Observations of lensing clusters with BlueMUSE

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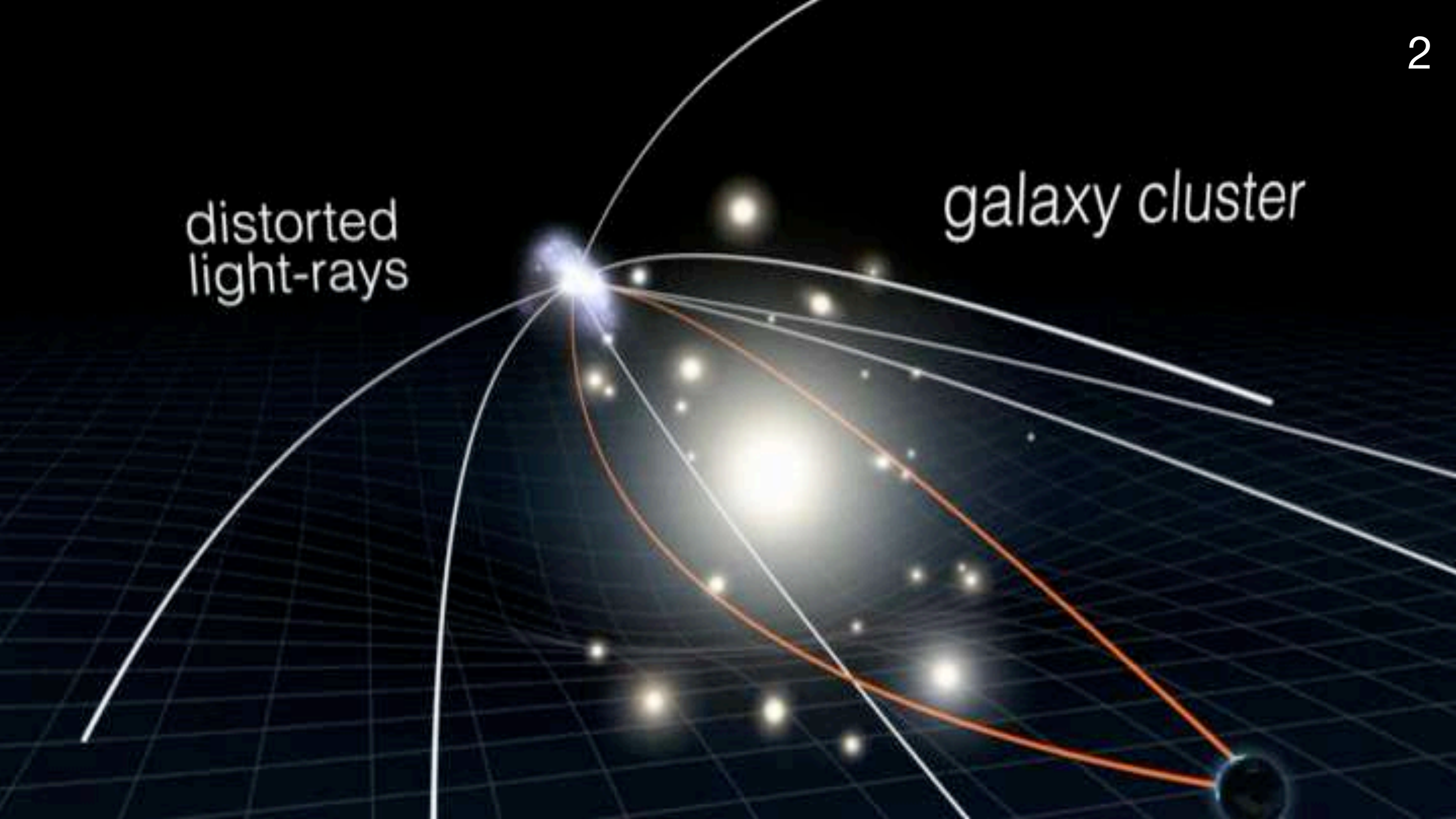
BlueMUSE
multi unit spectroscopic explorer

BlueMUSE Science meeting, April 25


distorted
light-rays
galaxy cluster

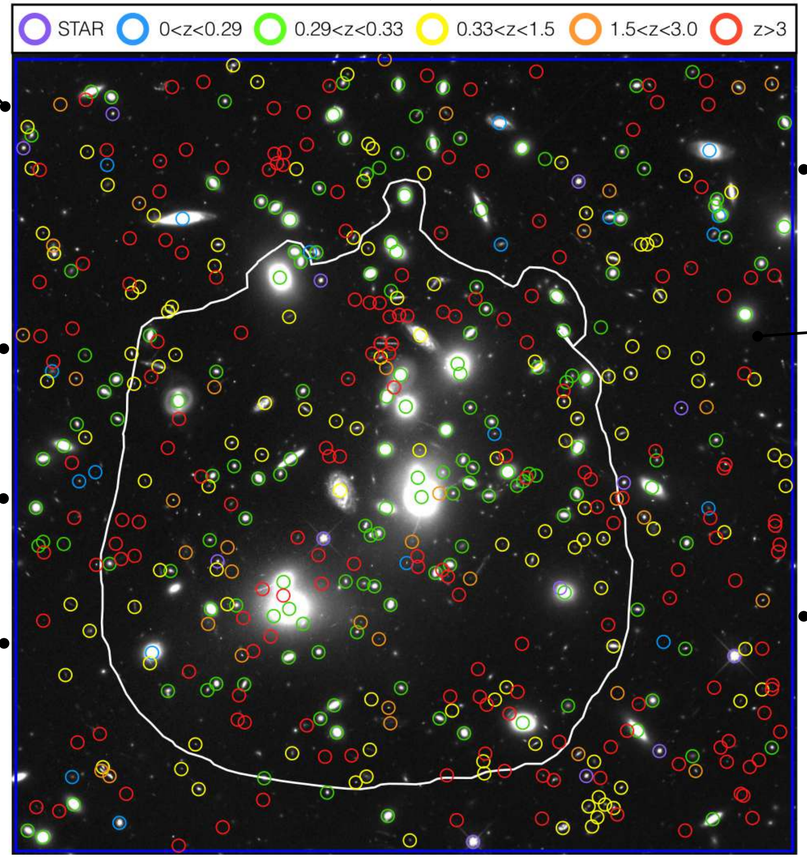
Through the lens with MUSE

Multiple images and lens model

Cluster core mass distribution

Resolved properties (arcs / arclets)

Velocity distribution of cluster members



Low mass intermediate redshift galaxies

Resolved properties of cluster members

Gas in the ICM / stripped galaxies

Low mass LAEs

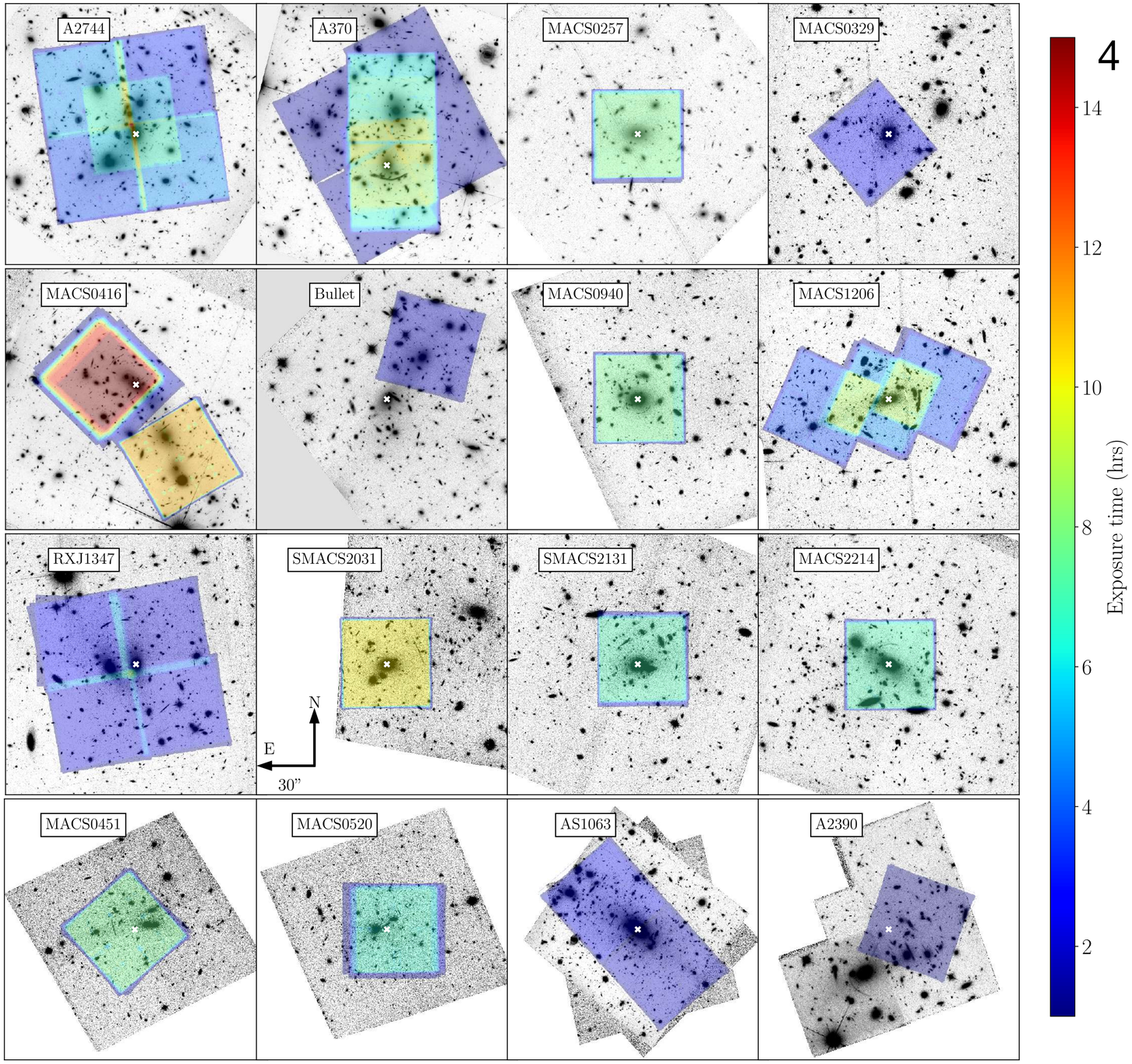
Mahler et al. 2018

Lensing clusters observations with MUSE

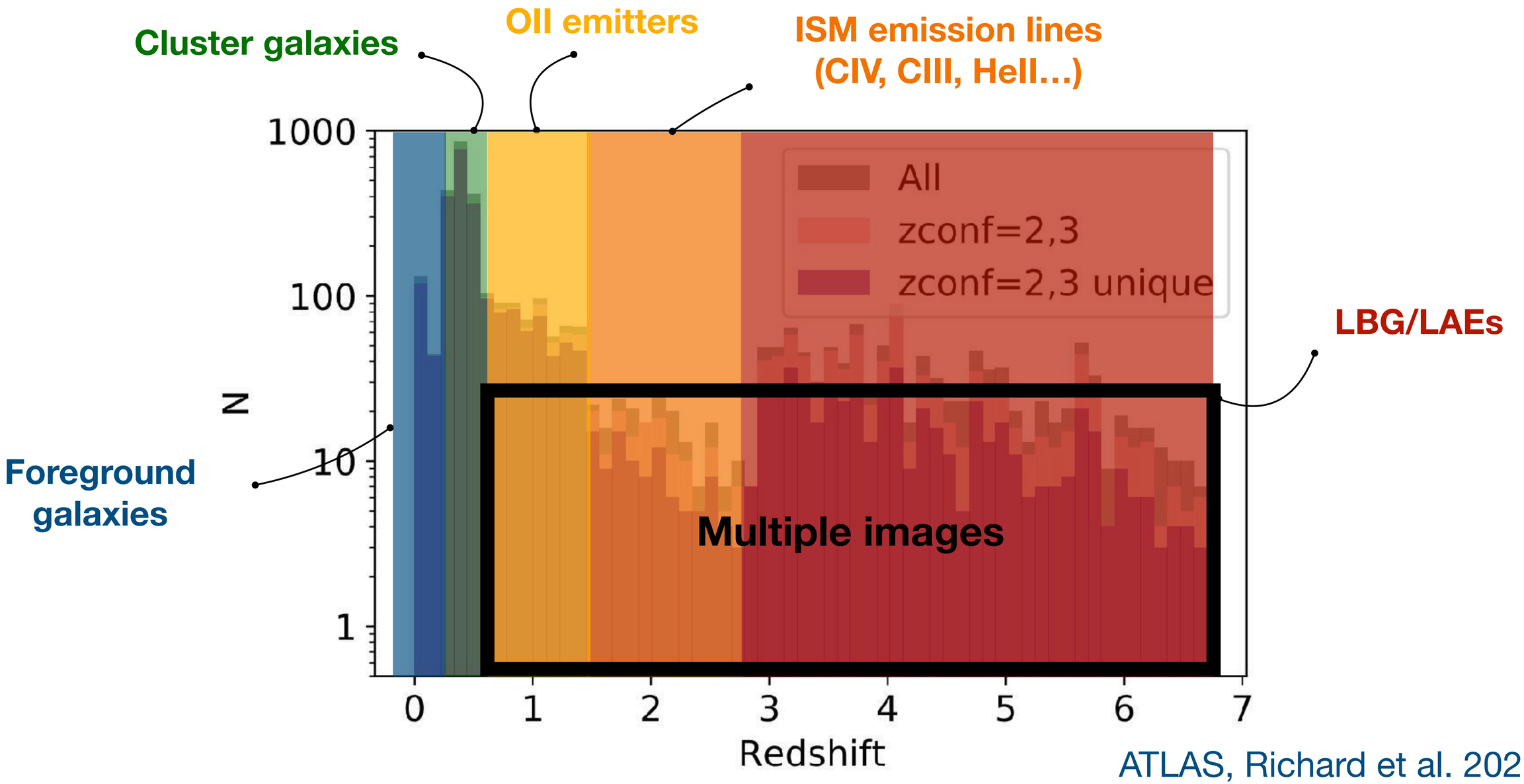
>150 galaxy clusters observed with MUSE

- Kaleidoscope
- Frontier fields
- CLASH
- BUFFALO
- GTO…

ATLAS
Richard et al. 2021



Lensing clusters observations with MUSE



ATLAS, Richard et al. 2021

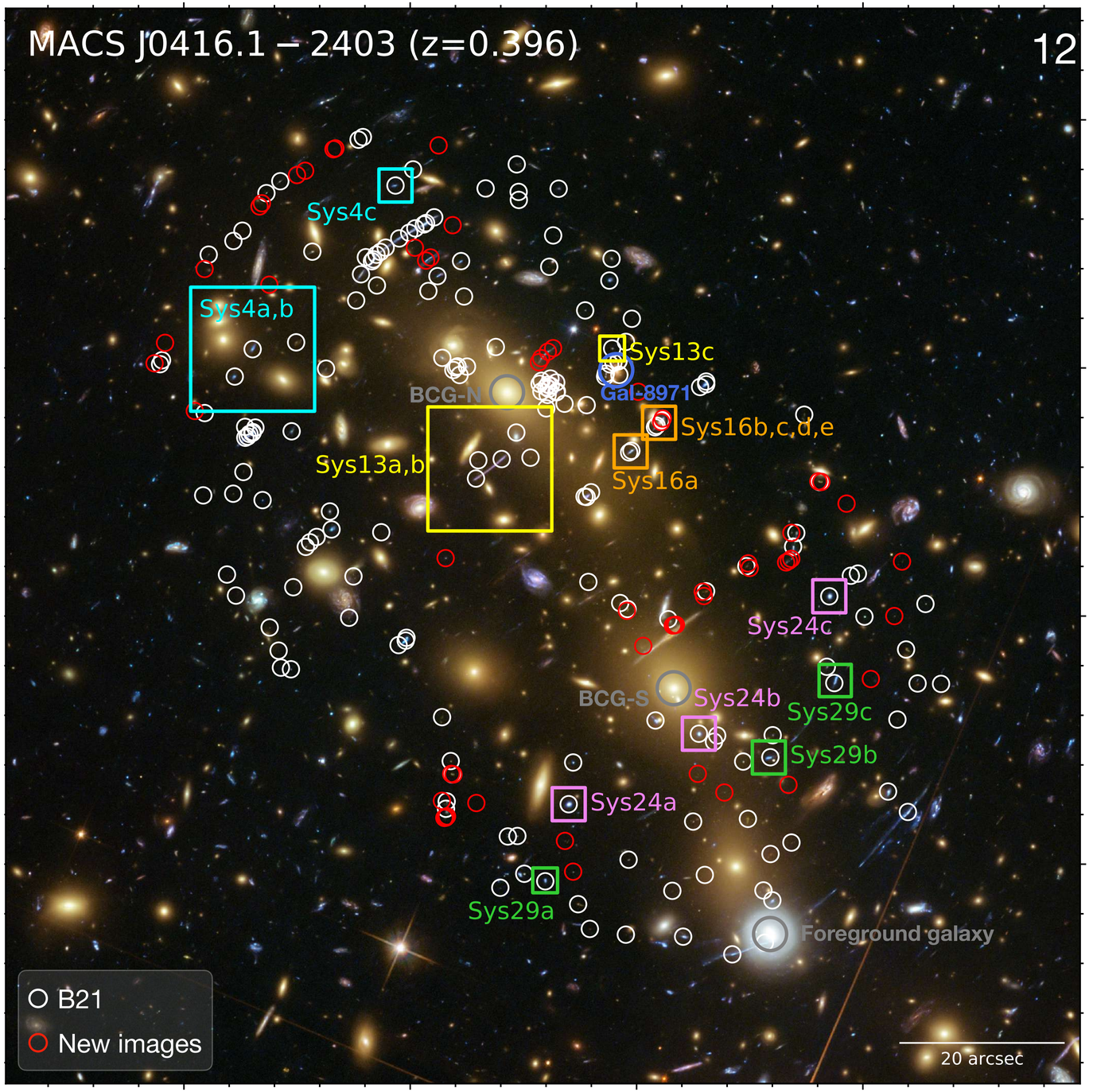
Clusters mass models : multiple images

- MUSE revolutionised the cluster lensing modeling power
- Provide accurate mass models for the study of background galaxies

237 spectroscopically confirmed multiple images in MACS0416

MUSE lens models are used for all lensing clusters observations: HST, JWST…

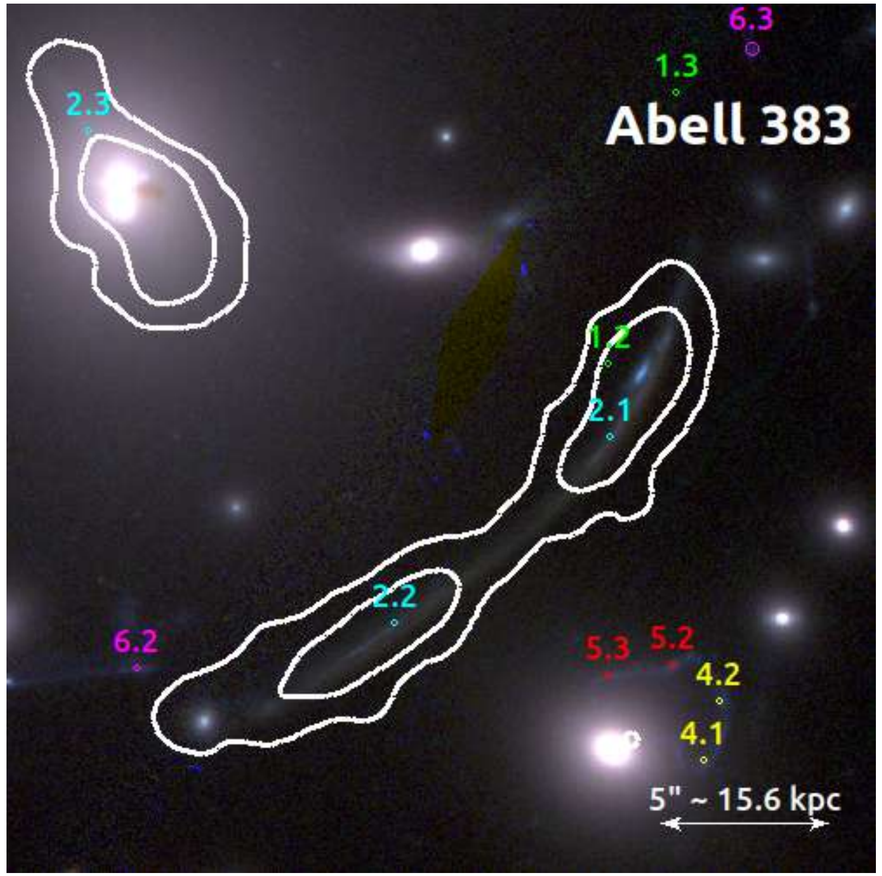
Bergamini et al. 2023



Dark matter profile within the clusters

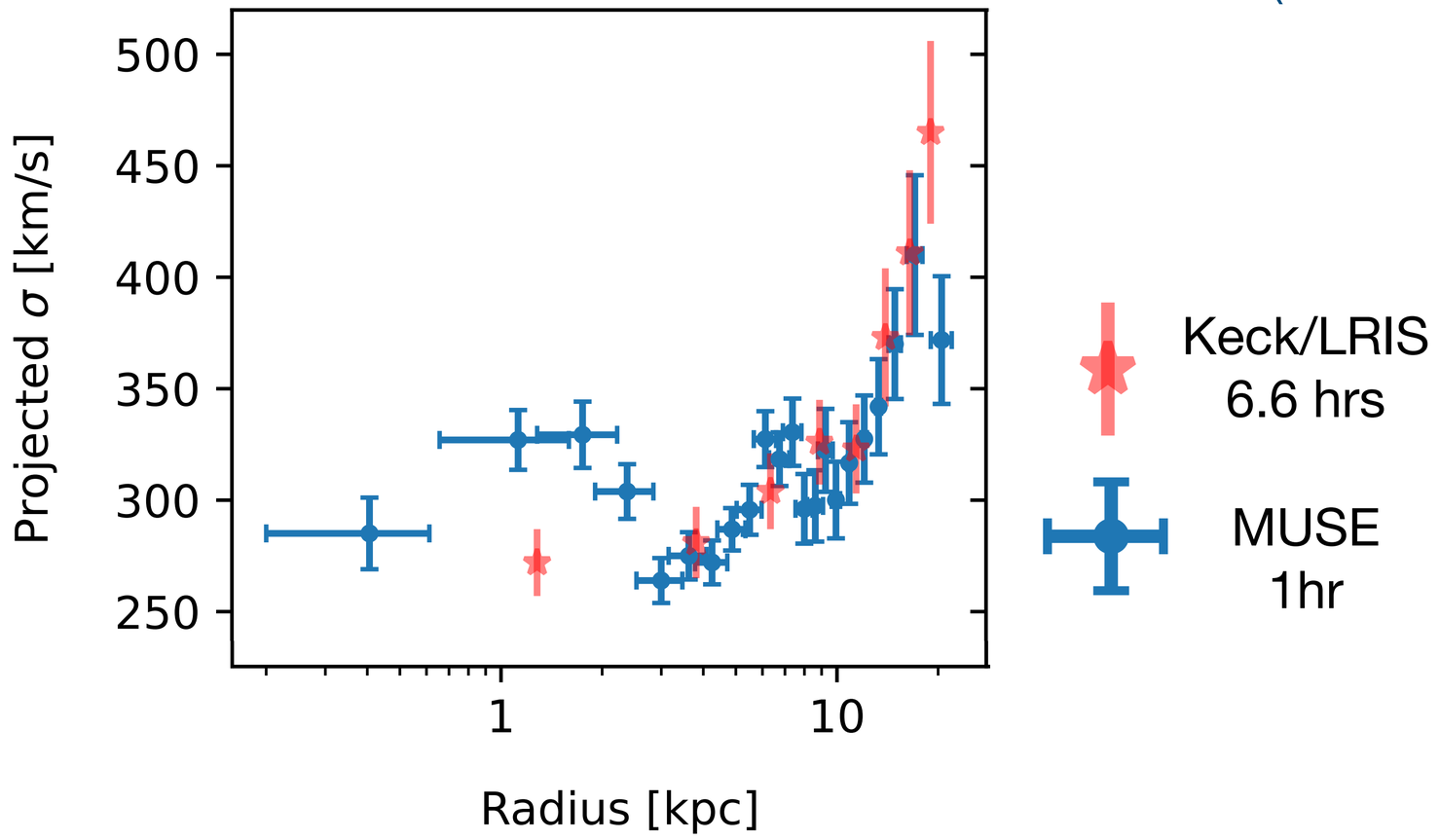
- Constrain the inner slope of the dark matter profile

HST RGB image + MUSE contours



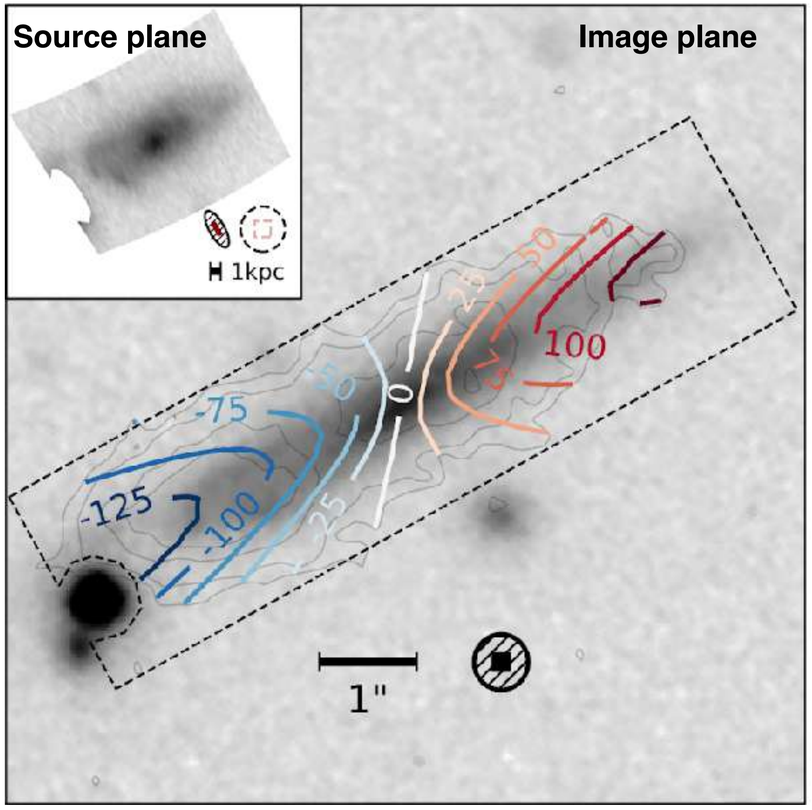
Velocity dispersion BCG

C. Cerny & M. Jauzac (Durham)



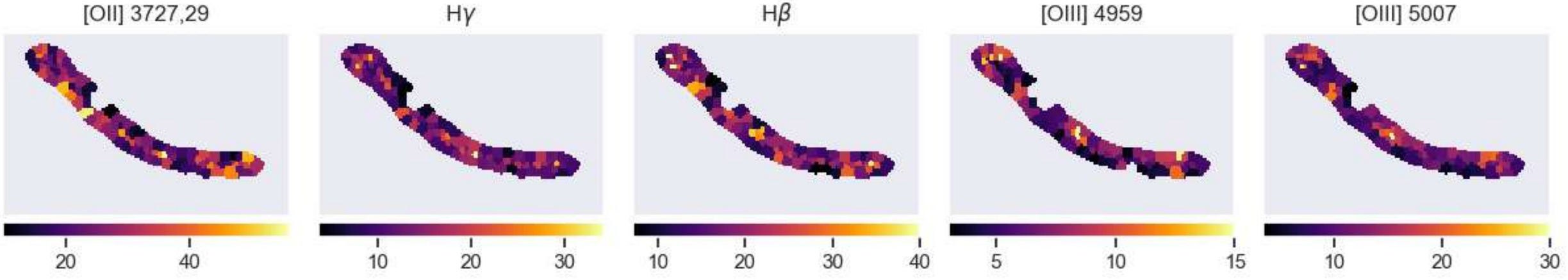
Resolve distant galaxies kinematics

- Map emission line properties at a sub-kpc scale at z>1
- Get resolved galaxy properties (metallicity, extinction, SFR…)
- Measure OII kinematics and constrain the internal DM profil within SFing galaxies



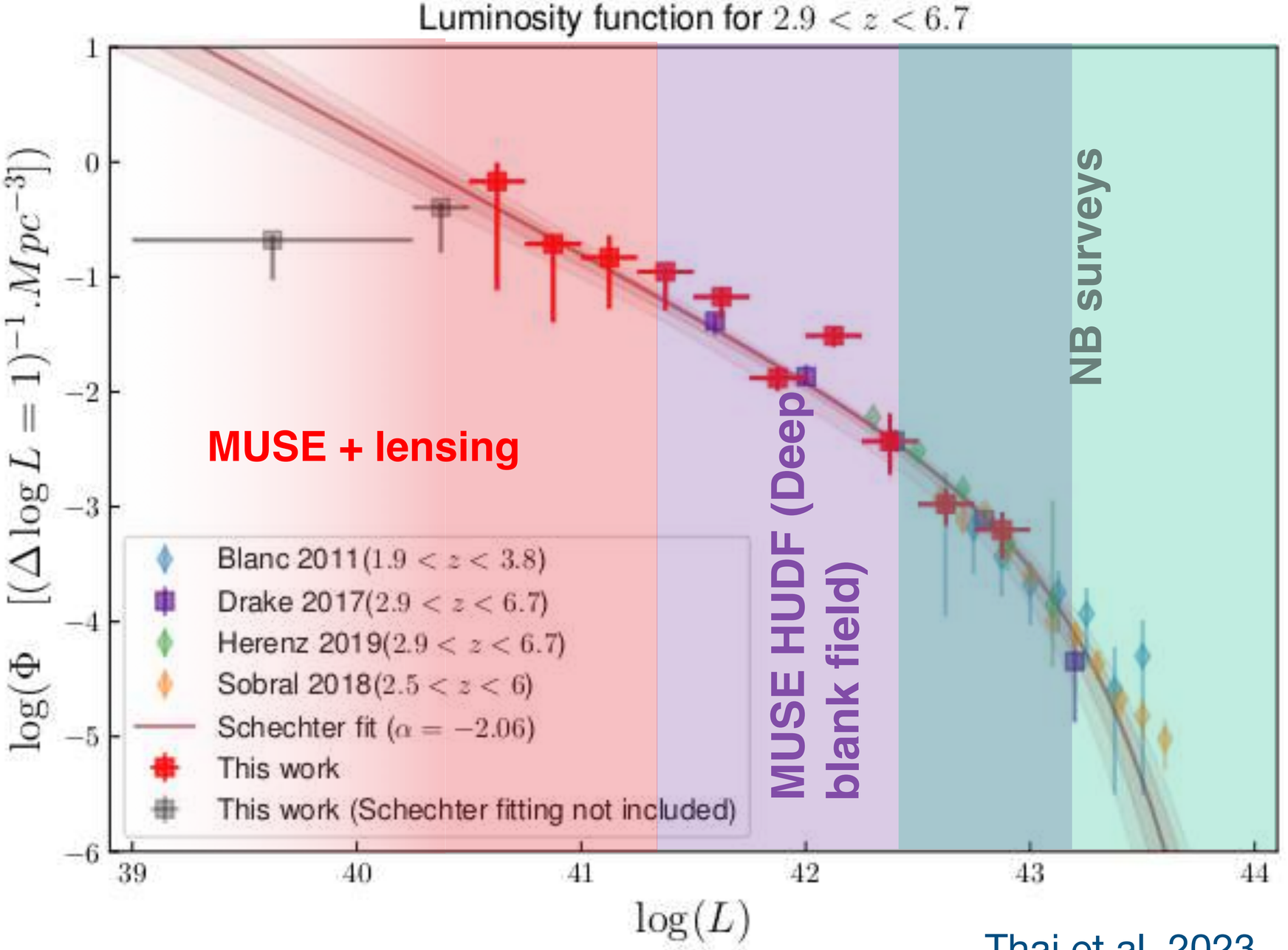
A. Jeanneau

Patricio et al. 2019



Probe faint LAEs

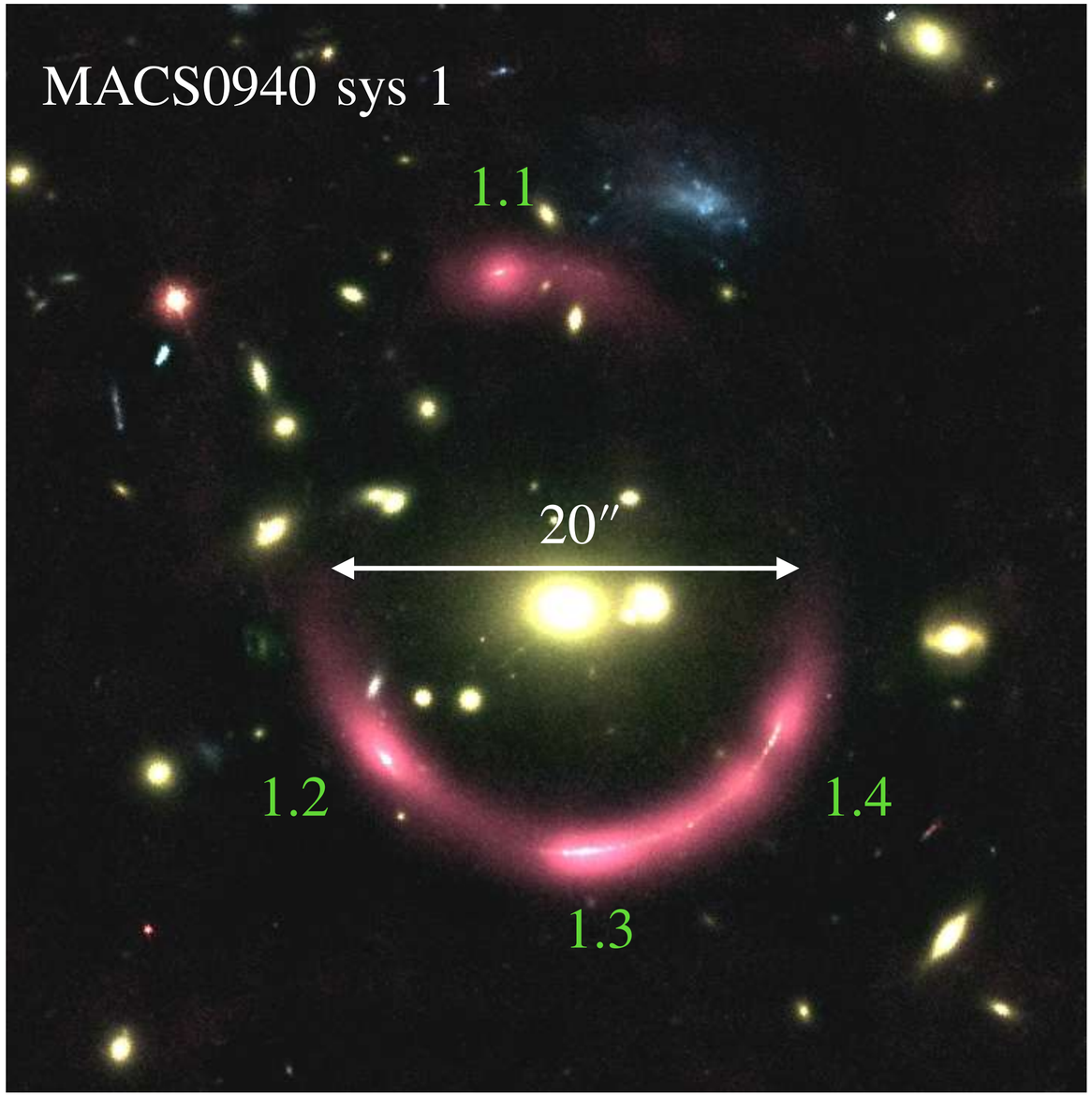
Lensing + MUSE probe very faint LAEs



Thai et al. 2023

Resolve spatially the Lyman-alpha haloes

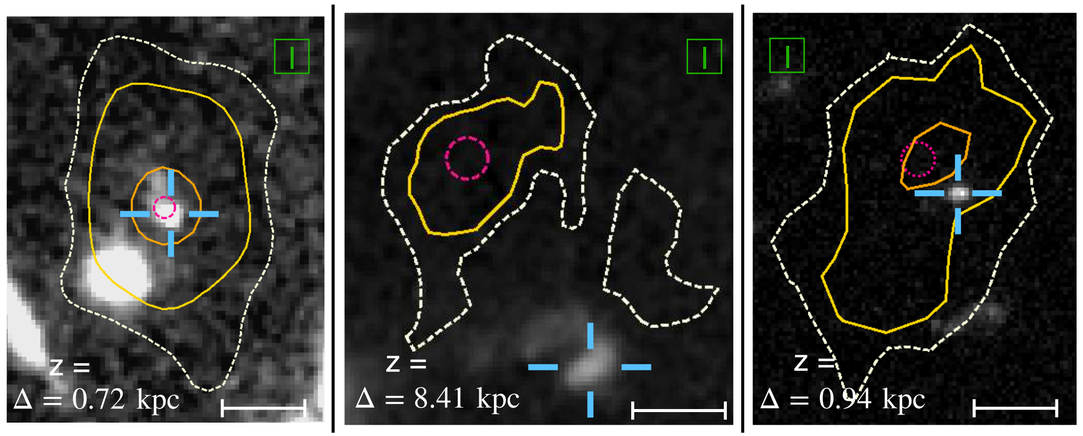
- Map the Lyman-alpha emission across the haloes
- Measure spatial and spectral properties of the faint and distant LAEs

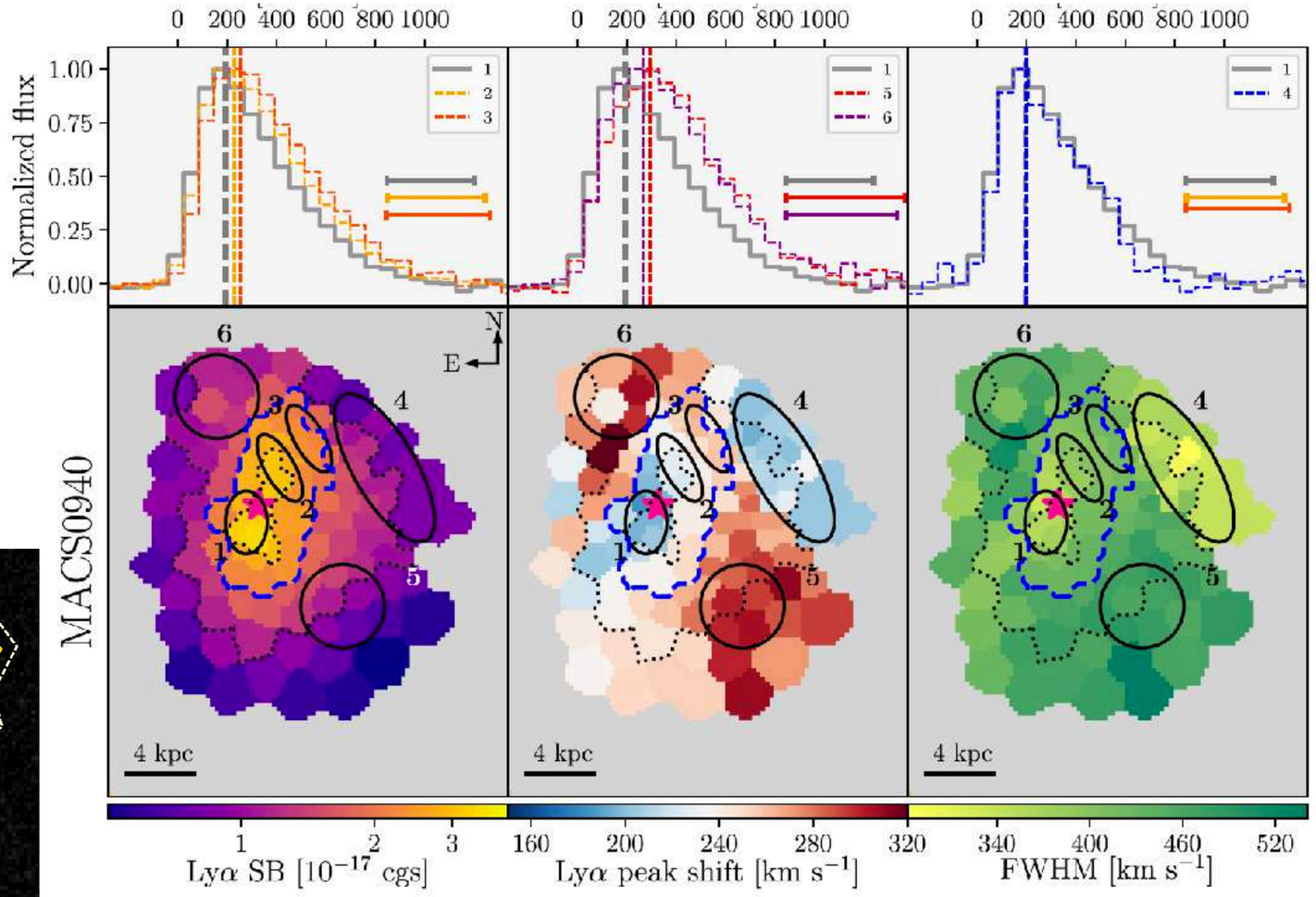


Claeyssens et al. 2019

Resolve spatially the Lyman-alpha haloes

- Map the Lyman-alpha emission across the haloes
- Measure spatial and spectral properties of the faint and distant LAEs
- Spatial offset between the UV and Lya emission





Claeyssens et al. 2022

Claeyssens et al. 2019

What is next with BlueMUSE ?

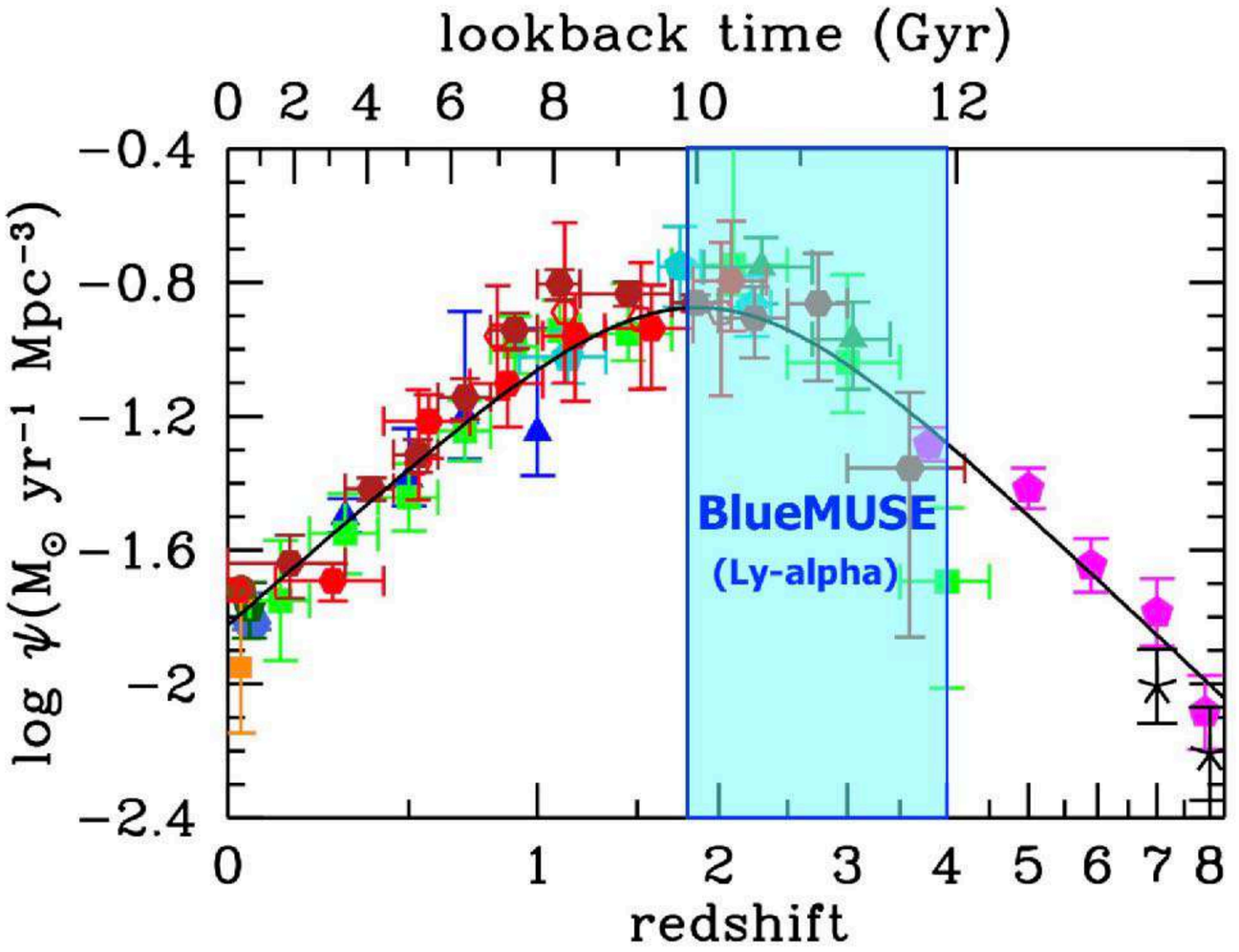
Lensing clusters sciences cases with BlueMUSE

— Collect more multiple images, especially at z=1.8-4

— Extend the magnified LAEs study down to z=1.8

— Study substructures in giant arcs at Cosmic Noon

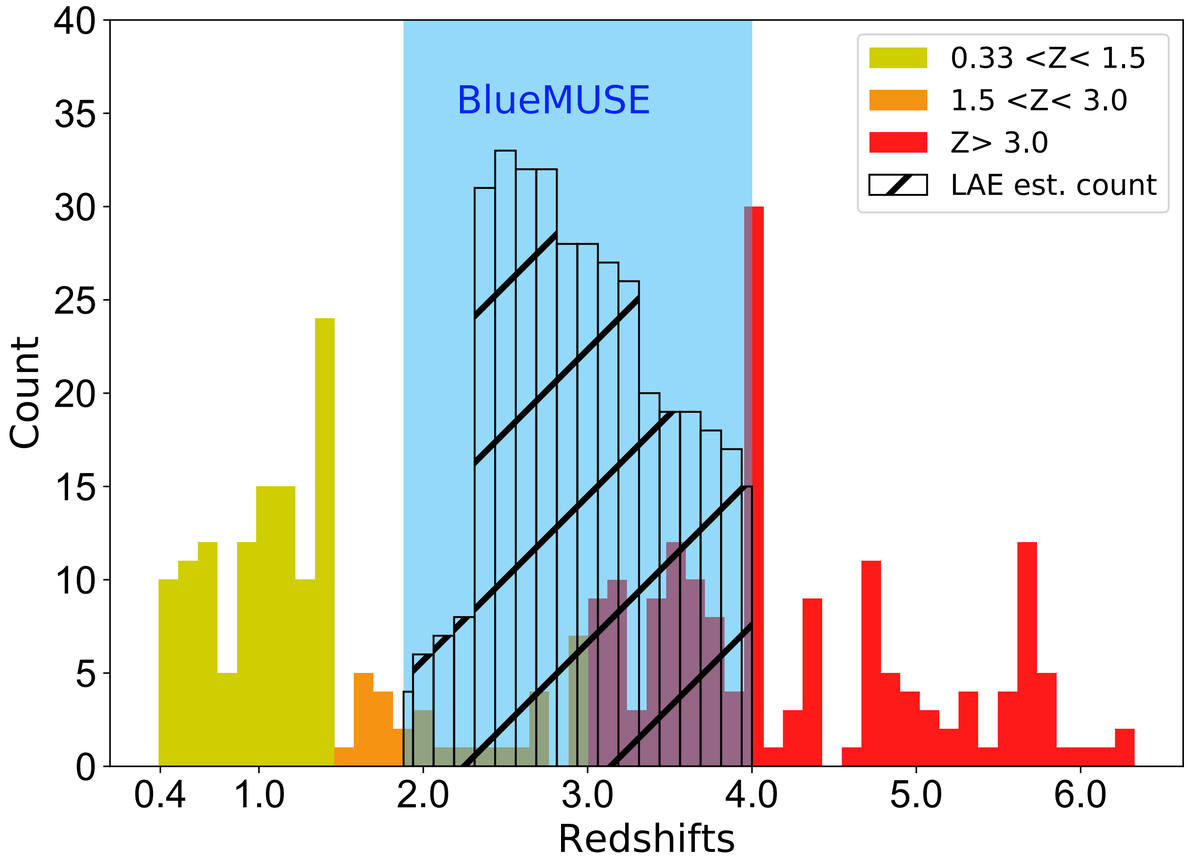
— Study the CGM in absorption thanks to giant arcs

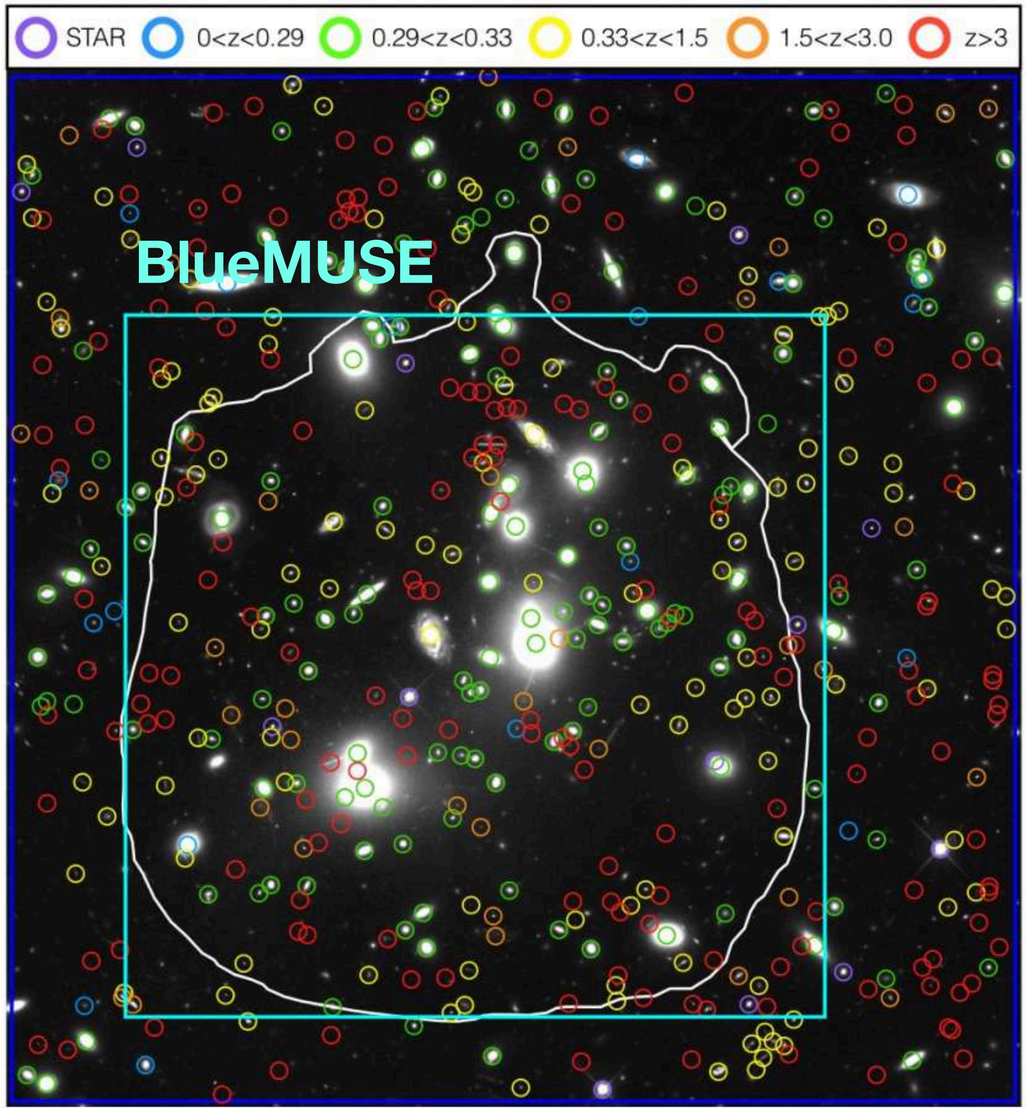


Madau & Dickinson 2010, Richard et al. 2019

Multiple images and cluster mass models

Significant increase of the multiple images at z=1.8-4

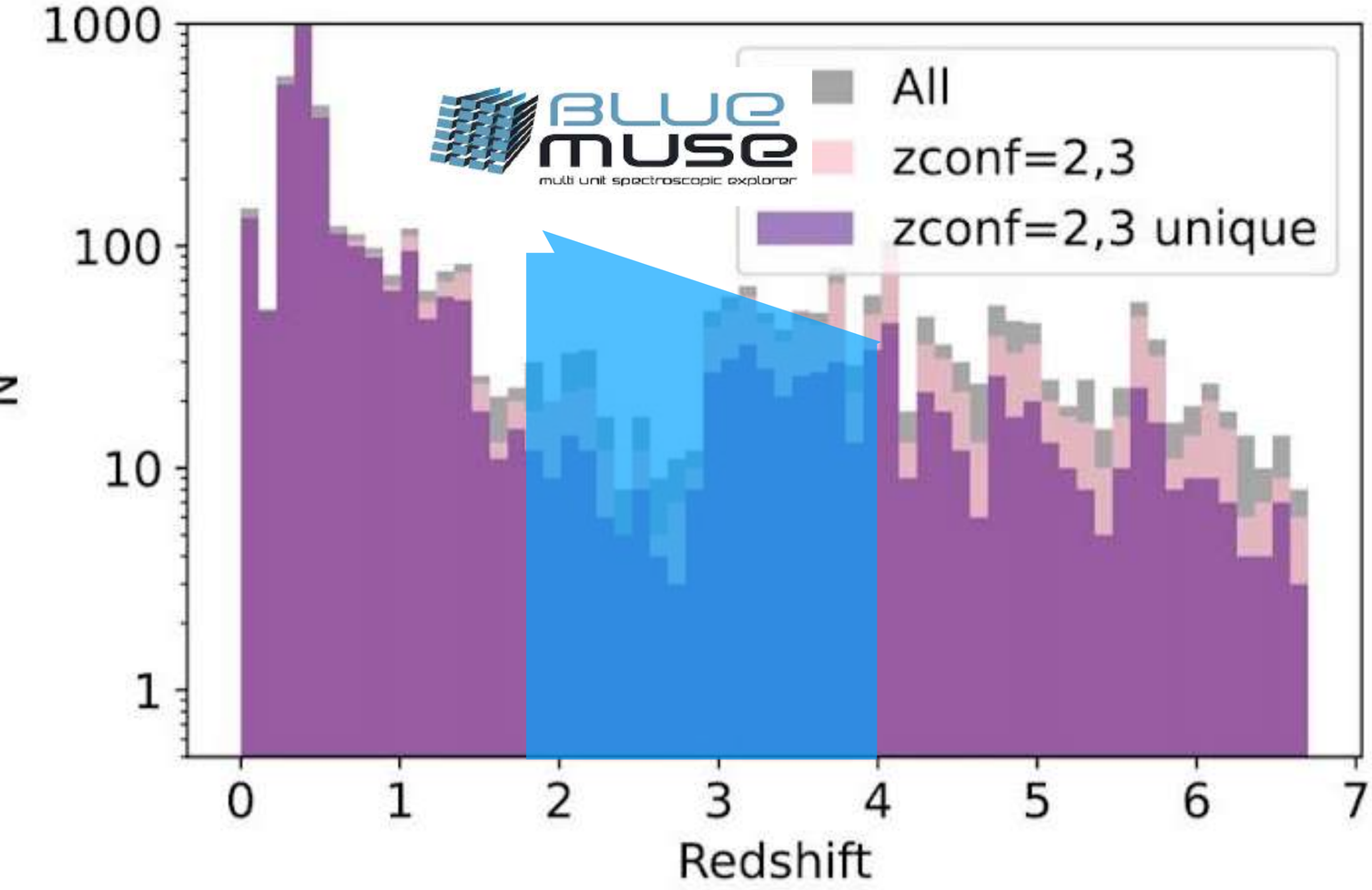




Richard et al. 2019, Mahler et al. 2018

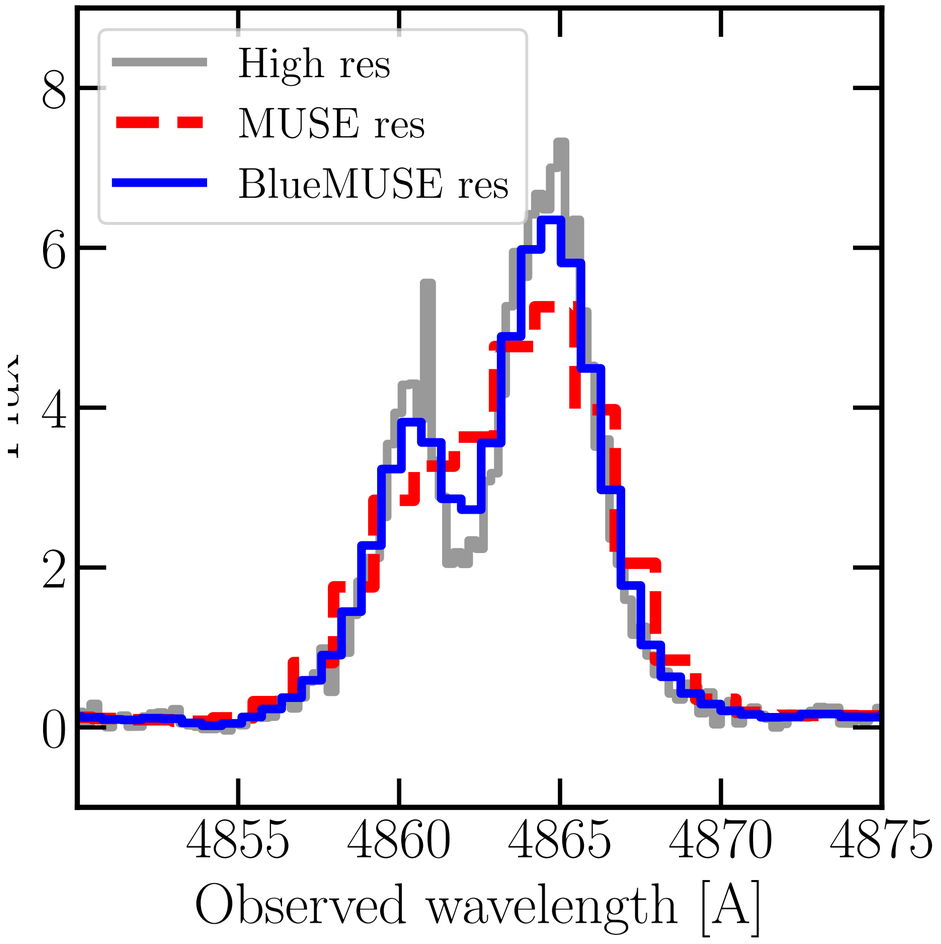
Magnified LAEs at z=1.9-4

Extent the study of magnified LAEs down to z=1.9



Richard et al. 2021

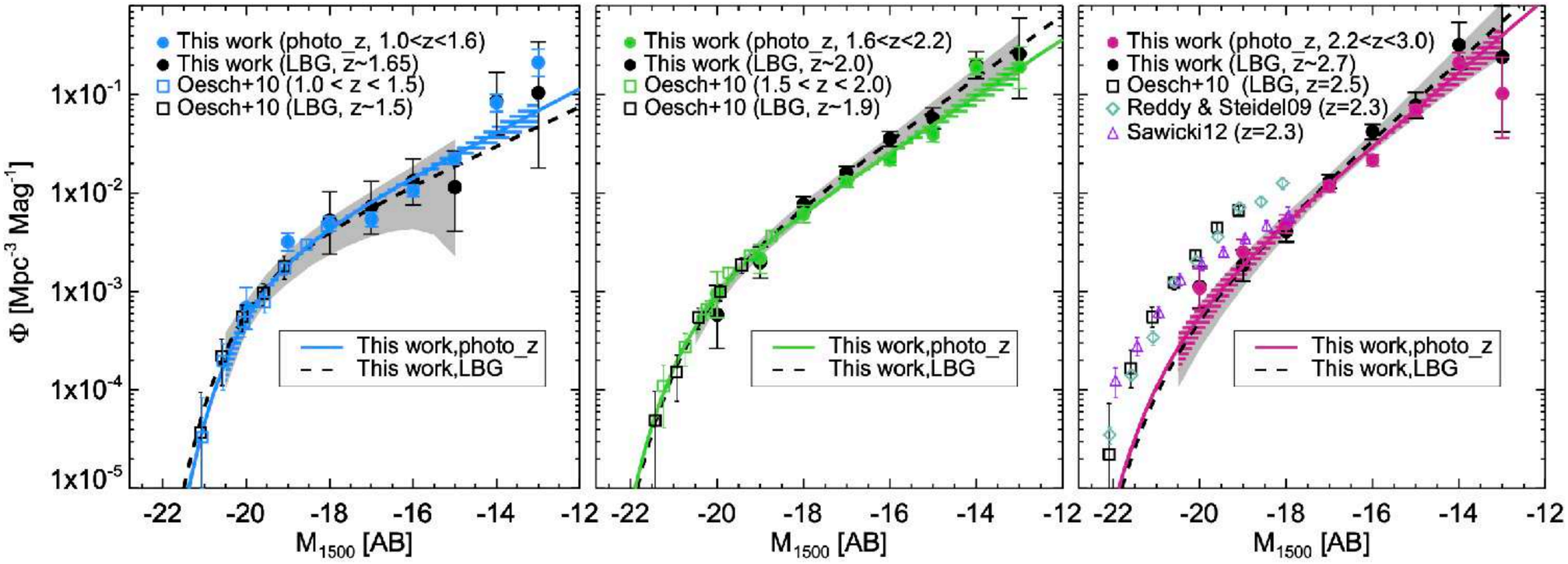
Resolve the spectral line profiles



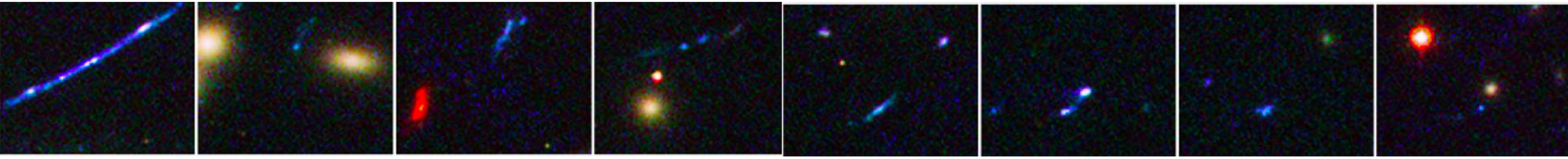
Claeyssens et al. to be subm

Cosmic noon galaxies

- Luminosity Distance effect: probing at z=2 the very low-mass end of the luminosity function - dwarf galaxy population and analogues to sources of reionisation.



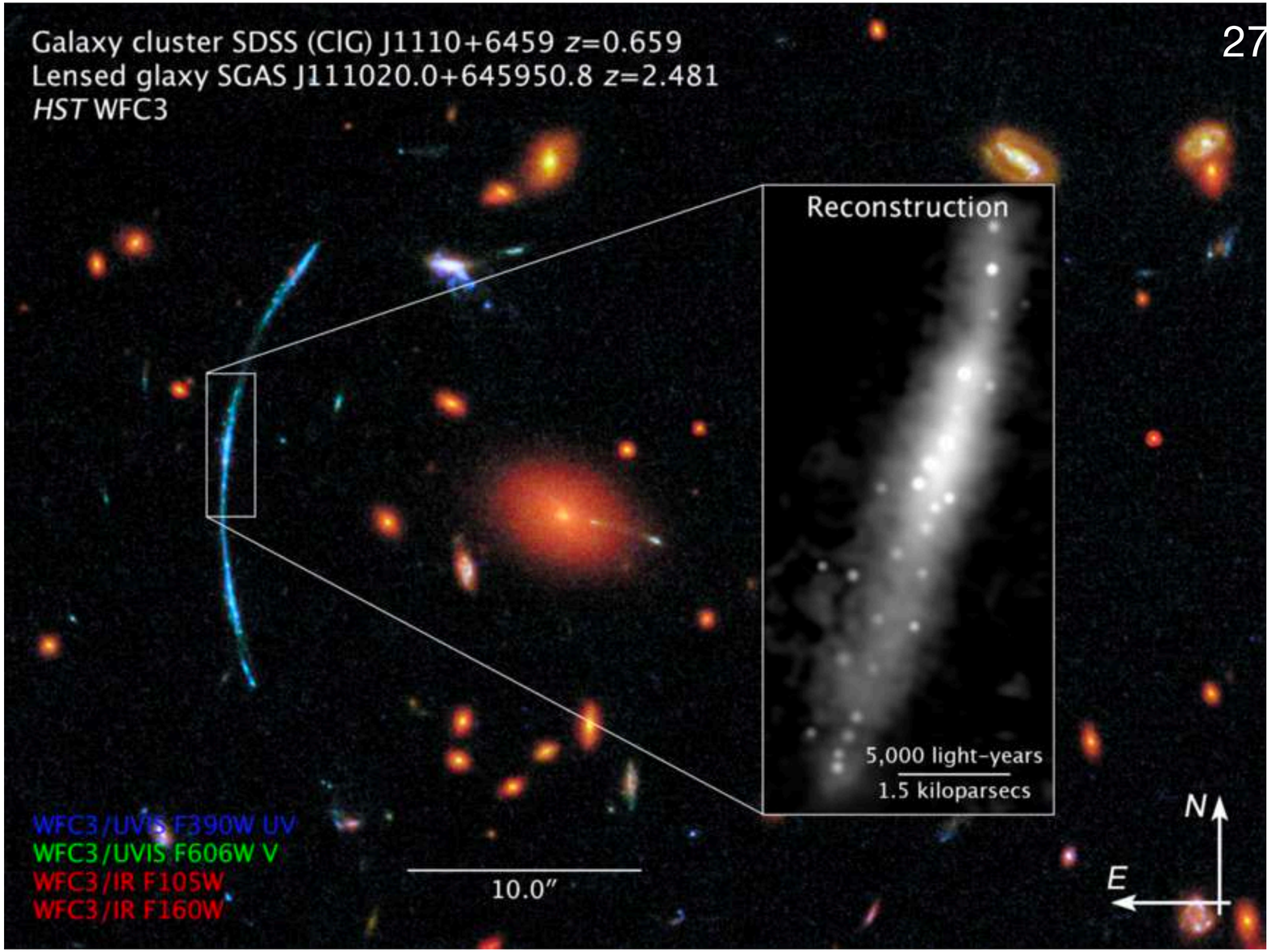
Alavi et al. 2016



Giant arcs at z=1.5-3

- Bright giant arcs are more numerous at z=1.5-4
- Cosmic noon galaxies have very clumpy morphologies
- Resolve structures within the ISM and the CGM

Great synergy with LSST and Euclide to follow-up on clusters with giant arcs

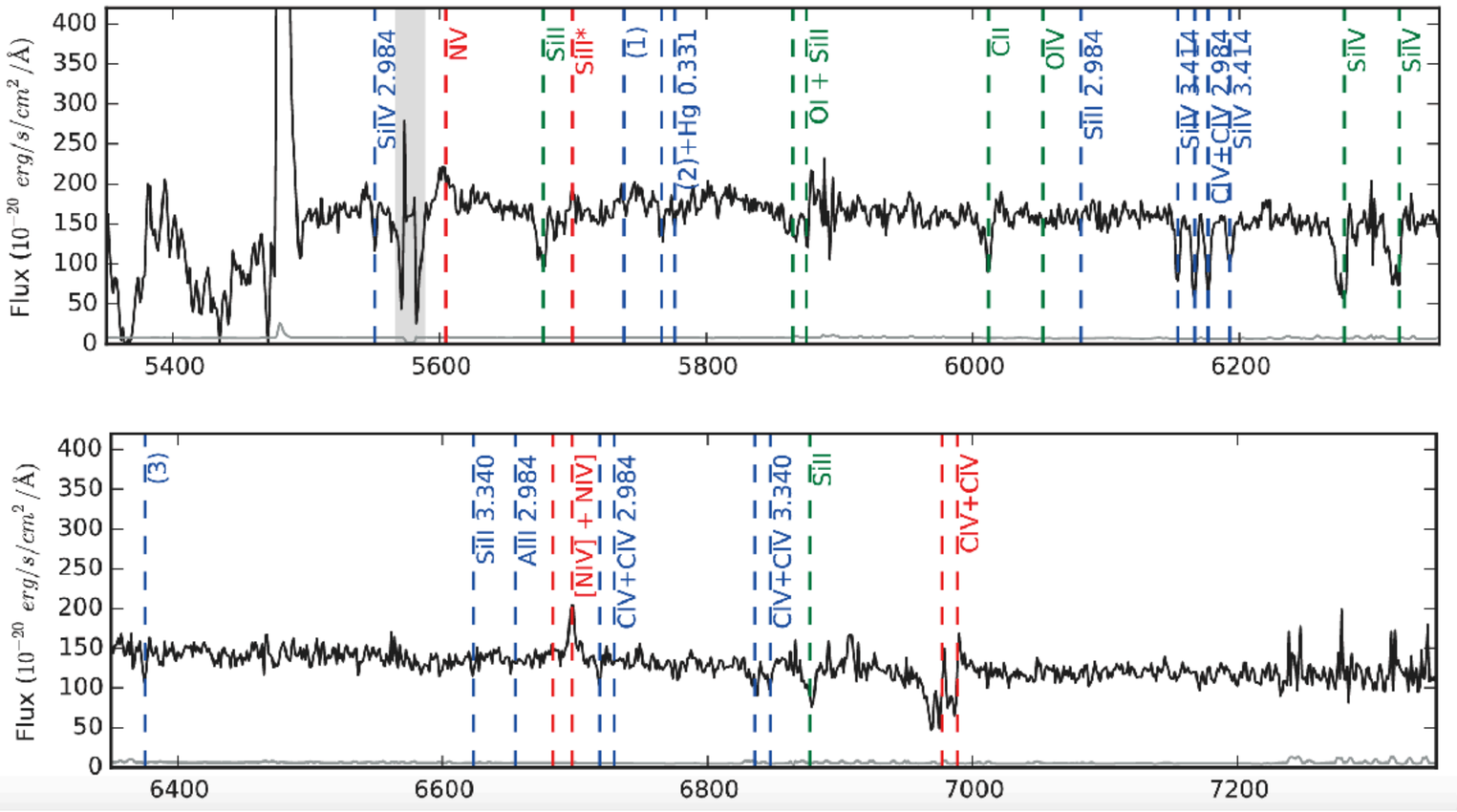


Johnson et al. 2018

Giant arcs at z=2-3

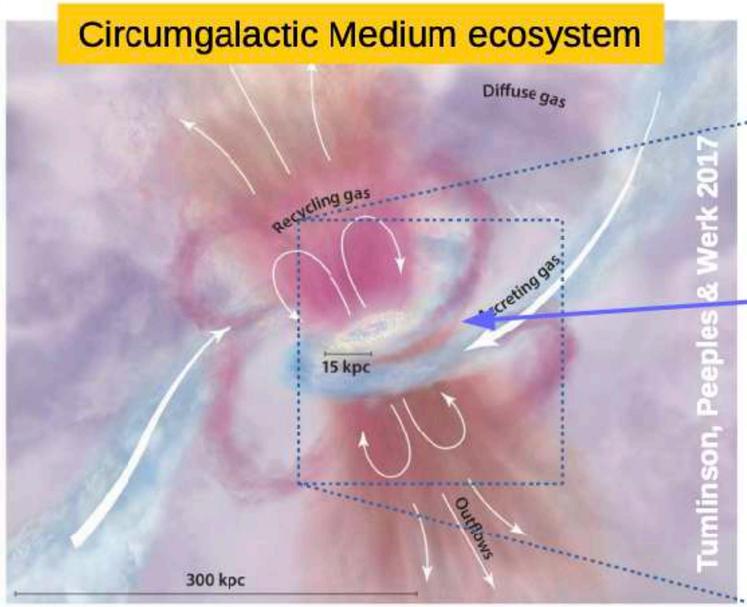
- Bright giant arcs are more numerous at z=1.9-4
- Cosmic noon galaxies have very clumpy morphologies
- Resolve structures within the ISM and the CGM
- Strong potentiel for resolving UV absorption lines spatially across normal star-forming galaxies

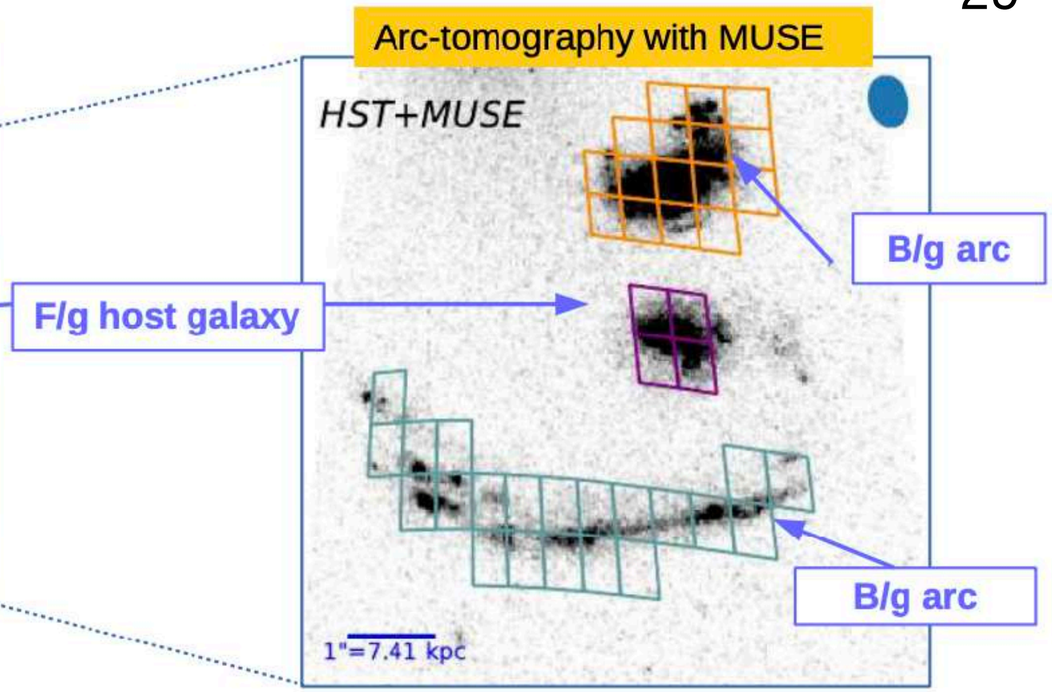
Patricio et al. 2016:
high SNR spectrum at z=3.5

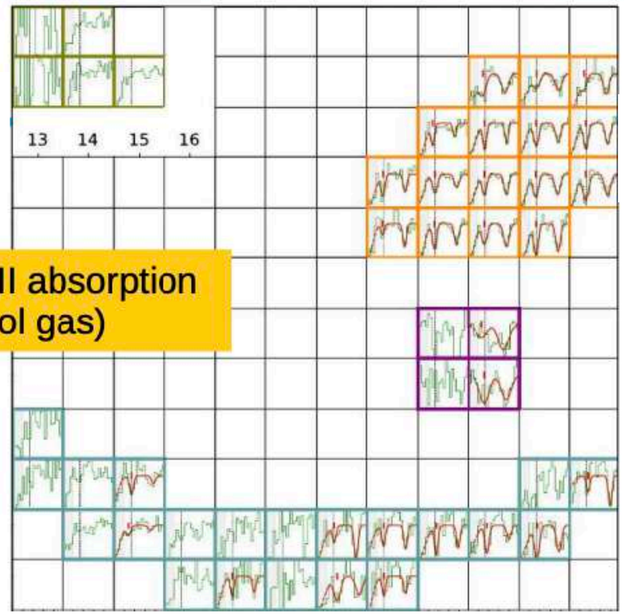


Giant arcs at z=2-3

- Break the degeneracies of complex QSO selection function
- Probe CGM up to 100 kpc with a 4 kpc sampling
- Continuous sampling of enriched gas
- Individual halos in one shot







Tejos et al. 2020

CGM in absorptions at large scale

Conclusions

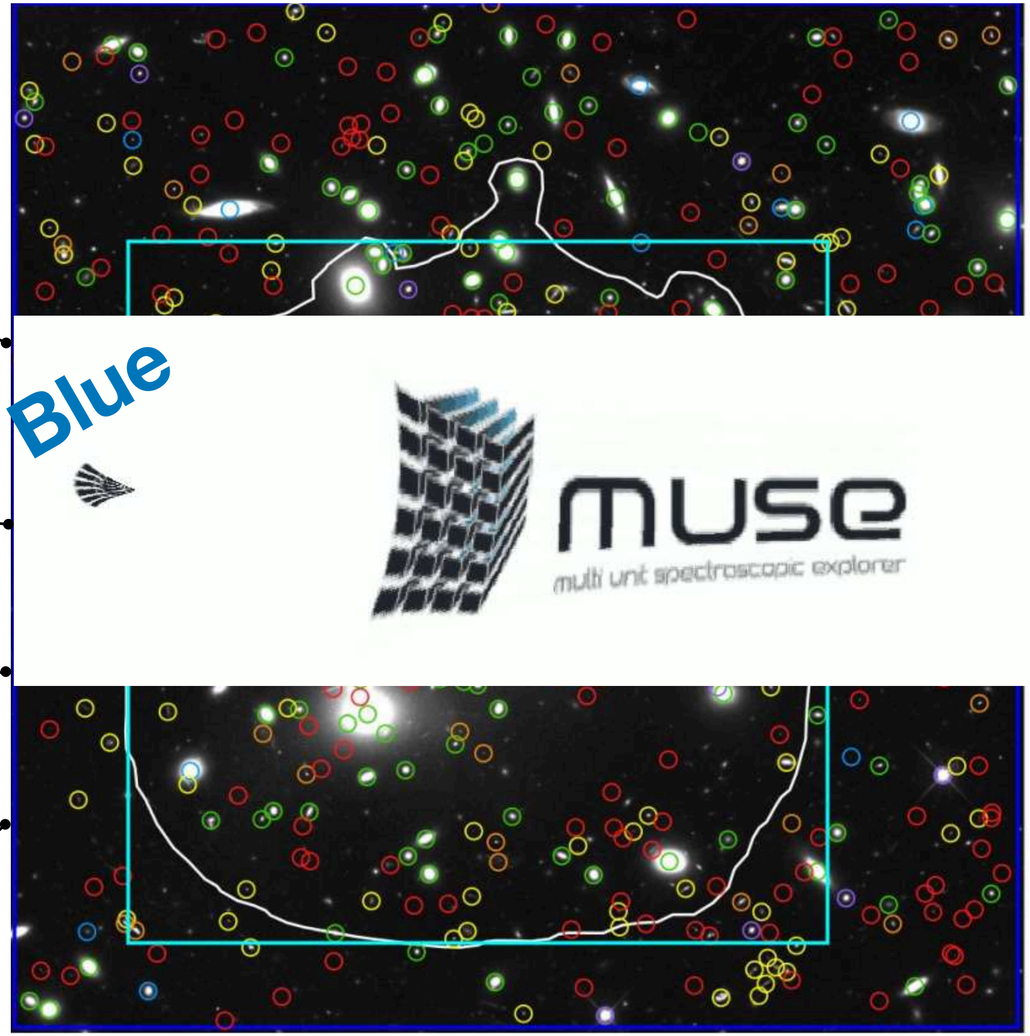
BlueMUSE on Lensing clusters

Increase the multiple images detection / quality of the lens models

Dark matter profile of the galaxy cluster

Luminosity function faint galaxies at z=2

Faint LAEs at z=1.8-4



Giant arcs

Large scale CGM in absorption

Small scale CGM morphologie in Lya

Small scale ISM mapping

Richard et al. 2019, Mahler et al. 2018