# Studying Cosmic Star Formation History with [OII] emitters from HETDEX

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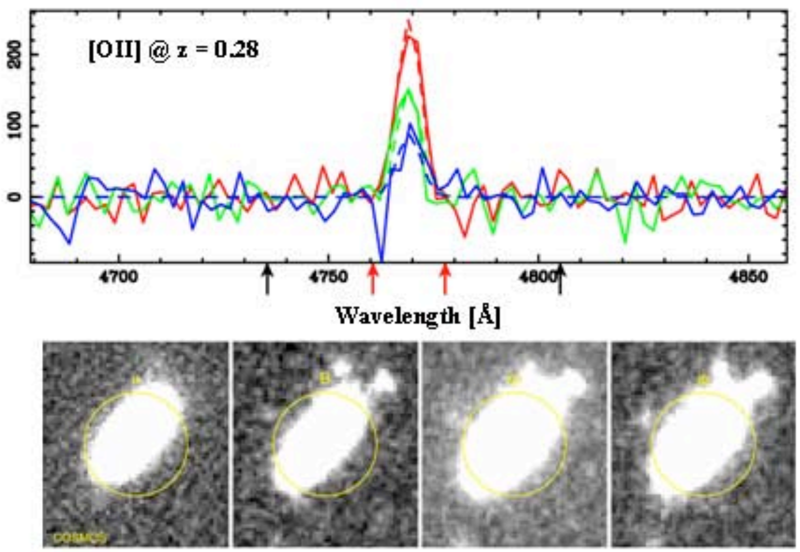
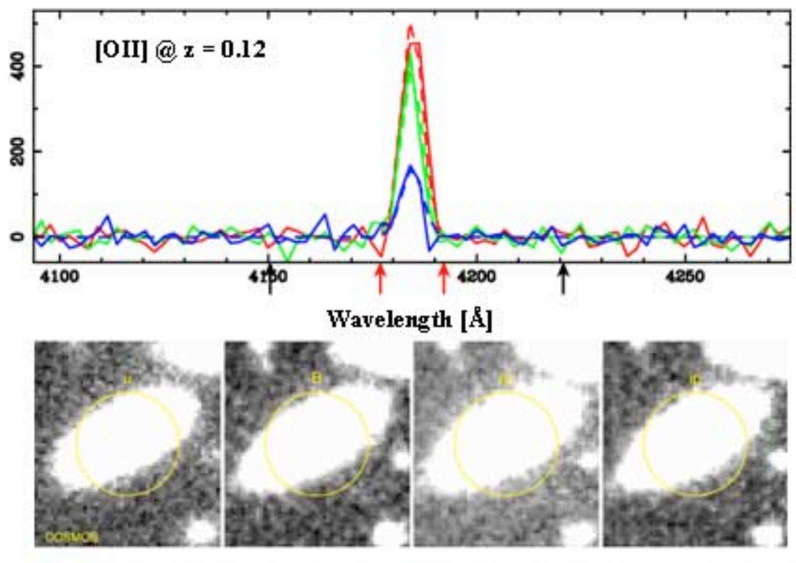
# [OII] emitters in HETDEX

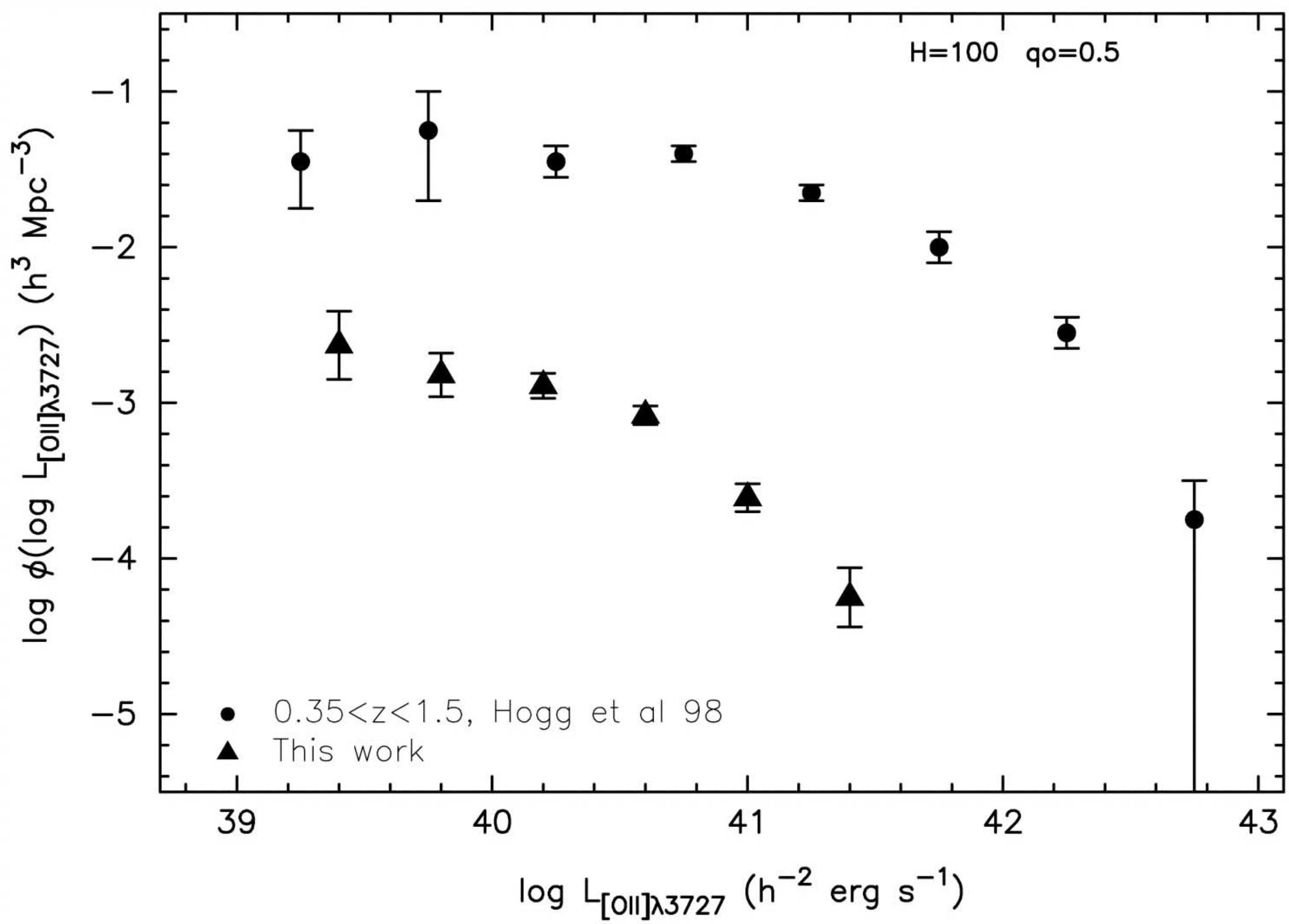
- [OII] emitters are primary “contaminant” in LAE search for HETDEX, $z < 0.5$, last 5 Gyr of cosmic time.
- [OII] is a tracer of SFR, so can trace star formation history.
- Can be distinguished from LAEs with EW cut.
  - Observed EW > 80Å (e.g., Gronwall et al. 2007)
- Will be discovered in large numbers (at least ~1 million) over a large field of view (420 $deg^2$).
- Large sample/area allows for study of properties as a function of luminosity/mass, environment, etc. Also allows for discovery of intrinsically rare objects.

# [OII] emitters from VIRUS-P



# Evolution in the [OII] LF




Gallego et al (2002)

# Evolution in the [OII] LF

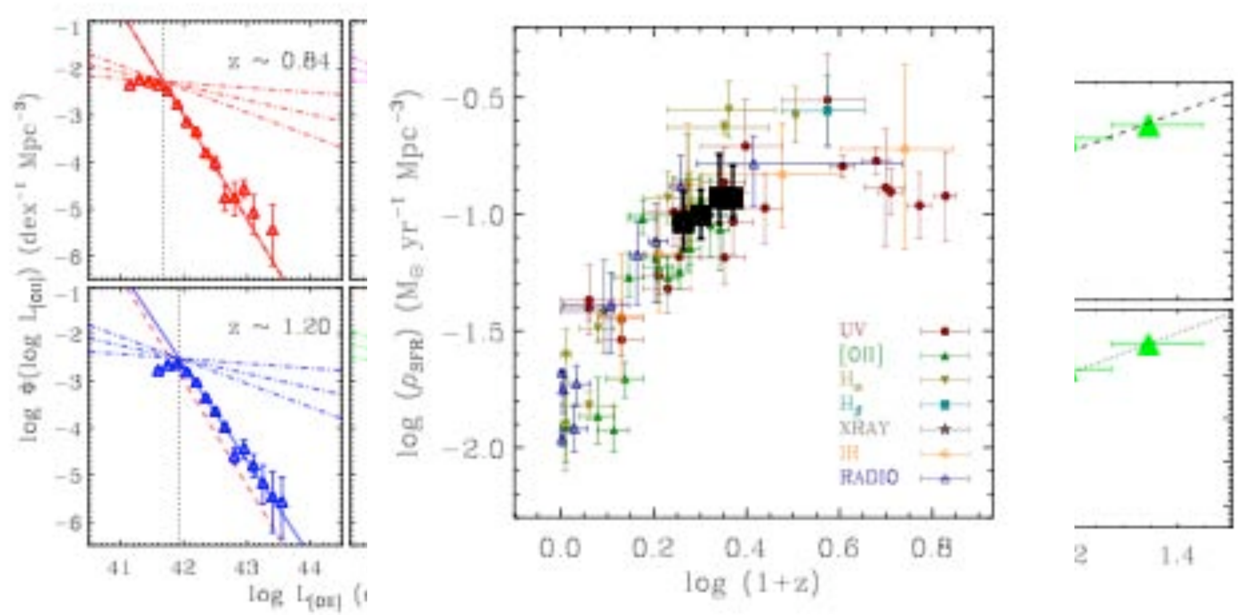



FIG. 1.— Observed [O II] lumino… bins. The solid lines are the power law… luminosity function. The dashed lines… bins correspond to the solid line in t… dashed-dotted lines correspond to th… −1.1, −1.3 and −1.5, and the dotted… the turnover in the luminosity functi…

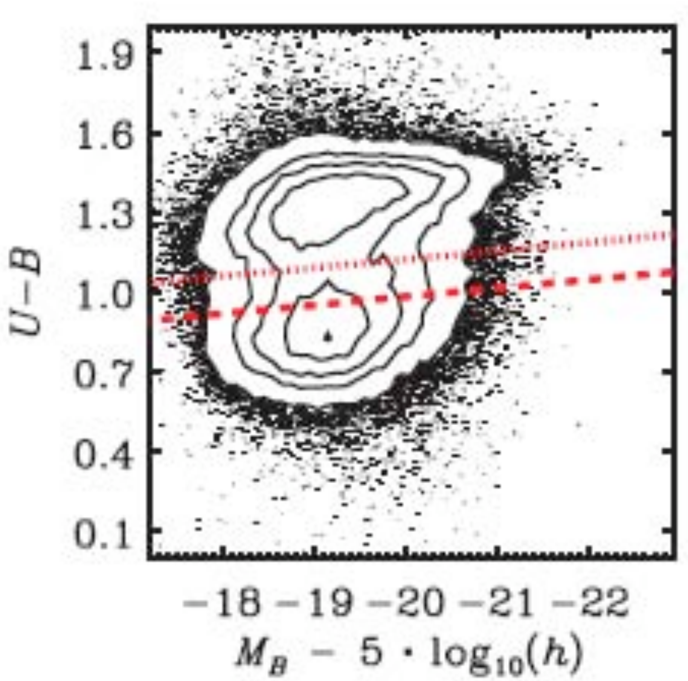
FIG. 5.— SFR density, $\rho_{SFR}$, versus redshift based on various multi-wavelength SFR indicators (Hopkins 2004). Our four estimates of $\rho_{SFR}$ are shown as large filled squares, where the vertical error bars are obtained by allowing the turnover positions and the slope of the faint end of the [O II] luminosity function to vary in a sensible way (see text for details).

…osity function. (*Top*) Evo-… $c^{-3}$ of the strongest [O II]-… g $s^{-1}$. The dashed line is… (*Bottom*) Evolution of the… …fined by where the space… …als $10^{-3.5}$ dex$^{-1}$Mpc$^{-3}$. The dotted line is the linear fit to the data given by eq. (8).

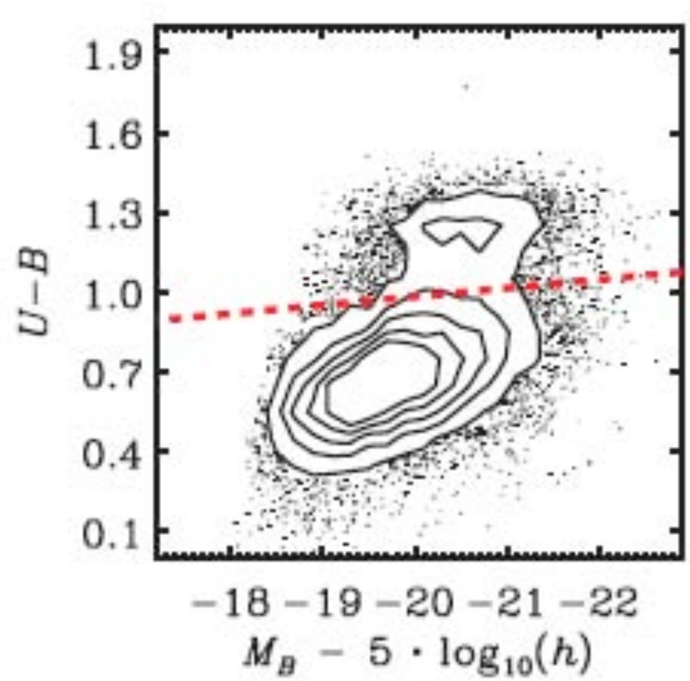
Zhu et al (2008)
DEEP2
n~14,000

# SFR vs Environment

SDSS @ z~0




DEEP2 @ z~1




Cooper et al (2008): n~100,000/15,000

# SFR vs Environment

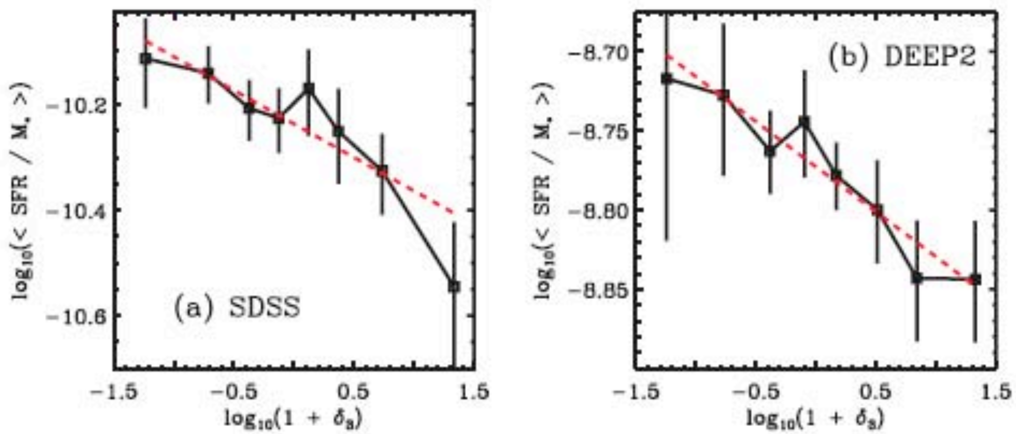



**Figure 10.** The dependence of mean sSFR on environment at $z \sim 0.1$ in the SDSS (left-hand panel) and at $z \sim 1$ in DEEP2 (right-hand panel). We plot the logarithm of the mean and of the error in the mean of the sSFR in discrete bins of galaxy overdensity within the SDSS-A and DEEP2-A samples. The dashed red line in each plot shows a least-squares linear regression fit to the data points, with coefficients of the fits given in Table 2.

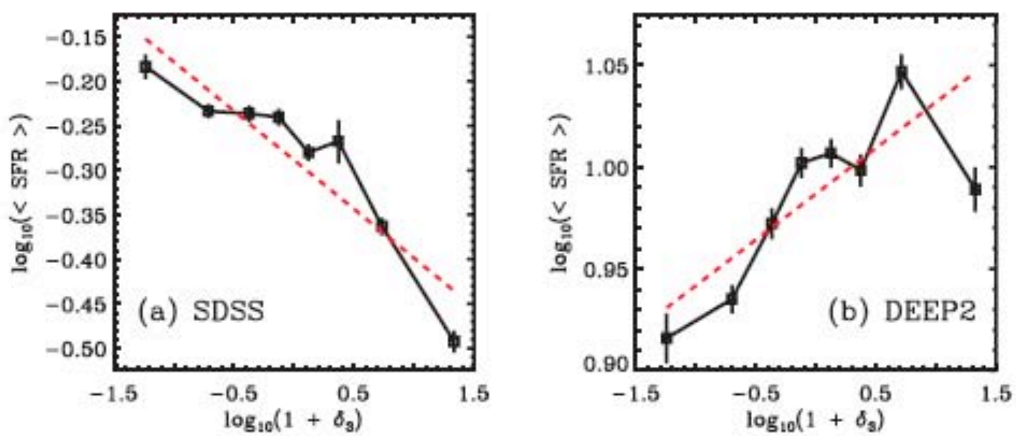
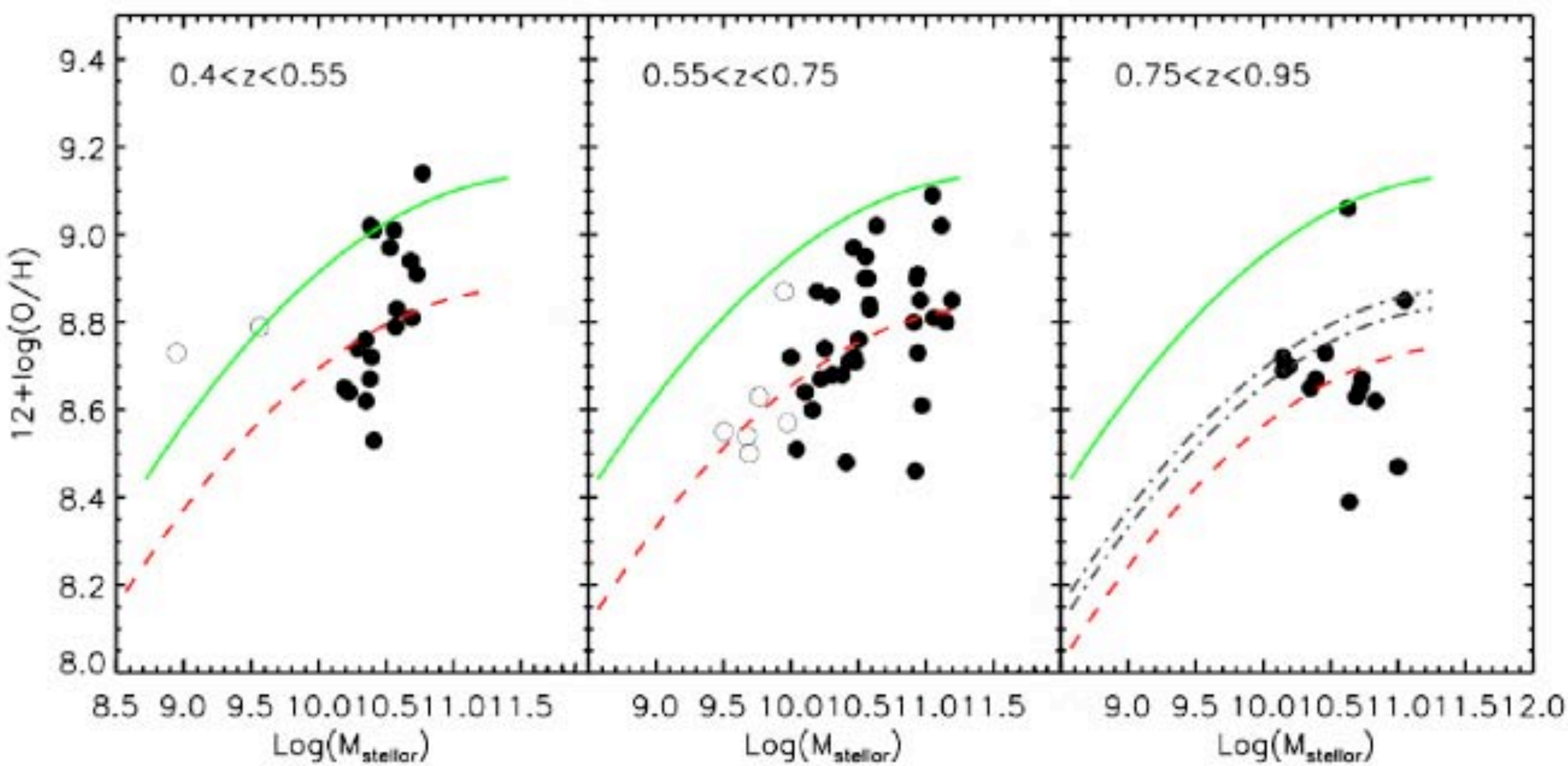



**Figure 11.** The dependence of mean SFR on environment at $z \sim 0.1$ (left-hand panel) and at $z \sim 1$ (right-hand panel). We plot the logarithm of the mean SFR and of the error in the mean SFR in discrete bins of galaxy overdensity within the SDSS-A and DEEP2-A samples. The dashed red line in each plot shows a linear regression fit to the data points, with coefficients of the fits given in Table 3. Note that the SFR is given in units of $h^{-2}\ M_{\odot}\ yr^{-1}$.

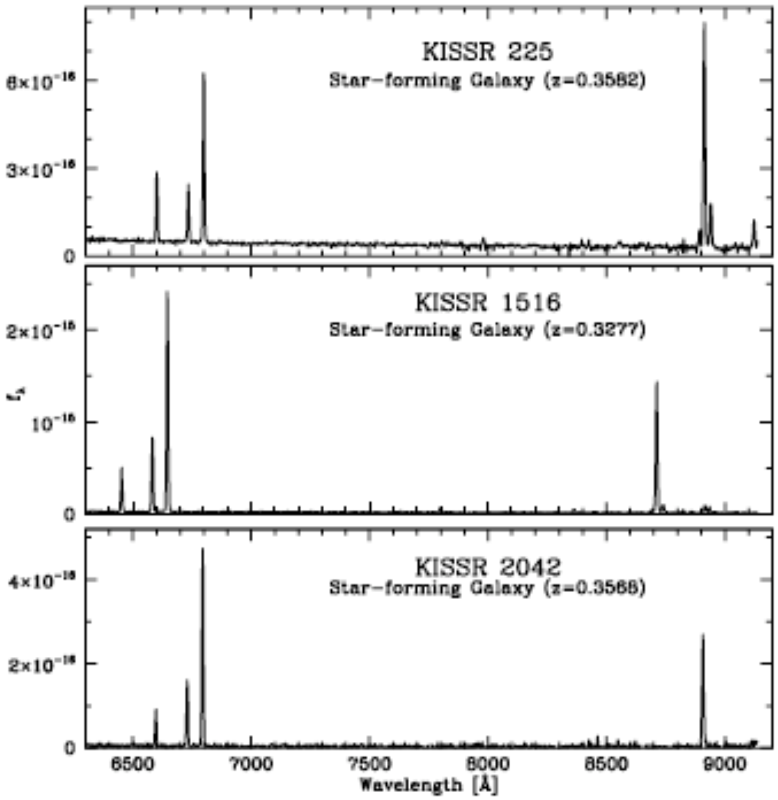
# Evolution in Metallicity

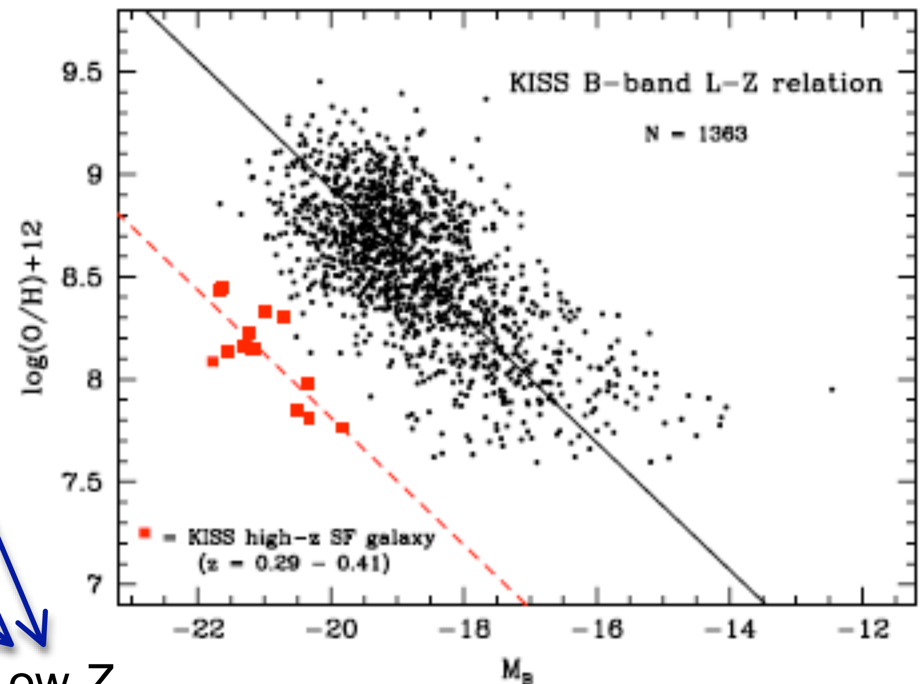



Rodrigues et al (2008); n~88

# Outliers in Metallicity-Luminosity

Salzer, Williams, & Gronwall (2009)

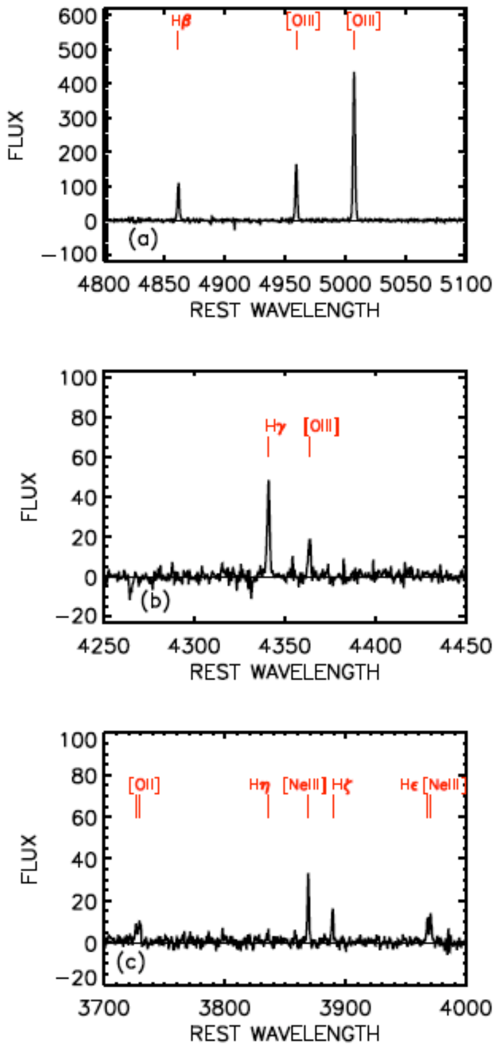



Low-Z

Late forming massive galaxies? Infall of pristine gas?

# Low Metallicity Galaxies




Ultra-strong Emission-Line Galaxies (USELs)

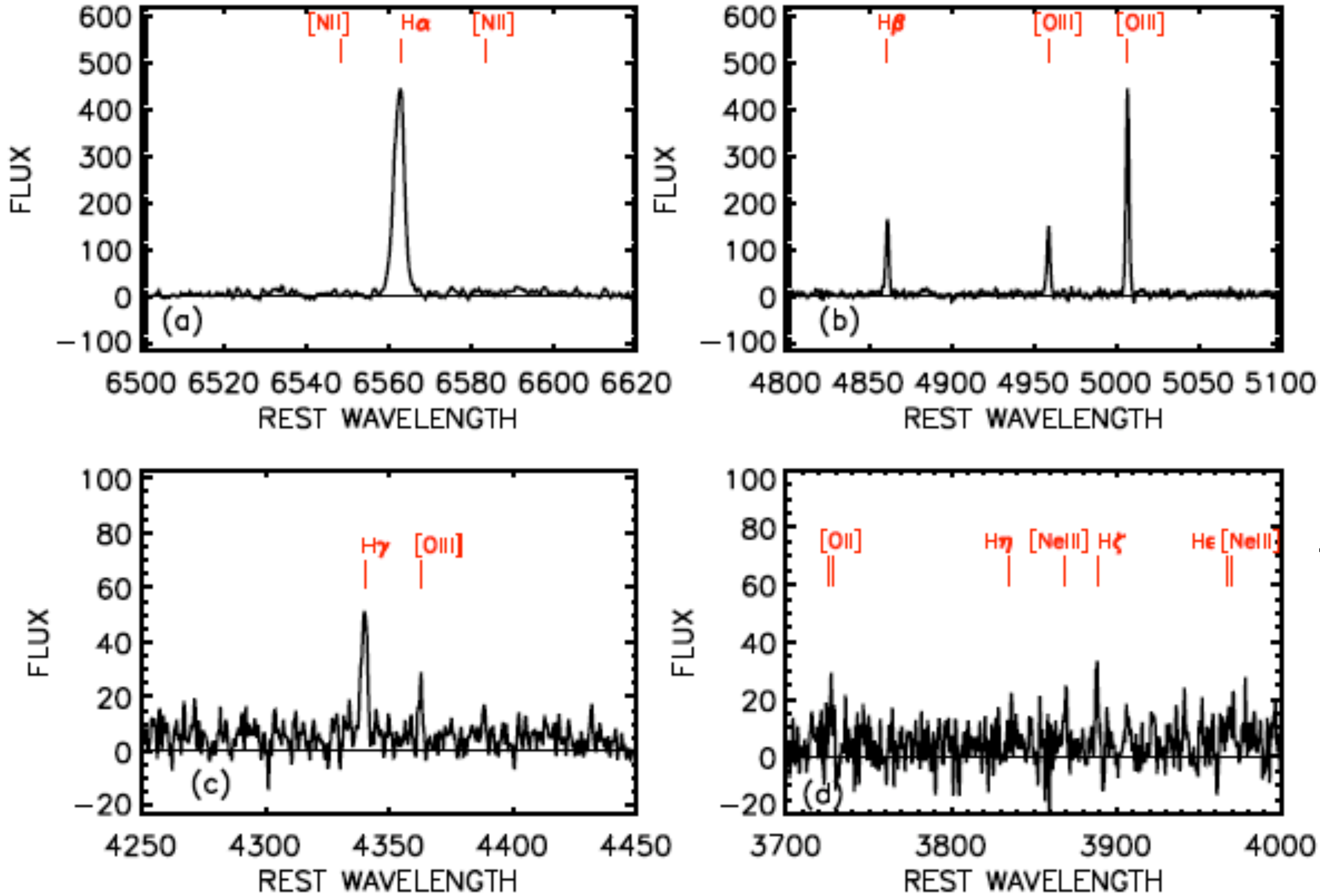
High-EW Hα, [OIII] in NB815 and NB913 surveys for z=5.7/6.5 LAEs

All have 12+log(O/H) < 8.4,
7 are extremely metal poor with
12+log(0/H) < 7.65

12+log(O/H)=7.25±0.03
z=0.818

Hu et al (2009)/Kakazu et al (2007)

# Low Metallicity Galaxies




12+log(O/H)=6.97±0.17
z=0.393

Hu et al (2009)/Kakazu et al (2007)

# [OII] Science with HETDEX

What we can do with ~1 million [OII] galaxies:

- Evolution of [OII] LF from z=0 to 0.5 (5 Gyr) ➔ cosmic star formation history.
- Evolution in metallicity vs. redshift.
- [OII] properties as a function of galaxy environment + redshift.
- Intrinsically rare objects:
  - Metal-poor glaxies
  - Outliers from metallicity-luminosity relation
  - Something we haven't thought of yet!
- Metallicity calculations will require red spectra for most of redshift range.  Follow-up with red grating of part of survey area?