The rest-frame UV luminosity function of protocluster galaxies at z~4 revealed by HSC-SSP

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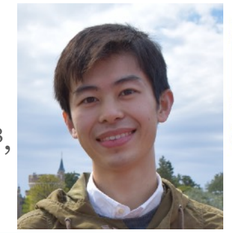

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Ito et al. (2020), ApJ, 899, 5 (ADS link: https://ui.adsabs.harvard.edu/abs/2020ApJ...899....5I/abstract)

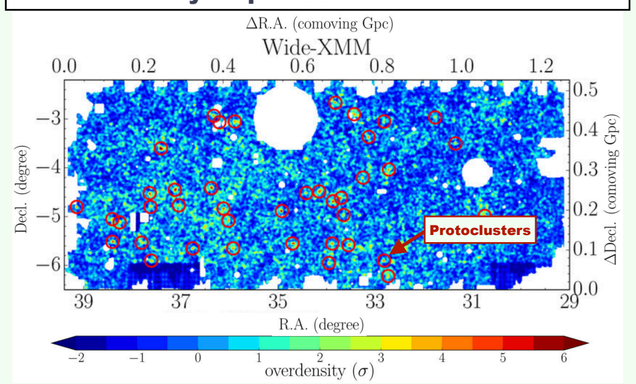
Background

- Enhanced SFR of protocluster galaxies at z~2 (e.g. Steidel+05, Koyama+13. Shimakawa+18)
- **How about higher redshift?**
  →Difficult to systematically understand
  (∵ small sample size)
- We estimate the UV luminosity function (UVLF) of protocluster galaxy at z~4 from Hyper Suprime-Cam Subaru Strategic Program (HSC-SSP)

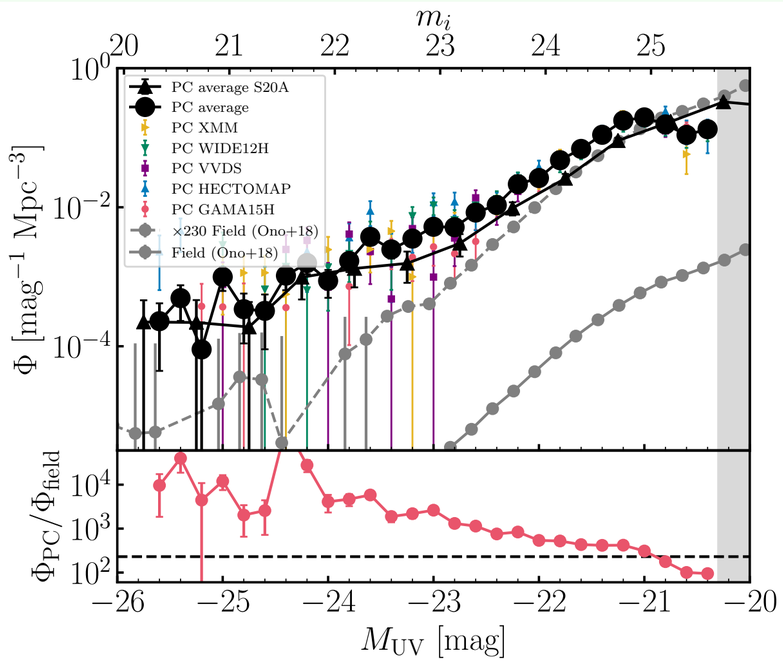
Dataset & Method

- **HSC-SSP**: Optical Imaging Survey (grizy) by Subaru Telescope
- **z~4 Protocluster Survey**: From LBGs' overdensity (>4σ), 179 protocluster candidates are selected from 121 deg² (S16A, Toshikawa+18)
- **Rest-UV luminosity function measurement**
  - Focused galaxies : LBGs within 1.8' (0.75pMpc) from the protocluster center
  - Statistically excluding field contaminants
  - Correcting selection completeness of LBGs

Number density map of LBGs in one HSC-SSP field

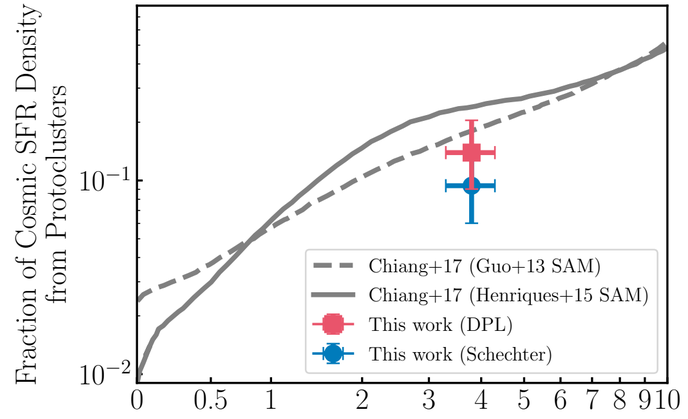


Protocluster Galaxy UVLF (PC UVLF)



- Two Differences between PC UVLF and field UVLF
  - Higher amplitude (×~230, black circles)
  - **Flatter shape, excess in the bright-end**
- The trend is similar for less massive protoclusters in DEEP field of the latest HSC-SSP data (S20A, preliminary, black triangle).
- **Protocluster galaxies tend to be UV brighter than field galaxies.**
  →They have higher SFR than field galaxies.

Star Formation Rate Density



- SFRD of the protocluster region is estimated as $\log_{10}\mathrm{SFRD}/(\mathrm{M_\odot yr^{-1}Mpc^{-3}}) = 1.61^{+0.33}_{-0.45}\,(1.71^{+0.26}_{-0.31})$ in the case of best-fit Schechter (Double Power-Law) function.
- Estimating the fraction of the Cosmic SFRD (CSFRD) from protoclusters
  - Correcting "completeness" and "purity" of the sample
  →6-20% of CSFRD occurred in protoclusters

Discussion

- Enhanced SFR of protocluster galaxies even at z~4
  - Frequent mergers in protoclusters?
  - Increase of the gas supply into protoclusters ?

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