[O III]/[N II] as Abundance Indicator

in H II regions, (esp.) at high red-shift

Max Pettini & B E J P

astro-ph / 04 01 128

H II gals, starburst gals, L B Gs

K-band arrays, 2·2 μm = Hα at $z = 2.3$
5007 $z = 3.4$

Problem: auroral lines too weak

Modelling needs broad spectral range

Hence 'empirical' methods

(NB 'Empiric' in old English = quack!)

Searle 1971 Scd neb lines reflect ∇Z

Jensen, Strom[2] 76 5007/Hβ

Alloin et al. 79 (5007/Hβ)/(6584/Hα) ≡ O3N2

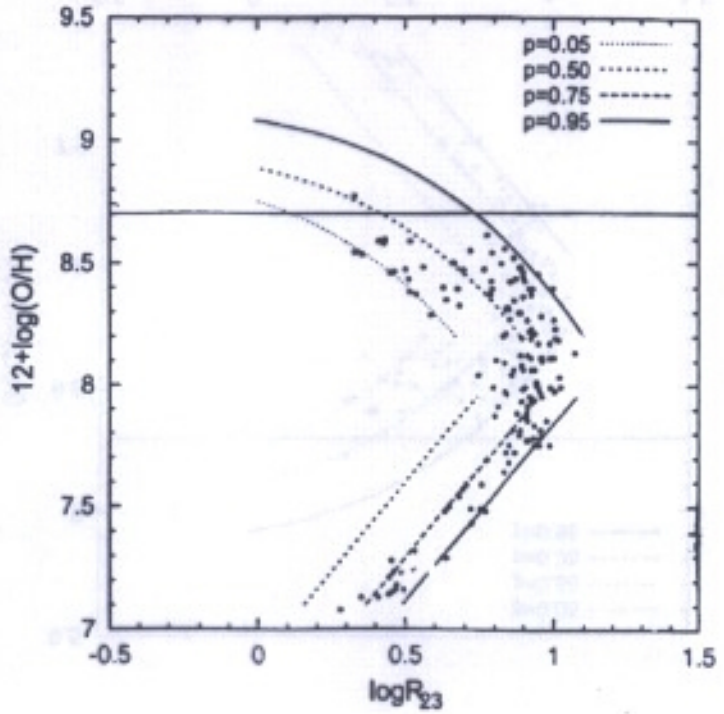
Pagel et al. 79 (3727+4959+5007)/Hβ ≡ R_{23}
improved by McGaugh, Pilyugin

Vílchez, Esteban 96, Christensen et al. 97
Díaz & Perez-Montero 2000 S_{23}

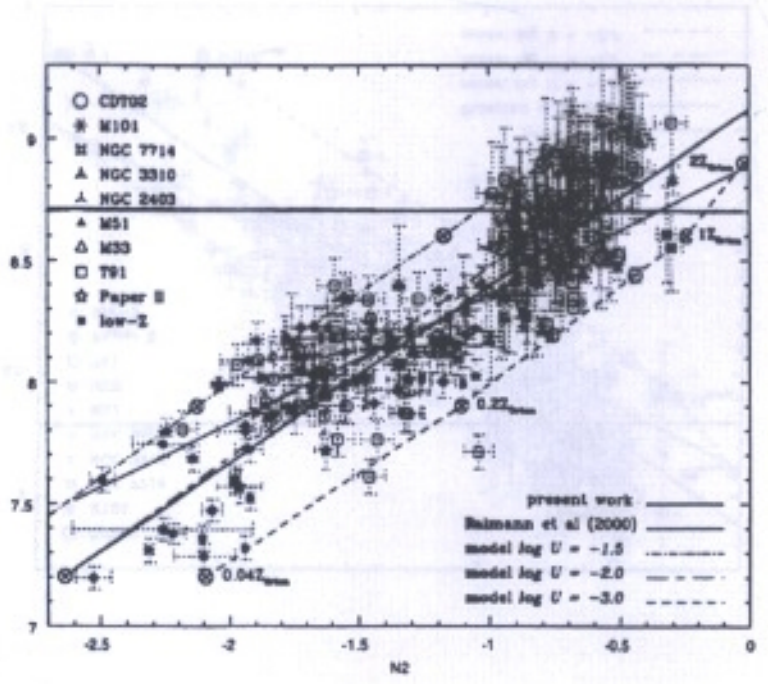
Dey et al. 02 S_{234}

Denicoló, Terlevich[2] 02 6584/Hα ≡ N2

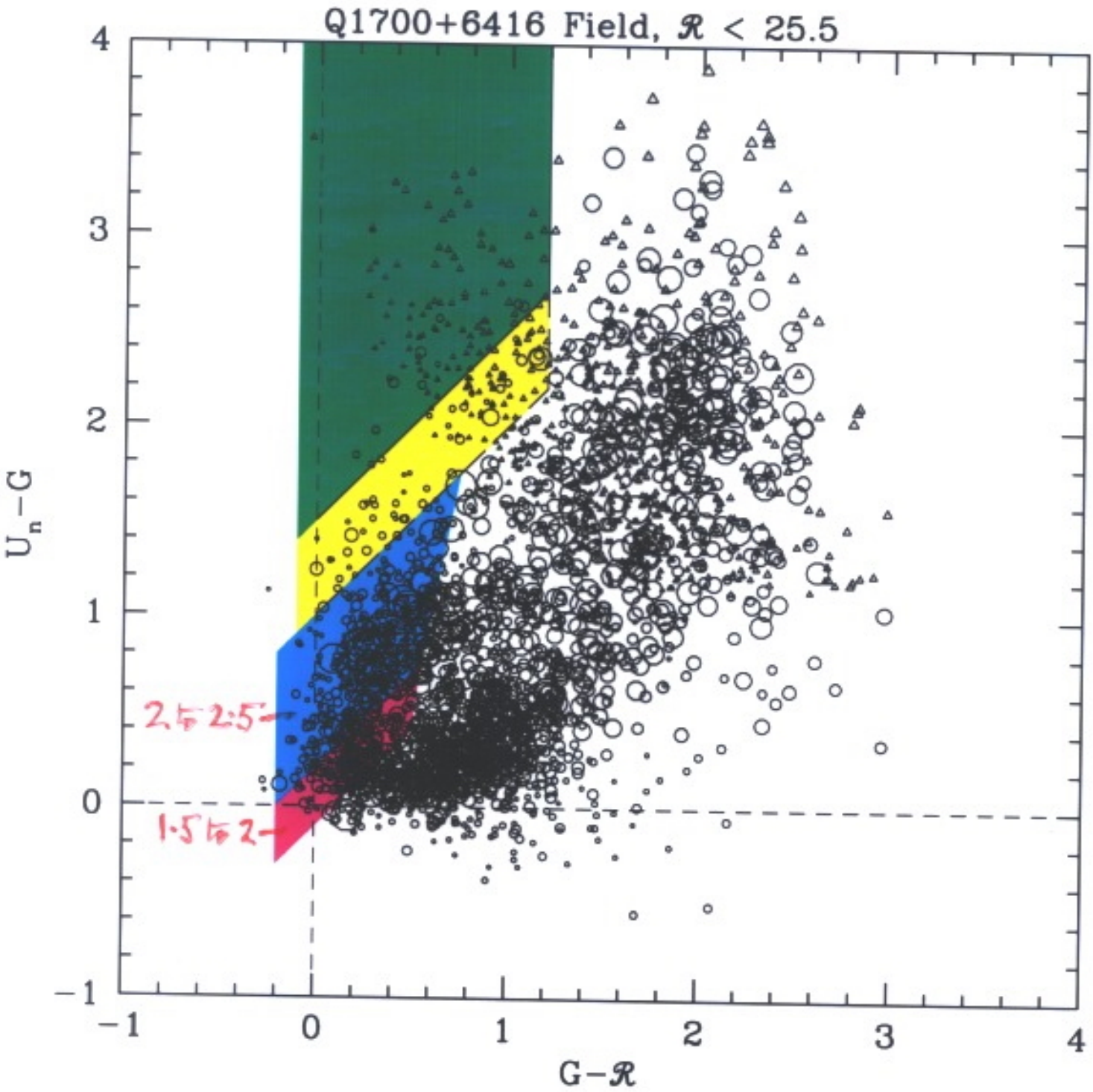
Pilyugin 2003



Denicoló et al. 2002

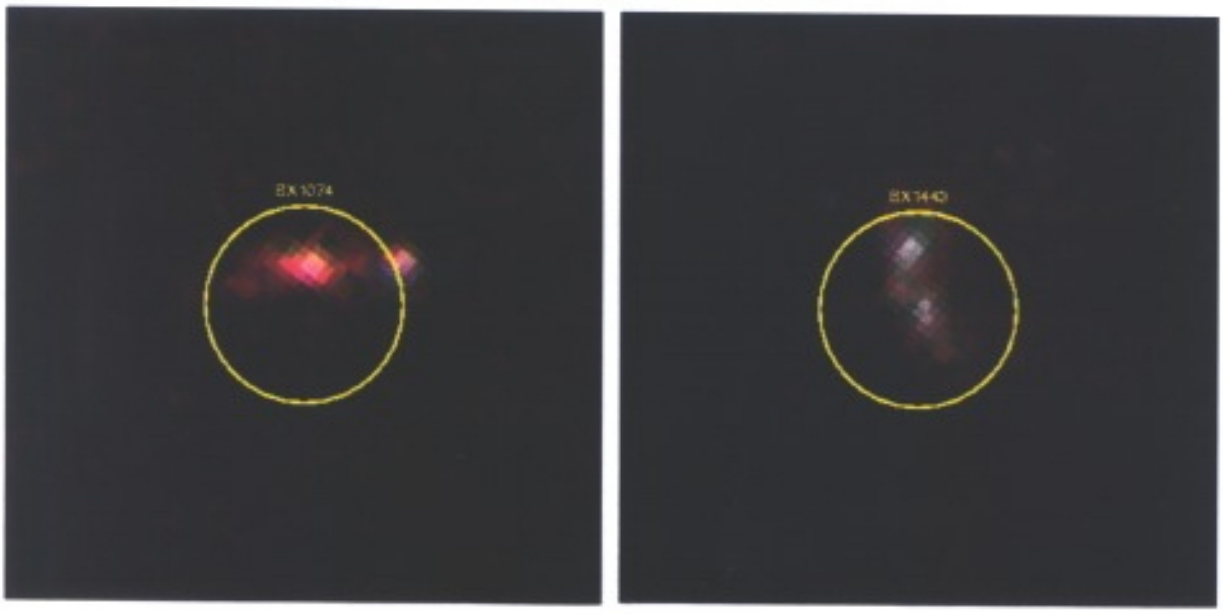


Steidel et al. astro-ph/04-01439



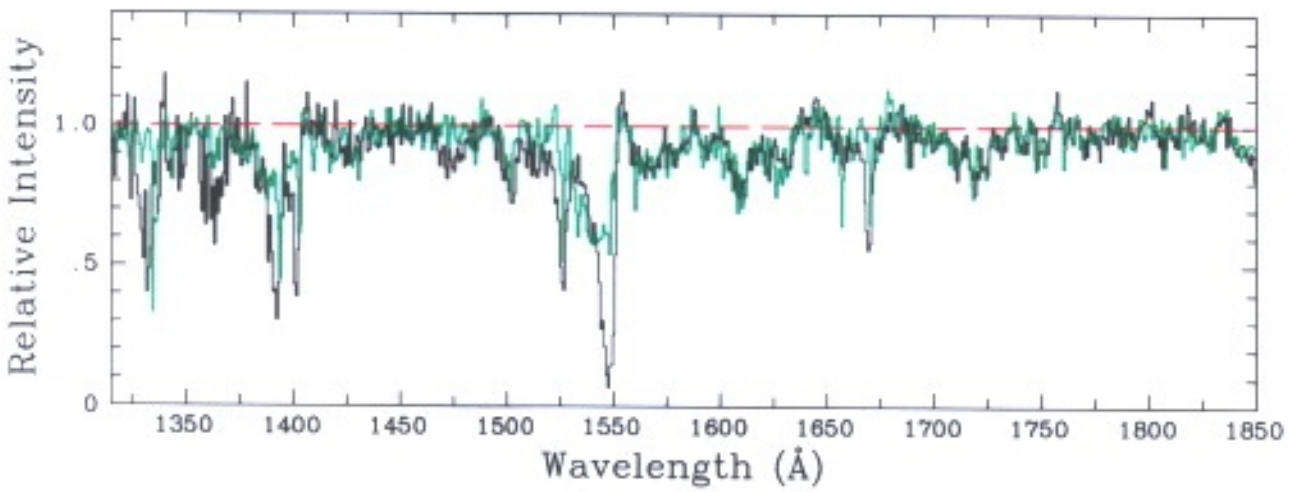
The Stellar Populations of Galaxies in the Redshift Desert

$(1.5 \lesssim z \lesssim 2.5)$



In collaboration with Chuck Steidel, Kurt Adelberger, Dawn Erb, Naveen Reddy, Samantha Rix & Alice Shapley

Q1307-BM1163

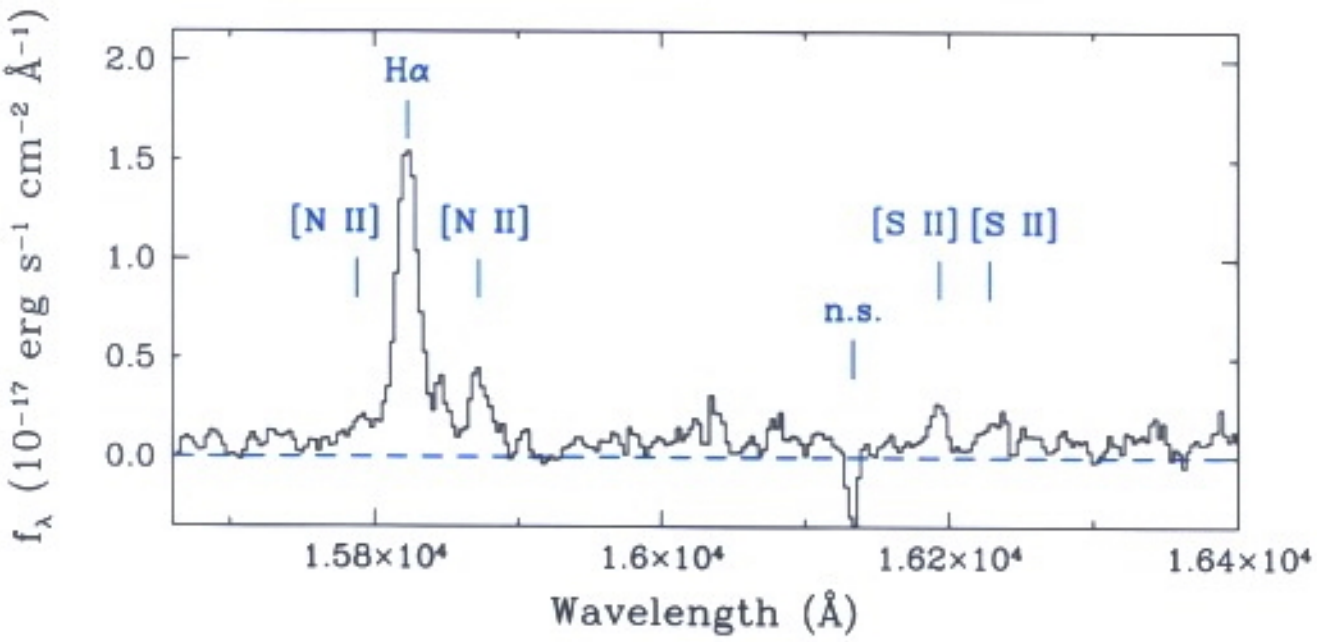


Observed Spectrum (Normalised)

Starburst99 Model with:

1. Continuous Star Formation (10^8 years)
2. Salpeter IMF ($\alpha = 2.35$)
3. Solar Metallicity

Q1307-BM1163 near IR H-band



$2 \times 900\,\mathrm{s}$ exposures with NIRPEC, $8.5\,\text{Å}$ resolution

$\mathrm{H}\alpha/[\mathrm{N\ II}] = 4.5 \implies$ **12+(O/H)=8.64** $Z = Z_\odot$

(using the calibration of $N2$ vs. (O/H) by Denicoló et al. 2002)

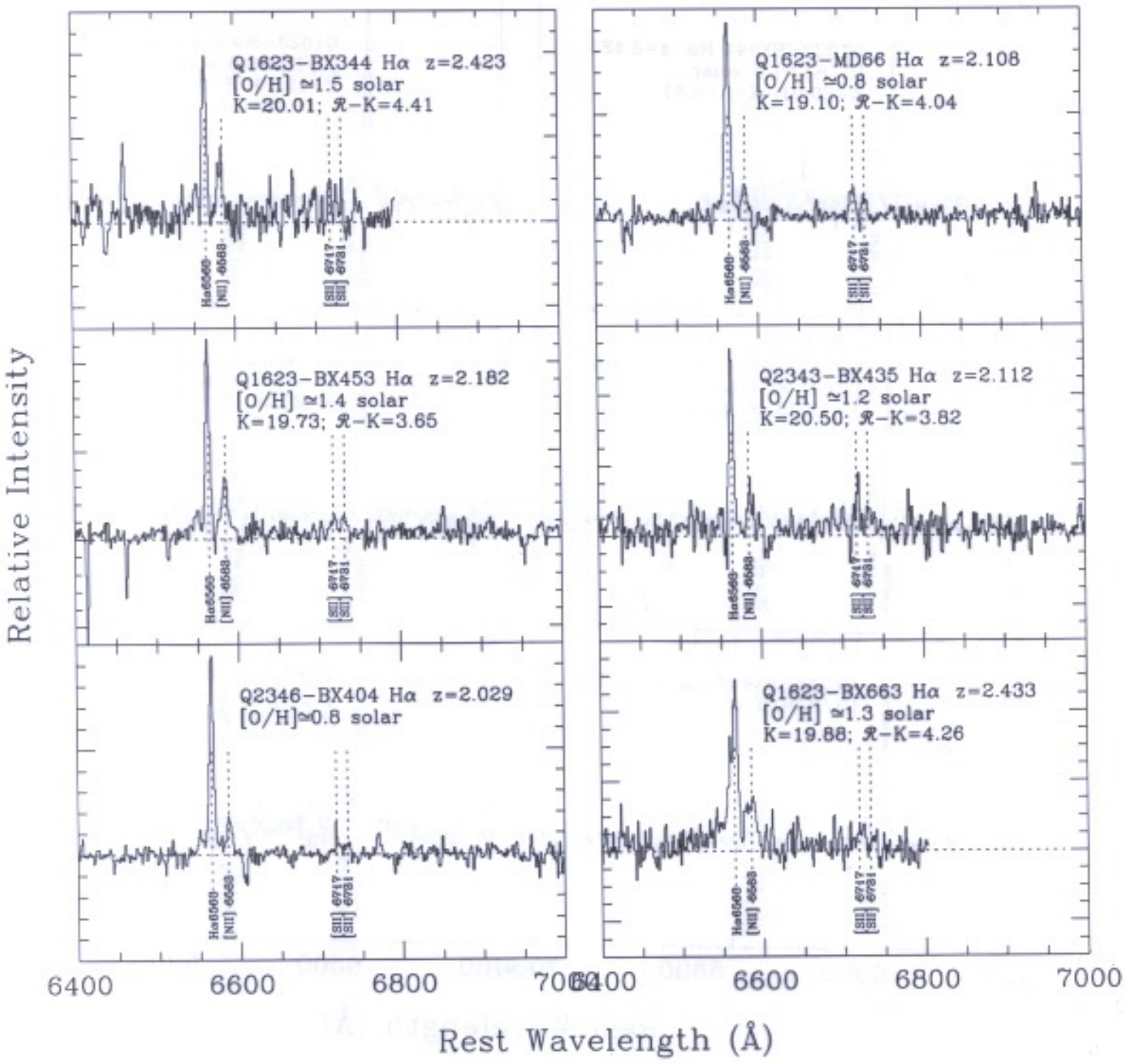
$F_{\mathrm{H}\alpha} = 2.9 \times 10^{-16}\ \mathrm{erg\ s^{-1}\ cm^{-2}}$

$L_{\mathrm{H}\alpha} = 3.6 \times 10^{42}\, h_{70}^{-1}\ \mathrm{erg\ s^{-1}}$

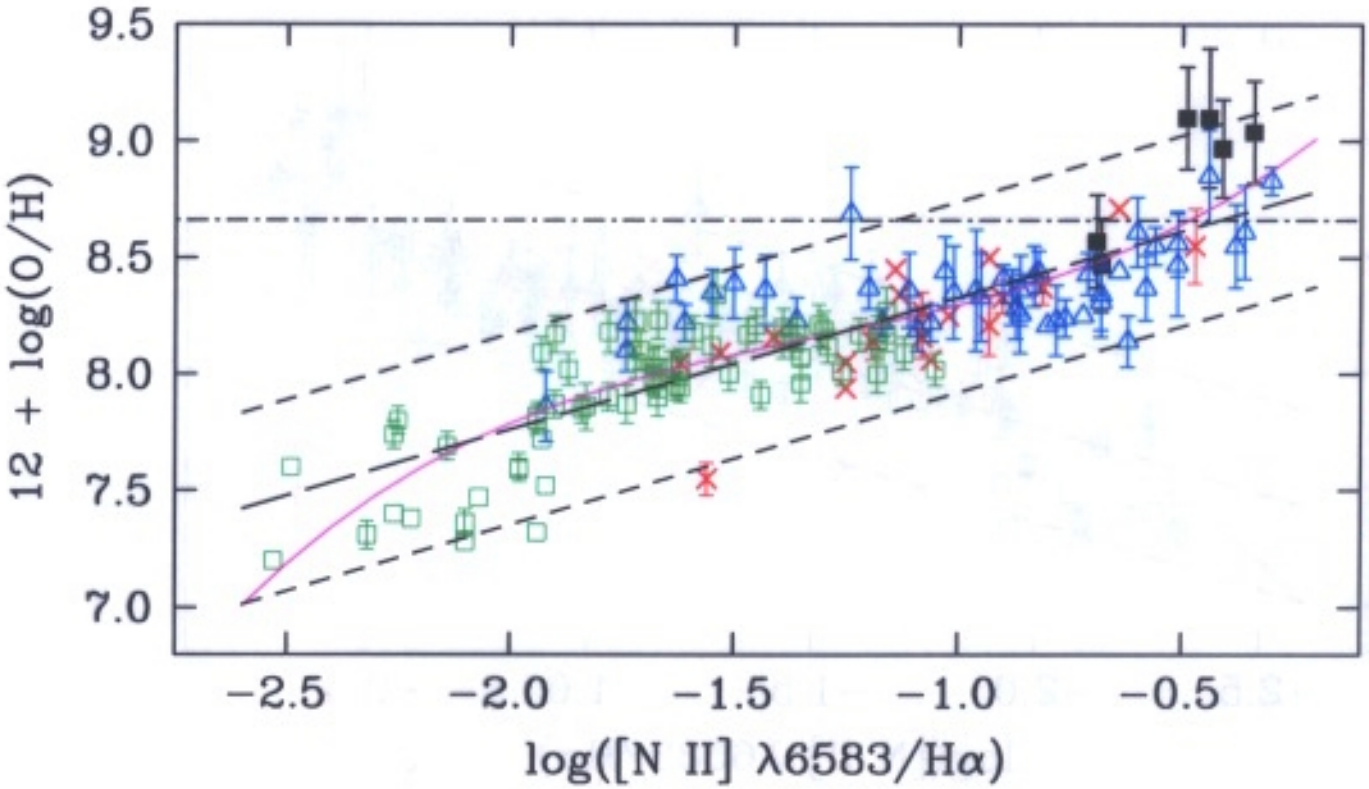
$\implies \mathrm{SFR_{H\alpha}} = 30 M_\odot\ \mathrm{yr^{-1}}$ – same as $\mathrm{SFR_{UVcont}}$

(using the calibrations of $L_{\mathrm{H}\alpha}$ and L_{UV} vs. SFR by Kennicutt 1998)

K-band


Q1623−BX344 Hα z=2.423
[O/H] ≃1.5 solar
K=20.01; ℛ−K=4.41
Q1623−MD66 Hα z=2.108
[O/H] ≃0.8 solar
K=19.10; ℛ−K=4.04
Q1623−BX453 Hα z=2.182
[O/H] ≃1.4 solar
K=19.73; ℛ−K=3.65
Q2343−BX435 Hα z=2.112
[O/H] ≃1.2 solar
K=20.50; ℛ−K=3.82
Q2346−BX404 Hα z=2.029
[O/H]≃0.8 solar
Q1623−BX663 Hα z=2.433
[O/H] ≃1.3 solar
K=19.88; ℛ−K=4.26
Relative Intensity
6400
6600
6800
7000
Rest Wavelength (Å)

95 % within ± 0.4 dex

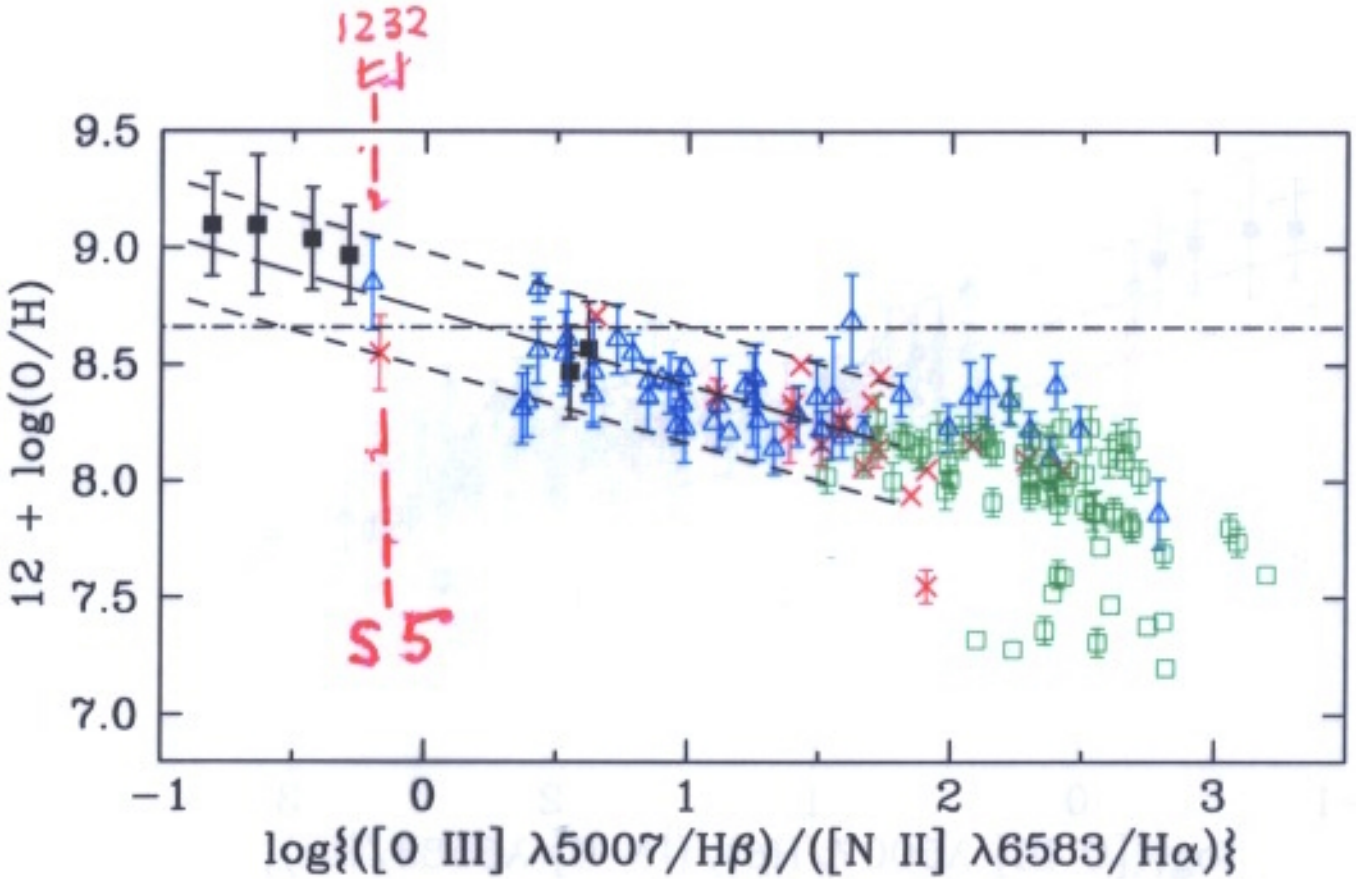


■ P.I. models (Díaz, Castellanos)

△ Spir, Irr.

□ BCGs

X M 101 (Kennicutt)



95% within ± 0.25 dex

if O3N2 < 1.9