WFMOSによる銀河進化研究
（ショートコメント）

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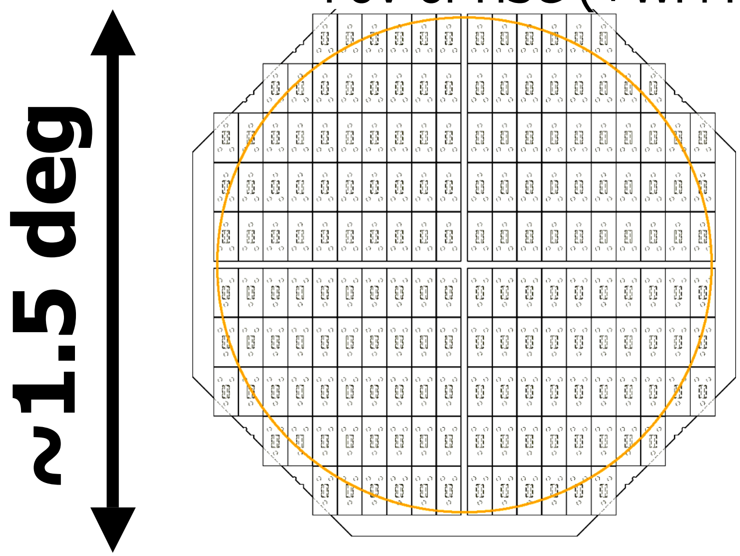
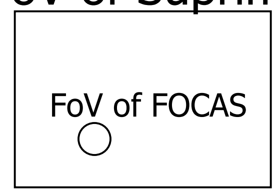
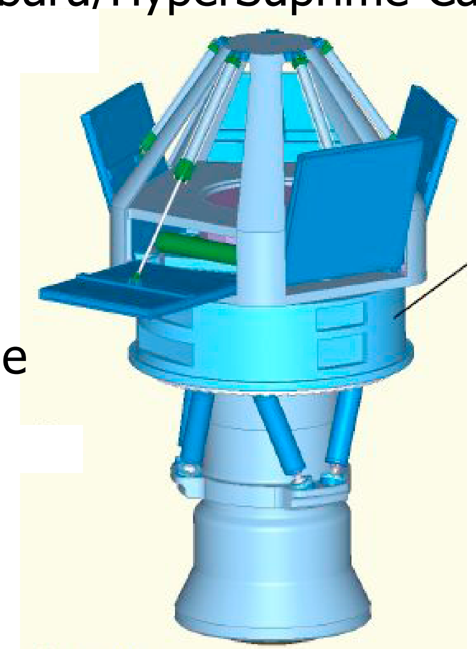
Synergy with HyperSuprime-Cam (HSC)





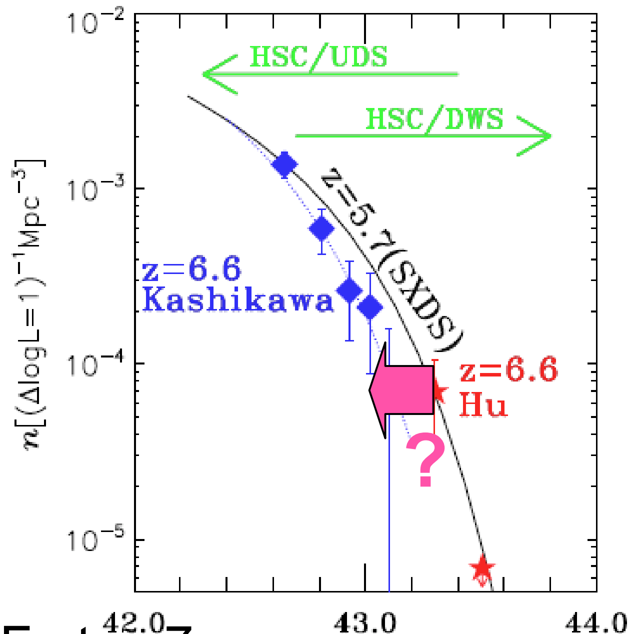


- Subaru/HyperSuprime-Cam: (FoV~1.5deg diam: x10 Suprime-Cam) is being developed. Planned FL in 2011.
  - Powerful for various studies from cosmology, galaxy formation, Galactic astronomy.
- The size of HSC FoV just fits to that of WFMOS (~1.5deg-diam) sharing the Subaru top-end hub+PFU.

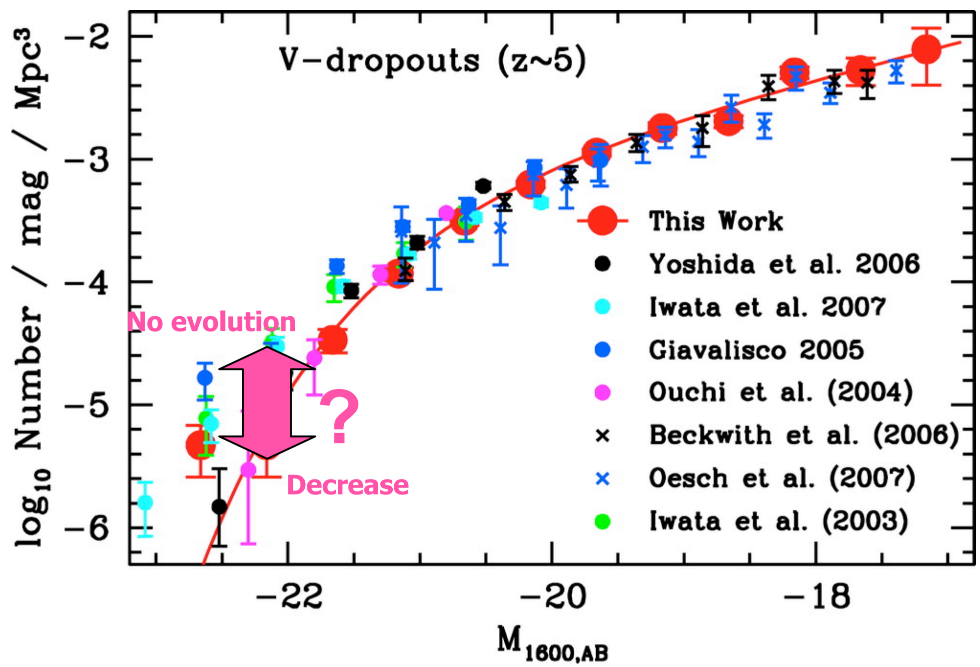
→Great synergy between HSC and WFMOS!!

1) Determination of Luminosity Function at z<7.5
Critical for cosmic reionization and galaxy formation

Lya LF of Lya emitters at z=6.6



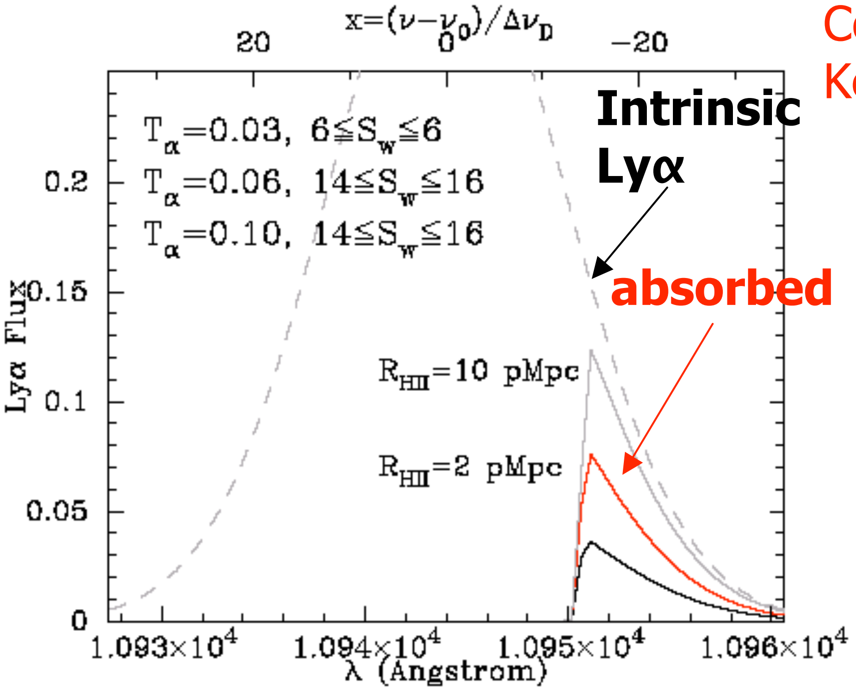
UV LF of dropout galaxies at z=5



- Lya LF at z~7 :
  - Evolved? → signature of reionization (Kashikawa+06)
  - No evolution? → no signature of reioinzation (Malhotra+04) Field variance? (Hu+06)
- UV LF at z=5-7 at the bright end
  - Evolution → signature of hierarchical structure formation (e.g. Ouchi+04, Bouwens+07)
  - No evolution → UV-bright galaxies following down-sizing (Iwata+03,07, Giavalisco+05)
- Large systematic uncertainties of HSC photometric samples in estimation of contamination rates and completeness. (e.g. z~3 LBG LF claim by spec. redshift survey of VVDS by Le Fevre+05, Paltani+06).

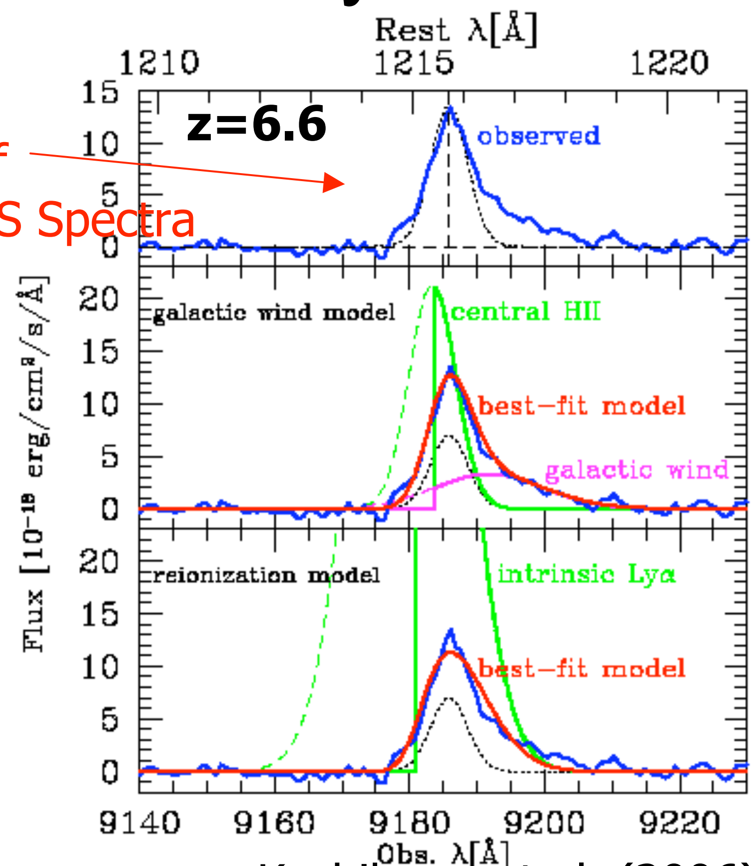
2) Constraining Neutral Fraction with Lya Profiles

Lyα line profiles of galaxies at z=8 (Model prediction)



Dijkstra et al. (2007)

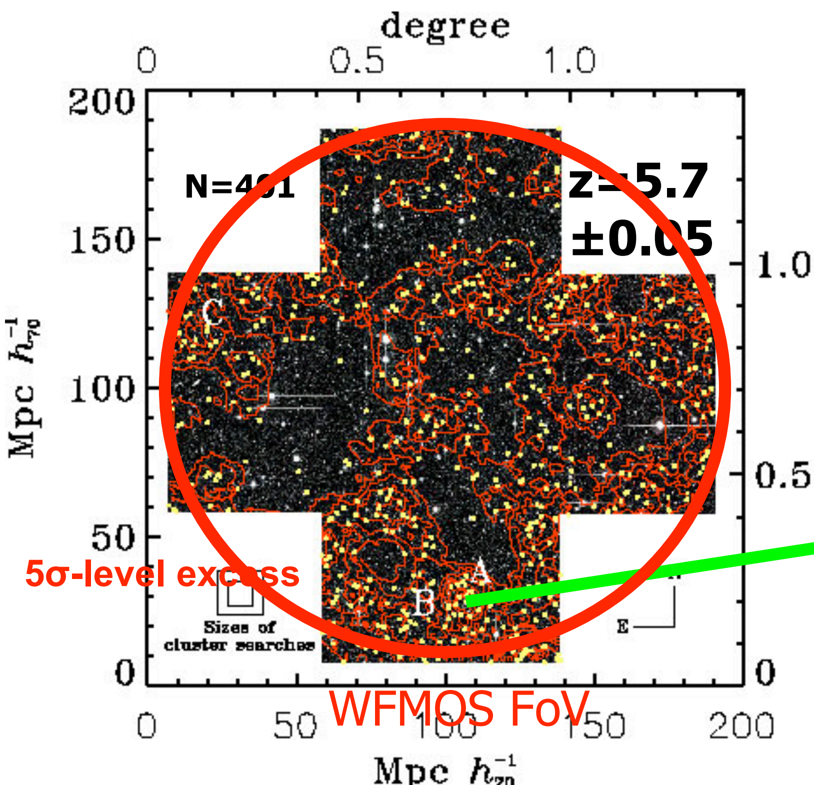
Composite of Keck/DEIMOS Spectra

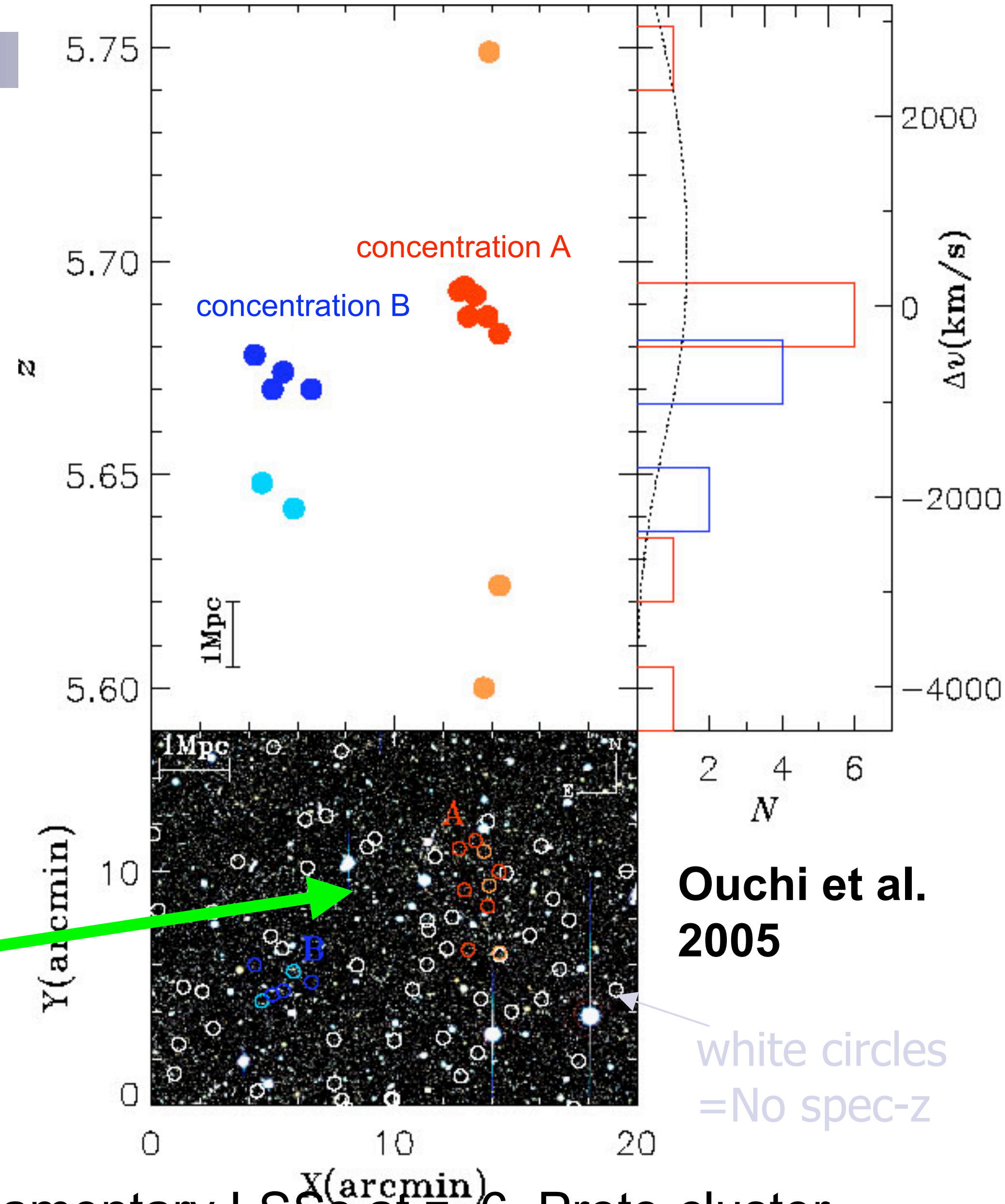


Kashikawa et al. (2006)

- Lya profiles give constraints on neural fraction of IGM in the epoch of reionization.
- Suprime-Cam+DEIMOS studies: Based on a composite of ~10 spectra of Lya emitters at z=6.5 Lyα profile is well explained by a galactic wind model. No significant feature of neutral IGM is found in a Lyα emission line... → No constraints on reionization (Kashikawa +06).
- Higher S/N spectra (i.e. more objects for stacking analysis) with medium-high spectral resolution (R~3000-4000) are needed.

3) Mapping out high-z Universe for tracing large-scale structures and proto-clusters

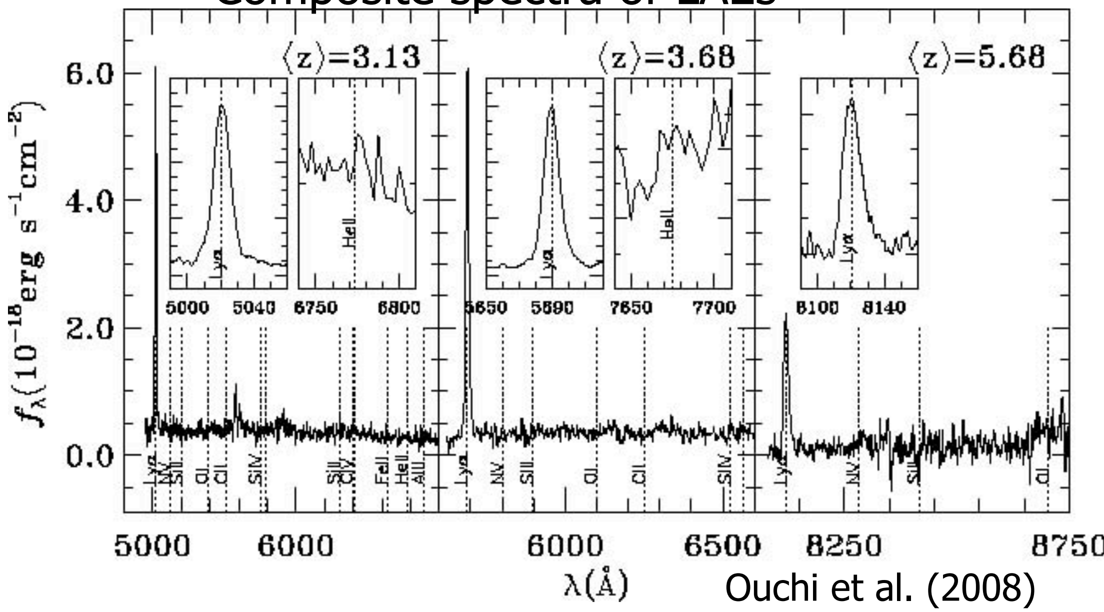




- Suprime-Cam has revealed the filamentary LSSs at z~6. Proto-cluster candidates are identified with FOCAS (+DEIMOS; Ouchi et al. 2005).
- A number of photometically selected Lya emitters have no spec-z.
- The 3-dimensional view of the high-z Universe has not obtained yet!!

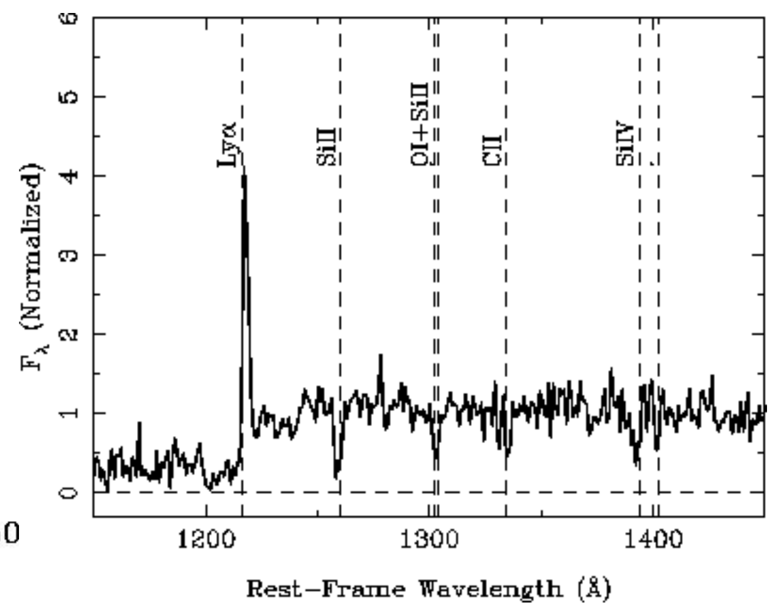
4) Statistics of faint emission/absorption lines in high-z galaxies

Composite spectra of LAEs



Ouchi et al. (2008)

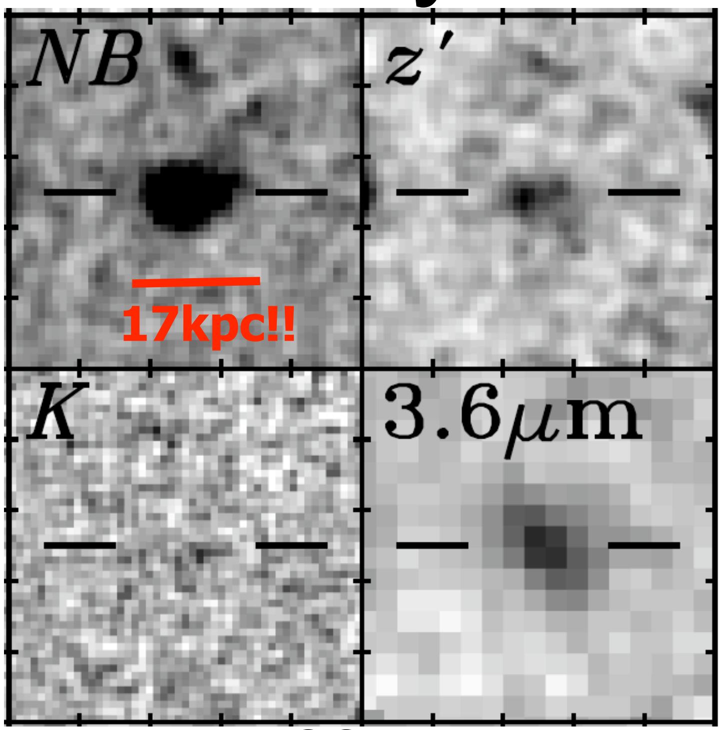
Composite spectrum of LBGs



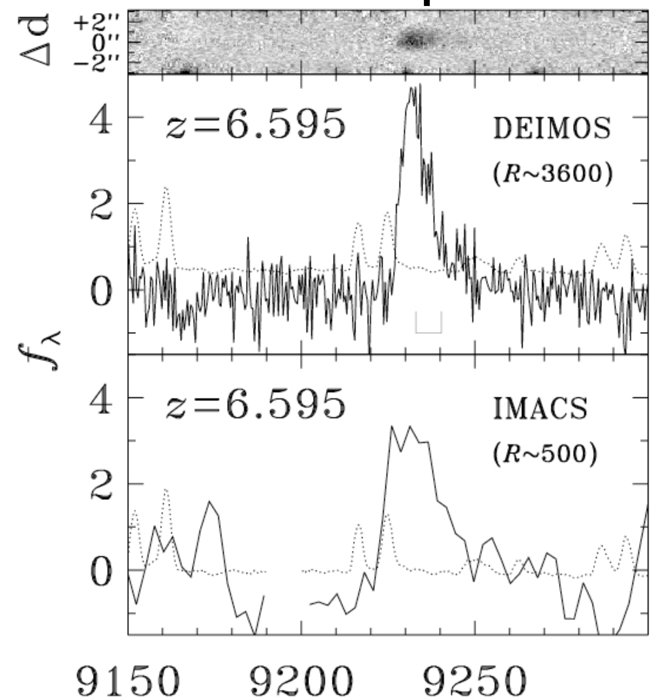
Ando et al. (2007)

- HeII emission line for identifying primeval galaxies (cold accretion and popIII)
  - No HeII lines from premeval population are detected in spec.(+composite spec.; e.g. Dawson+07,Ouchi+08; c.f. Jimenez & Haiman 2006)
- UV absorption lines to constrain metallicity. Composite spectra of 8 LBGs at z~5 (Ando+07, see+Shapley+03).→ More spectra to give strong constraints on the history of metal enrichment.

5) Identifying a rare population (a) : Extended Lyα sources at z<7.5

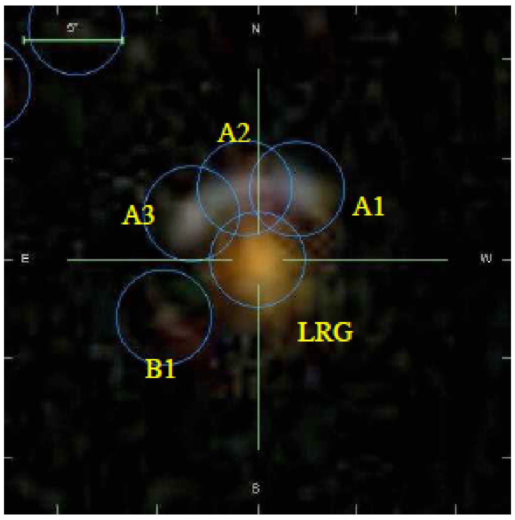


Ouchi et al. ApJ submitted

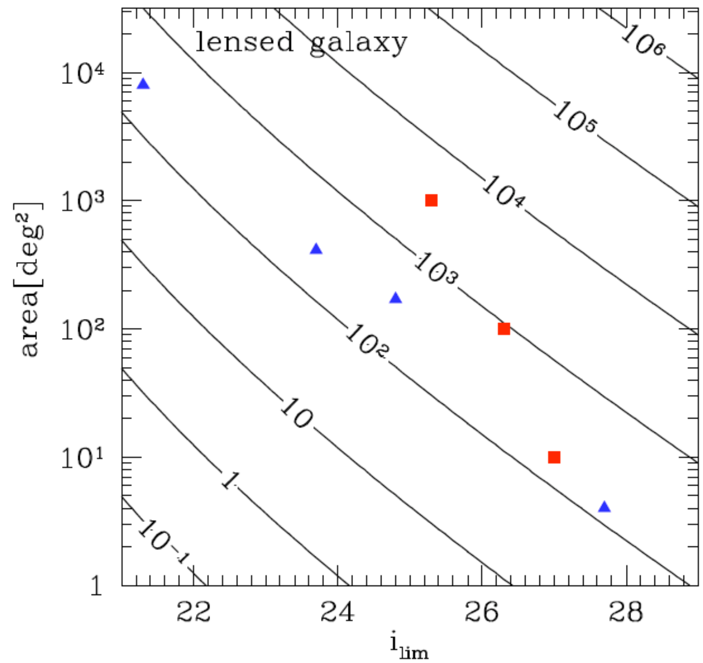


- Large area WFMOS spectroscopy will allow us not only to carry out statistical studies, but also to identify rare interesting objects at high-z.
- HSC+WFMOS surveys will provide a number of extended Lya sources (Lya blobs).
- Up to z~7. An example of z=6.595. ~3" (=17kpc) spatial extension in a narrow band with very bright Lya emission (L[Lya]=4x10^{43} erg/s) + Spitzer detection. → massive galaxy formation with outflow? Key for understanding early galaxy formation, metal enrichment, reionization.

5) Identifying a rare population (b) : Gravitationally lensed high-z galaxies



The brightest (i=19.0) lensed galaxy found in the SDSS field (z=2.7) Allam et al. (2007)



Expected number of strongly lensed galaxies by HSC surveys(Oguri et al.)

- Strongly lensed objects in HSC fields (c.f. galaxy-cluster)
- We expect ~400 lensed galaxy candidates from HSC surveys.WFMOS identification by spending spare fibers.→ studying halo profiles+ giving lensed high-z galaxies for studies with TMT-AO (+JWST,SPICA).

Summary

- Hyper Suprime-Cam (HSC) Surveys
  - WFMOS spectroscopy is quite suitable for objects found by HSC surveys

- Science drivers of WFMOS spectroscopy in the HSC fields

  1. Determination of UV+Lyaluminosity functions at z<7.5
  2. Lya profile for consraining cosmic reionization
  3. Mapping the high-z Universe for understanding strucure formation
  4. Statistics of high-z UV spectra for primeval gal. and dynamics/metal abundance
  5. Spc. Identification of rare extended LAEs and gravitationally-lensed obj.

(**質疑応答** — **Q:質問**, **A:回答**, **C:コメント** — **氏名無しは発表者の発言**, **敬称略**)

(Q) スリット分光に比べて、ファイバー分光は効率が悪くなると思うがどうか？ (**長尾**)

(A) ファイバー径を絞って、S/N が上がるように工夫する必要がある。また、ファイバーによるスループットロスは FMOS の例をみても 50 % までは行かないと思うので、WFMOS の高い multiplicity で十分ロスを補えるだろう。

(A) ファイバーによるスループットロスは短波長側ほど大きくなるので、FMOS と単純に比較してはならないだろう。589nm だと数%のロスになる。 (**高見**)

(C) 夜光の差し引きが一番大変。径を小さくすると夜光が入り難くなるので、多少はましになるだろう。 (**大藪**)

(C) R=3000 以上など、波長分解能が高くなれば、夜光の間を見ることができるので、引きやすくなるだろう。