

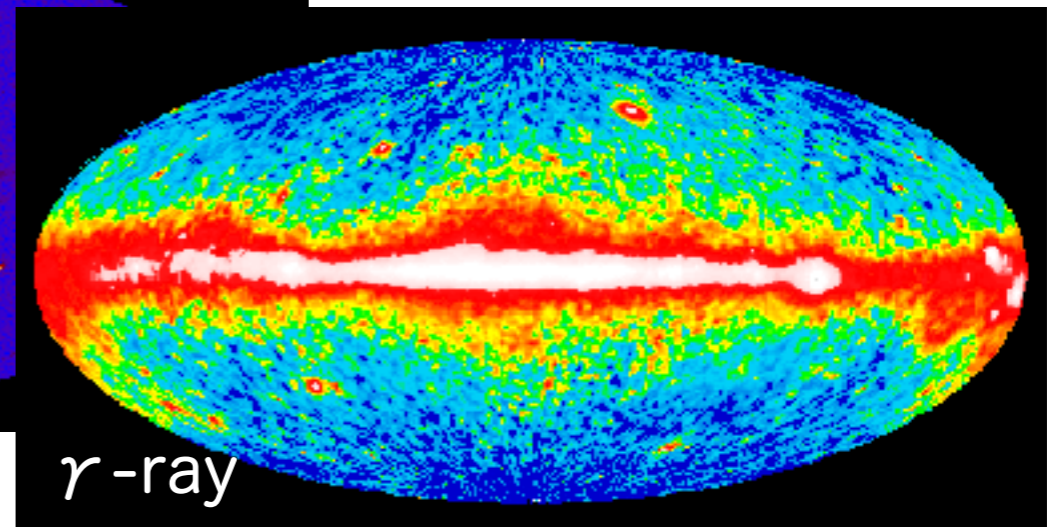
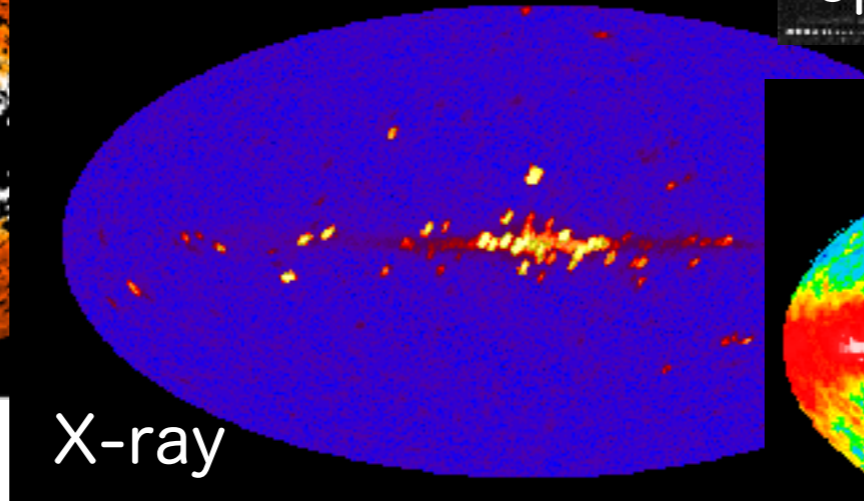
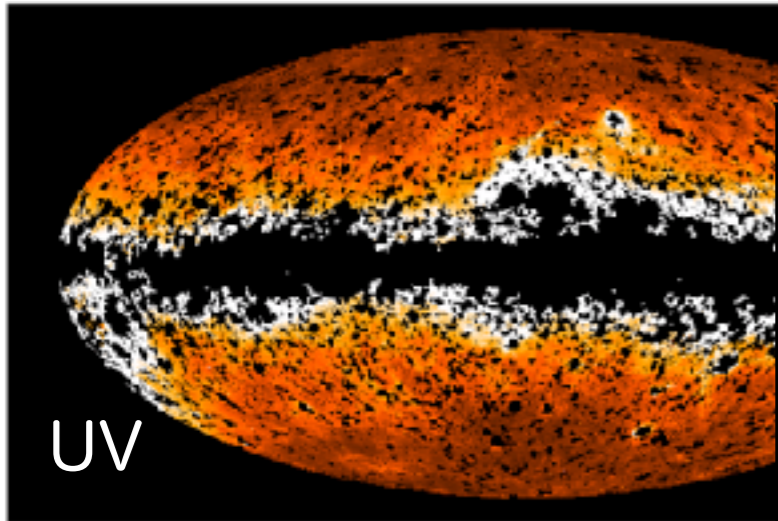
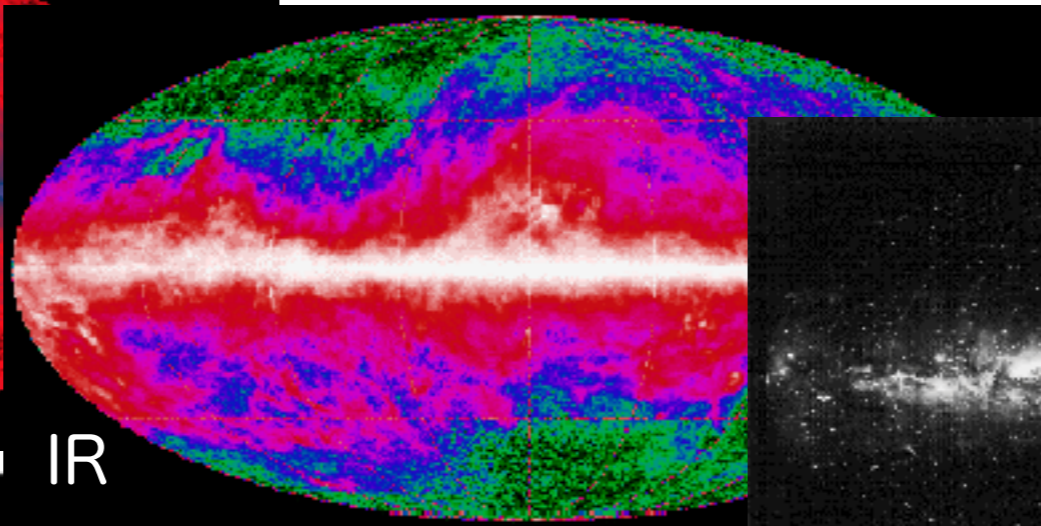
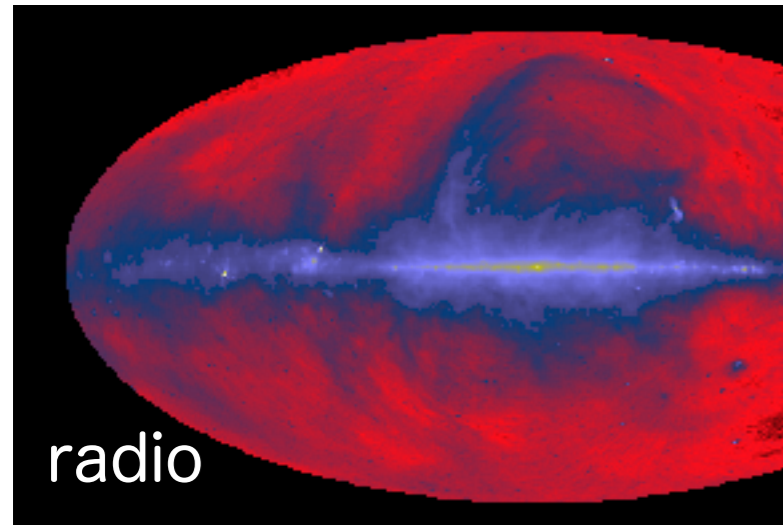
Component extraction from line intensity maps with conditional GAN

Moriwaki, K., et al., 2020, MNRAS, 496, L54

Kana Moriwaki (UTAP D2)

Intensity mapping

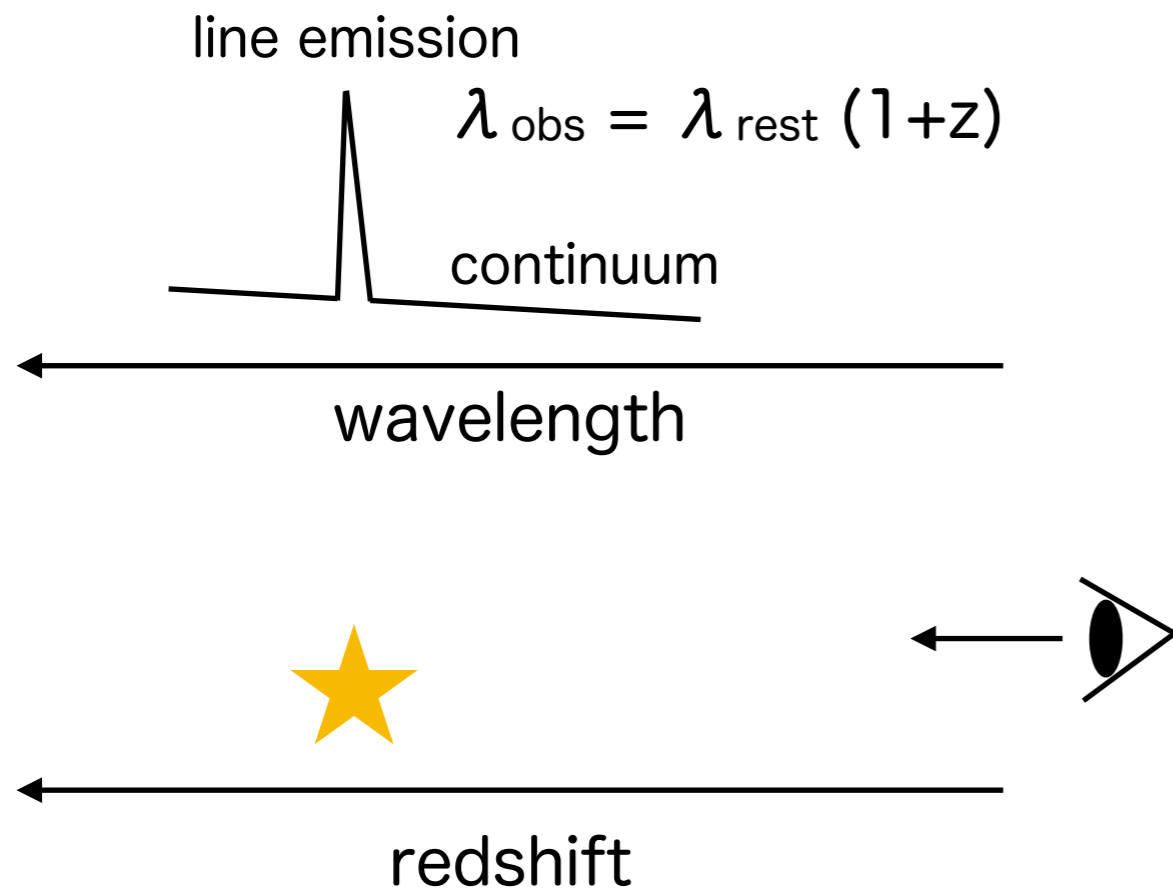
https://apod.nasa.gov/htmltest/jbonnell/www/multiw_sky.html



Line intensity mapping (LIM)

Broad/narrow band intensity mapping → 2D information

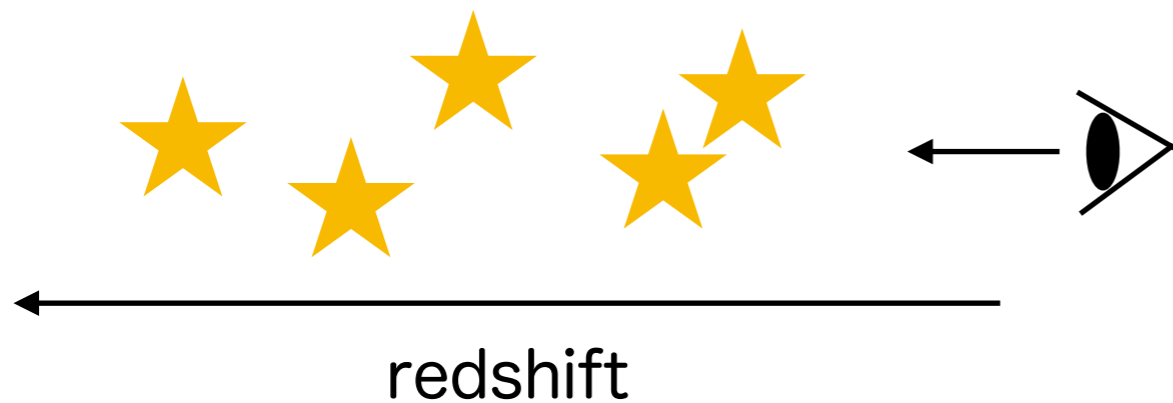
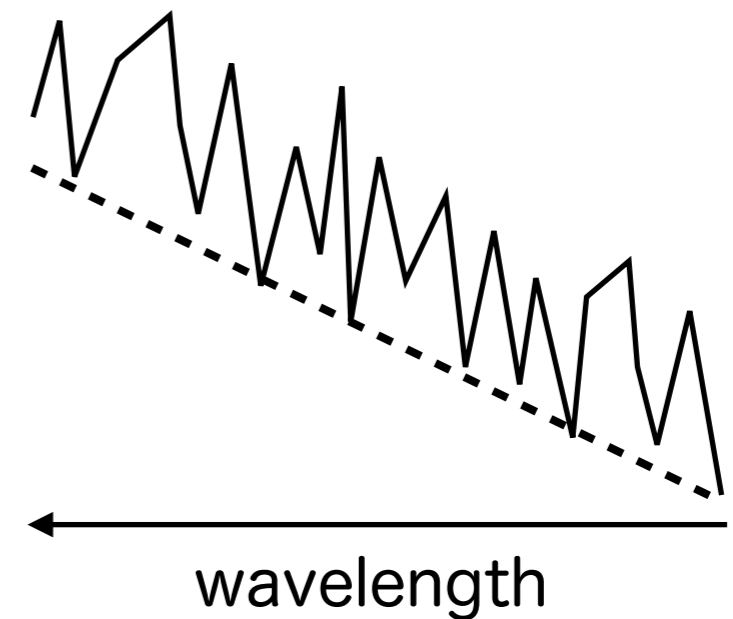
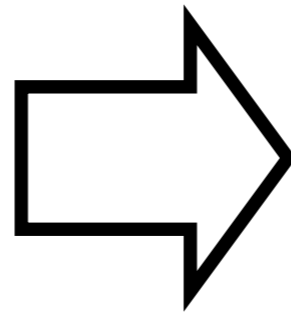
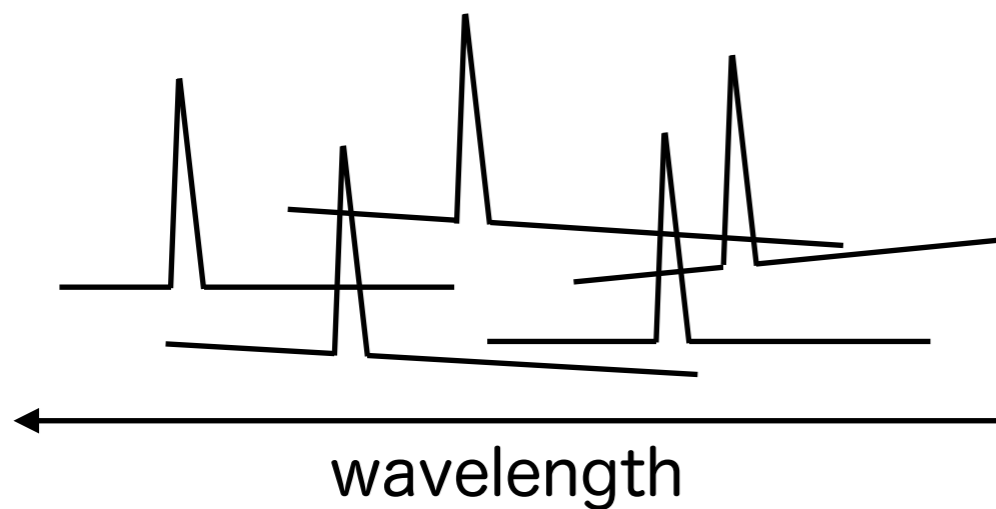
Spectroscopic survey → 3D information



Line intensity mapping (LIM)

Broad/narrow band intensity mapping → 2D information

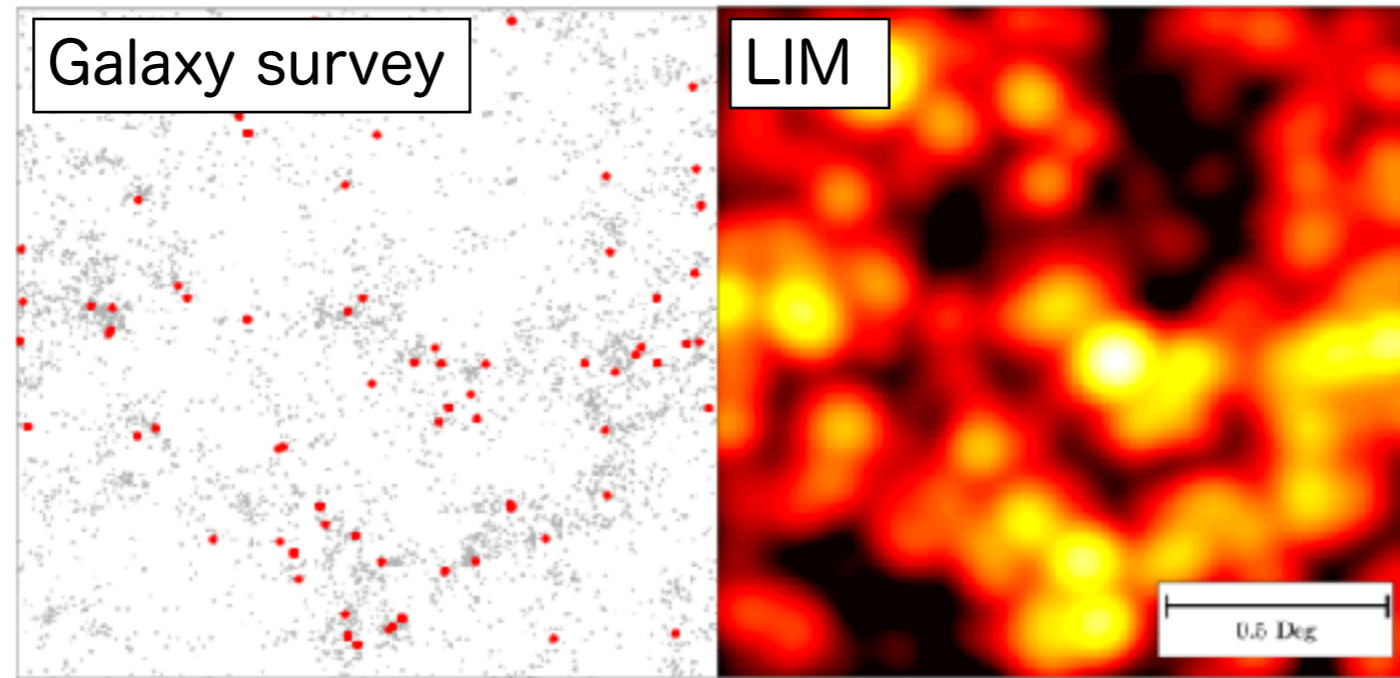
Spectroscopic survey → 3D information



smooth (continuum) + fluctuation (line)

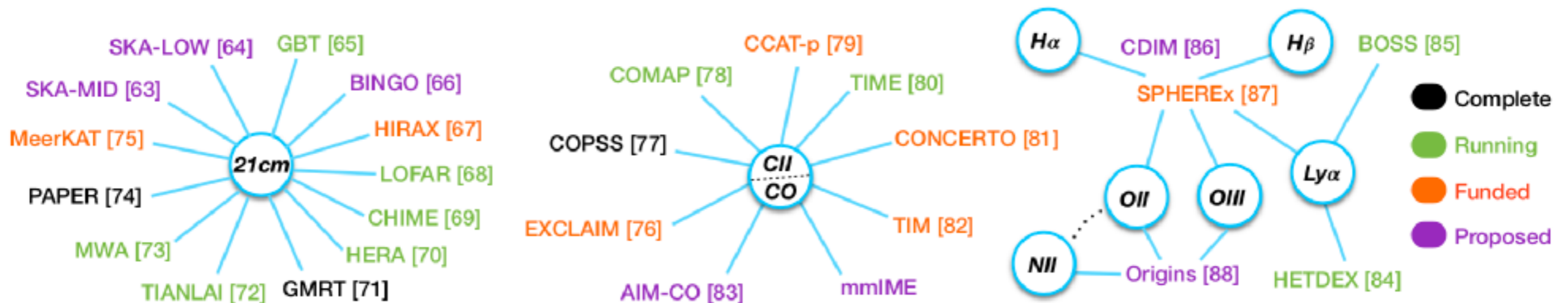
3D distribution of galaxies

Line intensity mapping (LIM)



Breysse et al. (2016)

Spectroscopic surveys are costly → low spectral/angular resolution

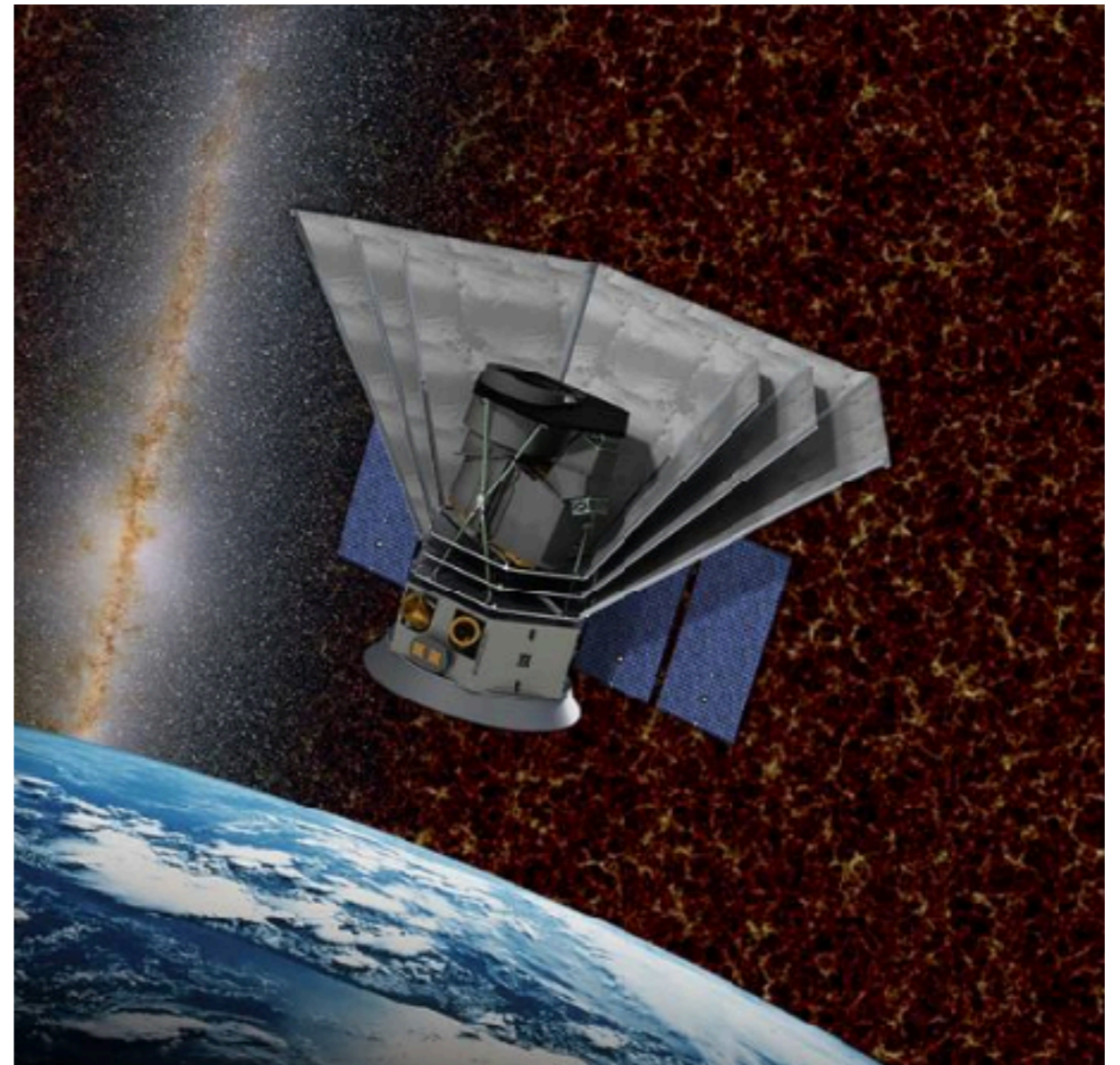
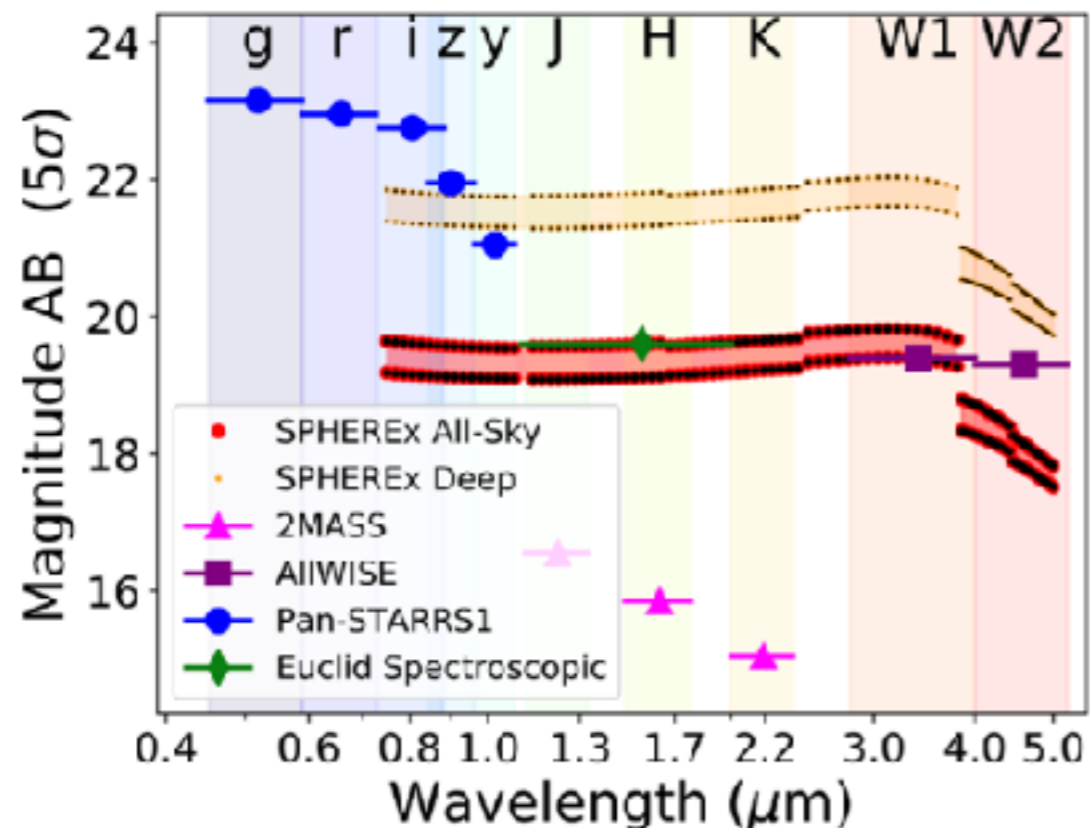


Kovetz et al. (2019)

Future LIM observation plan

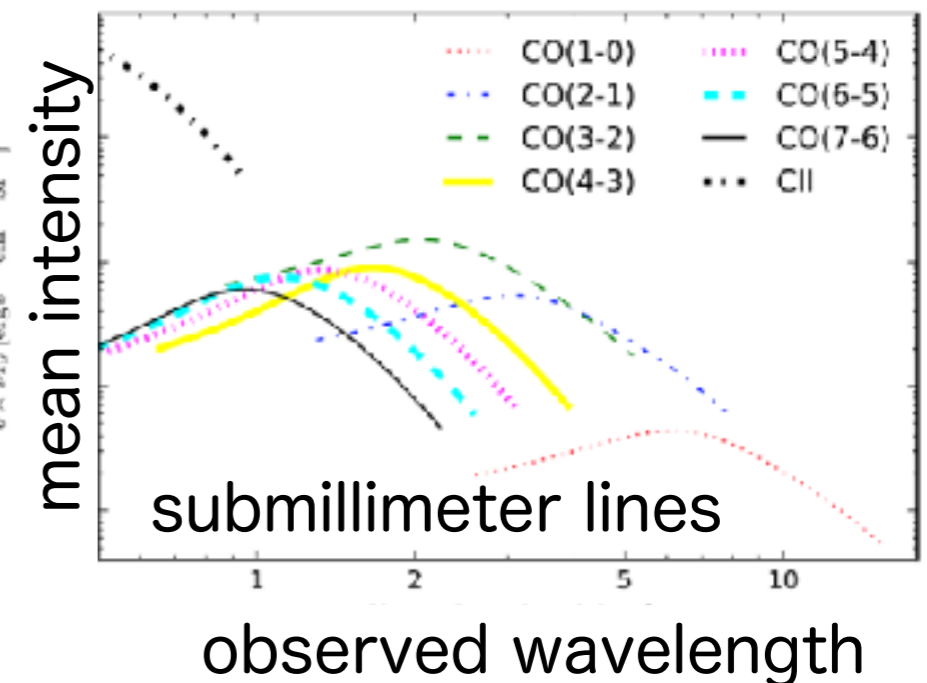
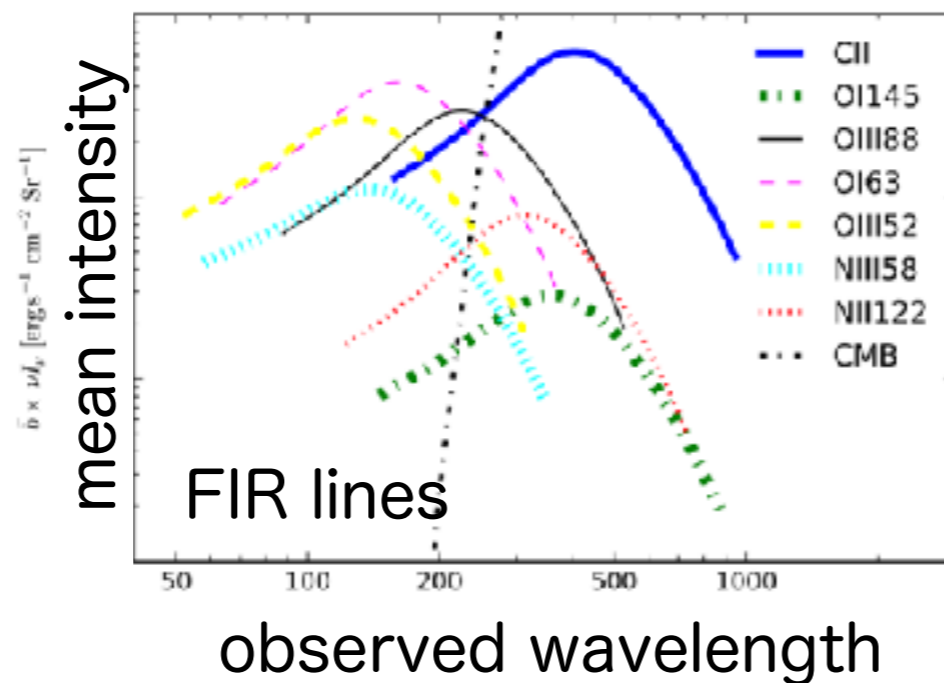
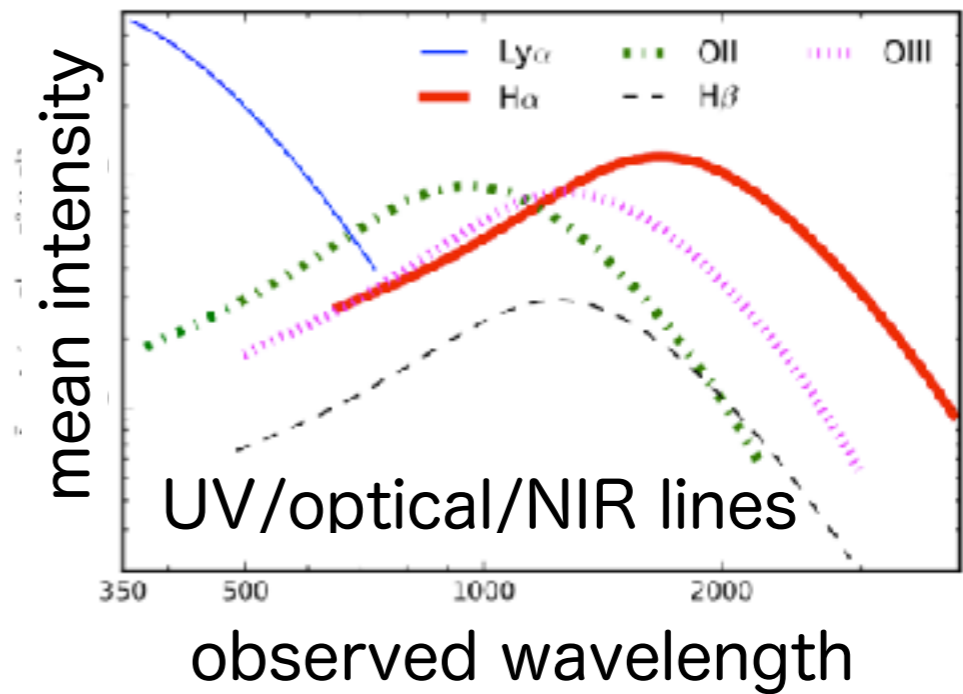
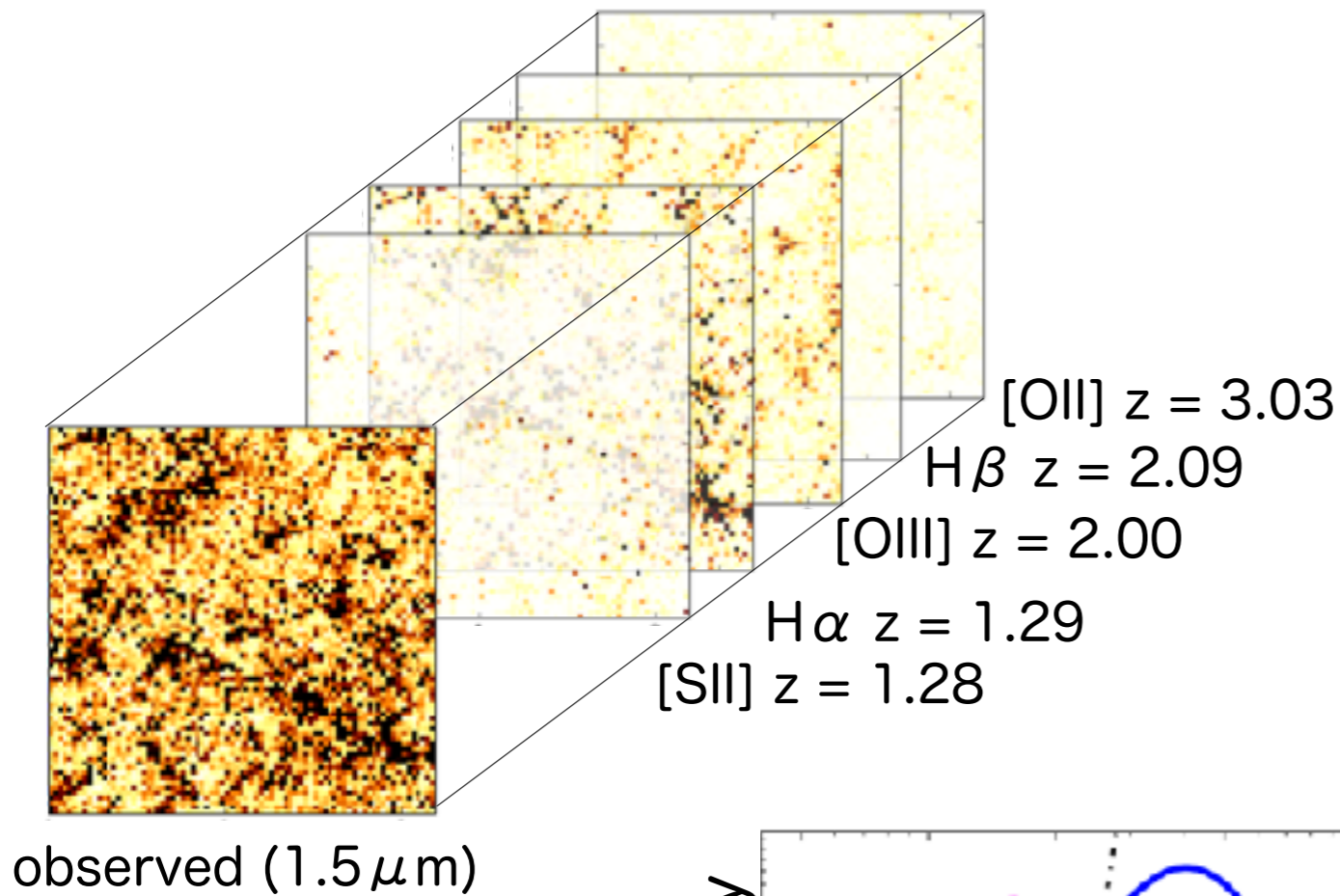
SPHEREx (2023~)

- survey area (deep): $\sim 200 \text{ deg}^2$
- $0.75 \mu\text{m} - 5 \mu\text{m}$
- $z_{\text{H}\alpha} = 0.1 - 6.6$, $z_{\text{OIII}} = 0.5 - 9.0$
- Probe cosmology and galaxy formation/evolution.



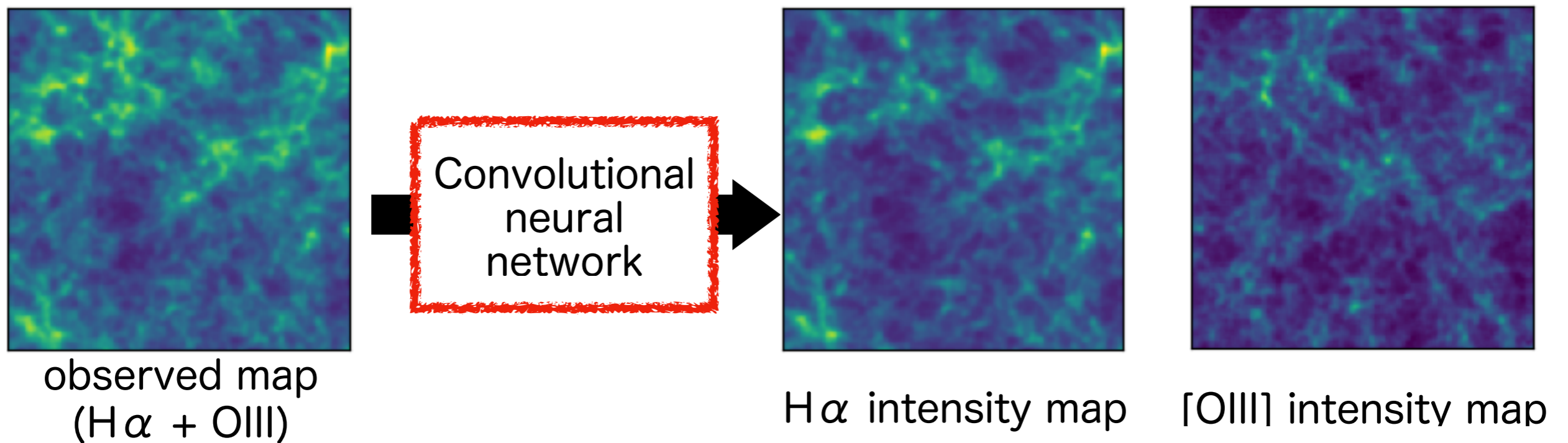
Problem in LIM: contamination (line confusion)

Fonseca et al. (2017)



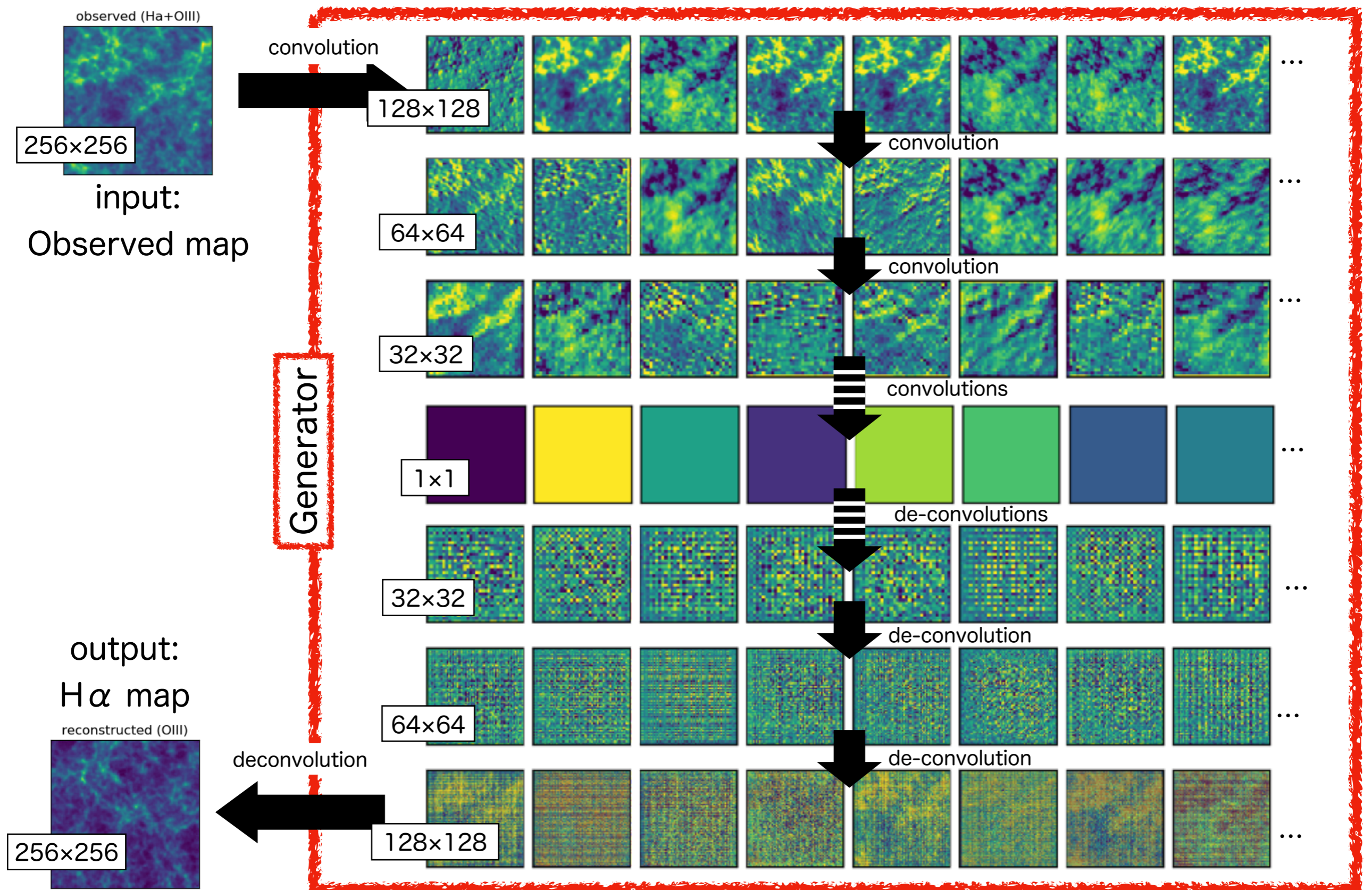
Solution for “line confusion problem”

Can we extract signals from a designated redshift?



We propose a new methods using machine learning.

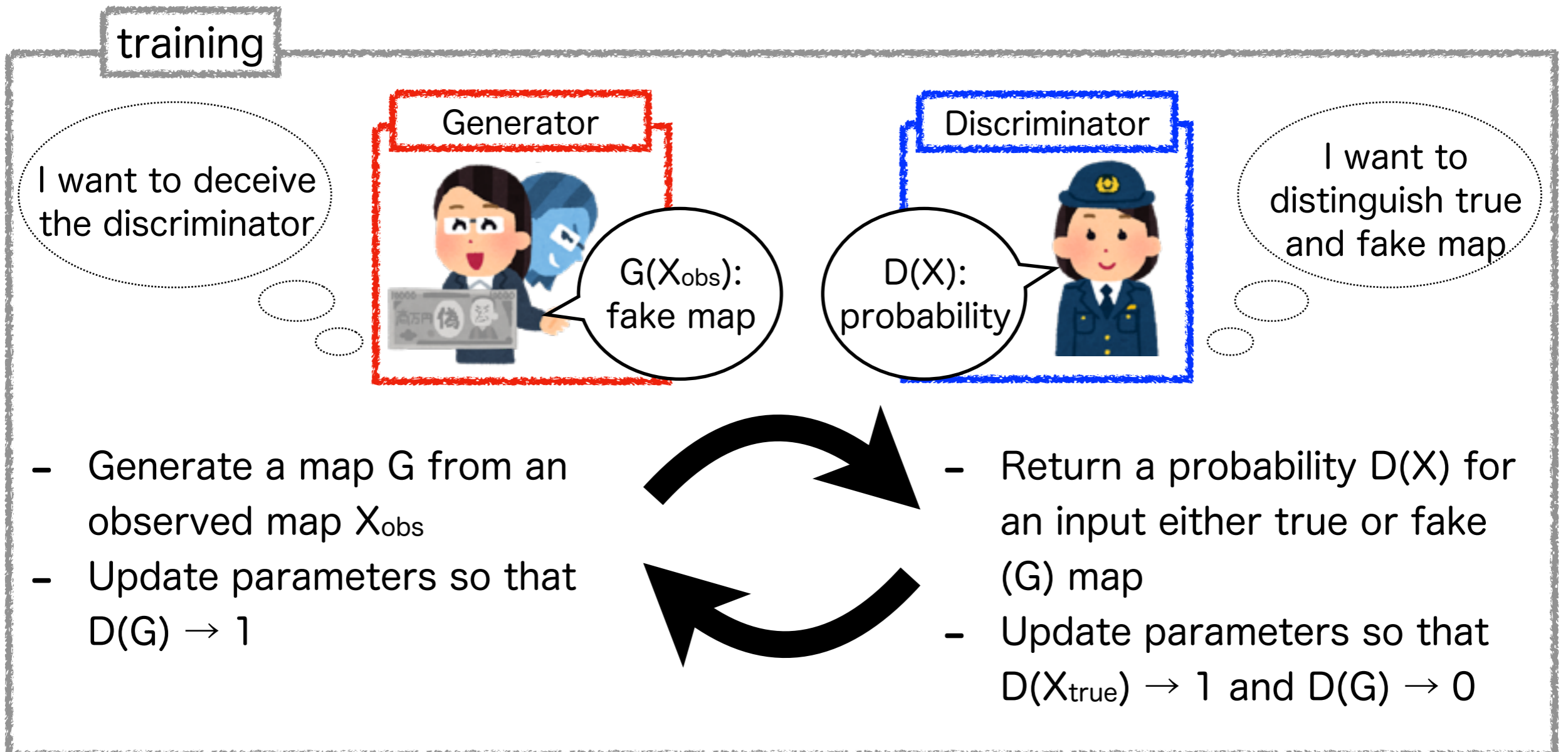
Our CNN (generator) consists of 8 convolution + 8 de-convolution layers



Generative Adversarial Network (GAN)

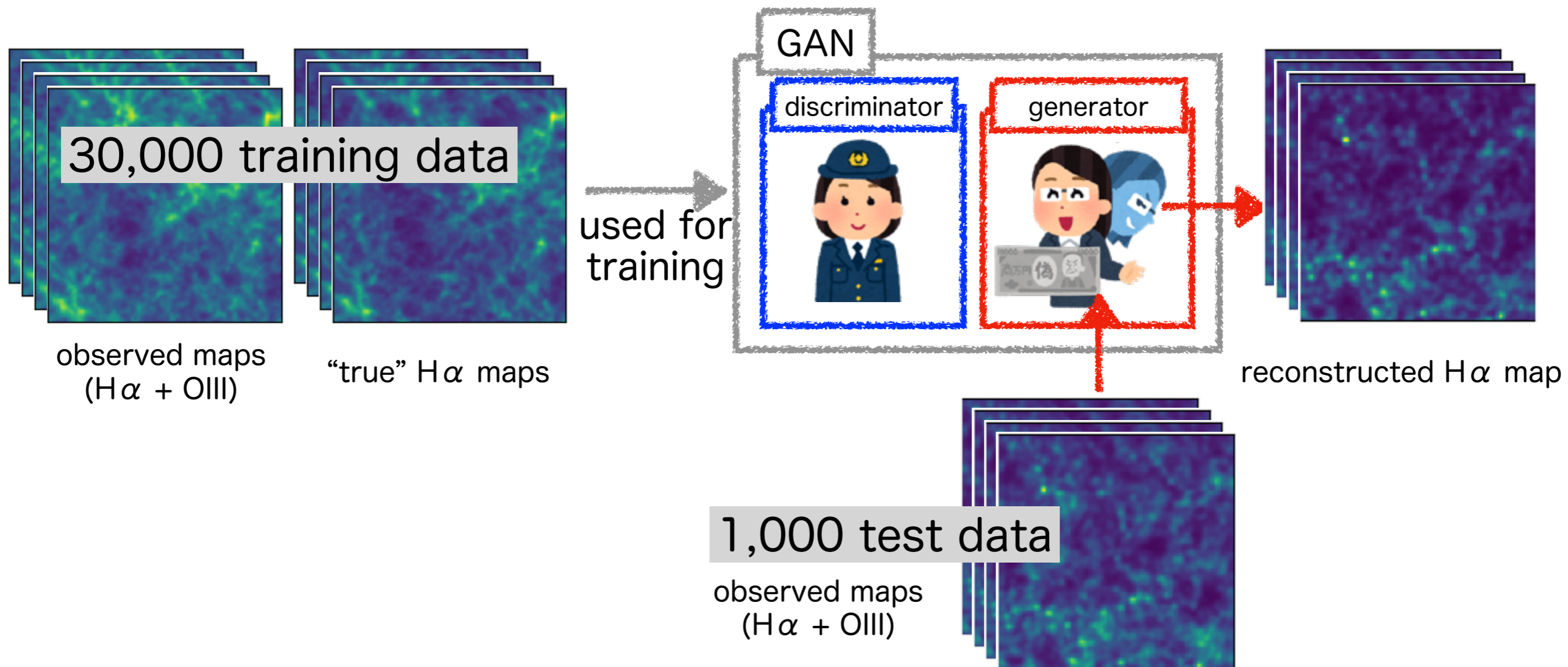
敵対的生成ネットワーク

Two networks (generator and discriminator) are updated in an adversarial way.

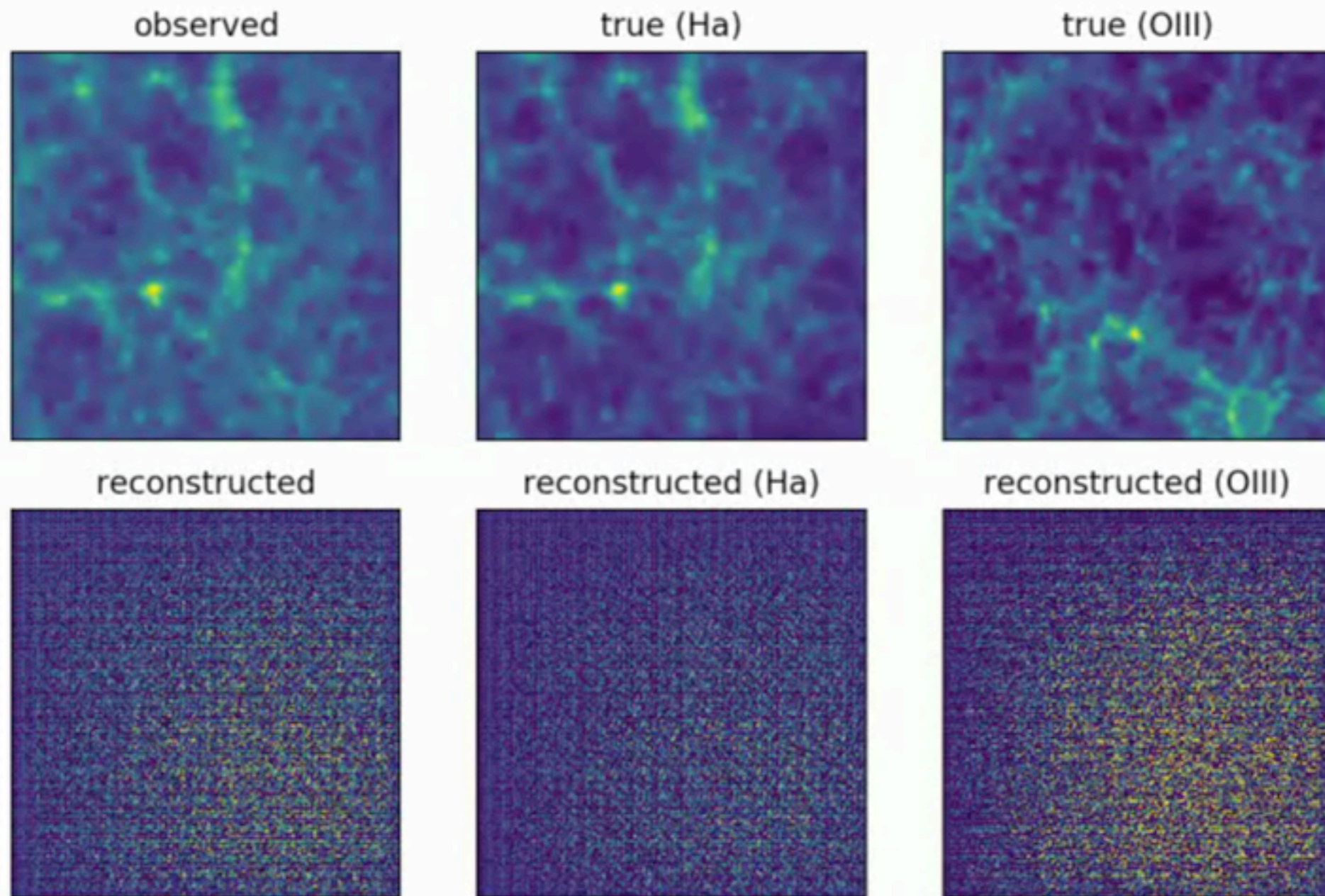


Training data

- Use halo generation code (Pinocchio; Monaco et al. 2013)
→ 30,000 mock maps for training, and 1,000 for test
- Consider $H\alpha$ ($z = 1.3$) + $[OIII]5007$ ($z = 2.0$) observed at $\lambda = 1.5\mu m$

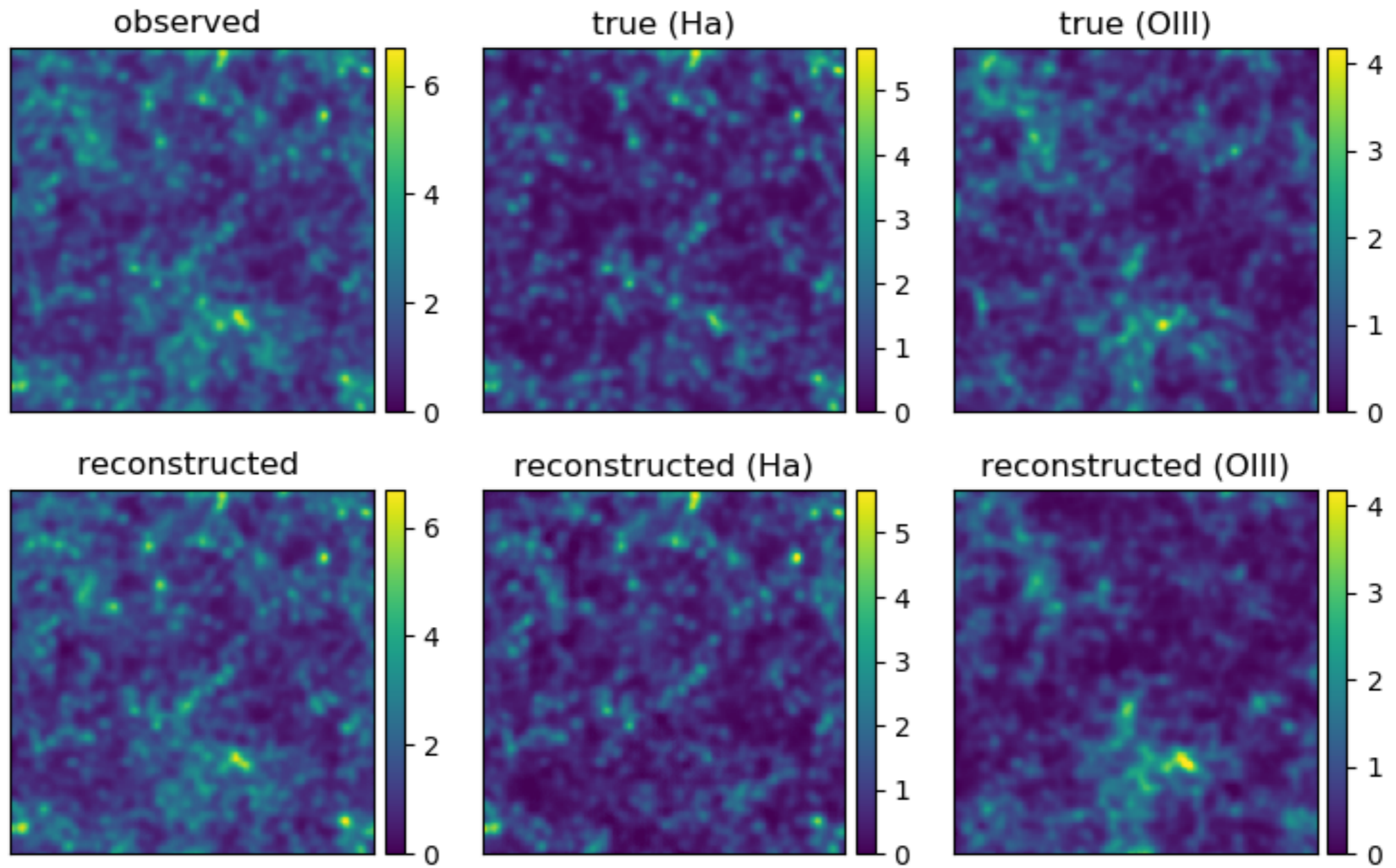


Results

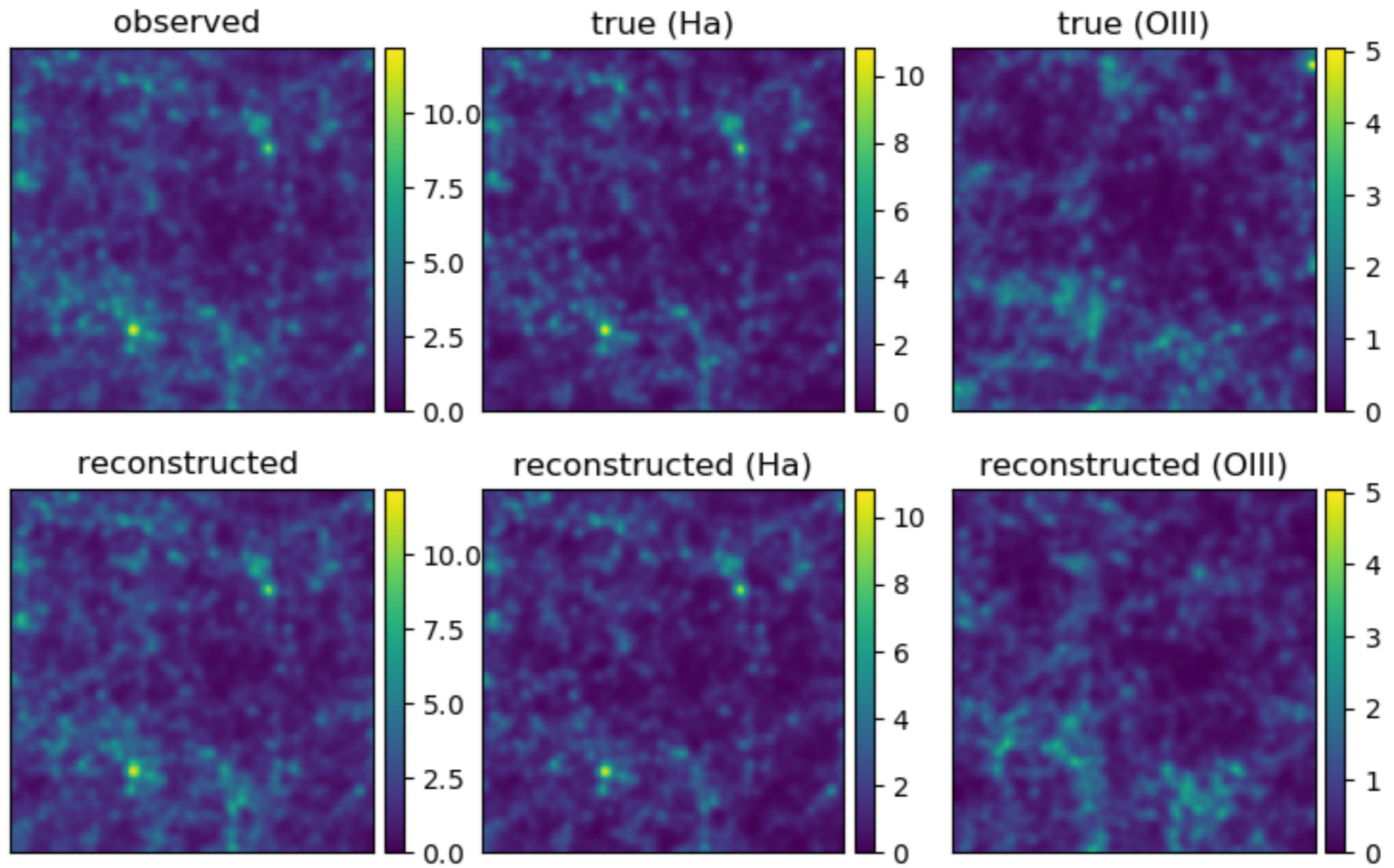


N: 1

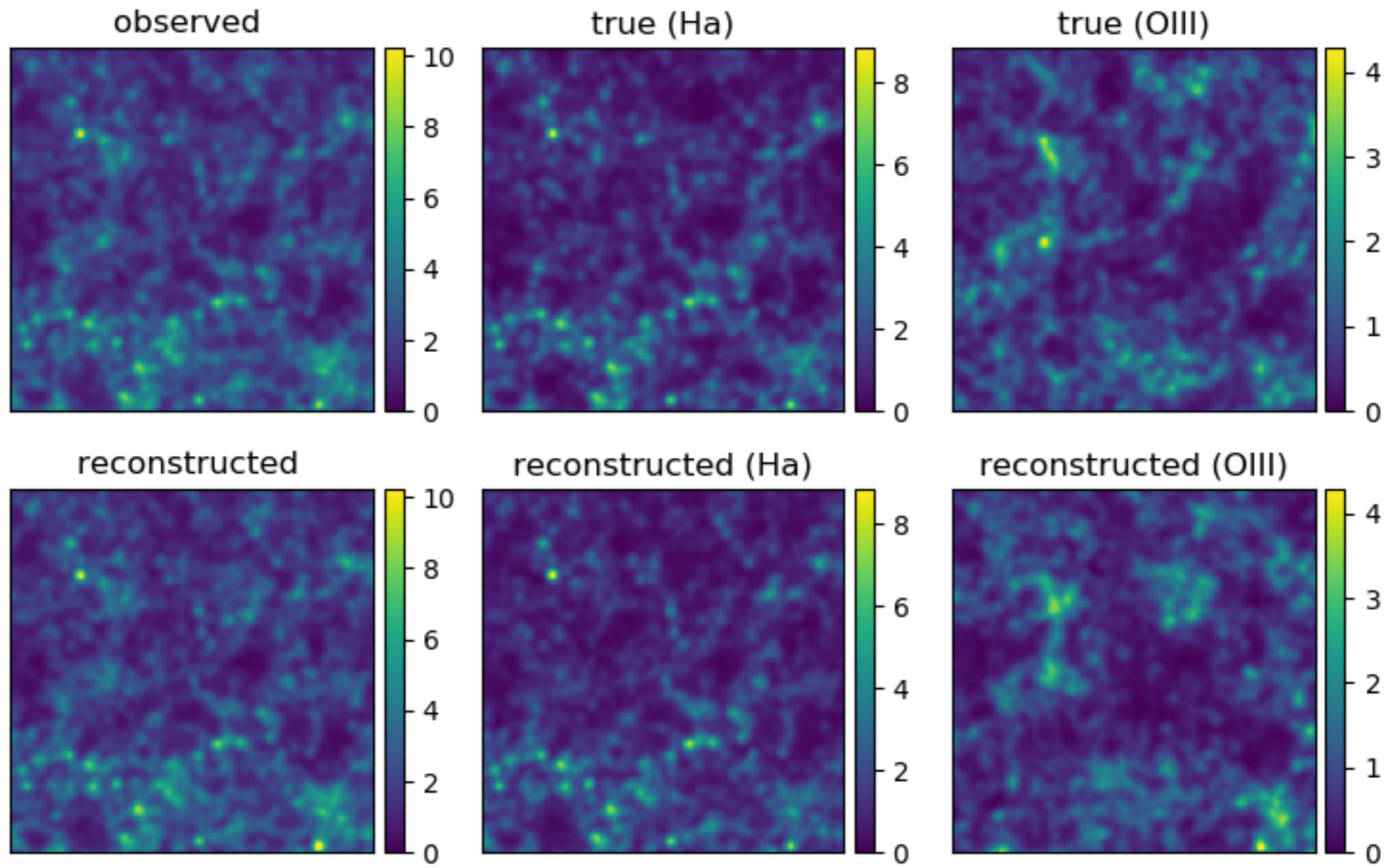
Results



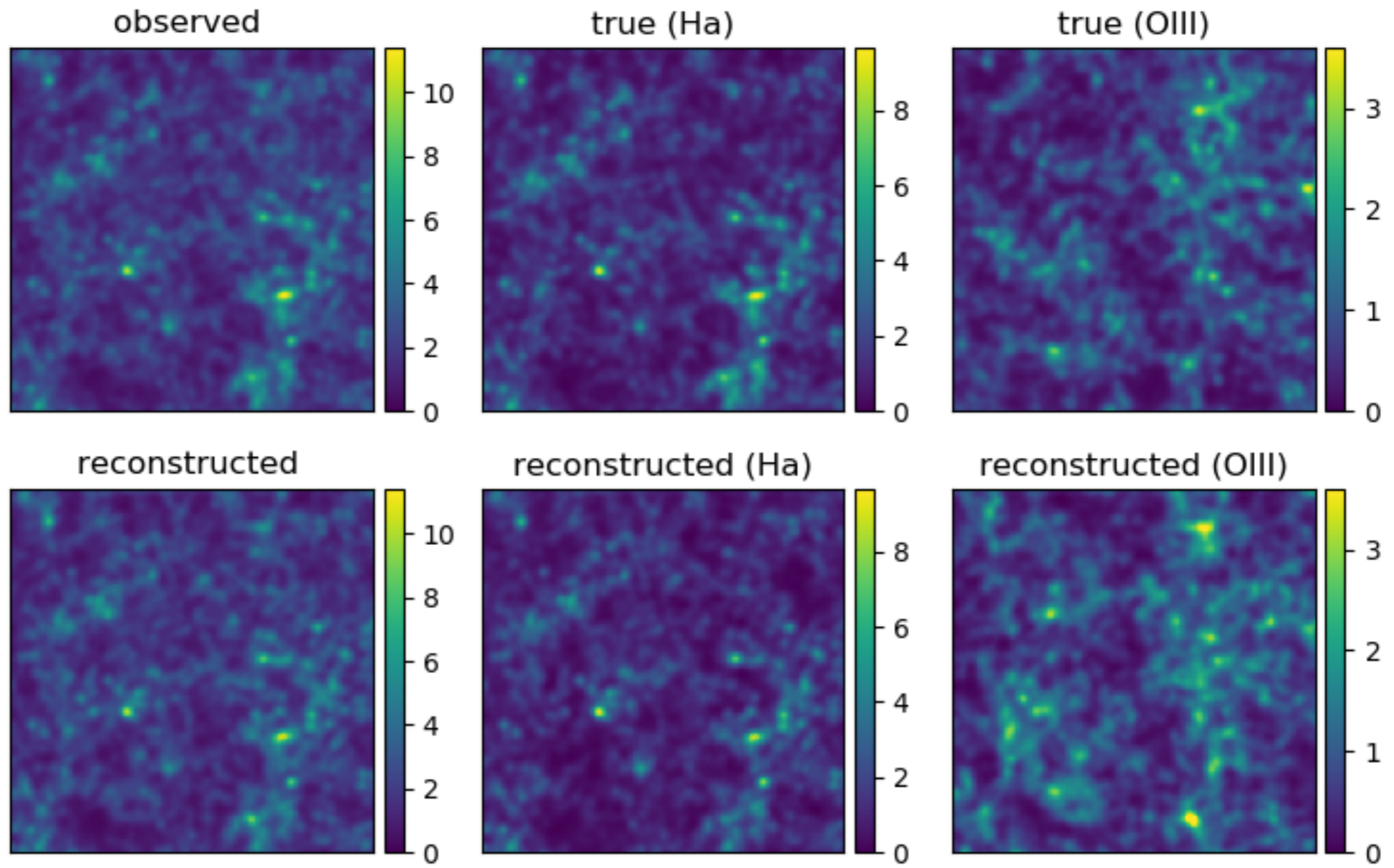
Results



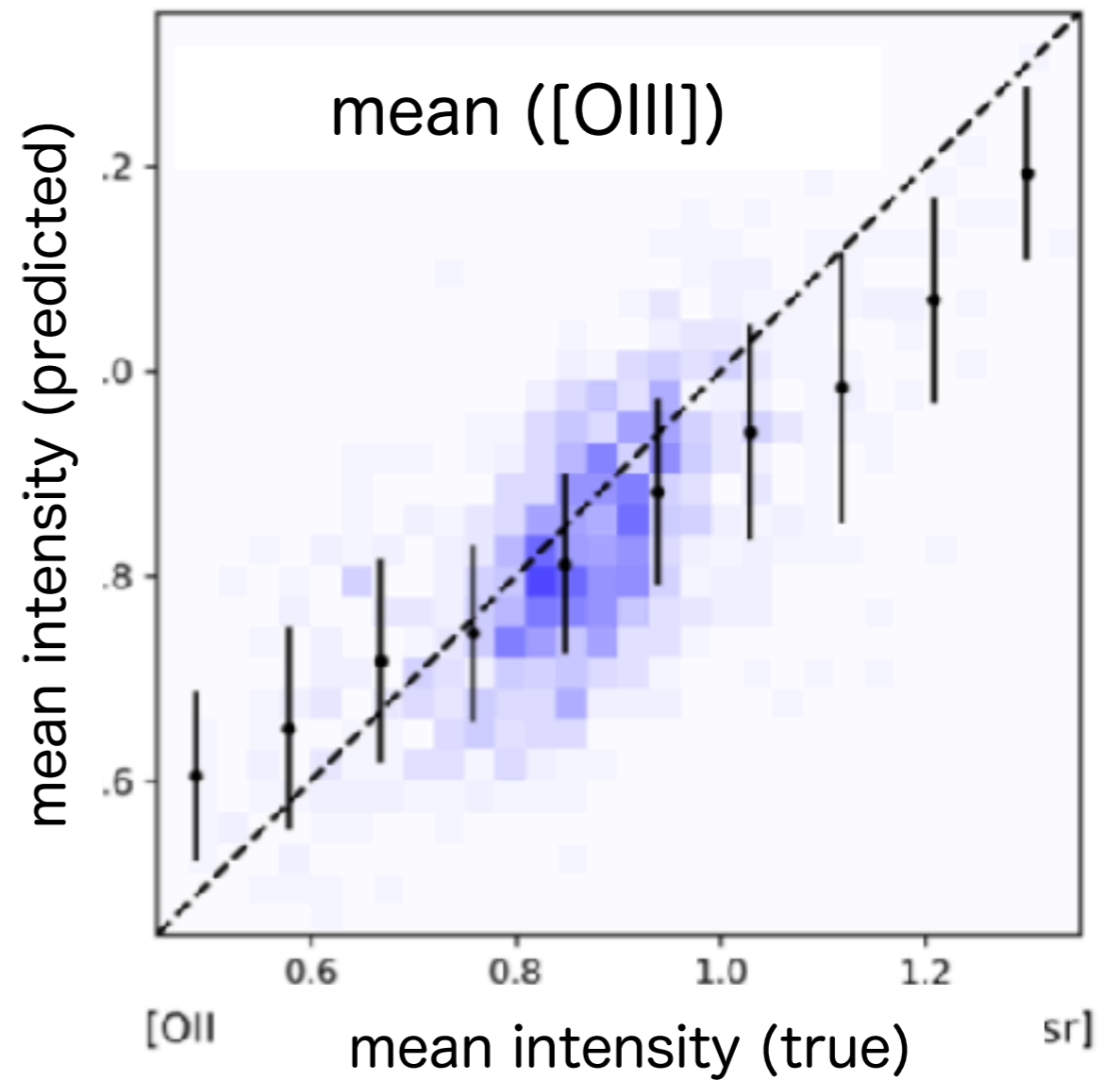
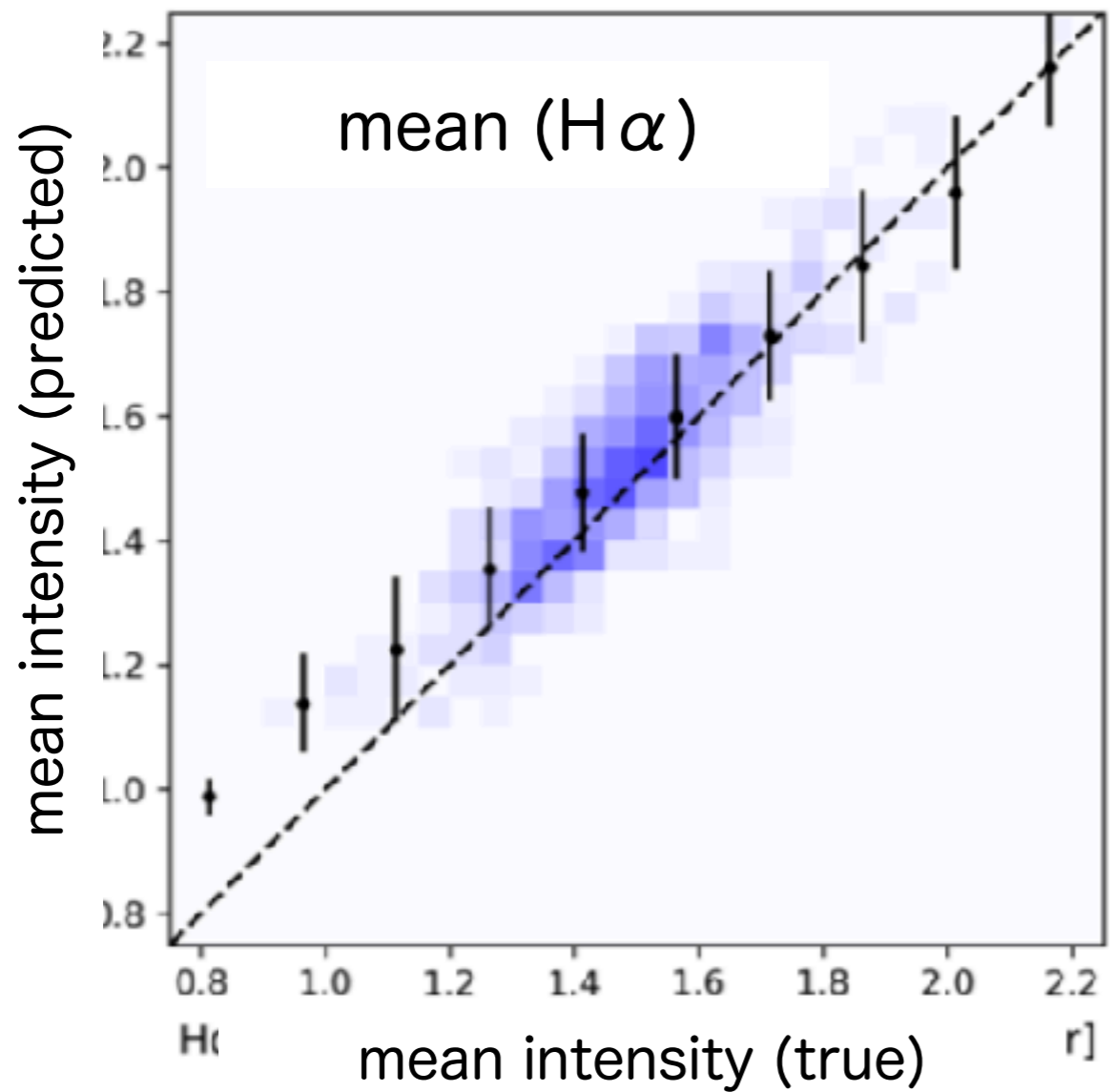
Results



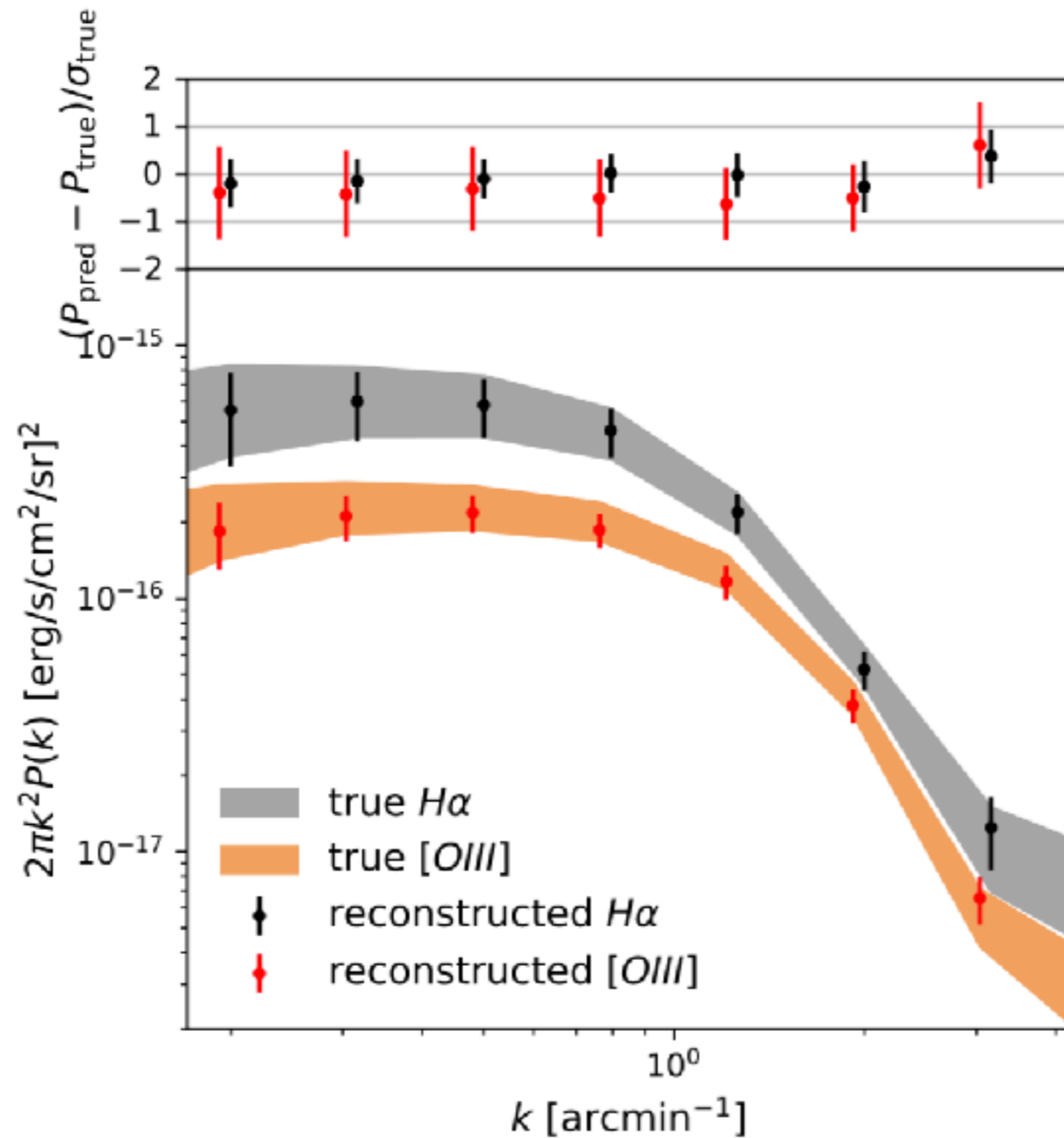
Results



Results: reconstruction of mean intensity



Results: reconstruction of power spectrum



Summary

- In the line intensity mapping observations, line confusion is a serious problem.
- We propose a new technique using conditional GAN to solve line confusion problem.

Future works

- To apply our network for the real LIM observation, we need to
 - include noise, more than 2 lines, etc. → Moriwaki et al. in prep.
 - make use of 3-dimensional data
 - test variety of astronomical/cosmological models