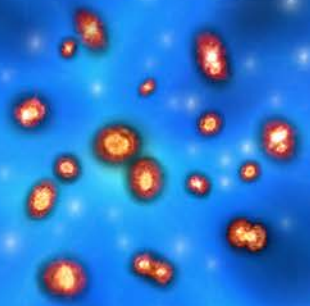
Gas filaments at z=3 revealed by MUSE



Hideki Umehata
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Outline

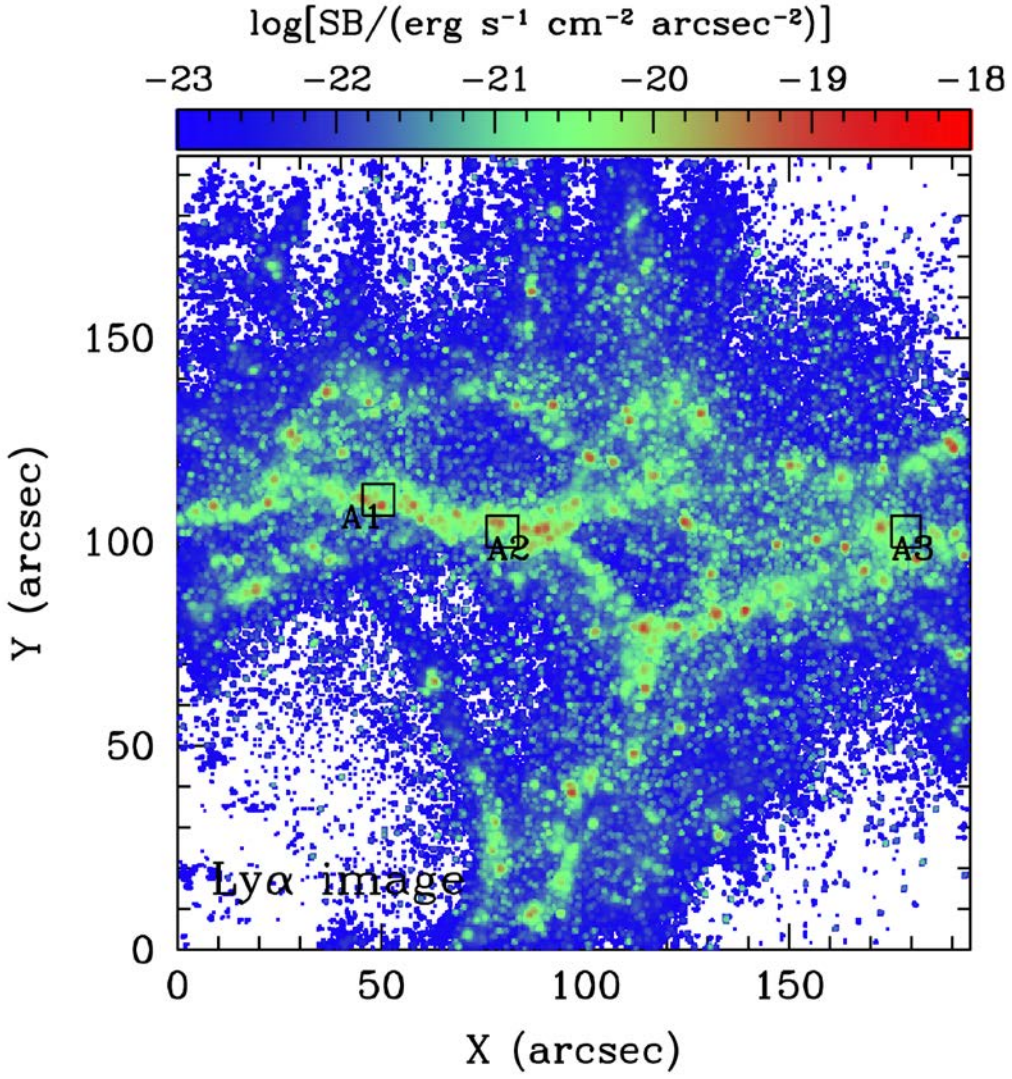
1. Introduction
   - Tracing Cosmic Web in emission.

2. Subaru S-Cam view in SSA22
   - LABs and filament candidates

3. MUSE Survey
   - Obs. and Results.

4. Summary
   - Identification of cosmic web filaments at z=3

Cosmic Web in Emission



Kollmeier+2010, ApJ

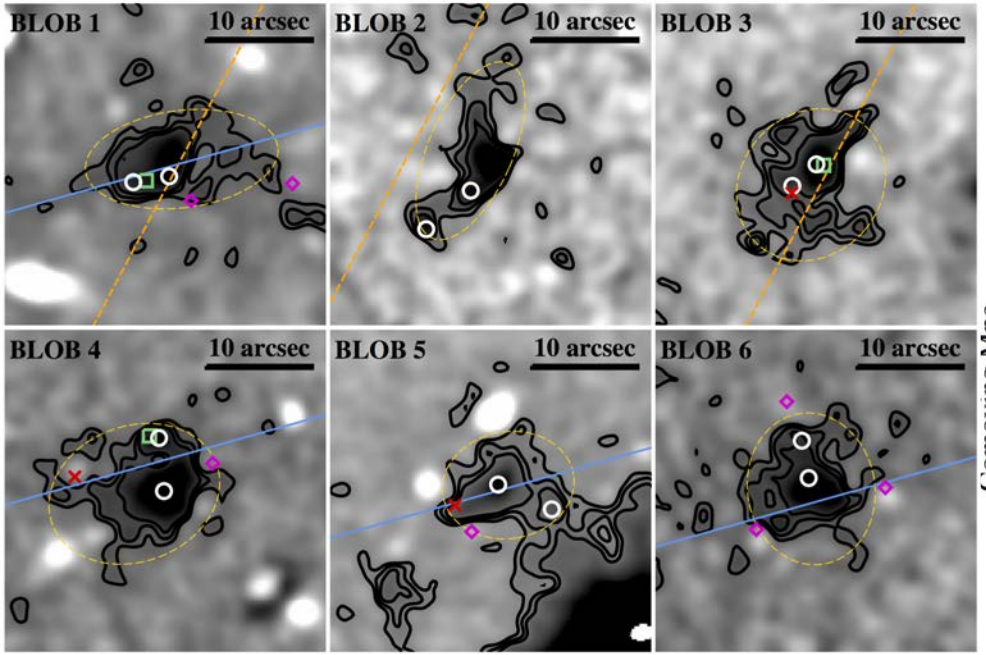
Fluorescence?
Cooling radiation?

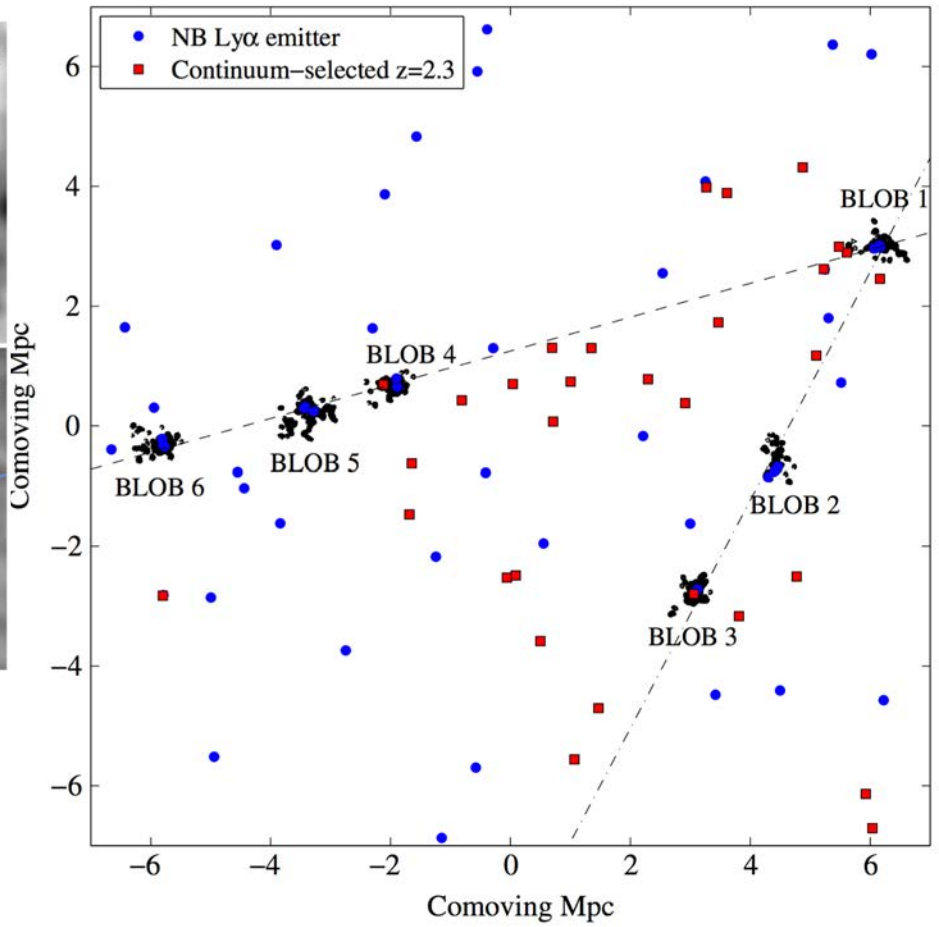
Motivation:

- geometry, contents, relation to galaxies,... in 3D.

LABs / ELANs

Erb+11, ApJ

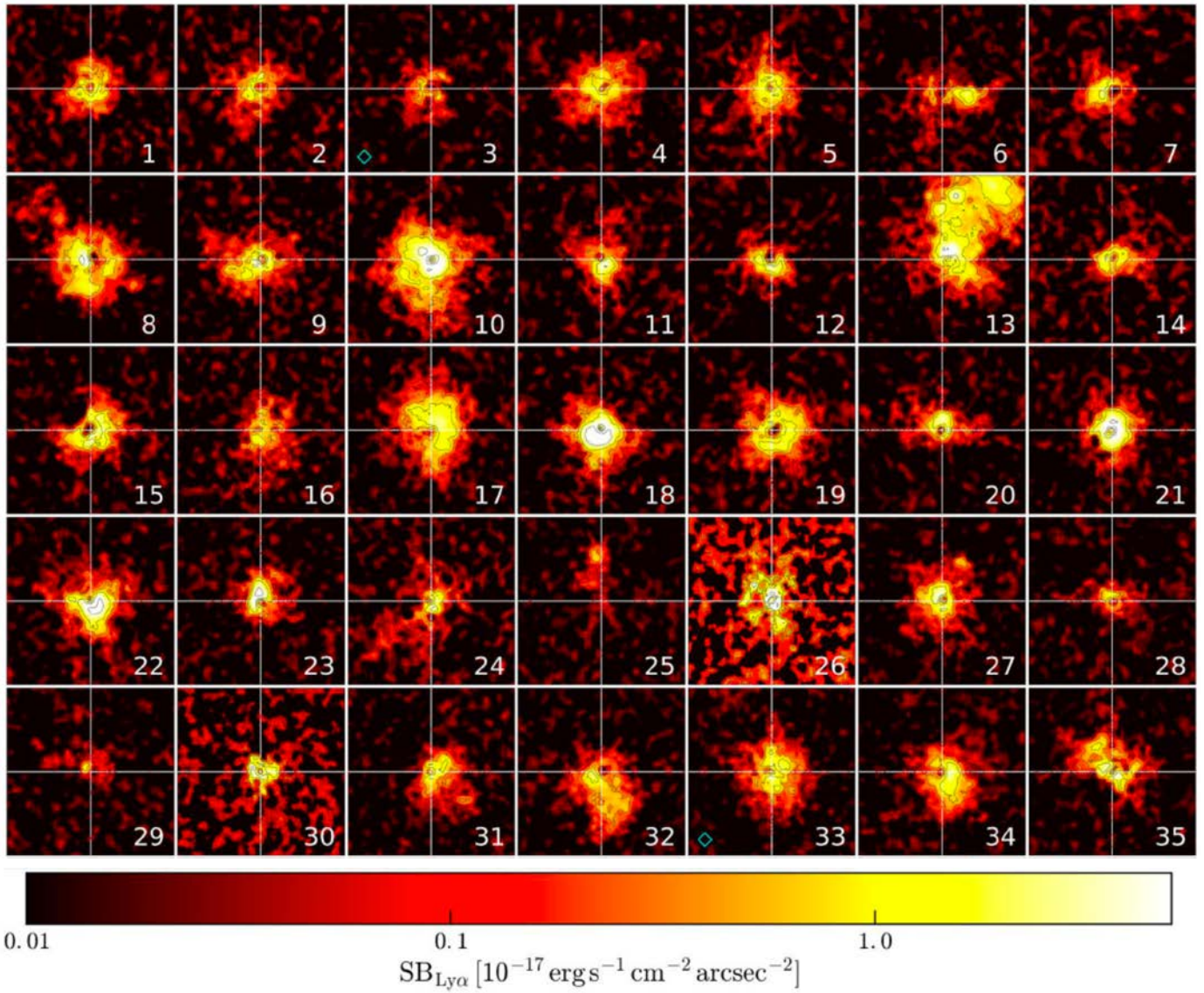




- LABs may be associated with larger cosmic structure.

LABs / ELANs

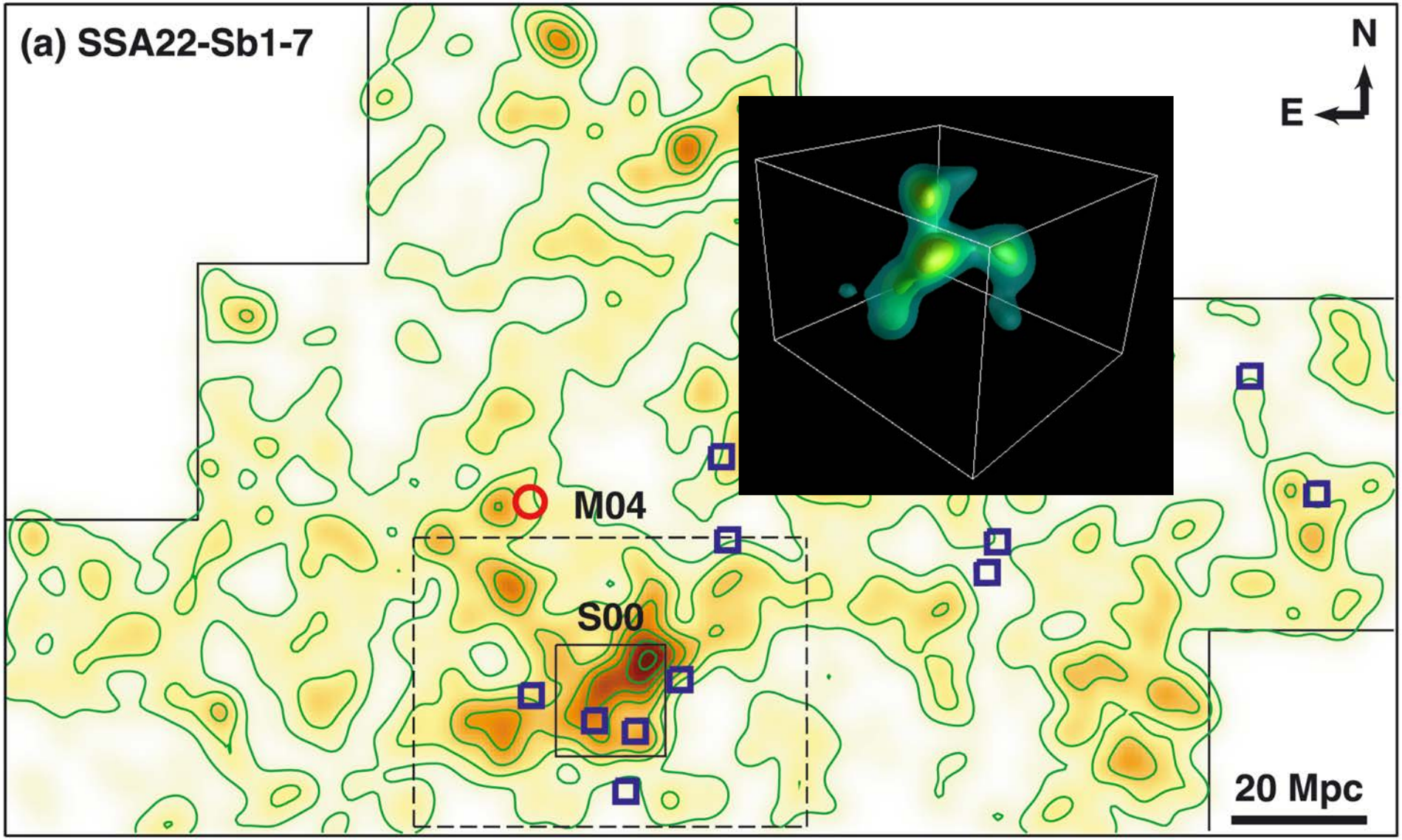
Arrigoni Battaia+19, MNRAS



30”x30”

- QSOs are generally associated with Lyα halos.

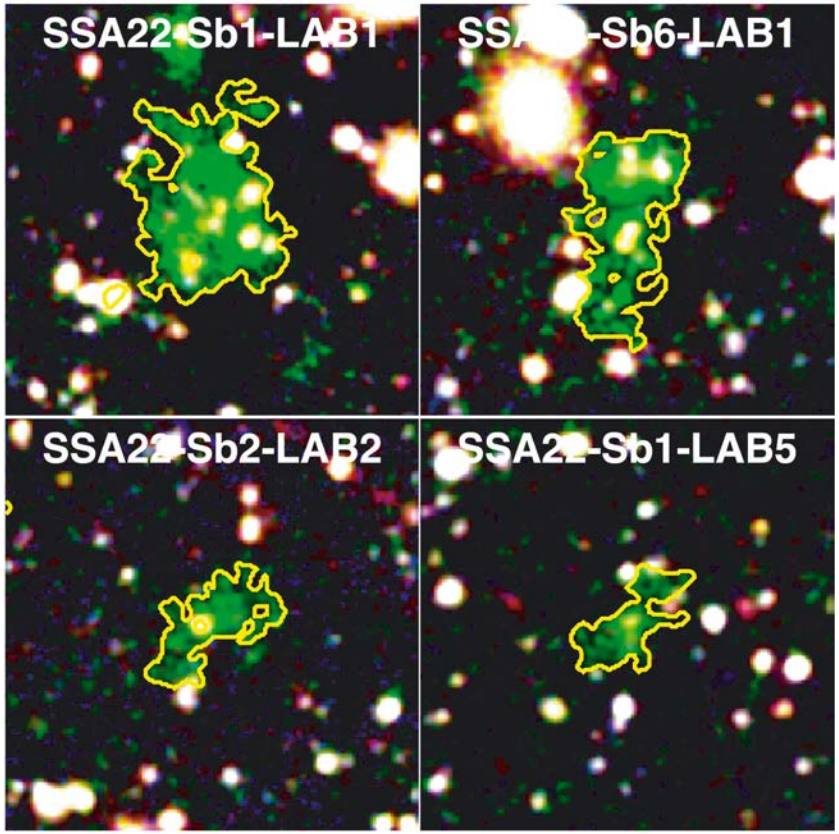
SSA22 Proto-cluster



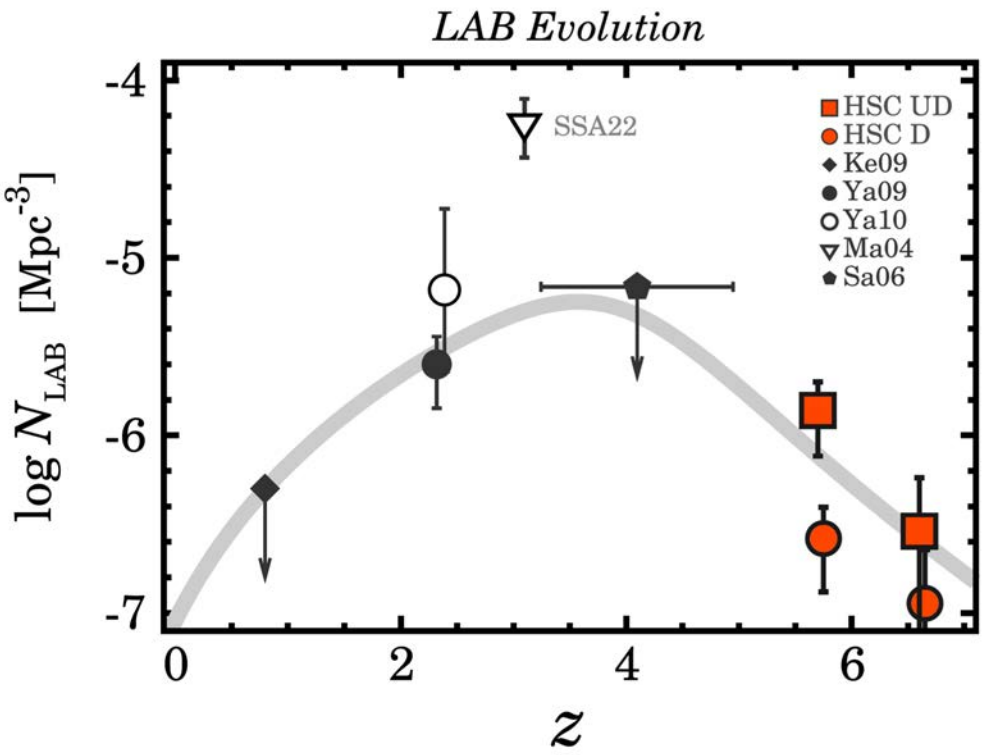
Matsuda+05/Matsuda+07

LABs in SSA22

Matsuda+07

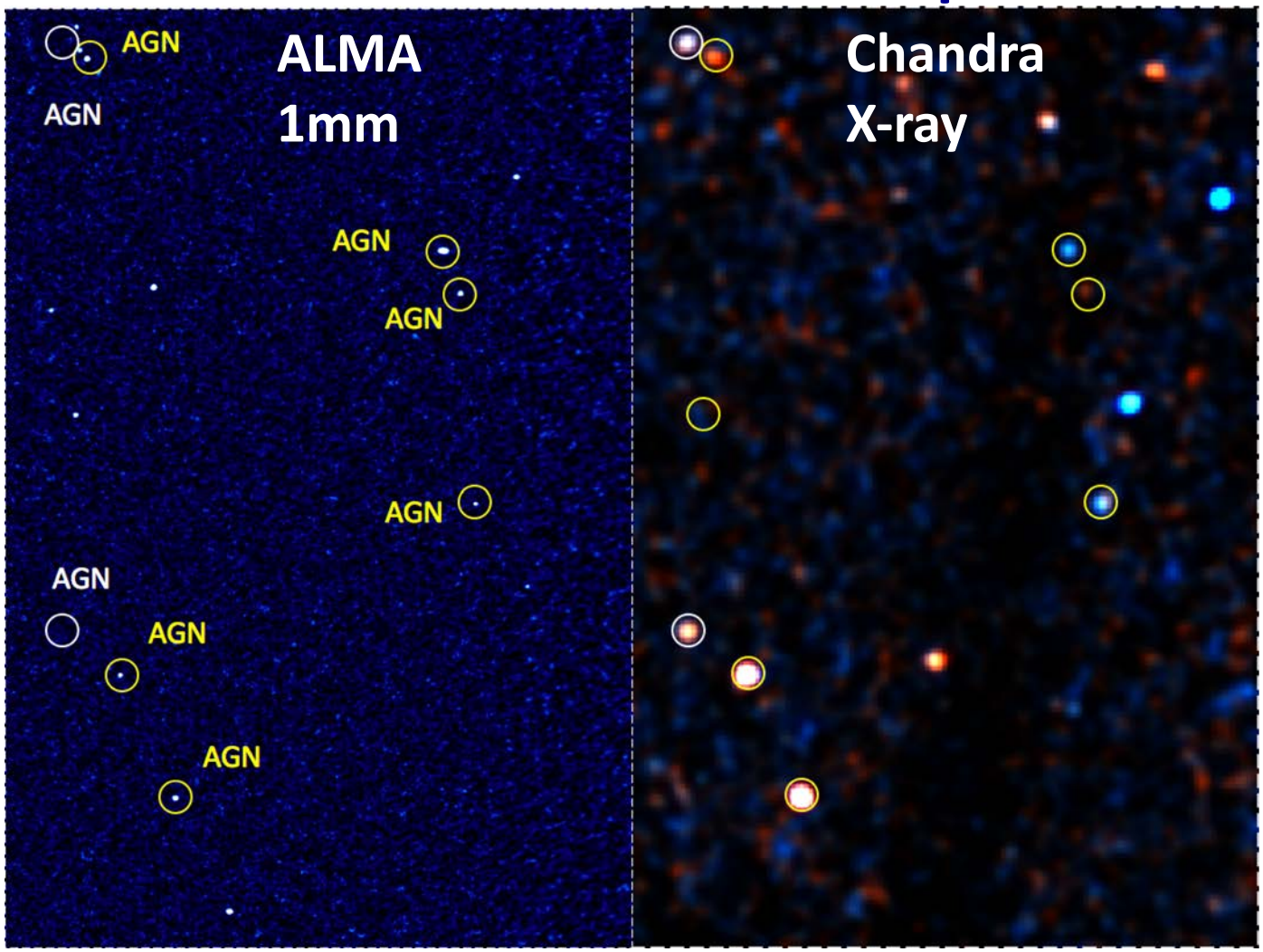


Shibuya+2018, PASJ



- SSA22 is extremely rich in LABs.
  - LABs would be somehow related to cosmic structures.

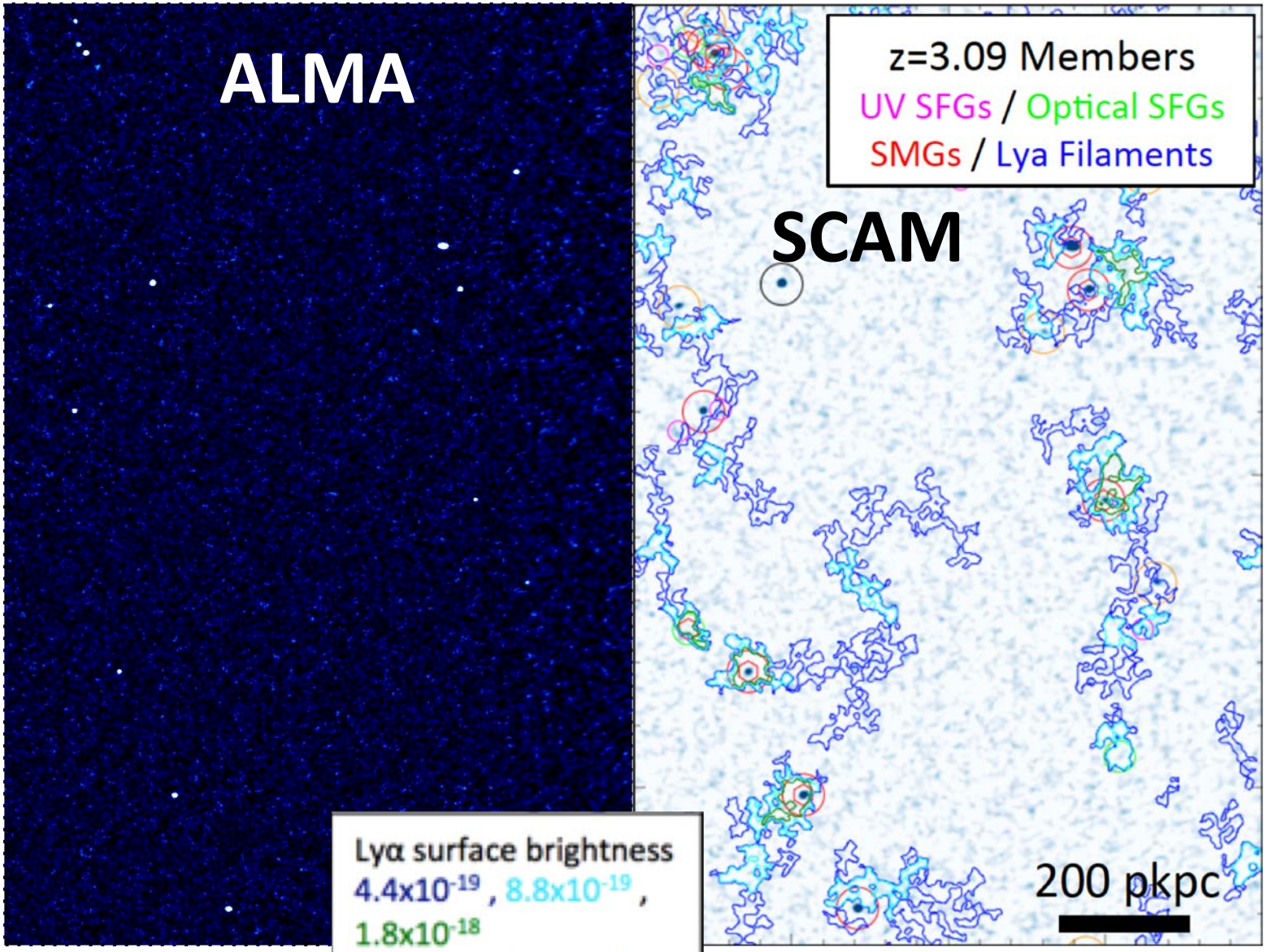
ADF22: ALMA Deep Field



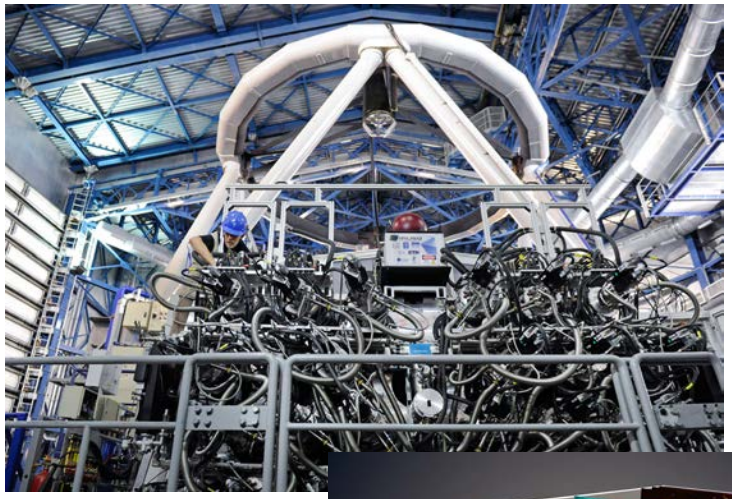
HU+15;19

- Unusually high densities of SMGs/X-ray AGNs.
  ... why?

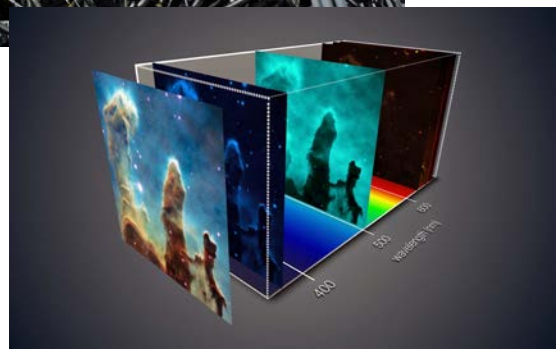
ADF22: ALMA Deep Field

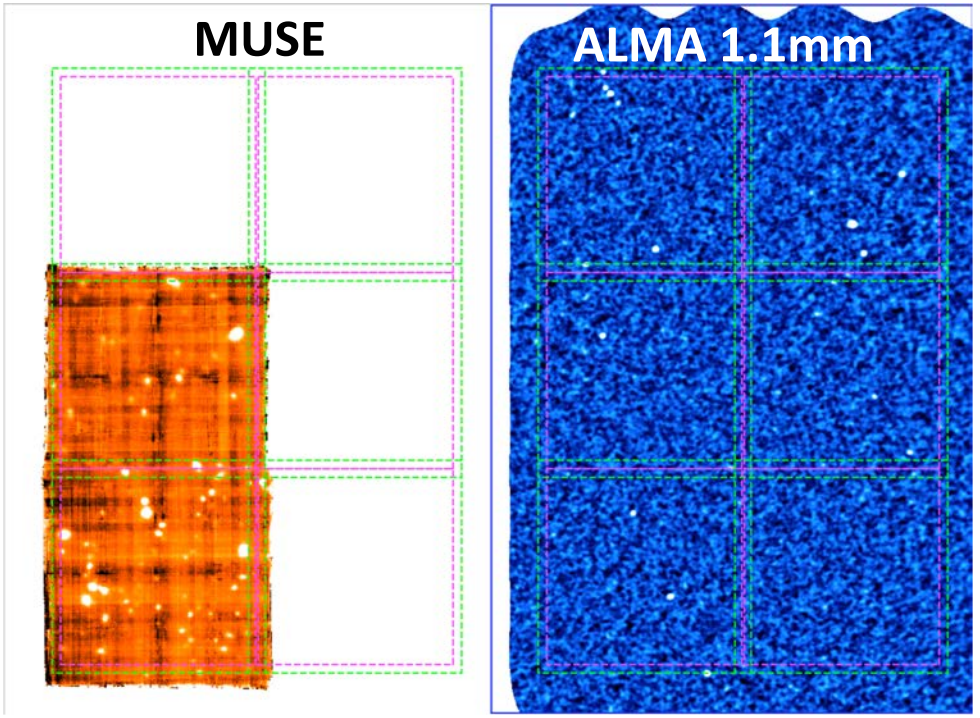


ALMA-MUSE Deep Field



© ESO





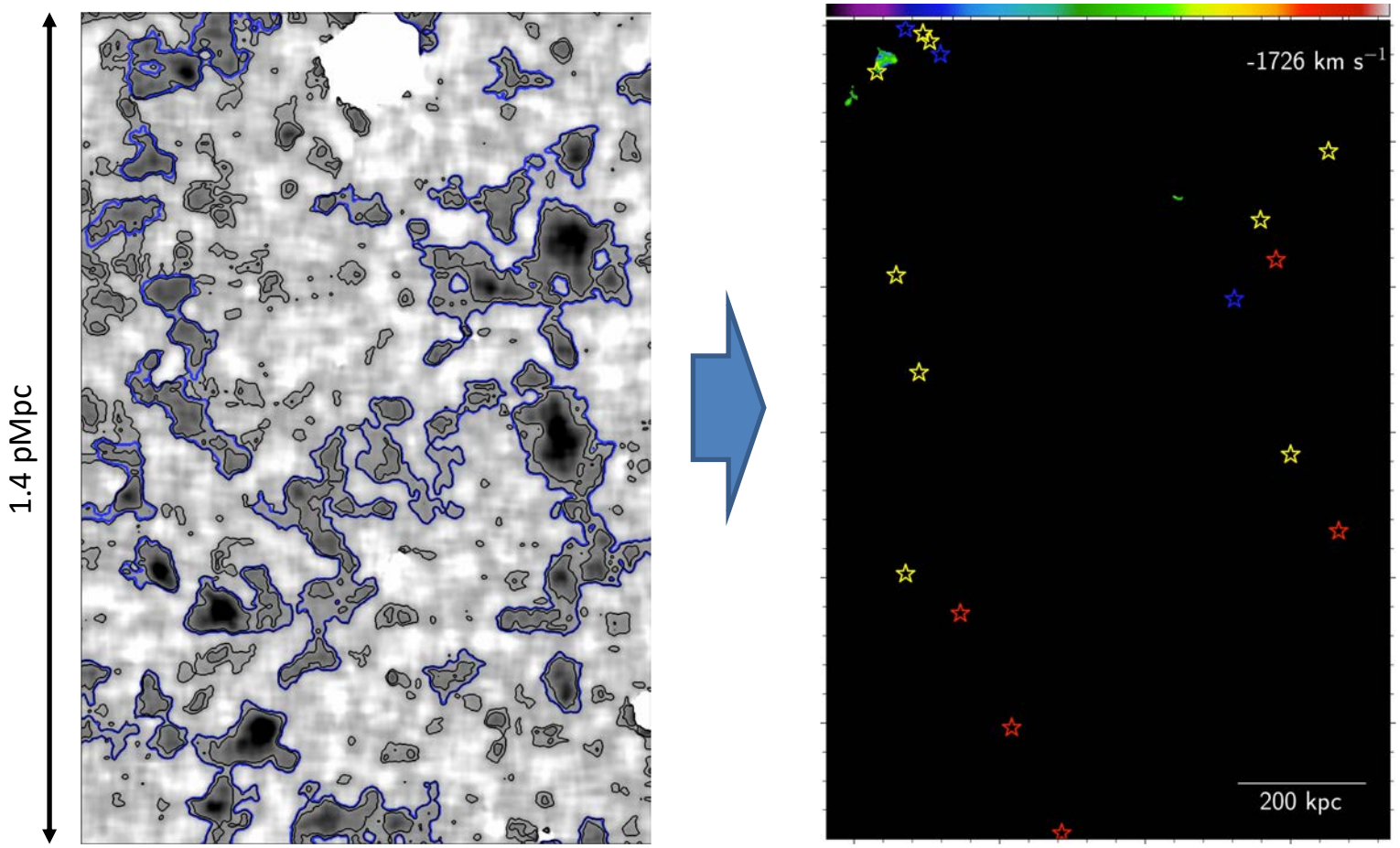
- We can trace Lyα emission in 3D
(cf: the NB filter has 77A width)
- 30 hours MUSE time was allocated (PI. HU).

Views of Lyα filaments

SCAM

MUSE

HU+19



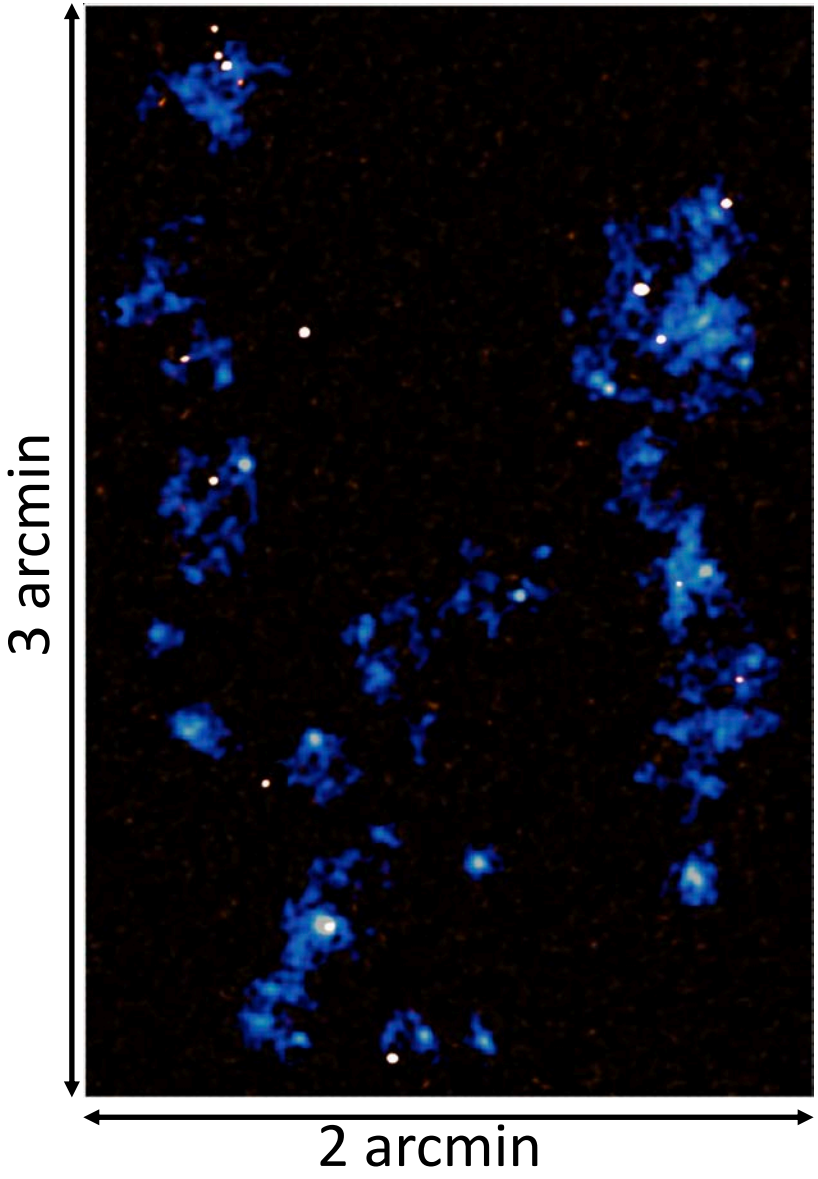
Star: SMGs and/or X-ray AGNs

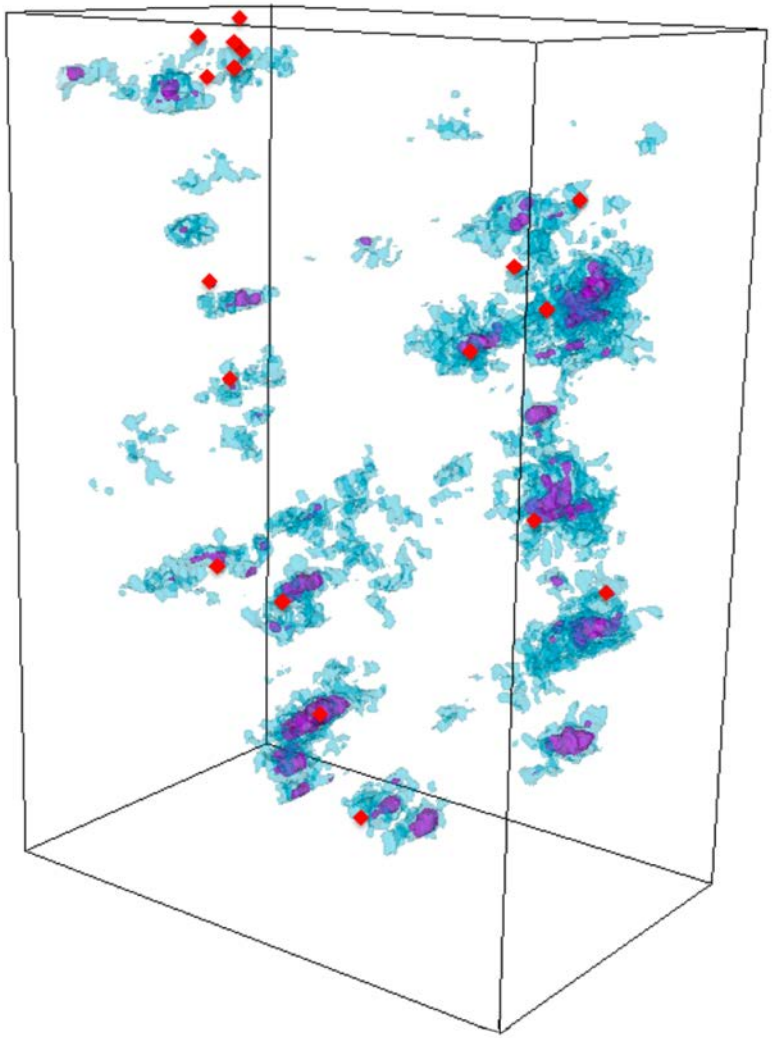
- Lyα filaments are seen on ~1 pMpc scale in both.

Views of Lyα filaments

ALMA + MUSE

HU+19





Summary

+ Lyα radiation is a way to tracing “cosmic web” in 3D.

+ SSA22 proto-cluster at z~3 is a nice laboratory.

+ MUSE revealed very extended Lyα filaments at the proto-cluster core. The filaments would fuel 18 SMGs/X-ray AGNs which are embedded in the filaments.

+ Optical IFU is a very powerful tool to investigate IGMs/CGMs.

- Wide Field of view. (cf: mosaic)
- Optimal extraction of a NB.
- Wavelength coverage.
- Kinematics...