CLASH

– Gravitational Lensing–

Future (well, present) Surveys of Galaxy Clusters

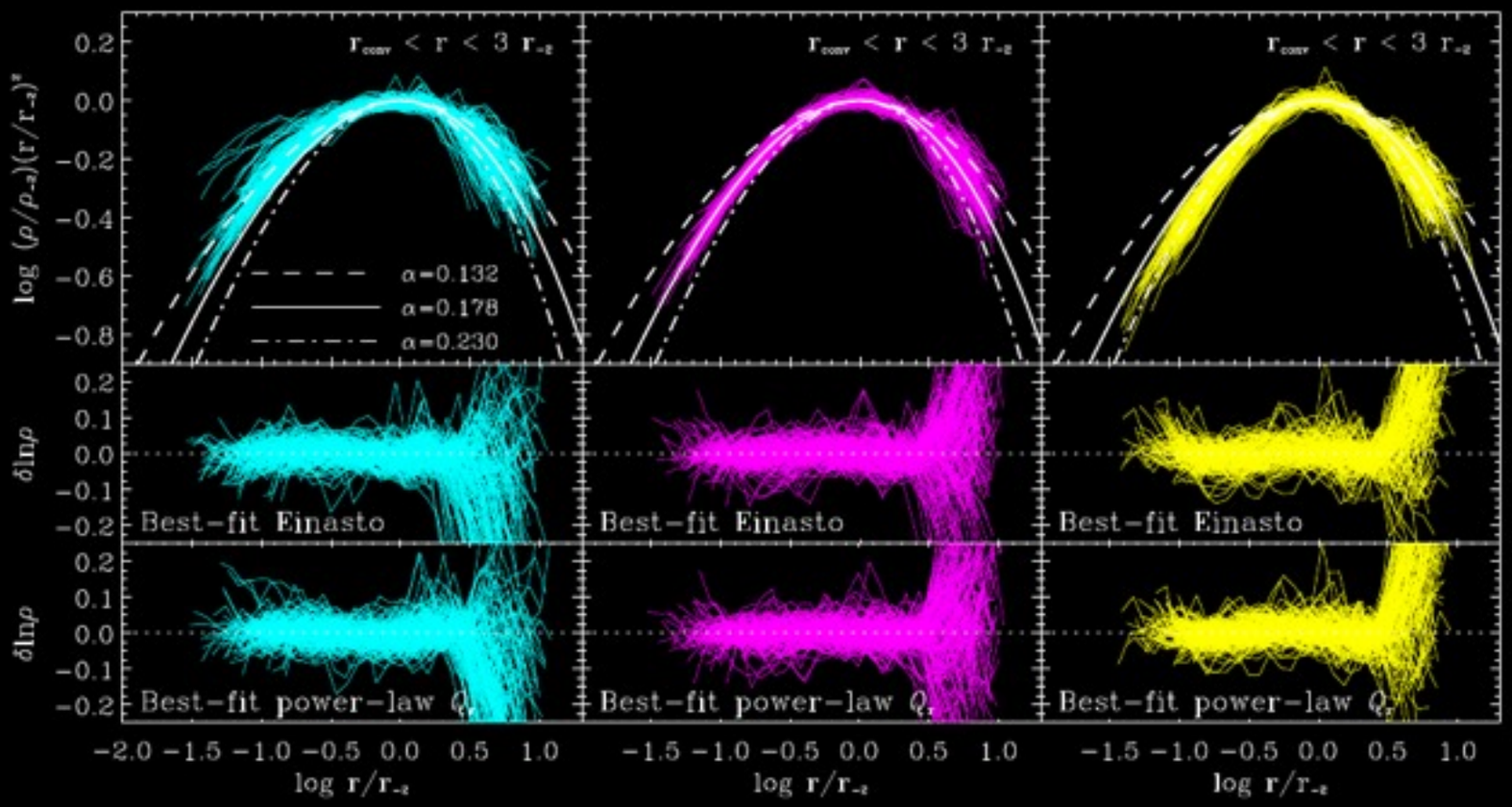
Sesto, July 2011

Julian Merten
Institute of Theoretical Astrophysics

University of Heidelberg

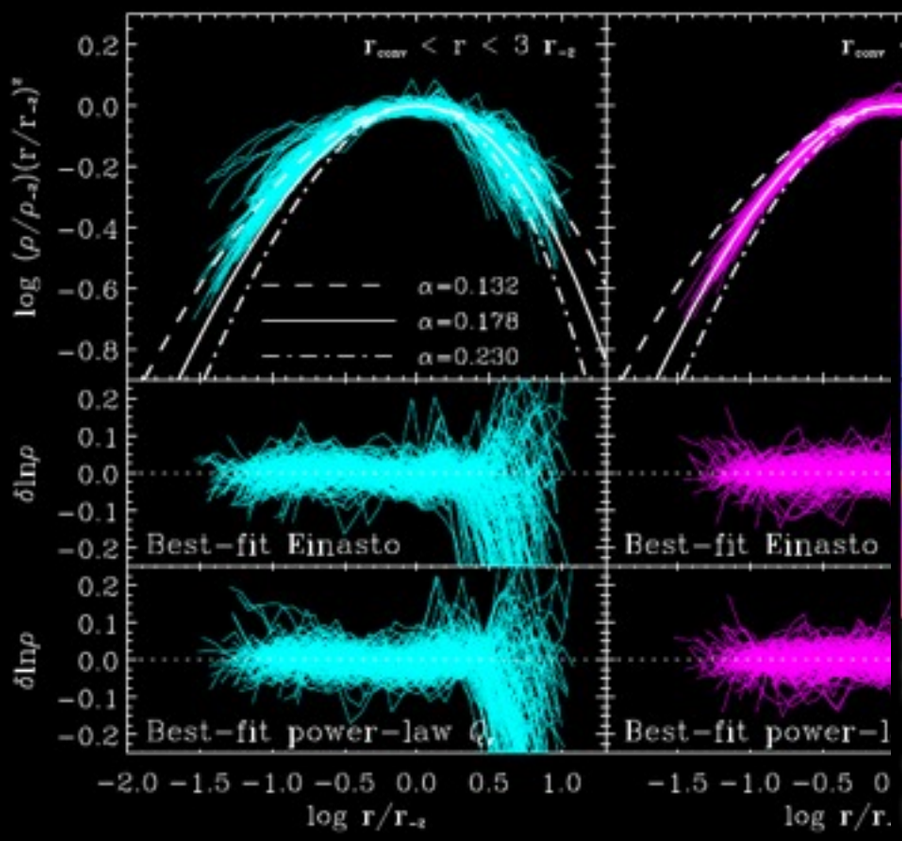
Puzzling clusters

Puzzling clusters



Ludlow+ 11

Puzzling clusters



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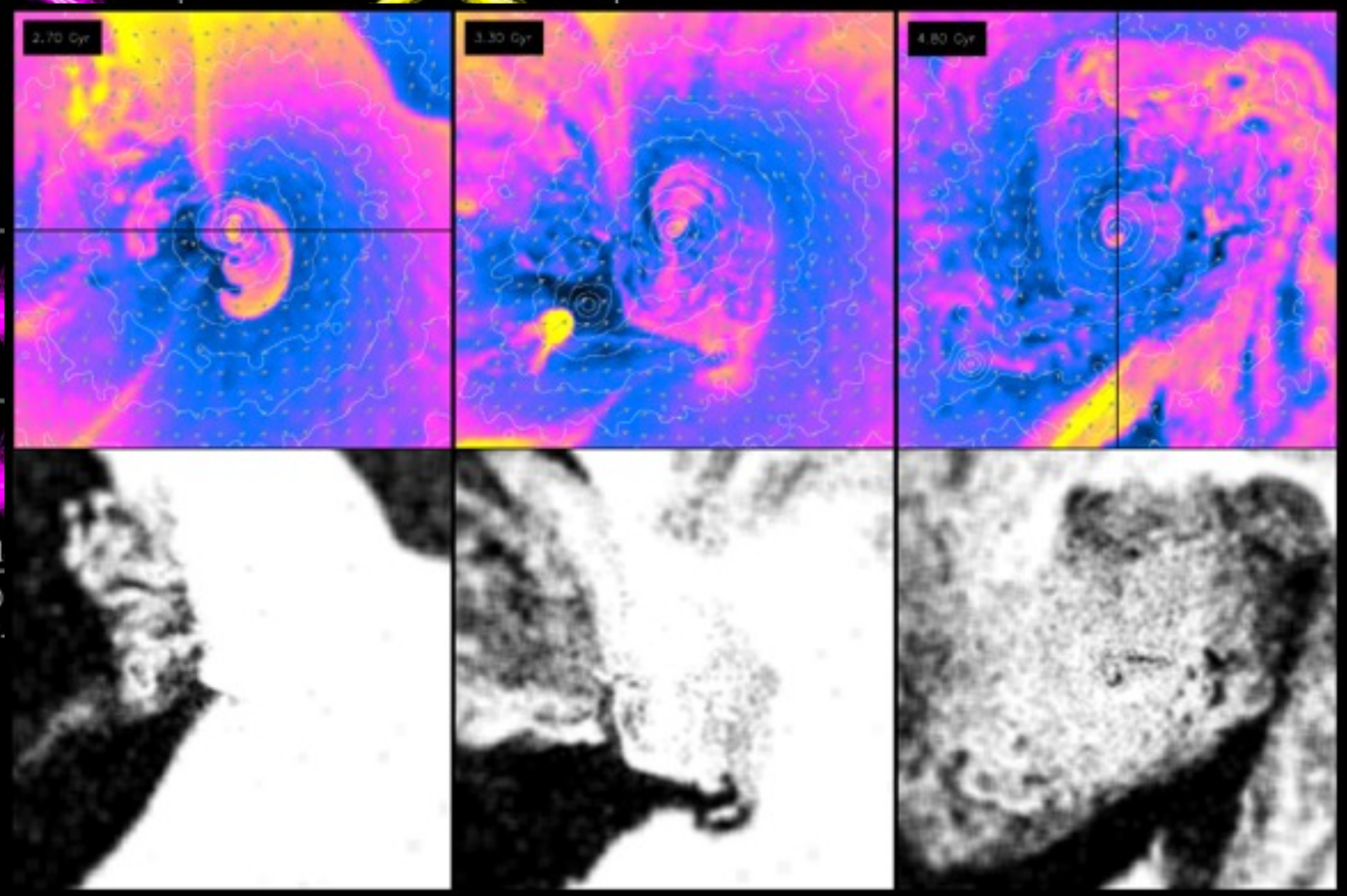
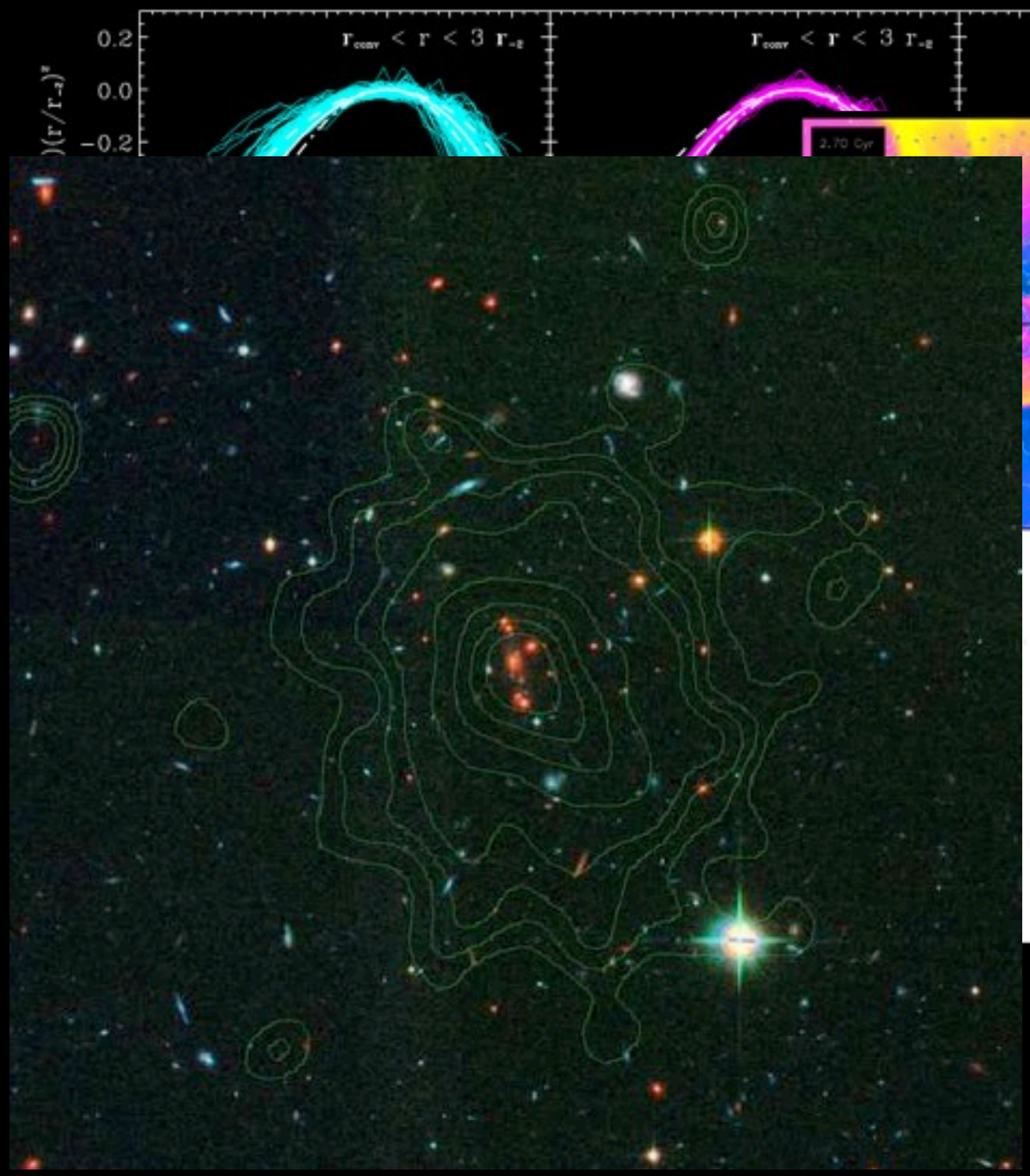
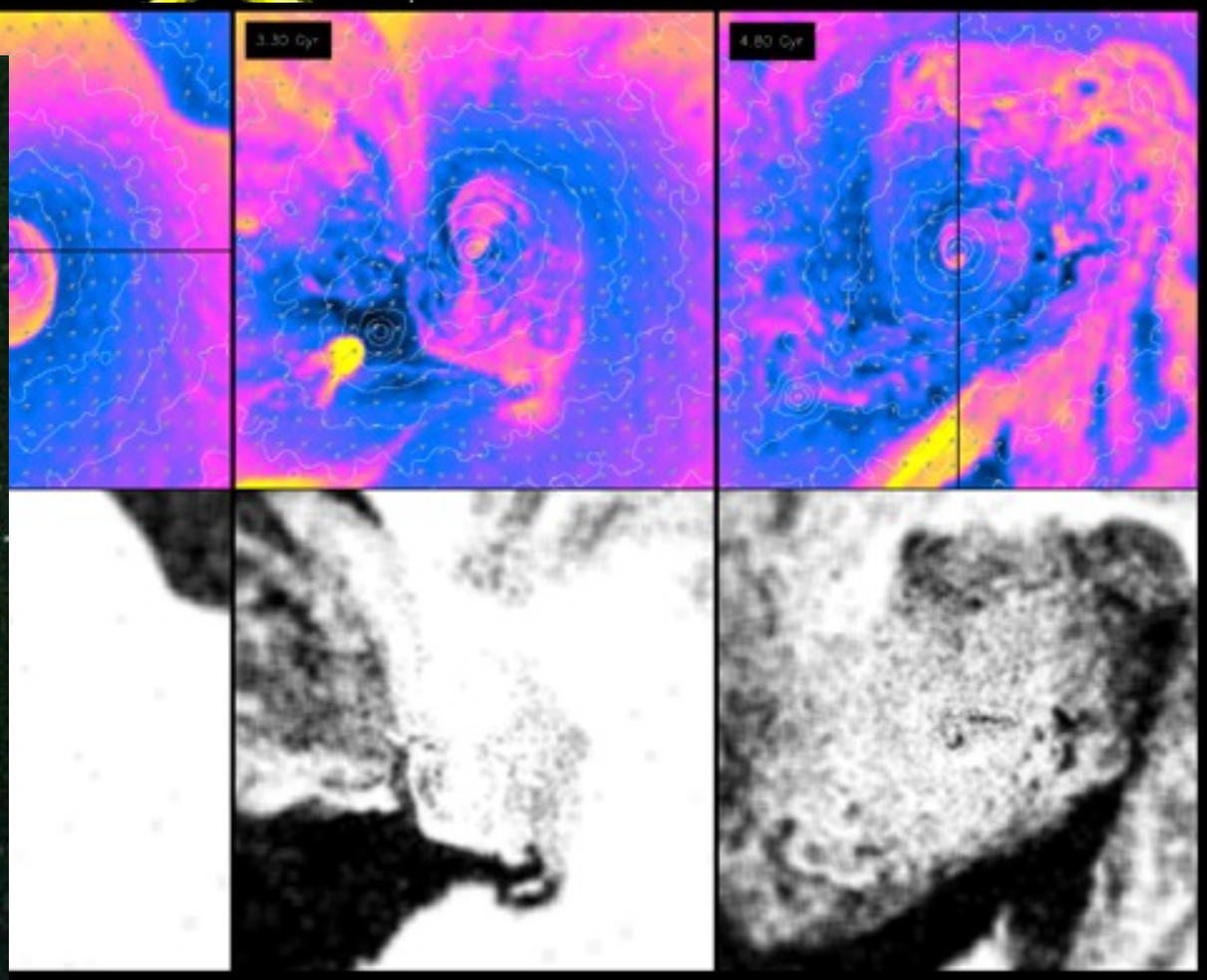


Ascasibar+ 06

Puzzling clusters



Rosati+ 09



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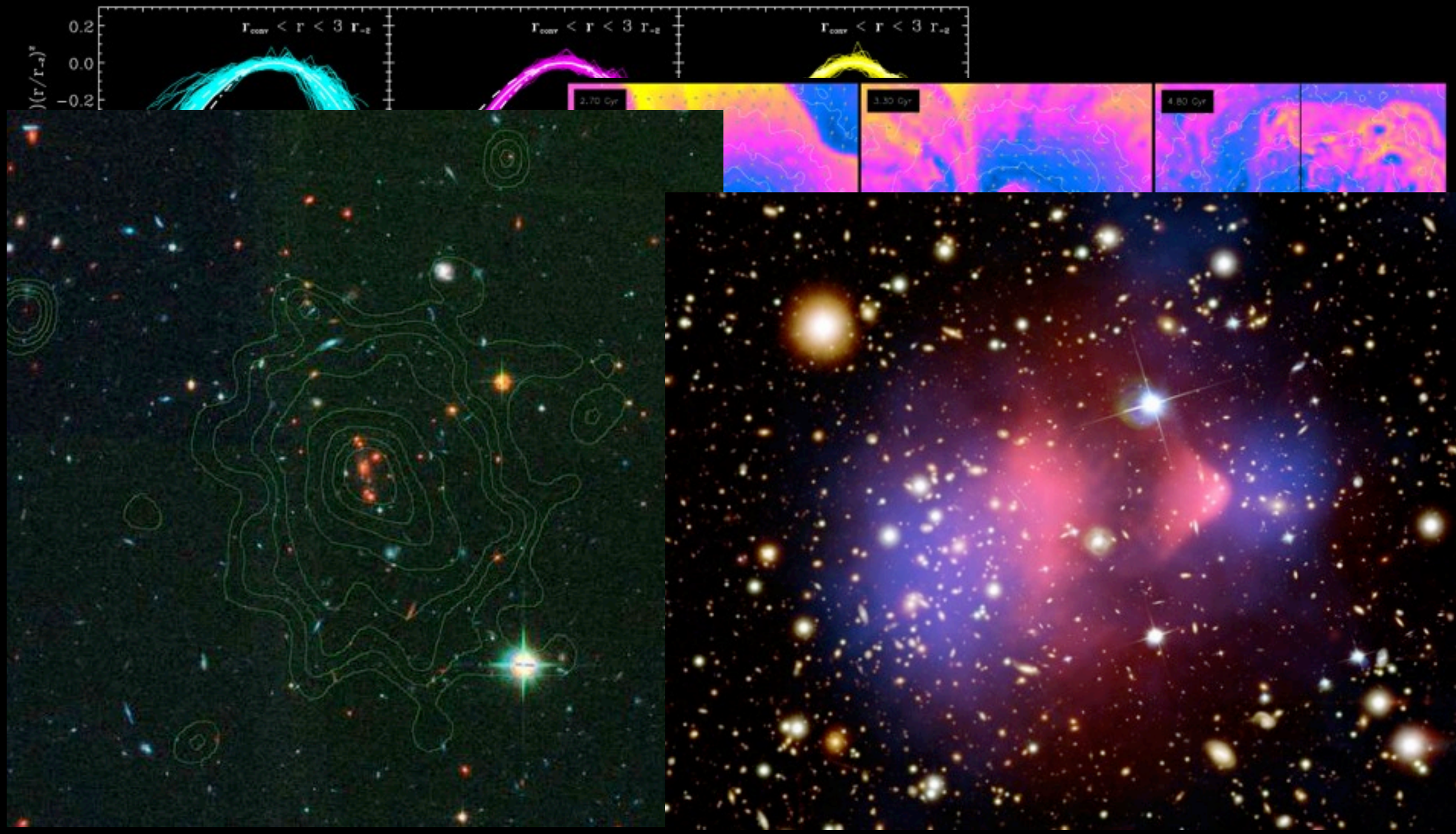

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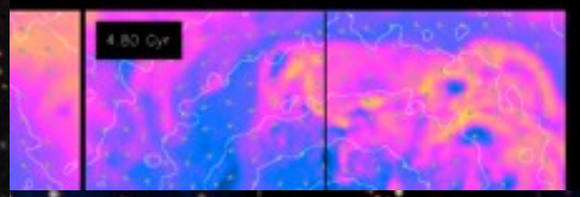

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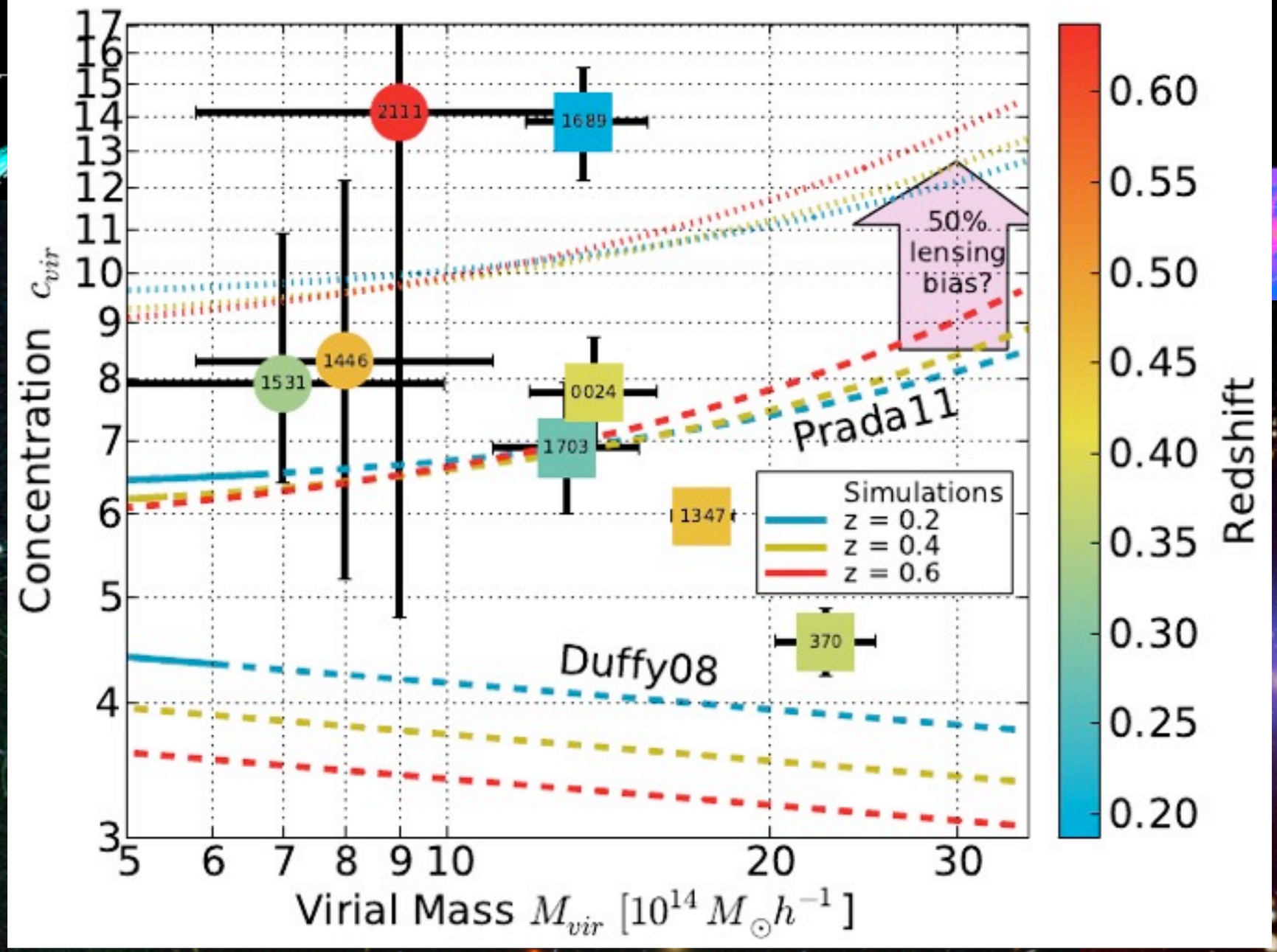


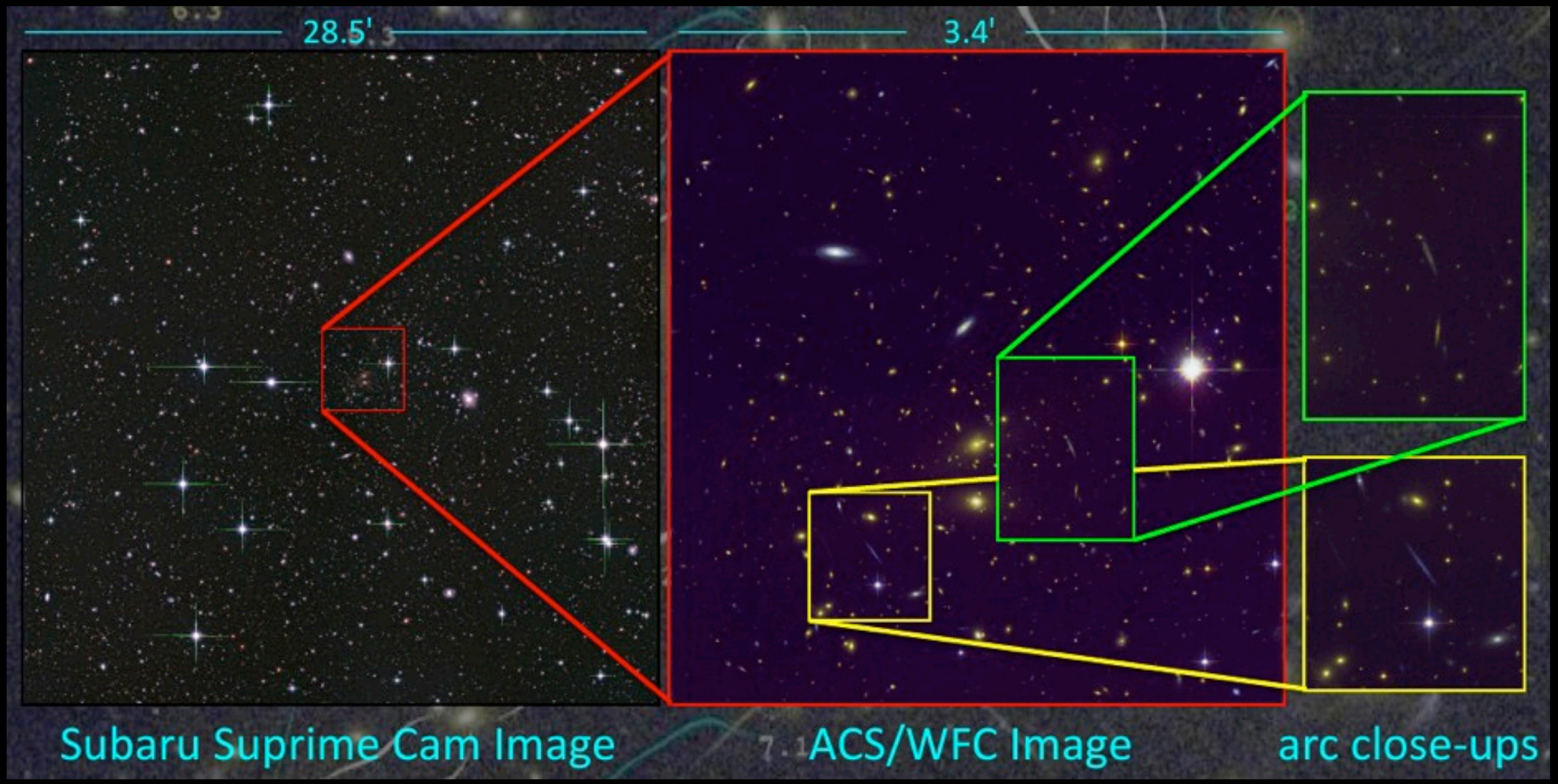
Postman & CLASH 11

Coe+ 10

Rosati+ 09

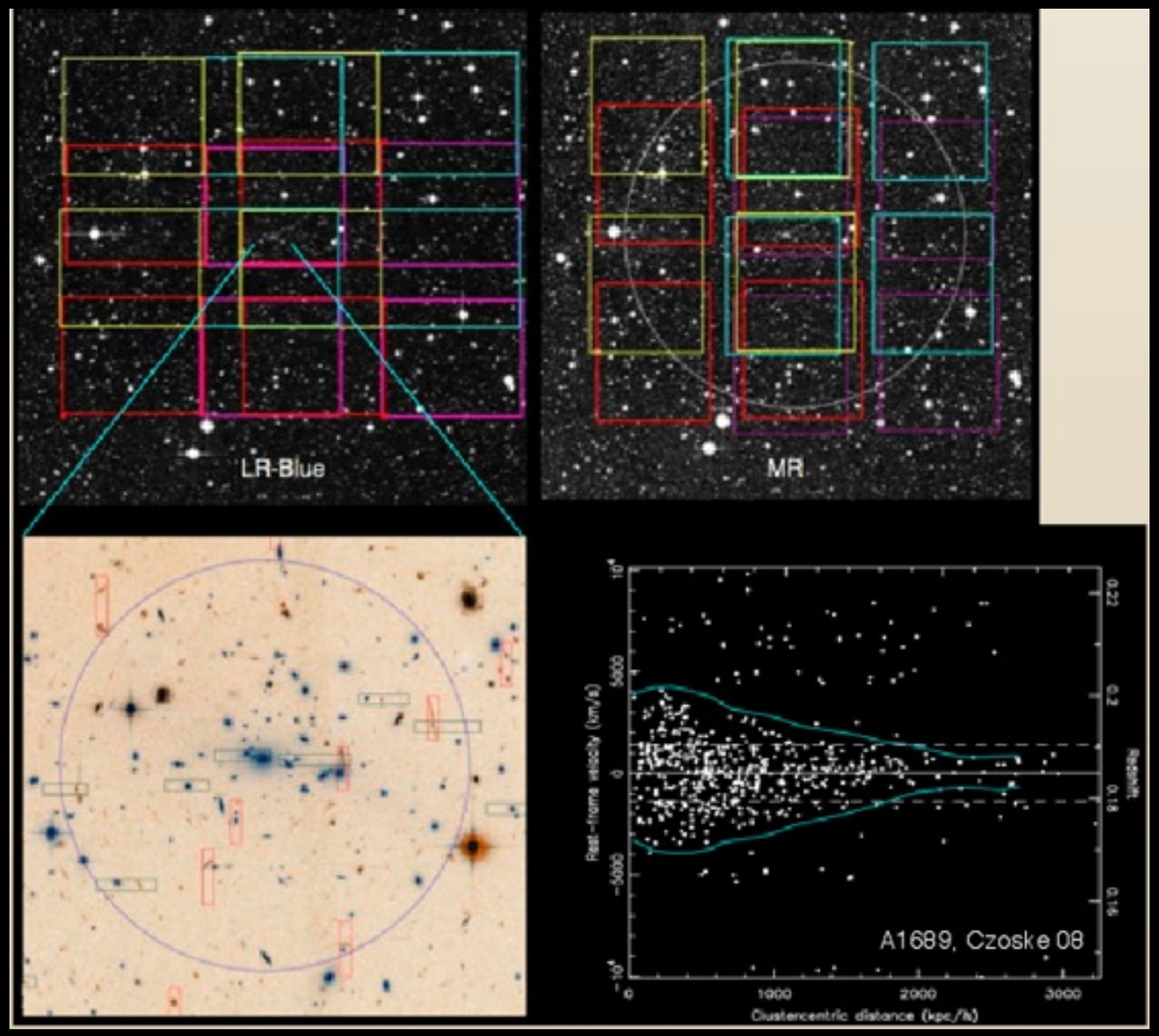
Clowe+ 06

The CLASH lensing strategy



HST multiband images with ACS and WFC3 will be awesome but that's not enough.

The CLASH lensing strategy



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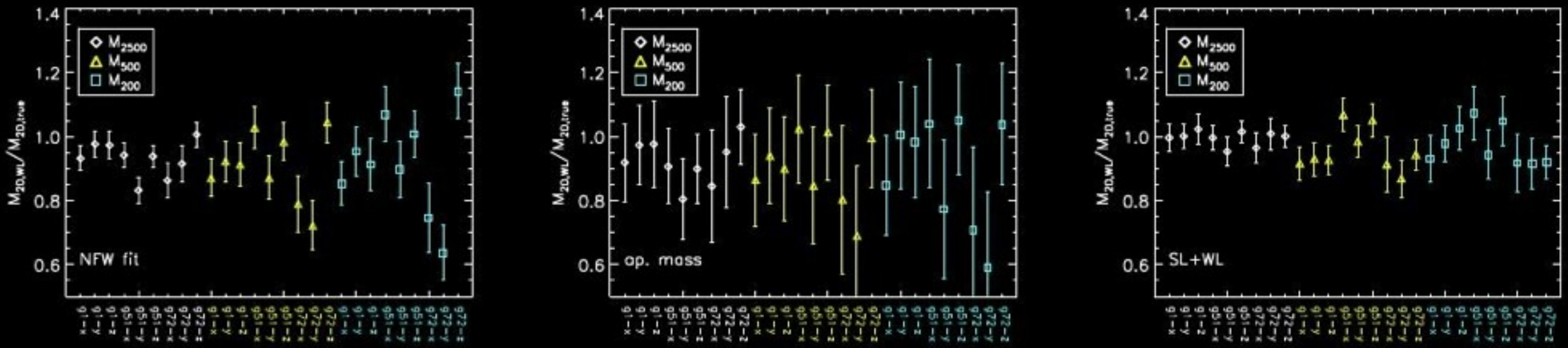
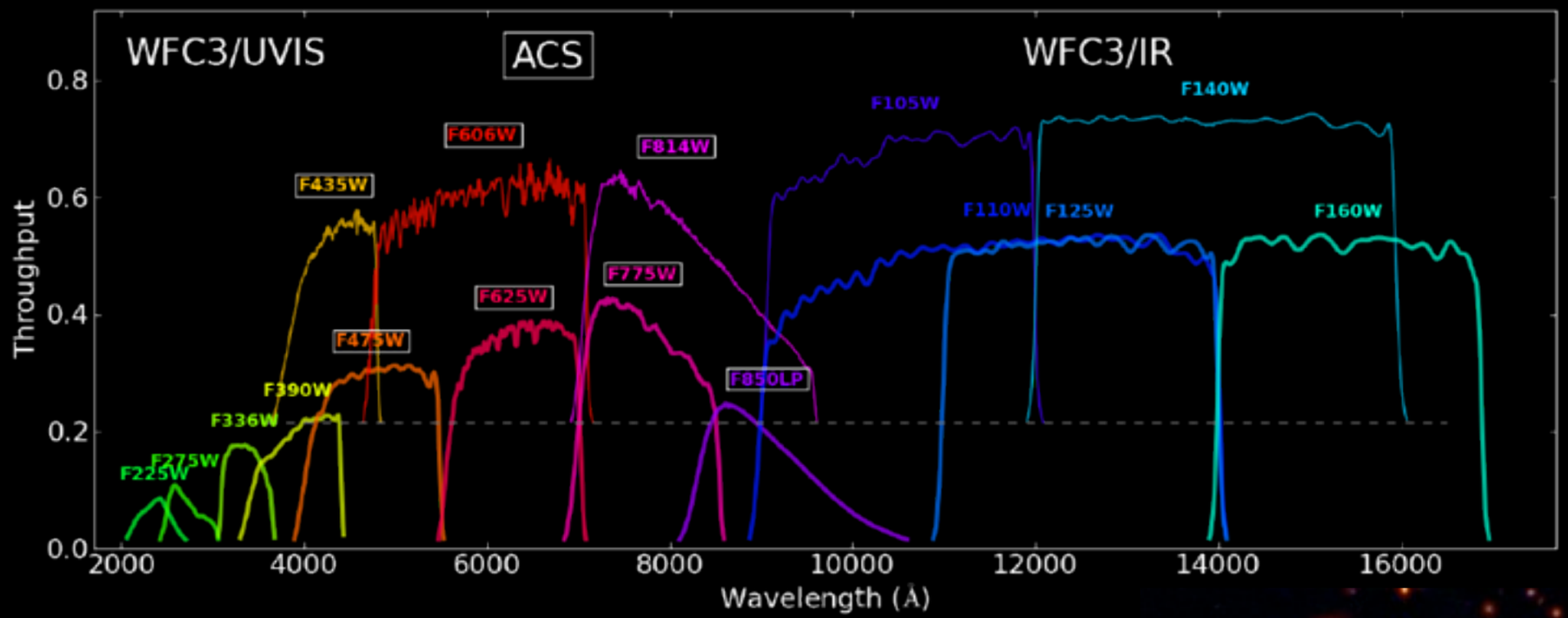
The CLASH lensing strategy

e.g. Meneghetti, Rasia, JM 2010:
Robust reconstructions of the cluster density profile ask for a multiscale approach.



For example: scatter in derived concentrations
SL: 59%, WL: 33%, WL+SL: 11%
also: |WL+SL| < |WL|+|SL|

Strong lensing: HST



Hubble's known image resolution

Excellent photo-zs

$$\delta z < 0.02(z+1)$$

High object density

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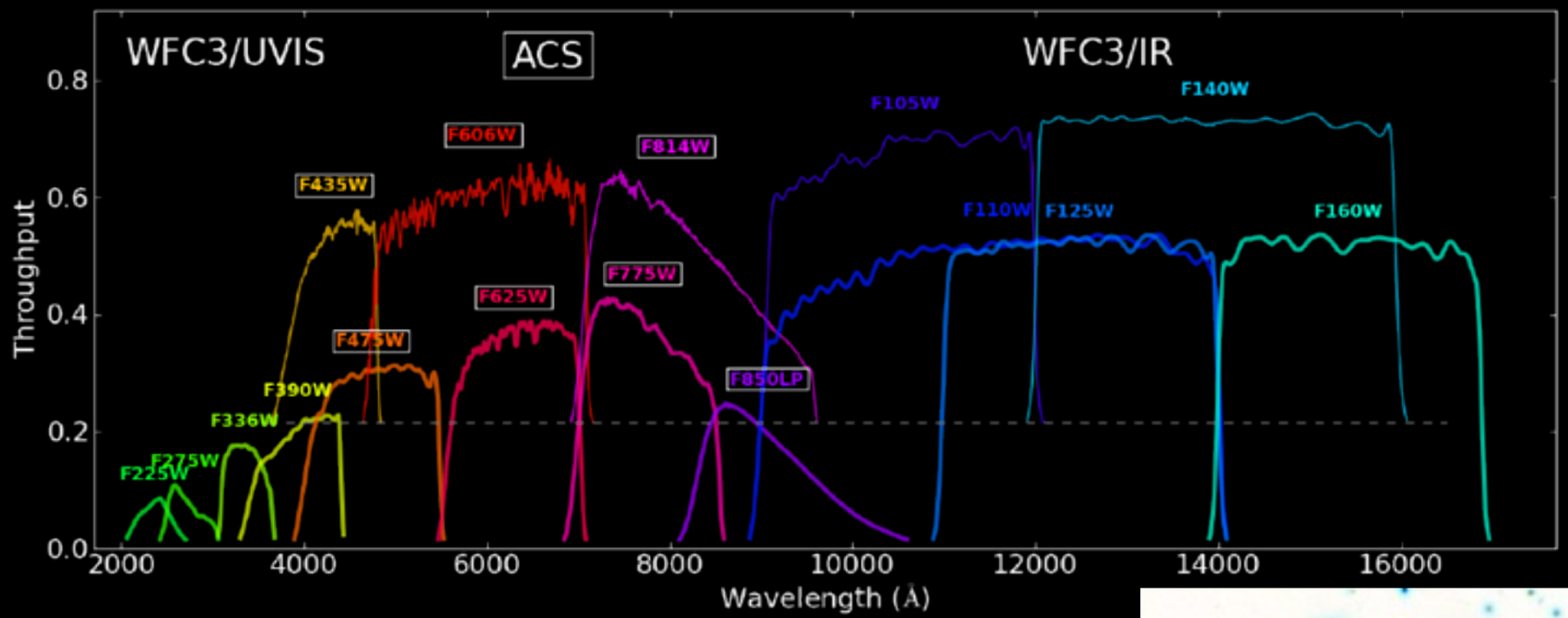

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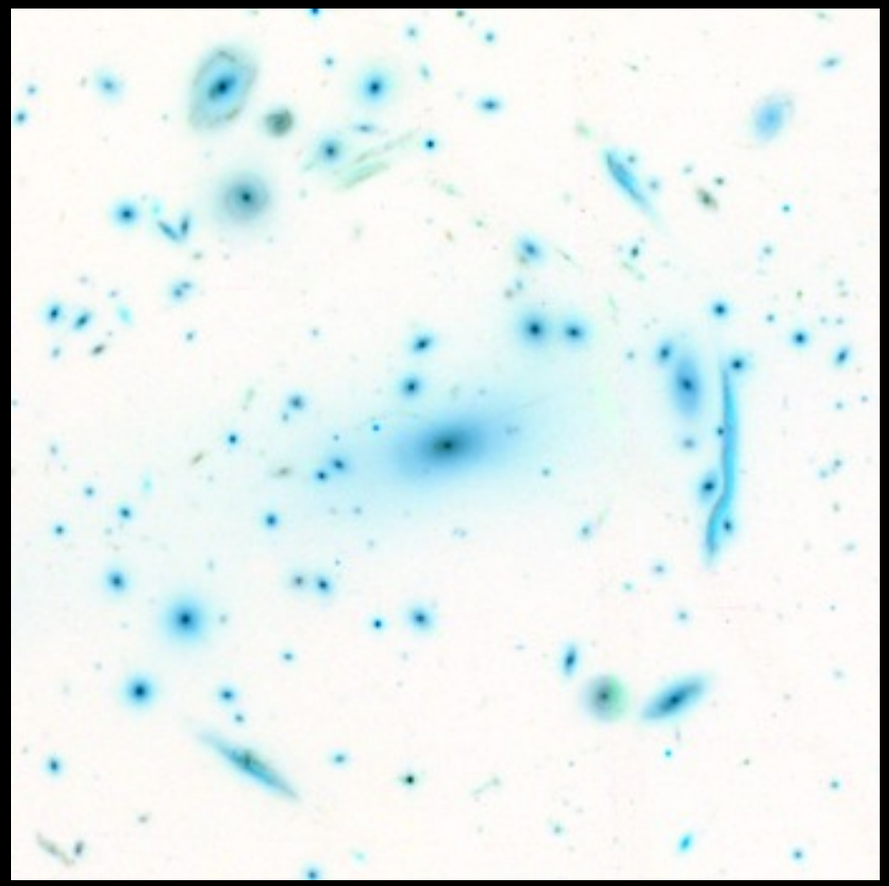

Wait...weak lensing and HST

A breathing telescope

ACS is not a problem
(e.g.: RRG02,
Leauthaud, Massey)

WFC3 is less understood but
we are on it
(Melchior et al. in prep)

Why bother anyway?

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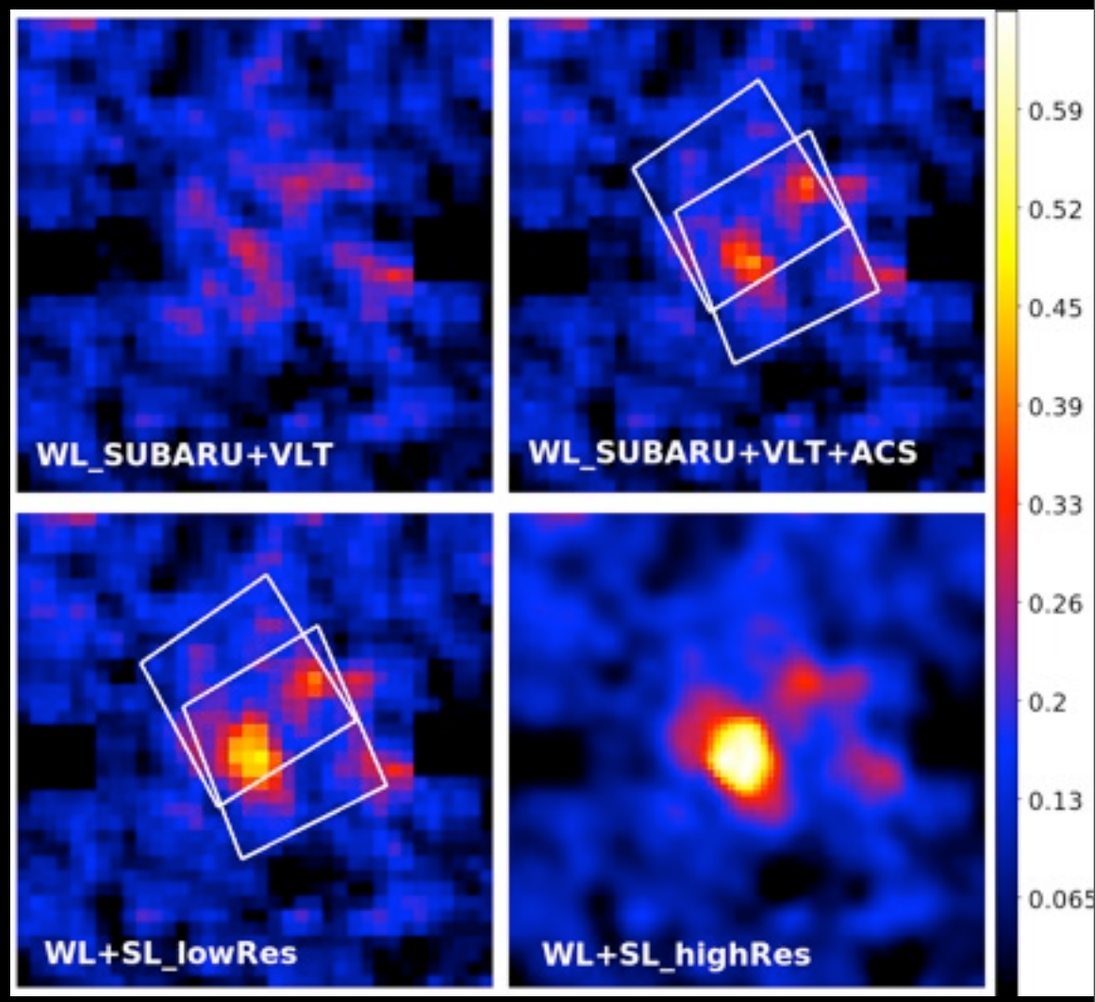

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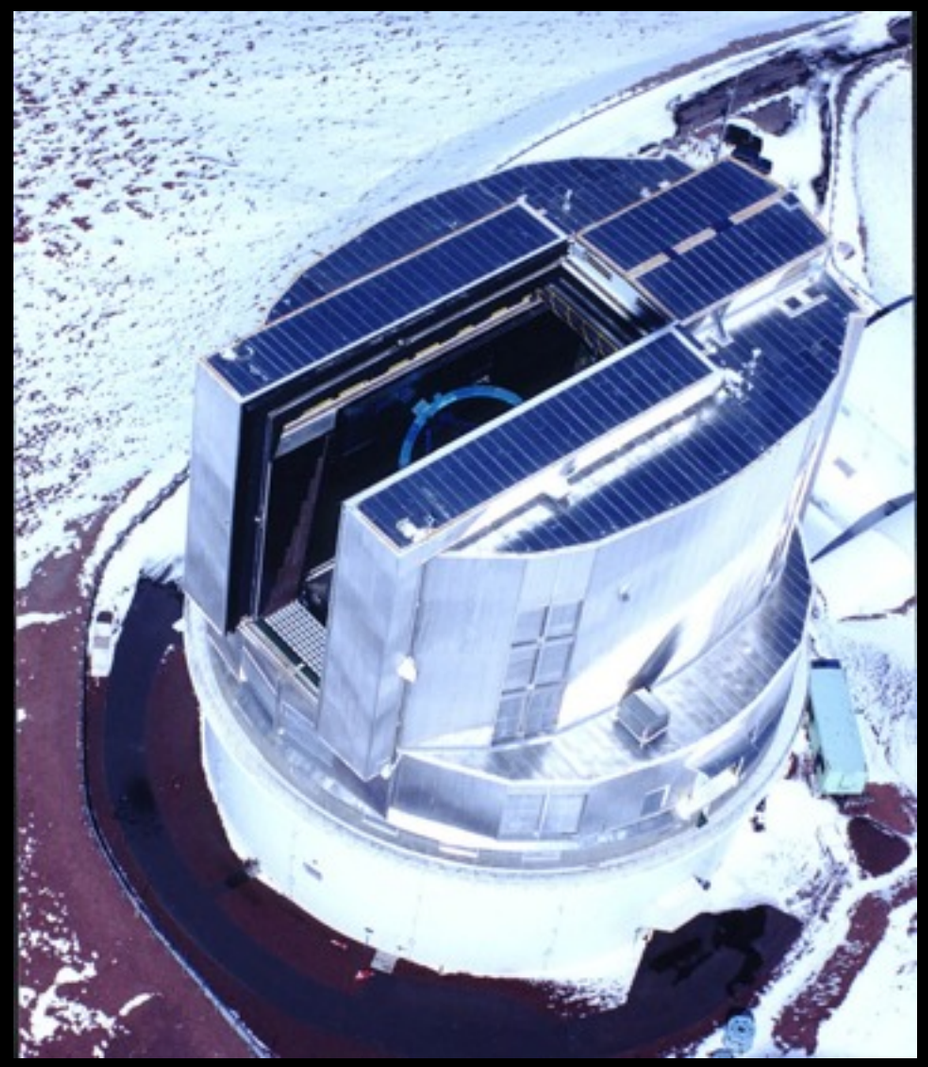
Weak lensing: Subaru

Almost all CLASH clusters will have Subaru BVRIZ imaging (Mario)



Background selection is crucial

Lensing people love this thing

Dilution can be a big problem (Medesinski+ 09)

Shear and magnification bias (Umetsu+ 09)

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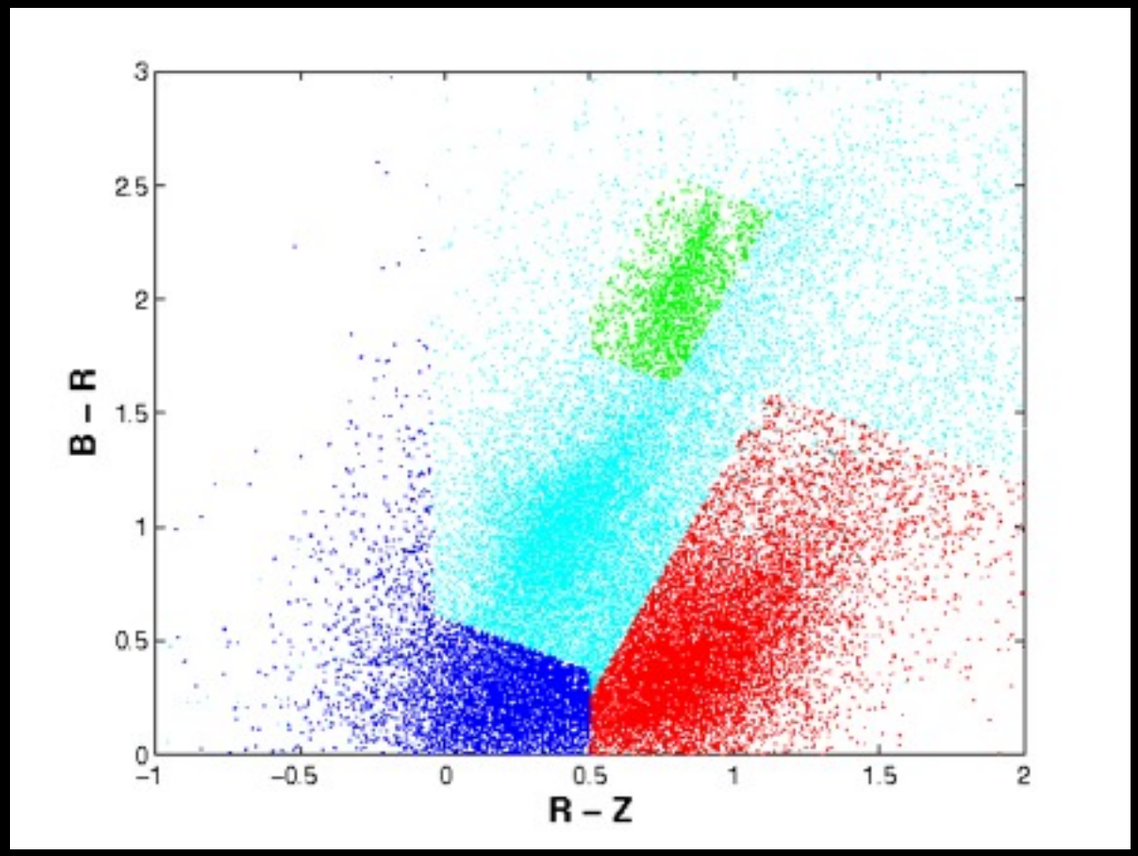

MACS1206, thanks Elinor

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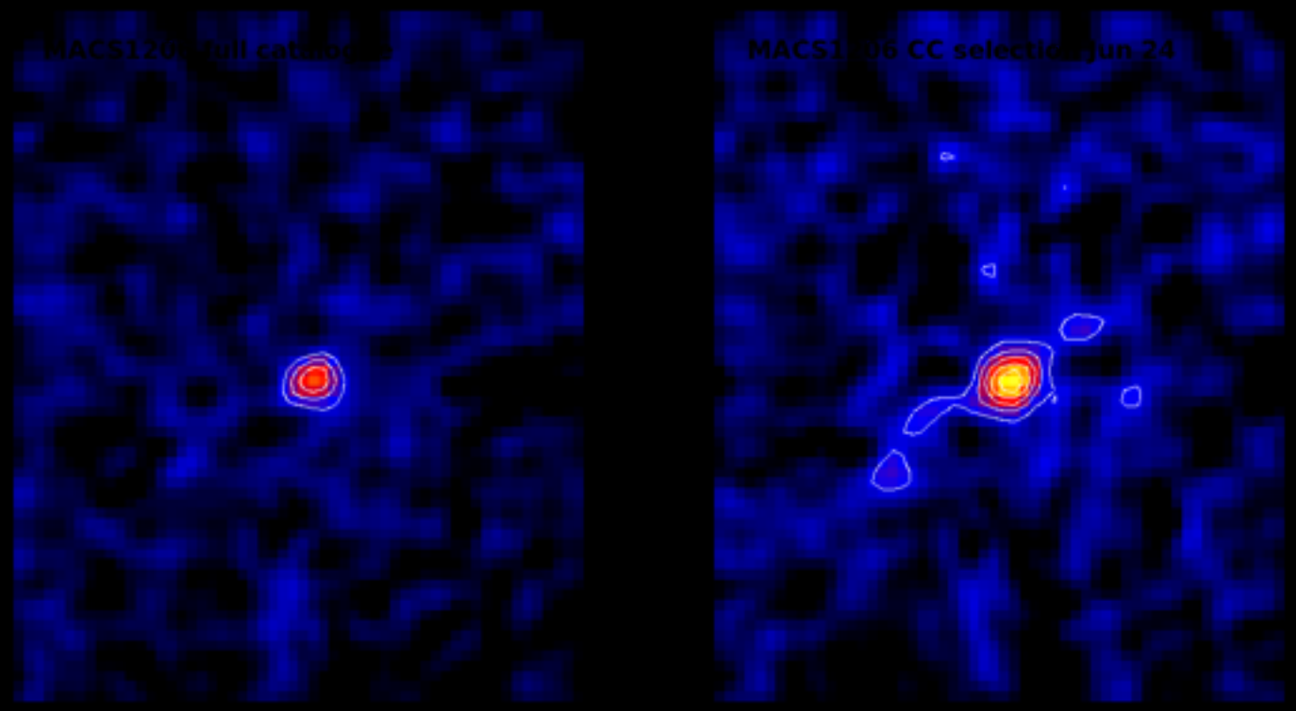

again MACS1206, more later

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Mass modelling zoo

Parametric

Zitrin et al.

Smoothes light distribution

Accounts for known multiple images

Assumes mass profile and iteratively reproduces photometry

Umetsu et al.

1D profile fits to multiple constraints

Takes into account given SL profile, shear and magnification bias

Allows to obtain full-scale mass profile very fast

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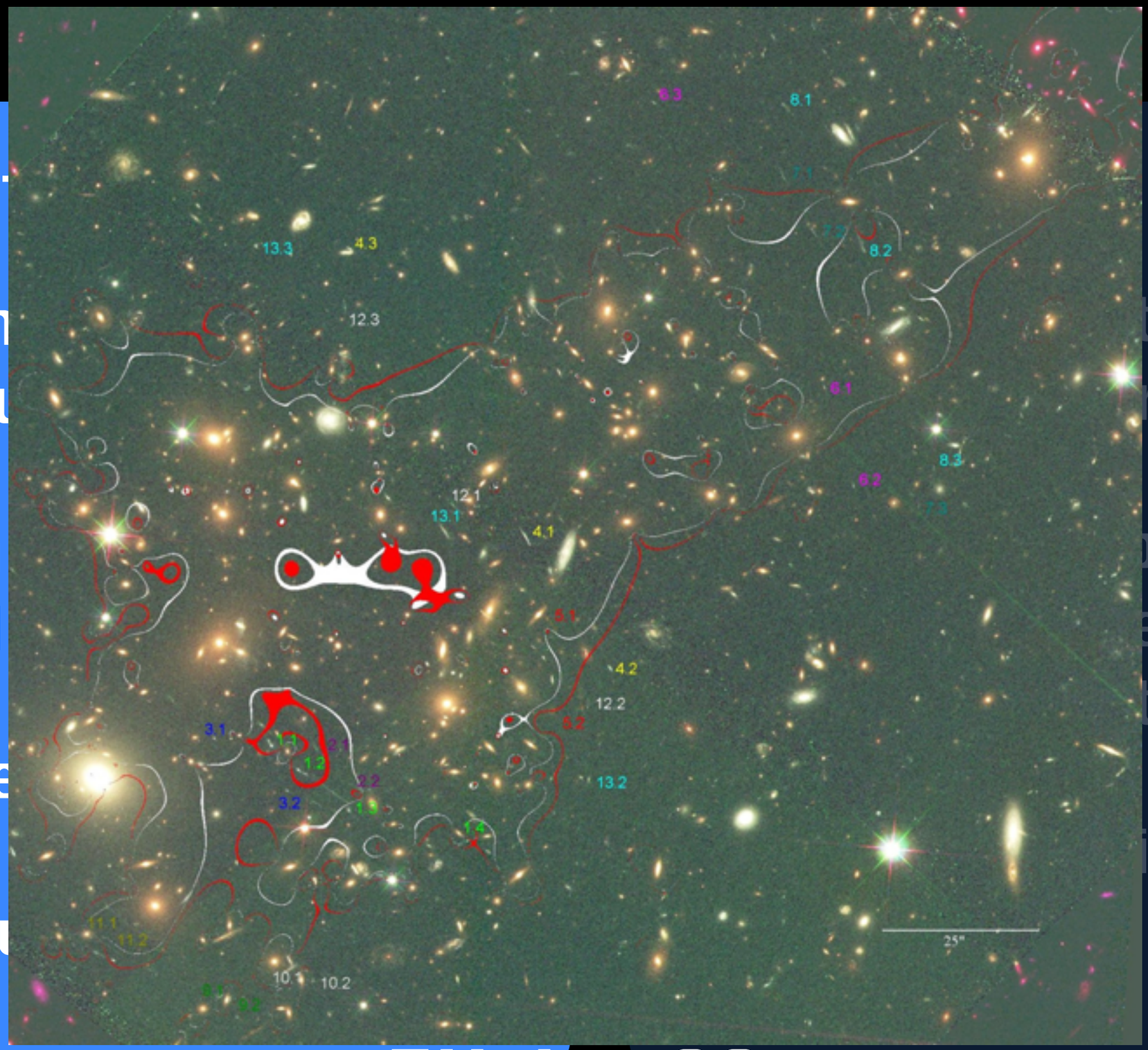

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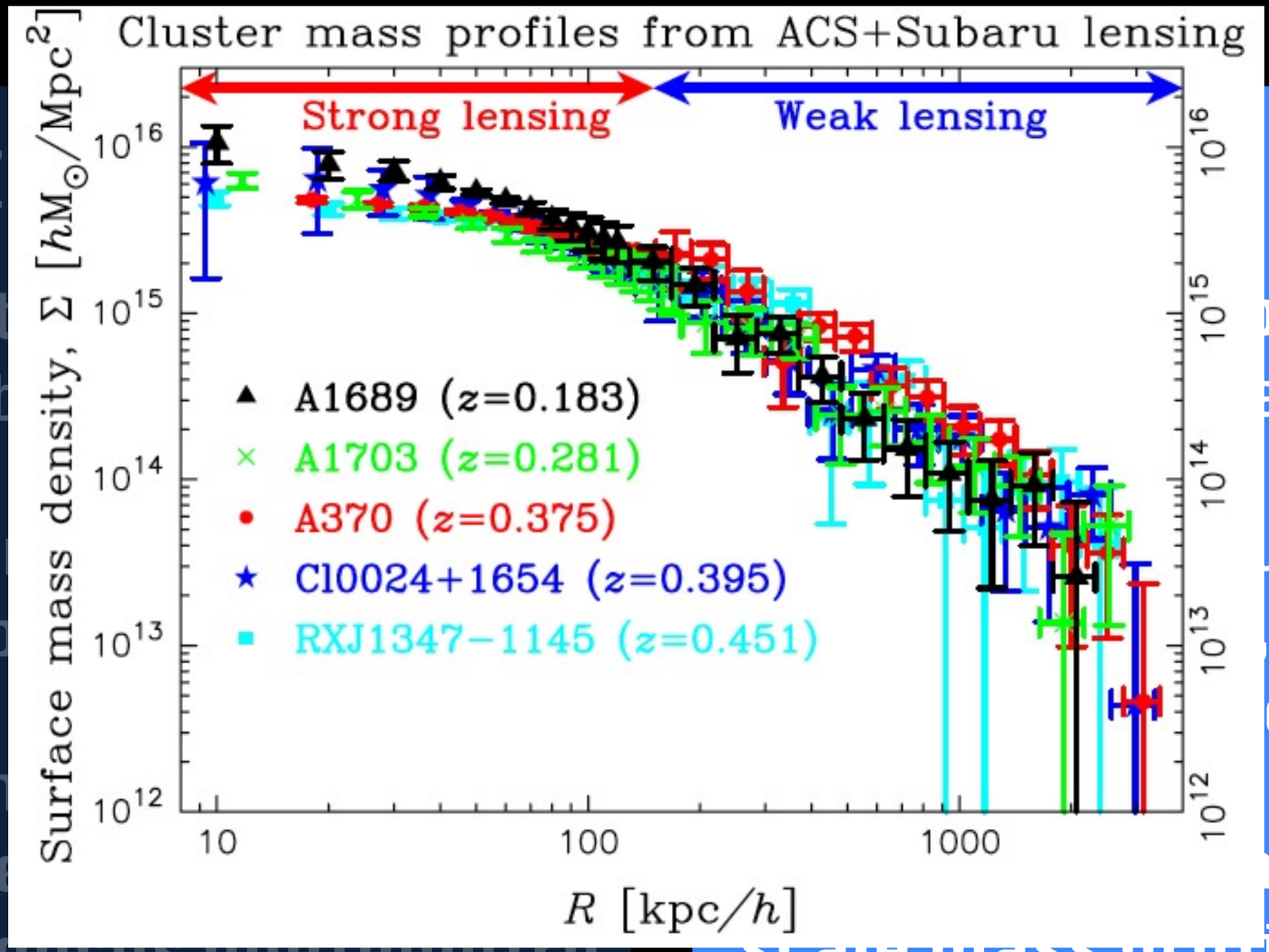

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Umetsu+ 11

Nonparametric

LensPerfect (Coe 09)

SL modelling by a curl-free interpolation of the deflection field

Relies on multiple image information and iterative source position guesses

High spatial resolution

SaWLens (JM 09)

Relies on shear, multiple images, critical line estimators and flexion

Does not reach pure SL resolution but spans large range

Runtime expensive

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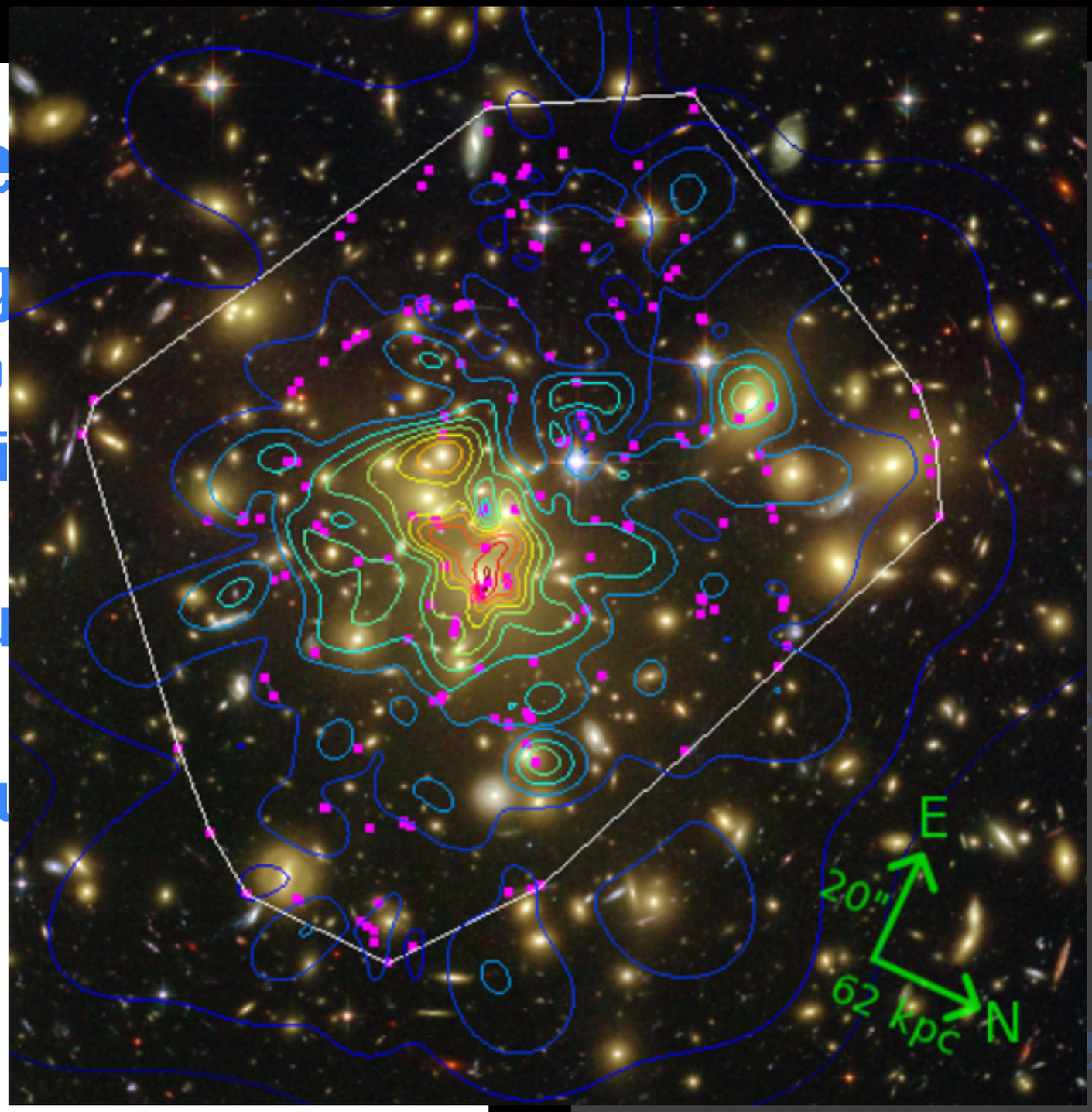

(JM 09)

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Pandora's Cluster

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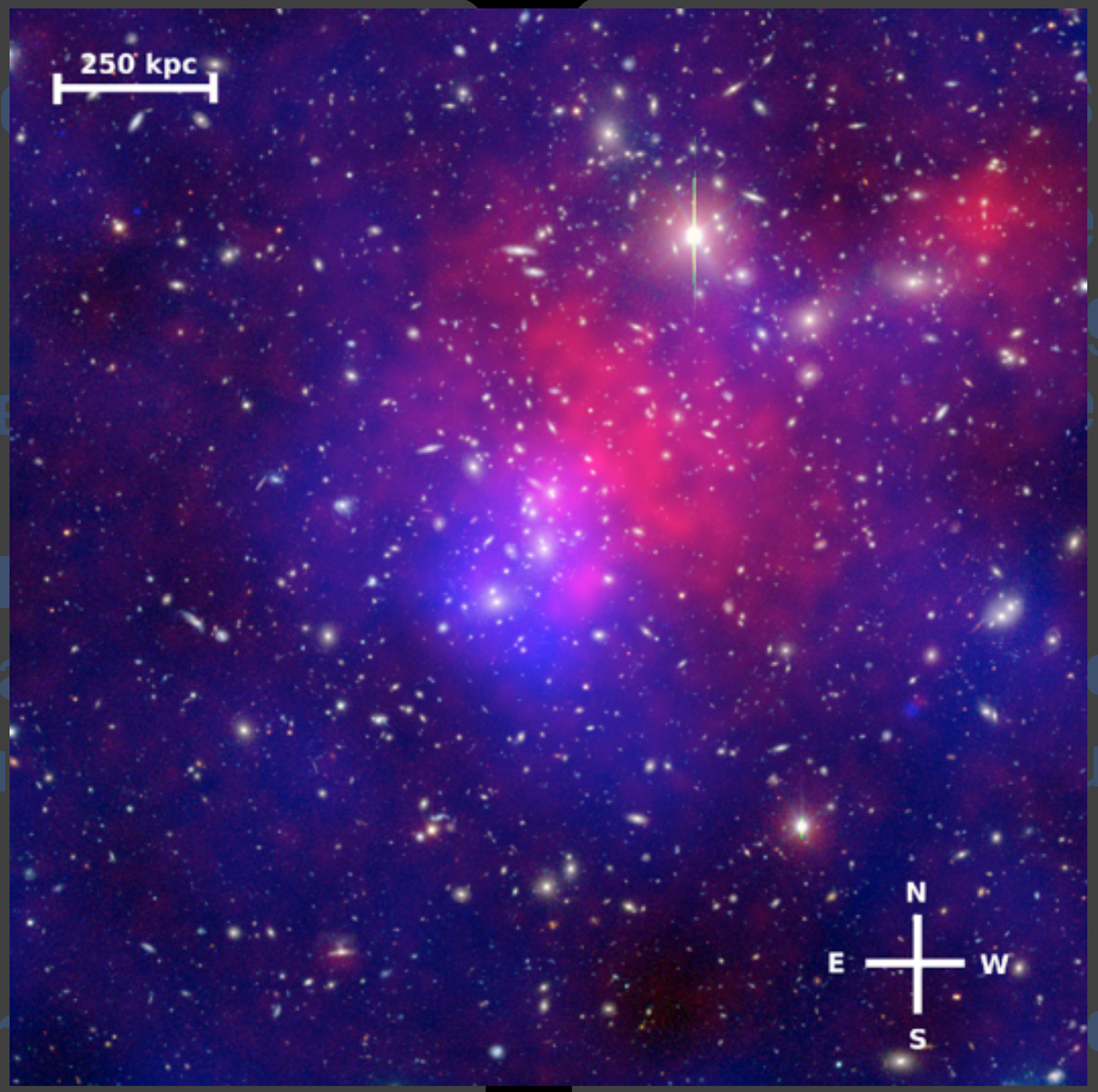
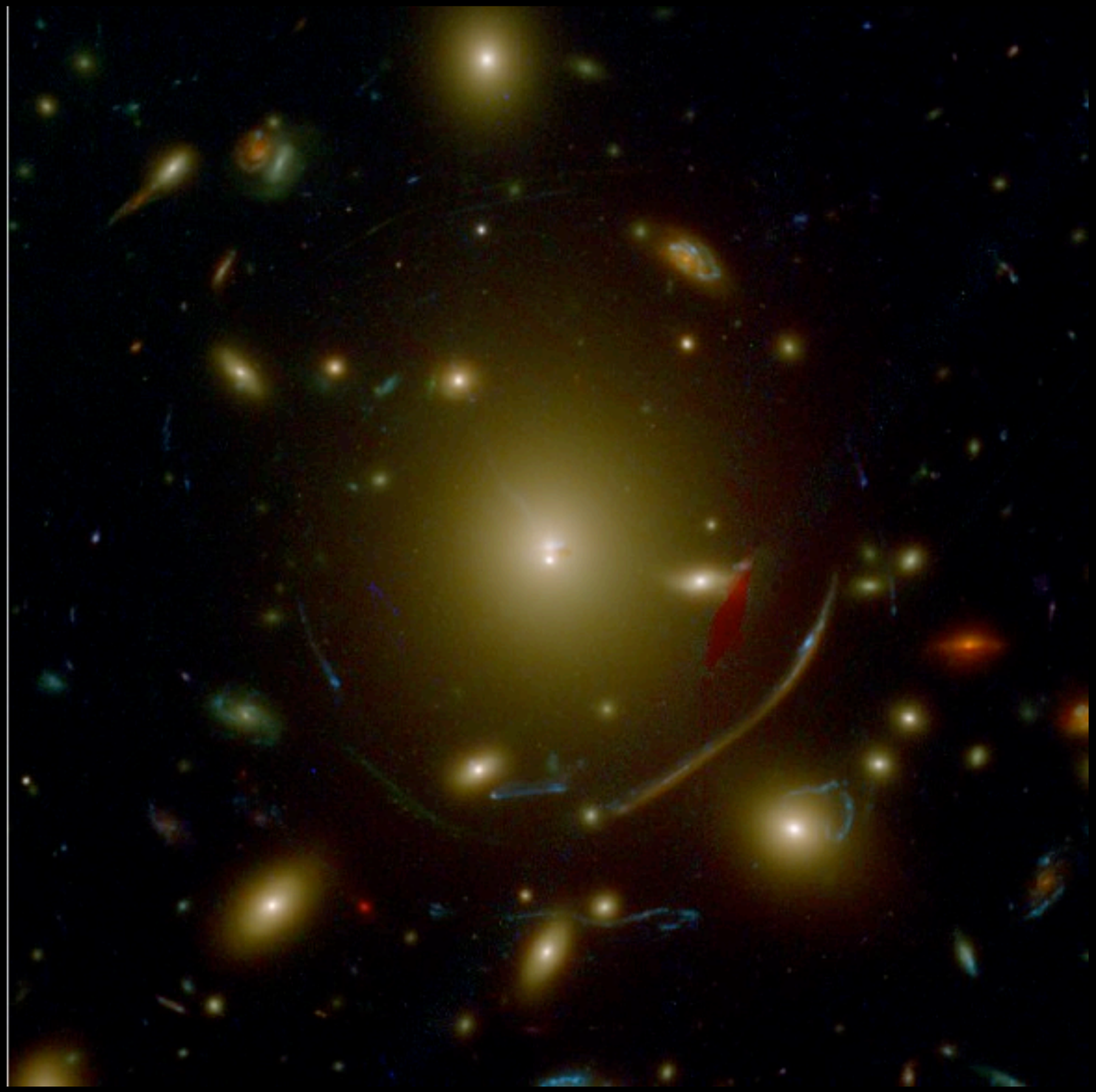
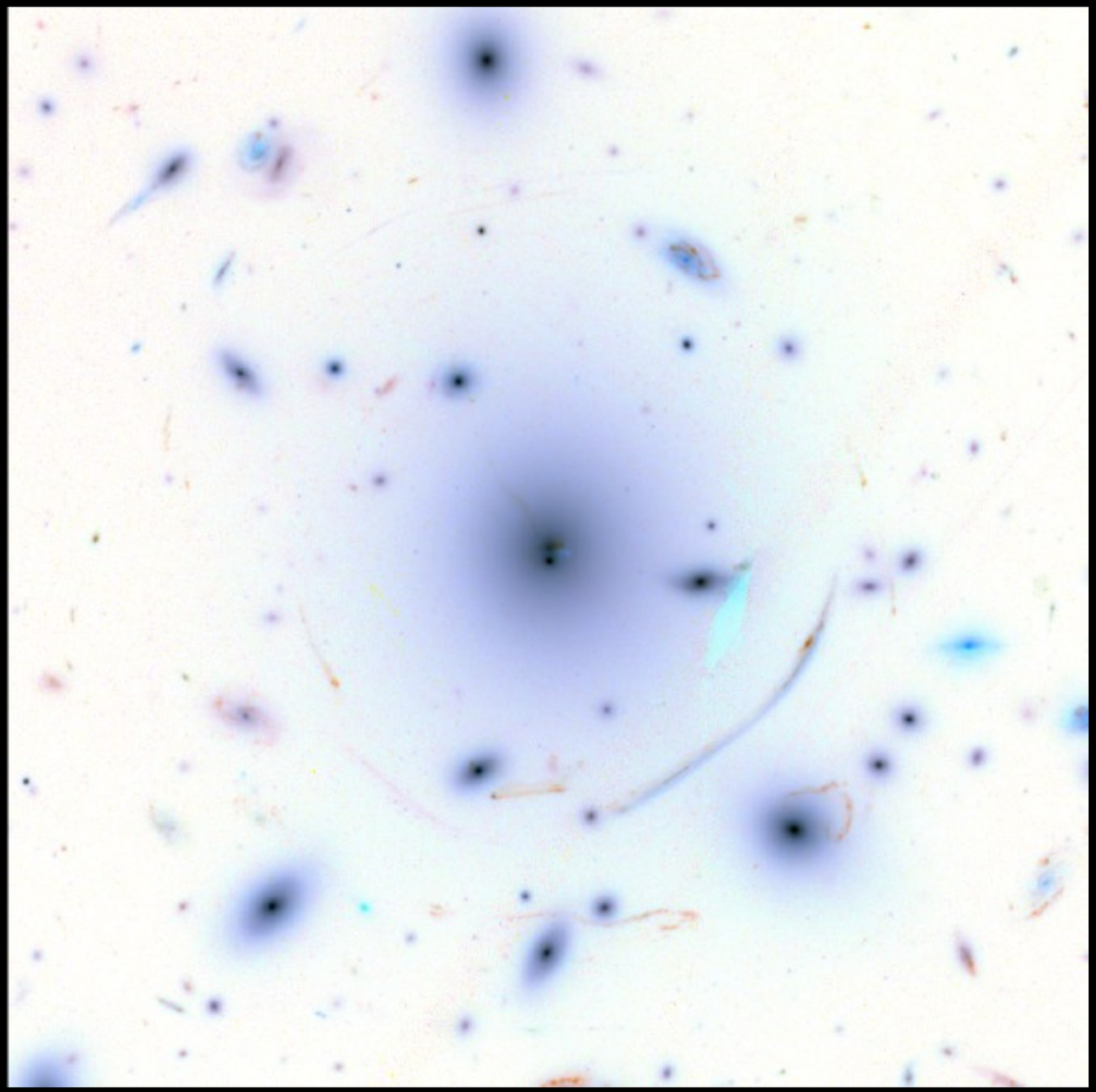


NASA, ESA, ESO, CXC, J. Merten, D. Coe

Abell 383



Abell 383



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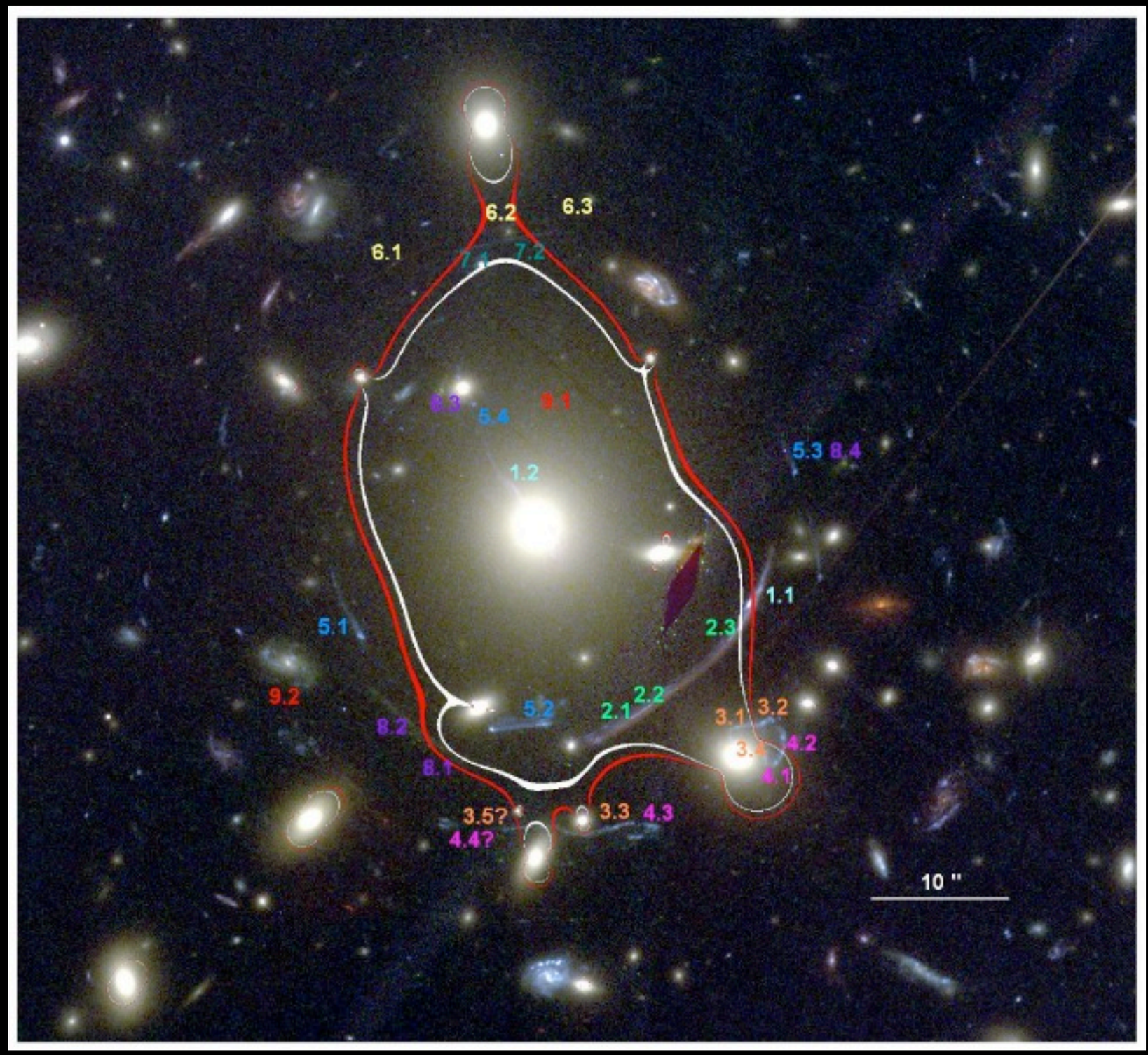
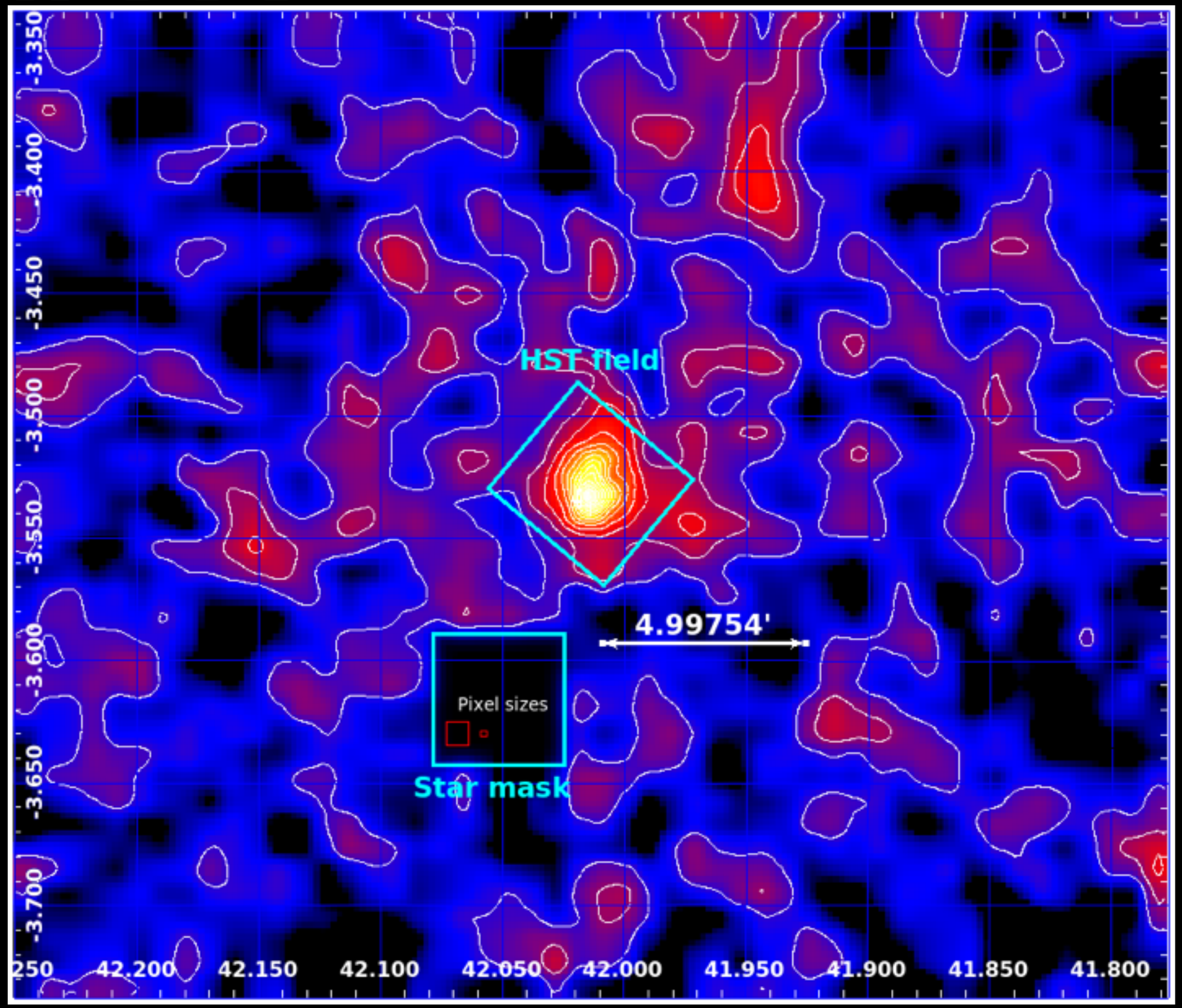


Zitrin & CLASH 11

Abell 383



JM, Medezinski, Umetsu & CLASH 11

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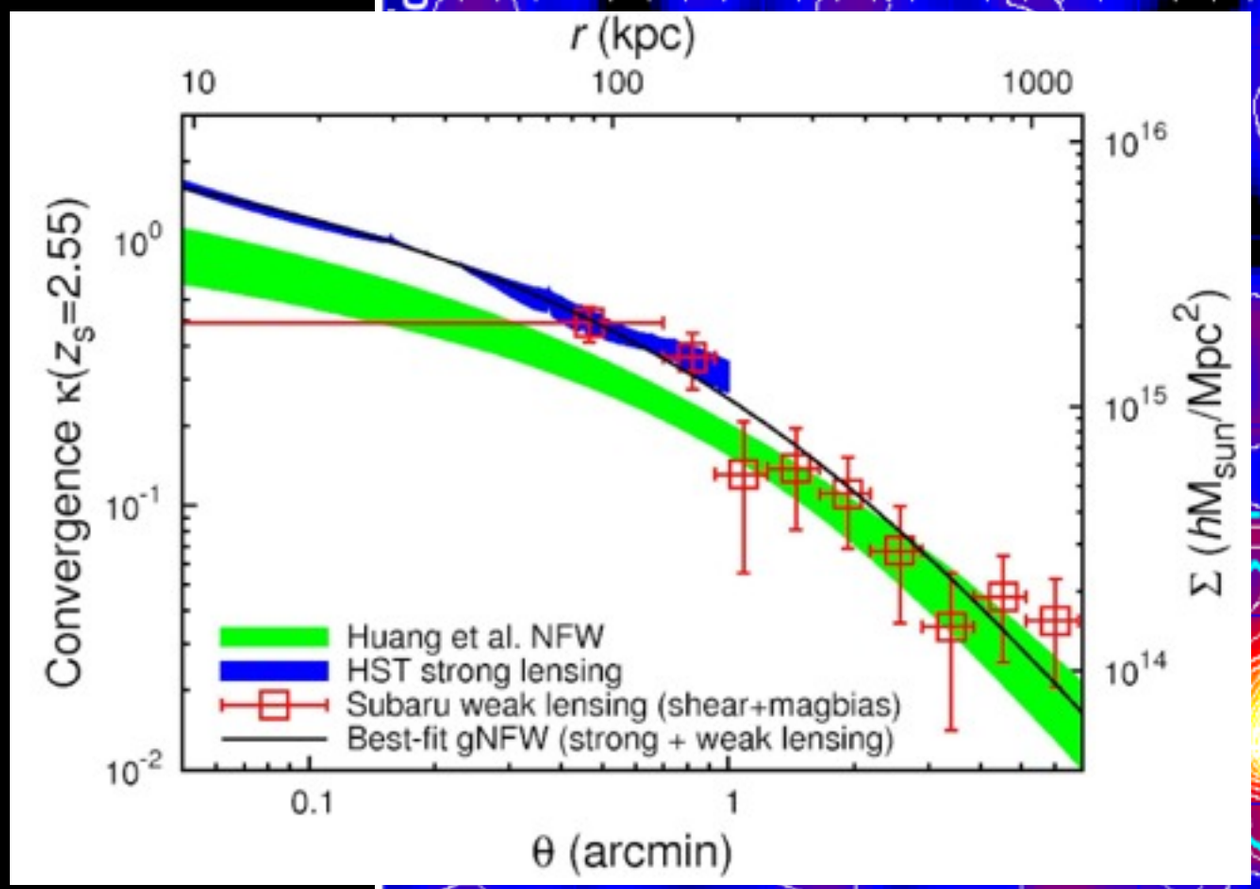

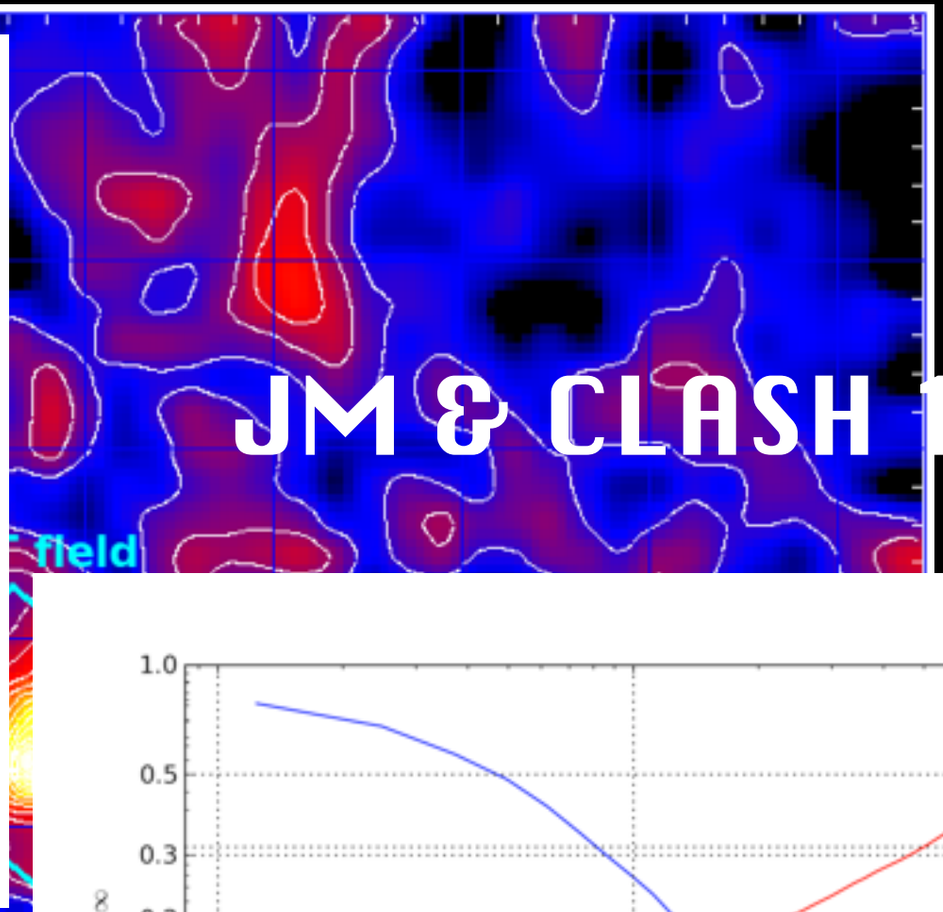

JM & CLASH 11

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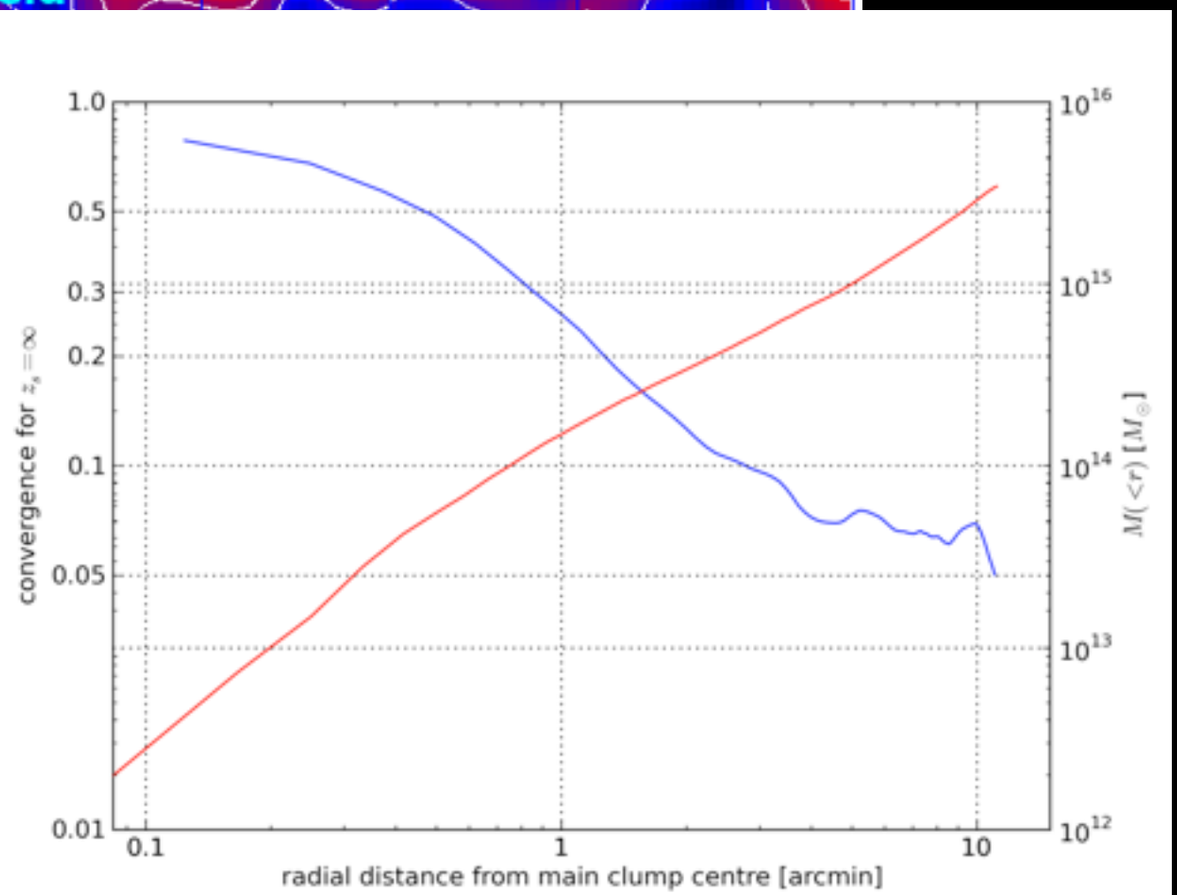

JM, Medezinski, Umetsu & CLASH 11

MACS 1206

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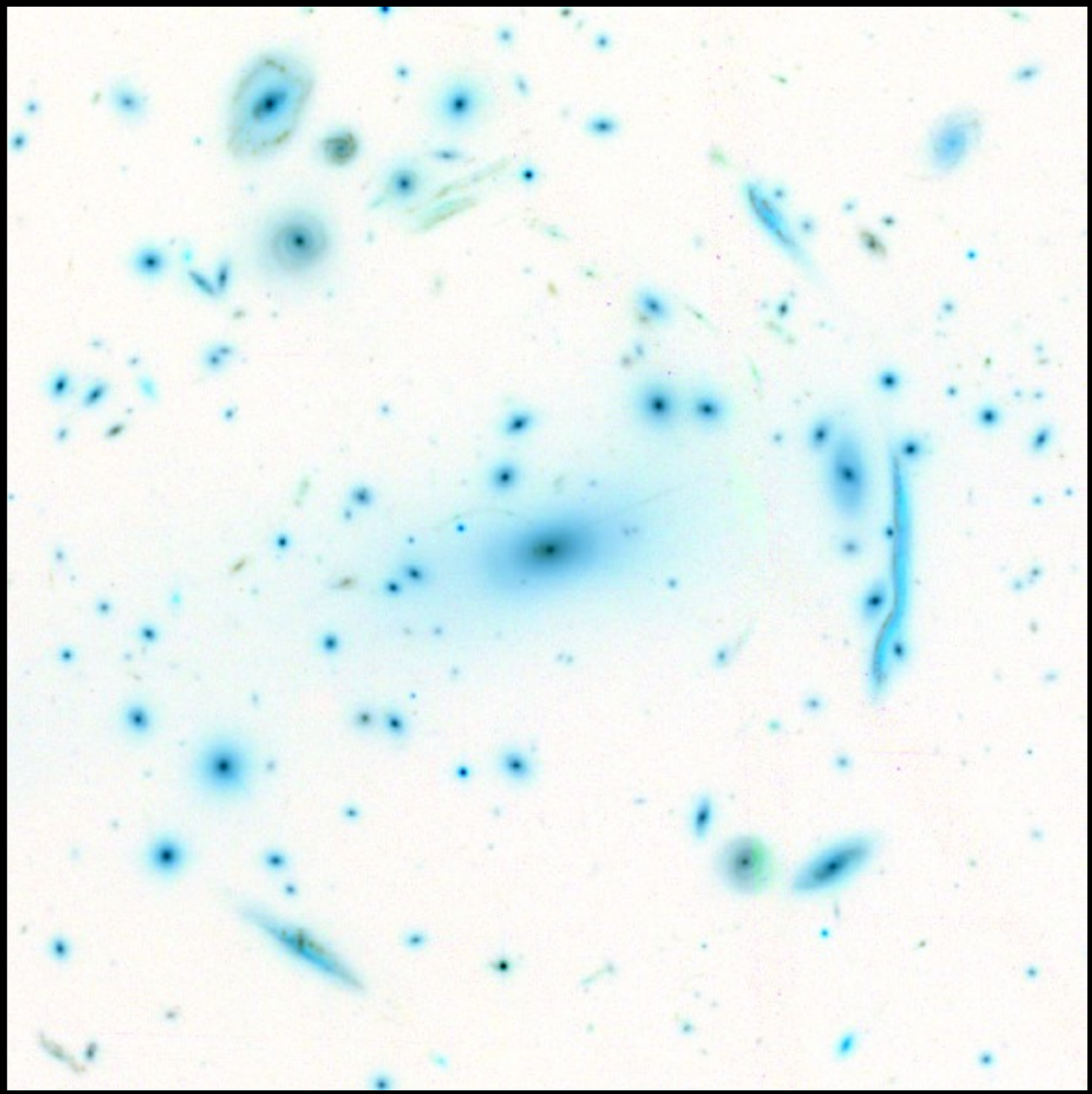

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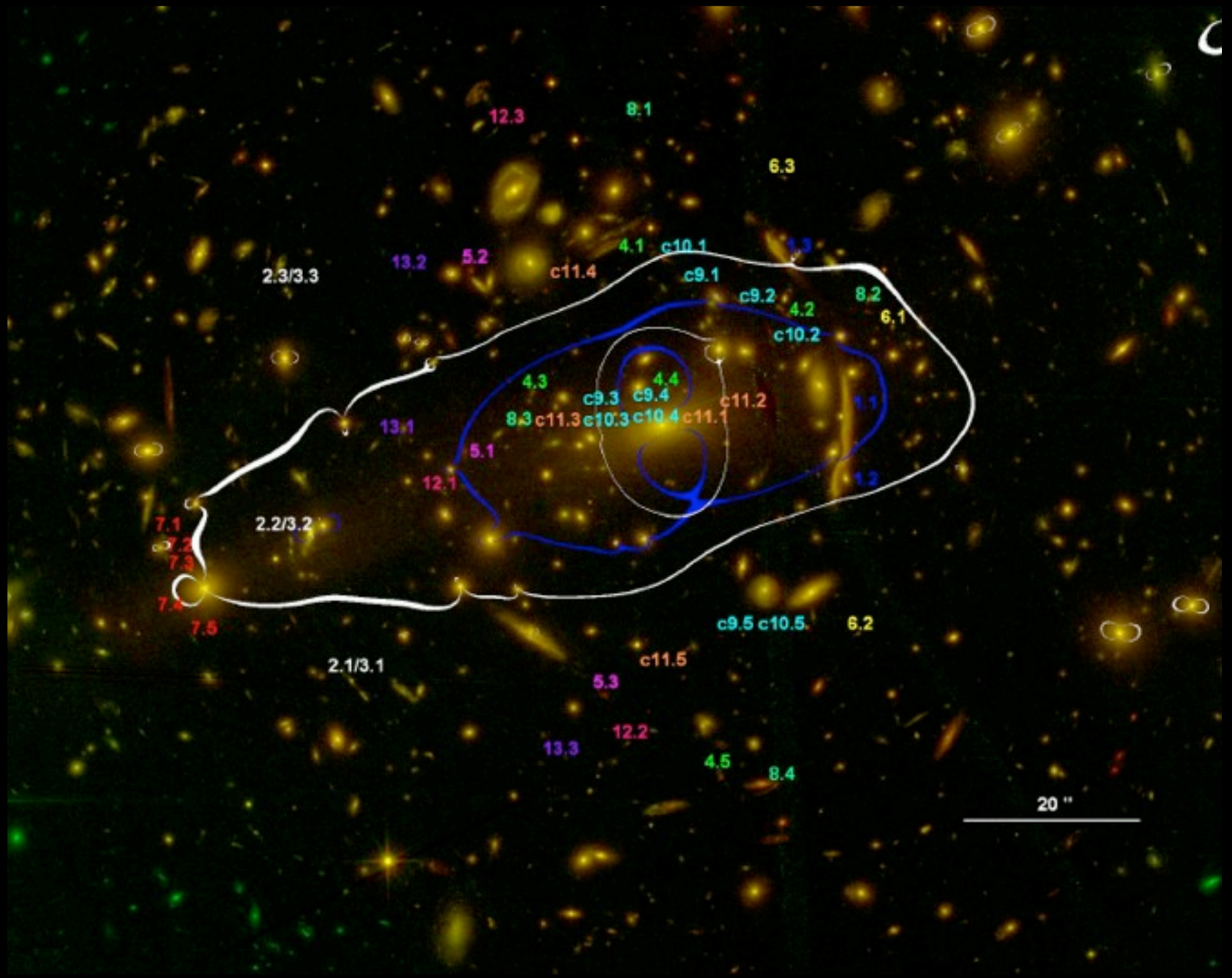

Zitrin, Rosati & CLASH 11

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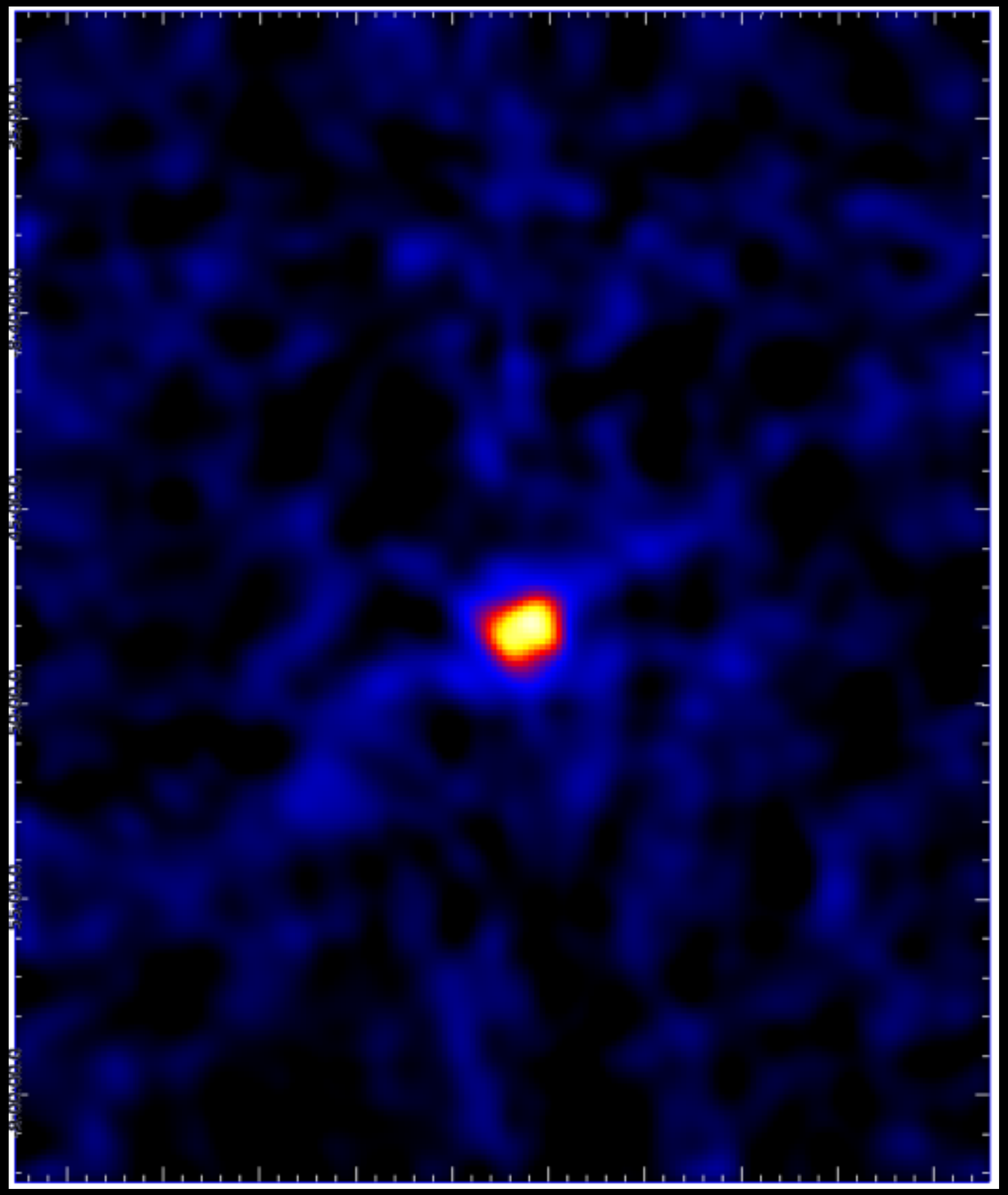

JM, Medezinski, Umetsu & CLASH 11

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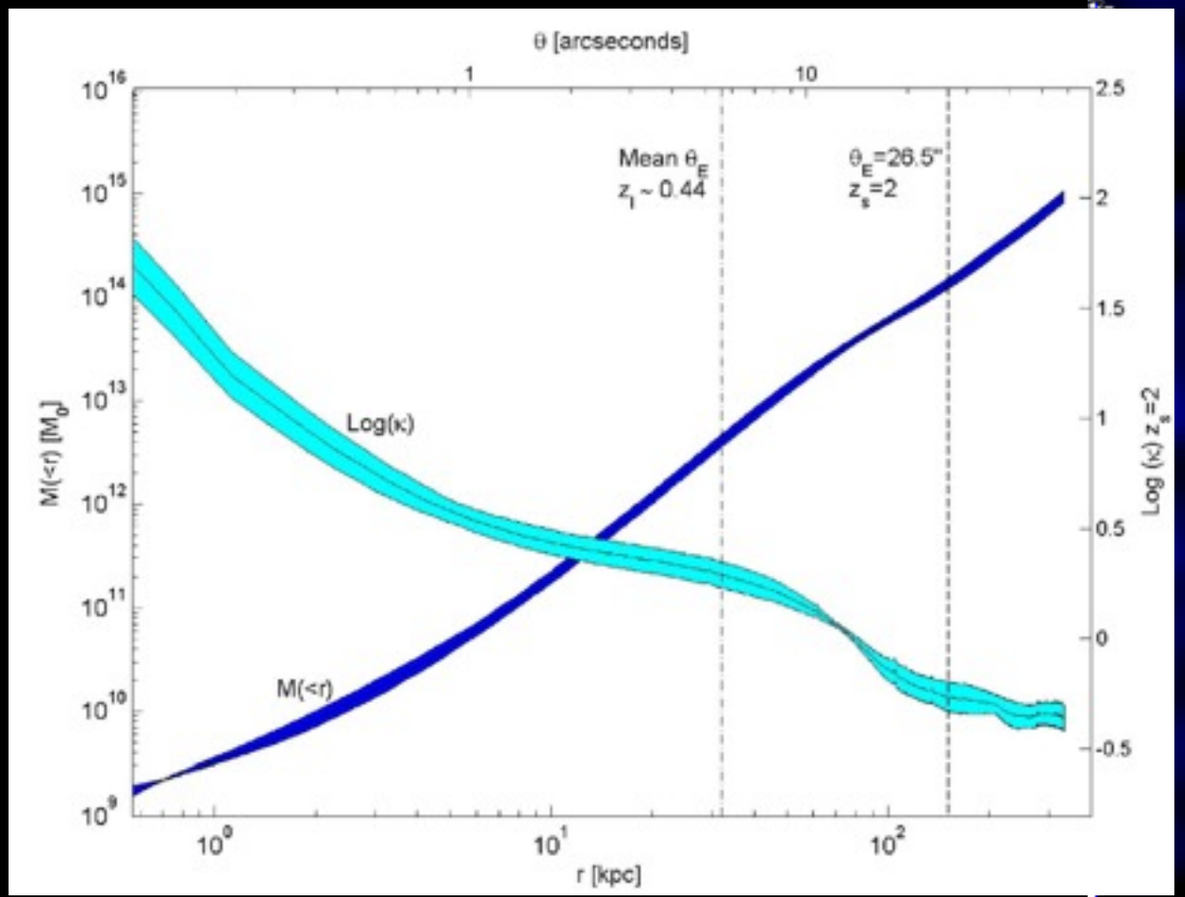

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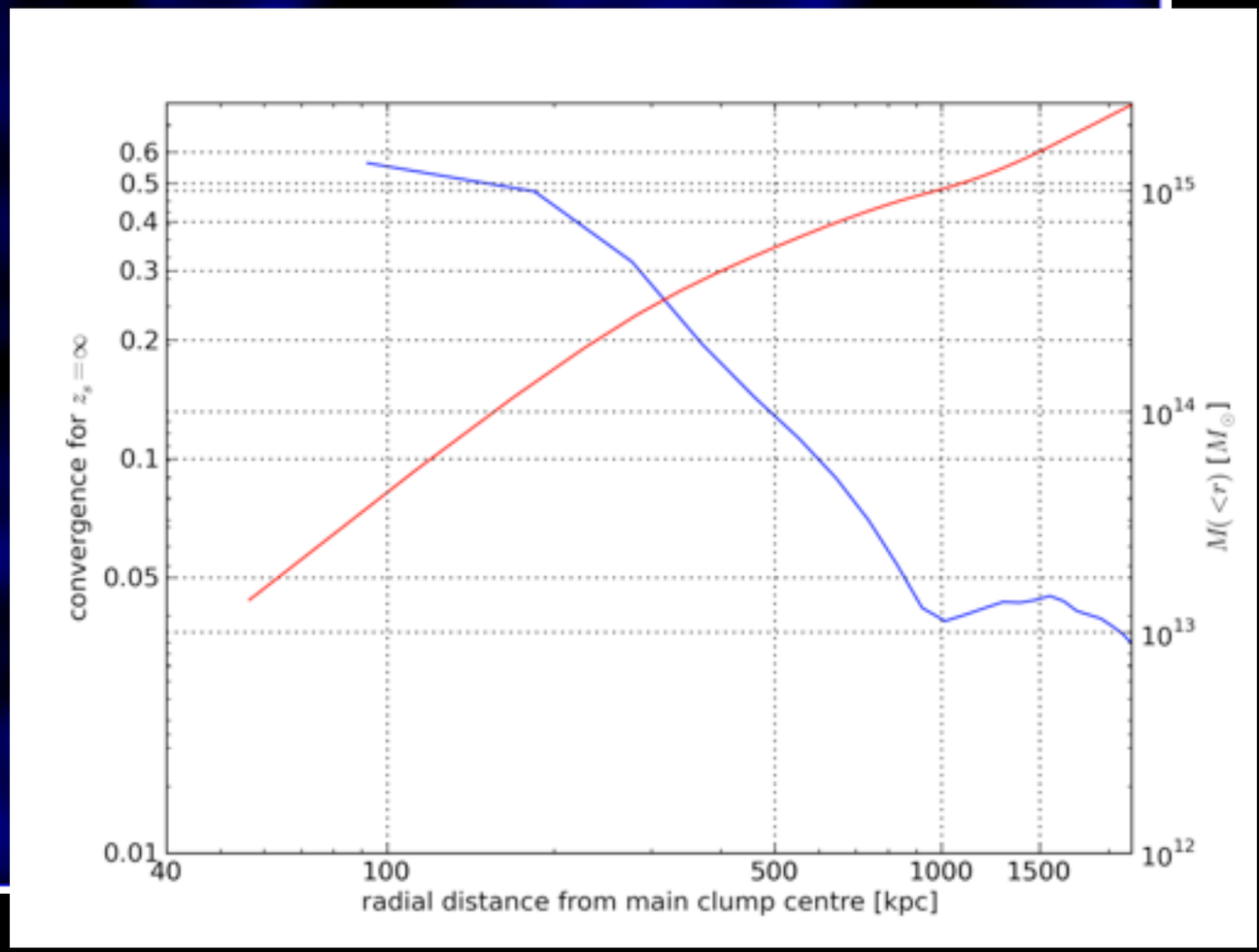
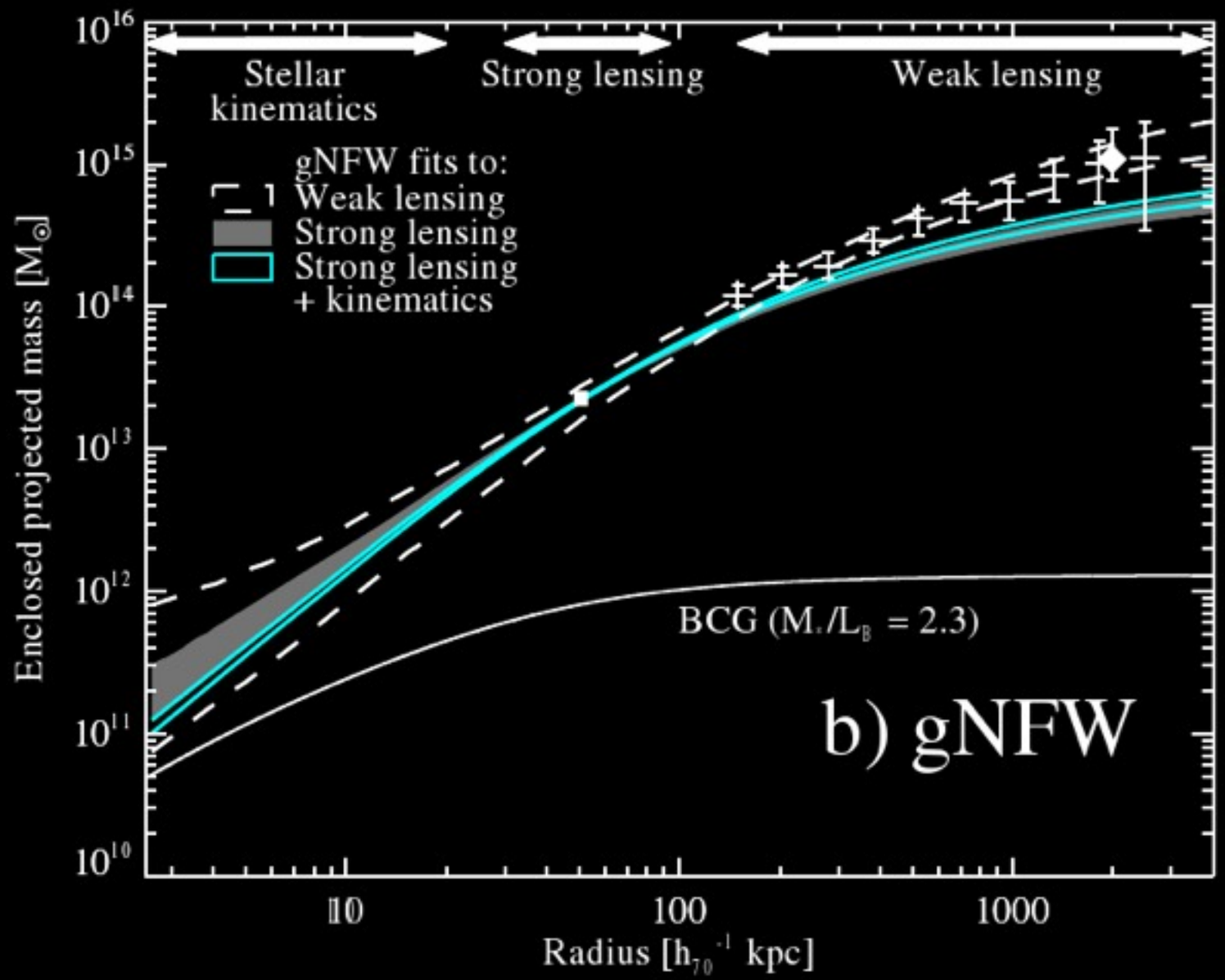


JM, Medezinski, Umetsu & CLASH 11

Incorporating more constraints, inner profile



Newman+ 11

Developing the perfect method:

Basically there is not much missing, esp. runtime concerns in the nonparam. regime are solved.

Provocative: Here is the ball simulators.

Conclusions

CLASH will deliver unprecedented data quality for cluster lensing

A multiscale approach to the data is mandatory for our science goal of pinning down the cluster mass profile

Parametric and nonparametric methods have to work hand in hand by now

Further improvements are needed esp. at the smallest radii, but basically everything is already in place