

MUSE integral-field spectroscopy towards the Frontier Fields Cluster Abell S1063

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In collaboration with:

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L. Christensen, A. M. Koekemoer, T. Kruehler, M. Lombardi, A. Mercurio,
M. Nonino, and A. van der Wel.



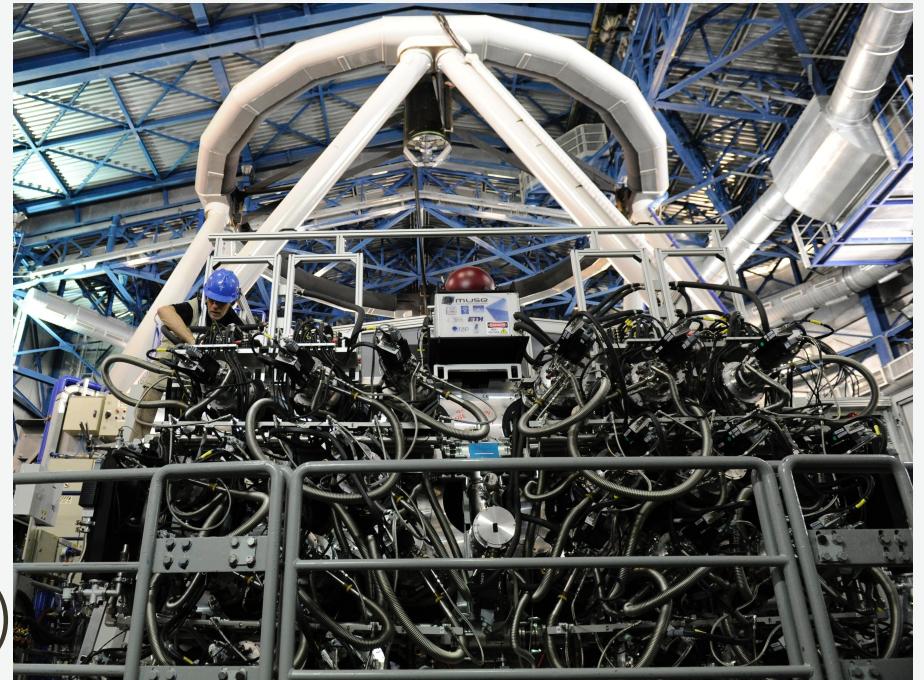
**university of
groningen**

AS1063 by MUSE

For more details see:
2015A&A...574A..11K

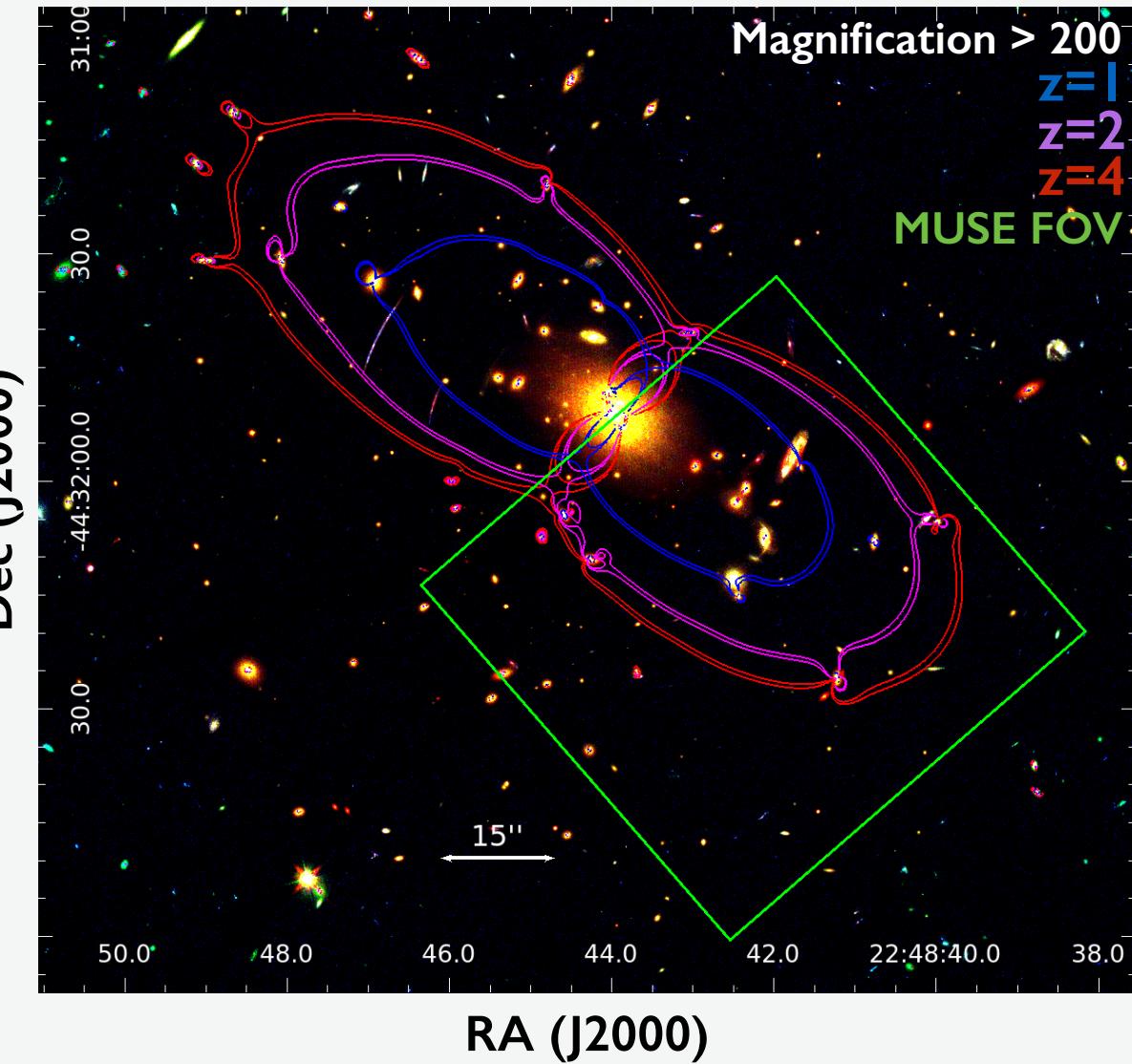
MUSE

- Multi Unit Spectroscopic Explorer (MUSE)
- Recently installed at VLT
- 24 Integral Field Units (IFUs)
- 4800-9300 Å (1.25 Å/px)
- 1'x1' FOV (0.2"/px)



Abell S1063

- Part of HFF and CLASH
- Merging cluster
- $z=0.348$
- $\sigma \approx 1500 \text{ km/s}$

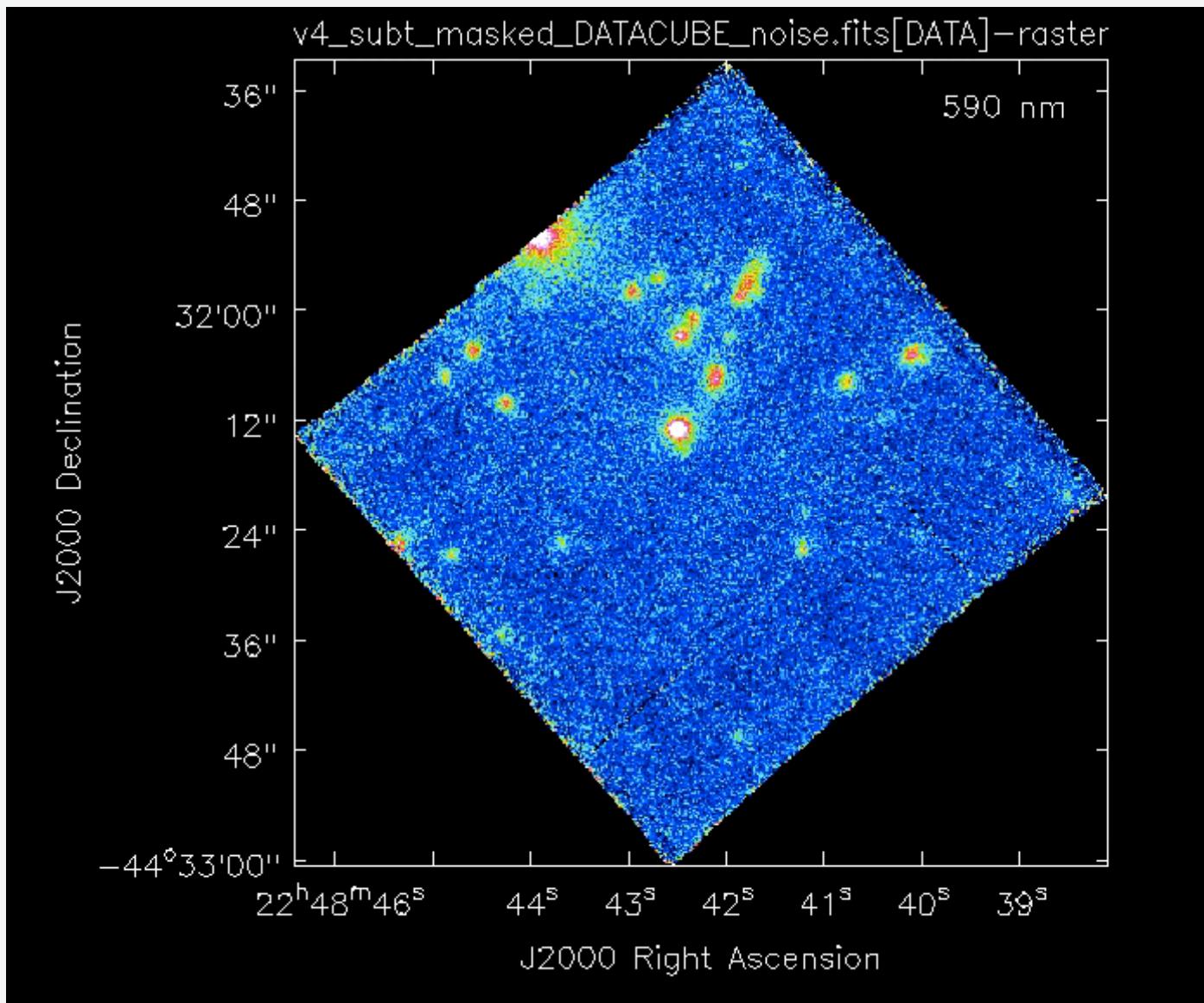


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Observations

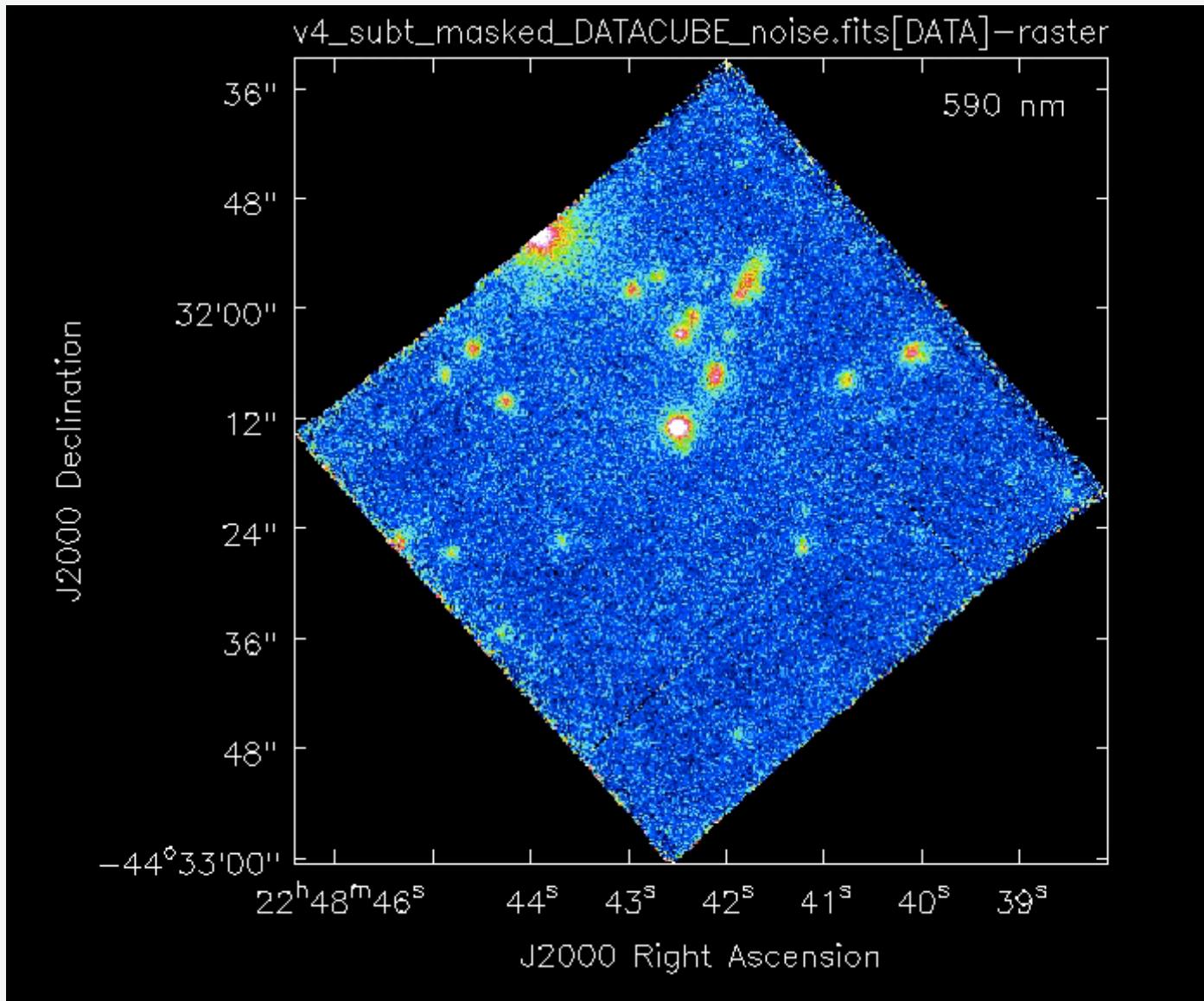
- Science Verification
- June 25th & 29th
- PIs: K. Caputi & C. Grillo / B. Clement
- 3.1 hours total exposure time
- Standard pipeline reduction
- 3D datacube

MUSE data



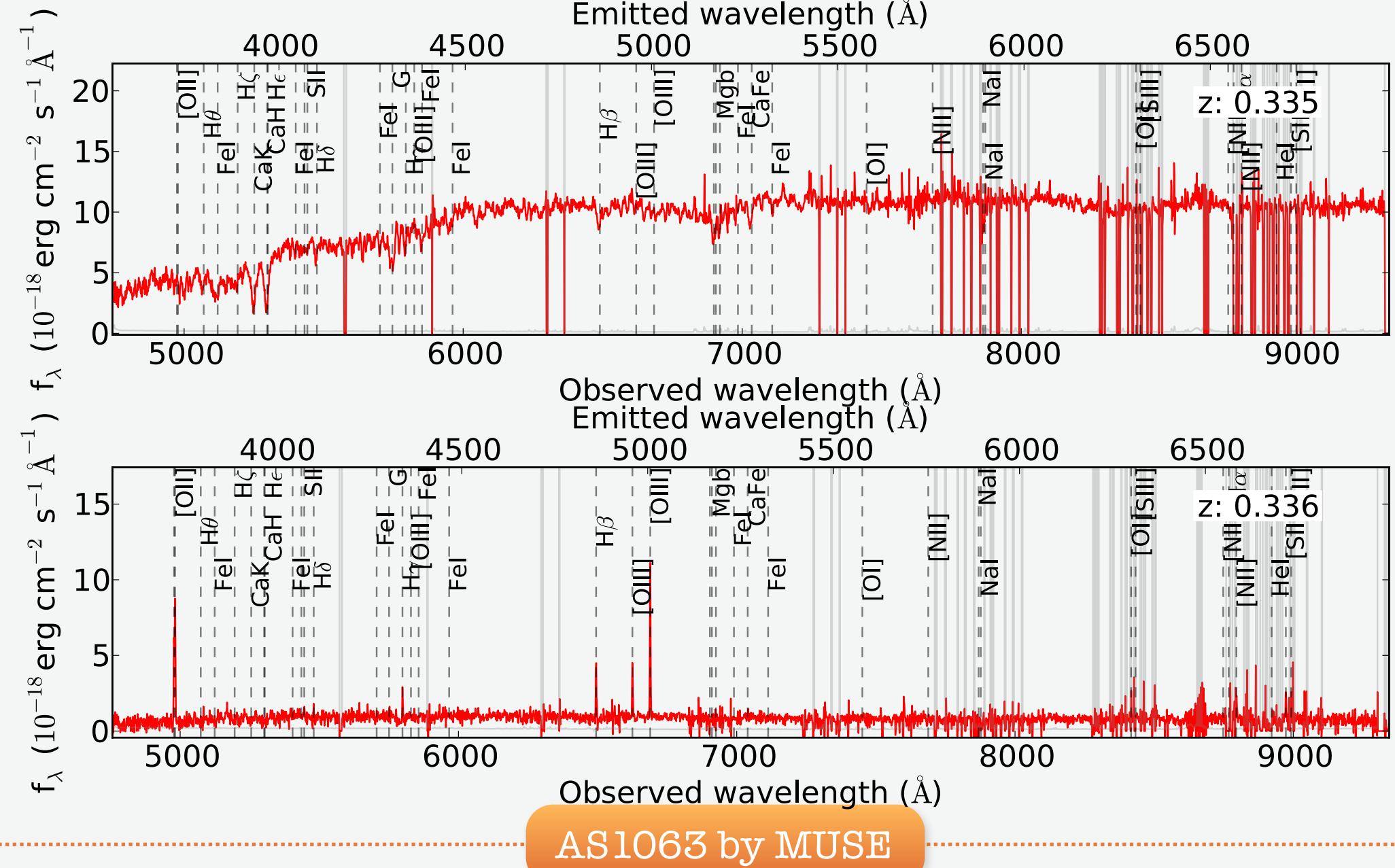
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MUSE data

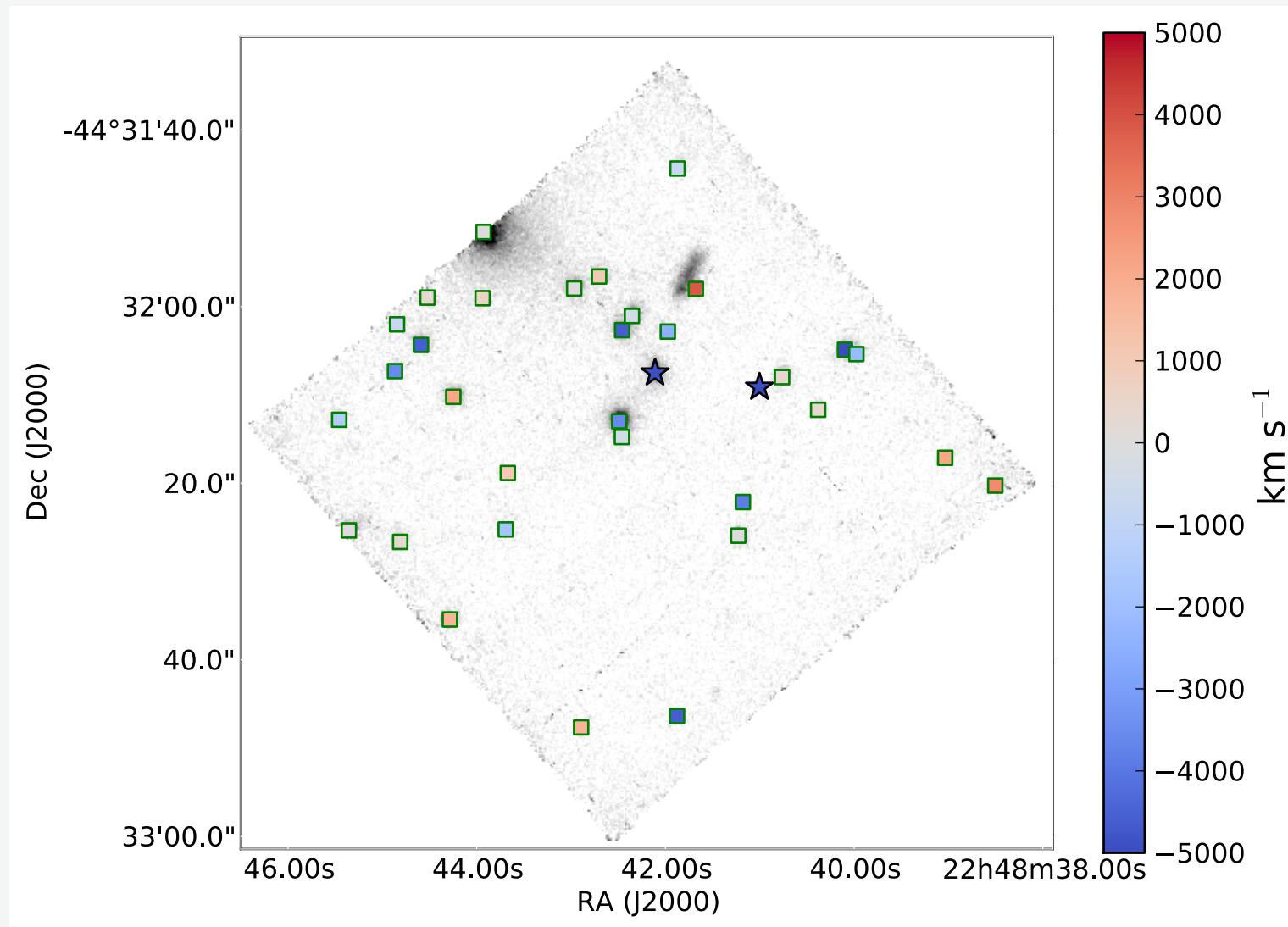


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Cluster members

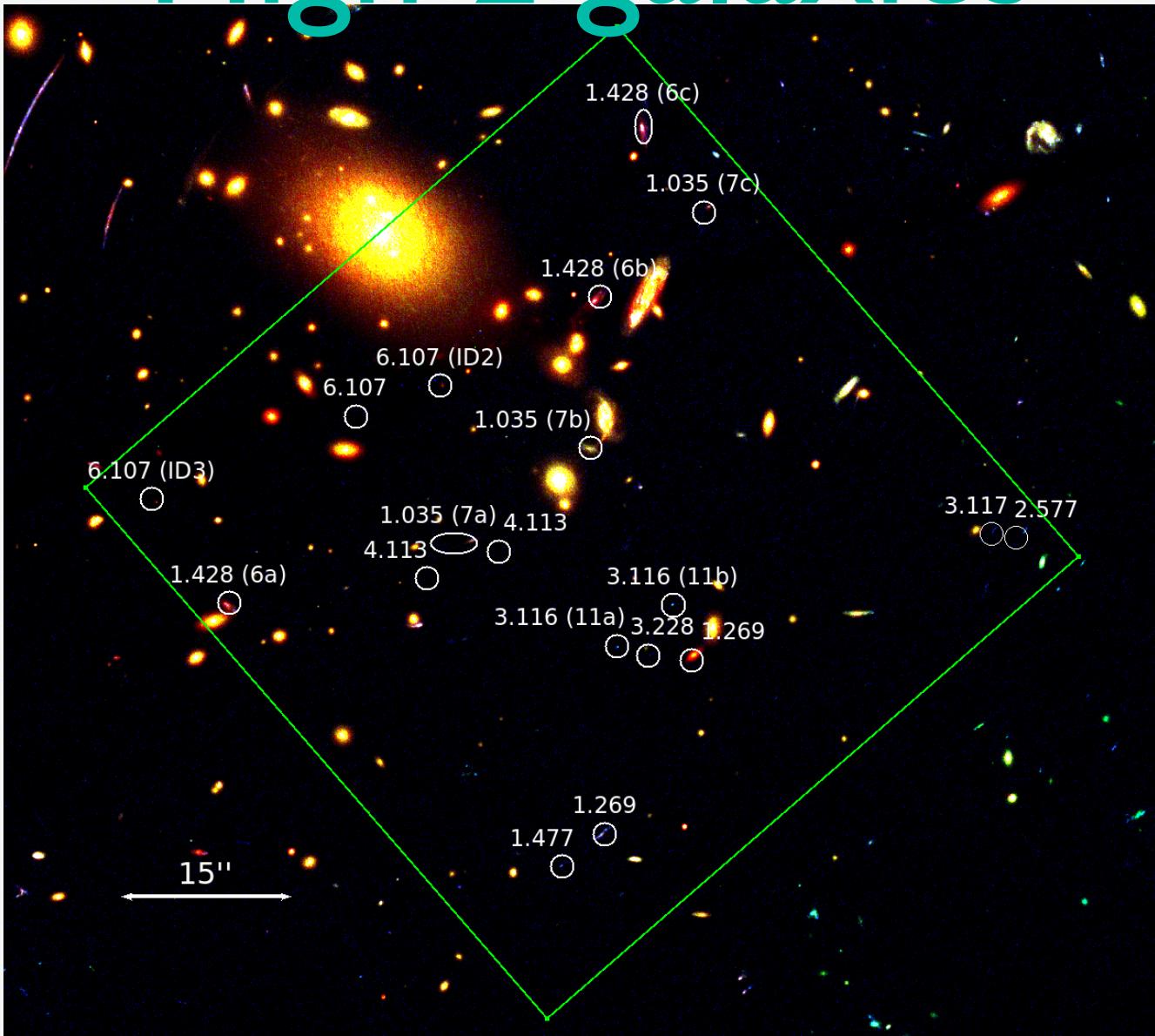


Cluster members



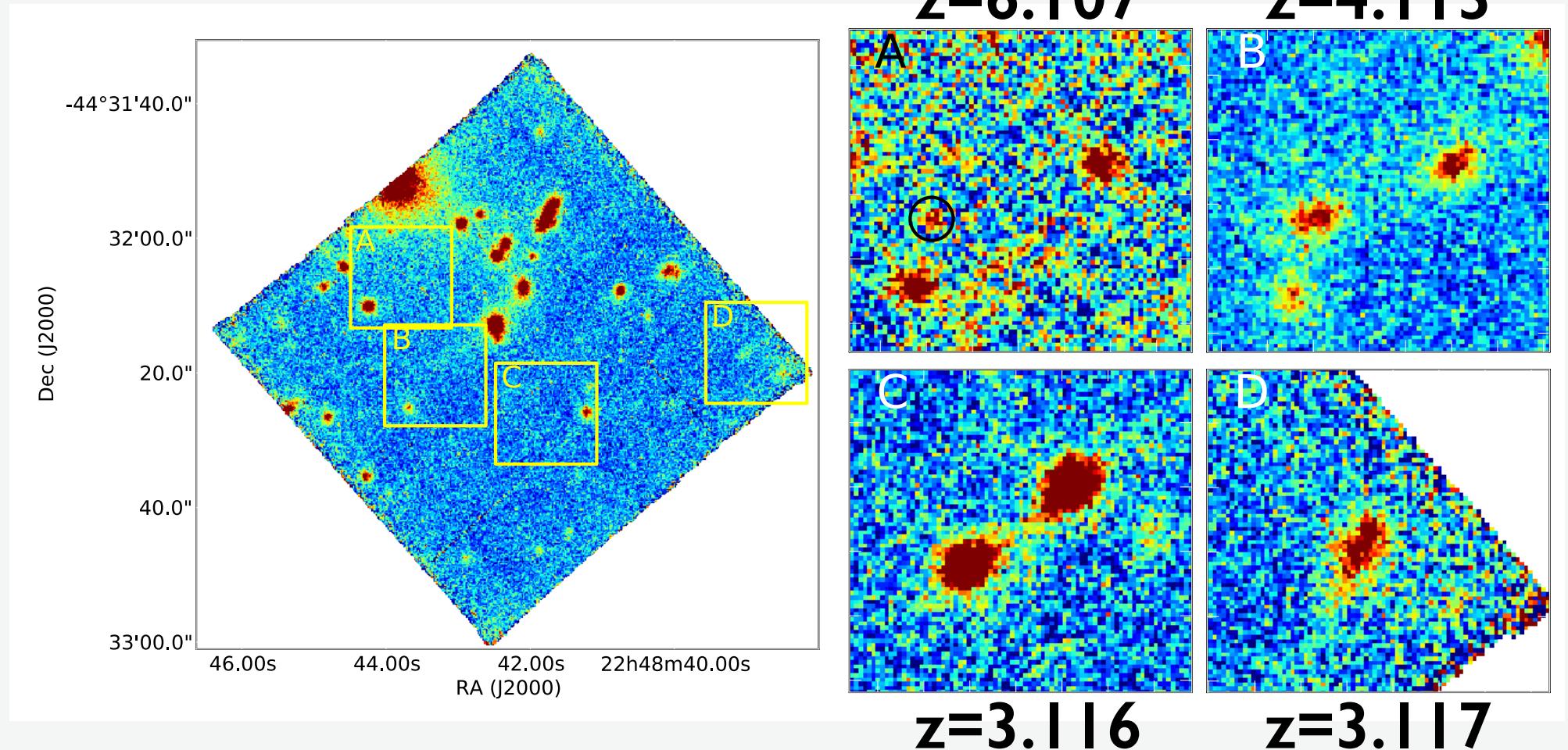
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High-z galaxies



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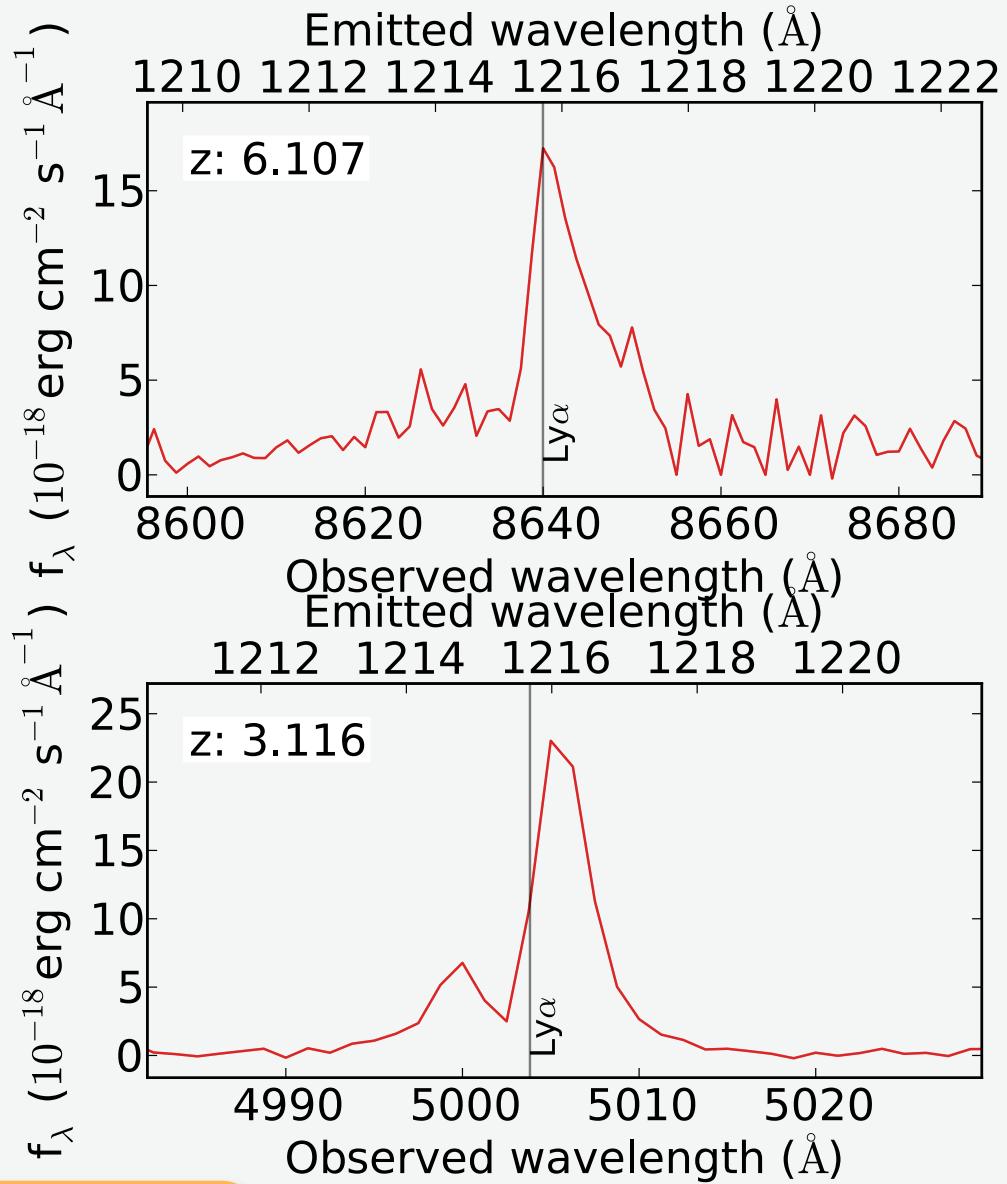
Lyman- α Emitters



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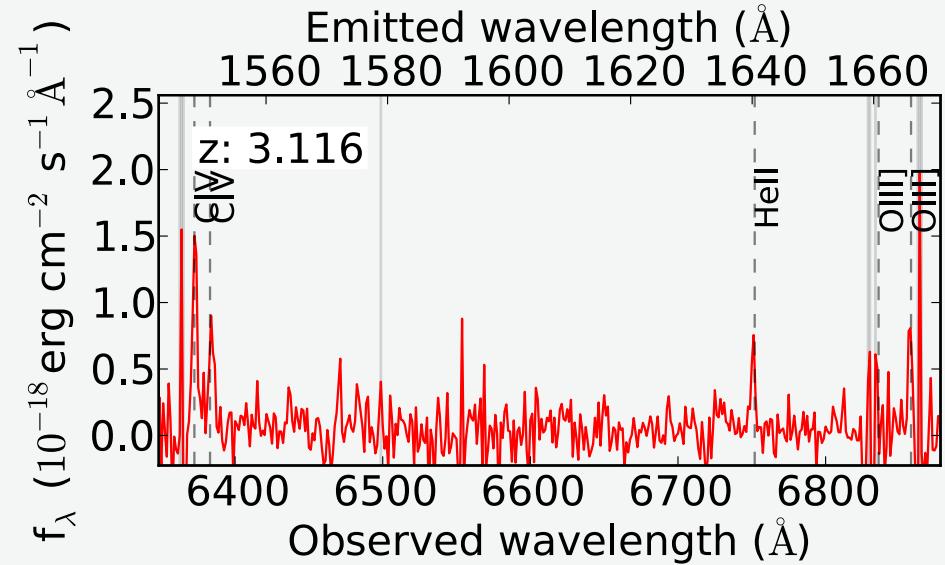
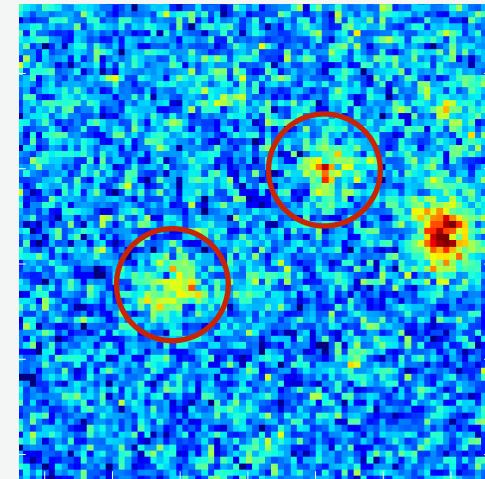
Ly α - profiles

- 5 LAEs
- $z=3.116; 3.117$ (**new!**);
 3.228 (**new!**);
 4.113 (**new!**); 6.107
- Narrow, FWHM=2.5 \AA
- Asymmetrical
- Double peaked with small separation

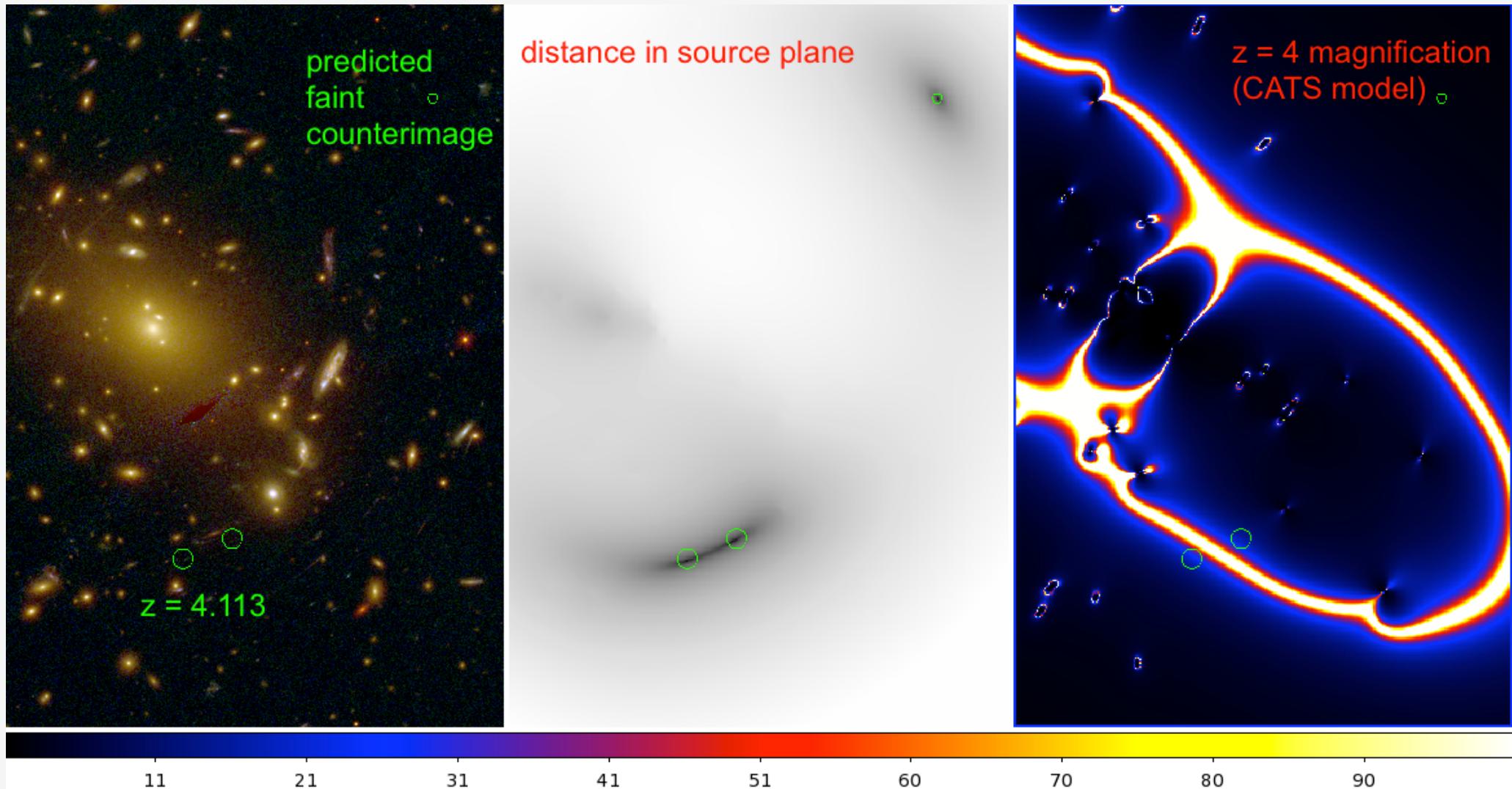


Presence of AGN

- Multiply lensed LAE at $z=3.116$
- UV emission lines
- C IV, He II, O III], and C III]



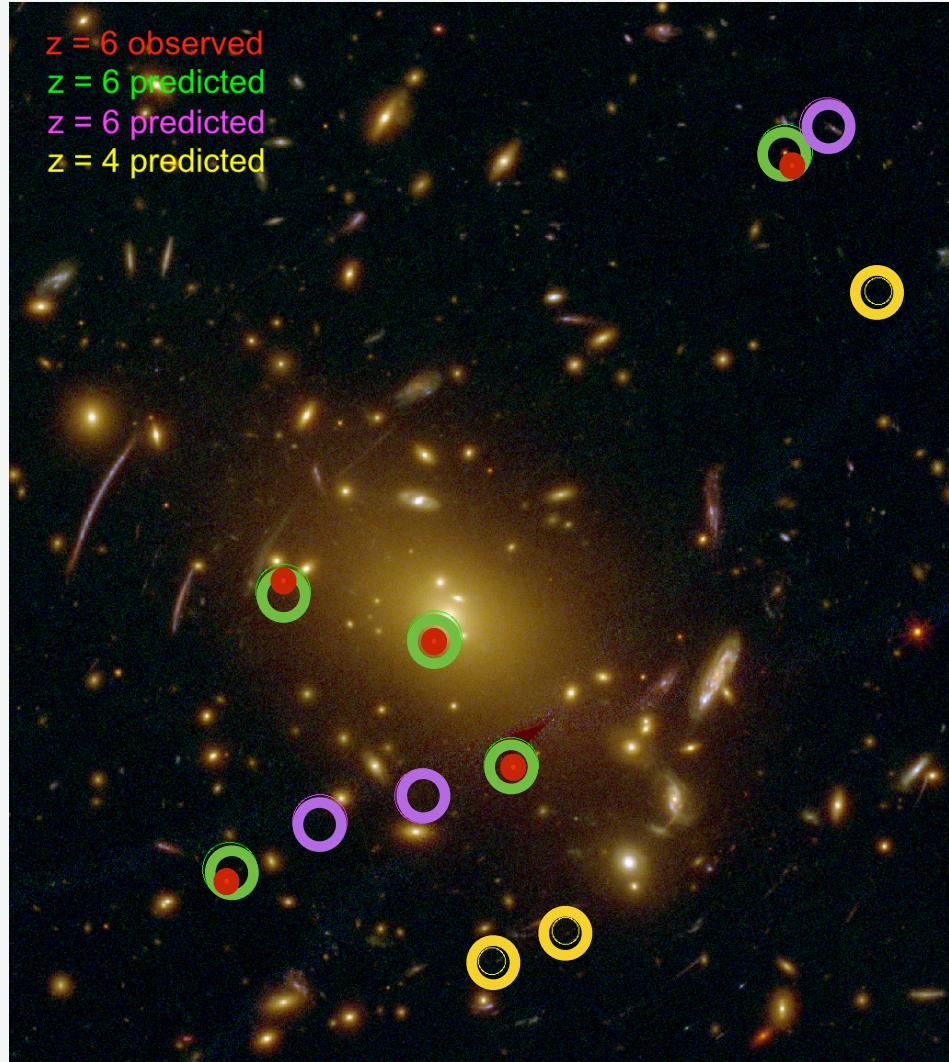
New z=4 LAE



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Figure provided by Dan Coe

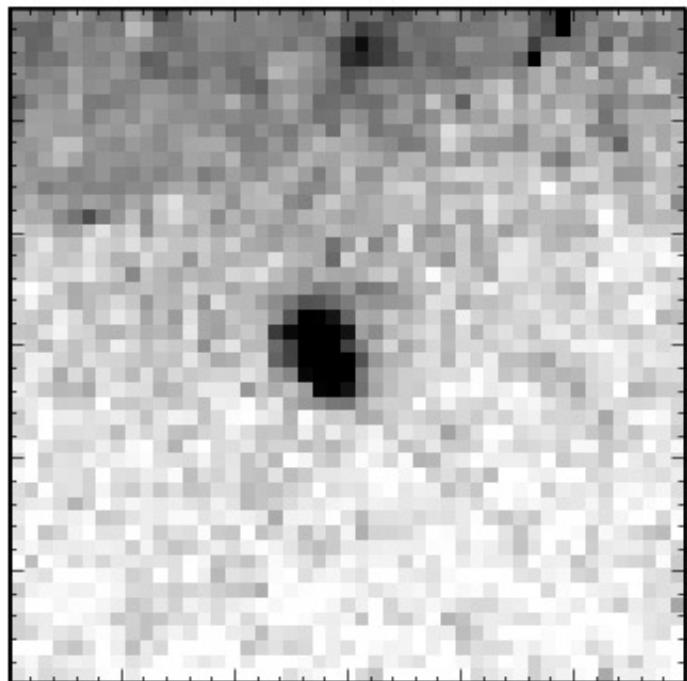
$z \sim 6$ galaxy pair?



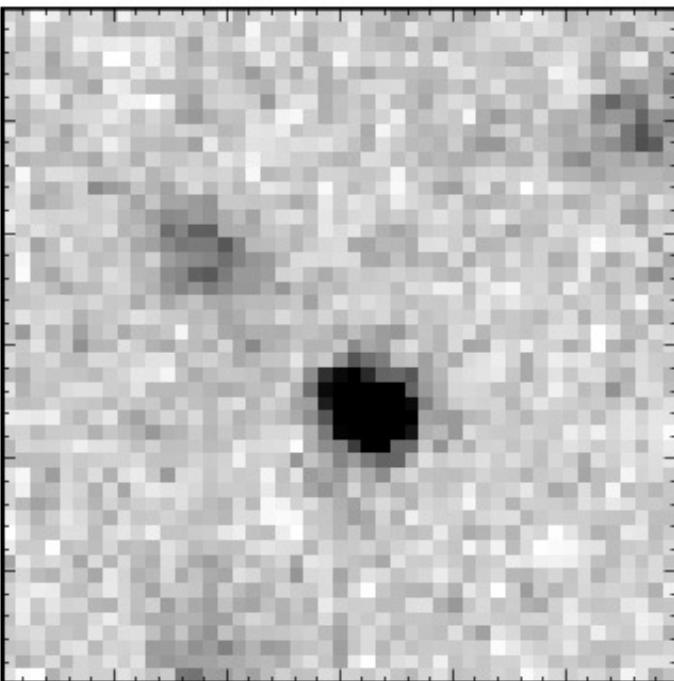
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$z \sim 6$ galaxy pair?

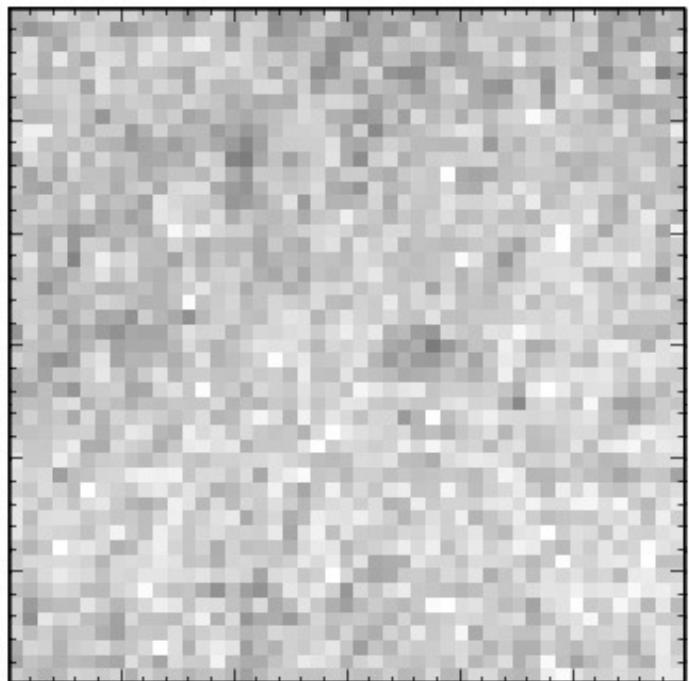
52a



52b



52c



Conclusions

- MUSE is ideal for observing clusters
- 53 redshifts determined with 3.1 h exposure
 - 34 cluster members, 29 new
 - 17 galaxies at higher z, 10 new
- Possible $z \sim 3$ AGN found
- New $z=4$ LAE found, consistent with models
- Wide range of science

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- June 15-19
- Groningen
- Abstract deadline:
March 22nd
- [www.astro.rug.nl/
archeocosmic](http://www.astro.rug.nl/archeocosmic)

university of
groningen

faculty of mathematics
and natural sciences

kapteyn astronomical
institute

June 15-19, 2015
Groningen, The Netherlands

FIRST STARS, GALAXIES, AND BLACK HOLES

Now AND THEN

Invited speakers:

- W. Aoki (NAOJ)
- T. Beers (U. Notre Dame)
- T. Brown (STScI Baltimore)
- E. Caffau (Obs. Paris)
- R. Cooke (U. California)
- A. Ferrara (SNS Pisa)
- S. Kashlinsky (NASA)
- A. Koch (ZAH Heidelberg)
- P. Oesch (Yale U.)
- K. Omukai (Tohoku U.)
- T. Oosterloo (ASTRON/U. Groningen)
- A. Reines (U. Michigan)
- D. Schaerer (U. Geneve)
- R. Schneider (INAF Rome)
- E. Skillman (U. Minnesota)
- E. Starkenburg (AIP Potsdam)
- B. Venemans (MPIA Heidelberg)
- M. Volonteri (IAP Paris)
- N. Yoshida (IPMU/U. Tokyo)

Scientific Organising Committee:

- V. Bromm (U. Texas)
- B. Ciardi (MPA Munich)
- M. Franx (Leiden Obs.)
- Z. Haiman (Columbia U.)
- V. Hill (Obs. Côte d'Azur)
- M. Geha (Yale U.)
- K. Nomoto (IPMU/U. Tokyo)
- M. Pettini (U. Cambridge)
- S. Salvadori (U. Groningen - Chair)

Image credits: Reines+2011, Greif+2008, Abel, Wise, and Koehler.

www.astro.rug.nl/archeocosmic

Emission lines

Line	λ	low-z	high-z
H α	6562.8	-	0.42
[O III]	5006.8	-	0.86
H β	4861.3	-	0.91
[O II]	3726,3729	0.29	1.50
C III]	1907, 1909	1.52	3.88
C IV	1548, 1551	2.10	5.00
Ly α	1215.7	2.94	6.65

Line ratio's

	Measured	AGN ¹	Hot O-stars ¹
C IV	17.3	1	1
He II/C IV	0.20	0.10-1.51	0.03
O III]/C IV	0.25	0.59-0.71	0.24
C III]/C IV	0.29	0.49-0.57	0.29

¹Binette et al. 2003, A&A, 405, 975

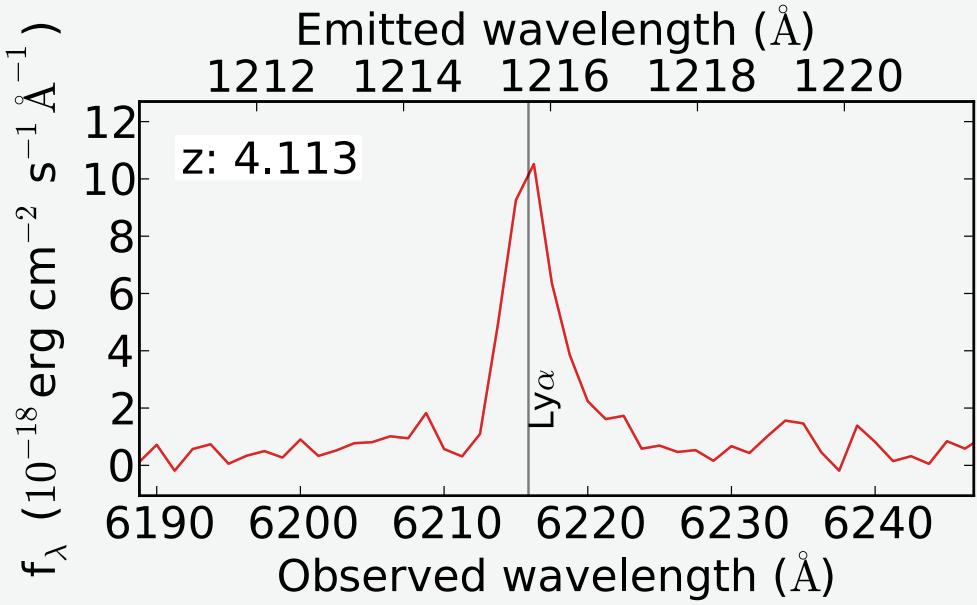
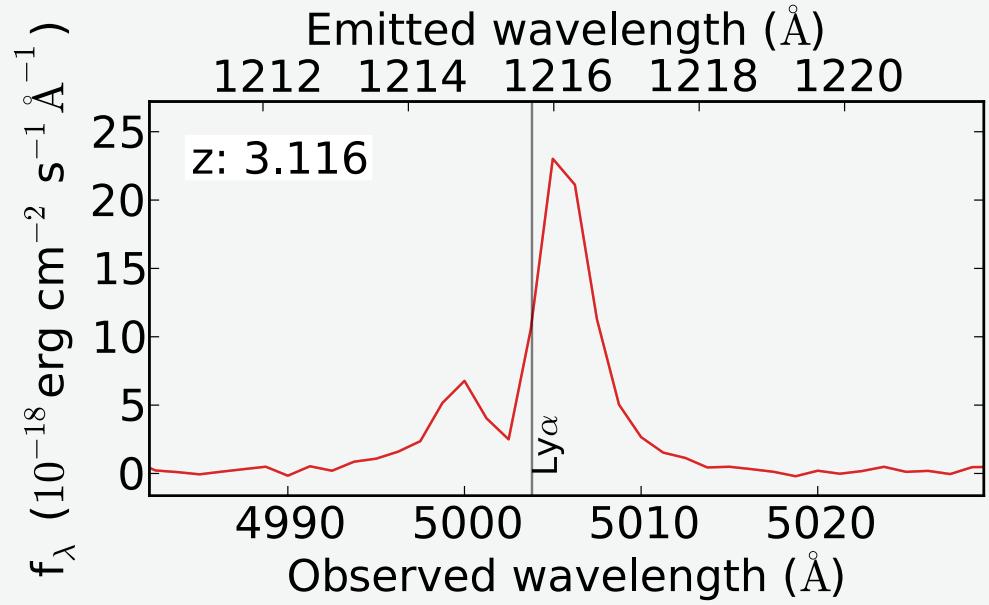
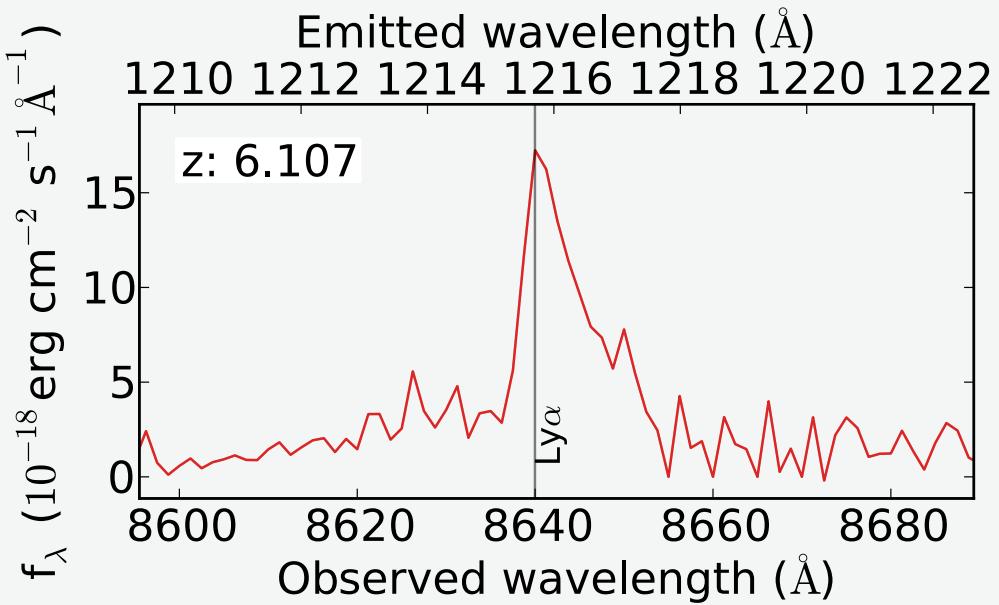
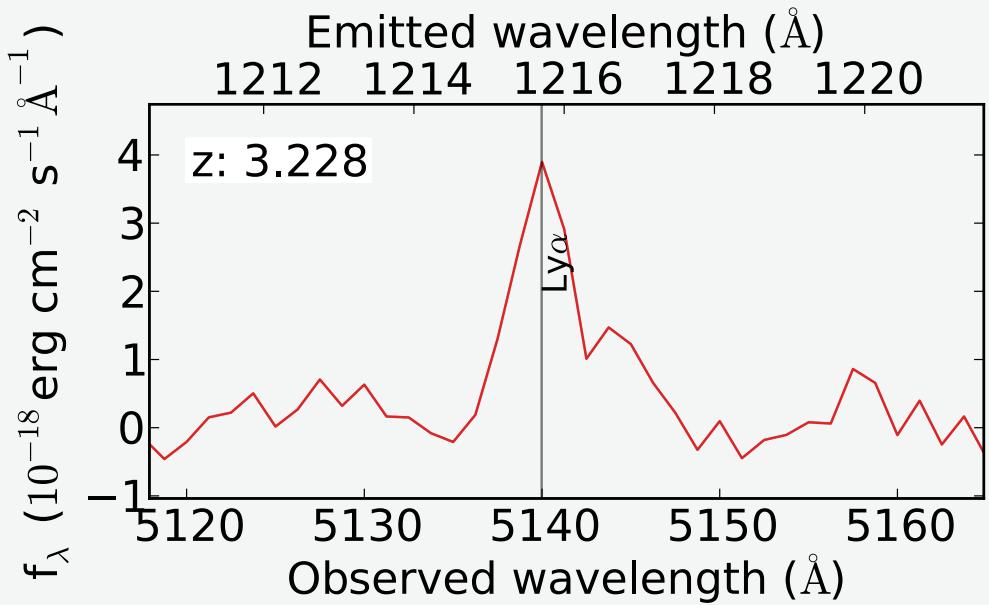
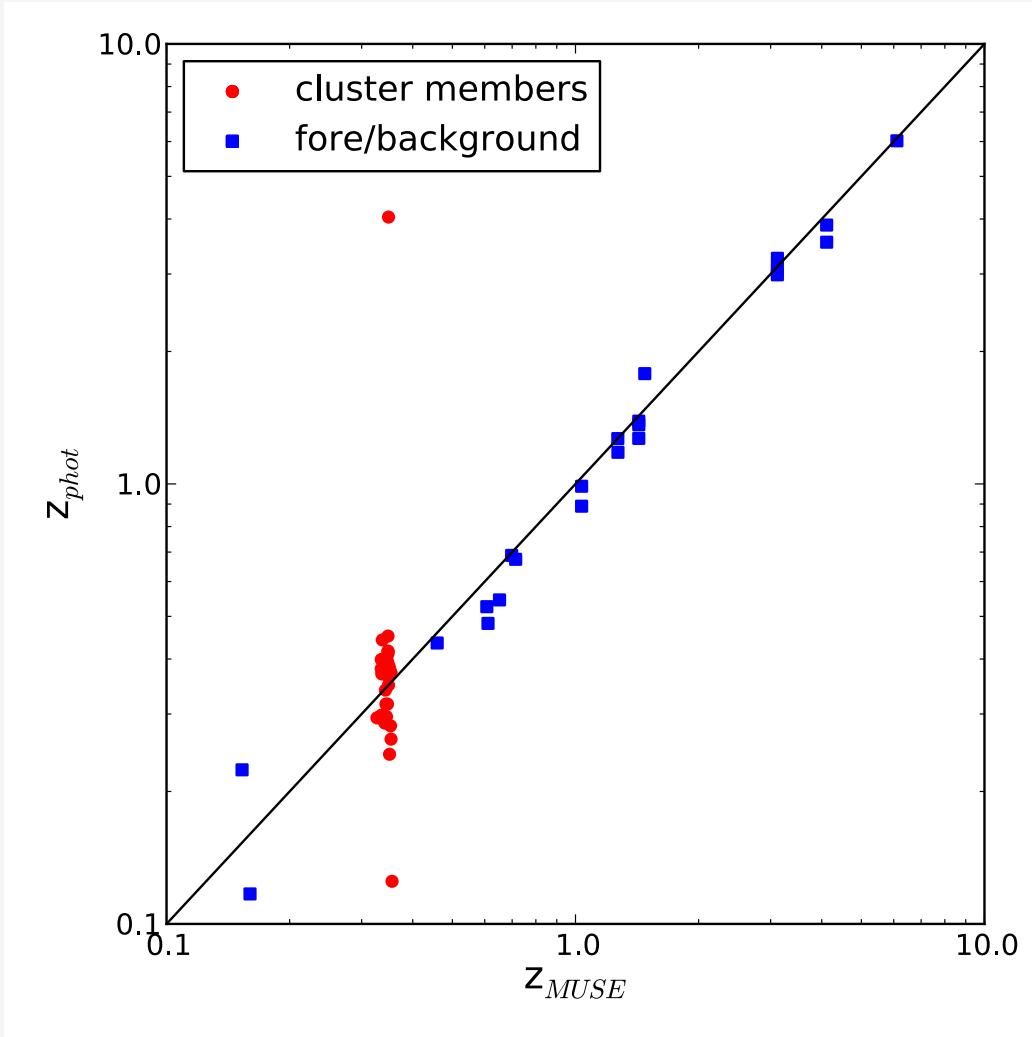


Photo-z estimates



AS1063 by MUSE

MUSE

- Wide Field Mode:
 - 1×1 arcmin 2 FOV
 - 0.2" per spaxel
- Wavelength:
 - 4800 - 9300 Å
 - 1.25 Å per spaxel
- Spatial accuracy $\sim 0.12''$

