Mapping the Galaxy Distribution in and around Galaxy Clusters

Hwang, Ho Seong (KIAS)

Mar. 23, 2017

Subaru International Partnership Science and Instrumentation Workshop

KIAS Astrophysics Group

cf. KASI

https://astro.kias.re.kr/

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Christophe Pichon (KIAS Scholar)

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Fadia Salmi
Seokcheon Lee (Sung Kyun Kwan Univ.)
Benjamin L'Huillier (KASI)

Group Activities

Astrophysics Journal Clubs
Wiki Page (members only)

Workshops

KIAS Workshop on Cosmology and Structure Formation
2016 2014 2012 2010 2008 2006 2004
Survey Science Group Workshop
2016.12 2016.02 2015 2014 2013 2012
Open KIAS Summer Institute
2015 2013 2011 2009
SDSS-KSG Workshop
2009 2008 2007 2005

Research Activities

Annual Reports
KDES Group Meeting
Publications
Press Release (mostly in Korean)

Research Areas

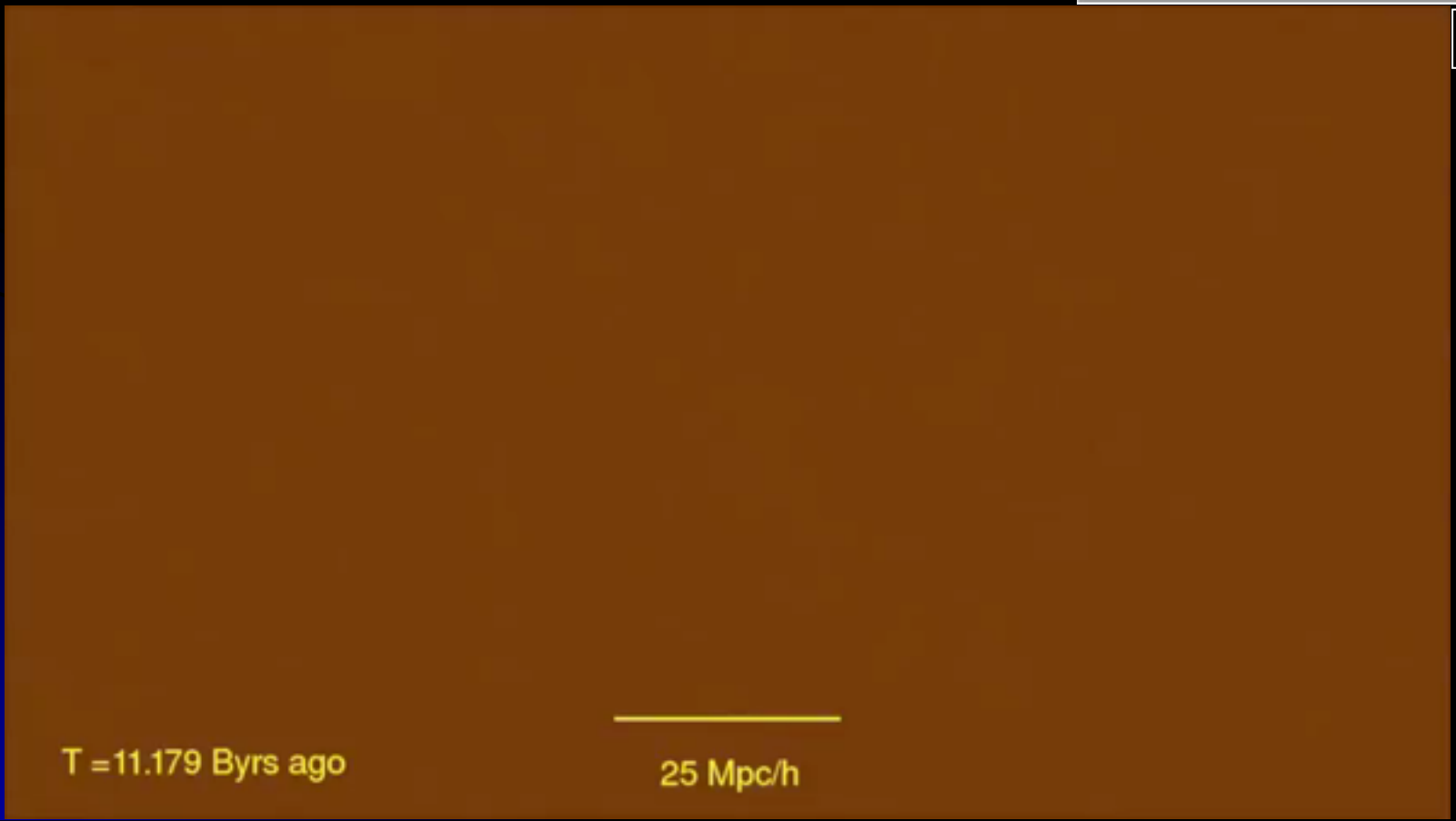
Inflationary model building
Cosmic Microwave Background
Large-scale Structures
Galaxy Formation
Cosmological simulations
Horizon Run Simulations
Historical Astronomy

Horizon Runs @ KIAS

➢ **One of densest and largest cosmological simulations**

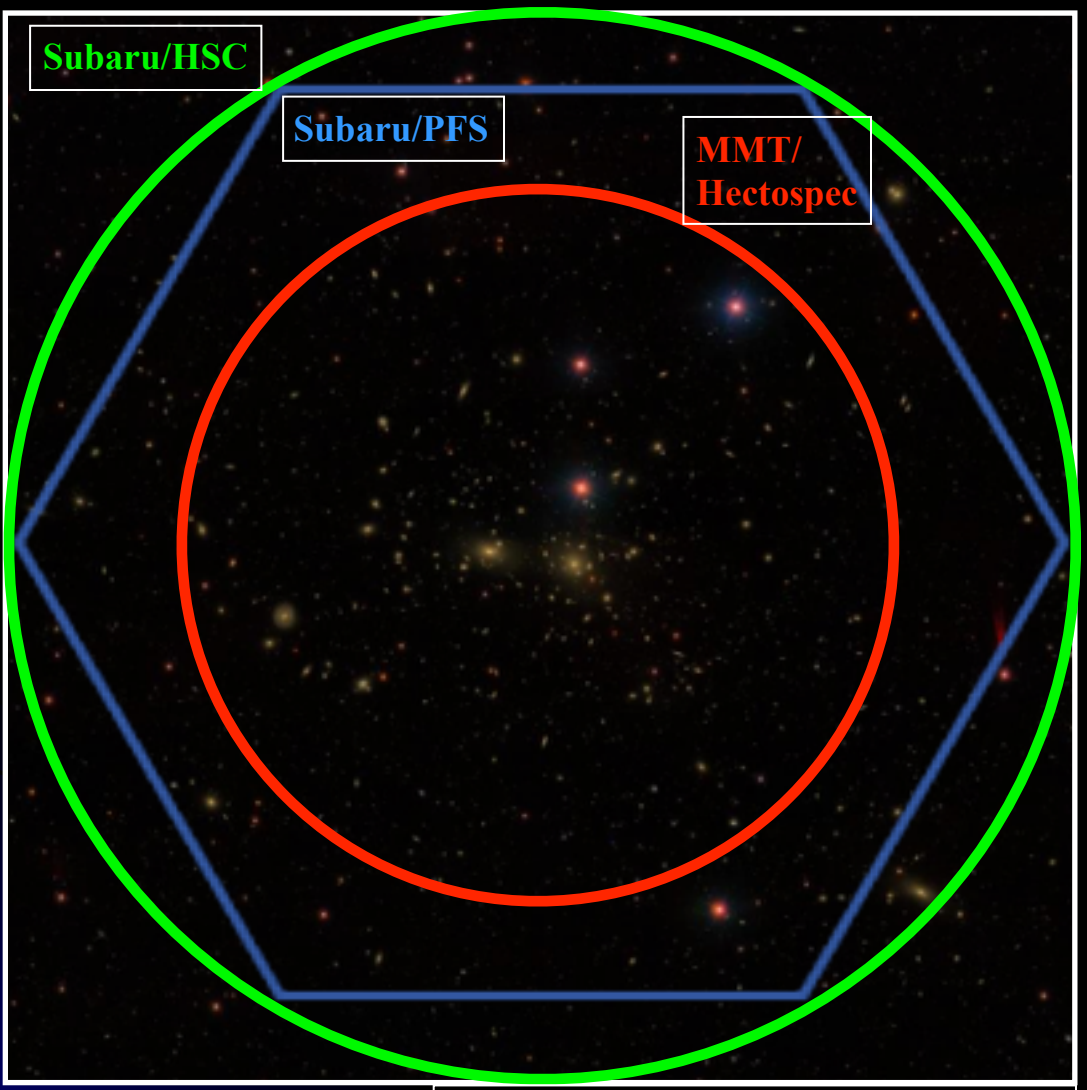
	HR1	HR2	HR3	HR4
Model	WMAP5	WMAP5	WMAP5	WMAP5
Ω_M	0.26	0.26	0.26	0.26
Ω_b	0.044	0.044	0.044	0.044
Ω_Λ	0.74	0.74	0.74	0.74
Spectral index	0.96	0.96	0.96	0.96
H_0 [100 km s^{-1}Mpc^{-1}]	72	72	72	72
σ_8	0.794	0.794	0.794	0.794
Box size [h^{-1}Mpc]	6592	7200	10815	3150
No. of grids for initial conditions	4120^3	6000^3	7210^3	6300^3
No. of CDM particles	4120^3	6000^3	7210^3	6300^3
Starting redshift	23	32	27	100
No. of global time steps	400	800	600	2000
Mean particle separation [h^{-1}Mpc]	1.6	1.2	1.5	0.5
Particle mass [$10^{11}h^{-1}M_\odot$]	2.96	1.25	2.44	0.0902
Minimum halo mass (30 particles) [$10^{11}h^{-1}M_\odot$]	88.8	37.5	73.2	2.706
Mean separation of minimum mass PSB halos [h^{-1}Mpc]	13.08	9.01	11.97	4.08

Kim J., Park C. +11;+15

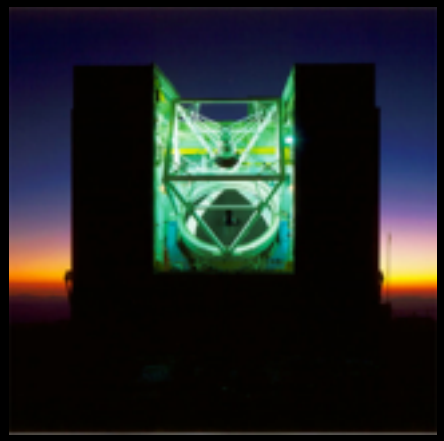


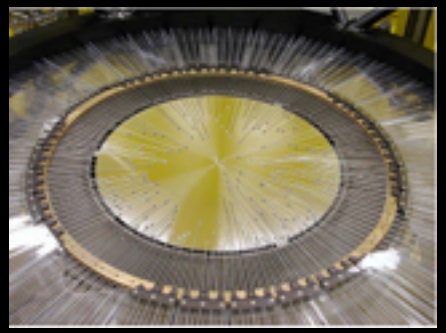
- Key words:
  - Galaxy Redshift Surveys
    - Galaxy Clusters
    - Large-scale Structure of the Universe
    - Cosmology

- In this talk,
  - Galaxy Redshift Surveys in and around Galaxy Clusters, but
  - We are also interested in Science Cases using the PFS SSP data



Coma Cluster 1.5 deg x 1.5 deg (SDSS)





➢ 6.5m on Mount Hopkins, Arizona, USA

➢ 300 fibers (2" diameter) with 1 deg diameter FOV:
R ~ 6 Mpc at z~0.2;
ideal for studying the infall region of clusters

➢ Wavelength:
365 - 920nm with R~1000 (cz_{error}~30 km s^{-1})

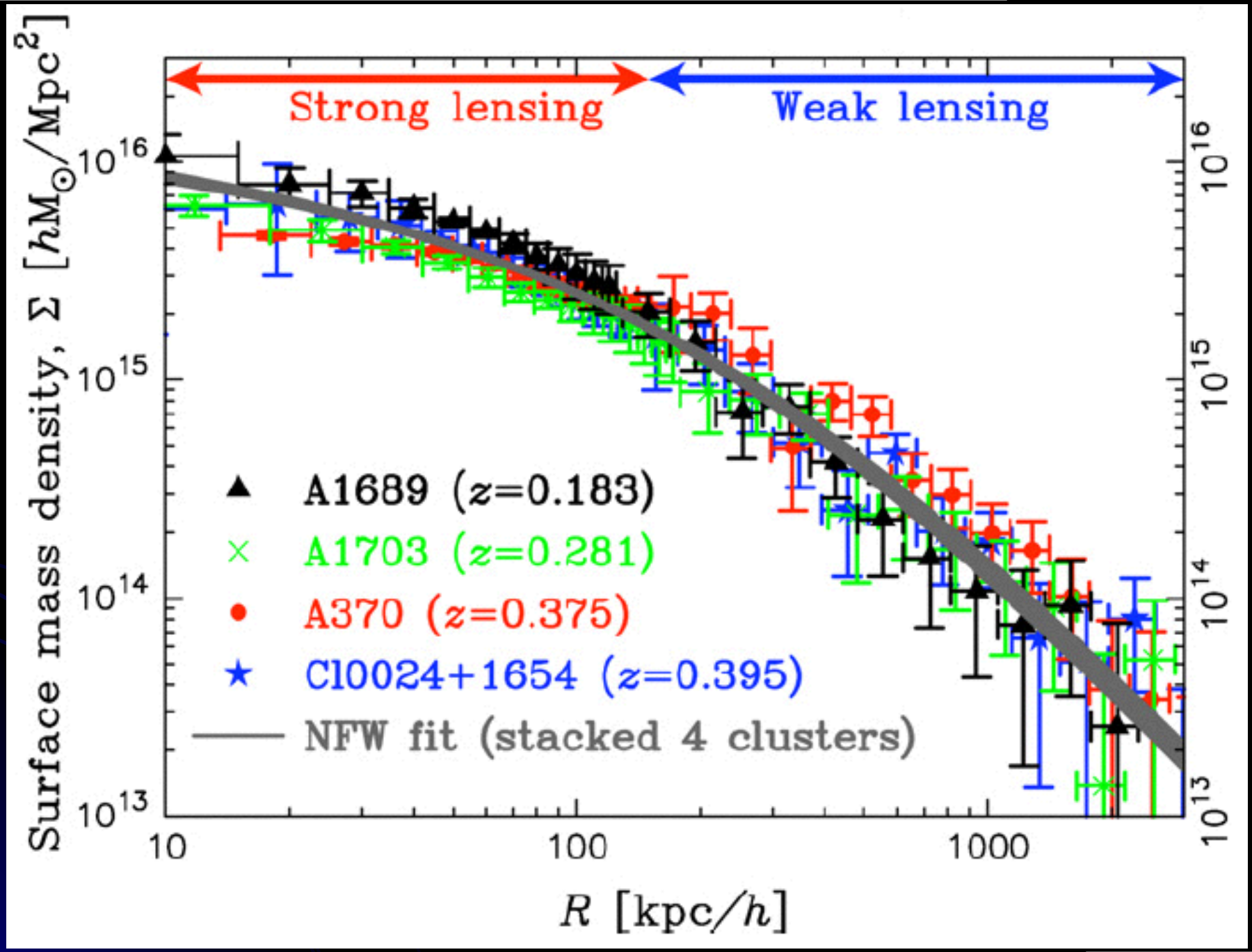
➢ Observe galaxies at r<21.5 with 0.5-2 hour exp:
Well combined with the SDSS photometric data

What we can do with Galaxy Redshift Surveys

- in Galaxy Clusters
  - Cluster Mass Profile: Weak Lensing + Kinematics
  - Comparison of the structures identified in weak-lensing maps and in redshift surveys

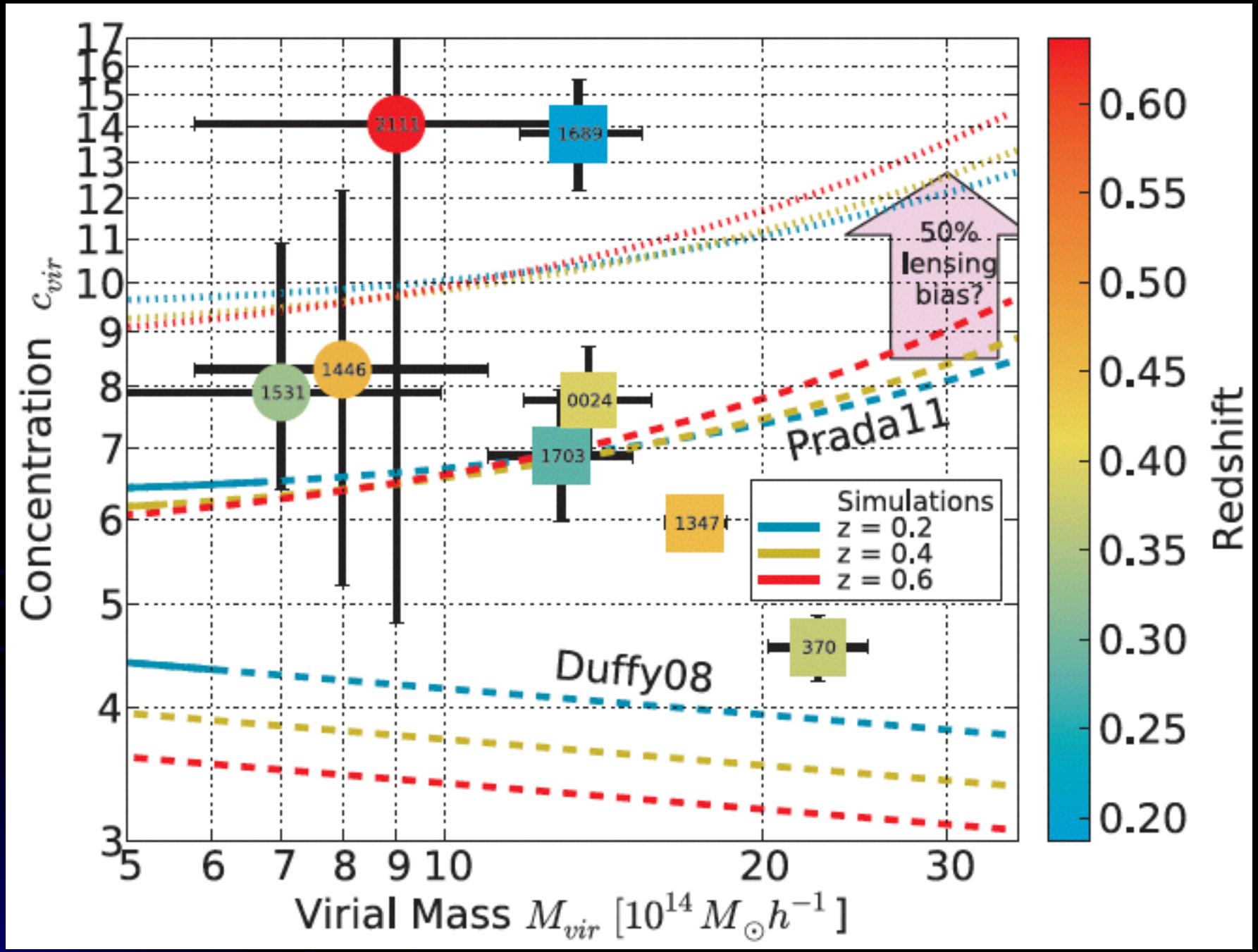
- around Galaxy Clusters
  - Large-scale Structure of the Universe: Combination of Redshift Surveys + Weak Lensing + Cosmological Simulations

Cluster Mass Profile



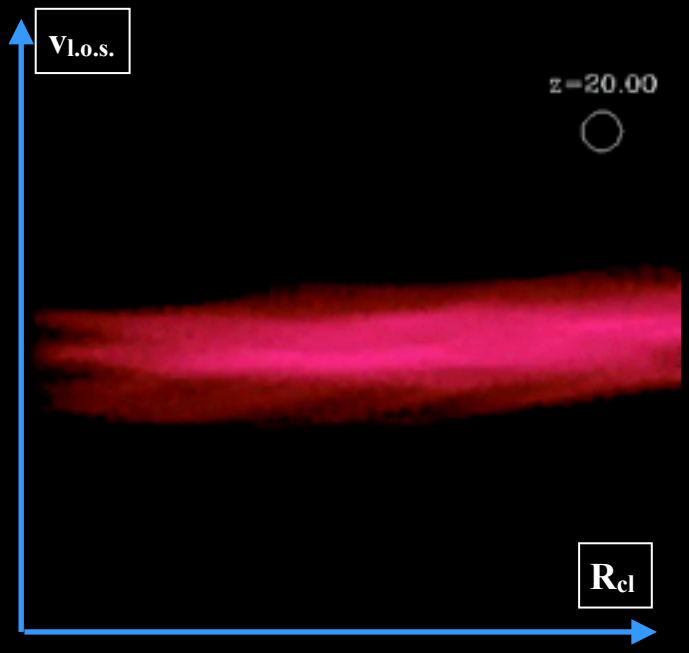
Postman+12; Rines+13

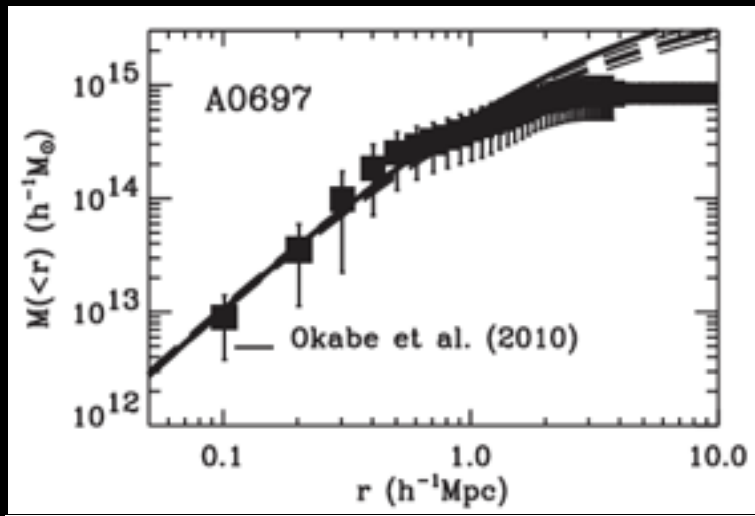
Cluster Mass Profile

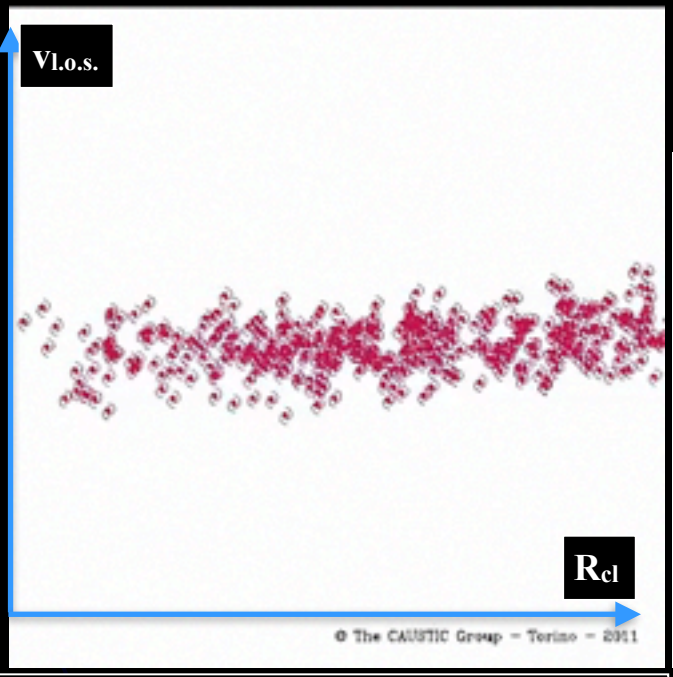


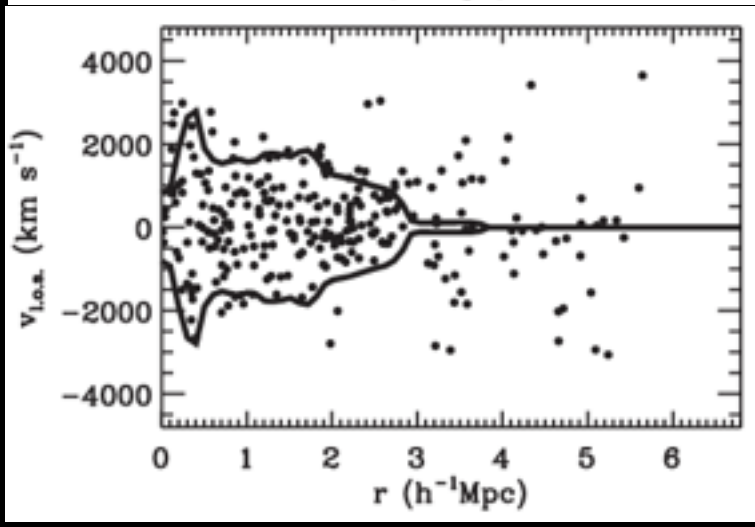
Postman+12;Umetsu+11+14

Cluster Membership: Caustic Technique





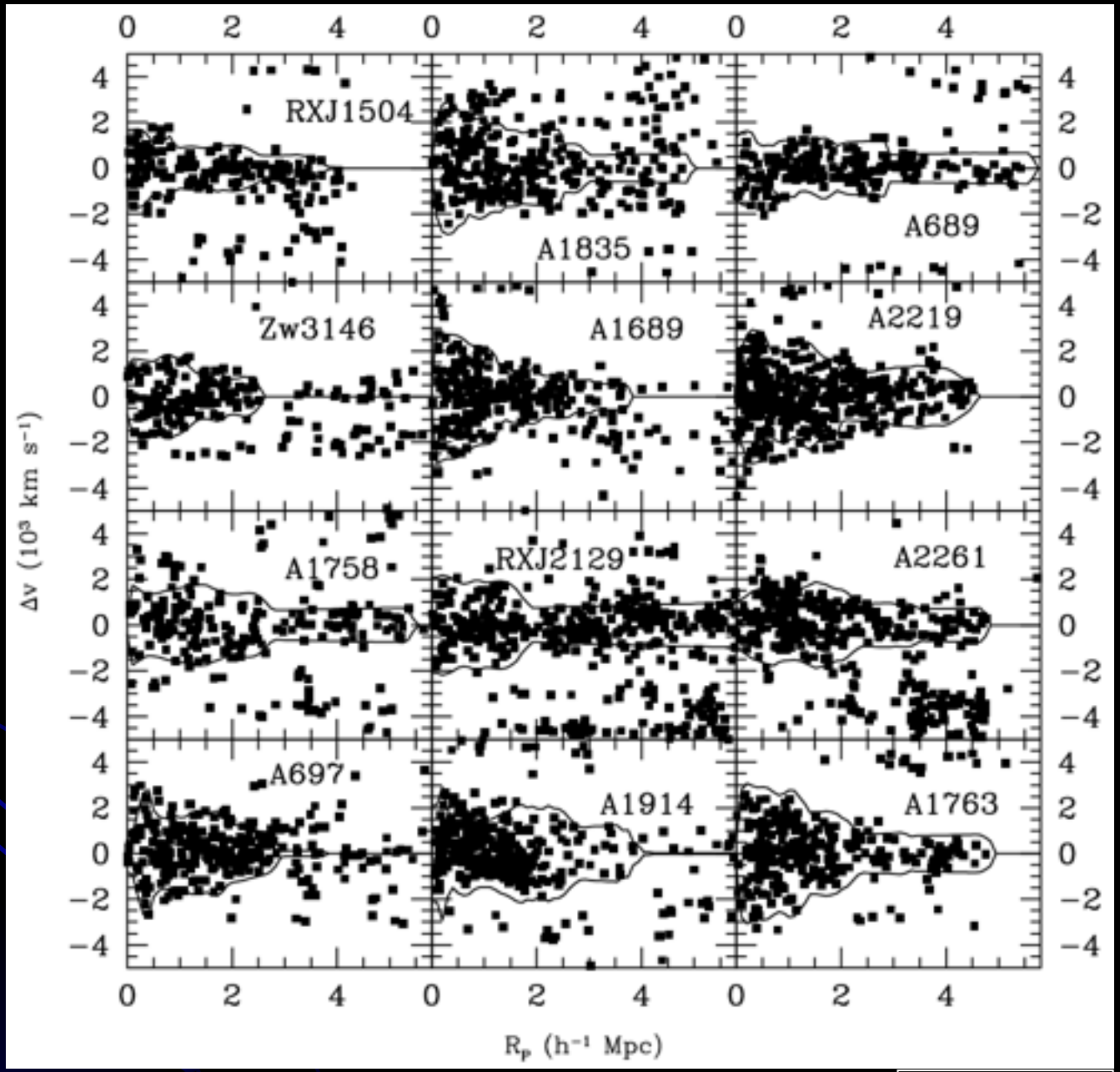




Geller+11 (Diaferio & Geller 97; Diaferio 99)

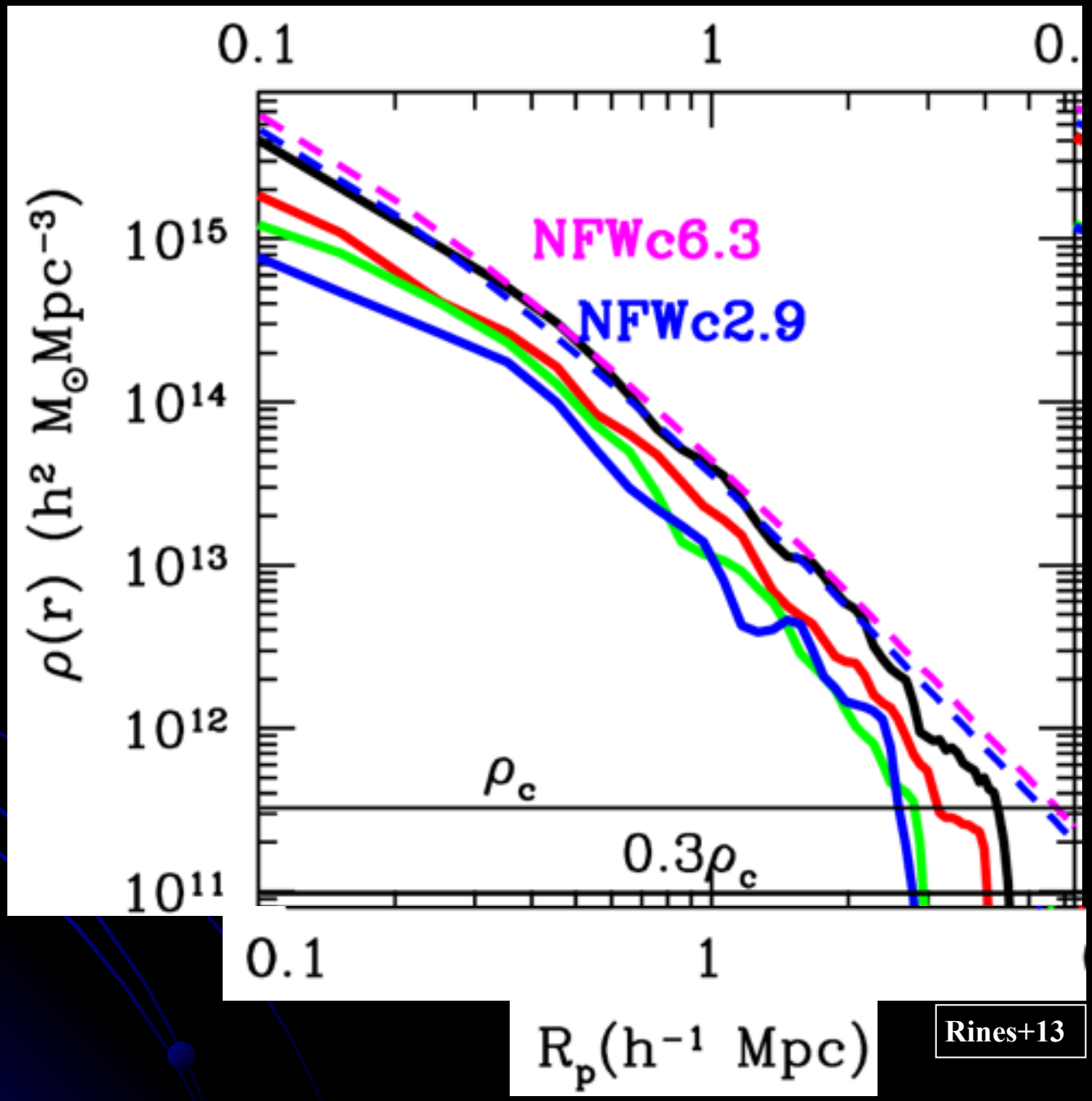
Geller+13

Cluster Membership: Caustic Technique



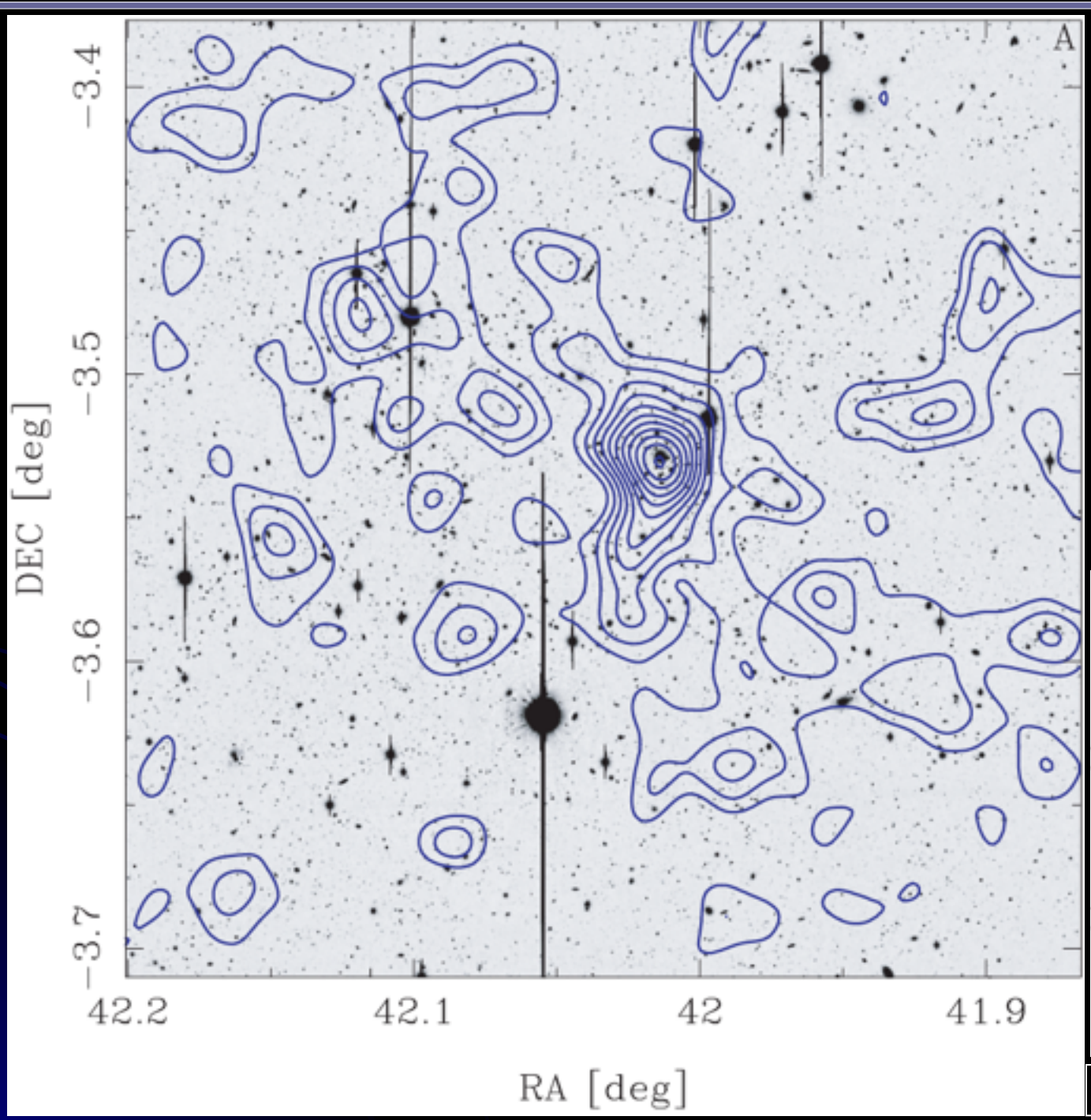
Rines+13;+16

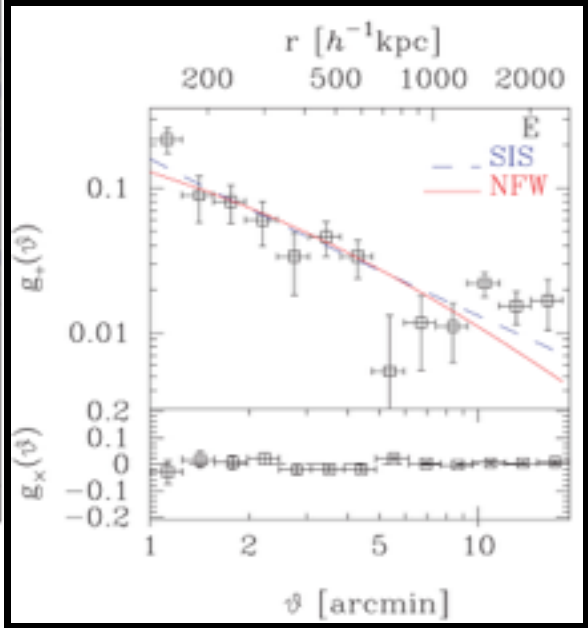
Cluster Mass Profile



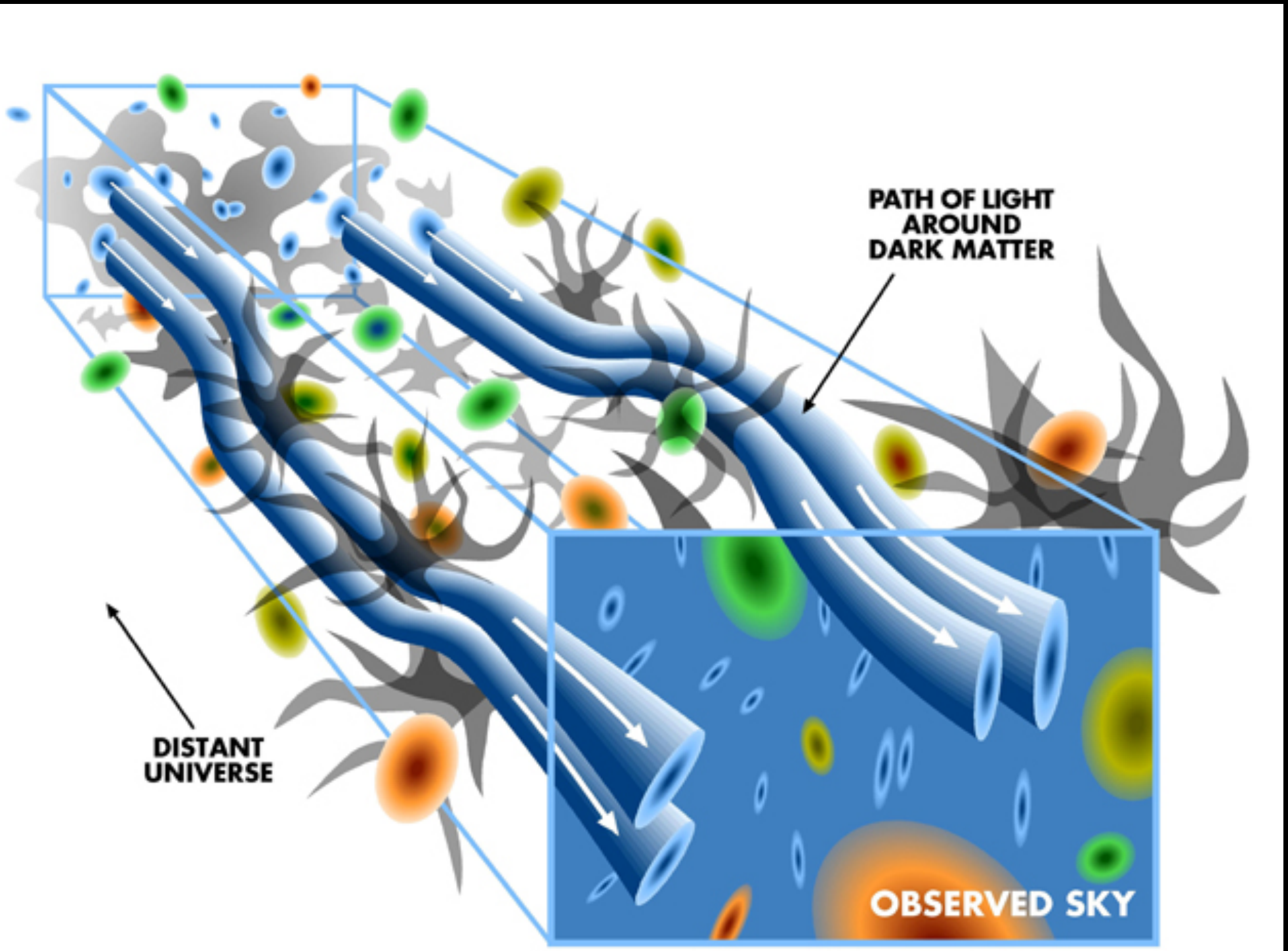
Rines+13

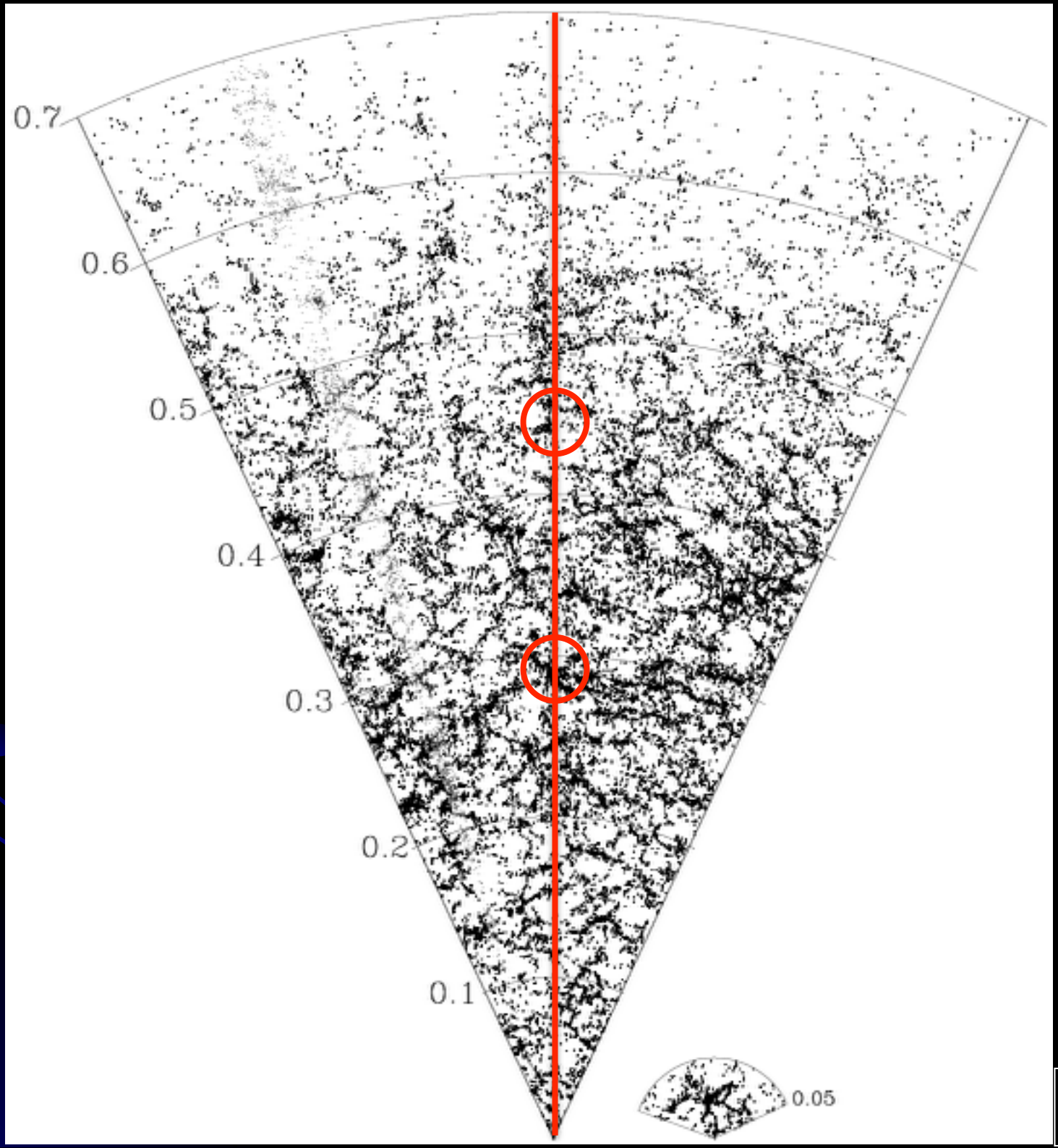
Comparison with Weak Lensing



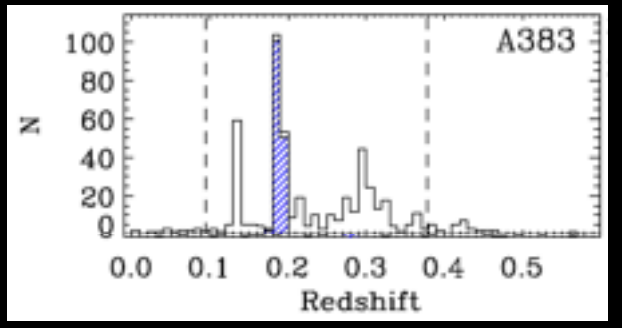


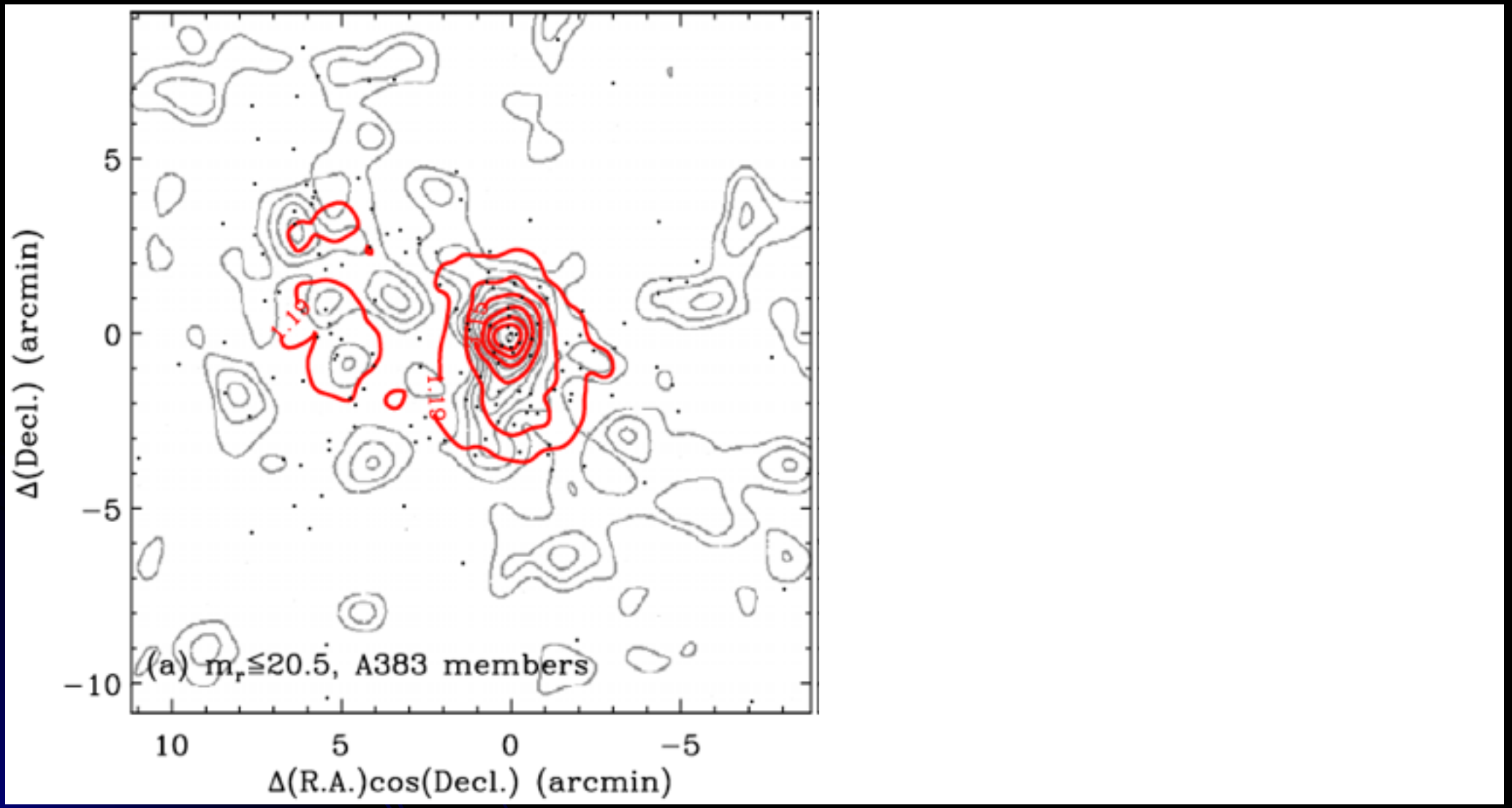
A383 (Okabe+10; Subaru/SC)


PATH OF LIGHT
AROUND
DARK MATTER
DISTANT
UNIVERSE
OBSERVED SKY

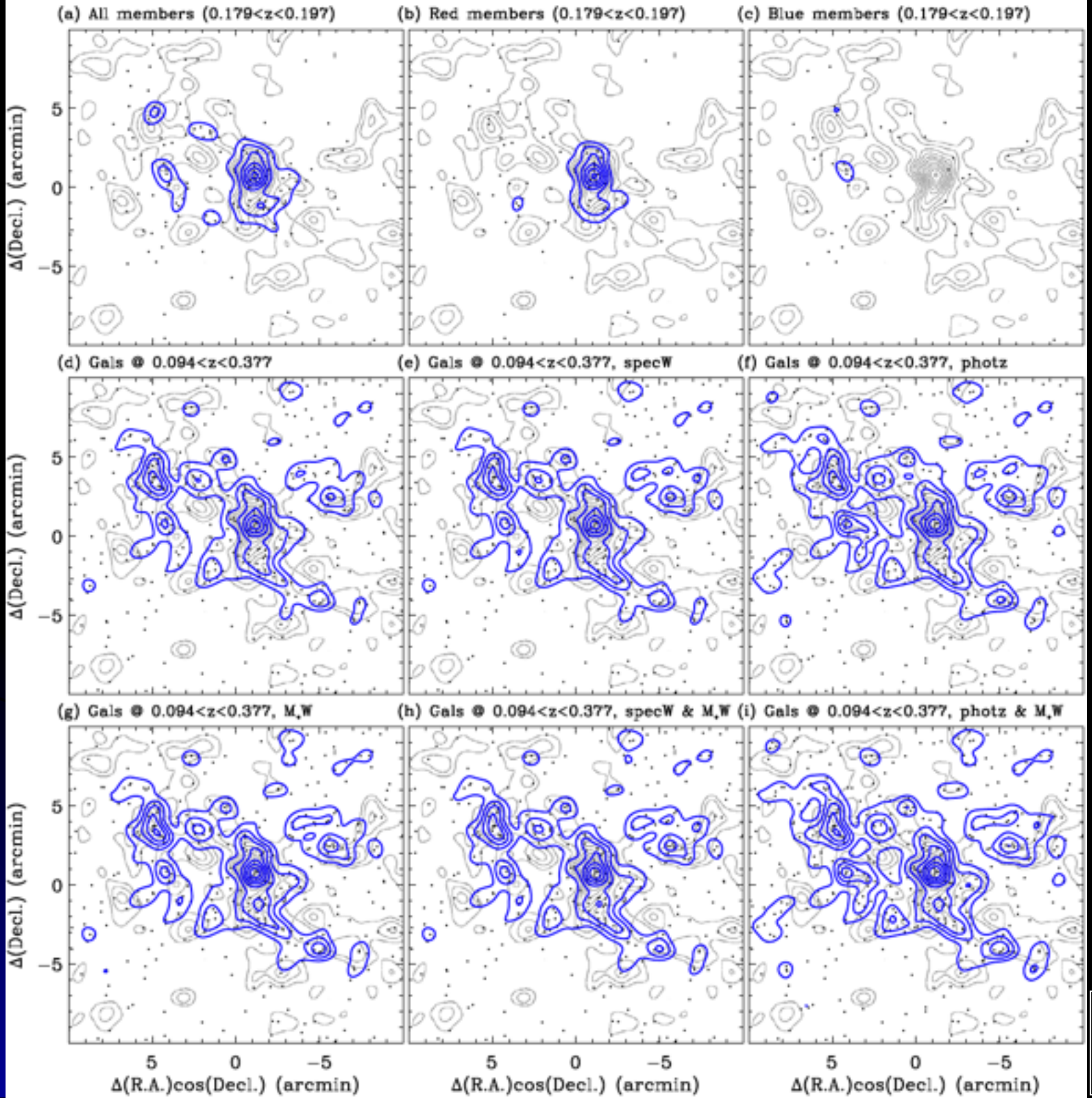


HectoMAP
(Geller, Hwang+14)



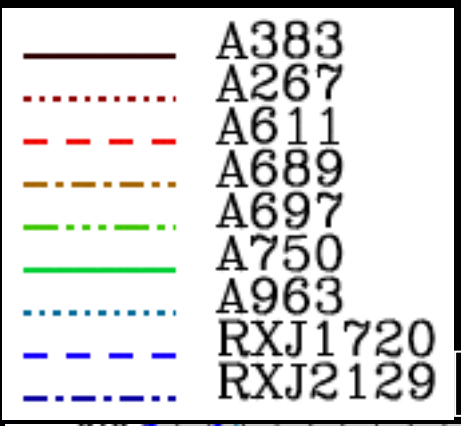


Geller,Hwang+14
(Subaru WL by Okabe+10 &
MMT Redshift survey)

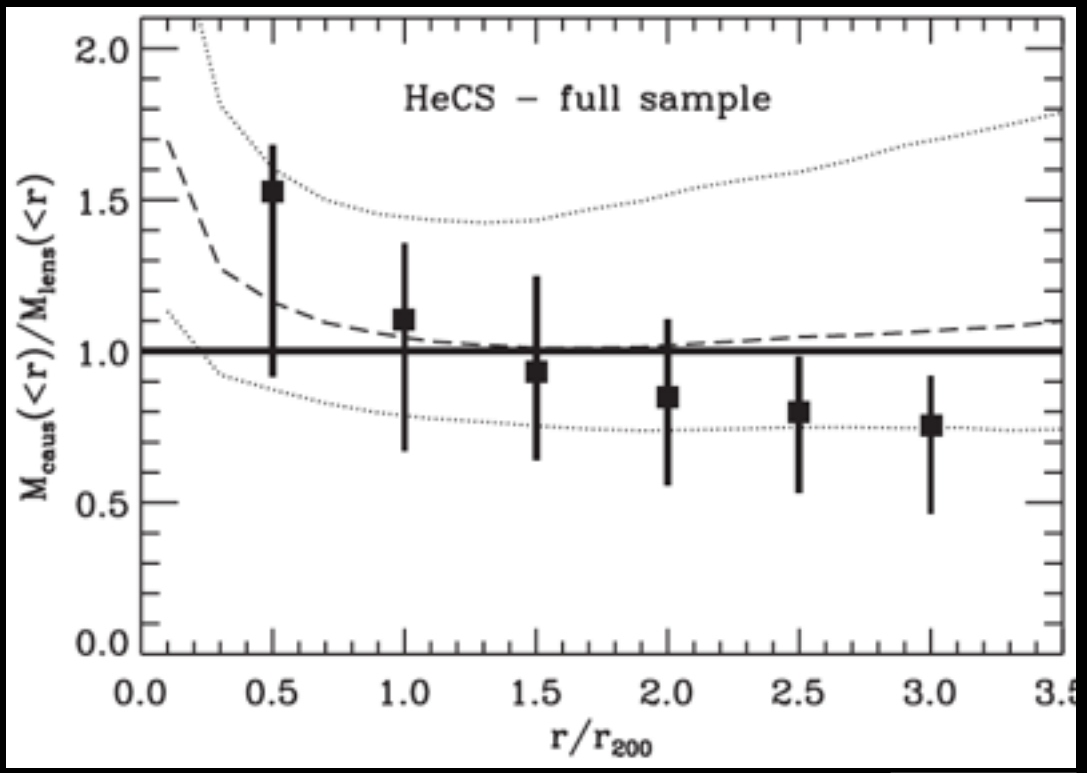


Hwang+14
(Subaru WL by Okabe+10 & MMT Redshift survey)

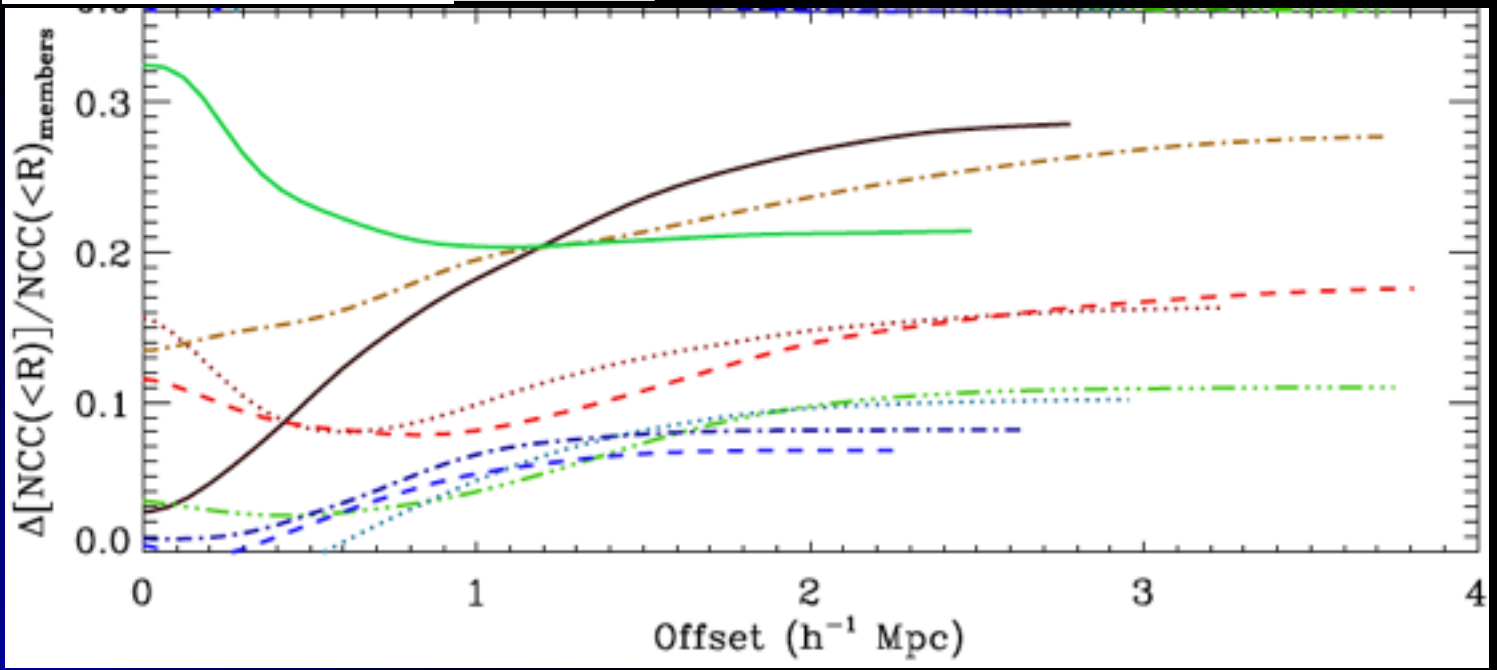
Cross-correlation of the galaxy number density maps with the WL maps



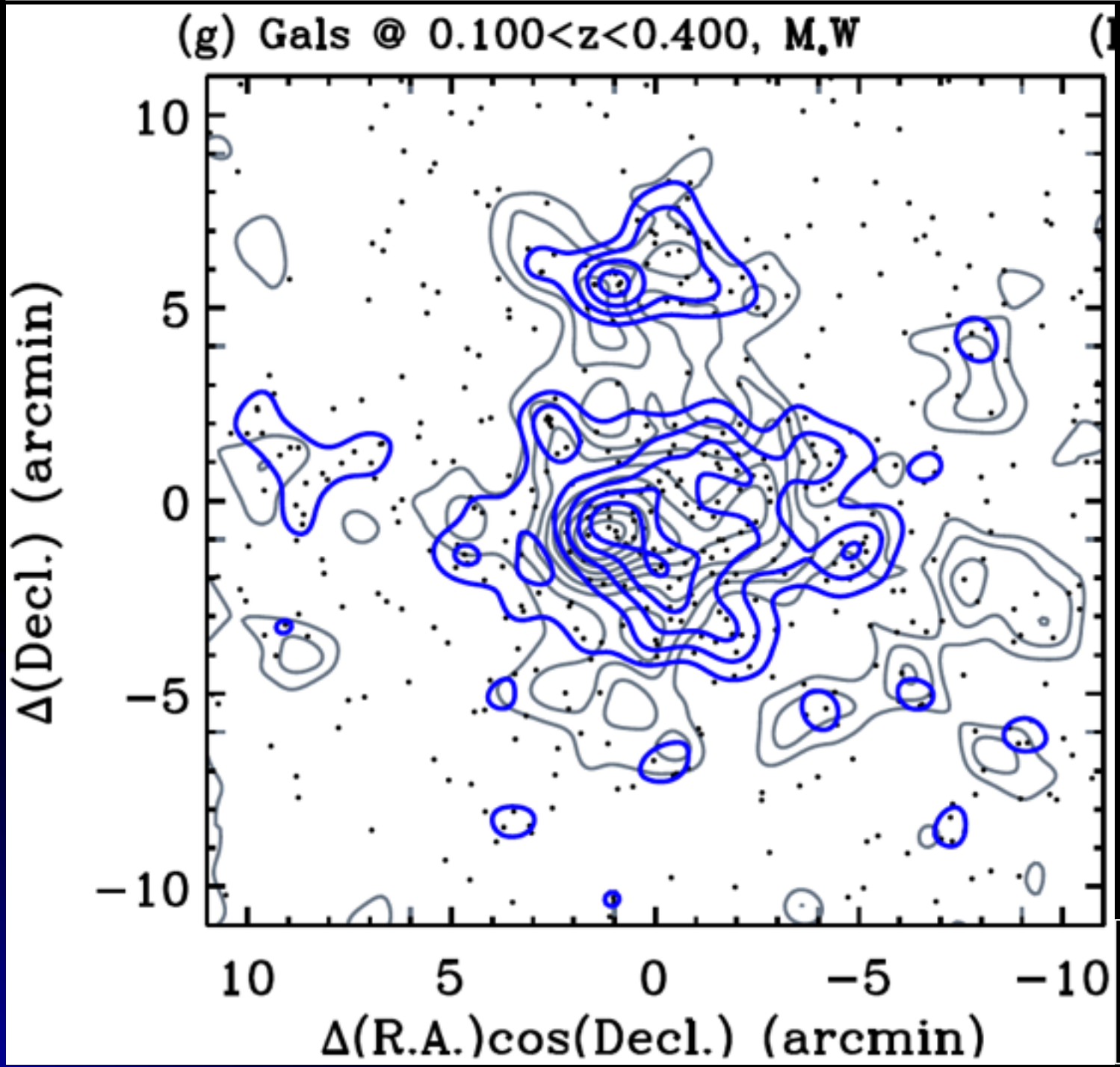
Hwang+14



Geller+13

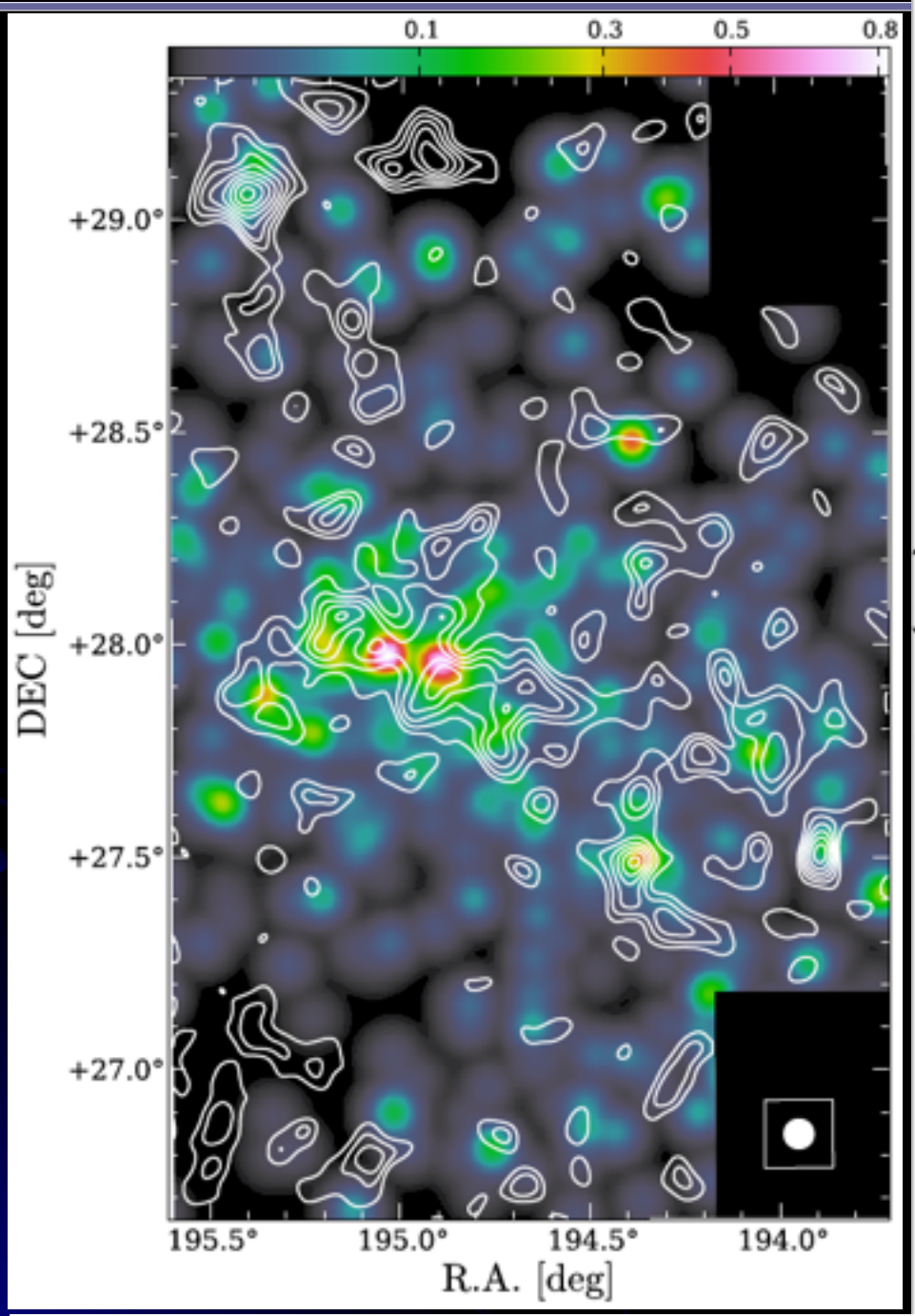


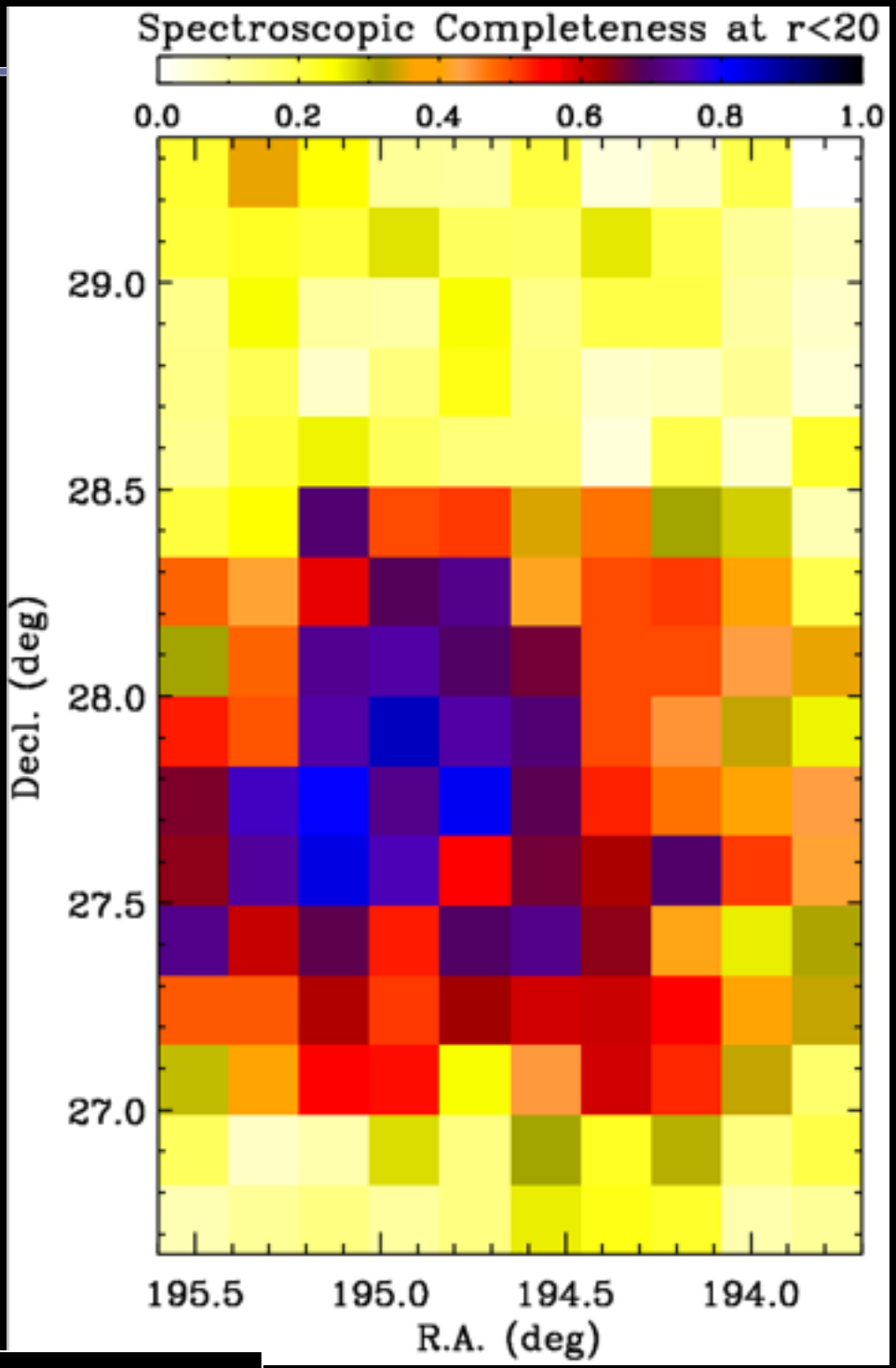
Merging Clusters: Critical role of spectroscopy



A2163
(Subaru WL by Okabe+11 &
MMT Redshift survey;
more with Okabe & Umetsu 08)

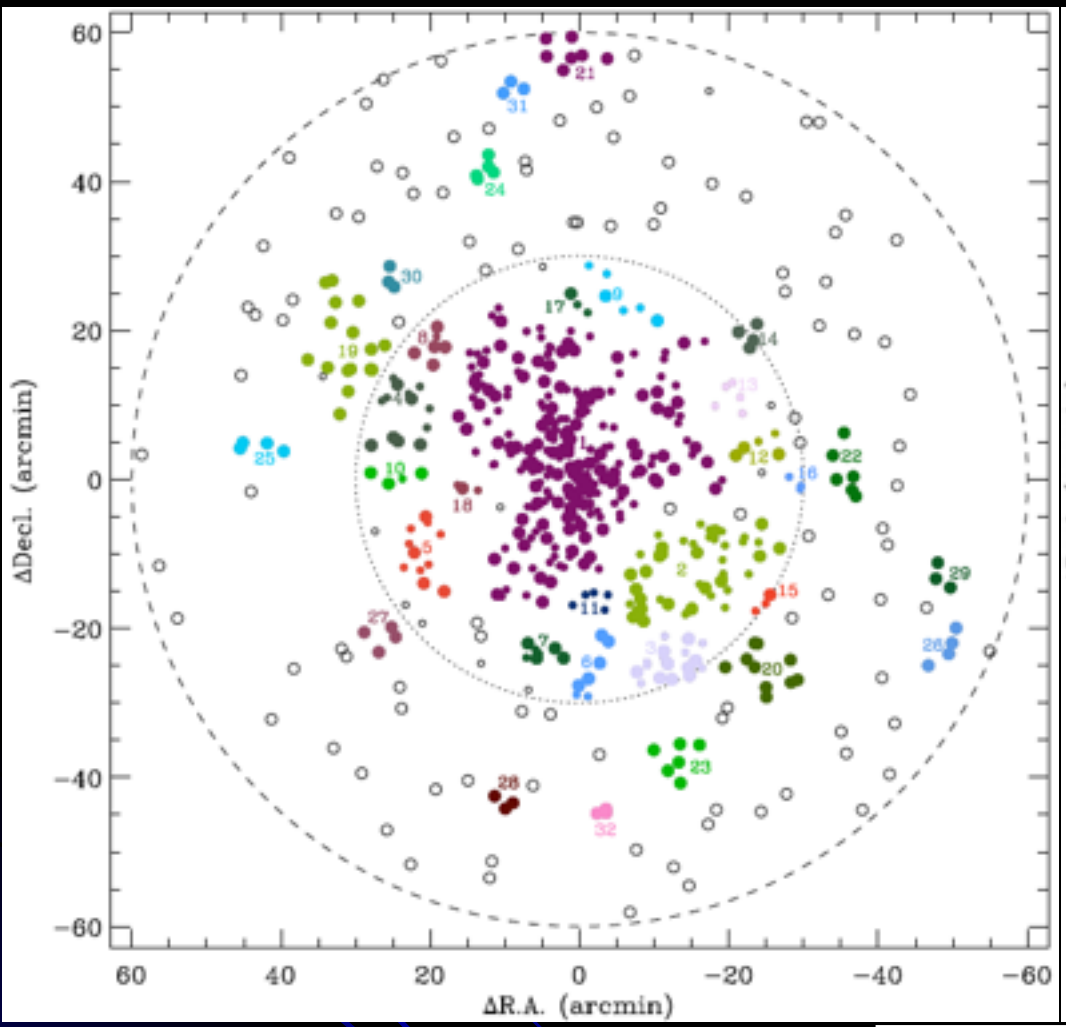
Nearby Clusters: Subhalos!

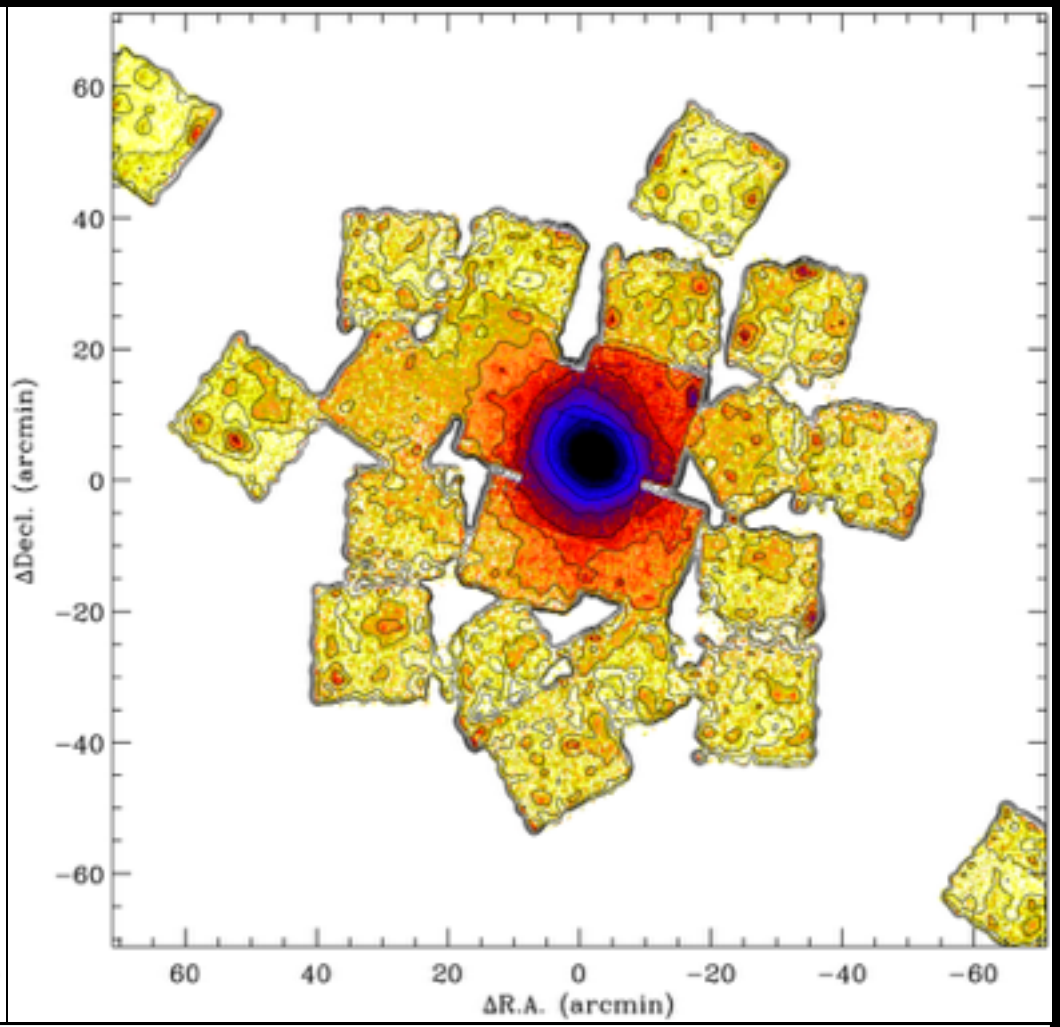




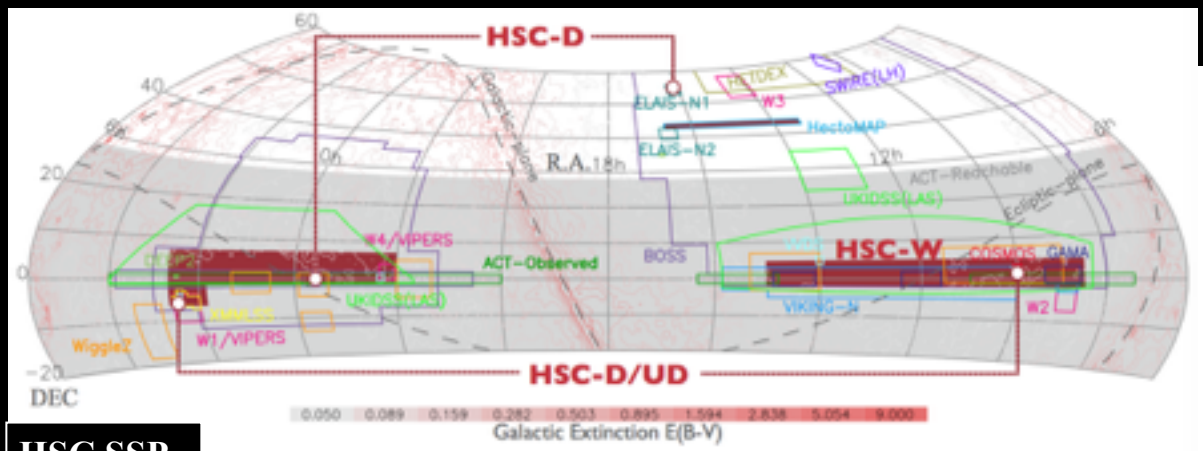
COMA (Subaru WL by Okabe+14 & MMT Redshift survey by Hwang+17)

Nearby Clusters: X-ray, Redshift Survey & (Weak Lensing?)

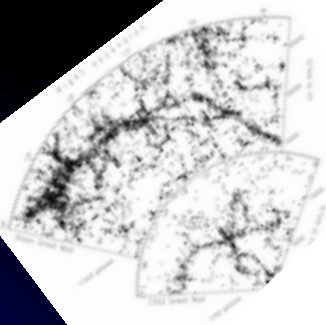




A2199 (Suzaku X-ray by Tamura+17 & MMT Redshift survey by Song+17)



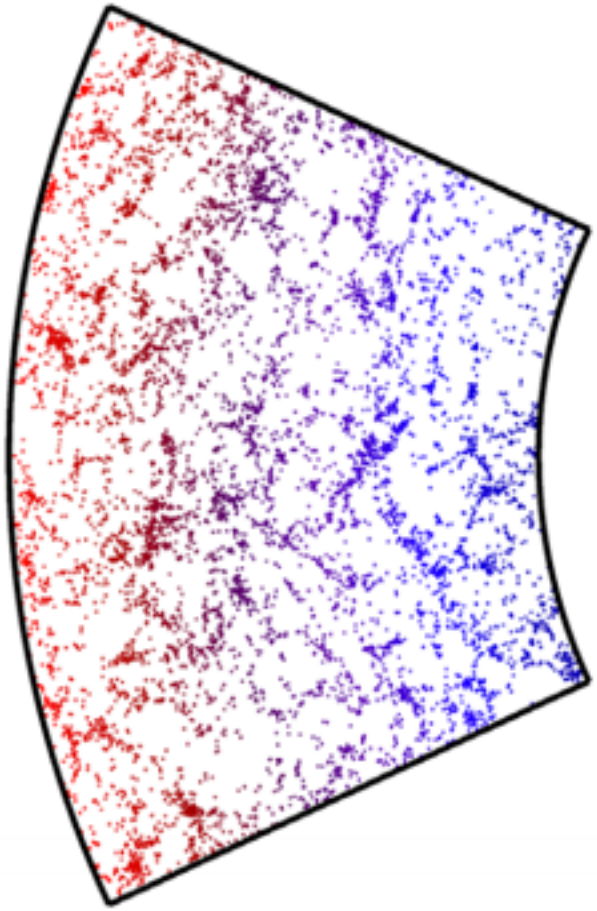
HSC SSP



HectoMAP (Geller, Hwang, Sohn+)

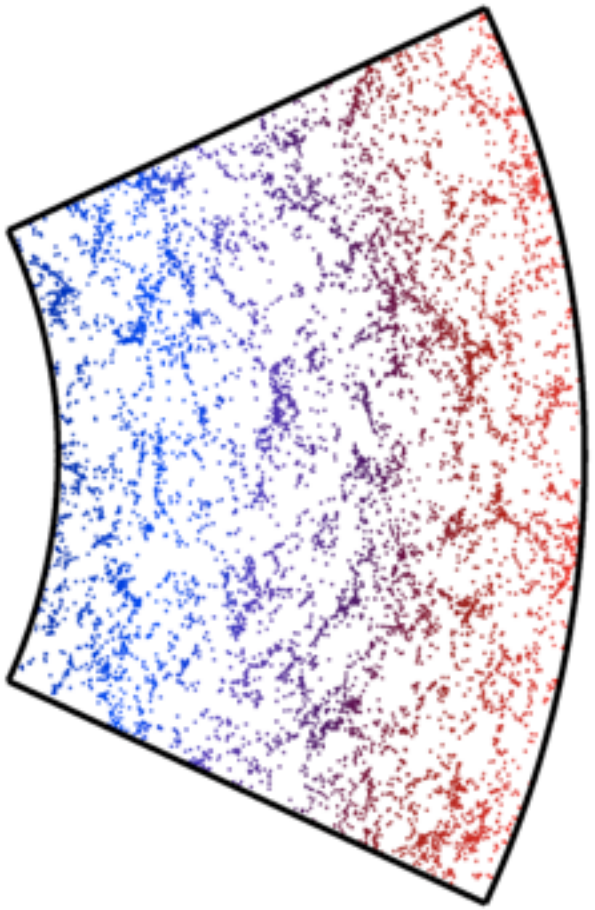
- One of densest and complete survey of red galaxies at r<21.3
  (Geller+11, Geller & Hwang 15)
  - HectoMAP: ~1250 gals/deg^2, BOSS: ~150 gals/deg^2
  - Examine the Large-scale Structure at Intermediate Redshifts (Hwang+16)

Large-scale Structures in the HectoMAP and Horizon Runs

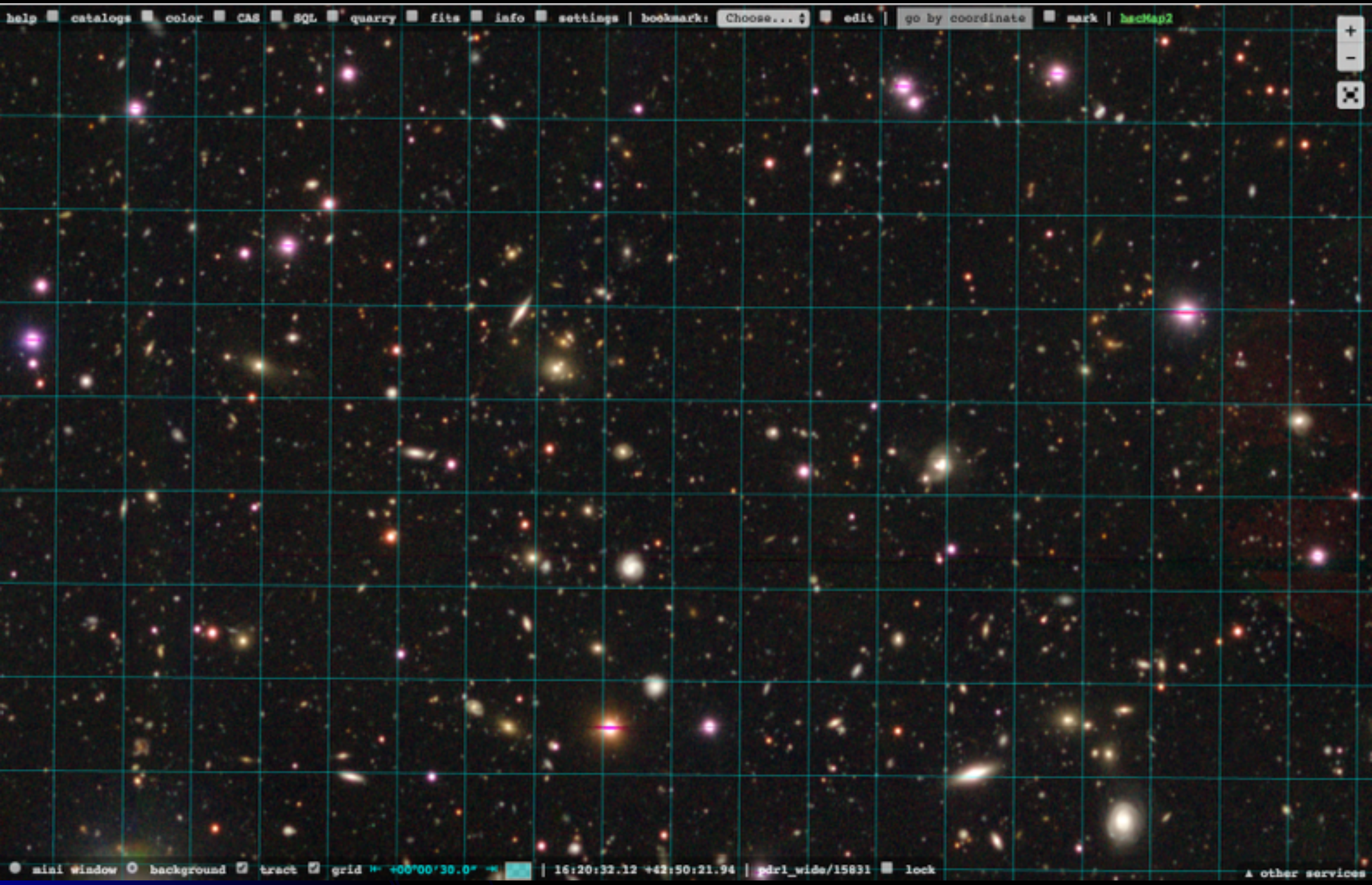


HECTOMAP

HORIZONRUN



Weak Lensing Analysis of Subaru/HSC images in the HectoMAP region



Conclusions and Future Prospects

- Redshift Surveys with PFS by combining deep HSC images
- Study of (Nearby: Wide & Deep) Galaxy Clusters!
  - Accurate Mass Measurements of Galaxy Clusters
    - Combination of Kinematics and Weak Lensing
    - Subhalos: mass function!
  - Faint Features of Cluster Galaxies + Intracluster light (ICL)
  - Faint-end slope of Luminosity Function
  - Environmental Dependence of Galaxy Properties

Thank you!