

CLASH MCTP Update

April 6, 2011

Marc Postman
Space Telescope Science Institute

The CLASH Science Team: 40 researchers, 22 institutions, 10 countries



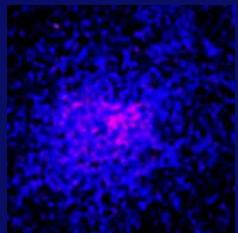
Marc Postman, P.I.
Matthias Bartelmann
Narciso Benitez
Rychard Bouwens
Larry Bradley
Thomas Broadhurst
Dan Coe
Megan Donahue
Holland Ford
Or Graur
Genevieve Graves
Øle Host
Leopoldo Infante
Saurabh Jha
Yolanda Jimenez-Teja
Stéphanie Jouvel
Daniel Kelson
Anton Koekemoer
Ofer Lahav
Ruth Lazkoz
Doron Lemze
Dan Maoz
Curtis McCully
Elinor Medezinski
Peter Melchior
Massimo Meneghetti
Julian Merten
Alberto Molino
Leonidas Moustakas
Mario Nonino
Brandon Patel
Enikö Regős
Adam Riess
Steve Rodney
Piero Rosati
Stella Seitz
Keiichi Umetsu
Arjen van der Wel
Wei Zheng
Adi Zitrin

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Universität Heidelberg
Instituto de Astrofísica de Andalucía (IAA)
Leiden University
STScI
University of the Basque Country
STScI
Michigan State University
The Johns Hopkins University (JHU)
Tel Aviv University (TAU)
University of California, Berkeley
University College London (UCL)
Universidad Católica de Chile
Rutgers University
IAA
UCL
Carnegie Institute of Washington
STScI
UCL
University of the Basque Country
JHU
TAU
Rutgers University
JHU
The Ohio State University
INAF / Osservatorio Astronomico di Bologna
Universität Heidelberg
IAA
JPL/Caltech
INAF / Osservatorio Astronomico di Trieste
Rutgers University
European Laboratory for Particle Physics (CERN)
STScI / JHU
JHU
European Southern Observatory
Universitas Sternwarte München
Academia Sinica, Institute of Astronomy & Astrophysics
Max Planck Institut für Astronomie
JHU
TAU

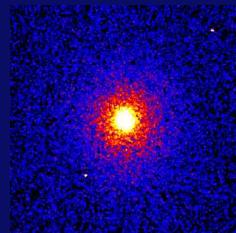


Post-doctoral fellow
Graduate student

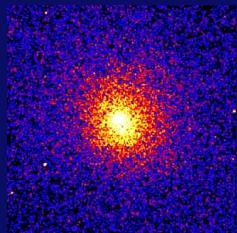
Allen et al. 2004; Schmidt & Allen 2007; Allen et al. 2008; Mantz et al. 2010



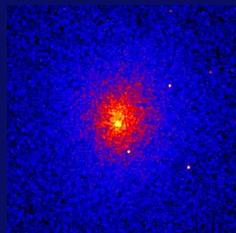
Abell 209



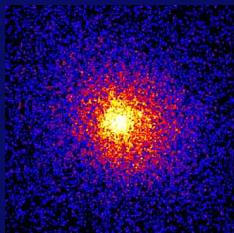
Abell 383



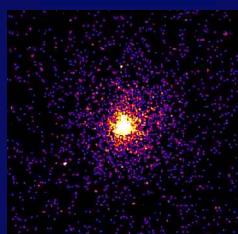
Abell 611



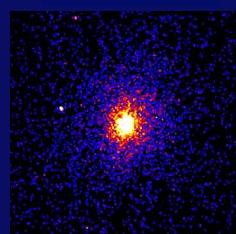
Abell 963



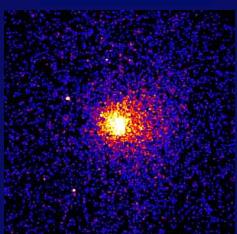
Abell 2261



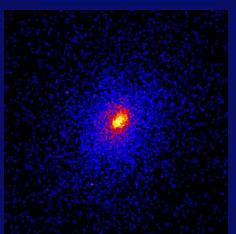
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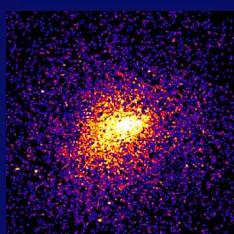
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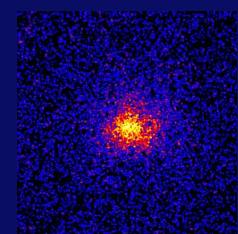
MACS 0744+3927



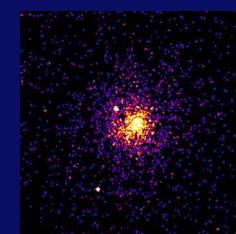
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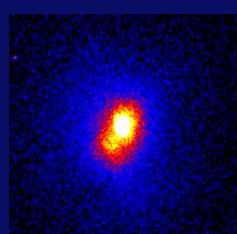
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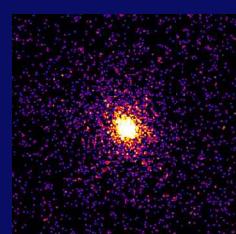
CLJ1226+3332



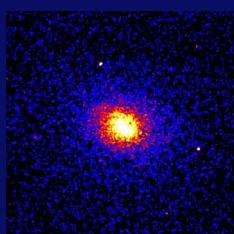
MACS 1311-0310



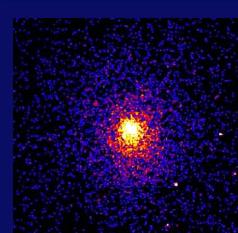
RXJ 1347-1145



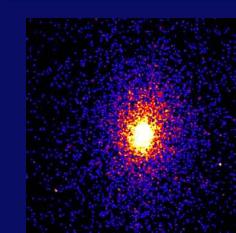
RXJ 1423+2404



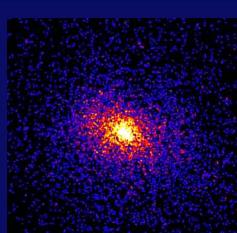
RXJ 1532+3020



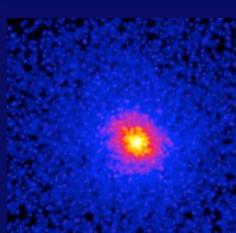
RXJ 1720+3536



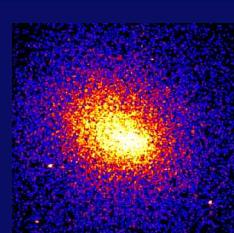
MACS 1931-2634



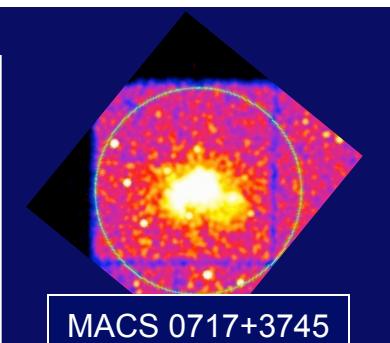
RXJ 2129+0005



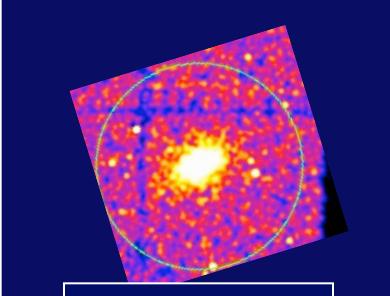
MS-2137



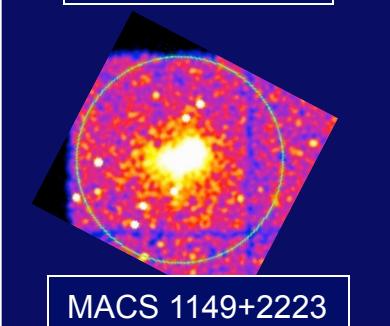
RXJ 2248-4431



MACS 0717+3745



RXJ 0647+7015

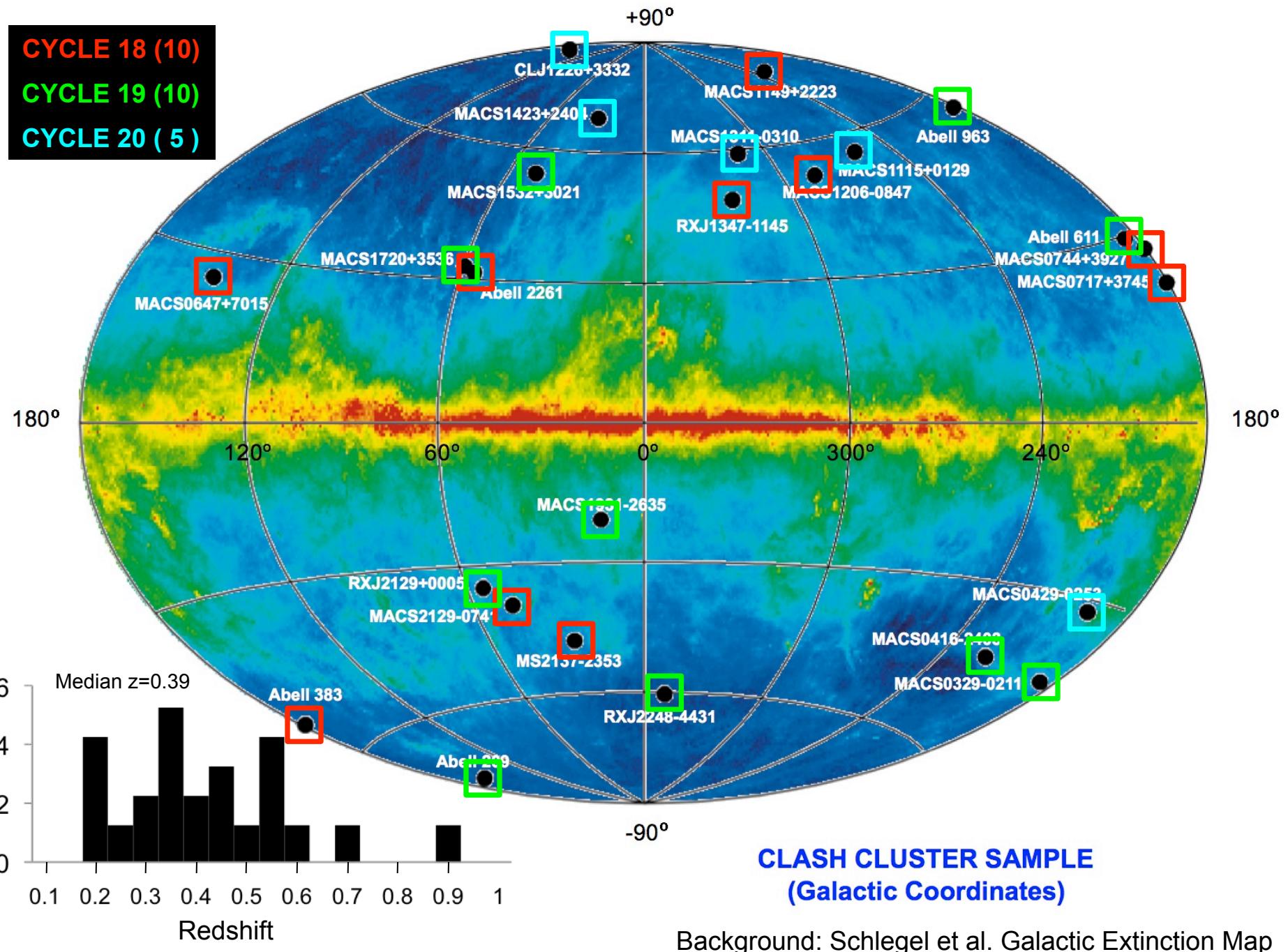


MACS 1149+2223

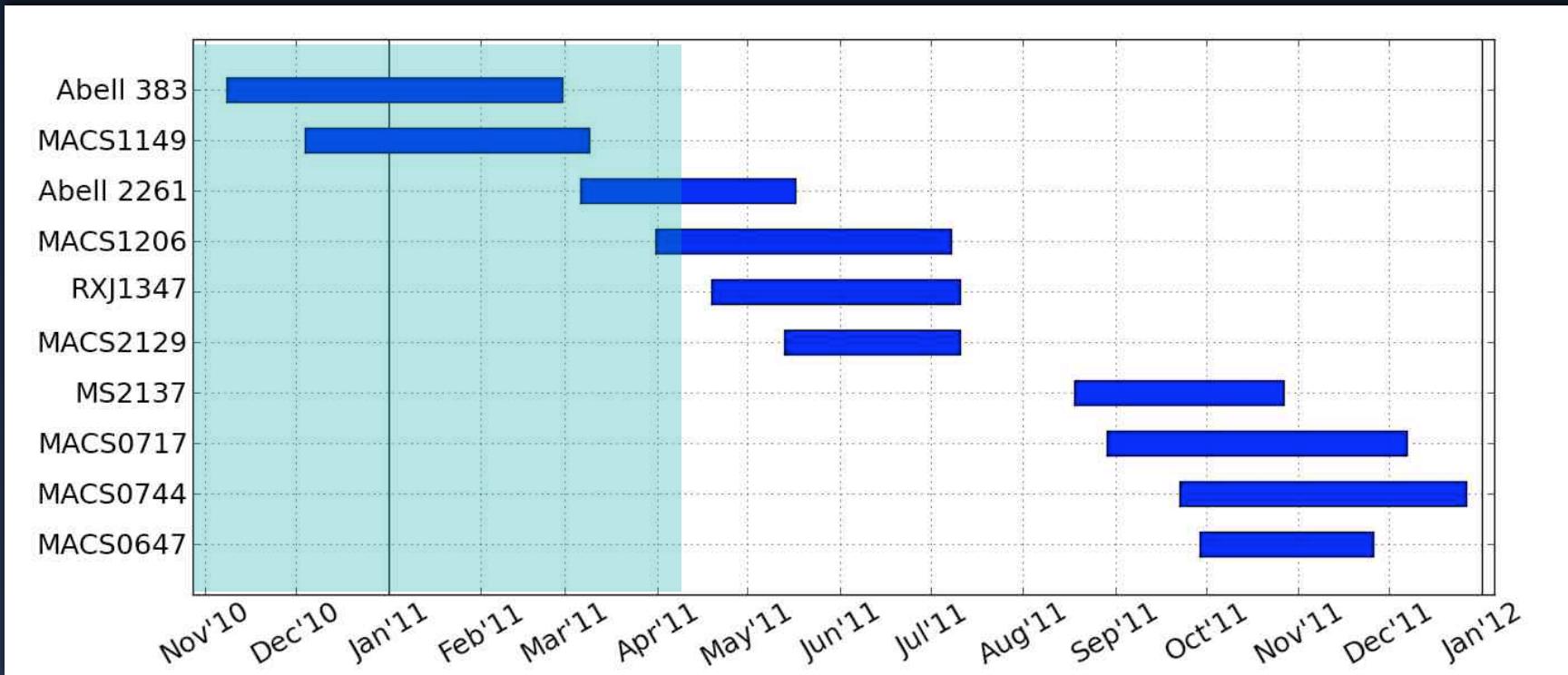
Almost all
have
 $T_x > 5 \text{ keV}$

X-ray images of 23 of the 25 CLASH clusters. 20 are selected to be “relaxed” clusters (based on their x-ray properties only). 5 are selected specifically because they are strongly lensing $\theta_E > 35''$

CYCLE 18 (10)
CYCLE 19 (10)
CYCLE 20 (5)



Cycle 18 CLASH Schedule

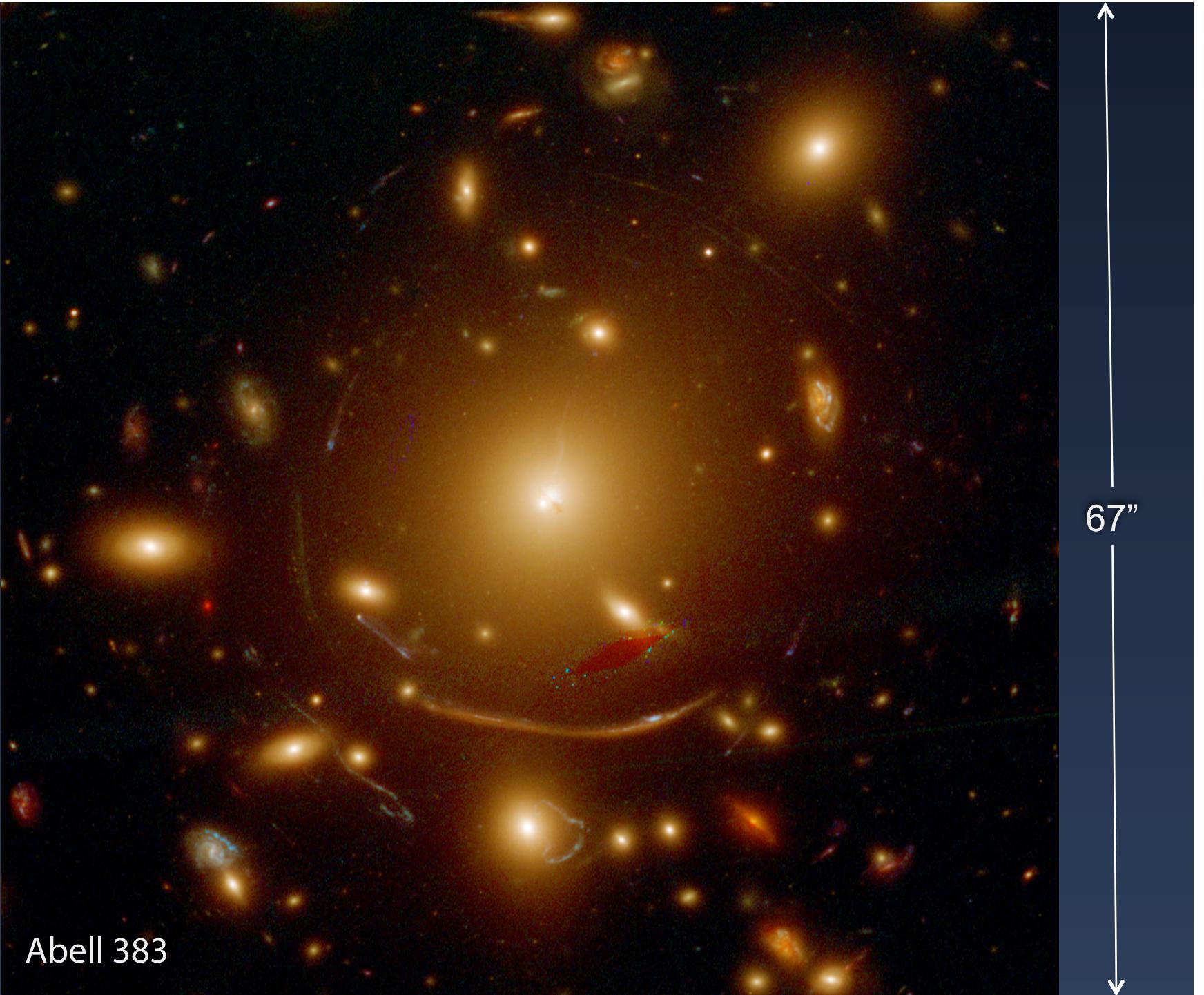


- Abell 383 and MACS1149 observations are completed.
- Abell 2261 and MACS1206 observations currently underway.
- RXJ1347 observations begin in 2 weeks.

First CLASH16-band Imaging

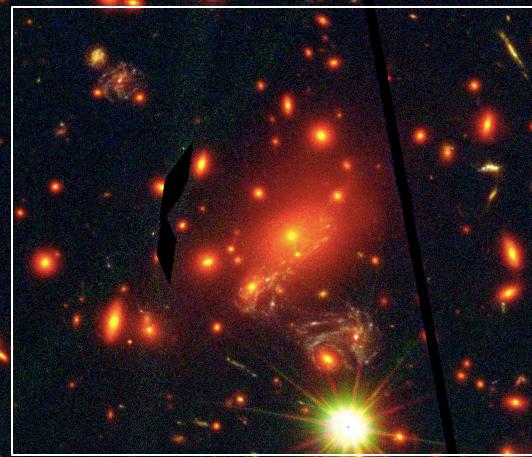


Abell 383



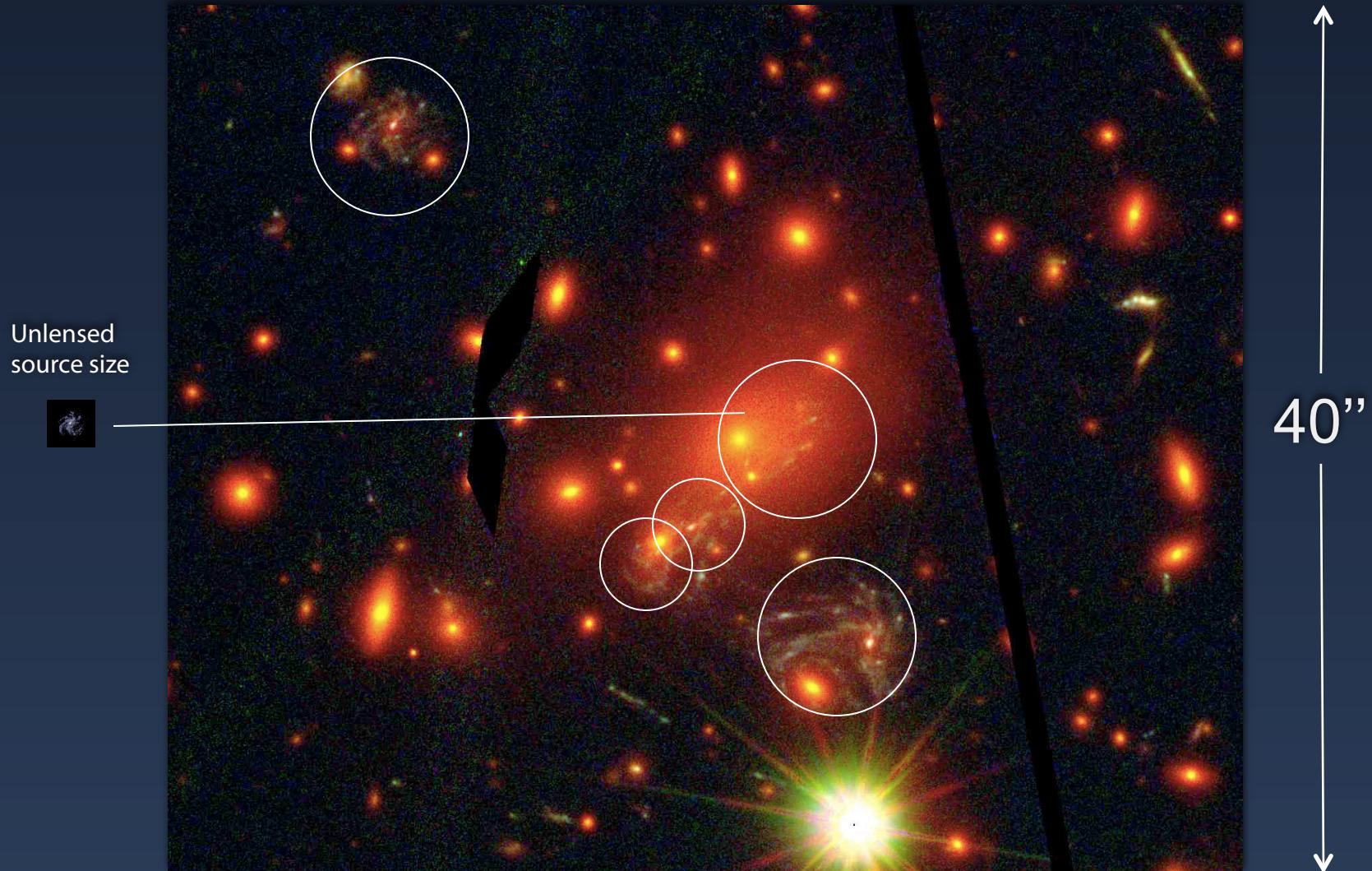
Abell 383

MACS 1149+2223



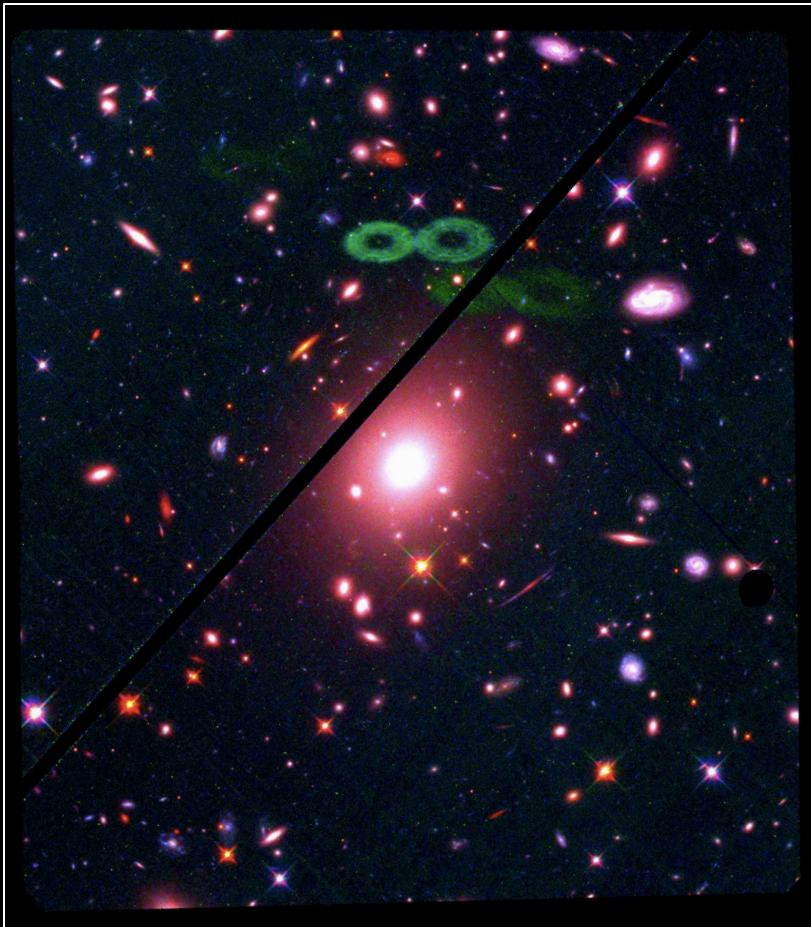
2.0'

MACS 1149+2223

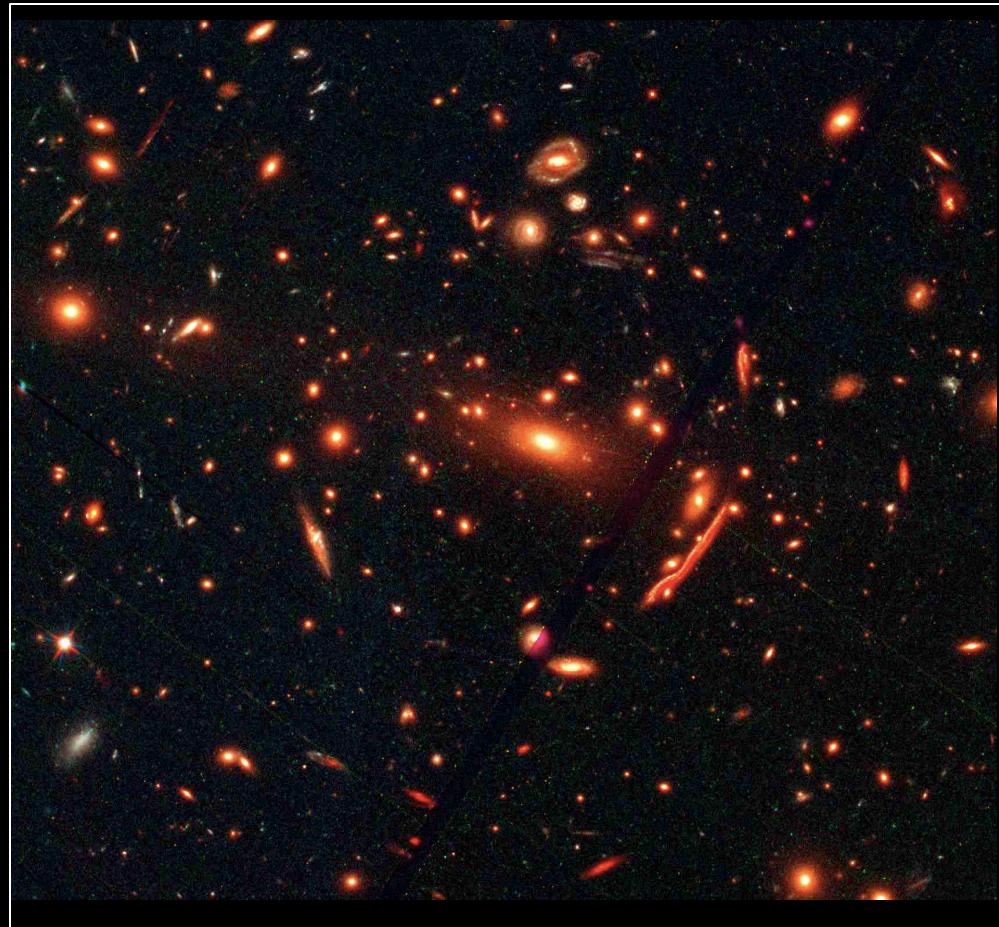


Quintuply-lensed spiral at $z=1.49$, magnification: $\sim 22\times$
(Zitrin & Broadhurst 2009; Smith et al. 2009; Yuan et al. 2011)

Latest Data – Just 4 days old



Abell 2261

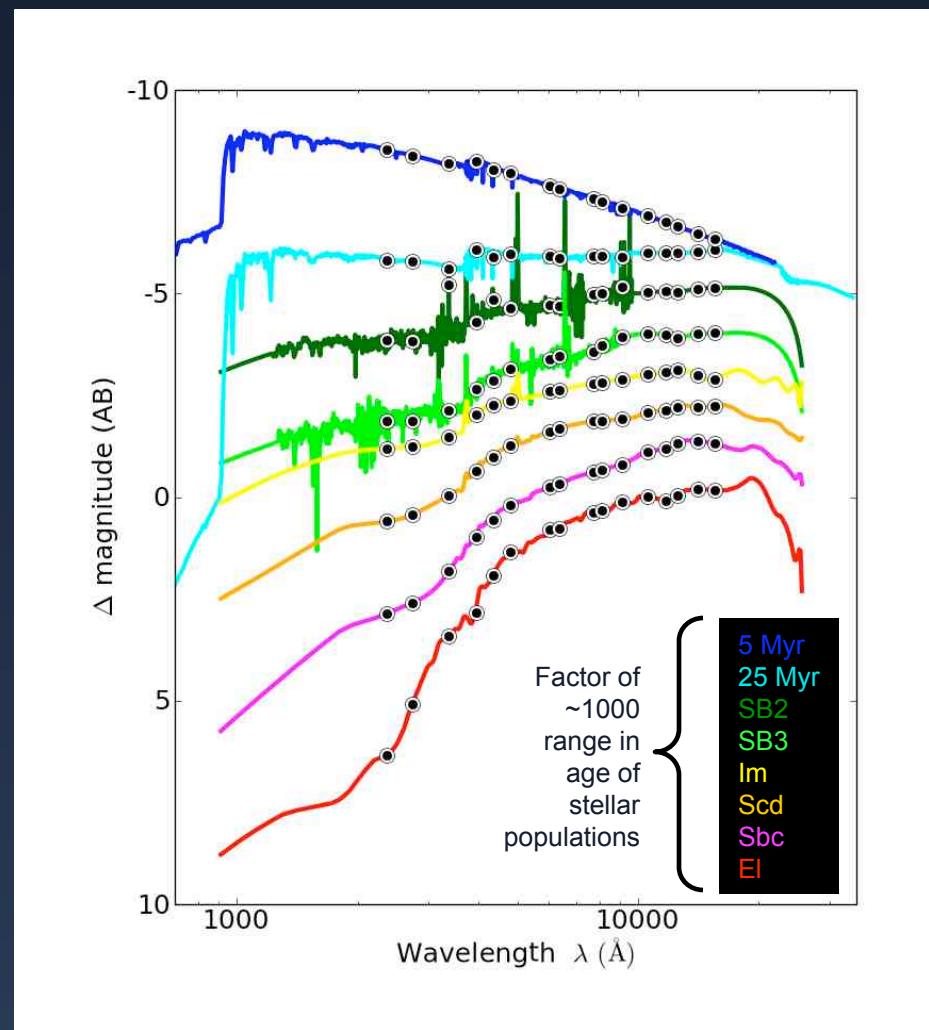


MACS1206-08

CLASH: 2% Photometric Redshifts from 16 filters

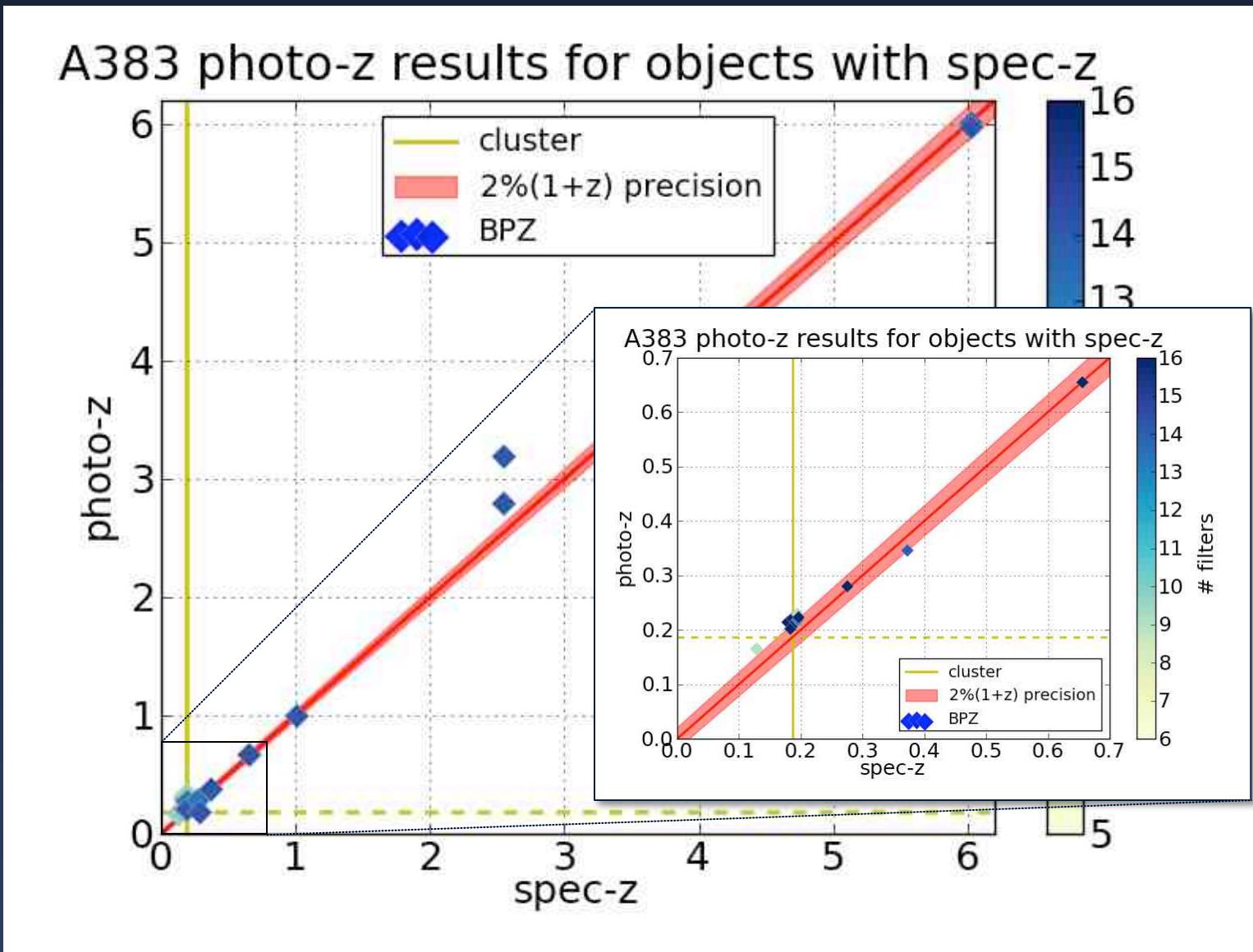
CLASH Filter set:

F225W ... 235.9 nm WFC3
F275W ... 270.4 nm WFC3
F336W ... 335.5 nm WFC3
F390W ... 392.1 nm WFC3
F435W ... 430.6 nm ACS
F475W ... 474.2 nm ACS
F606W ... 592.0 nm ACS
F625W ... 629.8 nm ACS
F775W ... 769.4 nm ACS
F814W ... 806.9 nm ACS
F850LP ... 906.0 nm ACS
F105W ... 1.055 μ m WFC3
F110W ... 1.152 μ m WFC3
F125W ... 1.248 μ m WFC3
F140W ... 1.392 μ m WFC3
F160W ... 1.536 μ m WFC3



Nearly complete redshift information for all objects as faint as 26 AB mag will allow reliable identification of multiply imaged sources, breaking of “mass-sheet” degeneracy and, hence, yield robust, accurate mass profiles of these clusters. Such extensive redshift info for such faint objects is enabled by HST’s new instruments.

Photo-z accuracy achieved



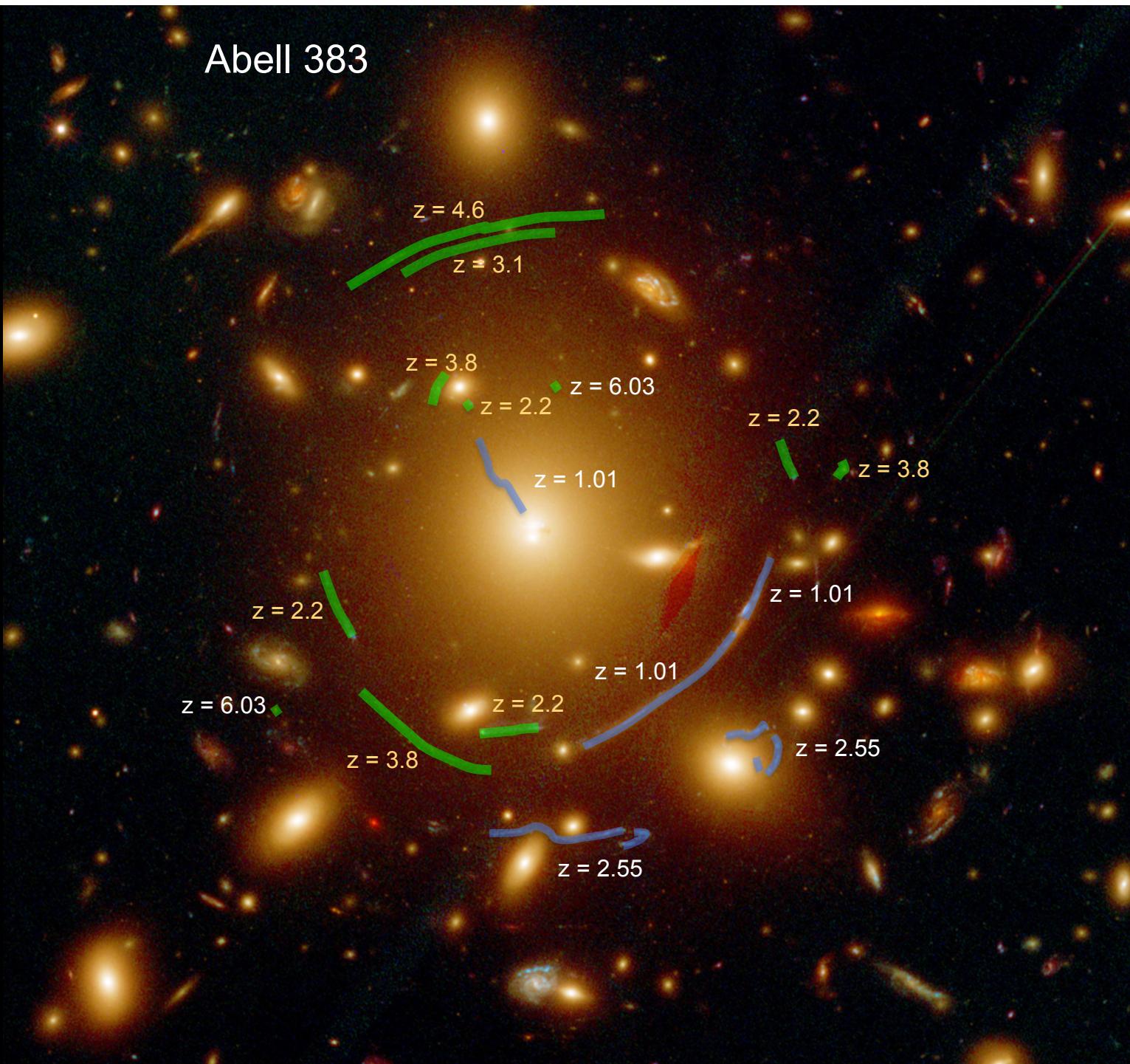
CLASH Science

1. Richard et al. (Feb. 24, 2011) – first paper to be submitted. Keck spectrum of $z = 6$ galaxy in A383 found in CLASH data. None of the authors are part of CLASH P.I. team – demonstrating high community interest in these data.
2. Zitrin et al. (Mar. 29, 2011) – first CLASH team paper to be submitted. A383 mass model from CLASH+Subaru data.

Abell 383

Previously
known &
modeled

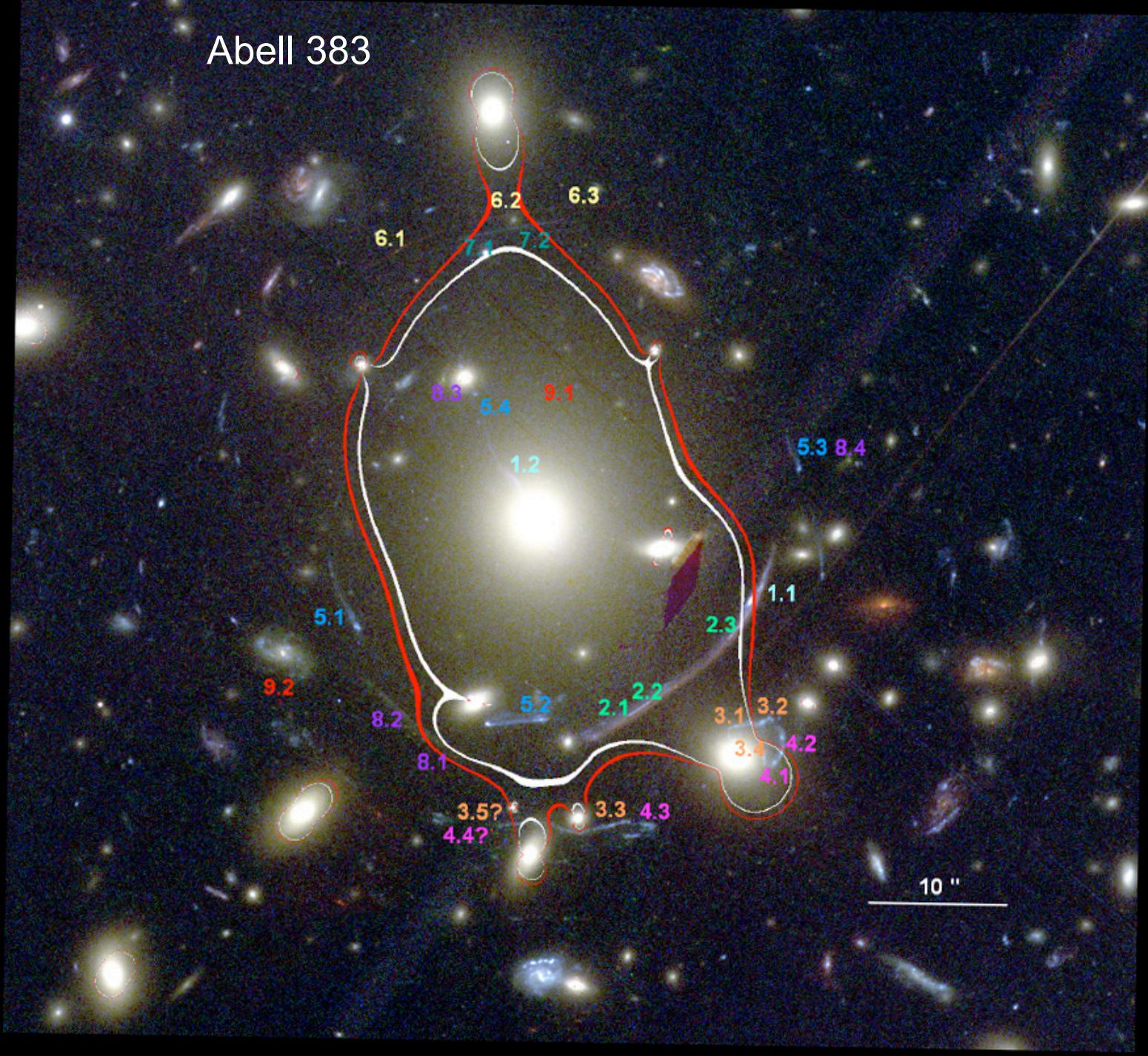
Newly
discovered
and/or
modeled
using
CLASH
data



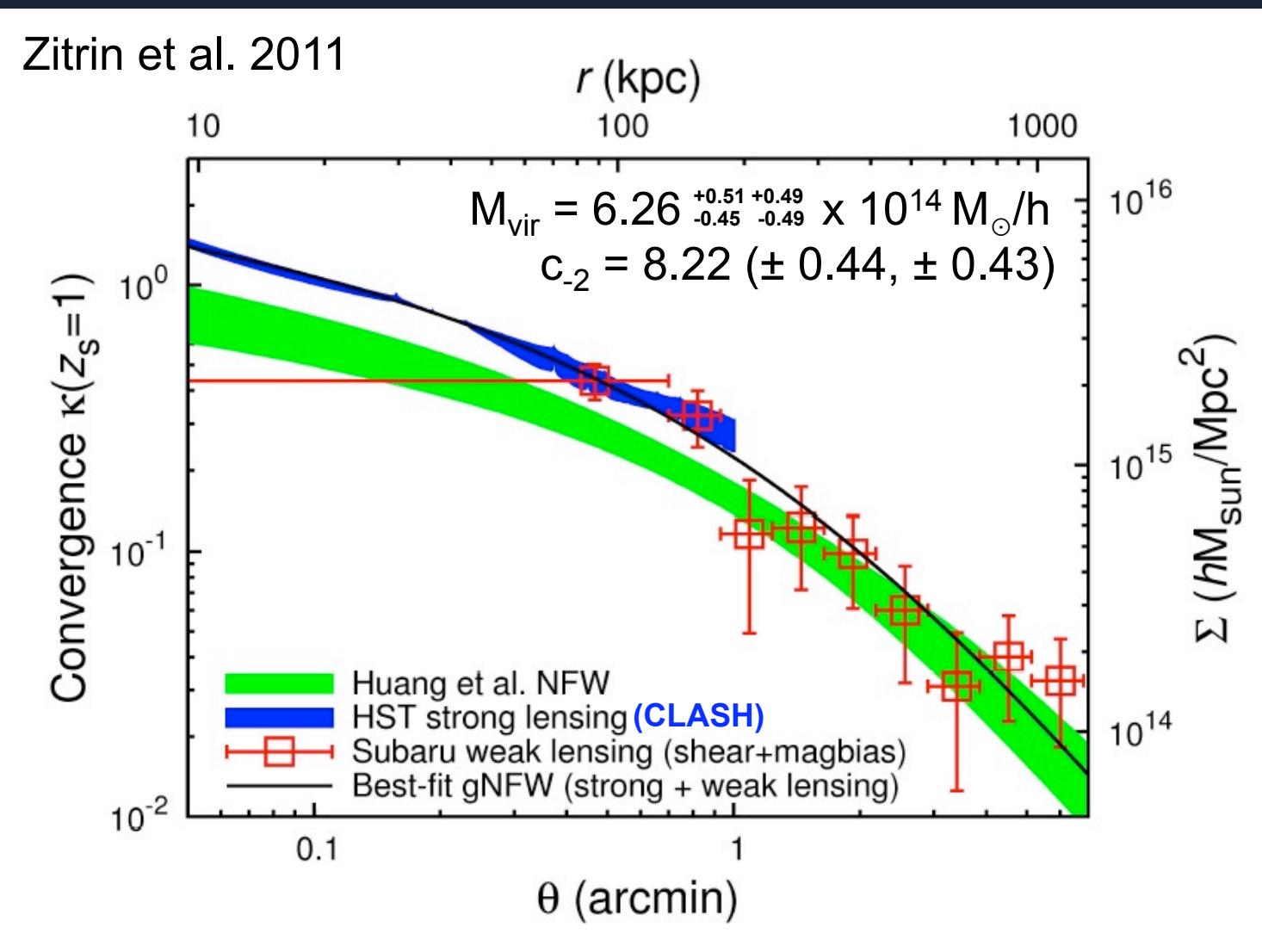
Abell 383

Critical
curve at
 $z=2.55$

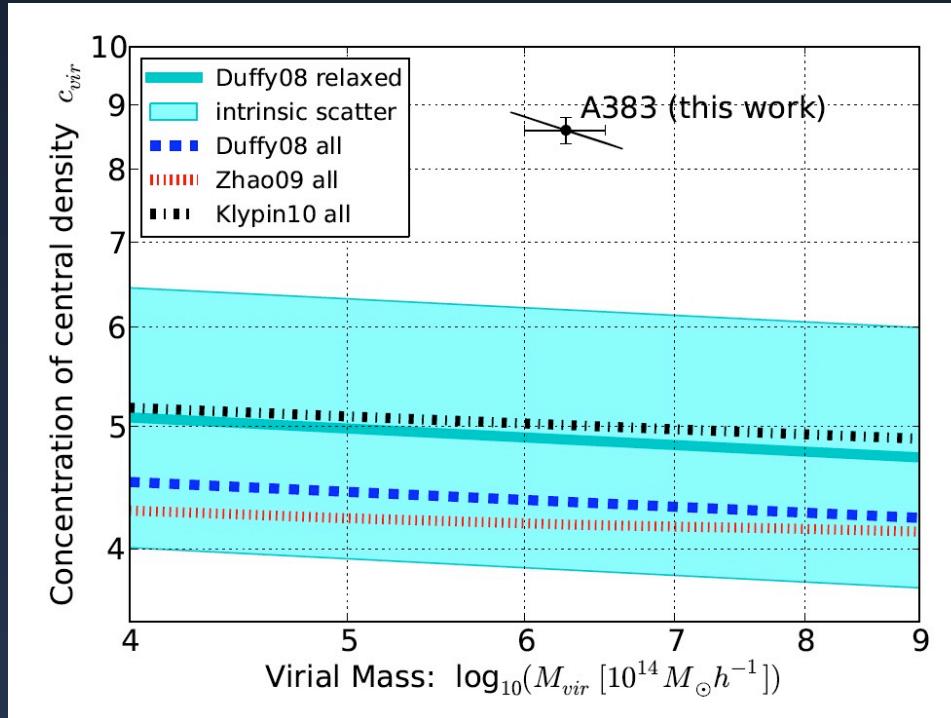
Critical
curve at
 $z=6.03$



Preliminary Results: A383



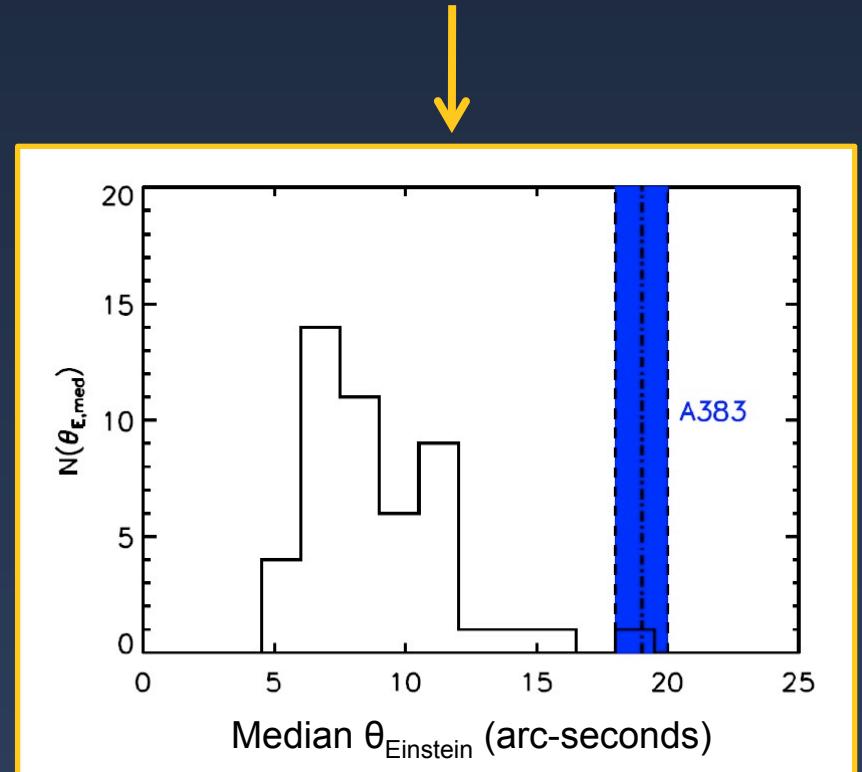
A383: a remarkably strong lens for its mass



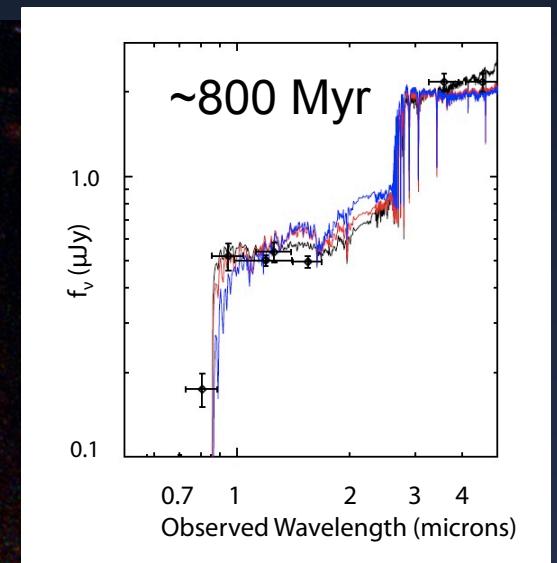
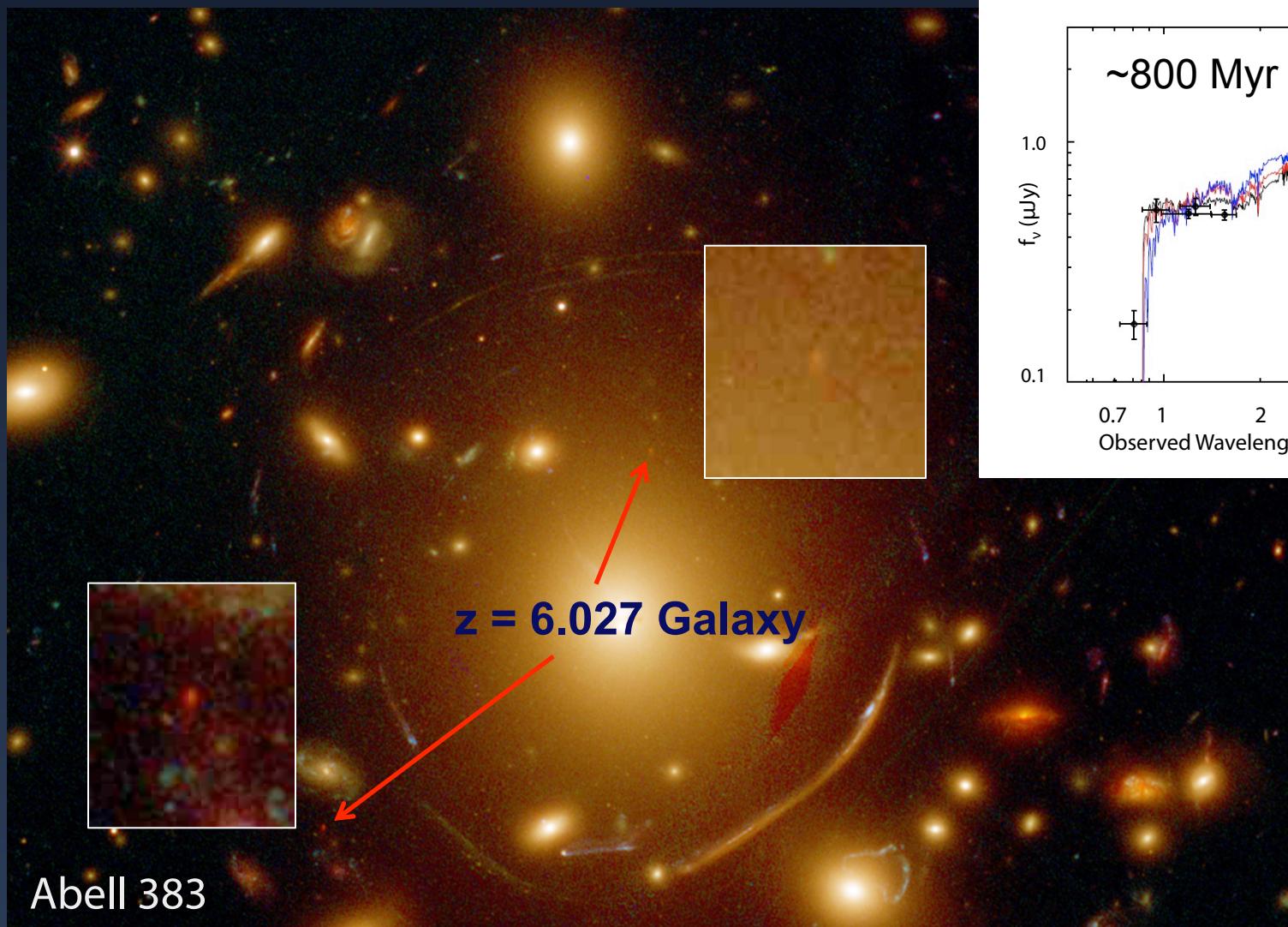
Zitrin et al. 2011

MNU cosmological simulation (Gottlöber & Yepes 2007, Meneghetti et al. 2010, Fedeli et al. 2010) is a $500^3 h^{-3} \text{Mpc}^3$ volume filled with 1024^3 DM and 1024^3 gas particles, evolved in the framework of a cosmological model with $\Omega_m = 0.3$, $\Lambda = 0.7$, and $\sigma_8 = 0.9$.

Distribution of the median Einstein radii of halos with $6 \times 10^{14} \leq M_{vir} \leq 7 \times 10^{14} h^{-1} M_\odot$ extracted from the Mare Nostrum Universe snapshot at $z \sim 0.19$. The blue-shaded region shows the size of the median Einstein radius of A383 (for $z_s = 2$) with its error-bar.



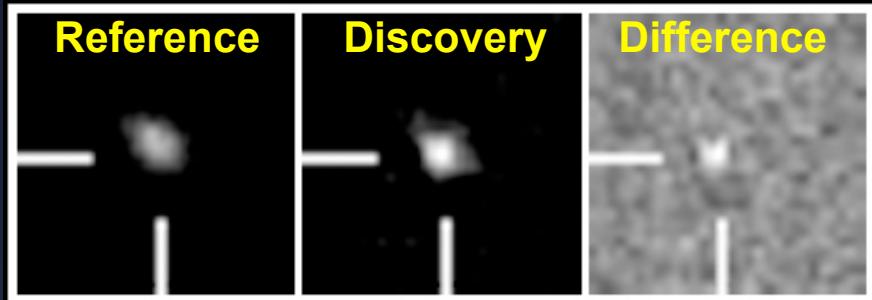
Richard et al. 2011: $z = 6$ lensed Galaxy



11.4 x magnification

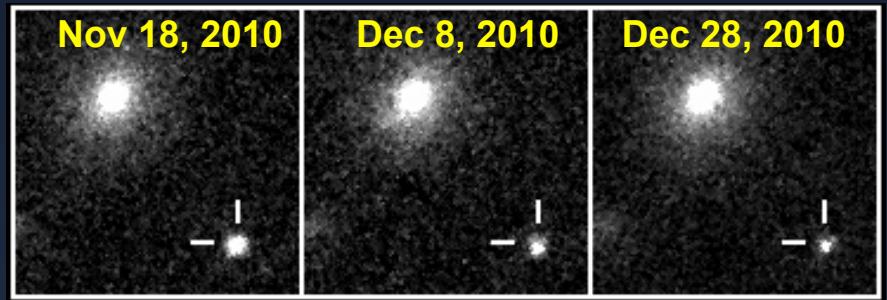
6 CLASH SNe Candidates in 2 Clusters so far

Abell 383 SN Candidate “Caligula” ($z \sim 1.7$)



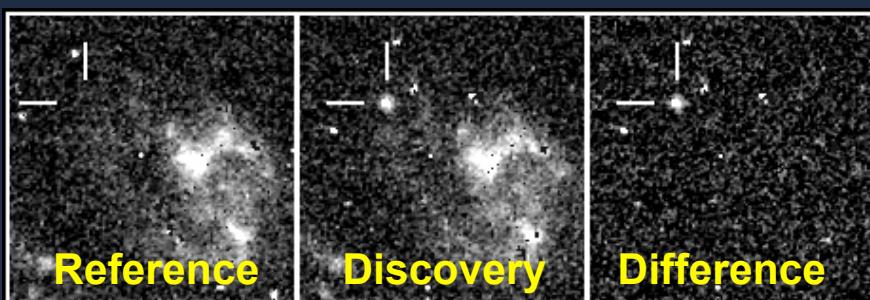
But “Caligula” might be an AGN ...

Abell 383 SN Candidate “Nero” ($z \sim 0.33$)



No reference since Nero was already in first epoch

Abell 383 SN Candidate “Tiberius” ($z \sim 1.1$)

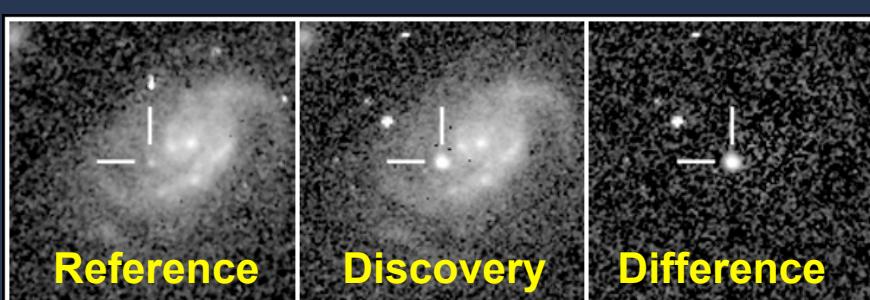


“Tiberius” too blue to be Ia, probably core collapse

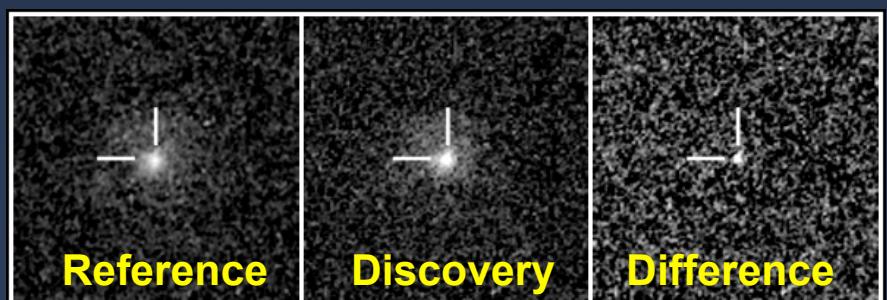
Abell 383 SN Candidate “Galba” ($z = 0.275$)



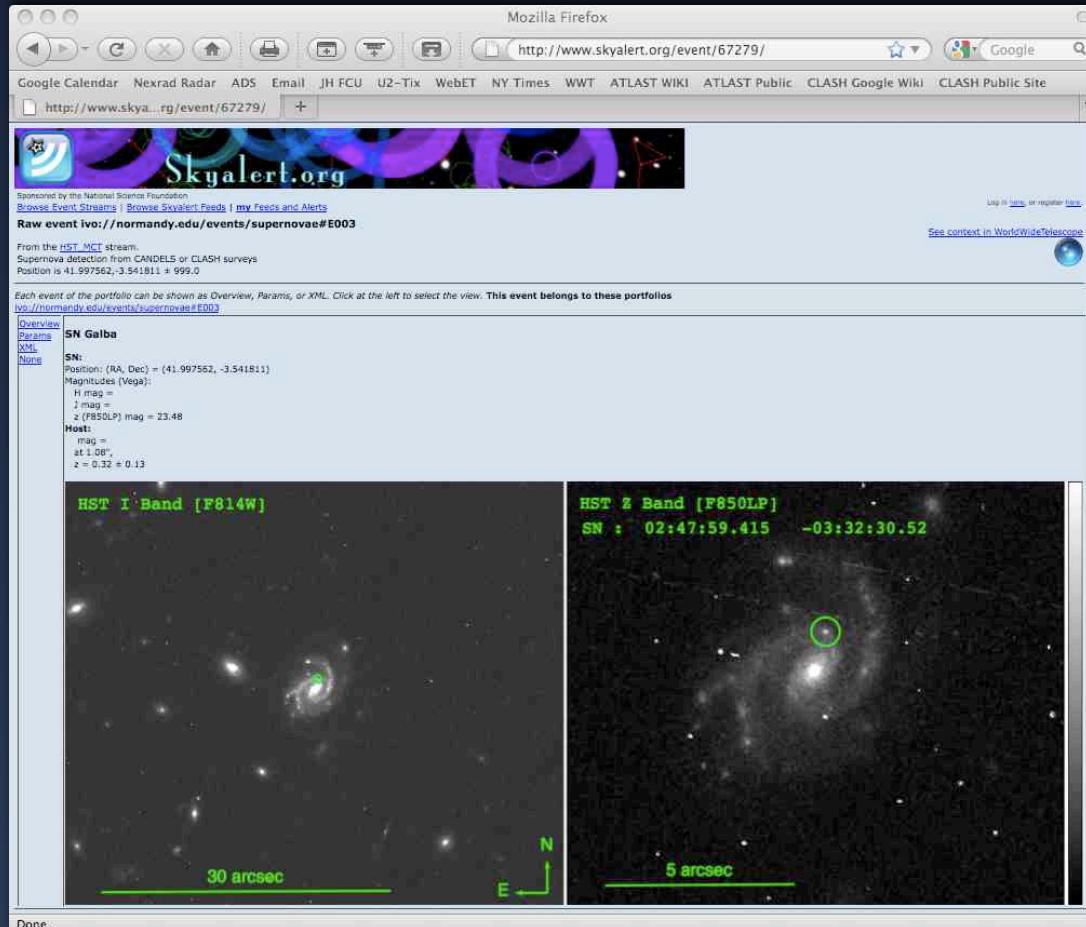
MACS1149 SN Candidate “Scarlet” ($z = 0.354$)



MACS1149 SN Candidate “Otho” ($z = 0.962$)



Brighter SNe Details Streamed to SkyAlert.org



Above: SN Galba Alert

High-Level Science Products

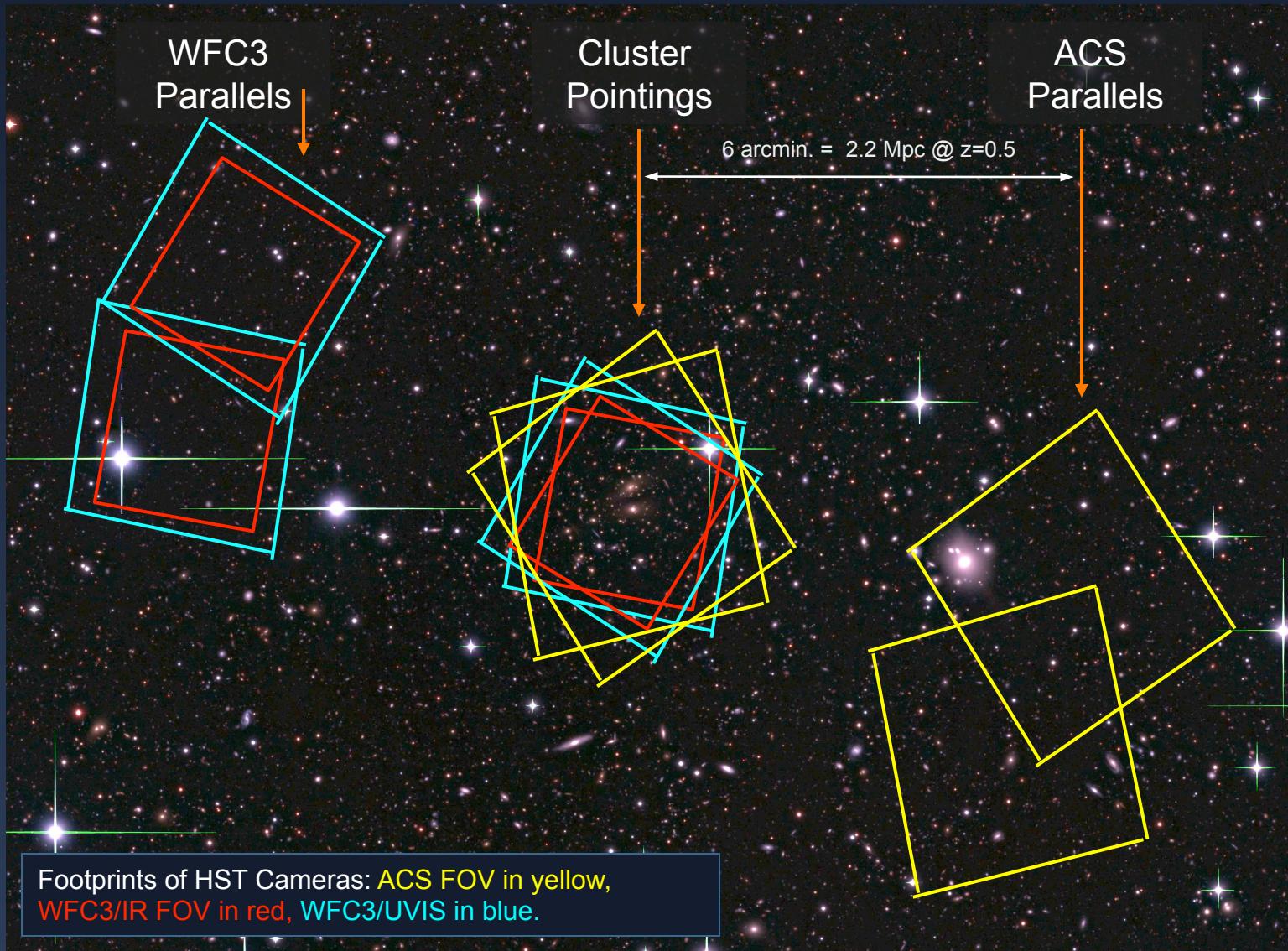
First Release includes

- Co-added, mosaic-drizzled images
- Master detection images
- Source list
- SN candidates (published in real time)
- Color images (jpeg, png formats)
- Additional data released with papers

A second (improved) version of the HLSP will be released 6 months after all data for cluster is acquired.

Cluster Name	50% Complete	100% Complete	First HLSP Release
Abell 383	Jan 5, 2011	Mar 1, 2011	May 1, 2011
MACS1149	Feb 13, 2011	Mar 9, 2011	May 9, 2011
Abell 2261	Apr 12, 2011	May 20, 2011	Jul 20, 2011
RXJ 1347	May 16, 2011	Jul 11, 2011	Sep 11, 2011
MACS2129	Jun 12, 2011	Jul 11, 2011	Sep 11, 2011
MACS1206	May 25, 2011	Jul 19, 2011	Sep 19, 2011
MS 2137	Sep 26, 2011	Oct 27, 2011	Dec 27, 2011
MACS0647	Oct 24, 2011	Nov 26, 2011	Jan 26, 2012
MACS0717	Oct 9, 2011	Dec 7, 2011	Feb 7, 2012
MACS0744	Oct 31, 2011	Dec 27, 2011	Feb 27, 2012

CLASH: Observation Footprint



Summary

- The CLASH MCTP is progressing on schedule.
- Supernovae that are bright enough for ground follow-up are sent to SkyAlert.org and VOAlert.
- Two refereed papers already submitted – one by CLASH team and one by MAST archive users.
- Minor tweak to UV filter exposure sequence to improve alignment.
- Supporting observations going well (slow start on VLT but now getting a lot of spectra). Significant SZE program with CSO/GBT.
- High-level science products will be released on a regular schedule, including compilations of x-ray, IR, sub-mm, and spectroscopic data.
- <http://www.stsci.edu/~postman/CLASH>