MIRACLES

S20B proposal was failed.

We will try again in S21A (or B).

(Page 1)

Subaru Telescope
National Astronomical Observatory of Japan

Semester	S20B
Proposal ID	S20B0075I
Received	03/03/2020

Application Form for Telescope Time
(Normal+Intensive Programs)

1. Title of Proposal

Mapping of ionizing radiation on the cosmic web with Lya emission and shadow

2. Principal Investigator

Name: Matsuda Yuichi
Institute: NAOJ
Mailing Address: 2-21-1 Osawa Mitaka Tokyo 181-8588
E-mail Address: yuichi.matsuda@nao.ac.jp Phone: 0422-34-3900-3101

3. Scientific Category

☐ Solar System	☐ Extrasolar Planets	☐ Star Formation and Young Disk	☐ ISM
☐ Normal Stars	☐ Metal-Poor Stars	☐ Compact Objects and SNe	☐ Milky Way
☐ Local Group	☐ Nearby Galaxies	★ IGM and Abs.Line Systems	☐ Cosmology
☐ Gravitational Lenses	☐ Clusters and Proto-Clusters	☐ Galaxy Properties and Environment	
☐ High-z Galaxies(LAEs, LBGs)	☐ High-z Galaxies(others)	☐ AGN and QSO Activity	☐ Miscellaneous

Purpose of MIRACLES

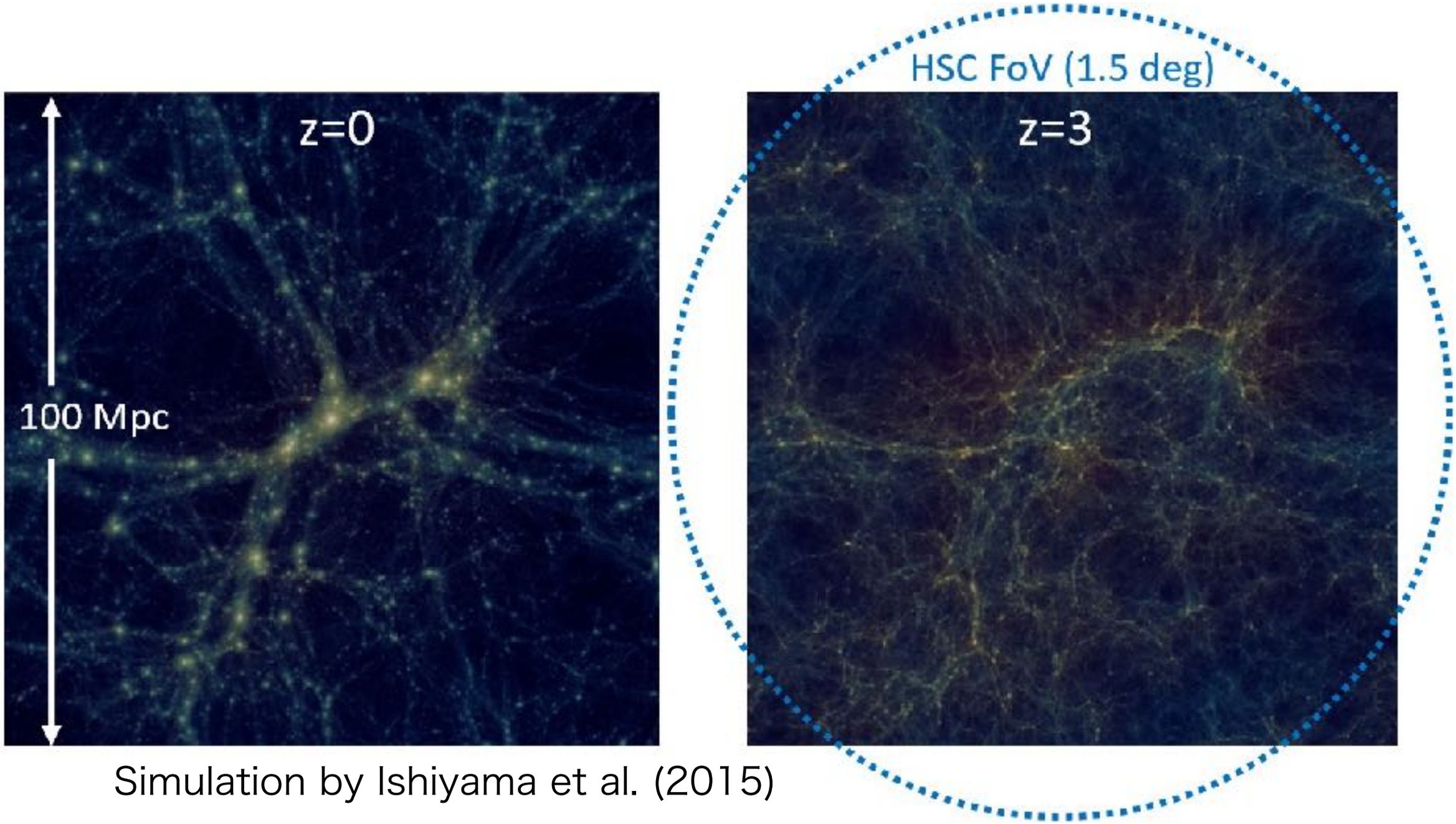
- **Physical properties of the cosmic web -** Surface brightness, width, length, HI+HII gas mass, ionizing state

- **The connection between the cosmic web and galaxies/AGN -** galaxy/AGN proximity zone

- **The role of the cosmic web on cluster formation -** covering fraction, multiplicity of filaments

Cosmic Web

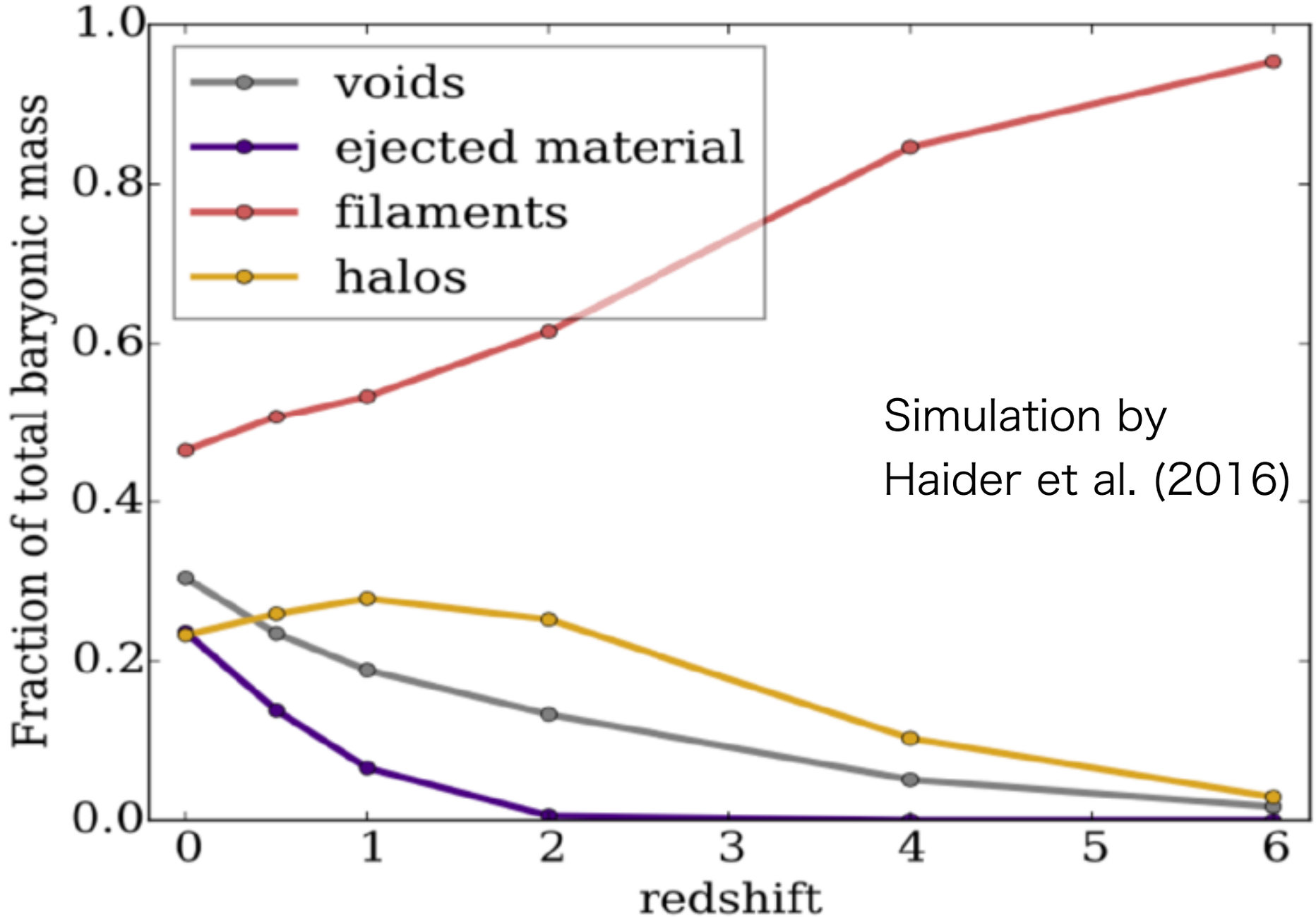
Galaxies form along the filamentary cosmic web and galaxy clusters form at their intersections.



Simulation by Ishiyama et al. (2015)

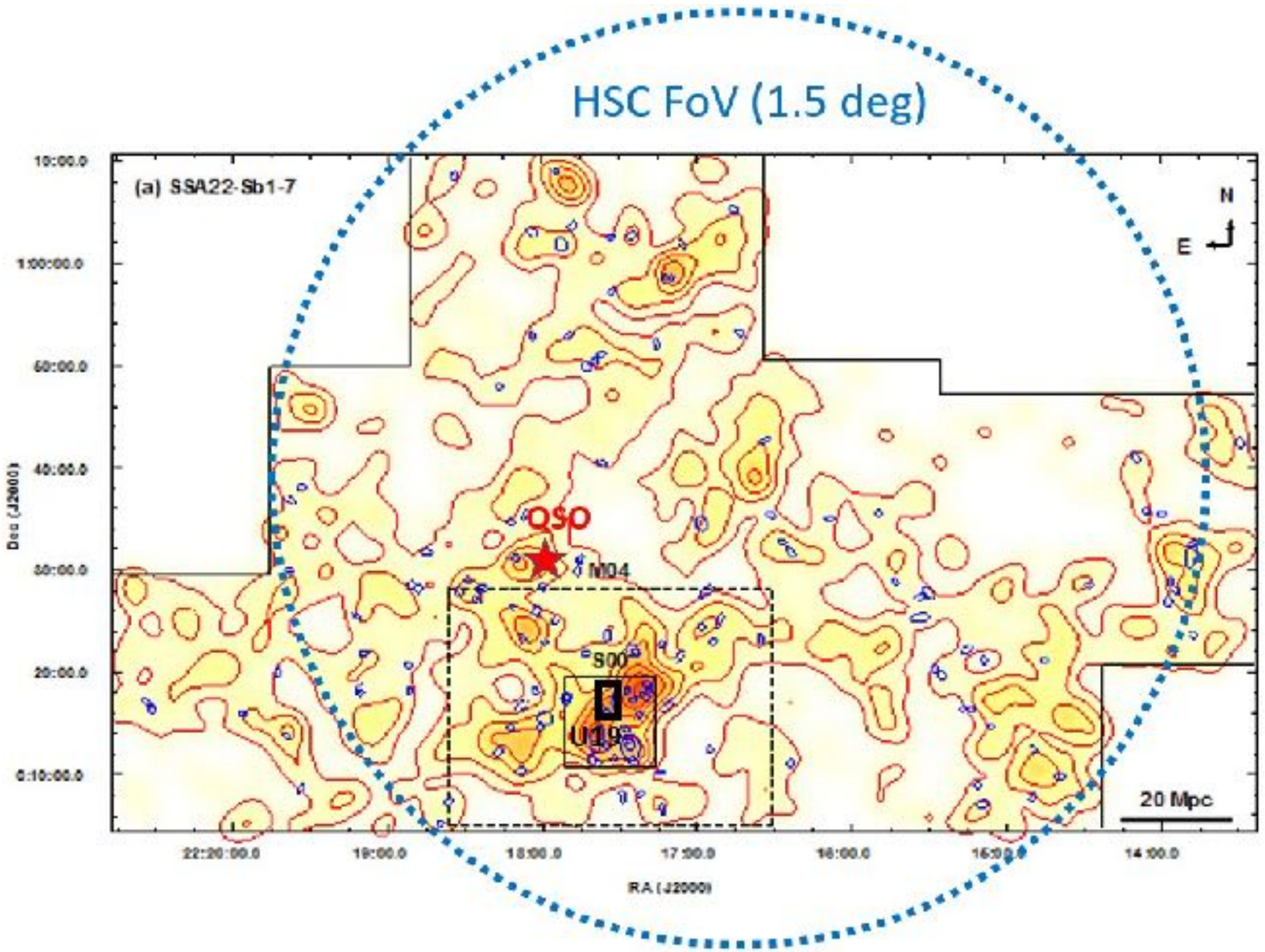
Cosmic Web

At z≥3 ~80% of baryonic mass reside in the filaments.



Proposed Observations (13n)

Target: SSA22 z=3.1 protocluster
Filters: NB497 (60h), NB527 (3h), g(6h), r(9h)

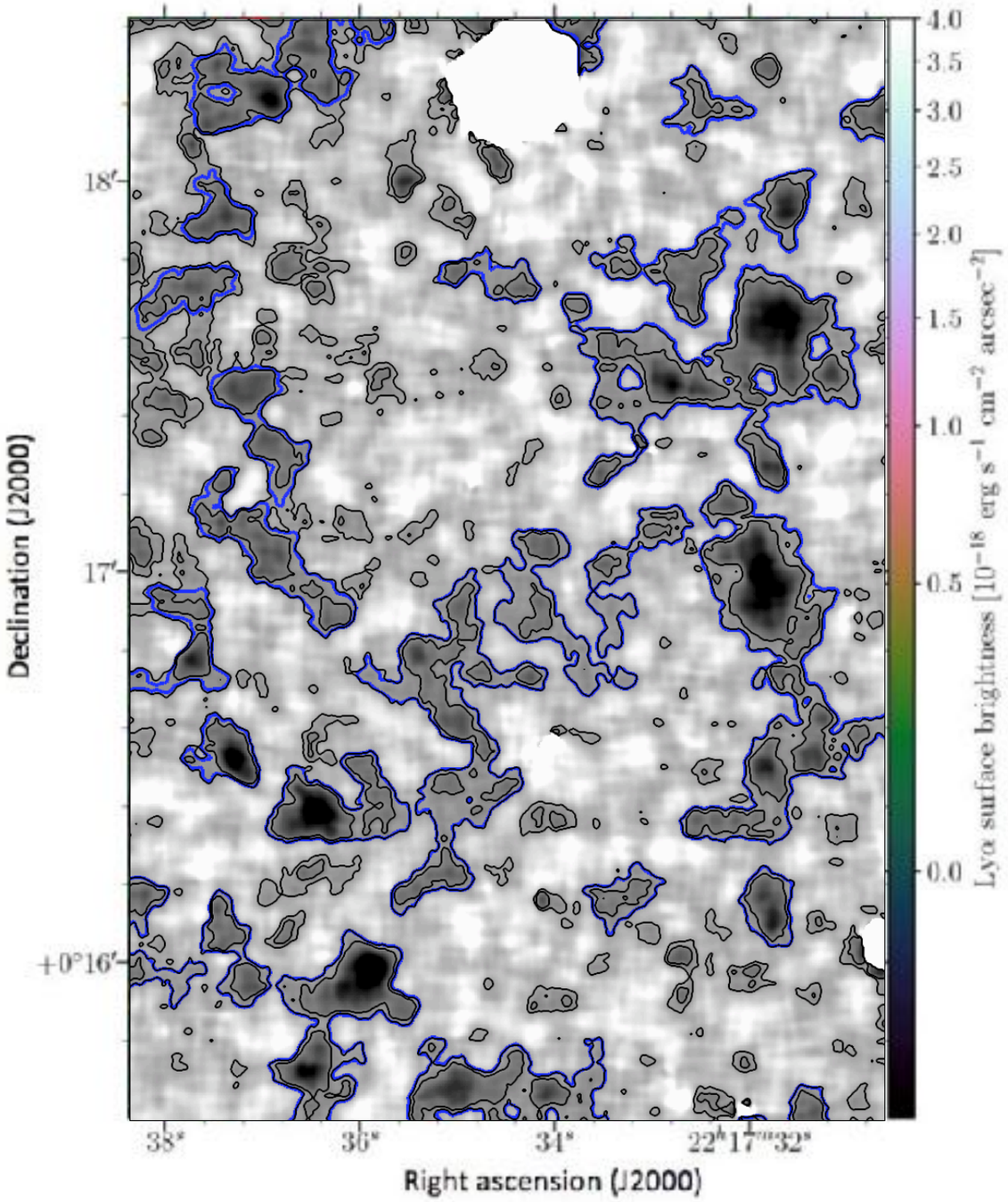


We expect
~15000 z=3.1 LAEs
& ~400 z=3.3 LBGs
in the HSC FoV.

Sky map of LAEs/LABs in and around SSA22 by Yamada et al. (2012) and Matsuda et al. (2012)

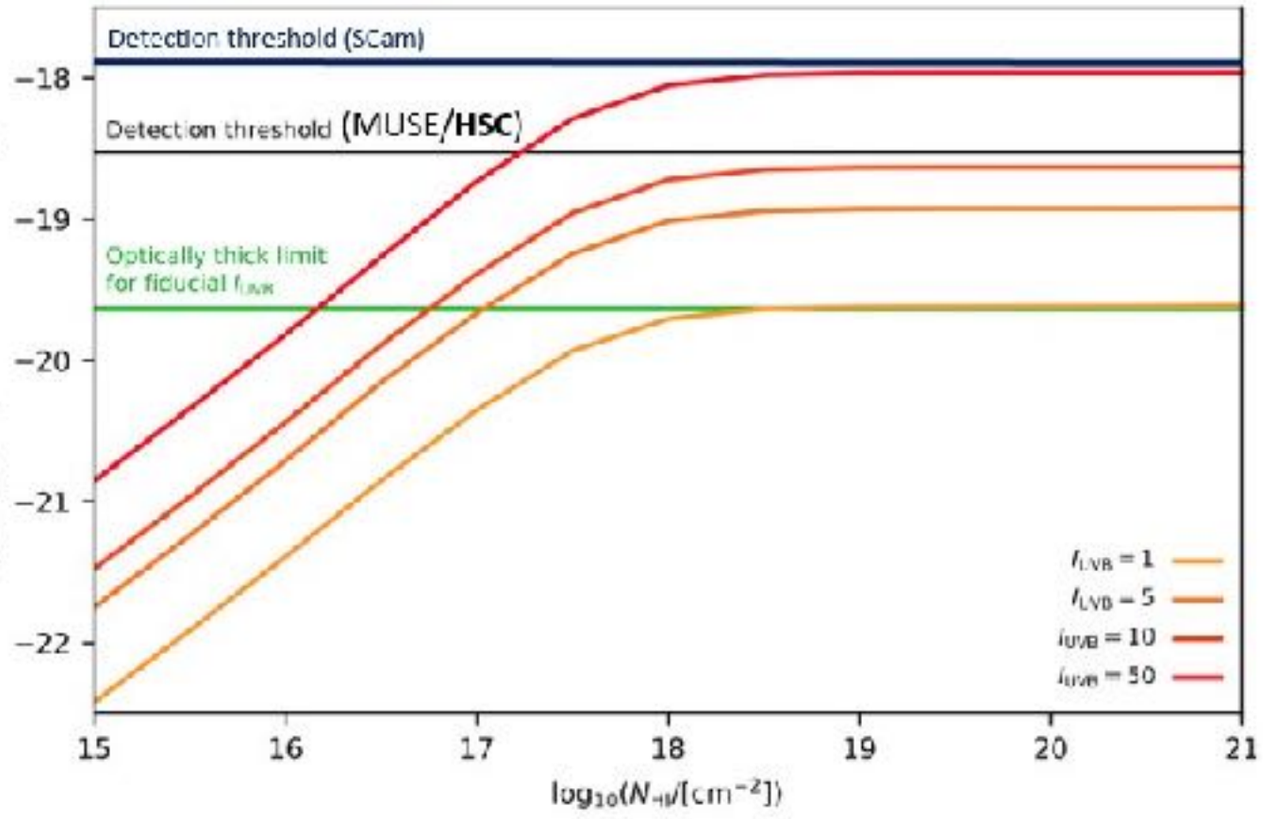
Lya Emitting Filaments

Subaru/Scam started to detect the Cosmic Web



7.2h observations with Scam

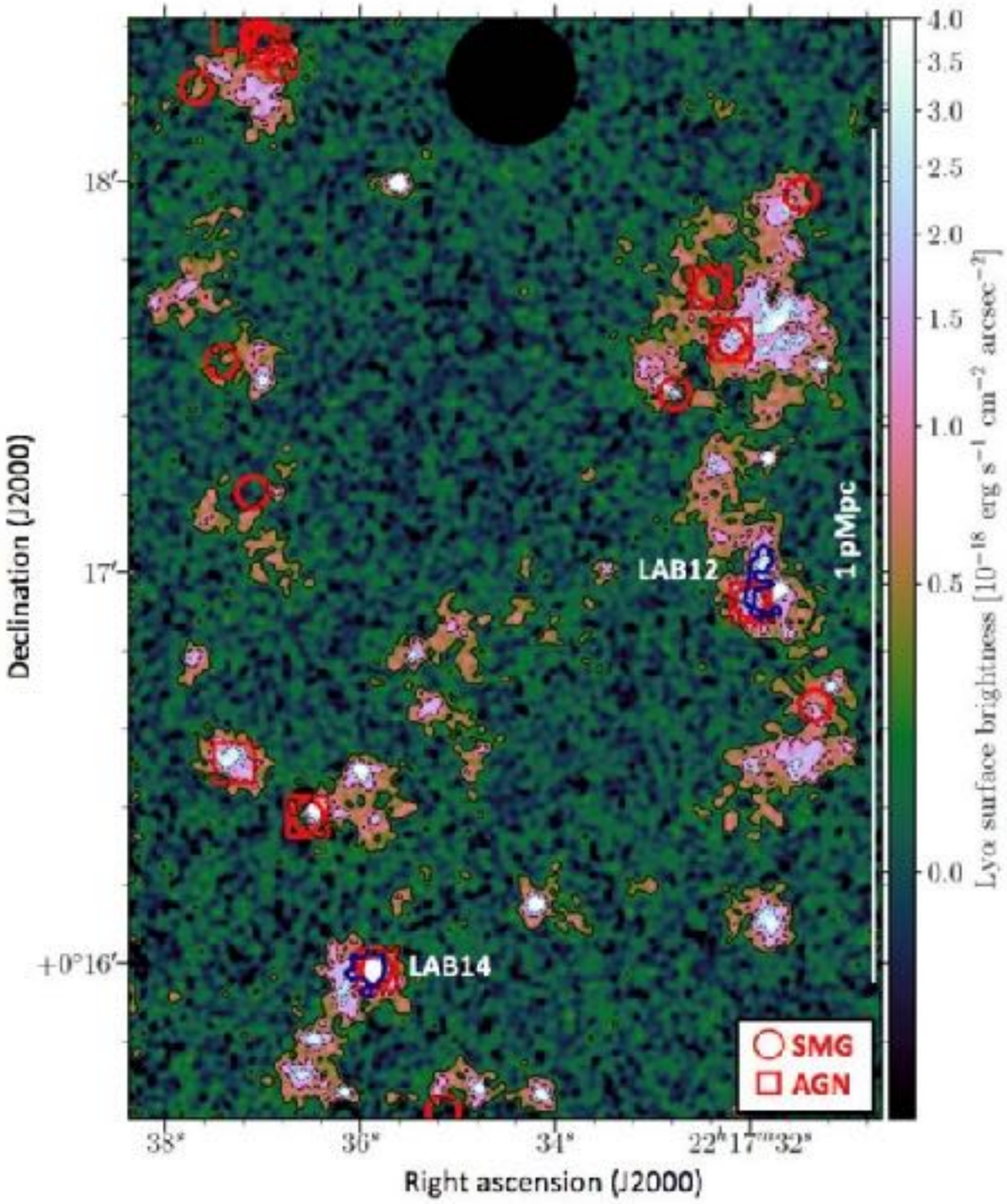
>10x UVB is required to reproduce the observed Lya surface brightness



Umehata et al. (2019)
also Momose-san's review talk

Lya Emitting Filaments

VLT/MUSE has confirmed the Cosmic Web



5h x 6 observations with MUSE

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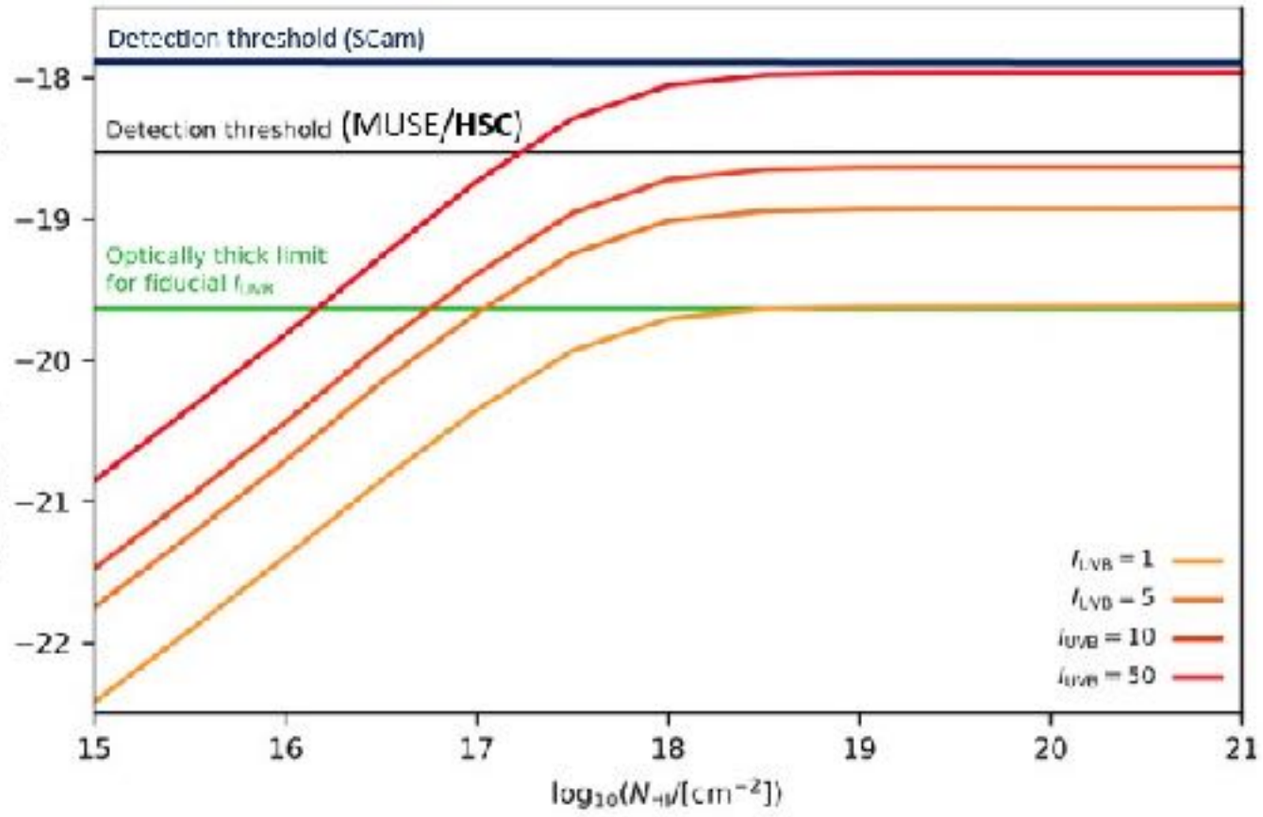

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Lya Emitting Filaments

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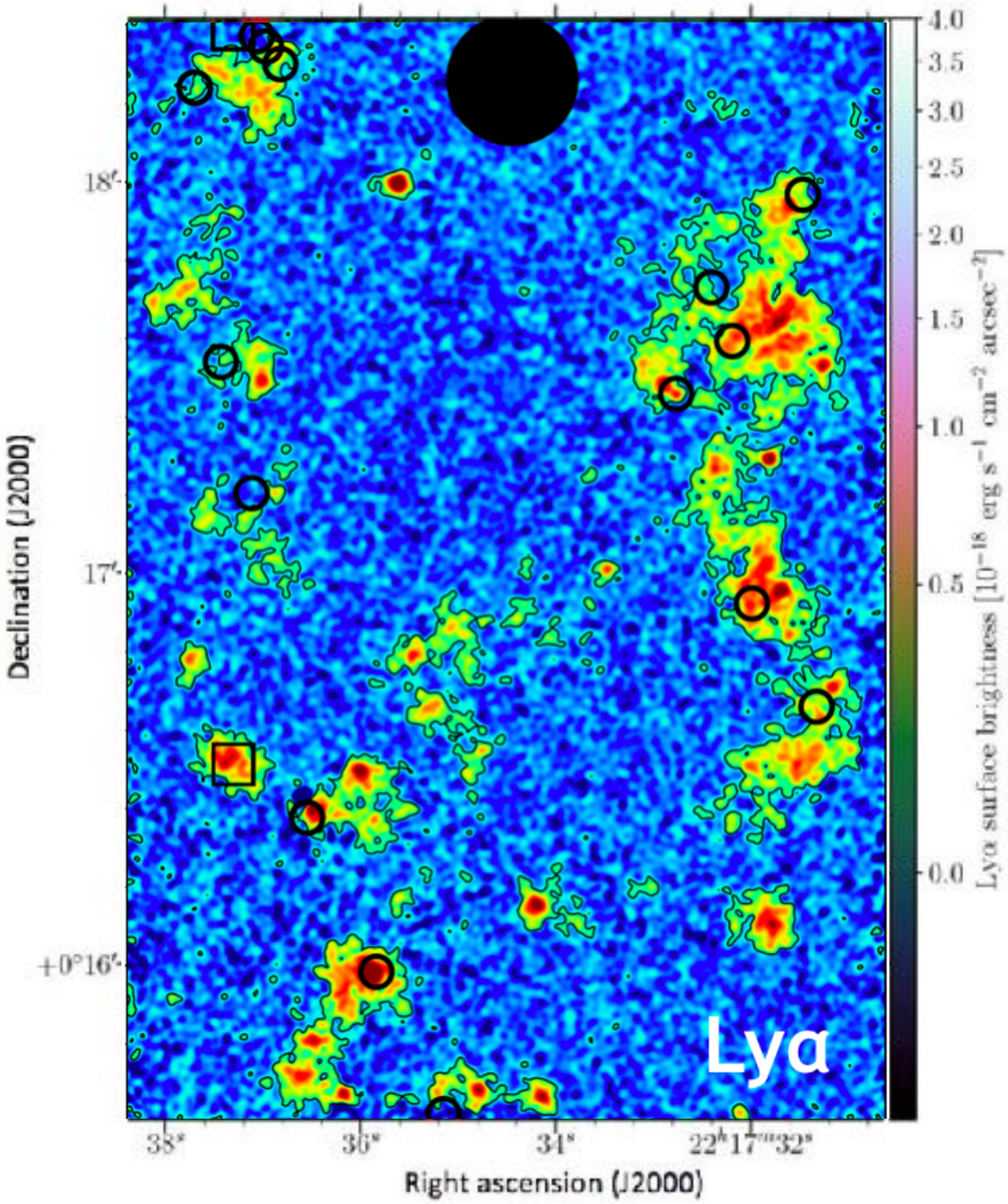

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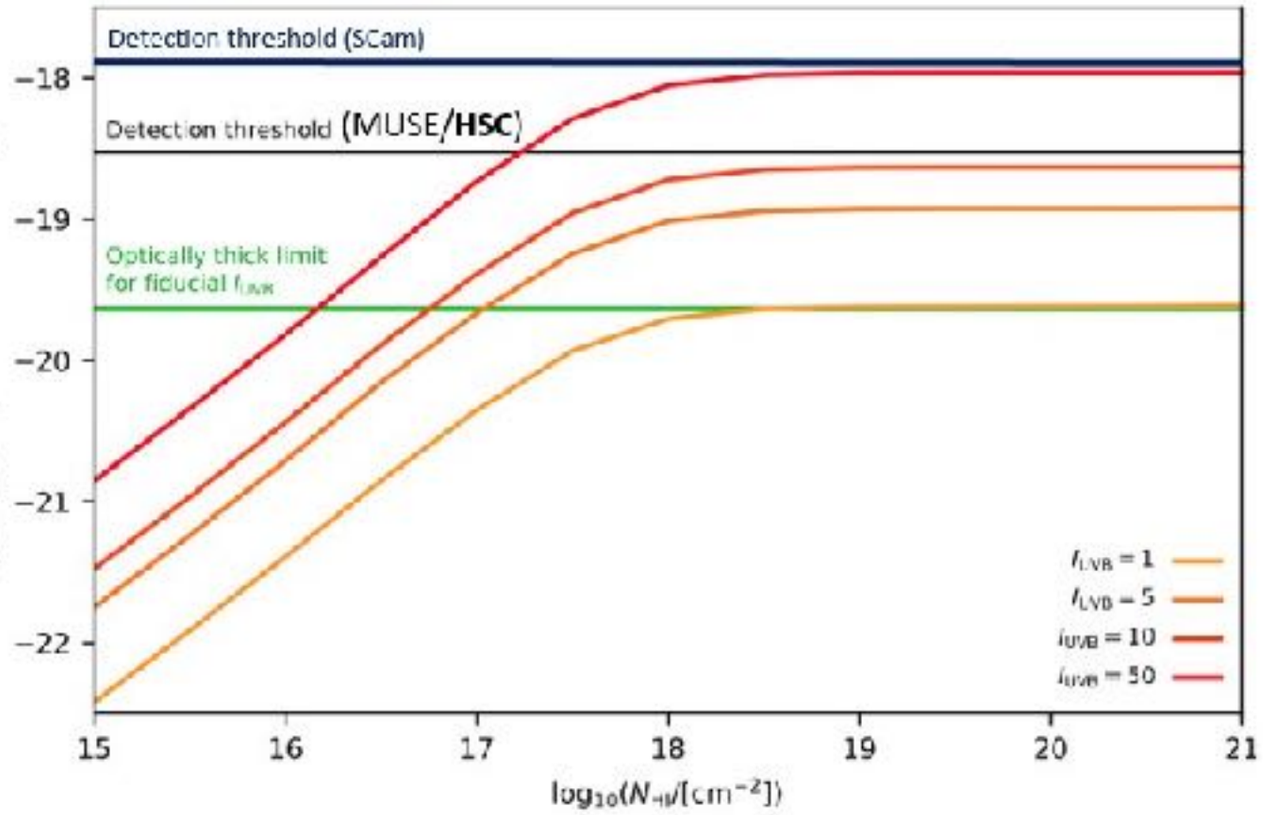

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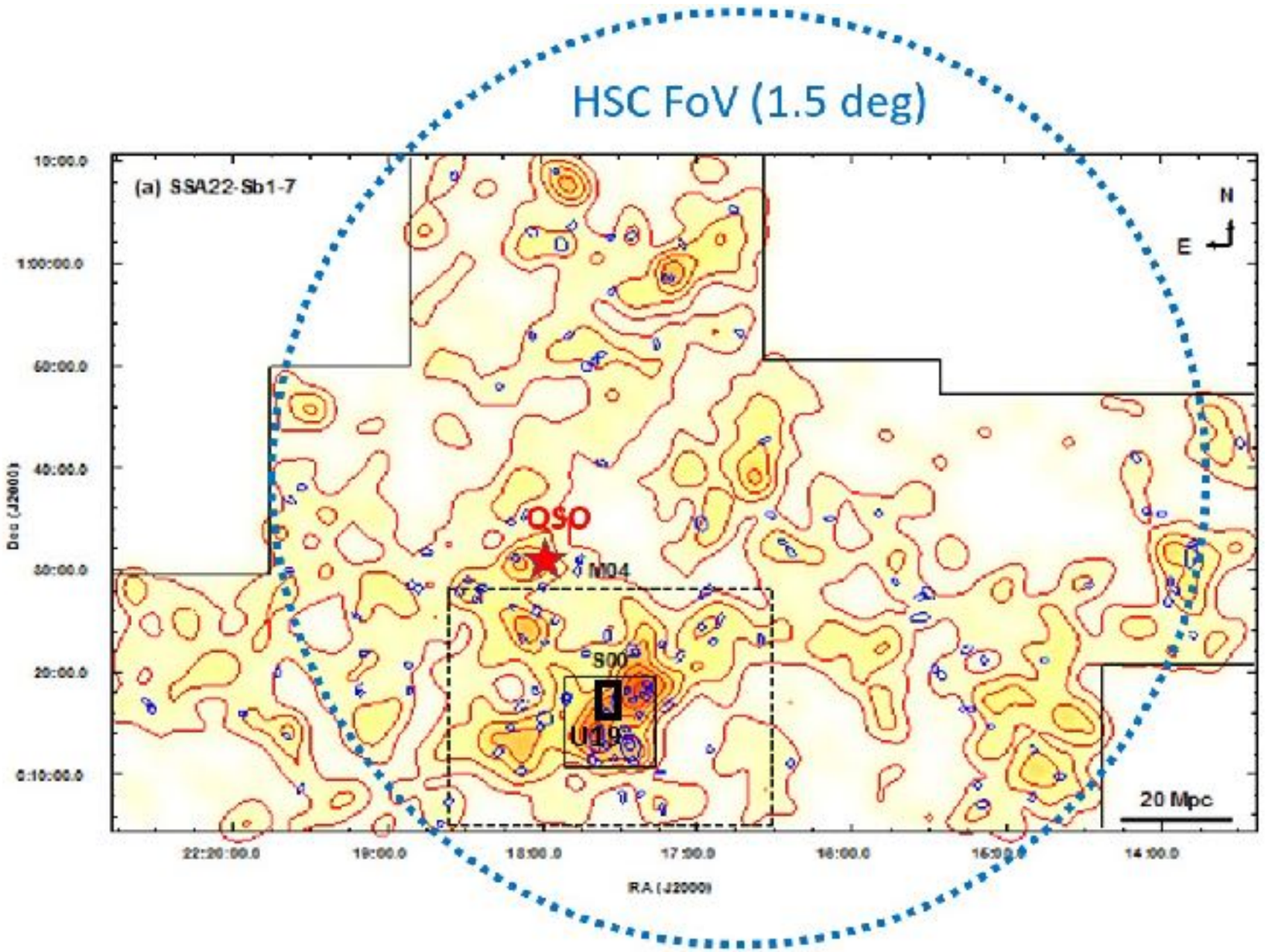

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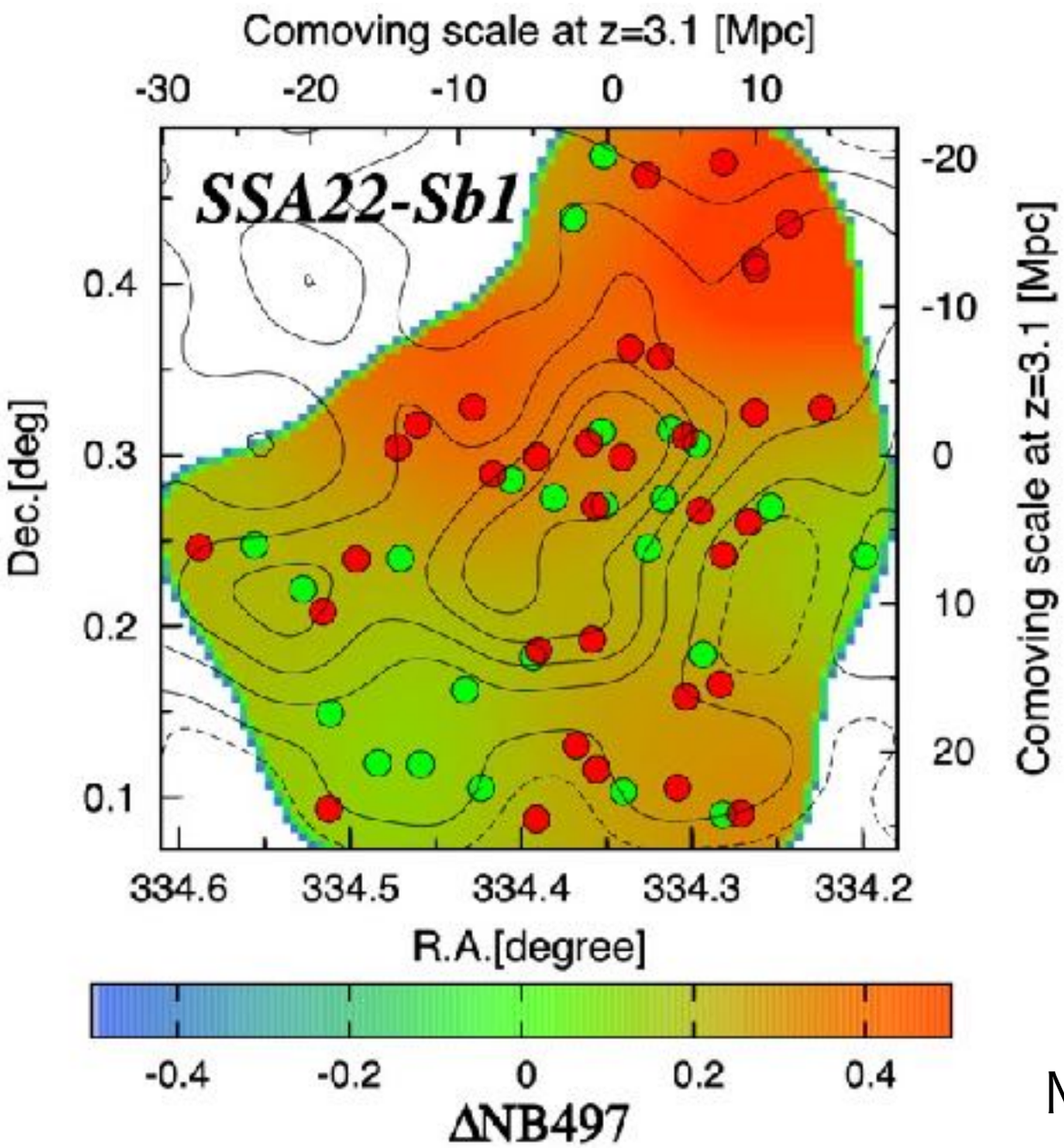
HSC FoV is >1000 x
larger than MUSE FoV.

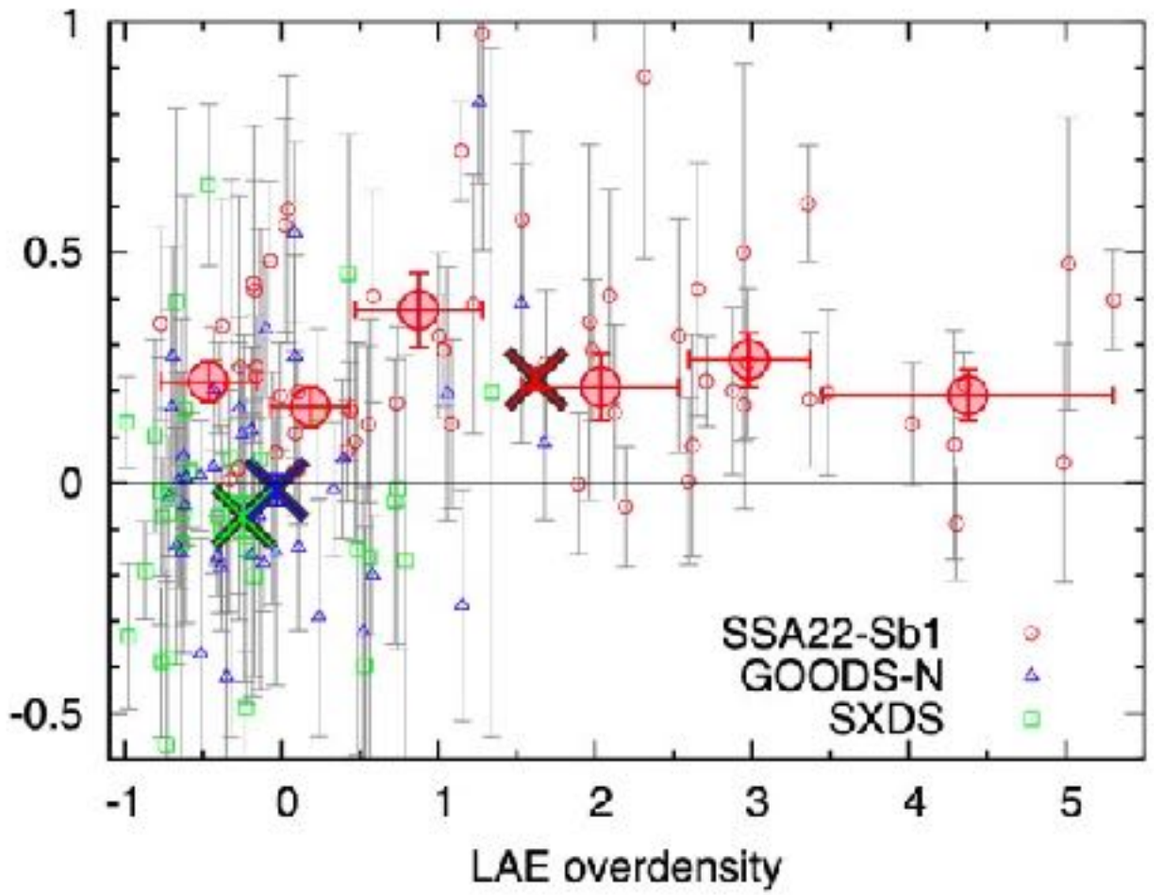
Sky map of LAEs/LABs
in and around SSA22 by
Yamada et al. (2012) and
Matsuda et al. (2012)

Lya Absorption with NB497

HI absorption map using background LBGs

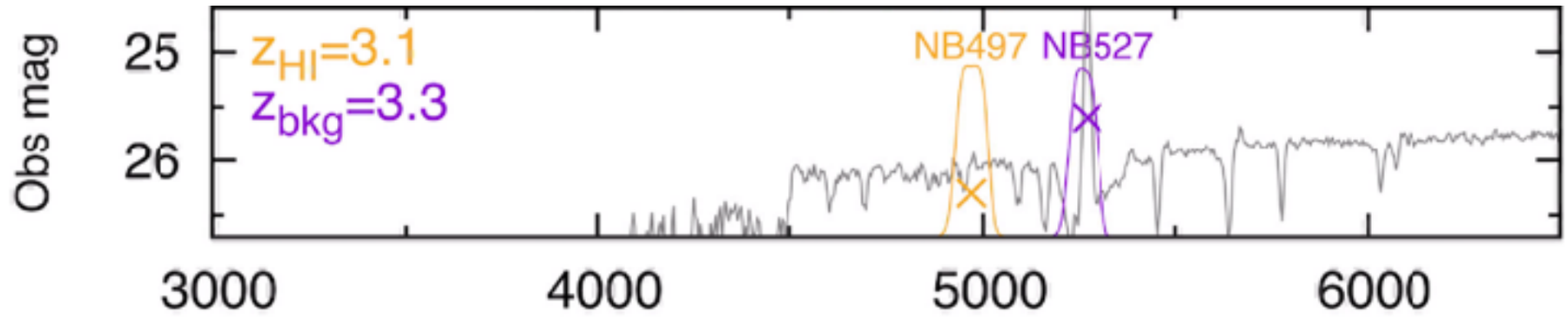


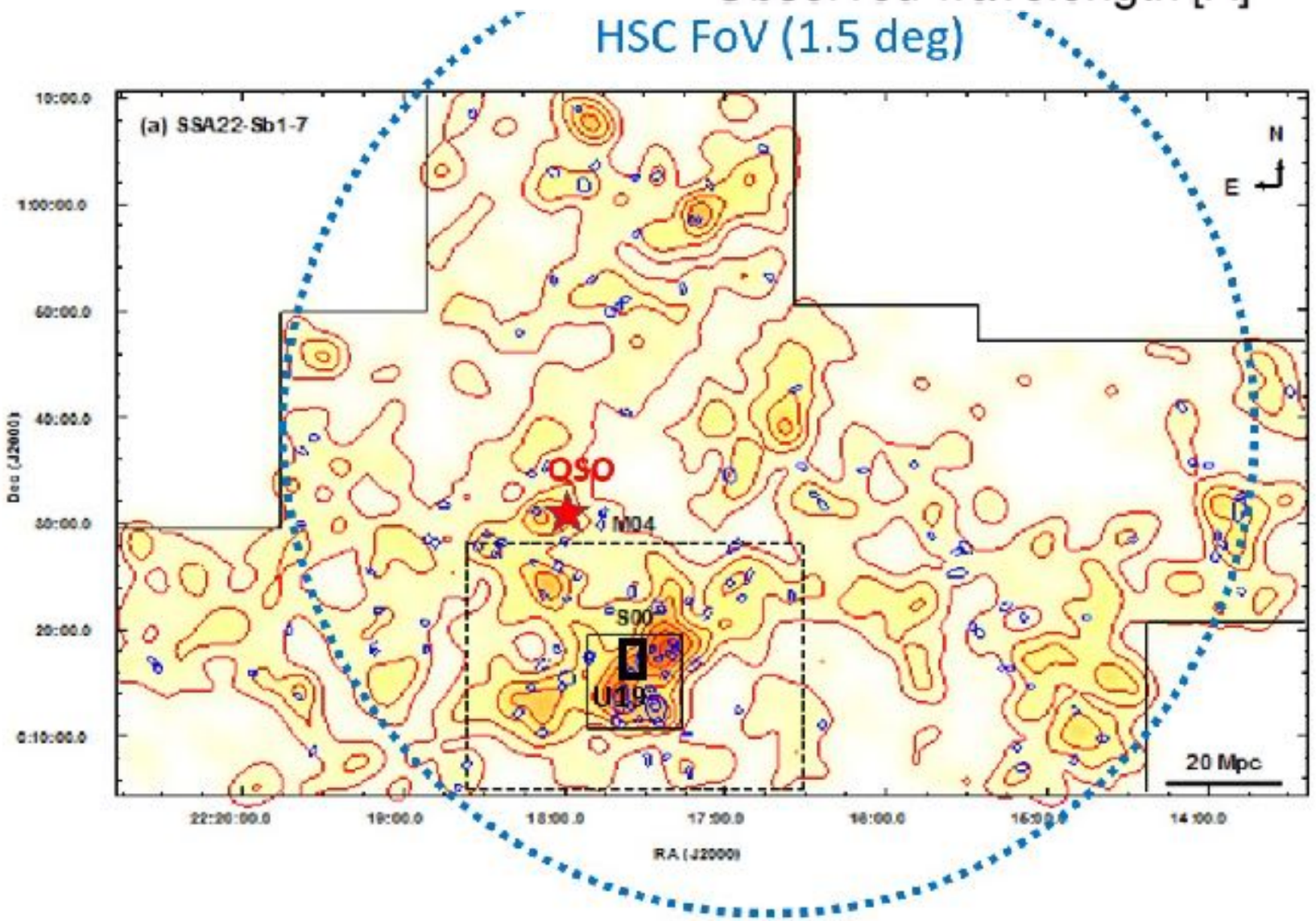
>50Mpc scale HI structure



Mawatari et al. (2017)

Proposed Observations (13n)





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Immediate Objectives of MIRACLES

- **Physical properties of the cosmic web -** Surface brightness, width, length, HI+HII gas mass, ionizing state

- **The connection between the cosmic web and galaxies/AGN -** Galaxy population requiring cold streams, galaxy/AGN proximity zone

- **The role of the cosmic web on cluster formation -** covering fraction, multiplicity of the filaments

TAC's suggestions

- **Scientific (particularly theoretical) motivation is unclear -** how to address galaxy formation process and missing baryon problem?

- **The necessity for the HSC's FoV & proposed depth -** direct mock surface brightness maps from simulations will help.

- **The expected number of ~10 z=3.3 LBGs behind the filaments sounds insufficient to map the cosmic web -** can we also use z=3.3 LAEs?

- **The technical feasibility of stacking so many (~180) frames with a total integration time of 60 hours to obtain low-surface brightness features -** test is needed using SSP UD (or Chorus) data although Kikuta et al. (2019) demonstrated that stacking of 389 g-band frames and 113 NB frames worked well.

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