Finding Low-Metallicity Galaxies in SuprimeCam Narrowband Surveys

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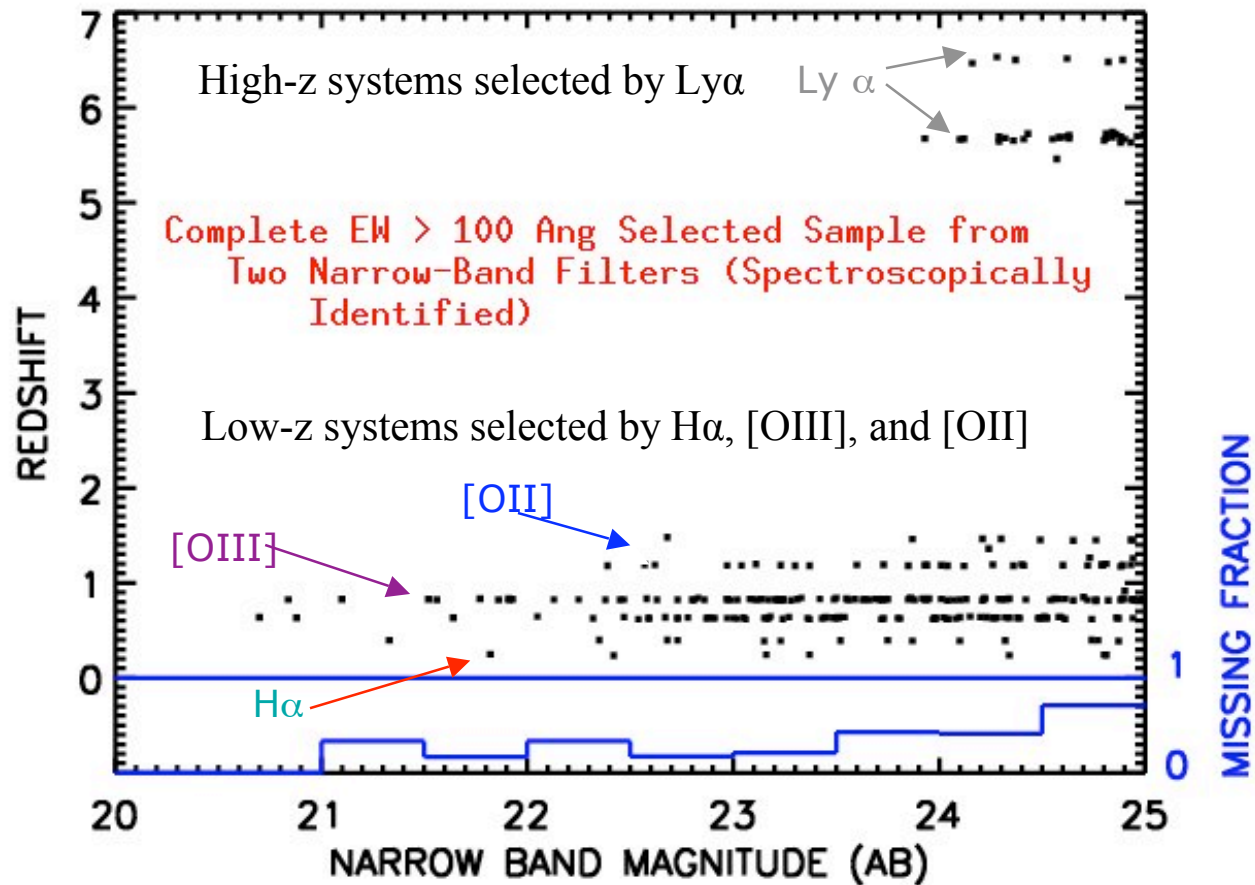
Subaru Users Meeting January 2010

Introduction

- Motivation: study the properties of galaxies using rest-frame UV selection with spectroscopic follow-ups to compare properties of galaxy populations with the high-z samples of Lyα and Lyman break galaxies

- Aim of unifying studies at both high and low redshifts

- This program focuses on emission-line selection of low-redshift galaxies in narrowband surveys to study low metallicity galaxies.

- Collaborators: Len Cowie, Amy Barger, Yuko Kakazu

Background

- Narrow-band surveys used to select high-z Lyα galaxies ($5 < z < 7$) successfully identify extremely low metallicity galaxies at lower redshifts ($0.2 < z < 0.5$; $0.6 < z < 1.0$)

- Kakazu, Hu, & Cowie 2007 ApJ 668, 853

  define **USELs** (ultra-strong emission line galaxies; rest-frame EW(Hβ) > 30 Å)

- Hu, Cowie, Kakazu, & Barger 2009 ApJ 698, 2014 bulk of **USELs** detected in auroral 4363Å [OIII] ⇒ this population contains a substantial number of **XMPGs (extremely metal poor galaxies)**

Low Redshift Systems with High EW
(a complete sample in a 0.5 square degree field)

High-z systems selected by Lyα   Ly α

Complete EW > 100 Ang Selected Sample from Two Narrow-Band Filters (Spectroscopically Identified)

Low-z systems selected by Hα, [OIII], and [OII]

[OII]

[OIII]

Hα

REDSHIFT

MISSING FRACTION

NARROW BAND MAGNITUDE (AB)

Hu et al. 2009

GOODS-NB816 selected [OIII] emitter at z = 0.64
One of the lowest metallicity galaxies known
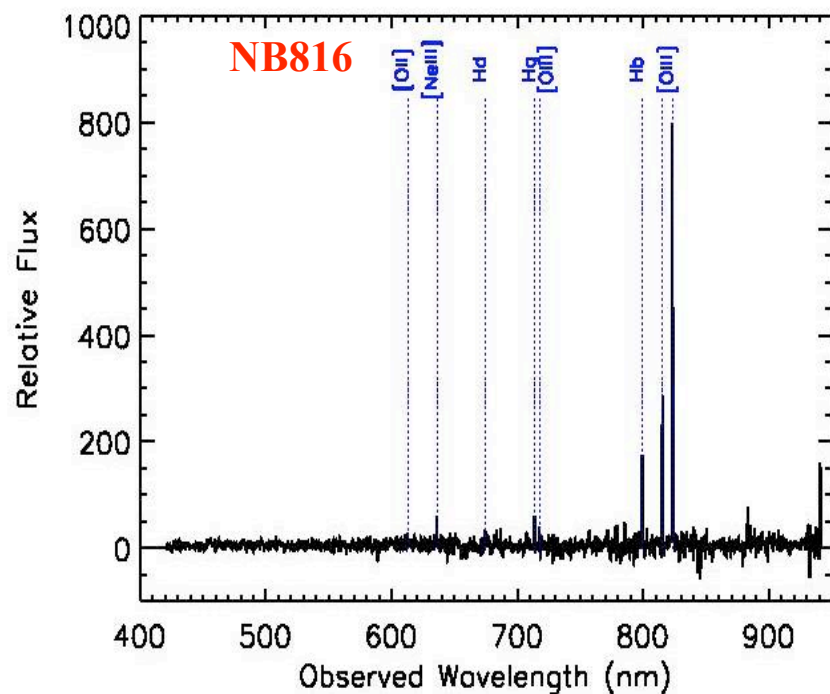
(Kakazu, Cowie & Hu 2007)
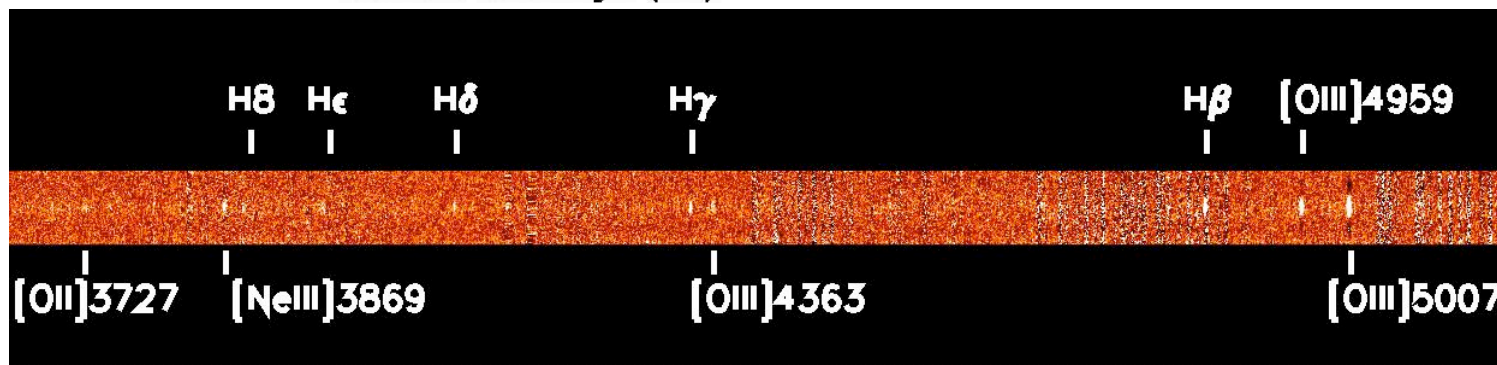
$12+\log (O/H) = 7.27 = (1/40\ Z_{\odot})$

$[7.17 - 7.39]$

Comparable to lowest metallicity galaxies seen locally

[e.g., I Zw18; $12+\log(O/H) = 7.1 - 7.2$]

Compact galaxy

6.5 hours Keck/DEIMOS 2D spectrum
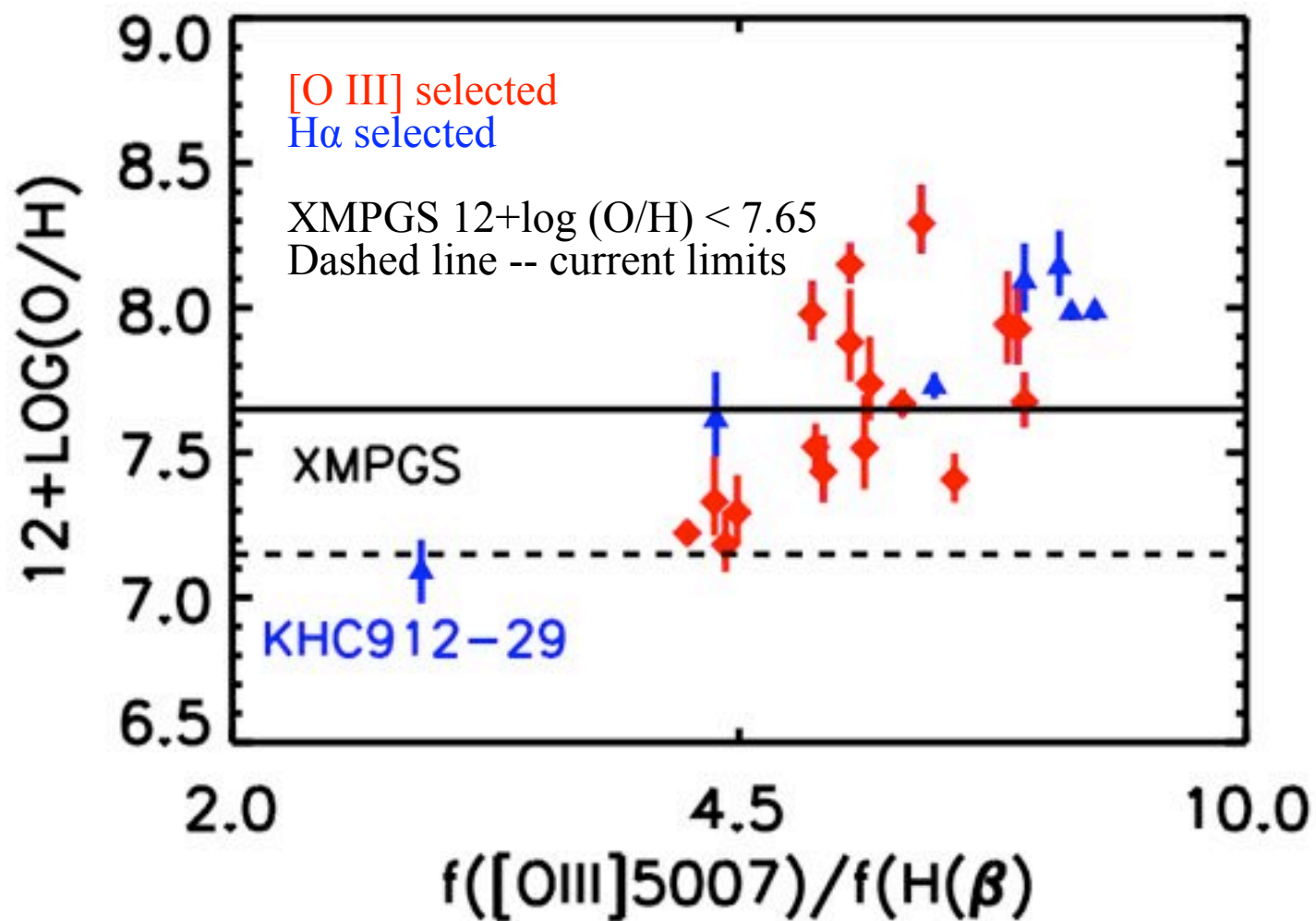
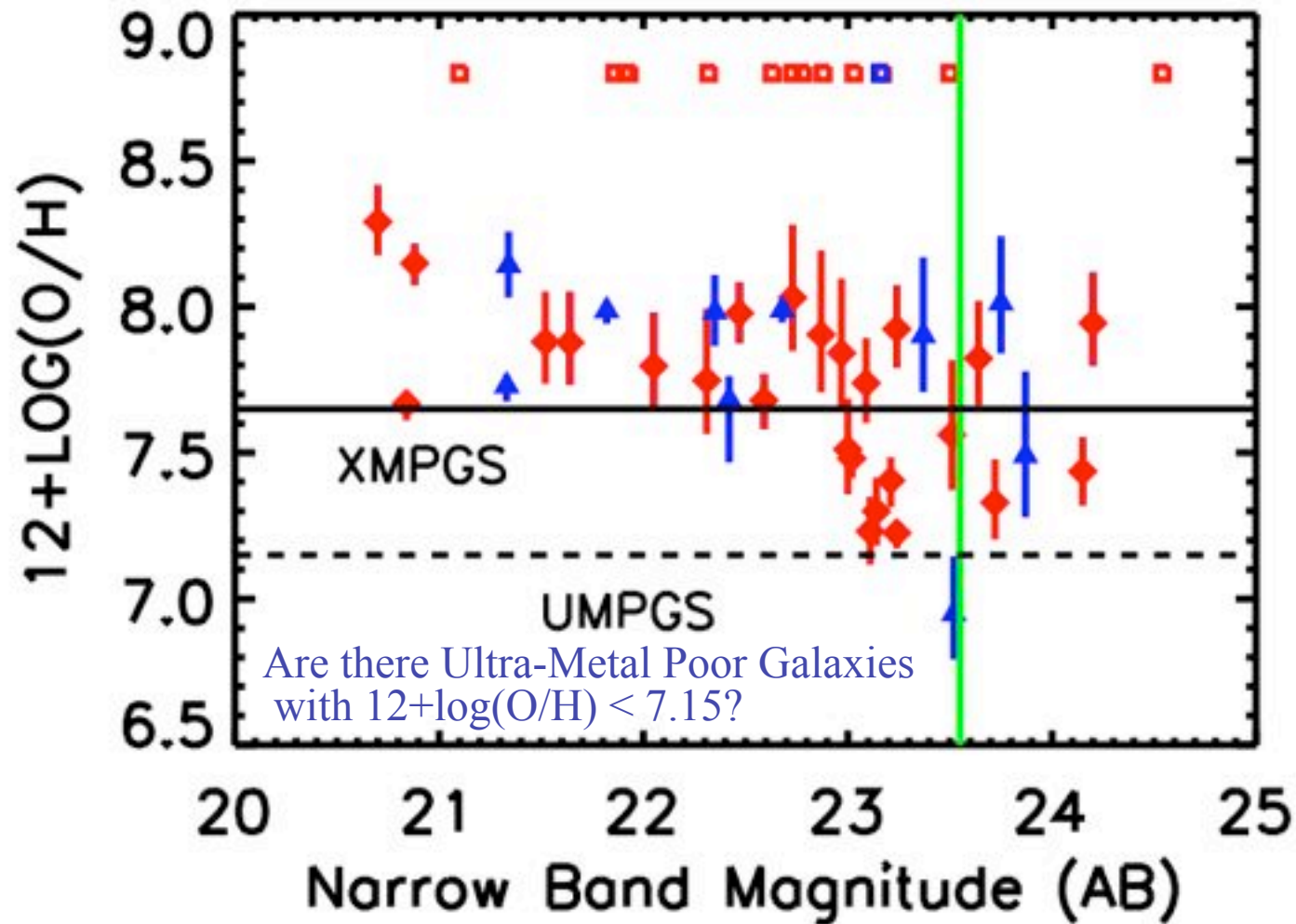HST/ACS (B, V, I)
12.5" x 12.5"

Methodology

- Follow up selections with deep DEIMOS spectroscopy on Keck
- Measure the metallicities with the "direct method" using line ratios from similar wavelength regions
- Characterize properties of the high quality, low metallicity sample (5 σ detections of [OIII] 4363 Å) e.g. metallicity-luminosity relations, ionization characteristics
- Sample Spectra -- examine ultra low metallicity cases for key features.
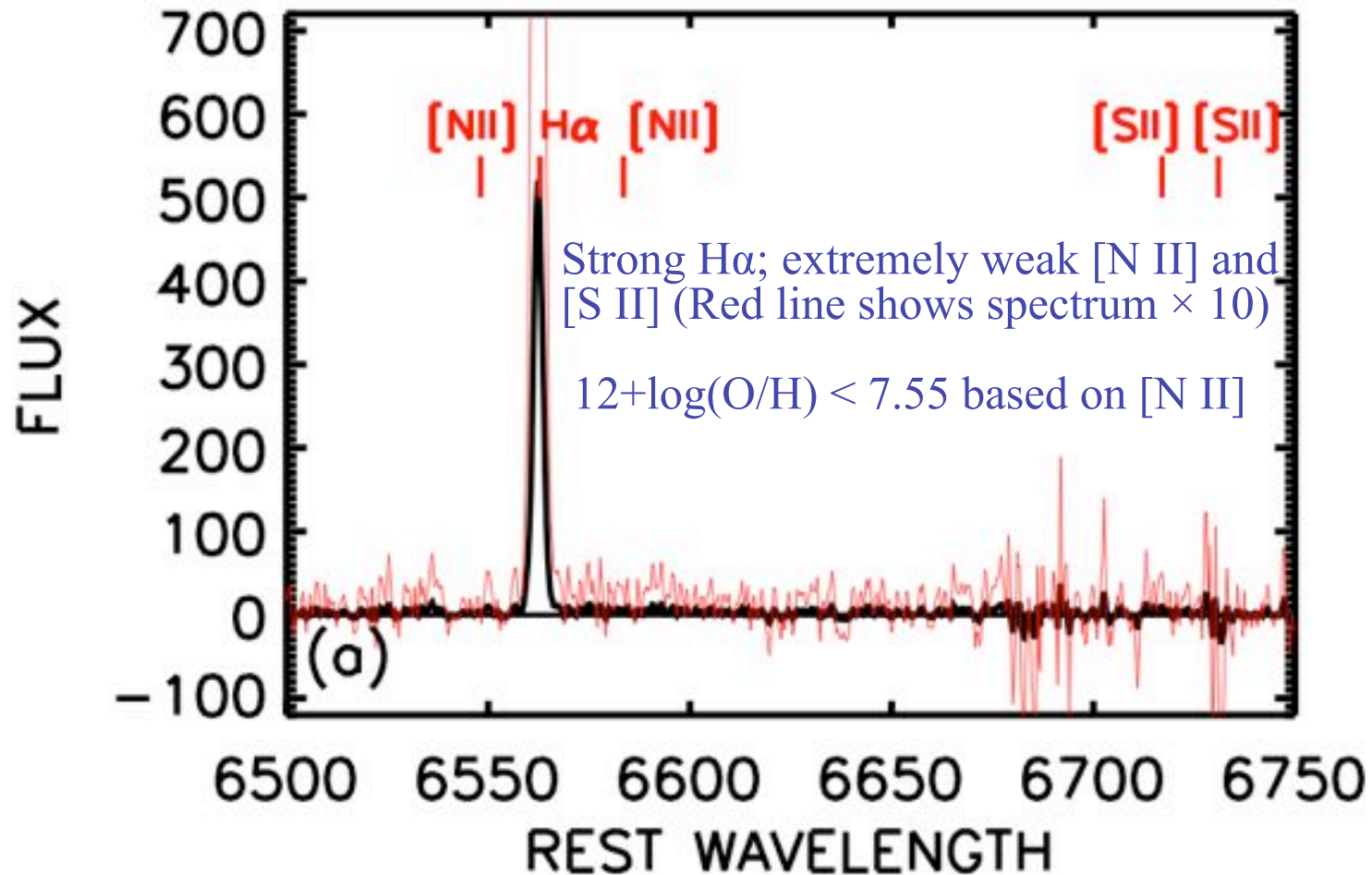
Metallicity Distributions

[O III] selected
Hα selected
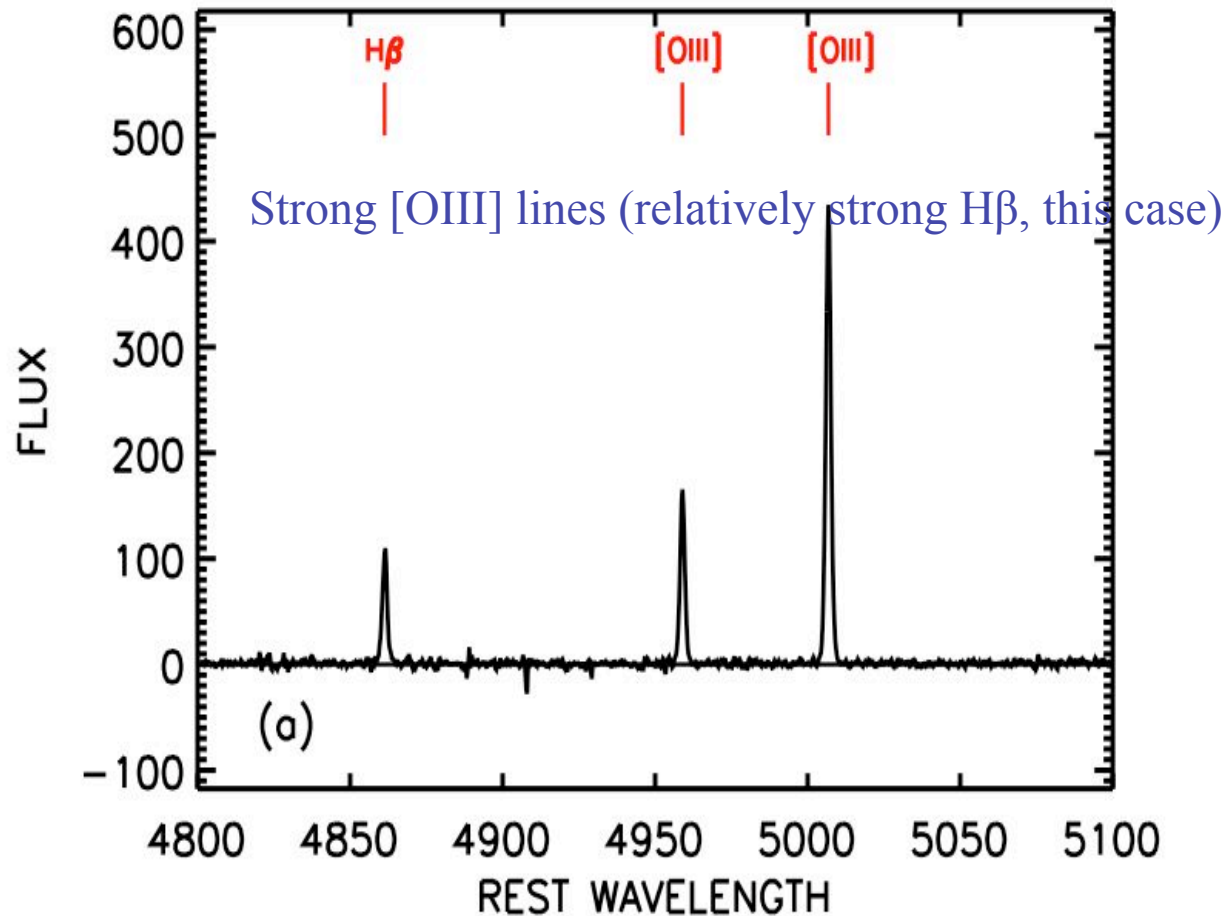
XMPGS 12+log (O/H) < 7.65
Dashed line -- current limits

XMPGS

KHC912−29

Metallicity Distributions

Are there Ultra-Metal Poor Galaxies with $12+\log(O/H) < 7.15$?

Ultra-Strong Emission Line Galaxy
(Low-z, High-Equivalent Width)

Strong Hα; extremely weak [N II] and [S II] (Red line shows spectrum × 10)

12+log(O/H) < 7.55 based on [N II]

Ultra-Strong Emission Line Galaxy
(Low-*z*, High-Equivalent Width)
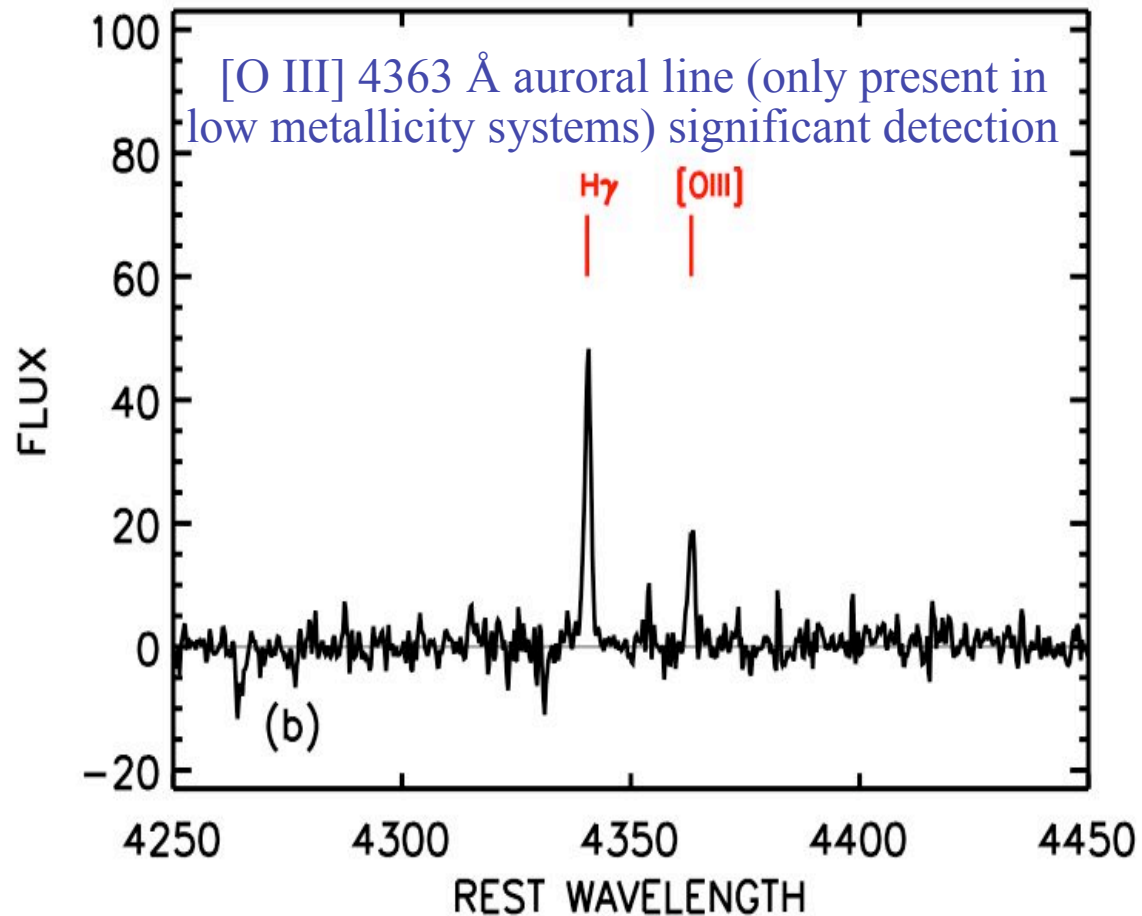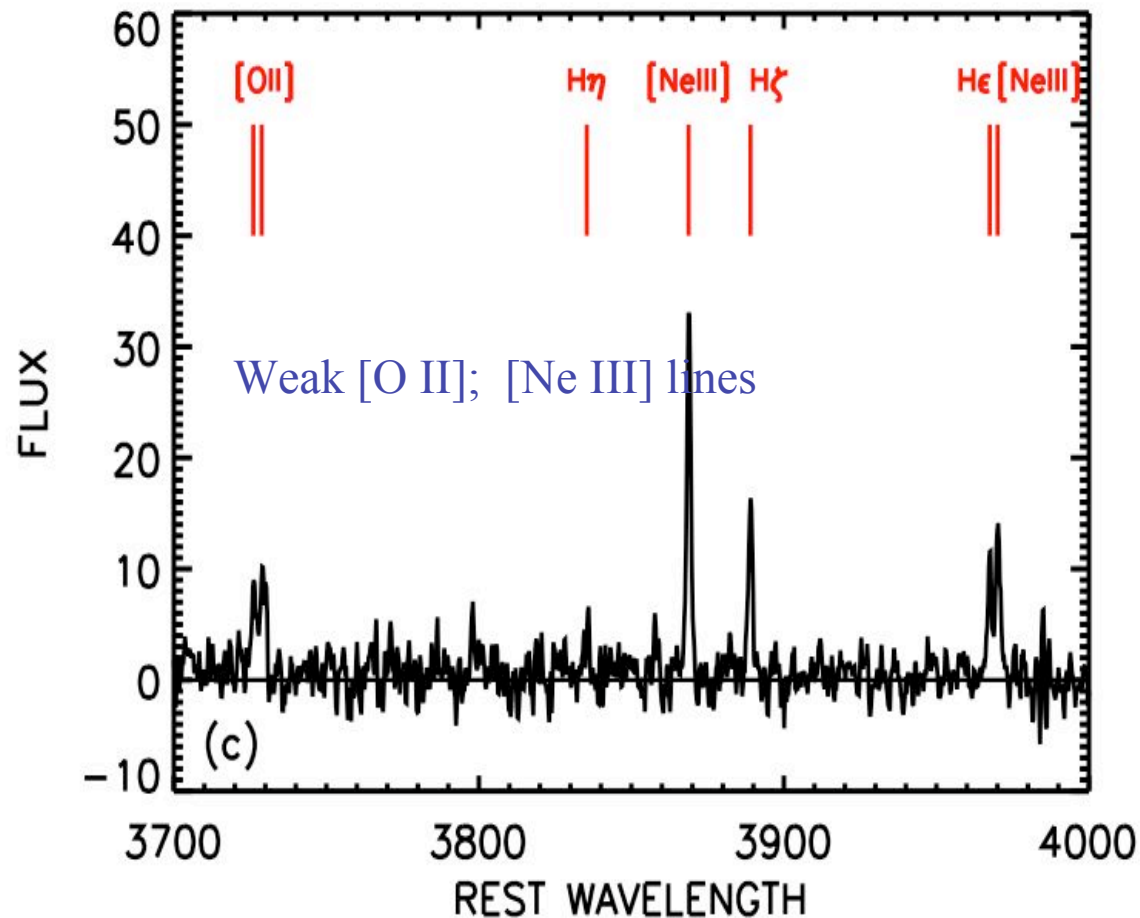

Strong [OIII] lines (relatively strong Hβ, this case)

Ultra-Strong Emission Line Galaxy
(Low-*z*, High-Equivalent Width)

Ultra-Strong Emission Line Galaxy
(Low-*z*, High-Equivalent Width)

SUMMARY

Recent studies (Kakazu et al. 2007, Hu et al. 2009) have shown the presence of substantial populations of galaxies with extremely high equivalent width in the redshift $0 < z < 1$ range identified in SuprimeCam narrowband surveys.

These objects have very low metallicities (and may be counterparts of the high redshift Lyα galaxies). They may also ultimately tell us whether there is a true metallicity floor for forming galaxies.