ESO

European Organisation for Astronomical Research in the Southern Hemisphere

High redshift nebulae ionized by hot stars

Anna Raiter (ESO)

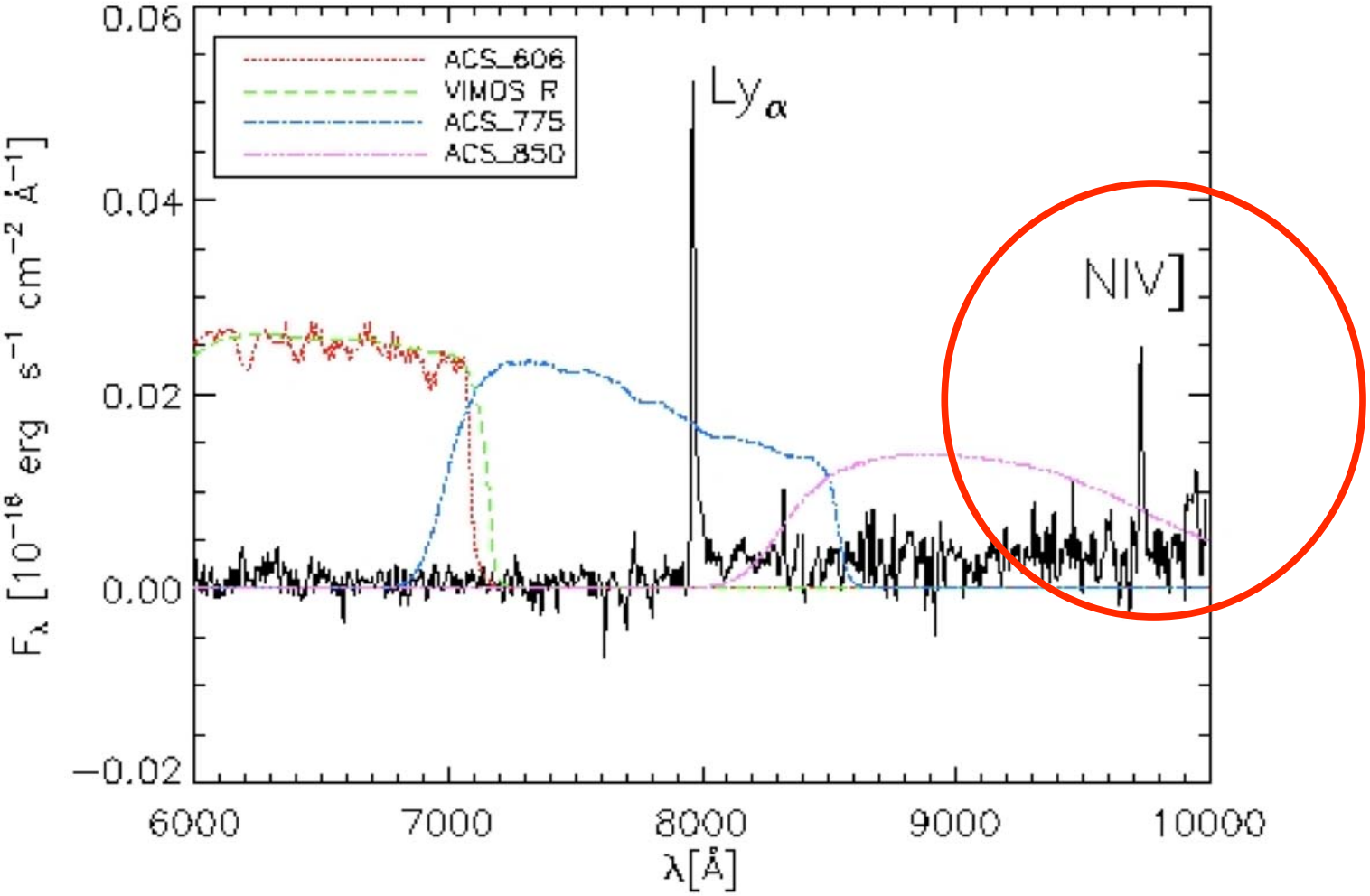
and B.Fosbury (ST-ECF)

IAP Paris 7 July 2009

The case of

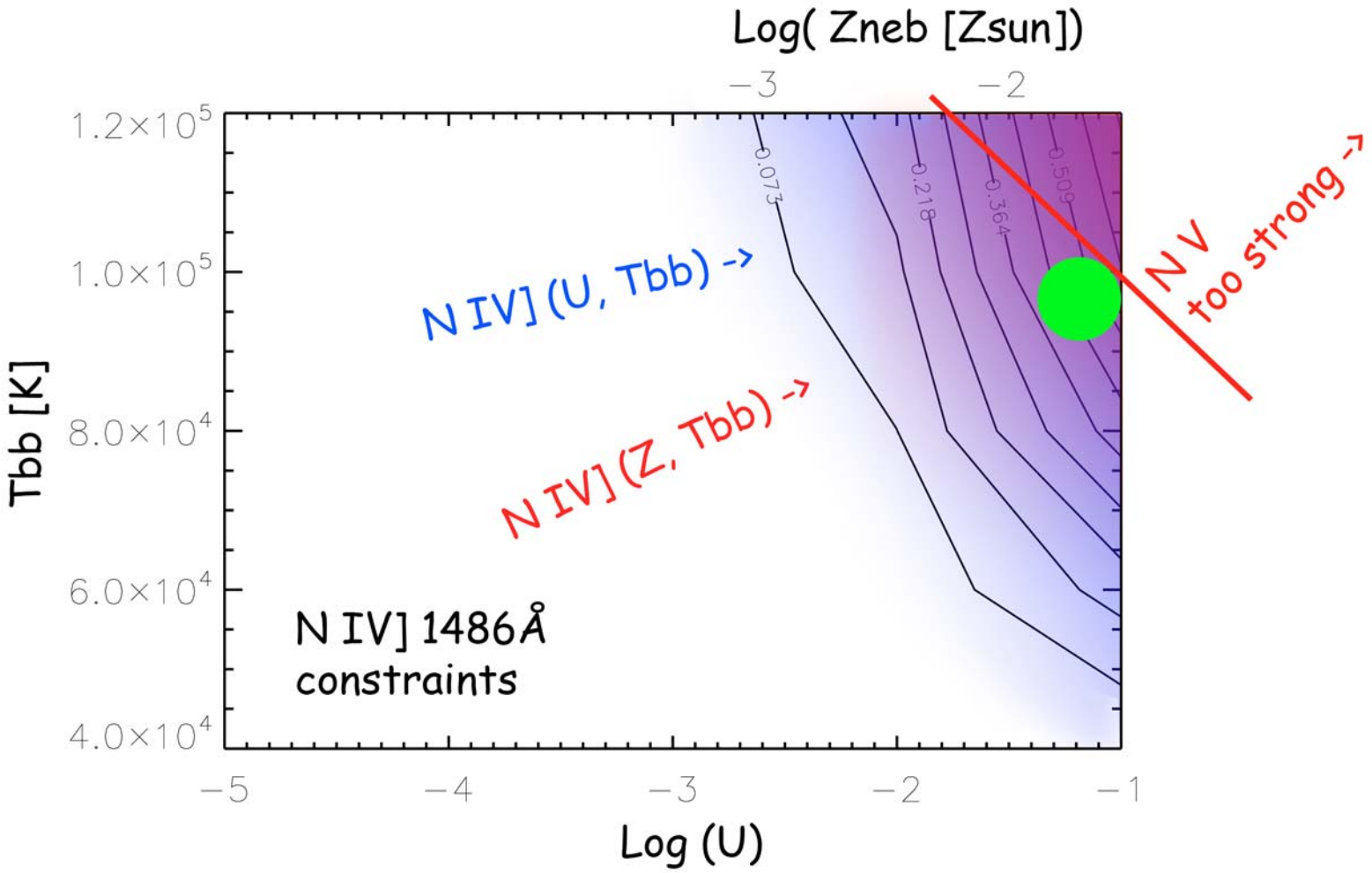
GDS J033218.92-275302.7 @ z=5.563

Vanzella et al. 2009, ApJ, 695, 1163

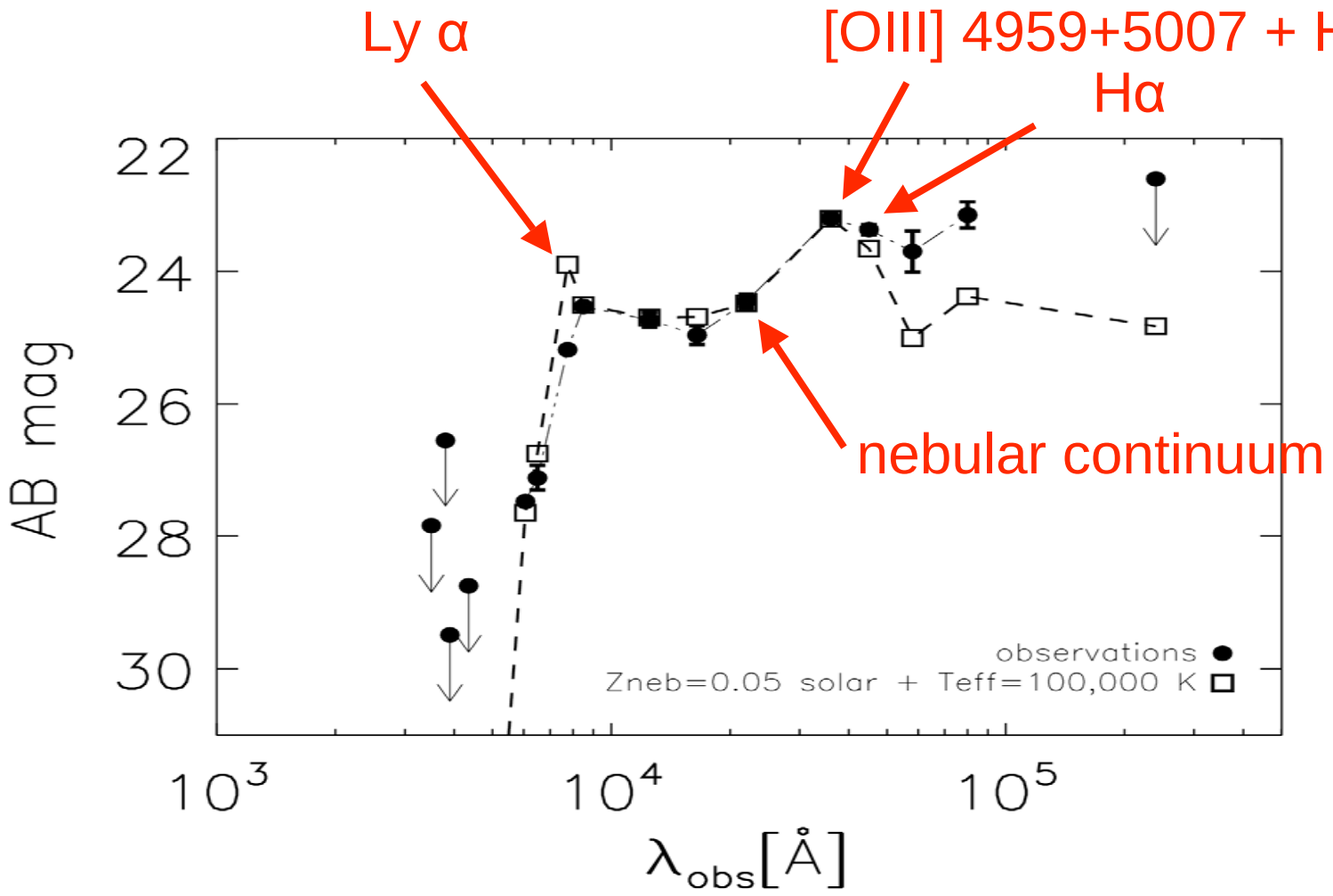


FORS2 spectrum – R ~ 660, L(NIV]1483+87) ~ 10^{43} erg/s

Modeling – how to produce NIV] line



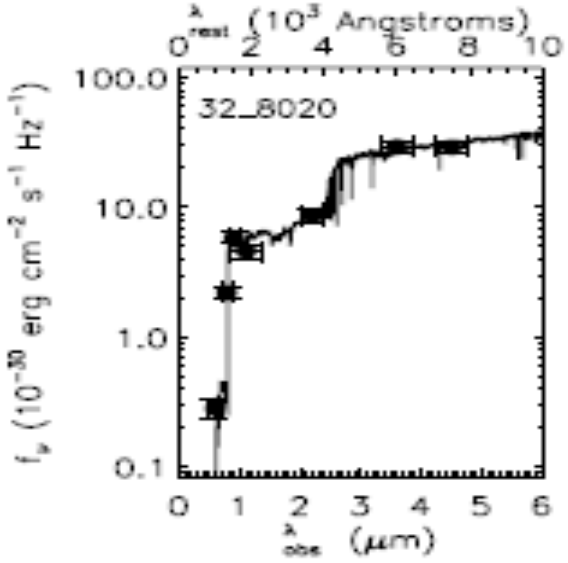
Photometry: GDS J033218.92-275302.7



Data: GOODS

GDS J033218.92-275302.7 – modeling

standard SED fitting



- old stellar population – age$_{\star}$ = 0.9 Gyr
- no reddening
- $M_{\star}$ = ~ 10^{11} $M_{\odot}$

Stark 2007, Wiklind 2008

nebular emission modeling

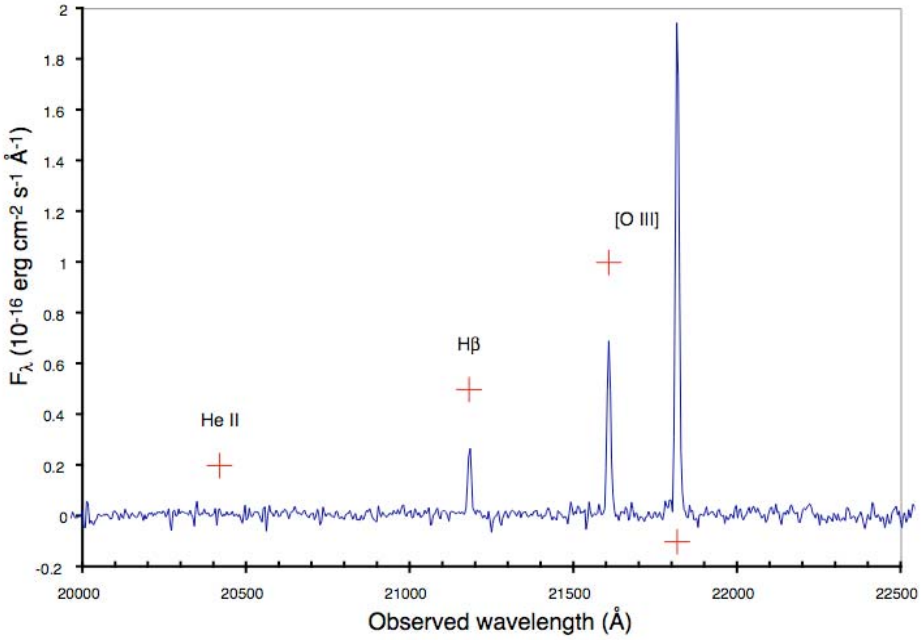
(assumes: spherical geometry, no assumptions on the IMF, constant density)

- Teff = ~100,000 K ($Z_{\star}$ ~ primordial)
- log(U) = -1
- Zneb = ~ 5 % $Z_{\odot}$
- Q(H) = ~ 3 x 10^{55} s^{-1}
- no dust in the nebula
- nebular emission dominates the SED – it explains the flat continuum and accounts for the observed Ks-IRAC1 bump ([OIII] lines mimic the Balmer break of old stellar population !!!)
- M ~ 3 x 10^{8} $M_{\odot}$

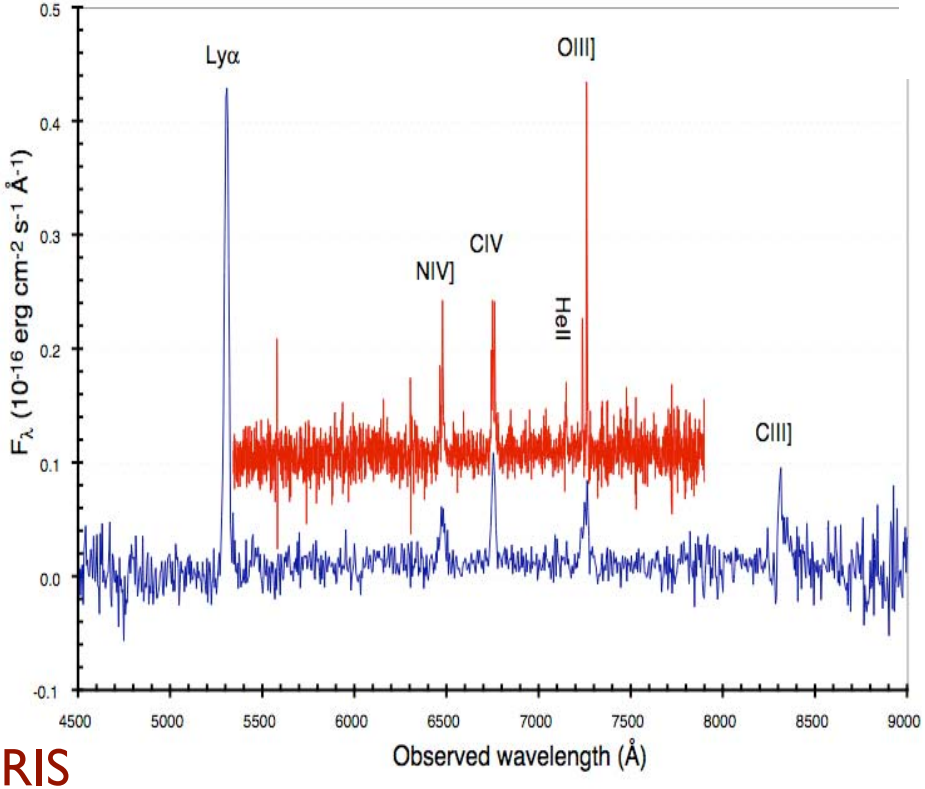
See also: Zackrisson et al. 2008, Schaerer & De Barros 2009

The Lynx arc, z=3.357

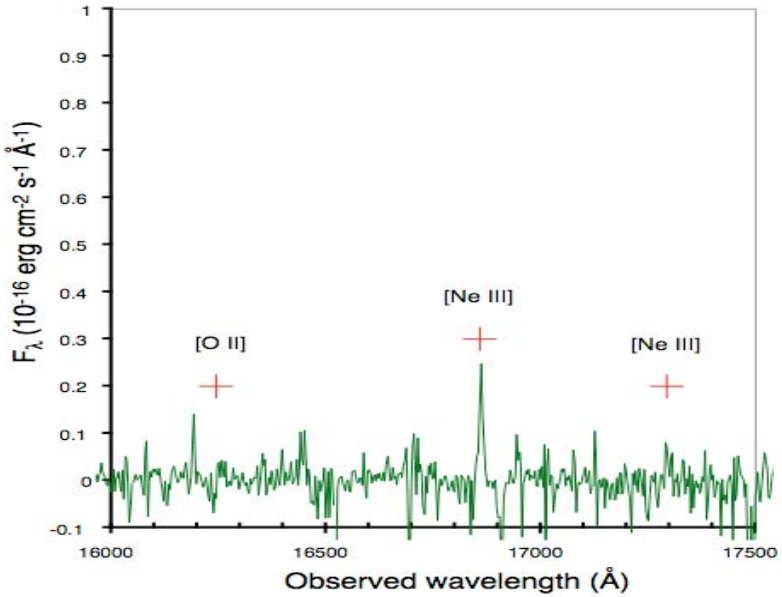
- Fosbury et al. 2003 ApJ, 596, 797
- Binette et al. 2003, A&A 405, 975
- Villar – Martin et al. 2004, MNRAS, 355, 1132



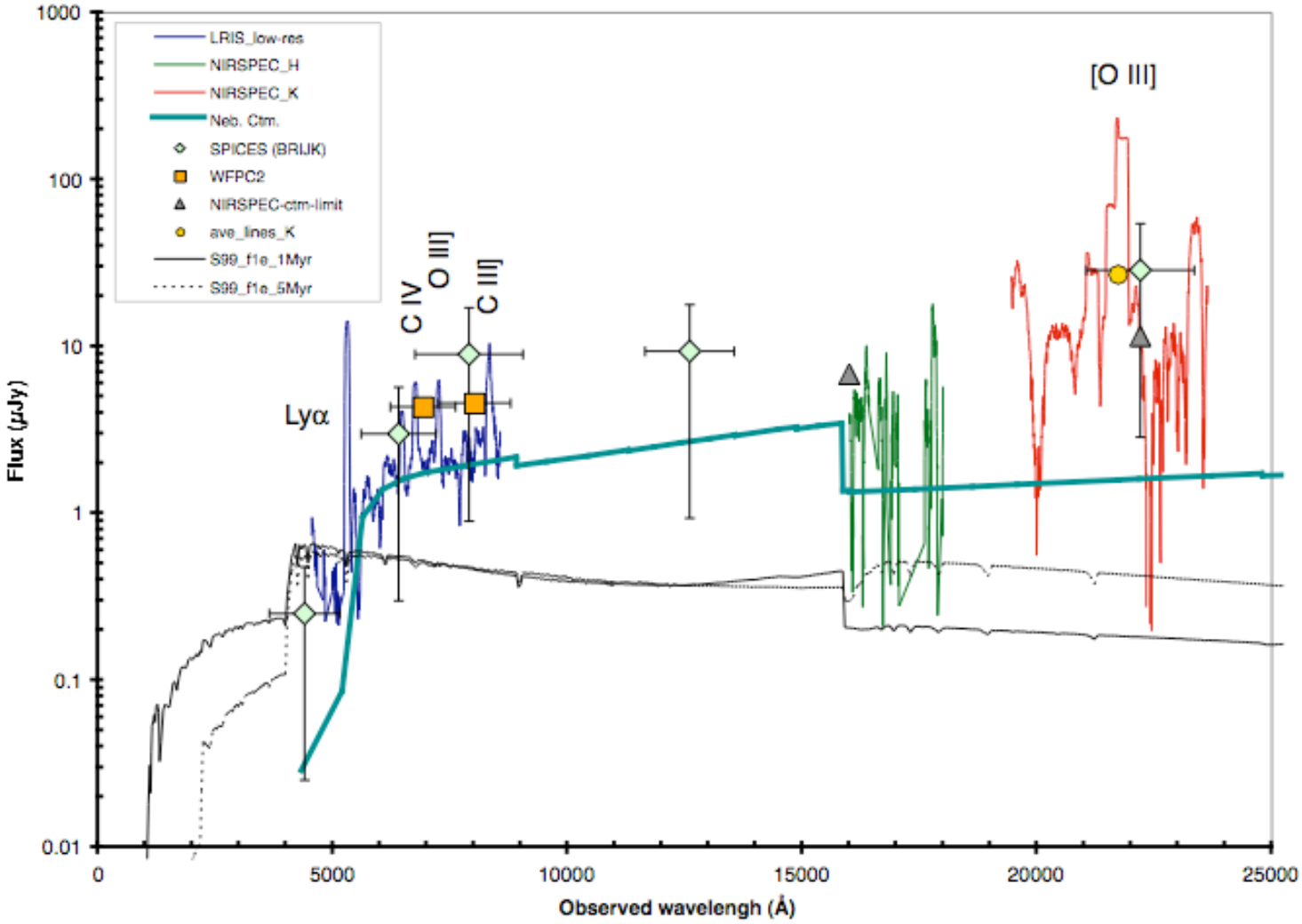
Keck NIRSPEC



LRIS



Photometry: Lynx arc



Search criteria

- **Lyα emission**
- **Other emission line(s) to diagnose the ionization mechanism**
- **Rule out AGN (power law)**
- **Hot stellar photoionization T_{eff} ~ 100kK**
- **Evidence for low nebular metallicity (but non-zero)**
- **NIV] 1483 + 86 Å – high T_{eff} in the absence of NIII] and NV**
- **Ionization by hot stars can result in a nebular spectrum (continuum approximately flat in fv and lines) that dominates the restframe UV-optical-NIR photometry**

Future prospects

- Observations:
- emission line spectroscopy at high redshift, access to the restframe intercombination lines of C, N, O and Si→ X shooter
- Theory:
- explain the enrichment process and create some general scenario (stellar winds, SNe)

If we find more sources we will be able to use high-z nebulae to trace early chemical evolution - from primordial stars onwards