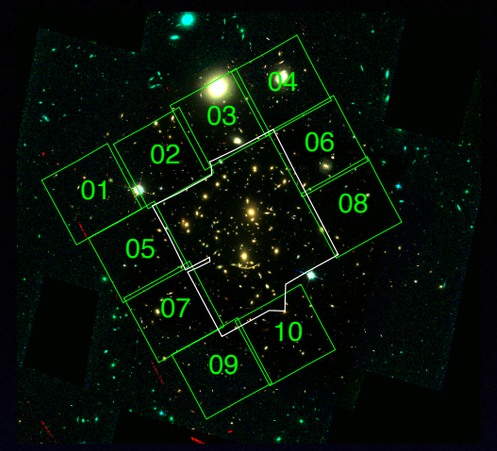
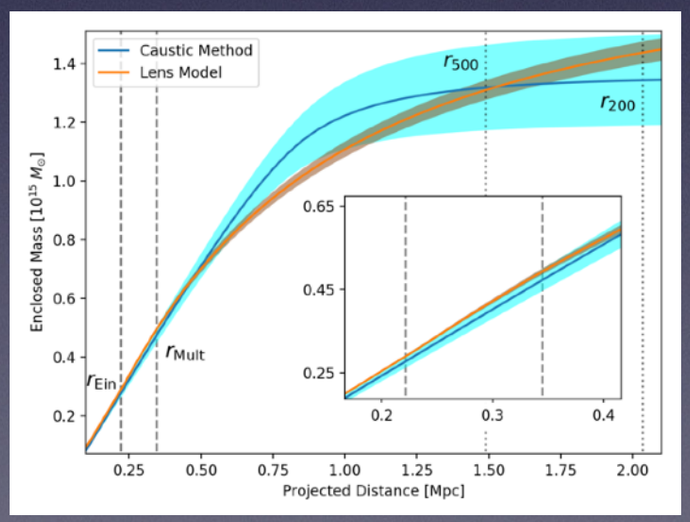
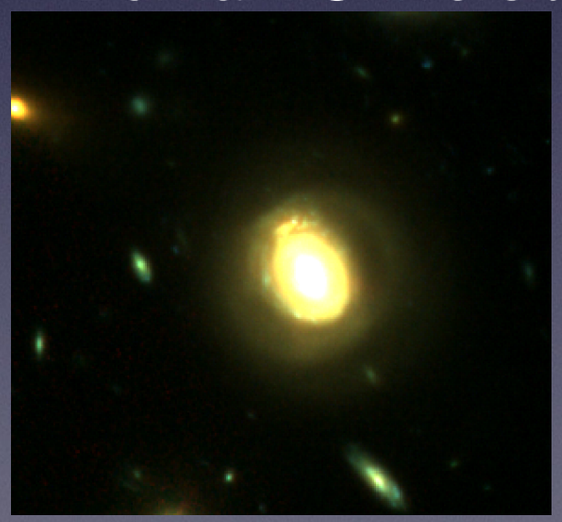


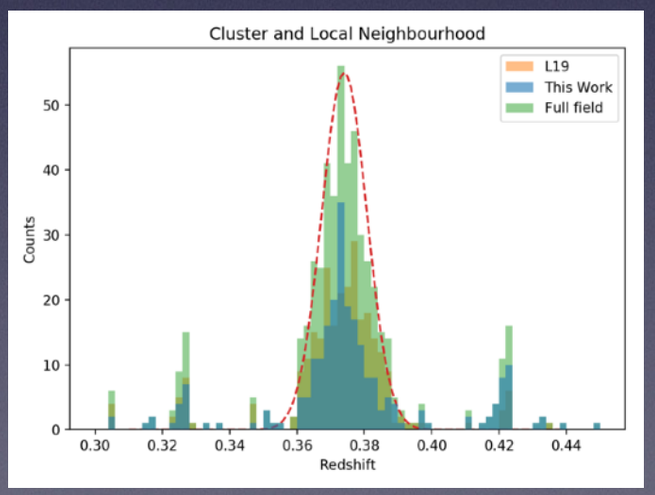
Pilot WINGS:

An extended MUSE view of the structure of Abell 370

David Lagattuta
Durham University







BUFFALO Meeting 2021 Online 13 July 2021

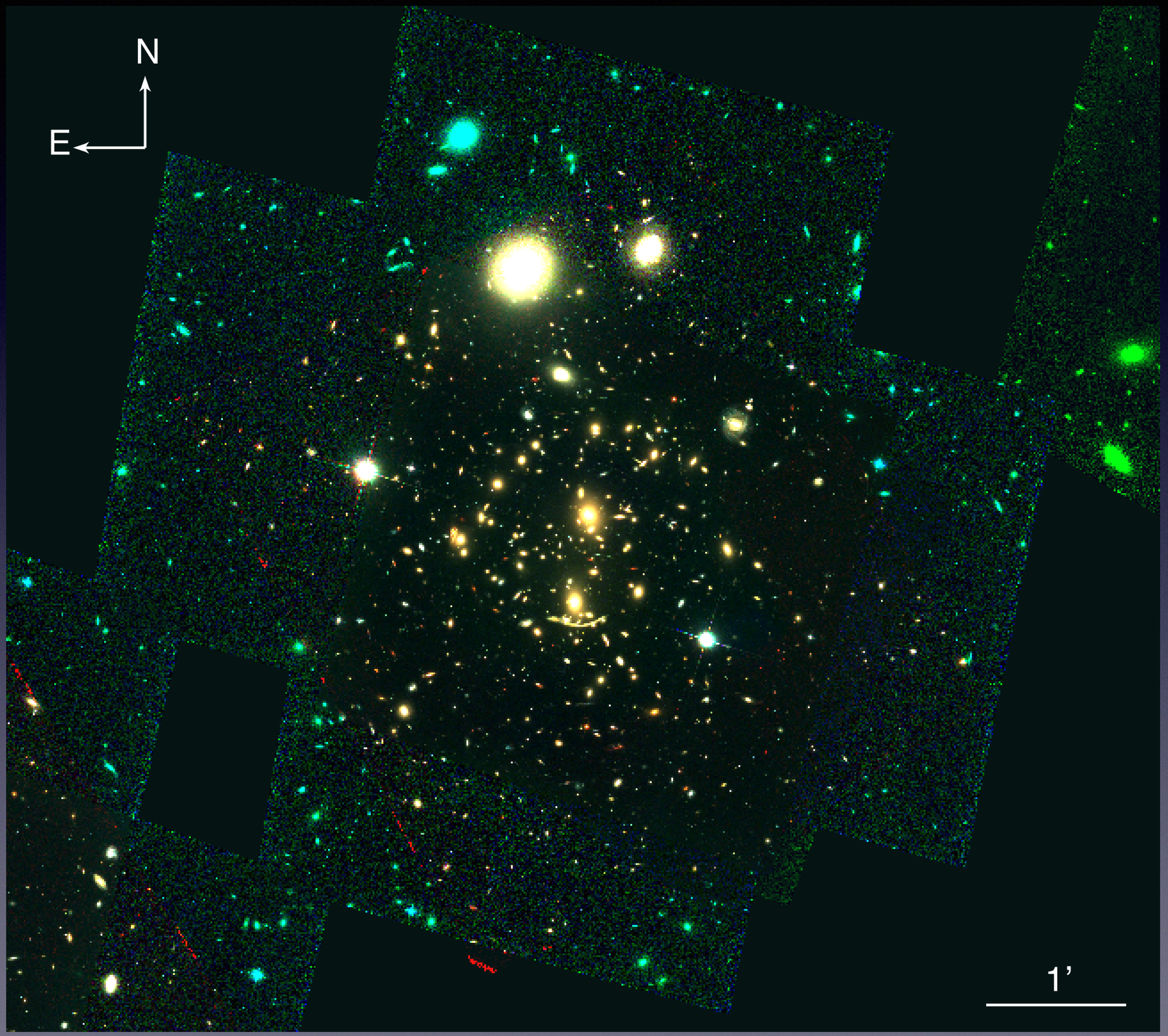
Motivation

- Pilot-WINGS: redshift survey of A370
  - Wide-area INtegral-field Galaxy Survey

- Leverage power from MUSE + HST
  - Wide-field data is key

- Reveal cluster structure + mass
  - Useful for cosmology, LSS, etc…

Data Coverage



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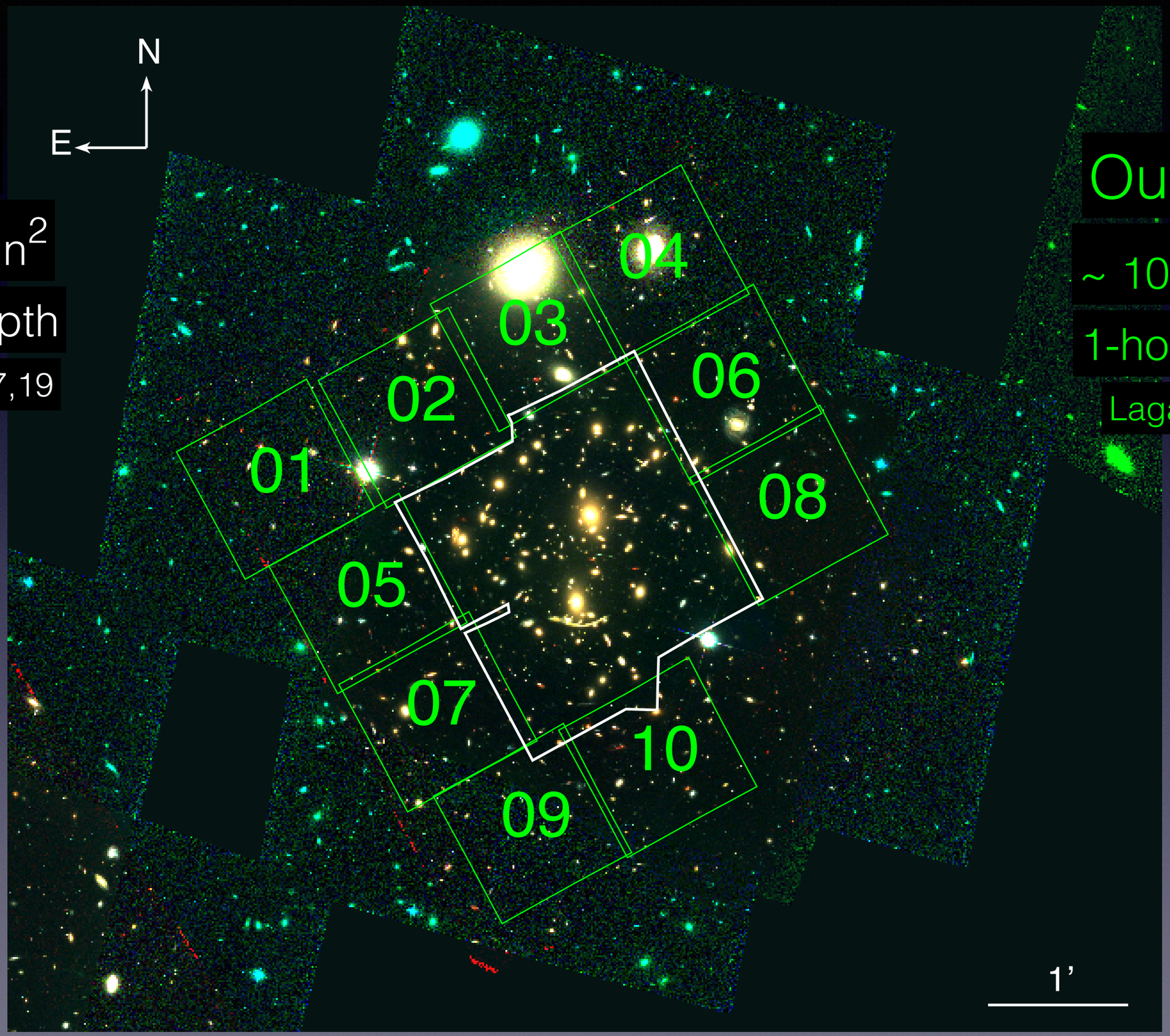


Core

~ 4 arcmin^2

8-hour depth

Lagattuta+17,19

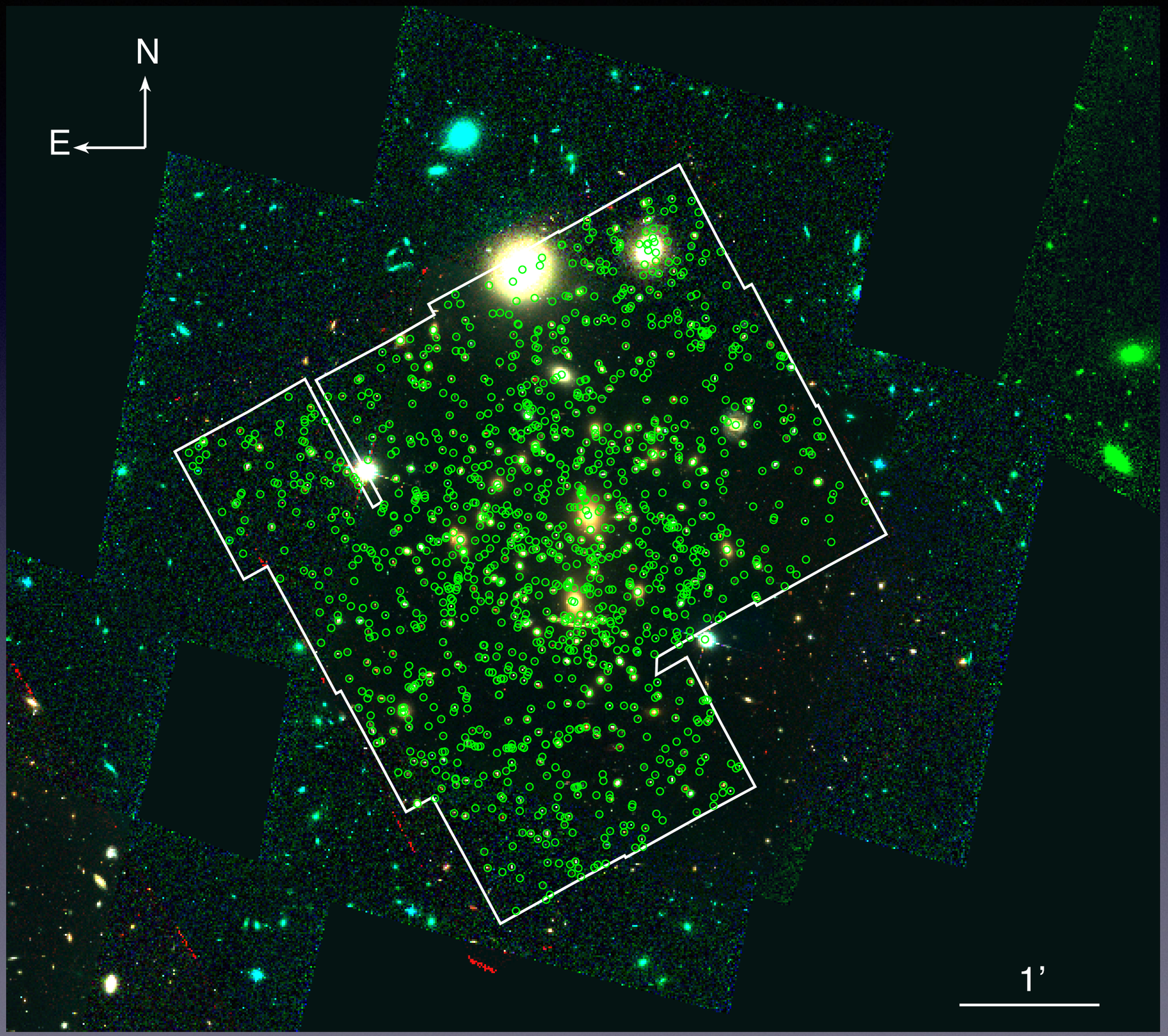
Outskirts

~ 10 arcmin^2

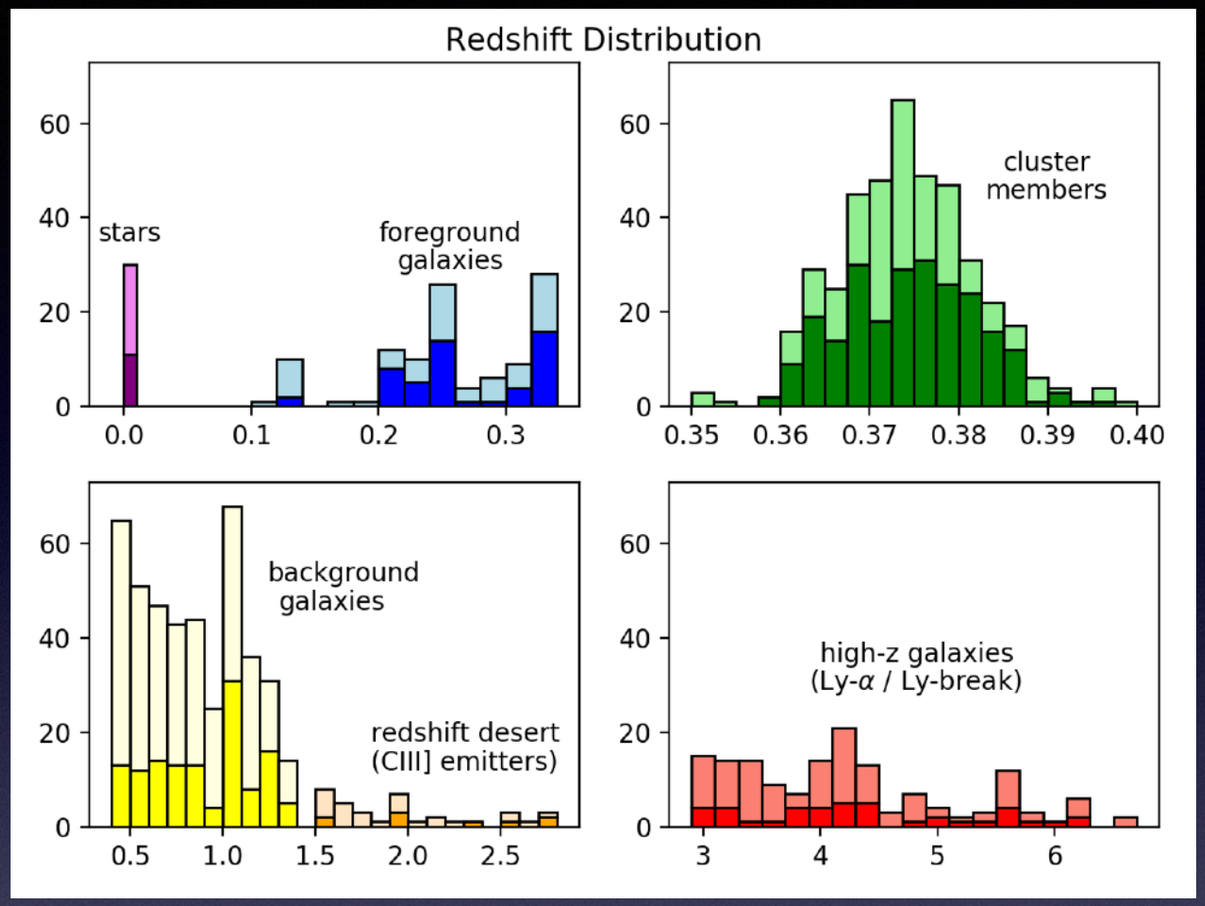
1-hour depth

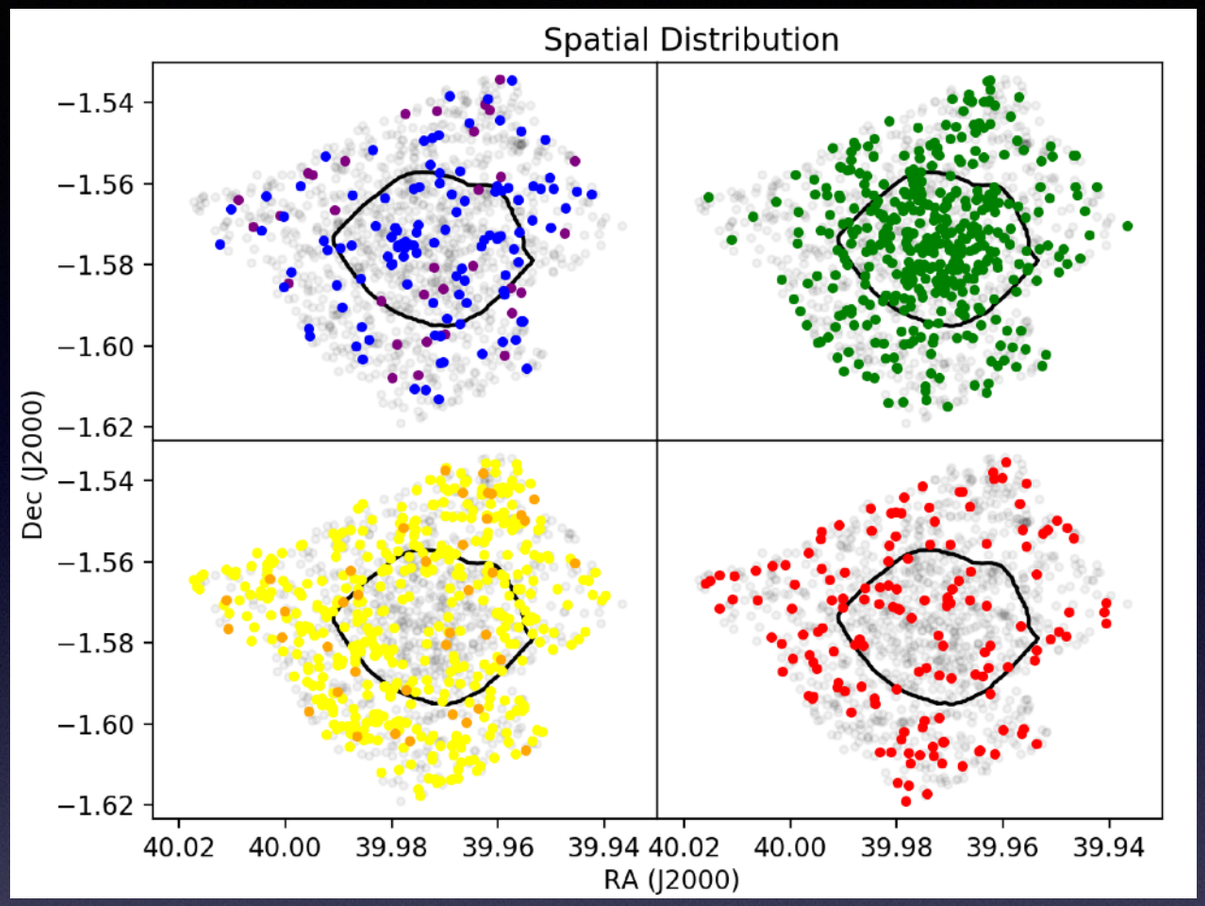
Lagattuta+21

Data Coverage



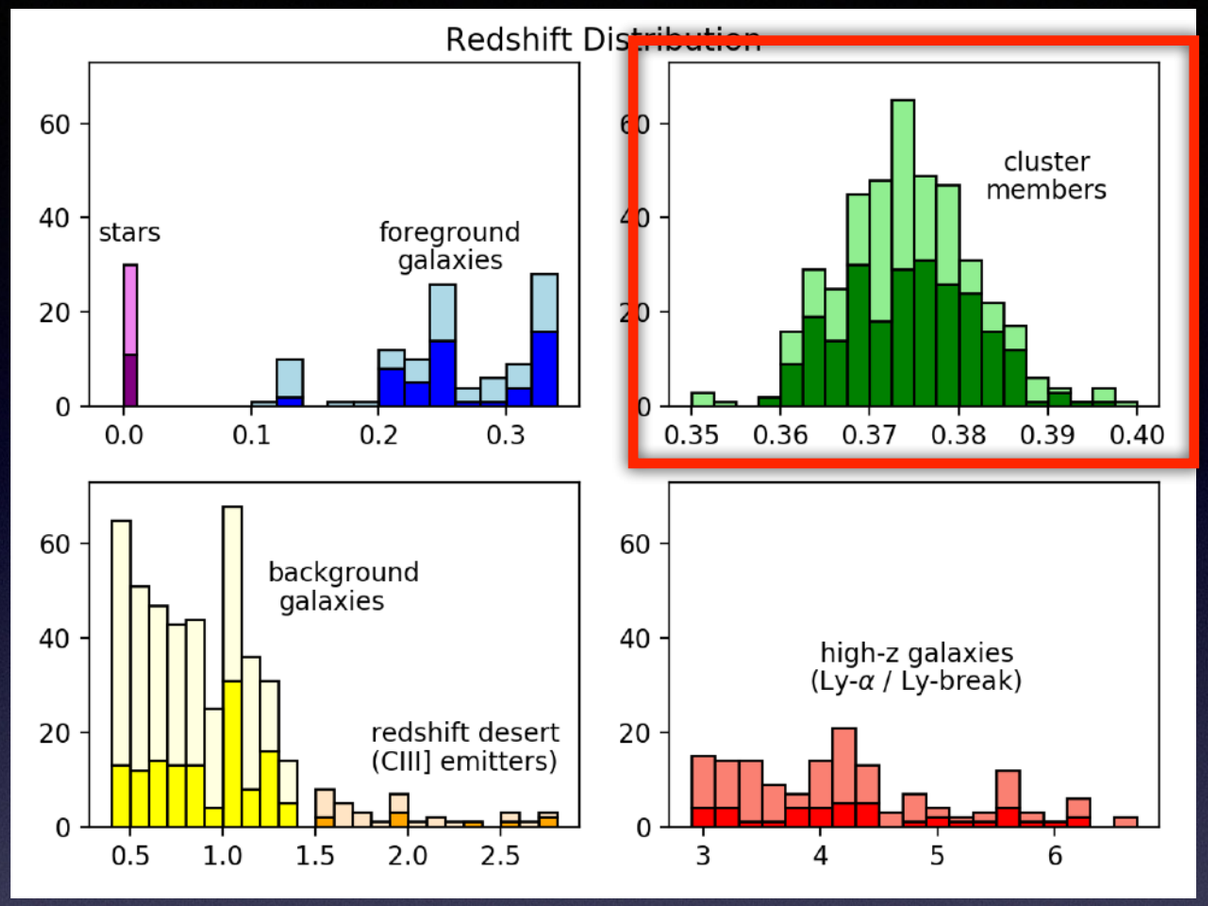
Redshift Catalog

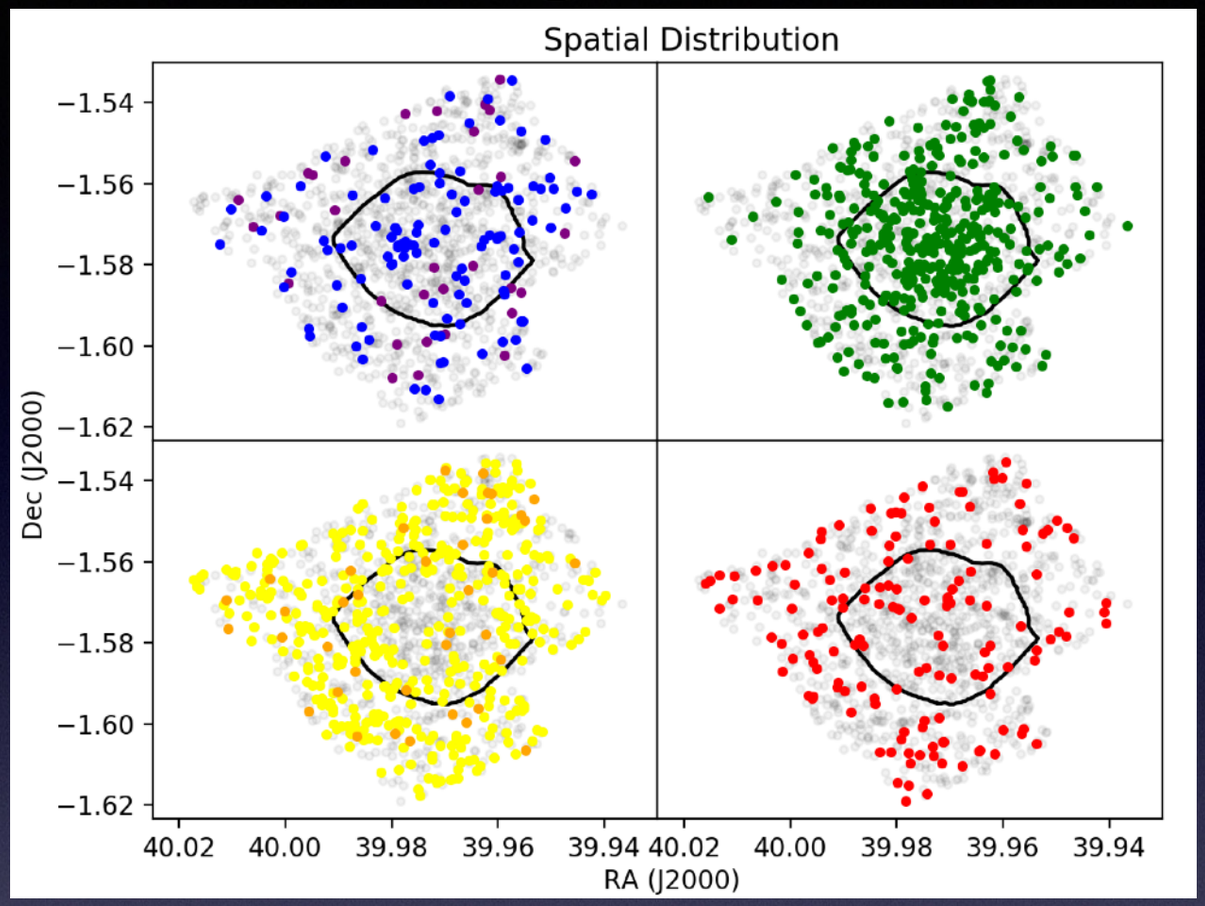




- Further breakdown by redshift/position
  - Cluster members dominate core
  - LoS more prominent in outskirts

Redshift Catalog





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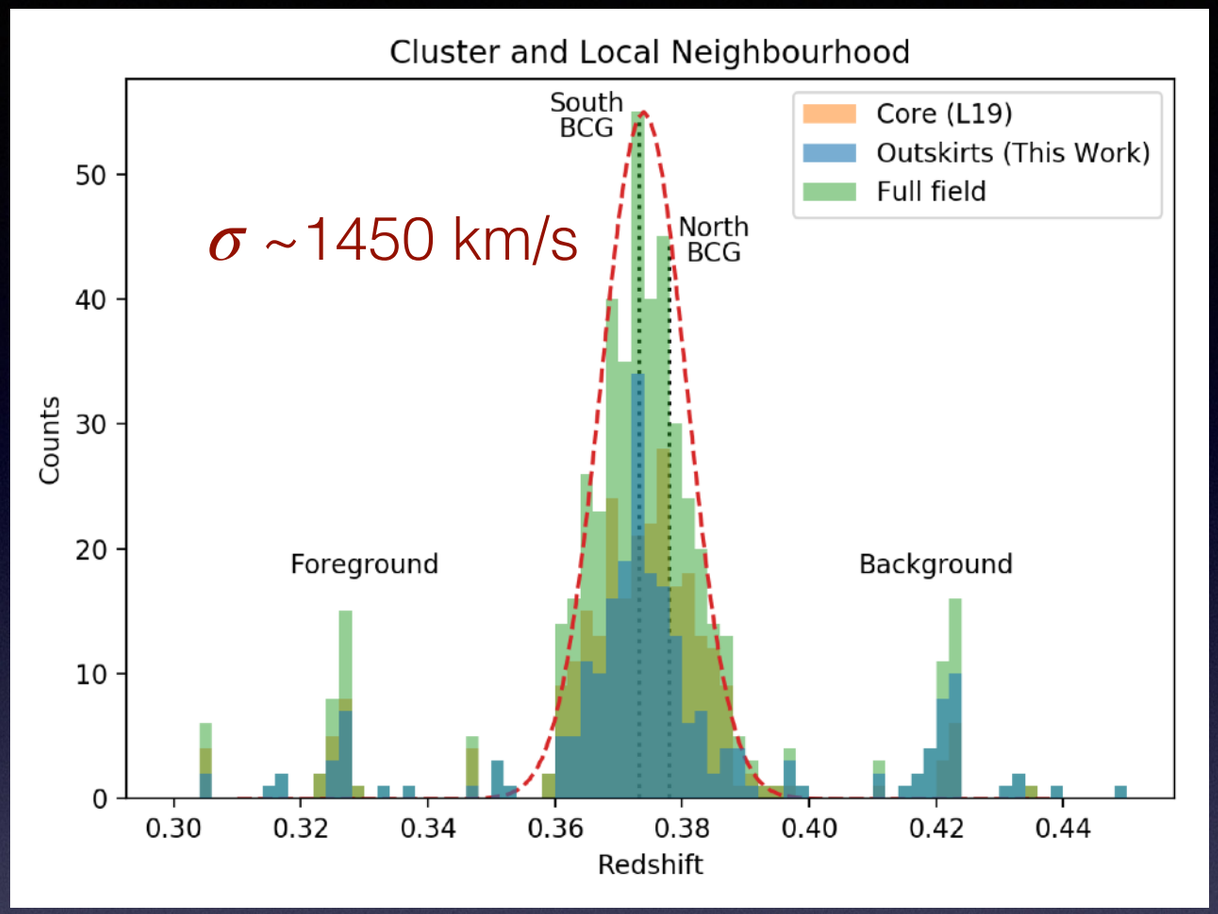
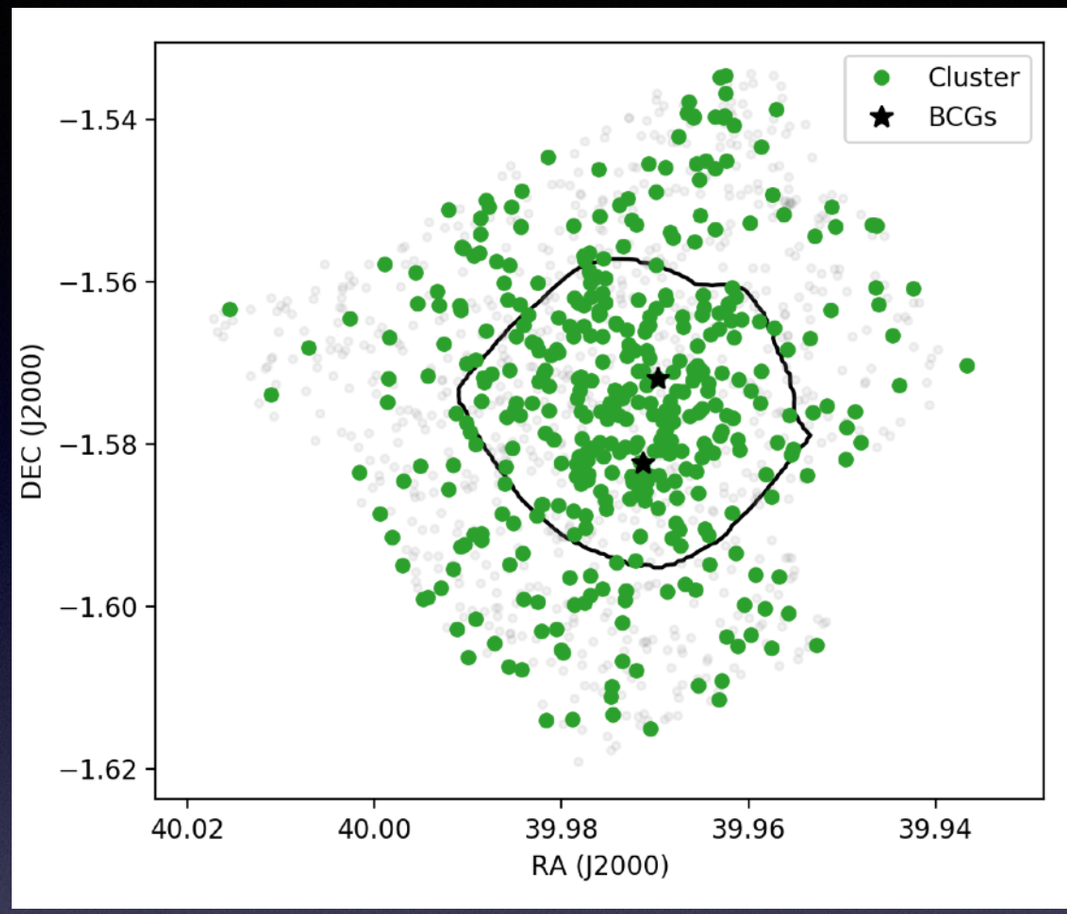
Cluster Members



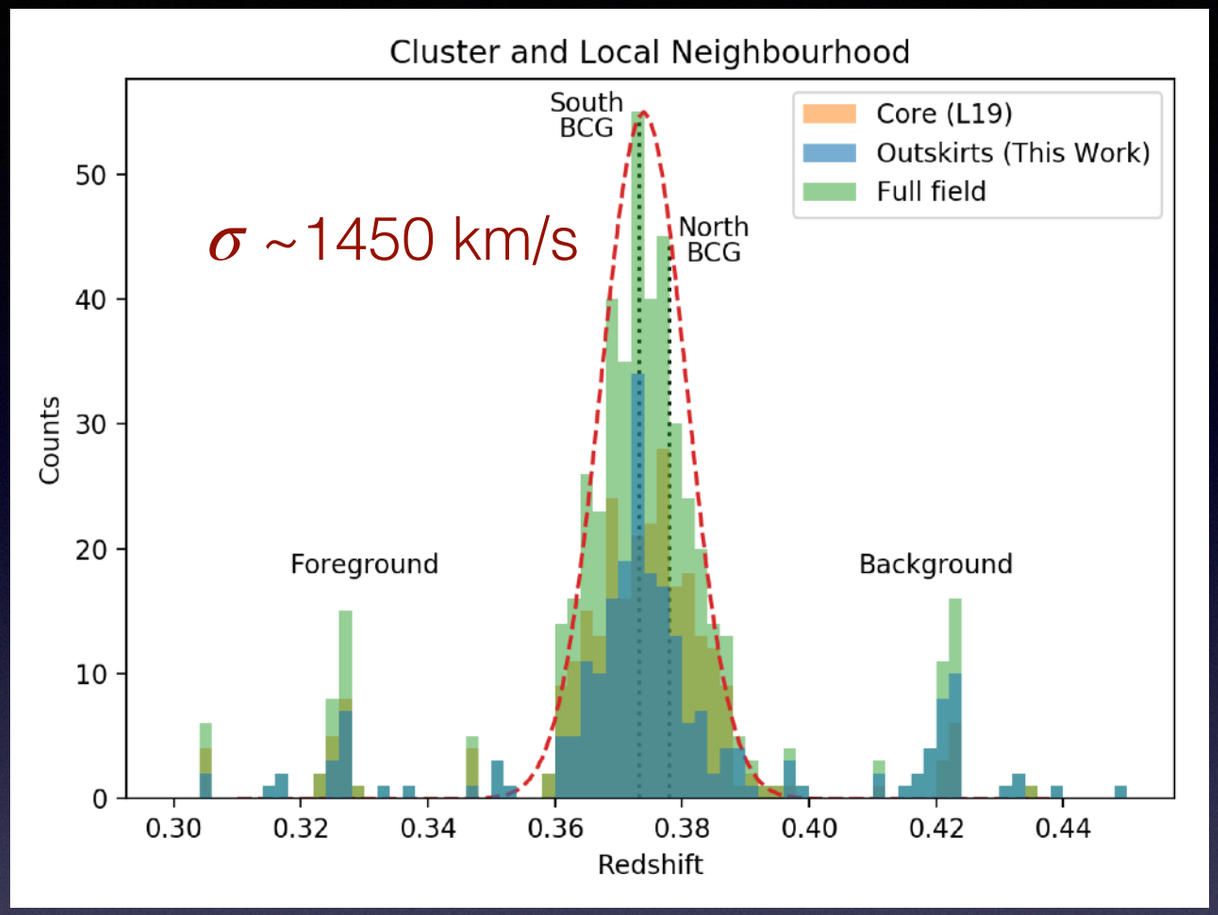


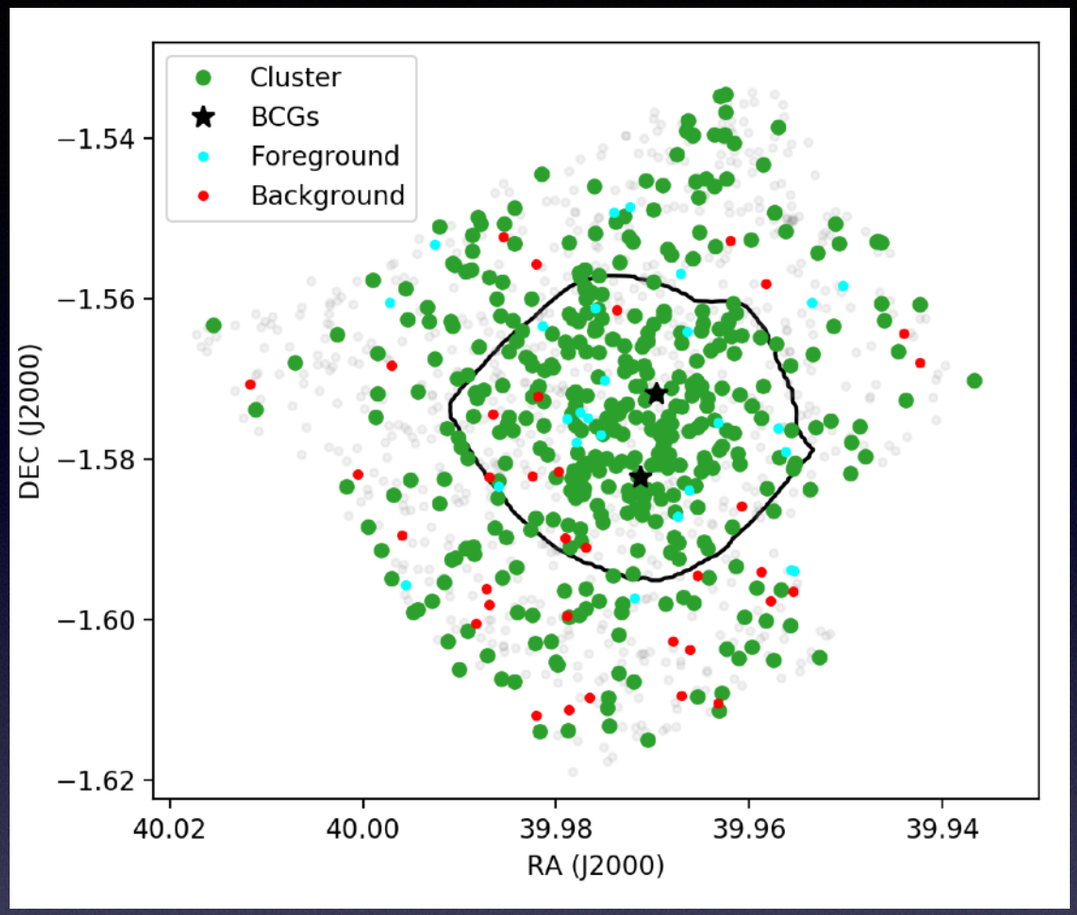
- Cluster region well-fit by Gaussian
  - Slightly broader velocity dispersion in core

σ_{core} ~1520 +/- 93 km/s σ_{outs}~1358 +/- 98 km/s

- Additional substructures seen along LoS

Cluster Members





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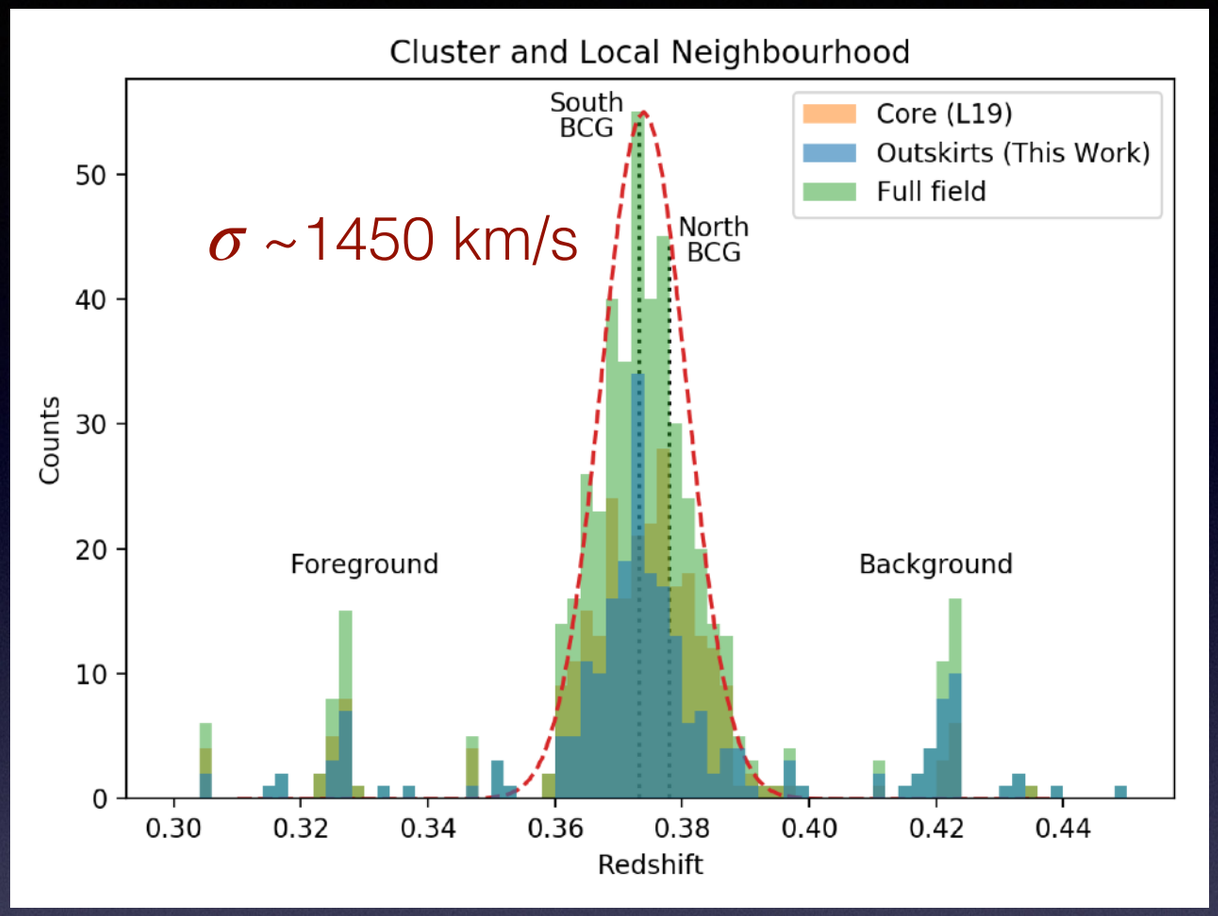

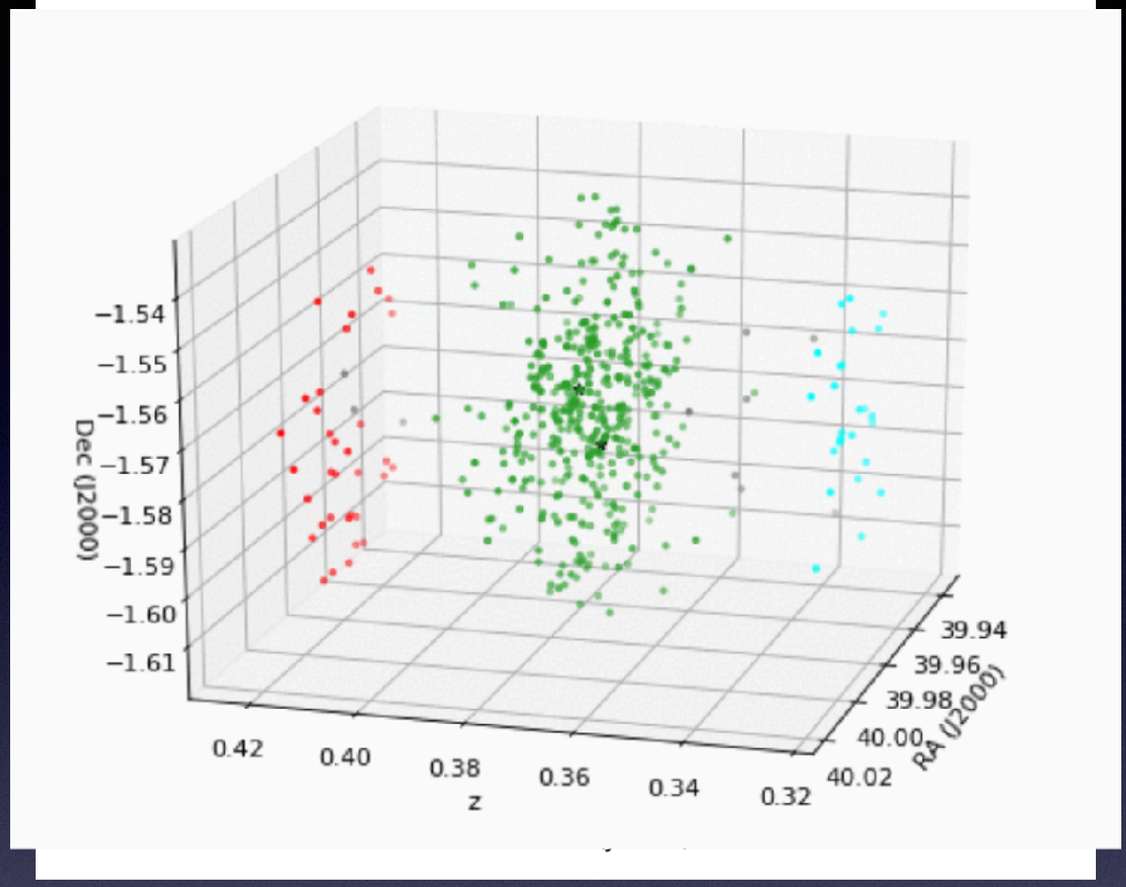

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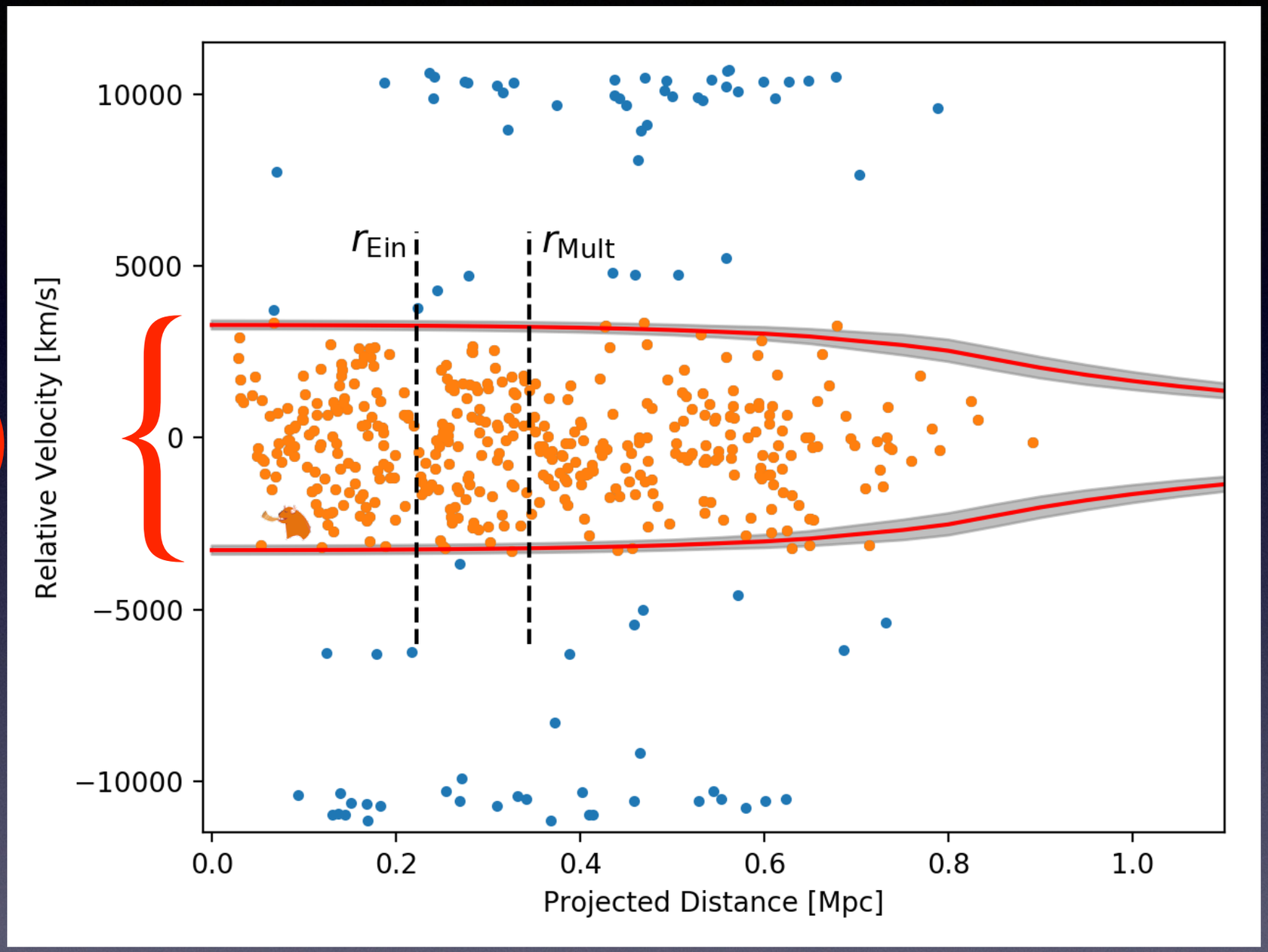
Caustic Method

A(r)

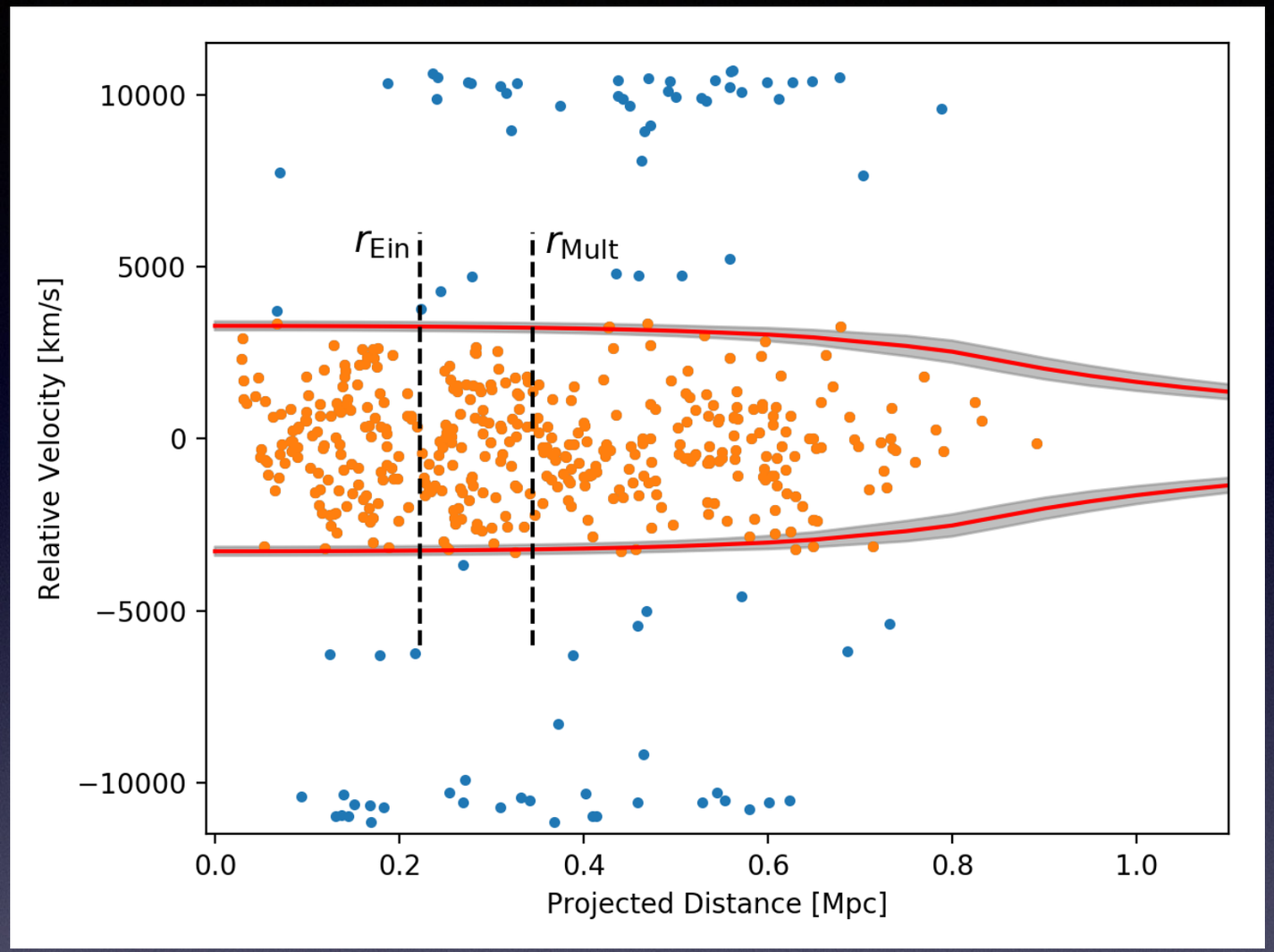


- To determine mass, measure amplitude A(r) in (r-v) phase plane (Diaferio&Geller97)

Caustic Method

$$v_{\rm esc}^2(r_p) = \langle v_{\rm los}^2 \rangle (r_p)\ \frac{3 - 2\beta(r_p)}{1 - \beta(r_p)} = -2\Phi(r_p)$$

$$\mathcal{A}^2(r_p)\ g(\beta(r_p)) = -2\Phi(r_p)$$



- Amplitude related to escape velocity, halo potential

Caustic Method

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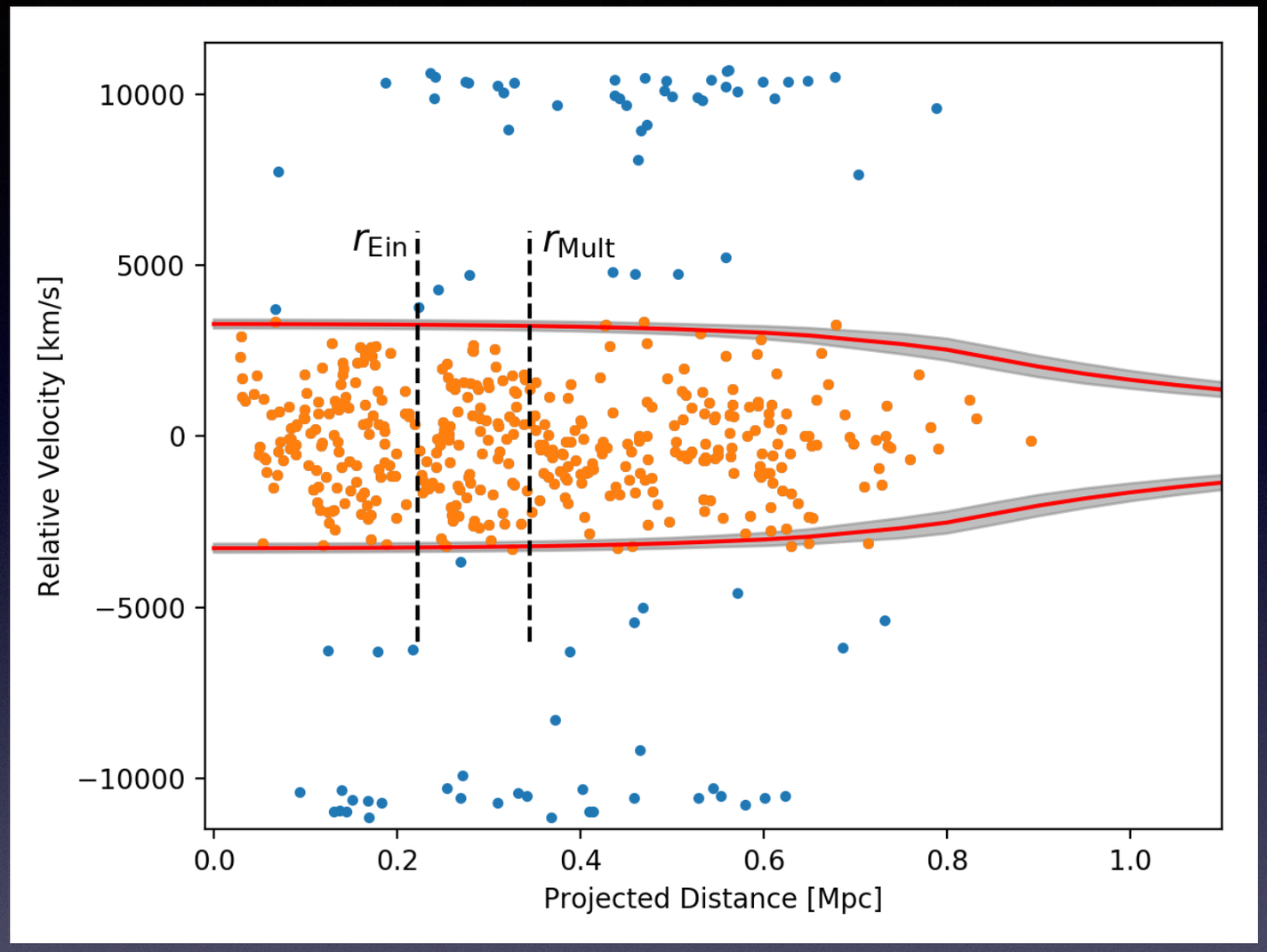

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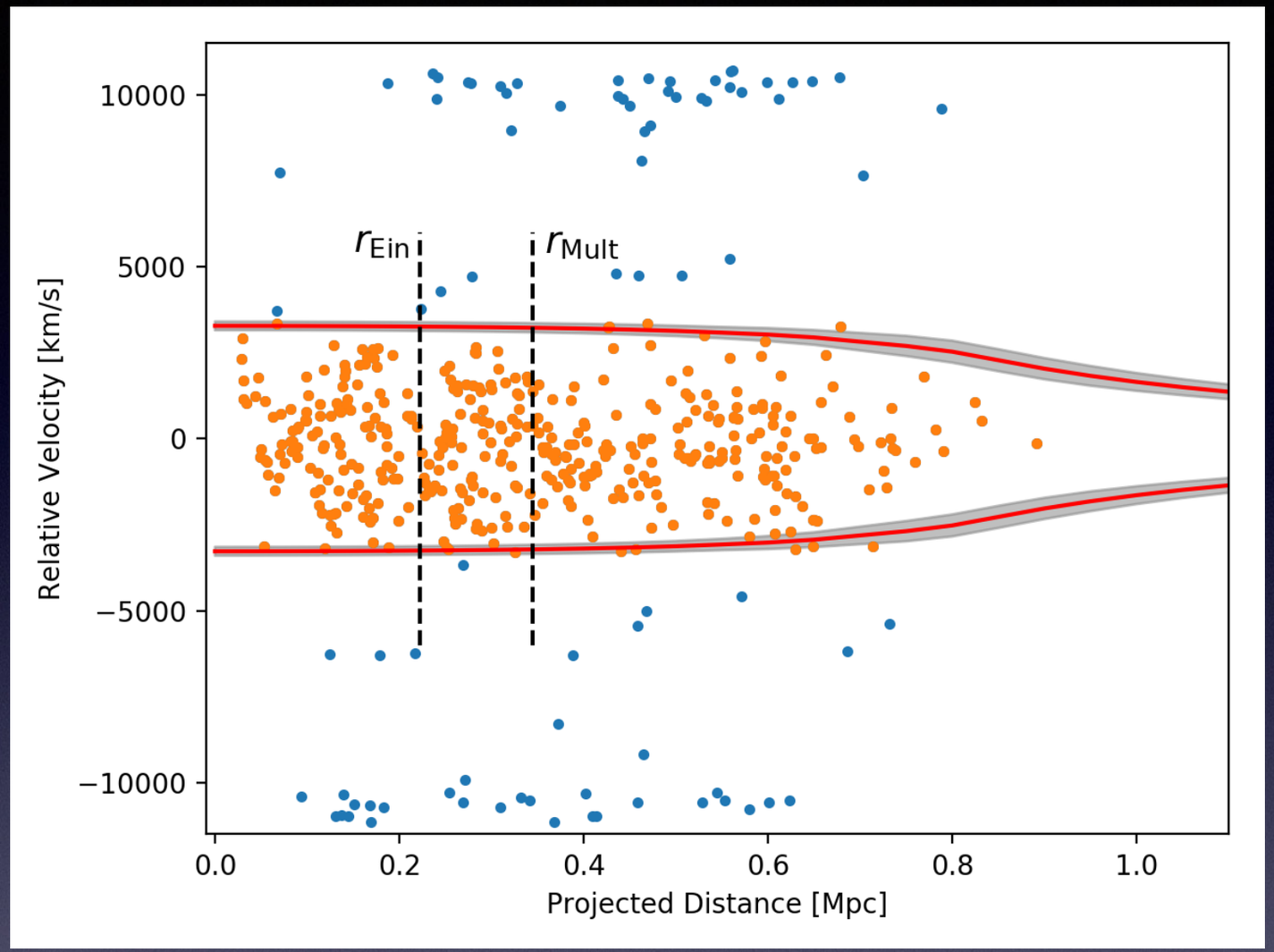
$$GM(< R) = \int_0^R -2G\pi\, \mathcal{A}^2(r_p)\, g(\beta(r_p))\, \frac{\rho(r_p) r_p^2}{\Phi(r_p)} d_{r_p}$$



- Amplitude related to escape velocity, halo potential
- Poisson equation relates potential to enclosed mass

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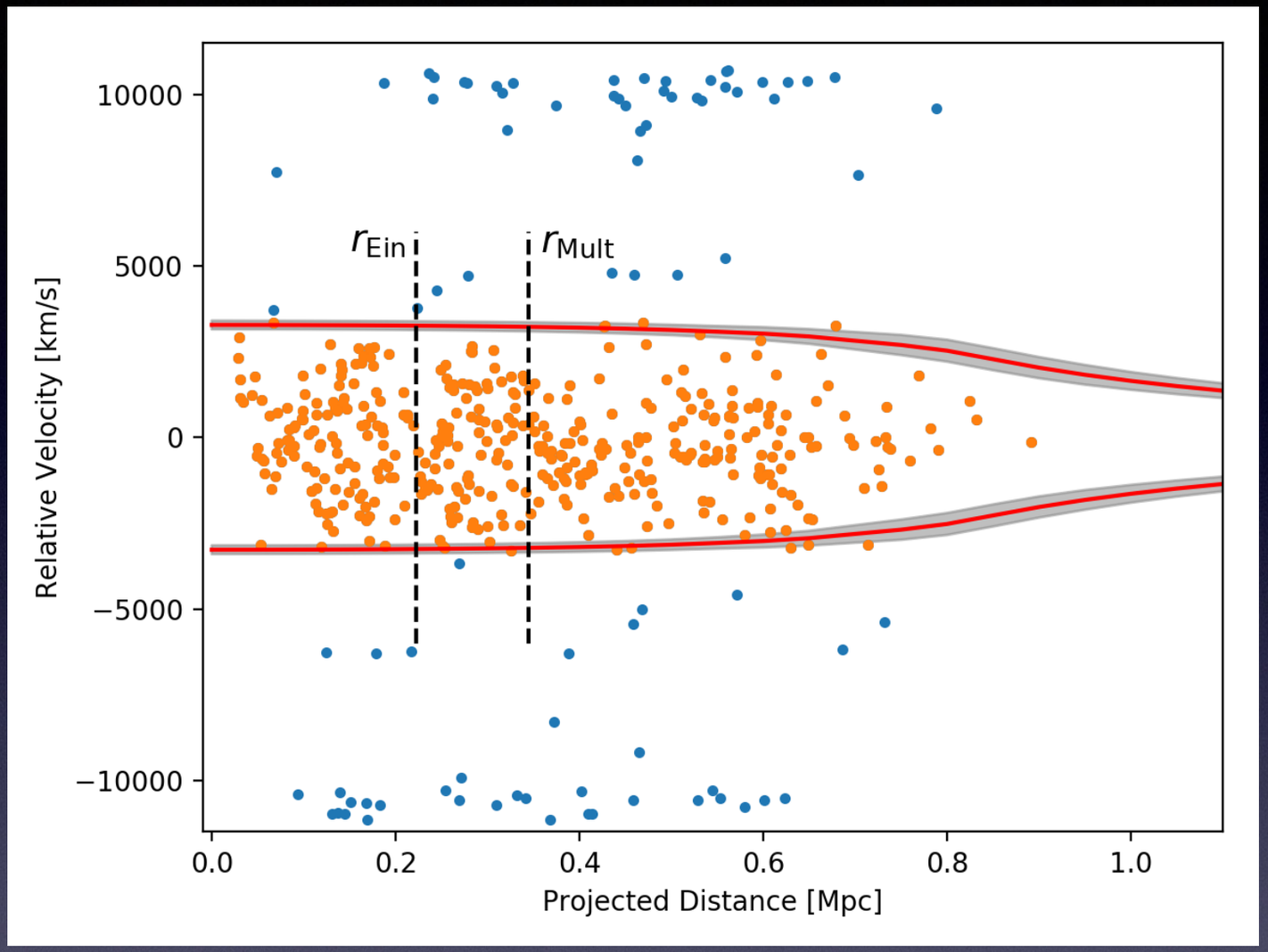
$$GM(<R) = \int_0^R \mathcal{F}_\beta(r_p)\,\mathcal{A}^2(r_p)\,dr_p$$

F_β nearly constant!
(calibrate from simulations)



- Amplitude related to escape velocity, halo potential
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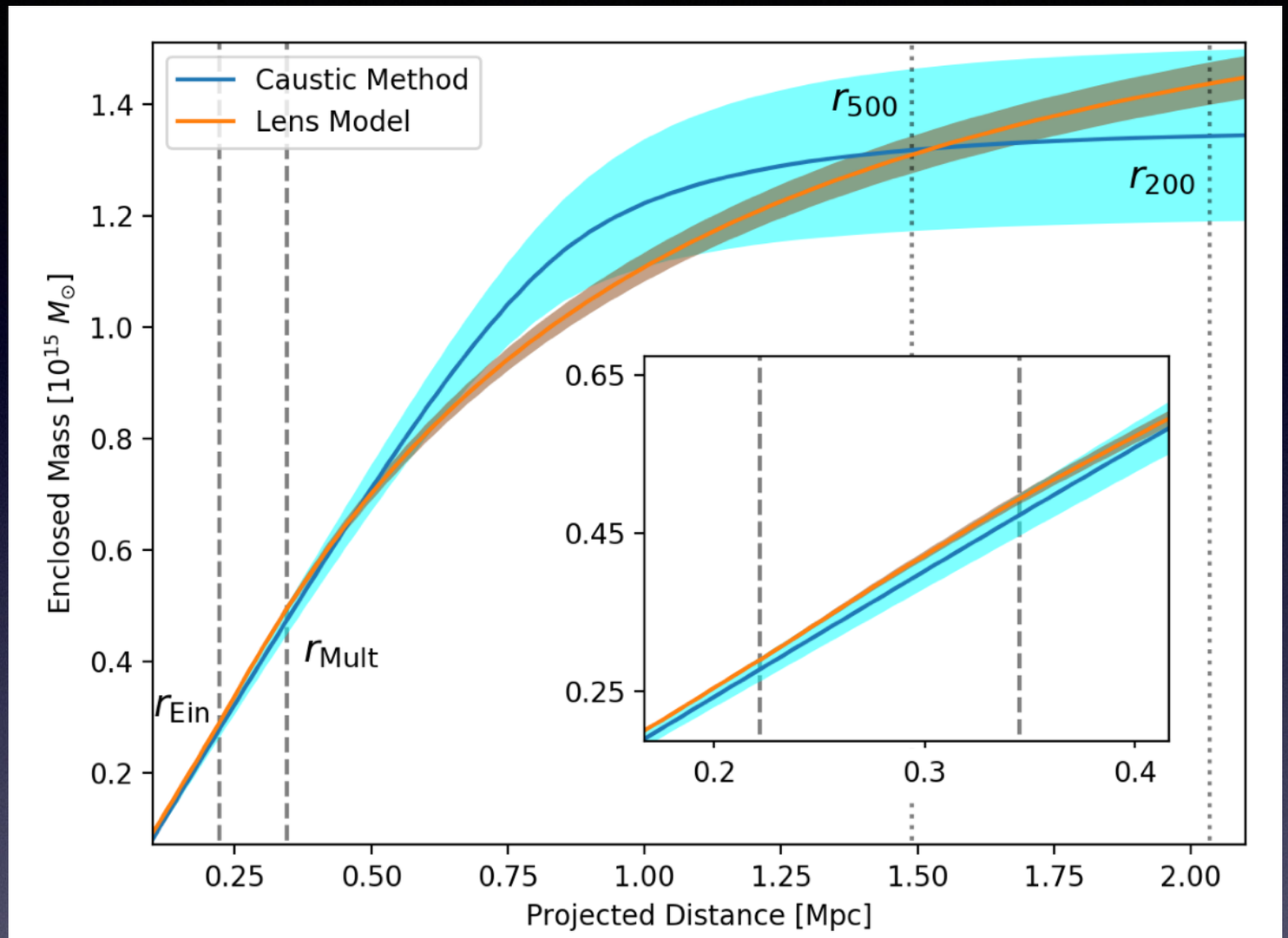
Caustic Mass

$$GM(<R) = \int_0^R \mathcal{F}_\beta(r_p)\, \mathcal{A}^2(r_p)\, d_{r_p}$$

$$\mathcal{A}^2(r_p) \propto \frac{(r_p/r_s)^2}{(1+r_p/r_s)^2\, \ln(1+r_p/r_s)}$$

Fit derived mass profile with NFW

$M_{500} = 1.3 \times 10^{15} M_{sol}$

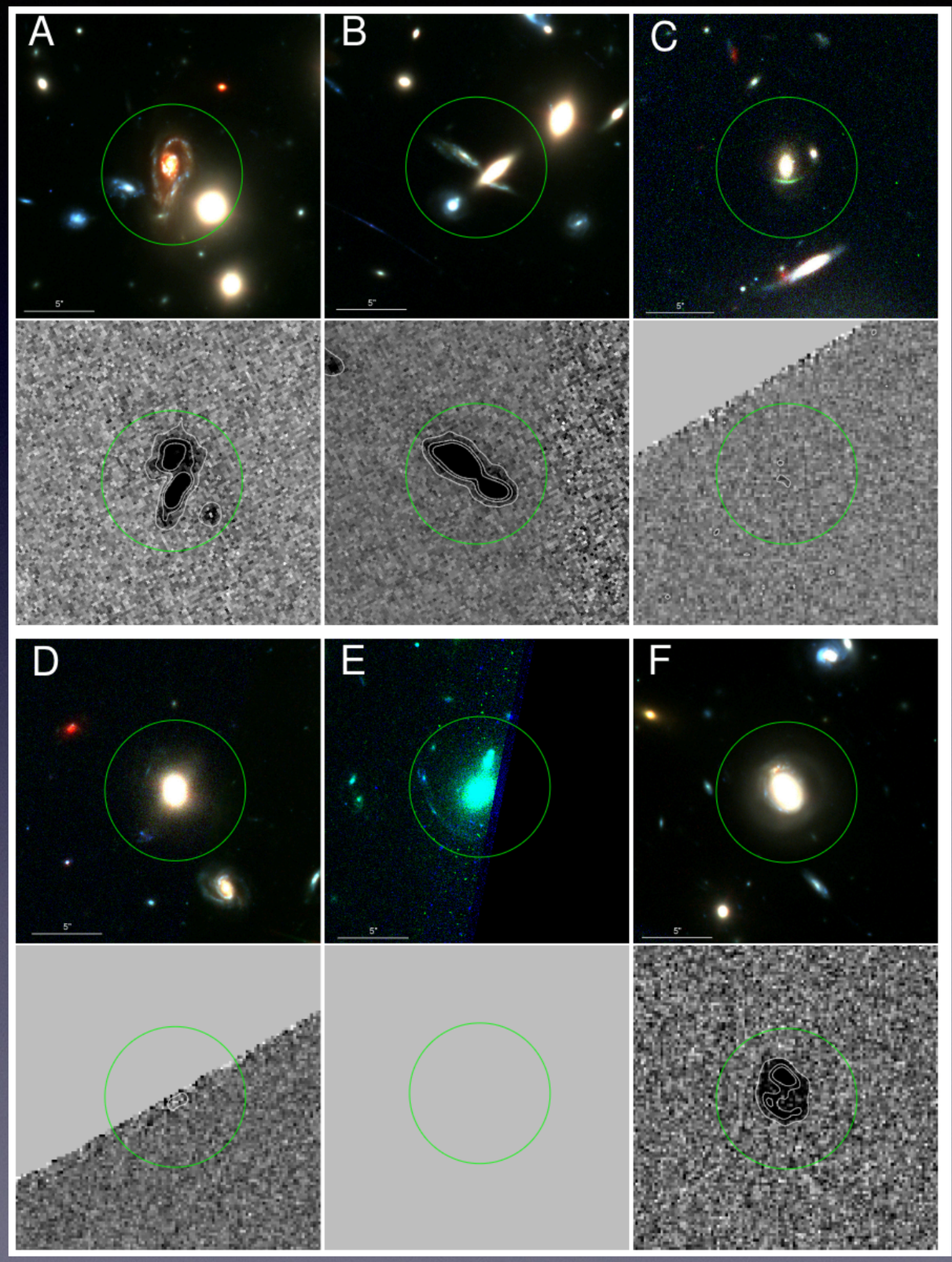


- Result can be compared to other methods (e.g., lensing)

Galaxy-Galaxy Lens search

- GGLs identified throughout the field
  - 6 found so far

- MUSE identifies source and lens redshift (in principle)
  - Also kinematic estimates



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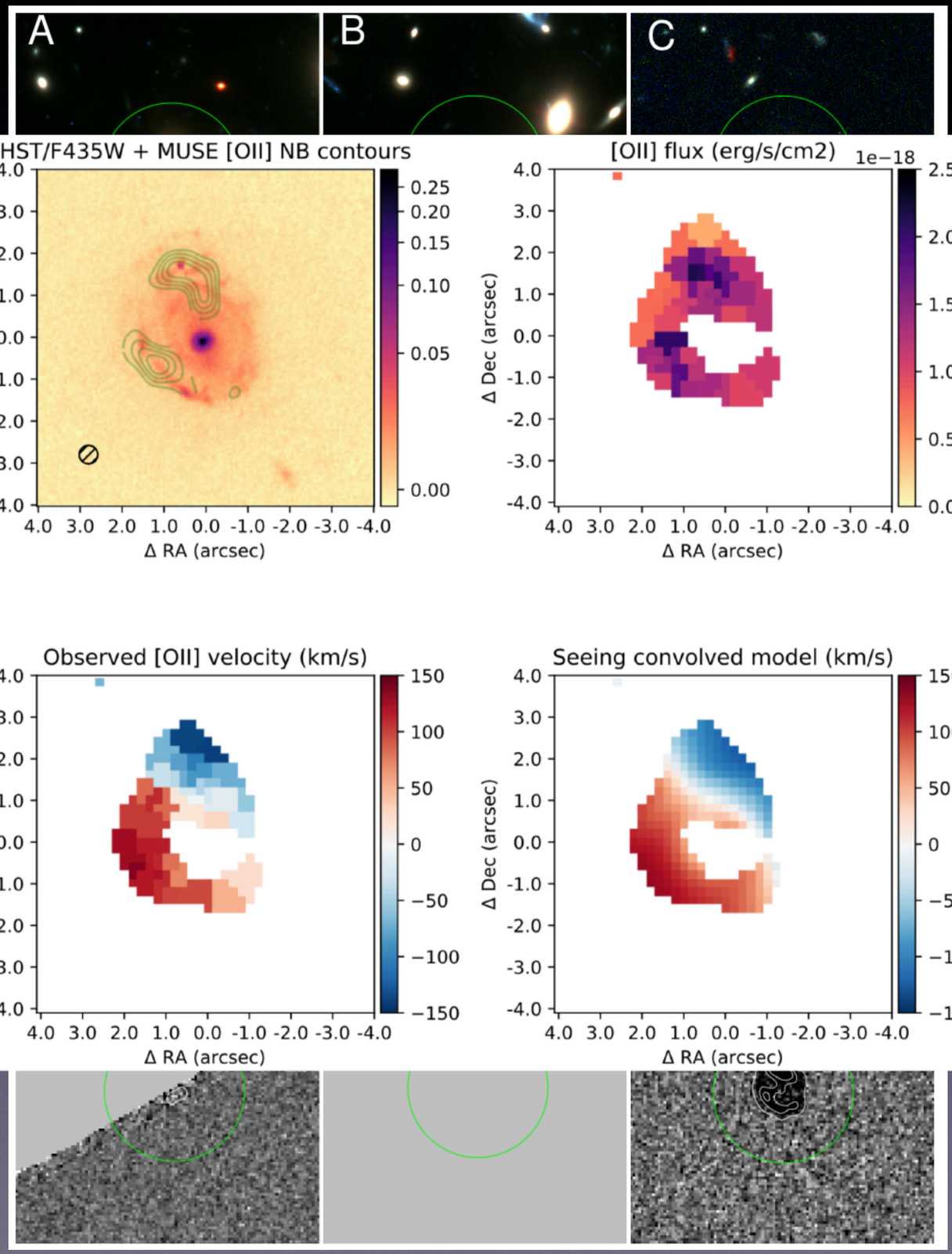
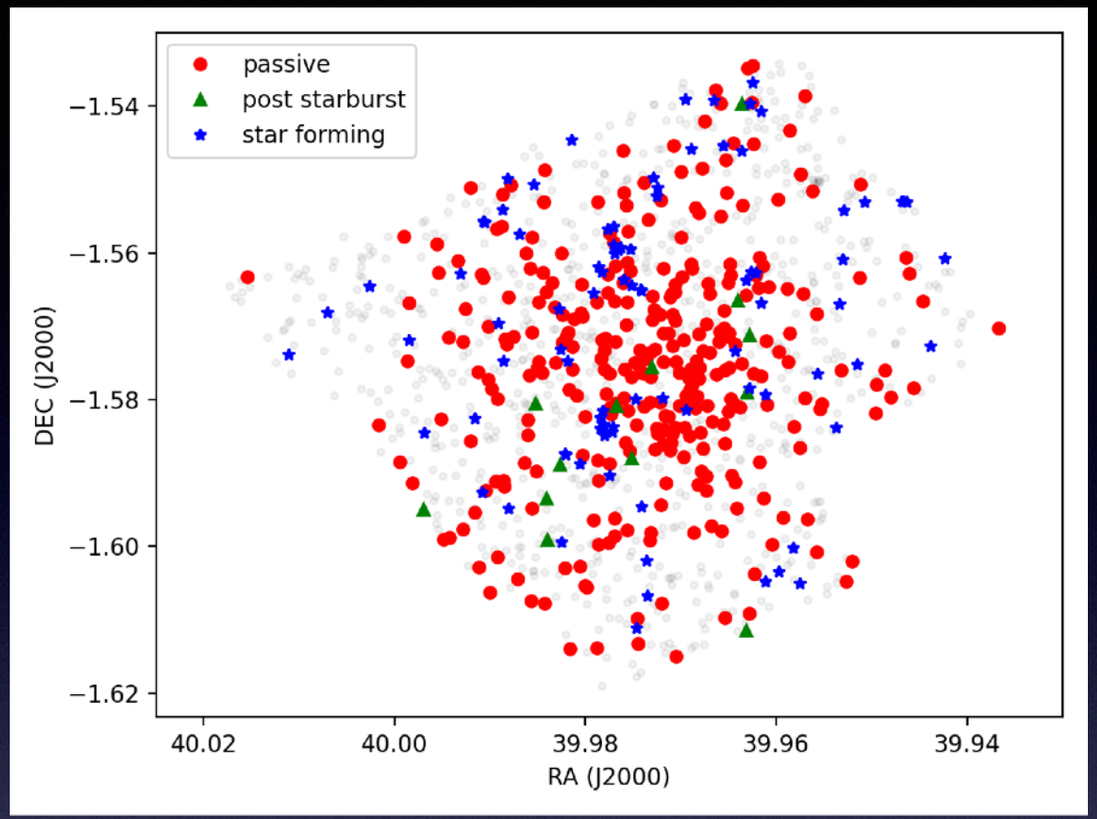
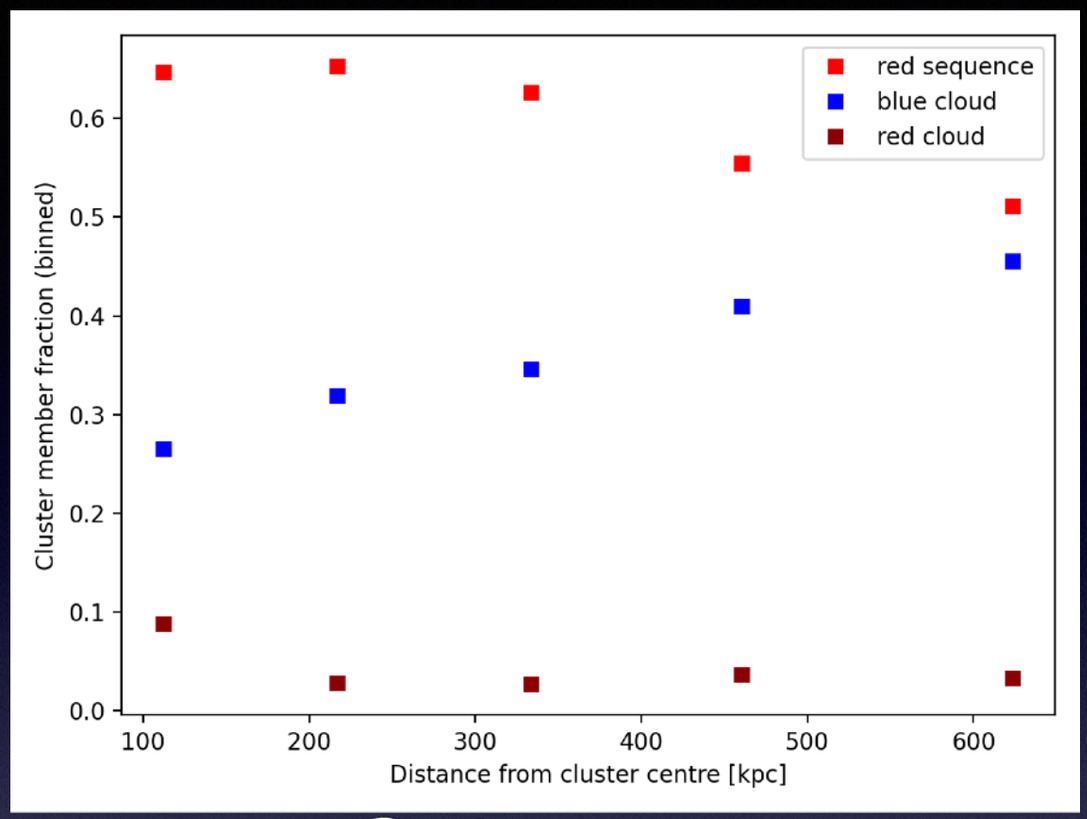


Other science possible!

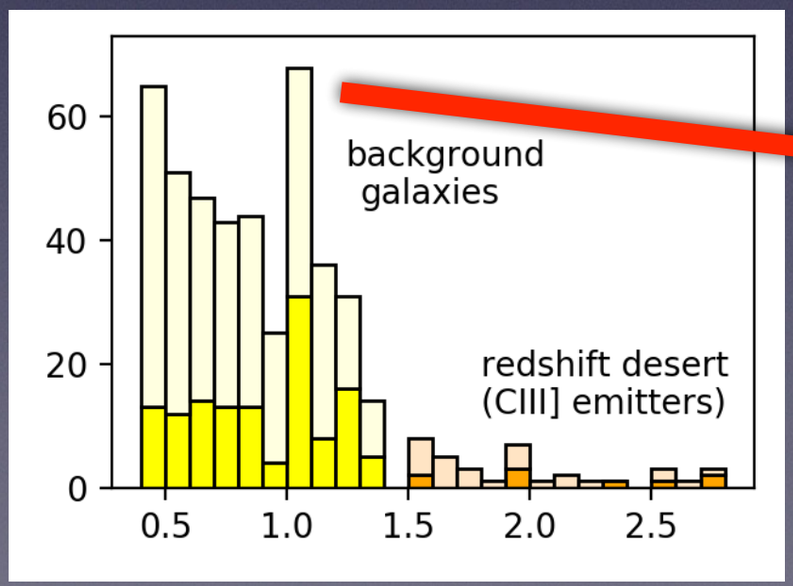


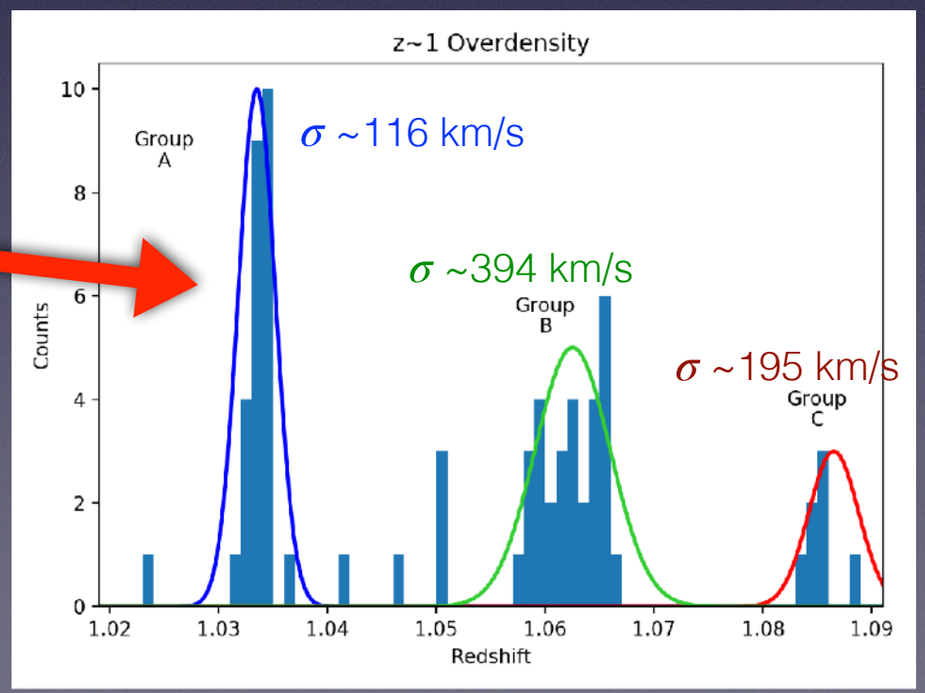
SFR / gas evolution



Color trends

LoS Structure

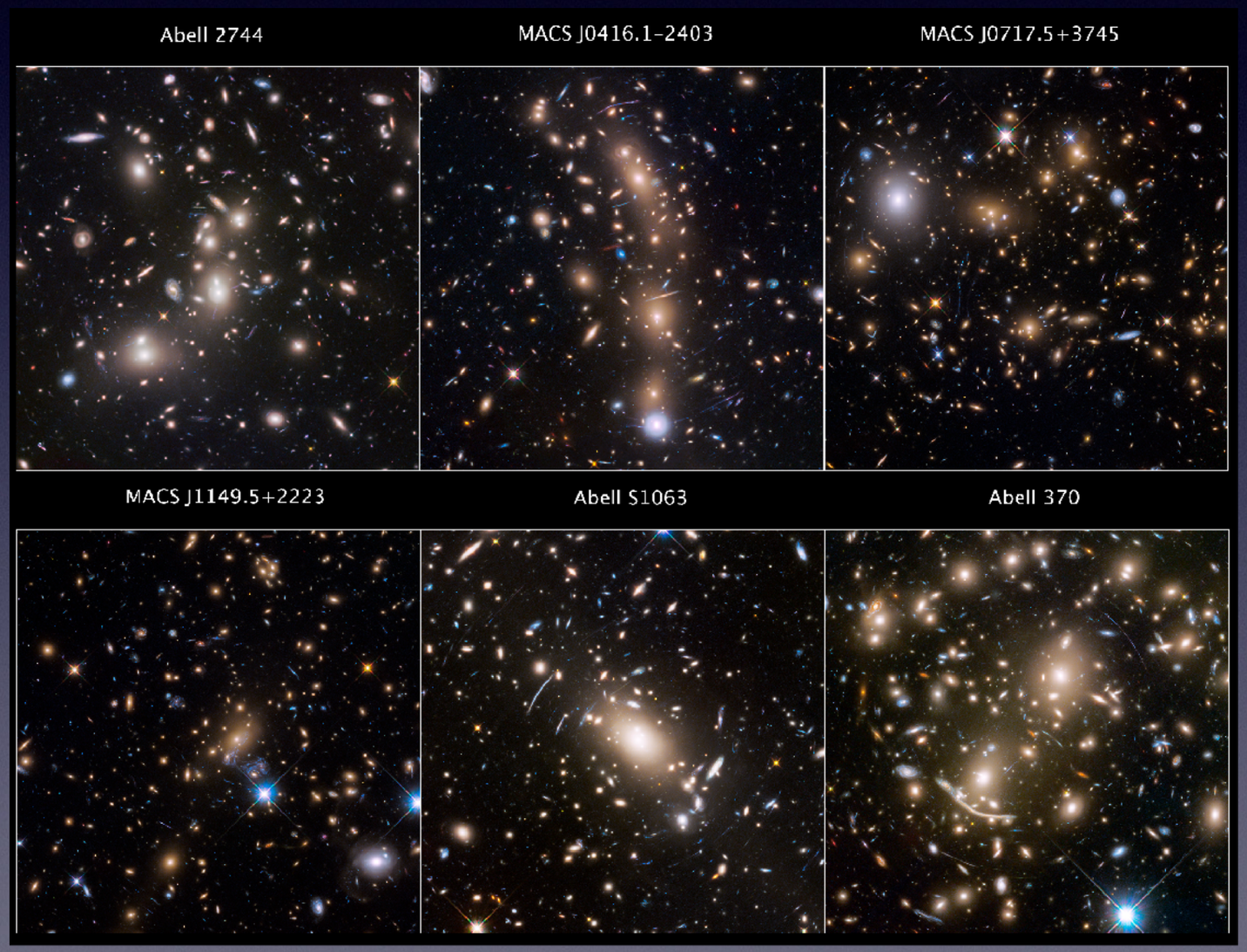




Possible expansion?

- Rich data set in hand, but more to explore / expand
  - Include other clusters as well

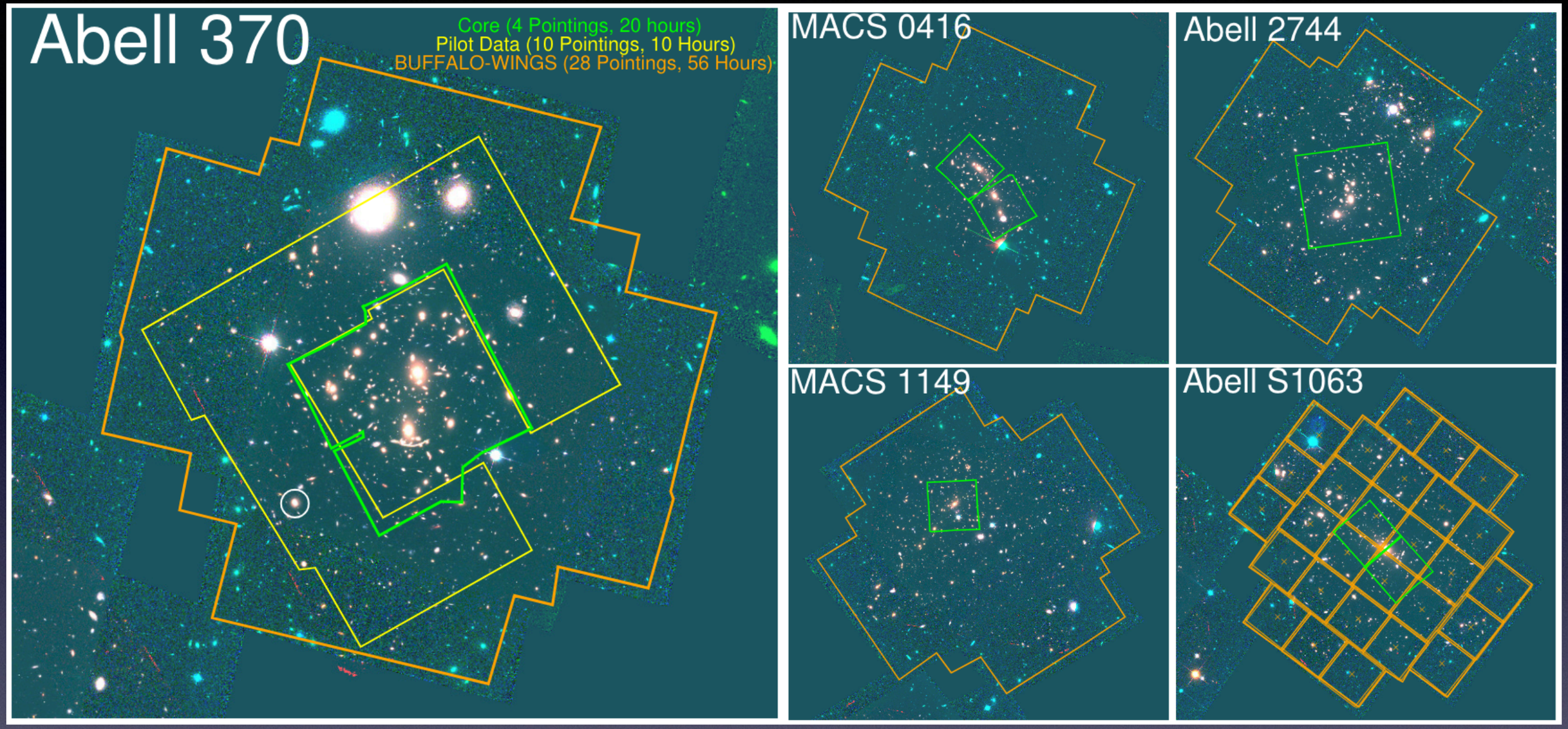
- Targeting other BUFFALO fields would be ideal



New Project Idea: BUFFALO-WINGS

Existing data: 4-8 hr depth
BUFFALO-WINGS: 2 hr depth

Survey Design



- Optimally fills BUFFALO footprint
  - 5 clusters possible (MACS0717 too far North for Paranal)
- Complements existing MUSE data
  - Can provide **~6000** new redshifts between z = 0 and z = 6.7

Conclusions

- Wide MUSE+HST surveys crucial for cluster mass studies
- Pilot program already revealing promising results
- Still more to do
  - BUFFALO-WINGS is the way forward!