



International
Centre for
Radio
Astronomy
Research

The importance of robust identification of simulated galaxies

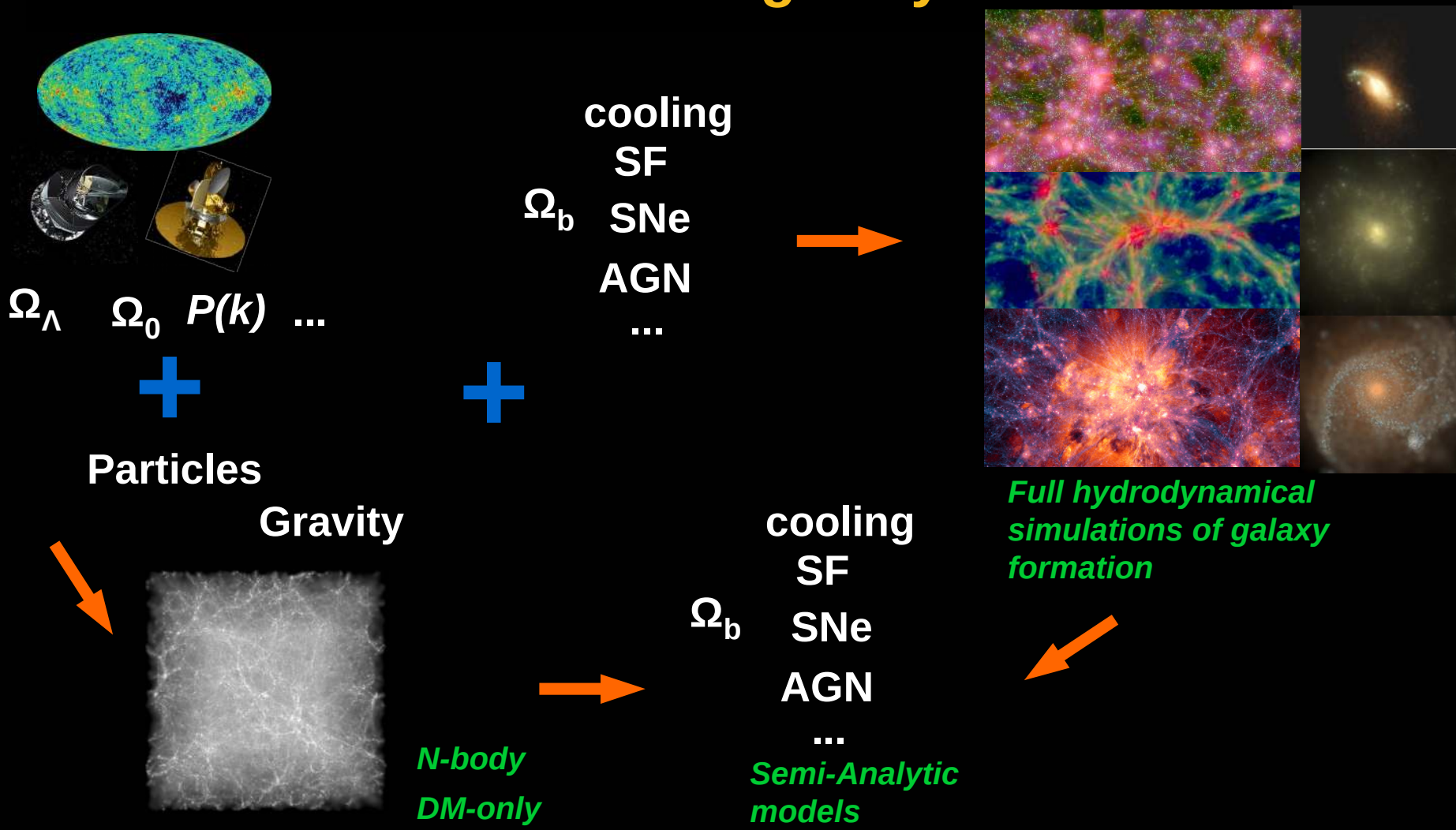
*Mock Perth:
Challenges for Simulations in the Era of
SKA and Large IFU Surveys*

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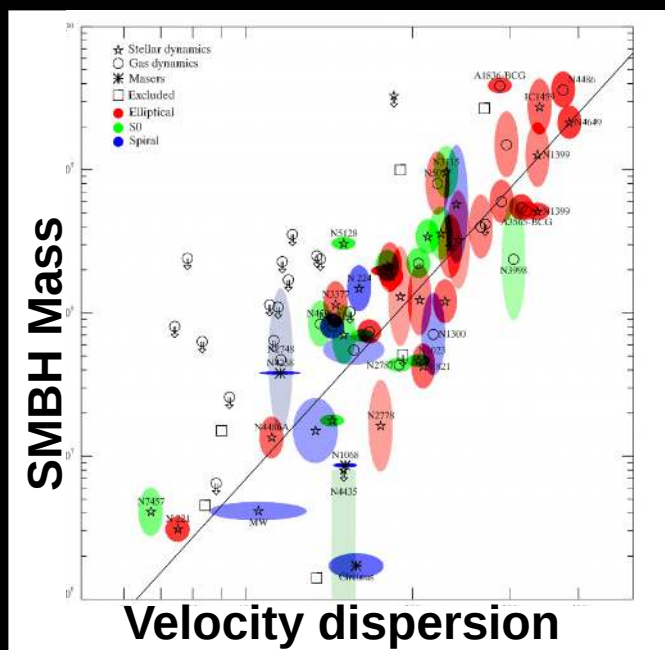
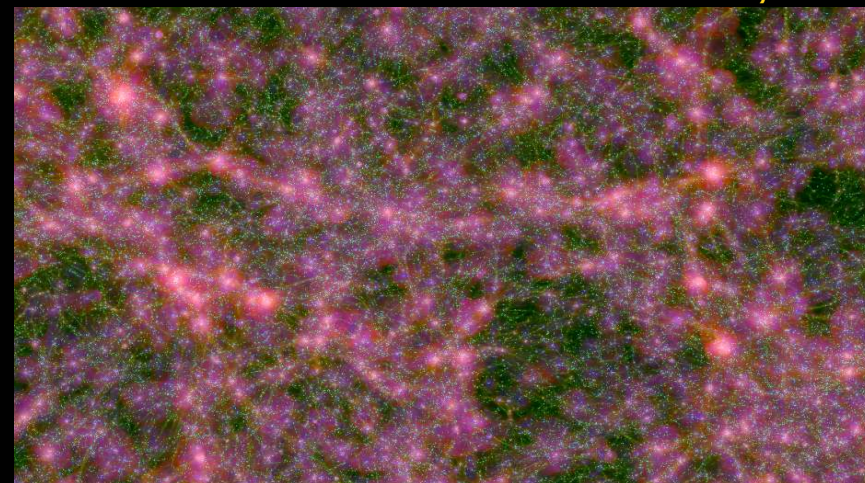
Pascal Elahi
Claudia Lagos
Chris Power
Charlotte Welker



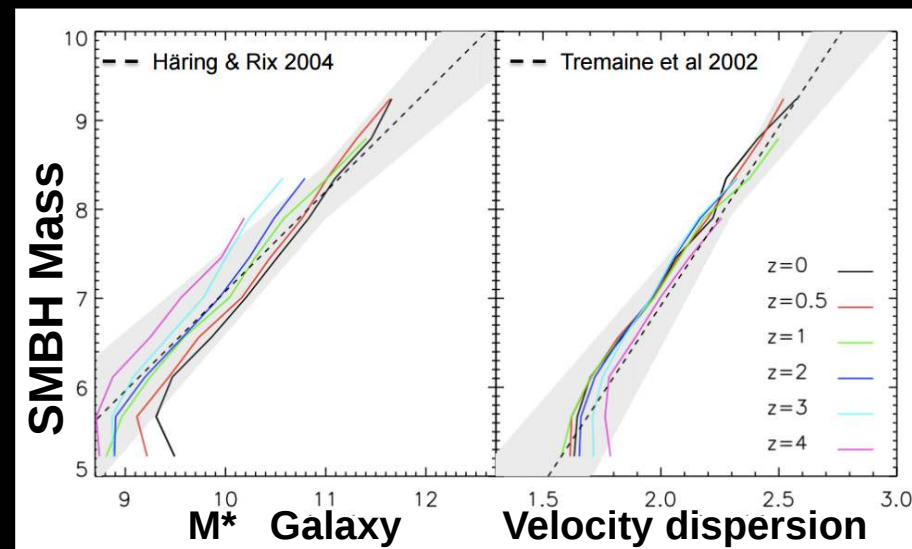
Numerical simulations of galaxy formation



- State-of-the-art cosmological simulation of galaxy formation
- Two AGN feedback modes: *radio* and *quasar*
- Coupling between SMBH and host galaxy
- AGN feedback tuned to reproduce observed scaling relations



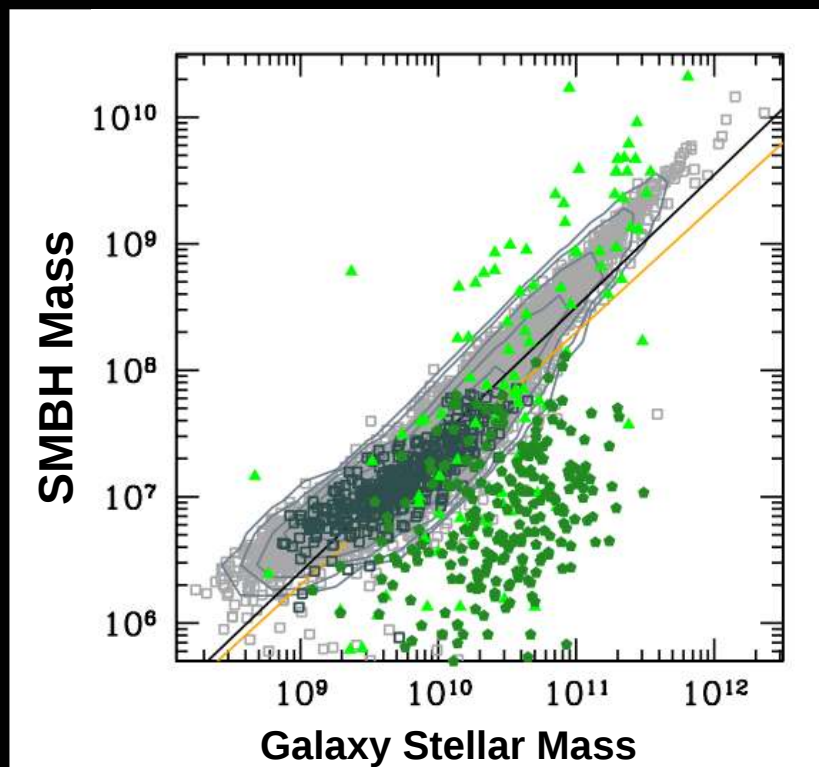
Gültekin et al., 2009



Dubois et al., 2012

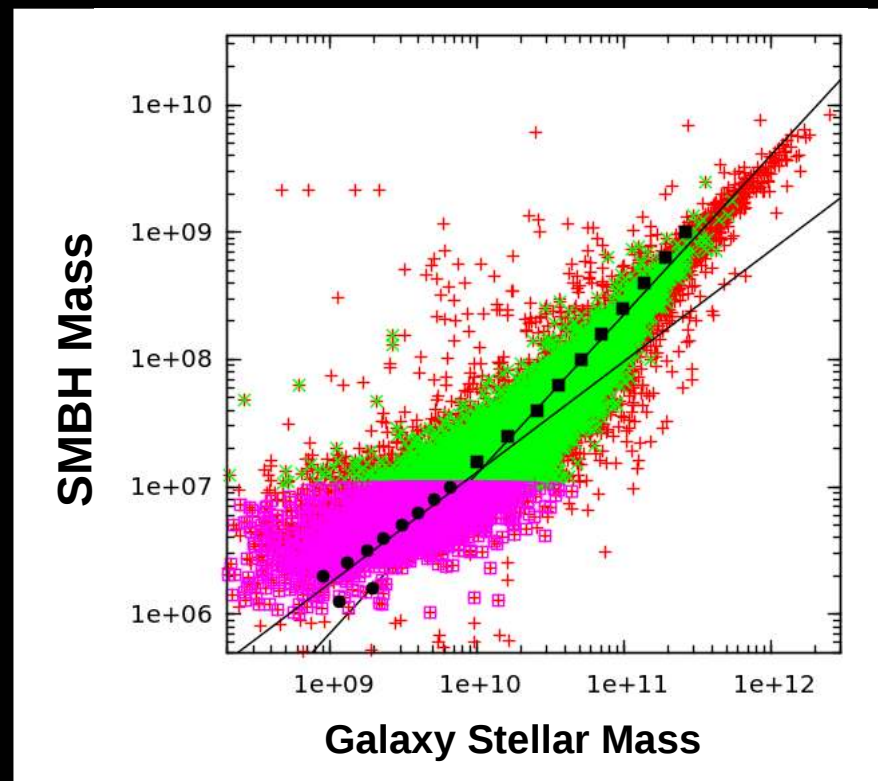
Exploring Horizon-AGN

- Reproduce already published Mbh-Mgal* relation



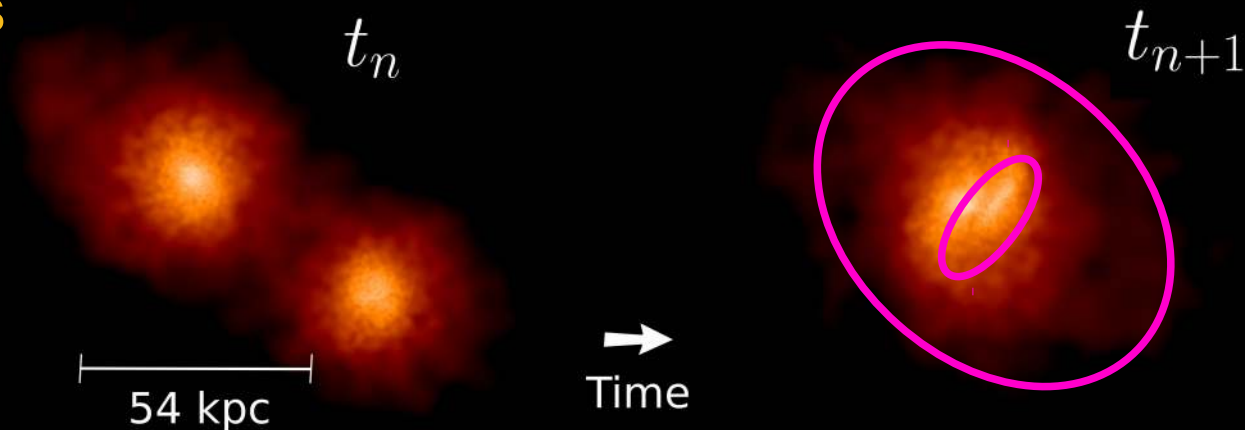
Volonteri et al., 2016

- More scatter than expected



What are these outliers?

Mergers



Galaxies in catalog (Halo-Maker)

What do we define as a galaxy?

“Well behaved” Mergers



Arp 271



NGC 2207 and IC 2163



• Arp 273

What do we define as a galaxy?

When things start to get messy

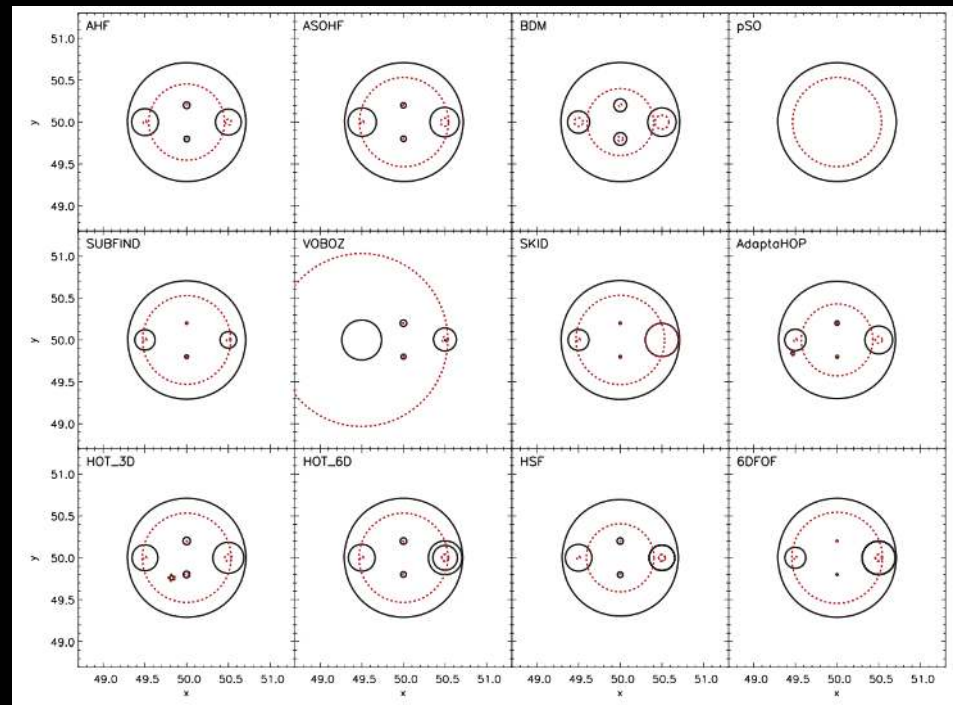
We can distinguish the cores

Important for the study of
AGN feedback!

Antennae Galaxies - NGC 4038, NGC 4039

“Crazy” Comparison projects

- Haloes gone MAD
(Knebe et al. 2011)
- Subhaloes gone Notts
(Onions et al. 2013;
Pujol et al. 2014;
Hoffmann et al. 2014)
- Galaxies going MAD
(Knebe et al. 2013)
- Streams going Notts
(Elahi et al. 2013)



Knebe et al., 2011

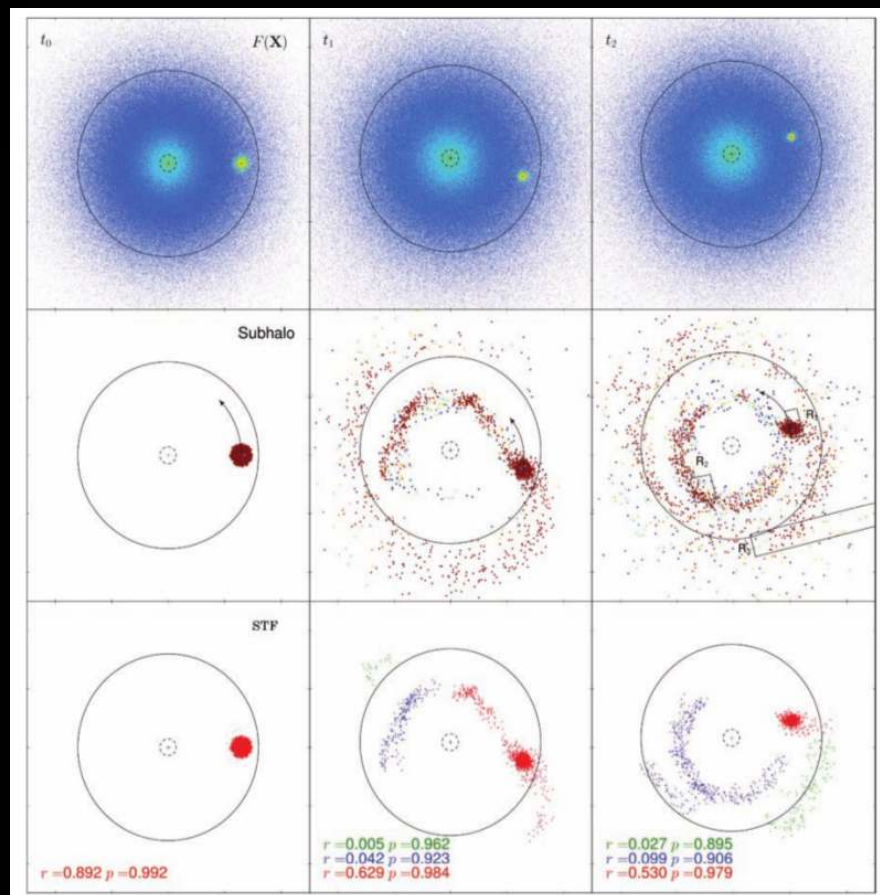


VELOCIraptor

a.k.a. STF (Elahi et al., 2011)

- FOF algorithm in 6D to find structures in simulations

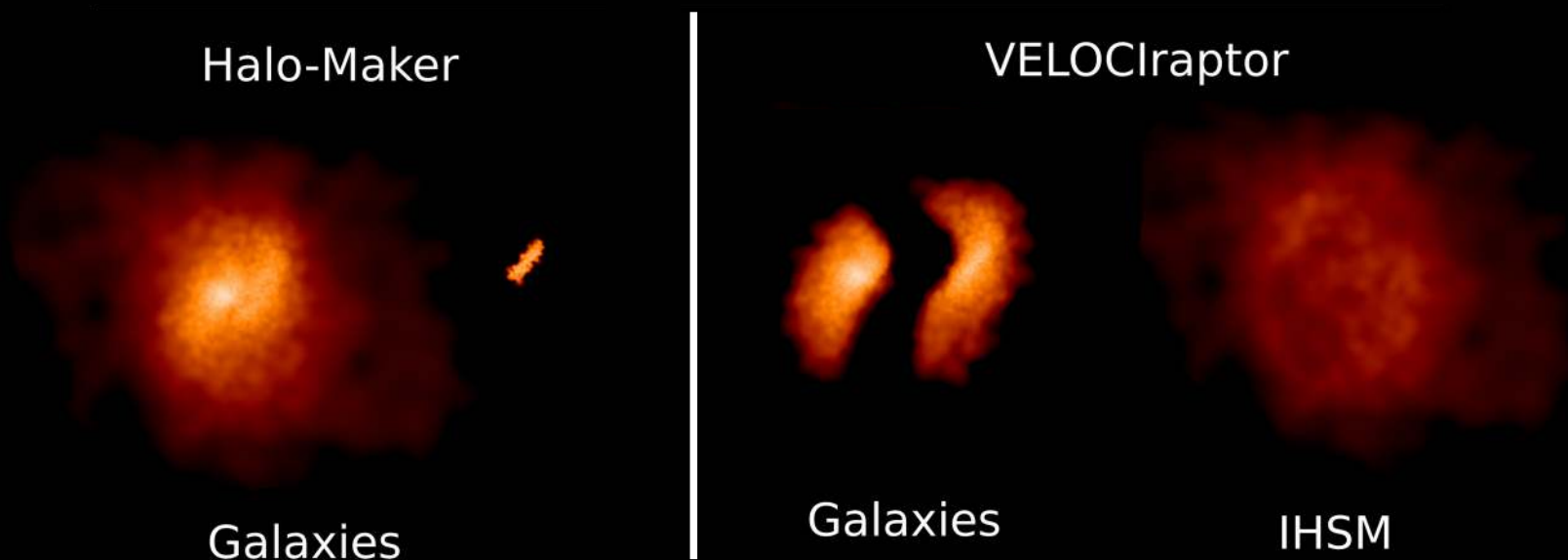
- Halos
- Galaxies
- Streams
- Shells
- ...



Elahi et al., 2011

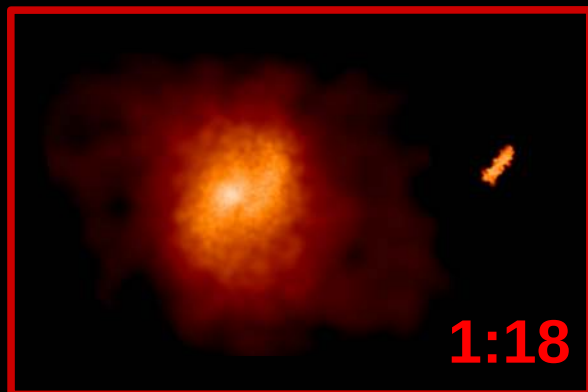
Modifications to VELOCraptor

- Adaptive linking lengths based on the distribution of the system (independent of resolution and environment)
- We can keep track of the Intra-Halo Stellar Mass (IHSM) at no additional computational cost

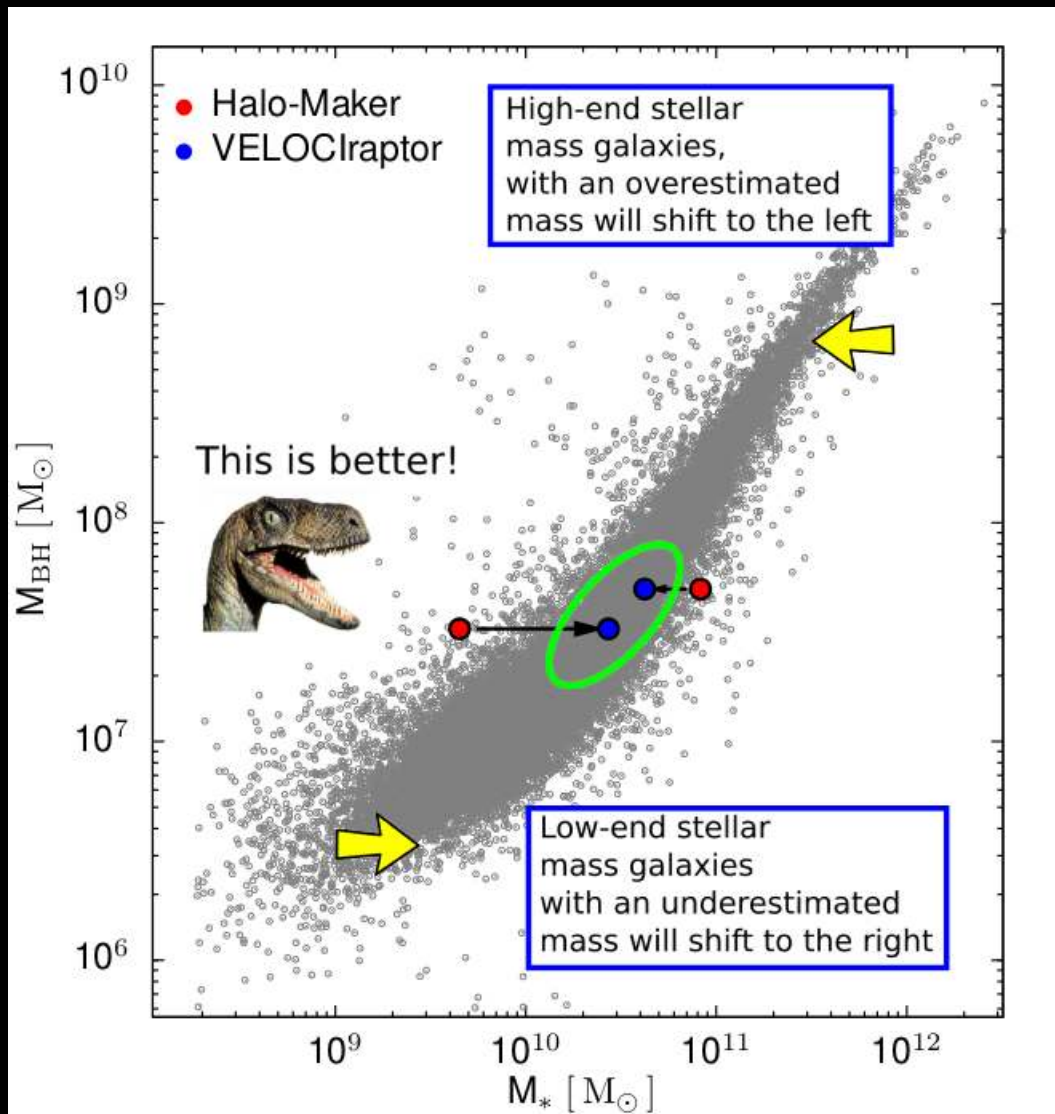
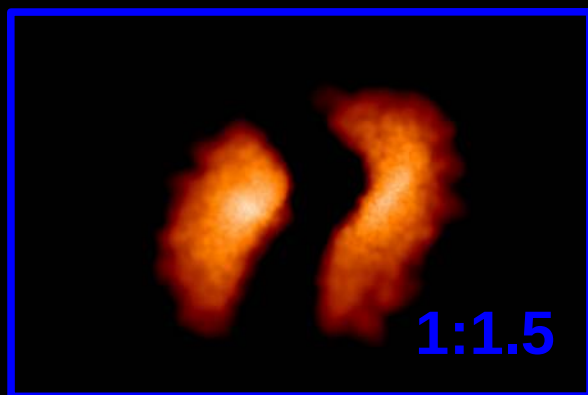


Why is this important?

Halo-Maker



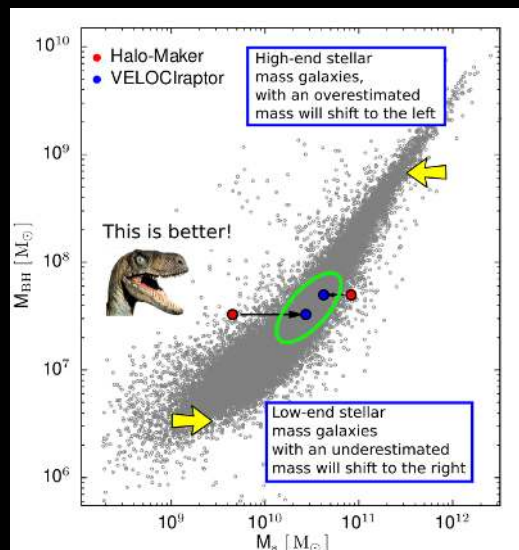
VELOCIraptor



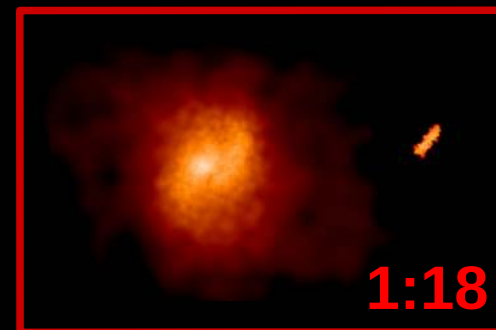
Why is this important?

Robust identification of galaxies

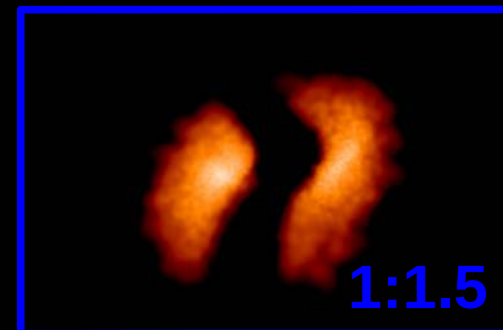
- Affects the scatter of scaling relations
- Mass functions
- Estimation of the number of major and minor mergers
- May impact tuning of subgrid physics



Halo-Maker

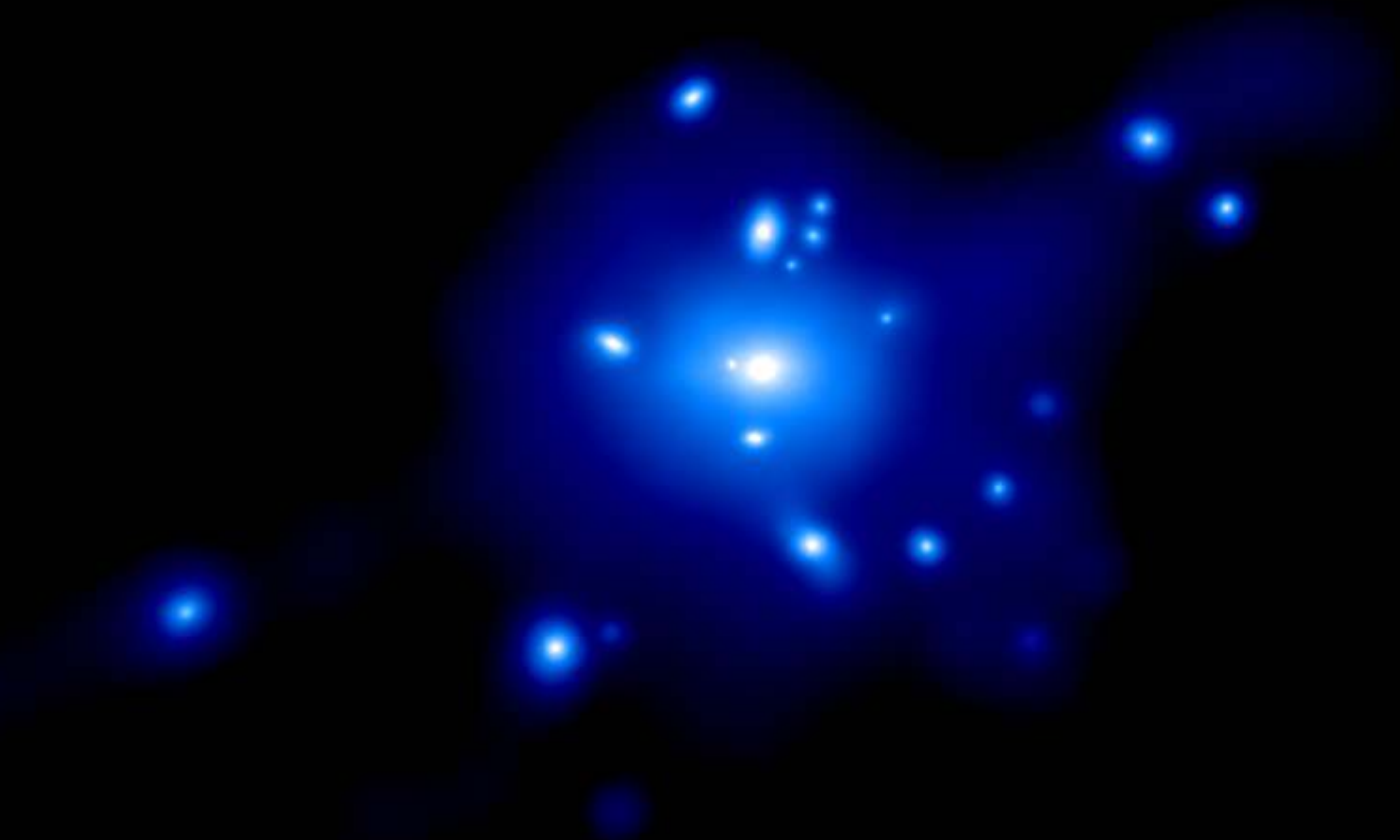


VELOCraptor

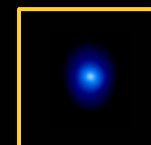
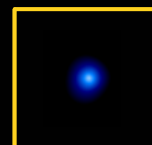
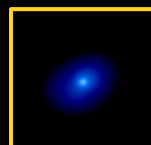
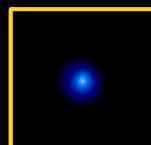
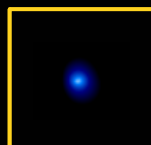
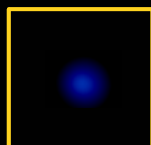
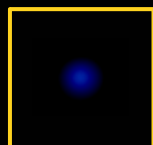
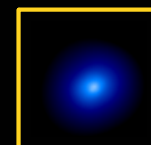
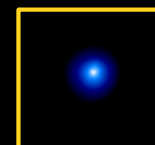
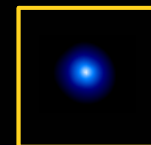
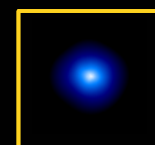
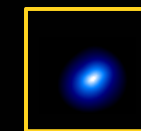
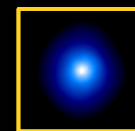
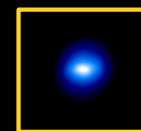
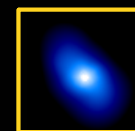
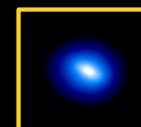
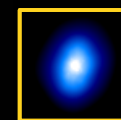
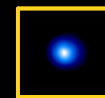
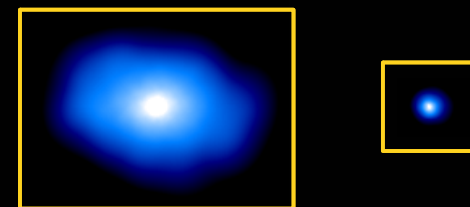
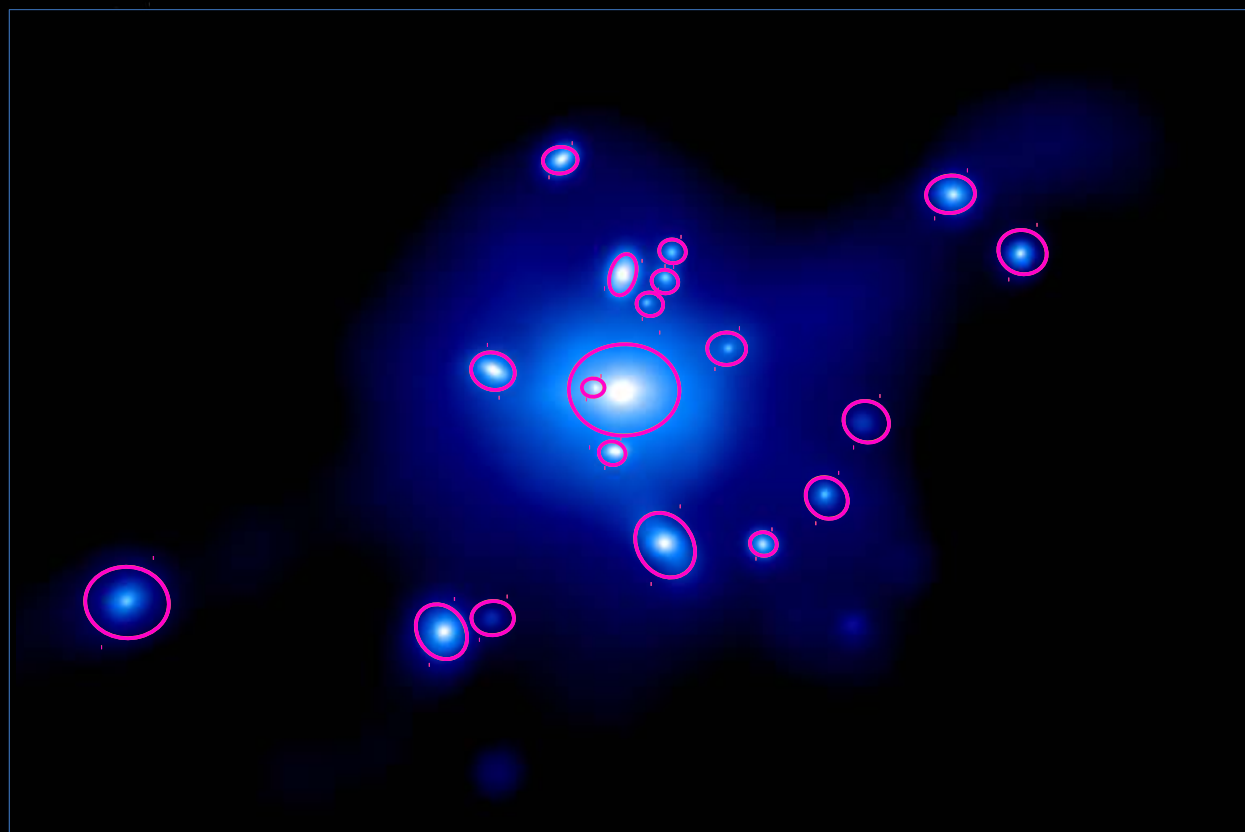




Groups of Galaxies



Groups of Galaxies

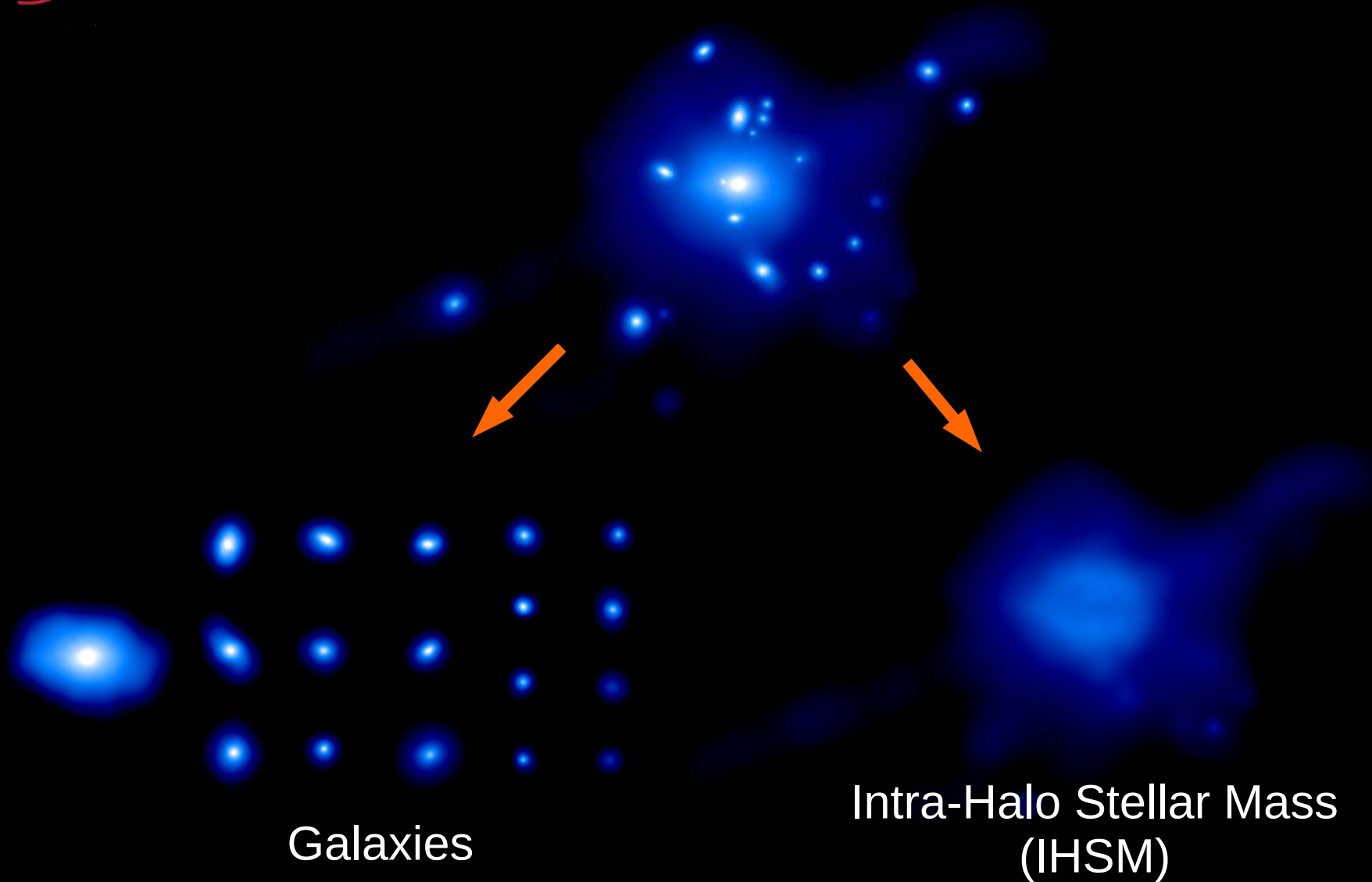




Groups of Galaxies

Intra-Halo Stellar Mass
(IHSM)

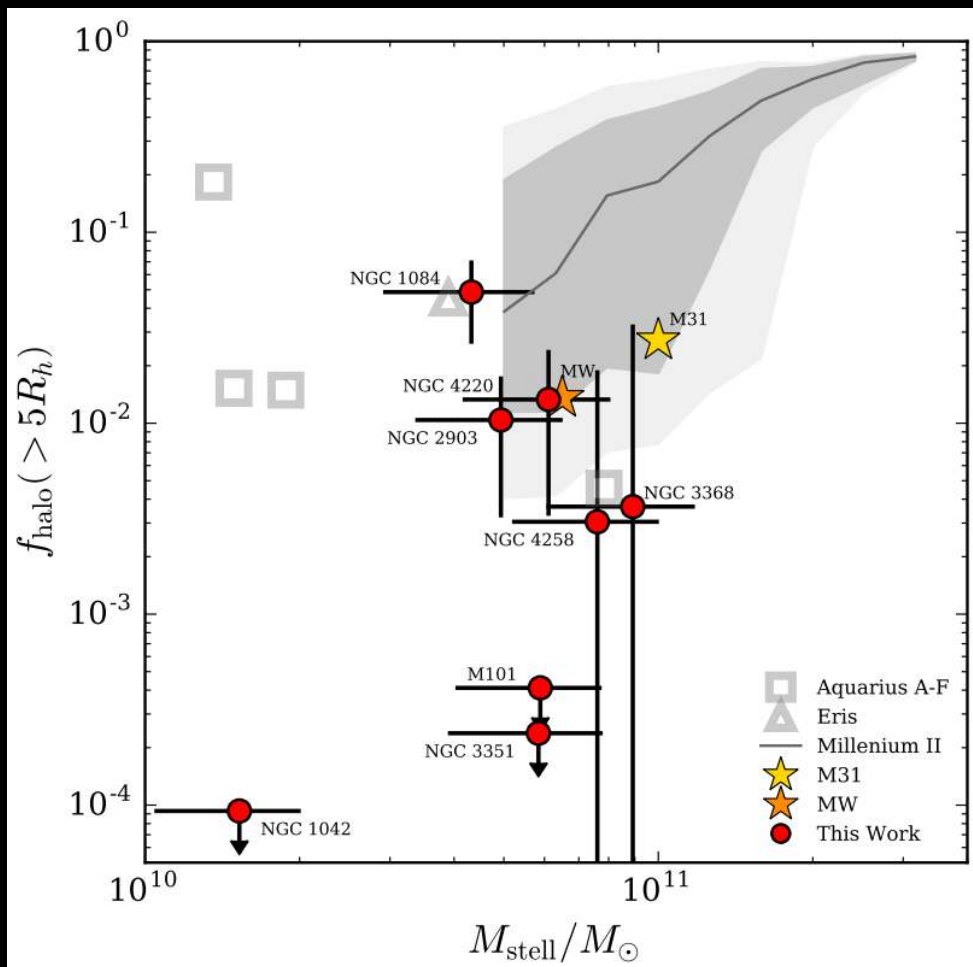
Groups of Galaxies



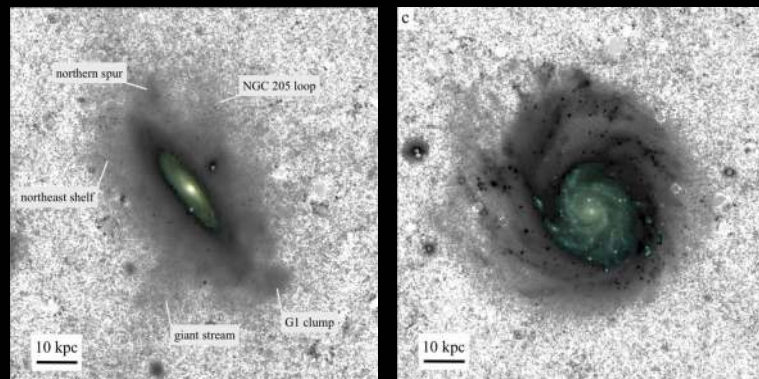
Galaxies

Intra-Halo Stellar Mass
(IHSM)

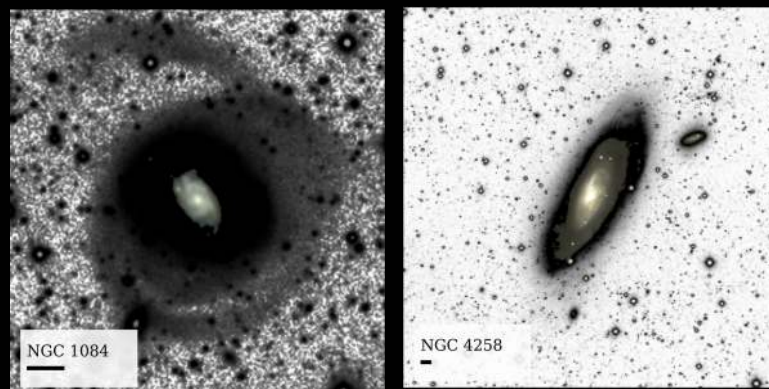
Diffuse stellar component



Merritt et al., 2016



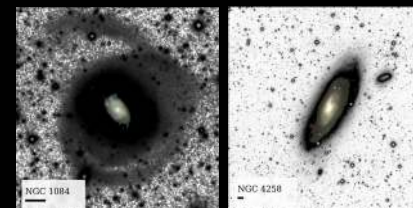
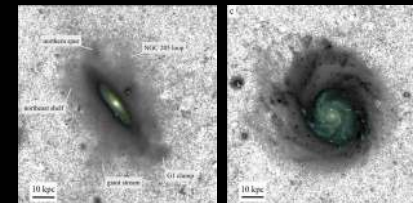
van Dokkum et al., 2014



Merritt et al., 2016

Intra-Halo Stellar Mass

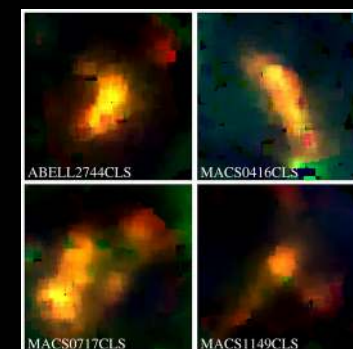
- Stellar halos (e.g. Merritt et al. 2016)
- Intra-Cluster Light (e.g. Morishita et al. 2016) van Dokkum et al., 2014
- Predictions for future observational projects and surveys (e.g WAVES, JWST, WFIRST)



Merritt et al., 2016

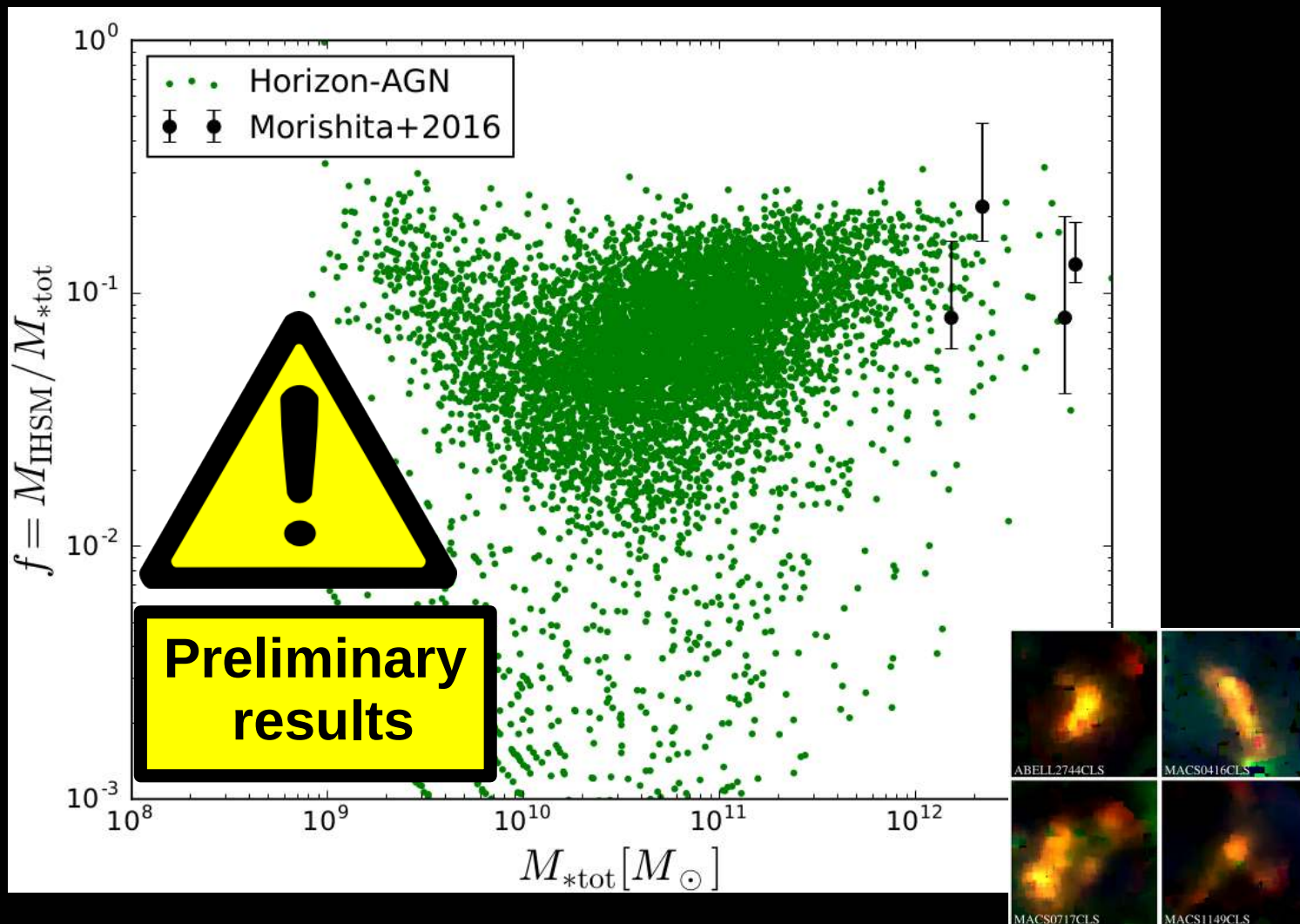
Galaxy identification

- Use improved VELOCraptor to build new galaxy catalogs
 - Horizon-AGN
 - EAGLE
 - Illustris

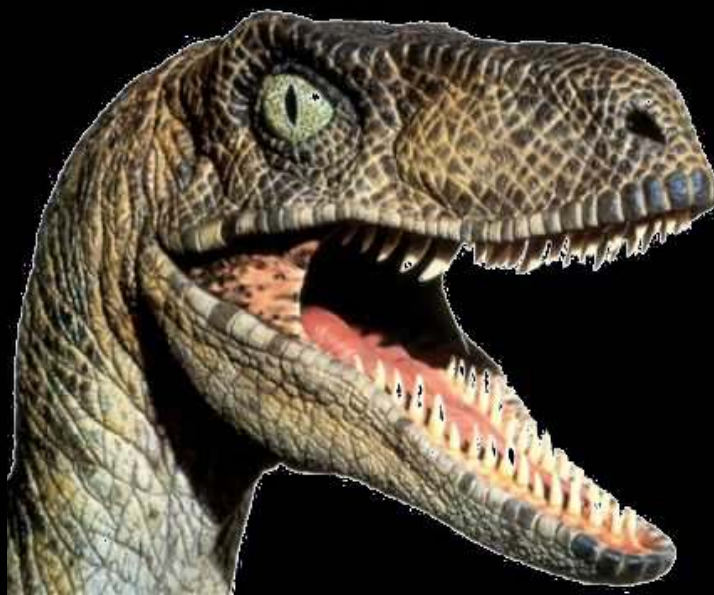


Morishita et al., 2016

Diffuse stellar component



Morishita et al., 2016



Thank you for
your attention!



References

- Dubois Y., et al., 2012, MNRAS, 420, 2662
- Dubois Y., et al., 2014, MNRAS, 444, 1453
- Elahi P. J., et al., 2011, MNRAS, 418, 320
- Gultekin K. et al., 2009, ApJ, 698, 198
- Merritt, A., et al., 2016, ApJ, 830, 62
- Morishita, T., et al., 2016, arXiv:1610.08503