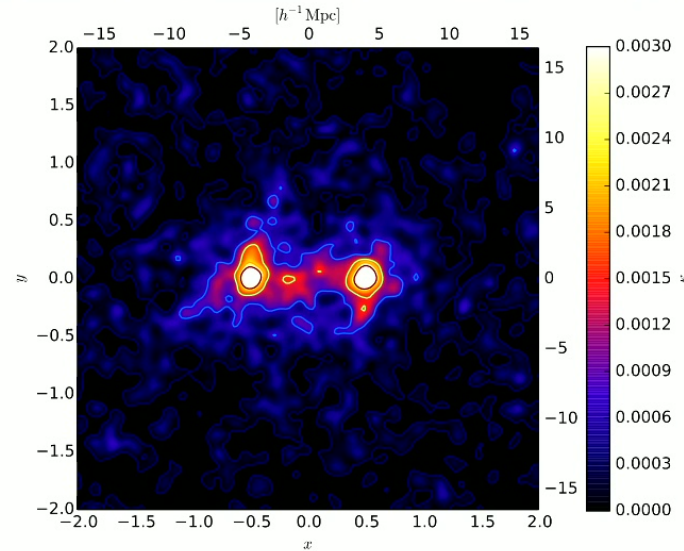


UNIONS survey details in Gwyn et al 25, [arXiv:2503.13783](https://arxiv.org/abs/2503.13783)

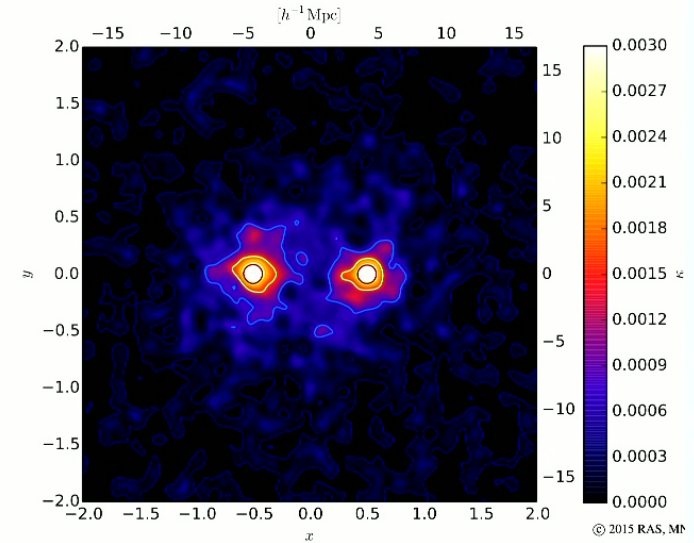
FILAMENTS IN THE COSMIC WEB



N-body Simulation
(Diemer)



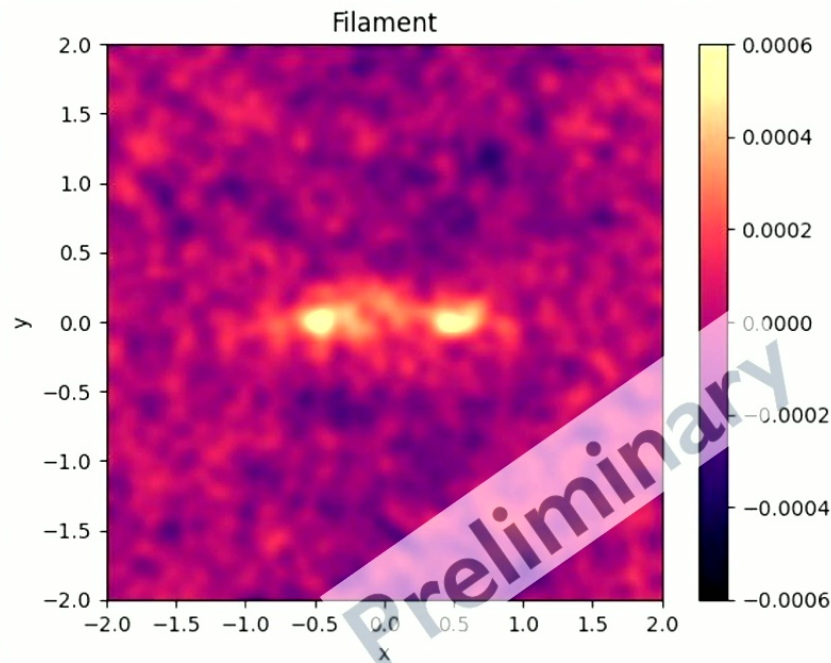
Physical LRG pairs



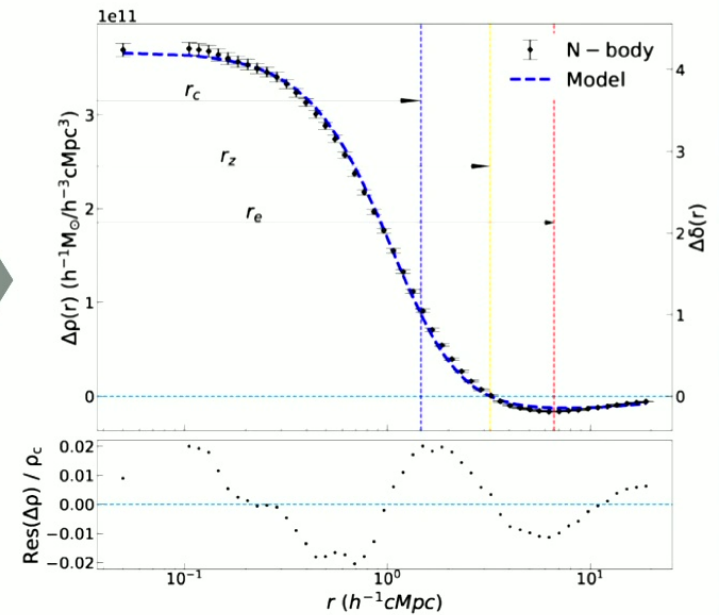
Projected LRG pairs

Epps & MH, 2017

FILAMENTS IN THE COSMIC WEB



To do: Compare



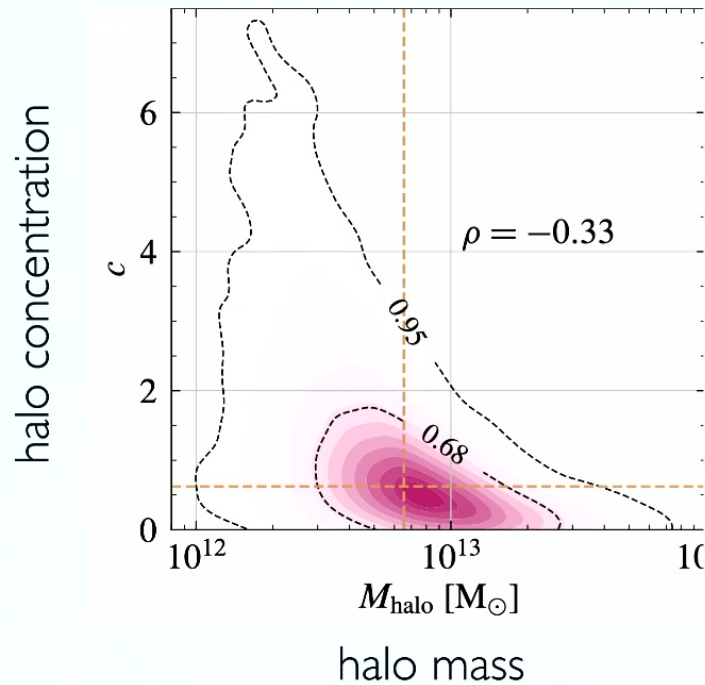
J. Zhang, P. Burger, MH et al in prep



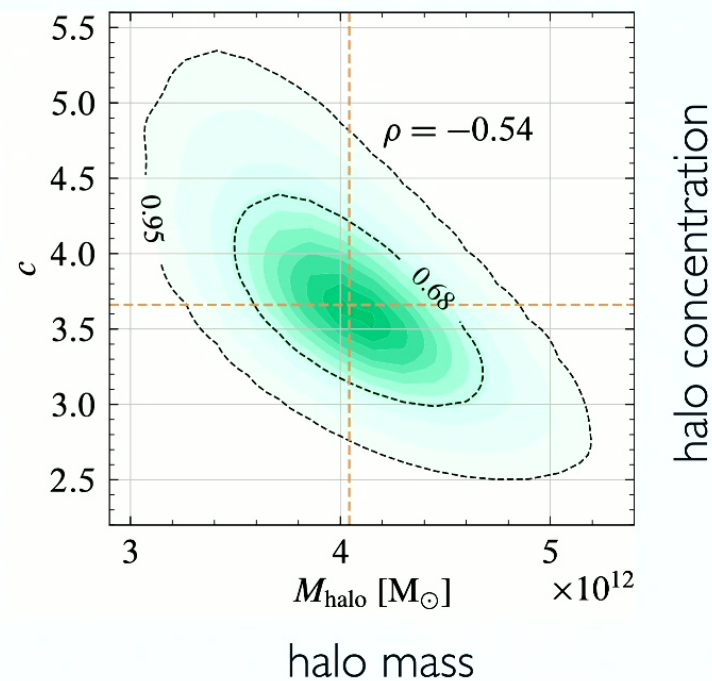
T. Yang, MH, N. Afshordi '22

HALOS OF GALAXY MERGERS

~1600 isolated Post-mergers

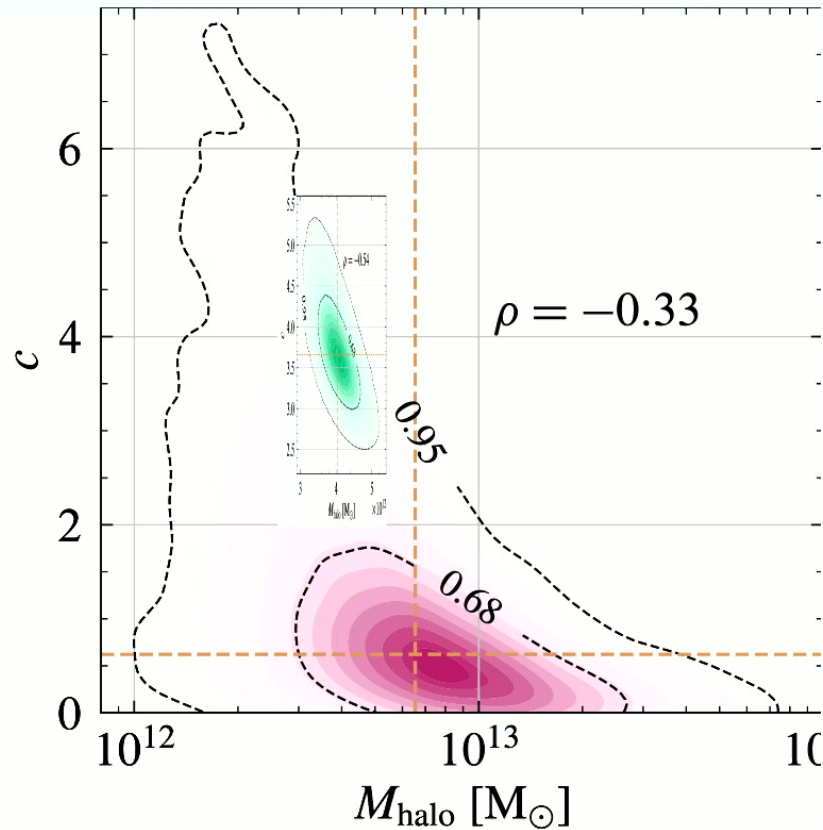


~30 000 isolated "Control" galaxies



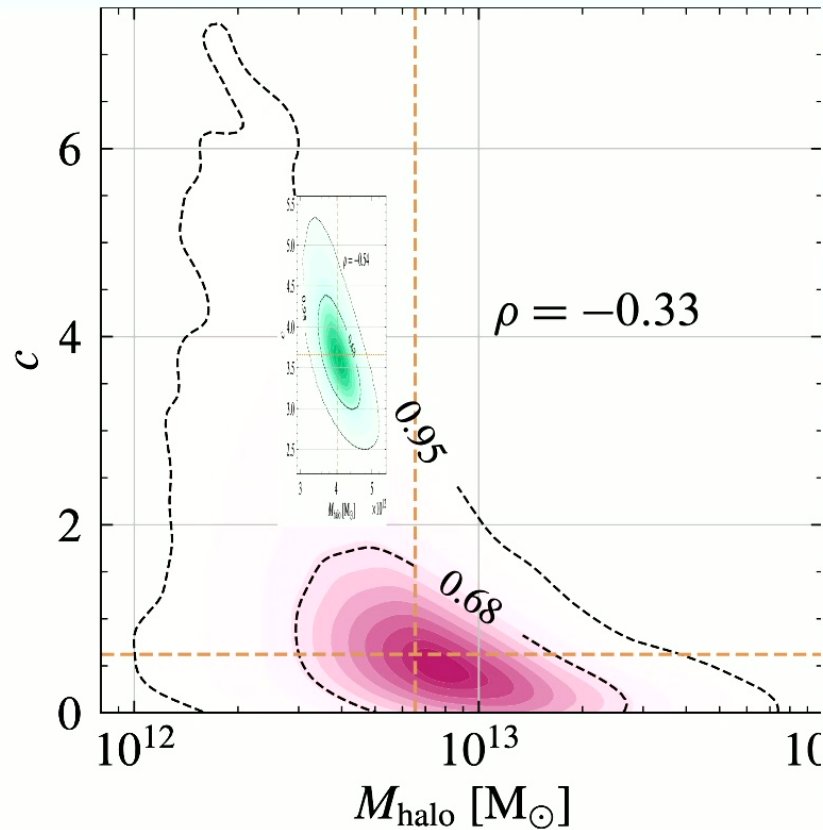
I Cheng, Elvin-Poole, MH et al 25
[arXiv:2502.00584](https://arxiv.org/abs/2502.00584)





- No significant difference, but can rule out extreme (60%) starbursts during mergers.

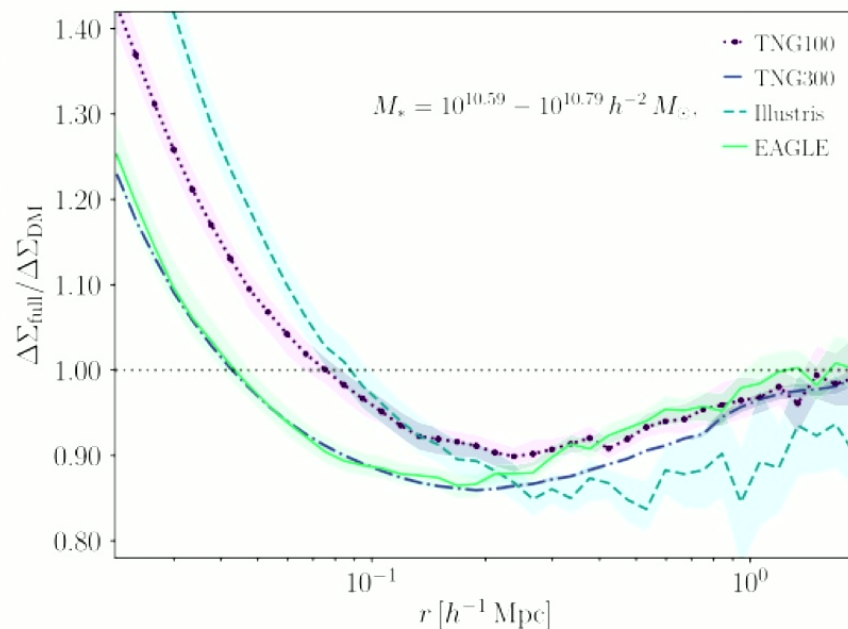
I Cheng, Elvin-Poole, MH et al. 25
[arXiv:2502.00584](https://arxiv.org/abs/2502.00584)



- No significant difference, but can rule out extreme (60%) starbursts during mergers.
- But what about the **low concentrations** of the isolated controls?

I Cheng, Elvin-Poole, MH et al. 25
[arXiv:2502.00584](https://arxiv.org/abs/2502.00584)

FEEDBACK AFFECTS DENSITY PROFILE

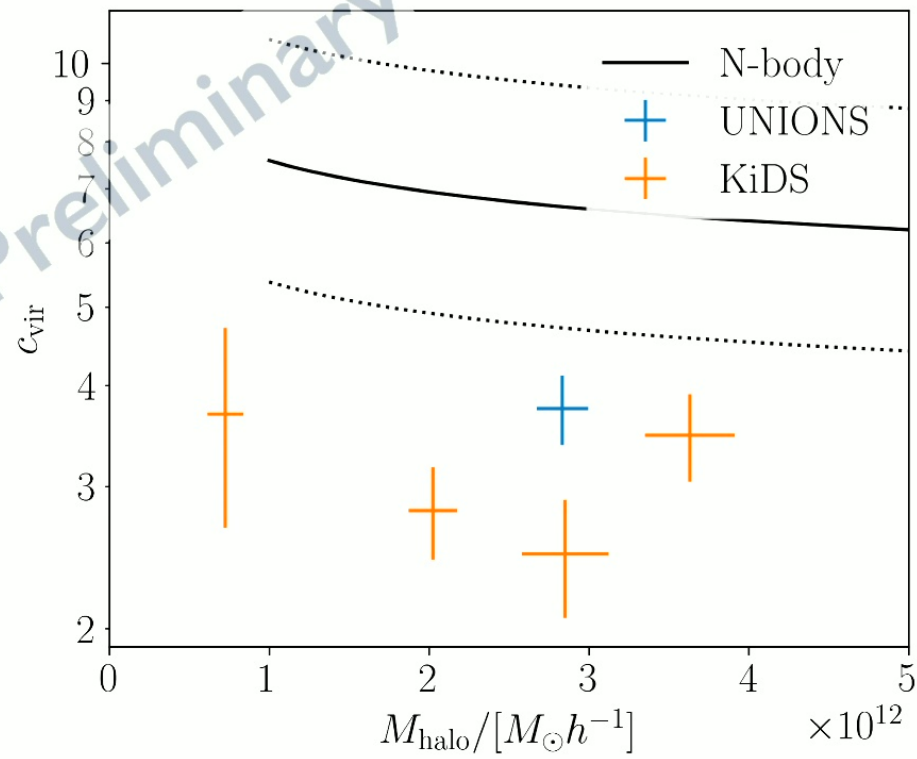


Renneby et al. 2020

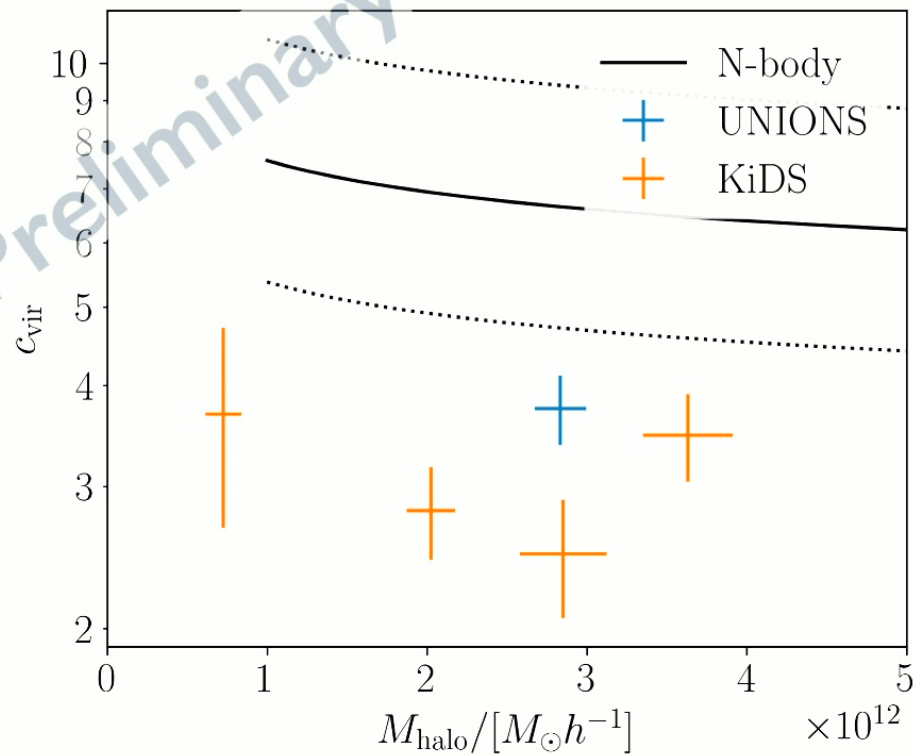
Feedback alters the ***total mass*** distribution:

both the gas and the backreaction on the dark matter

MASS-CONCENTRATION



MASS-CONCENTRATION

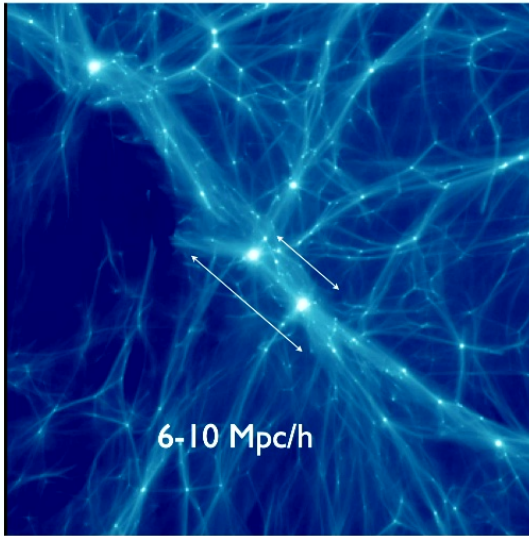


- Mis-centring?
- Assembly bias?
 - P. Burger finds only $\sim 5\%$ level differences in c for isolated galaxies.
- Feedback?
 - ... really **strong** feedback?

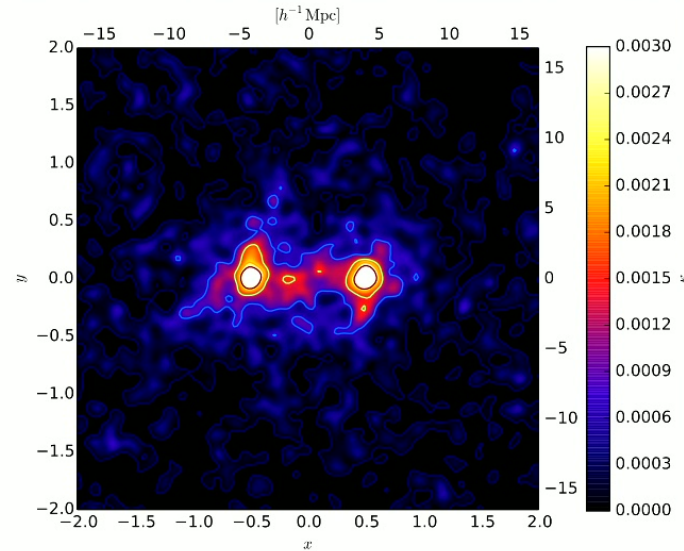
TAKEAWAY POINTS

- UNIONS has large overlap with spectroscopy (SDSS/BOSS/DESI)
- Weak Lensing lets us see DM structures directly:
 - Filaments of the cosmic web
 - Halo structure and its response to feedback

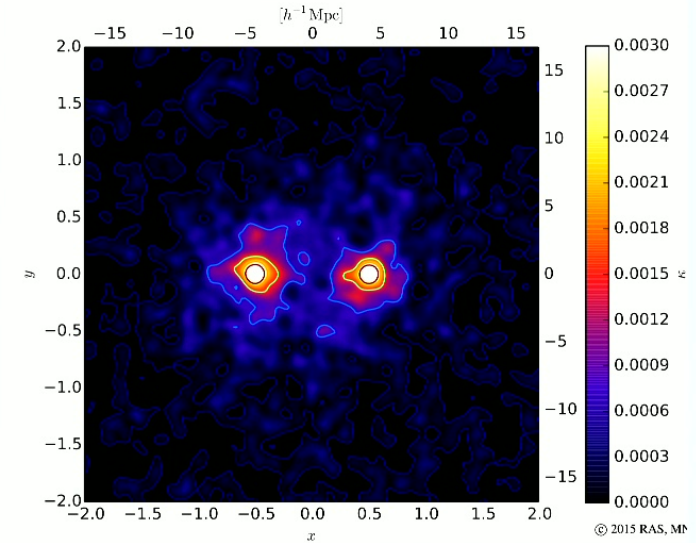
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