Low-metallicity Emission Line Galaxies with [OIII]λ4363 in the DEIMOS/DEEP2 survey.

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The DEEP project and the DEIMOS spectrograph.

Brief overview and history of the DEEP project.

DEEP=Deep Extragalactic Evolutionary Probe.
It started in 1991.

DEEP1. Pilot Survey for DEEP2. (1995-2001)

Fields Surveyed. SA68, Groth Strip and HDFn.
z=0.30-1.30 ; Limiting magnitude I_AB=24.
Instruments:LRIS, NIRSPEC, WFPC2, NICMOS.
Provided with photo-zs for DEEP2.

More info in http://www.deep.ucolick.org.

The DEEP project and the DEIMOS spectrograph.

The DEEP2 project.

DEEP2. Follow-up study (2001-2005)

Fields Surveyed: Groth Strip, 2 DSDSS and Last Zone Low Extinction.
Z=0.70-1.55, preselected using photo-zs.
Consists on two sub-surveys, the 1Hour-Survey and the 3Hour-Survey.

The 1Hour Survey.

65000 surveyed galaxies.
Limiting magnitude I_AB=23.5
Instruments:CFHT imaging and

DEIMOS

The 3Hour Survey.

7500 surveyed galaxies.
Limiting magnitude I_AB=24.5
Instruments:LRIS &

DEIMOS

More info in http://www.deep.berkeley.edu.

The DEEP project and the DEIMOS spectrograph.

The DEIMOS spectrograph.

The DEIMOS instrument, designed for the 10 meter Keck-II telescope located atop Mauna Kea in Hawaii, is the battle-horse of the DEEP2 project.

DEIMOS is a general purpose, multi-slit (80 slits per barrel), double-beam spectrograph. It is capable of operating in three different modes, direct imaging, single-object spectroscopy and multi-object, long-slit spectroscopy.

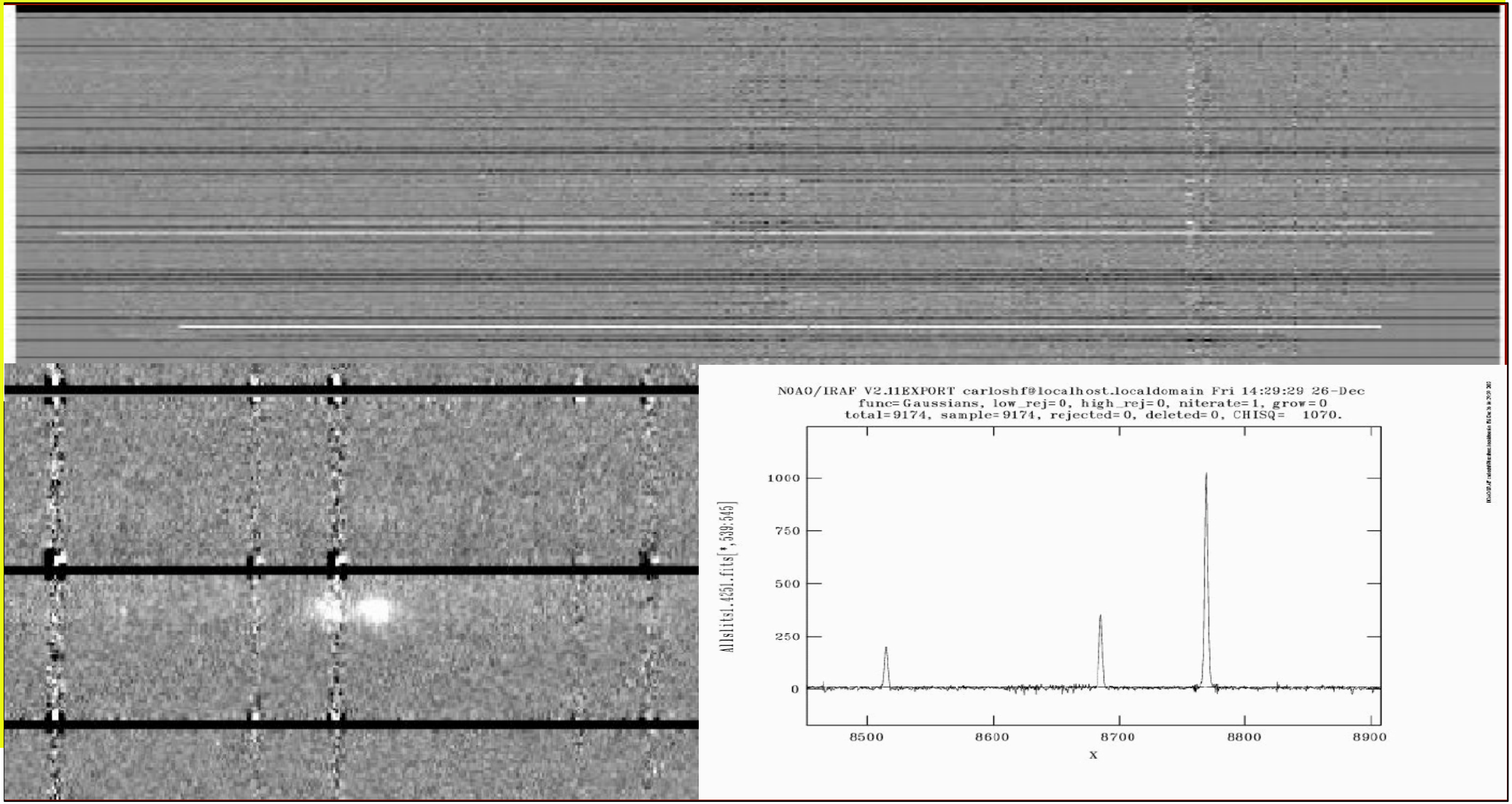
Its main features are:

- Wide spectral coverage (up to 5000 Å per exposure).
- High spectral resolution (down to ~1 Å).
- Long slit length on the sky (32'.6, sum of both barrels).
- High Throughput.

More info in http://www.ucolick.org/loen/Deimos/deimos.html

The DEEP project and the DEIMOS spectrograph.

Some examples of the spectra.



Motivation.

What led me to ask Mr D.C.Koo access to DEEP2 data to carry out this study?.

1)Evolution of the metallicity distribution for compact, emission line objects. Evolution of the luminosity-metallicity relationship. Comparison with M_B-Z evolution from DGSS results.

2)Search for high-luminosity eXtremely Metal Poor Galaxies (XMPGs).

3)My PhD.(TDB)

Results.

The galaxies we have found.

We have found 14 galaxies with [OIII]λ 4363 out of 3900. Armed with this measurement, we have derived the metallicity of these galaxies using the temperature sensitive method. As expected they are very luminous and blue. Their redshifts range from 0.55 to 0.85. In look-back time this translates to 5.4-7.1 Gyr. The cosmological dimming is around 8.

ID	z	12+log(O/H)	Wβ	M_B	(U-B)
1	0.851	8.0(0.15)	97	-19.85	-0.49
2	0.730	7.9(0.15)	90	-19.22	-0.49
3	0.749	7.8(0.20)	96	-19.19	-0.35
4	0.631	7.7(0.20)	8.4	-19.24	-0.44
5	0.636	8.2(0.20)	37	-19.21	-0.23
6	0.530	8.1(0.20)	130	...	...
7	0.659	8.1(0.20)	87	-19.99	-0.37
8	0.750	8.1(0.20)	85	-20.56	-0.47
9	0.657	8.3(0.20)	48	-21.40	-0.53
10	0.551	8.0(0.20)	72	-18.51	0.14
11	0.680	8.2(0.15)	90	...	...
12	0.703	8.3(0.20)	96	-19.93	-0.58
13	0.725	7.8(0.20)	55	-19.54	-0.28
14	0.706	8.1(0.20)	63	-20.09	-0.39

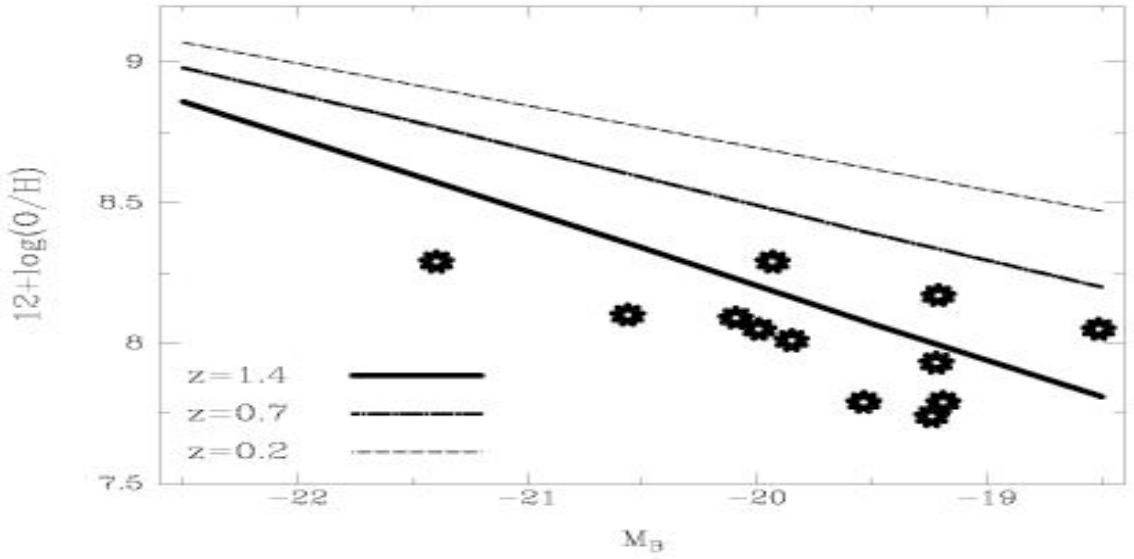
Discussion 1.

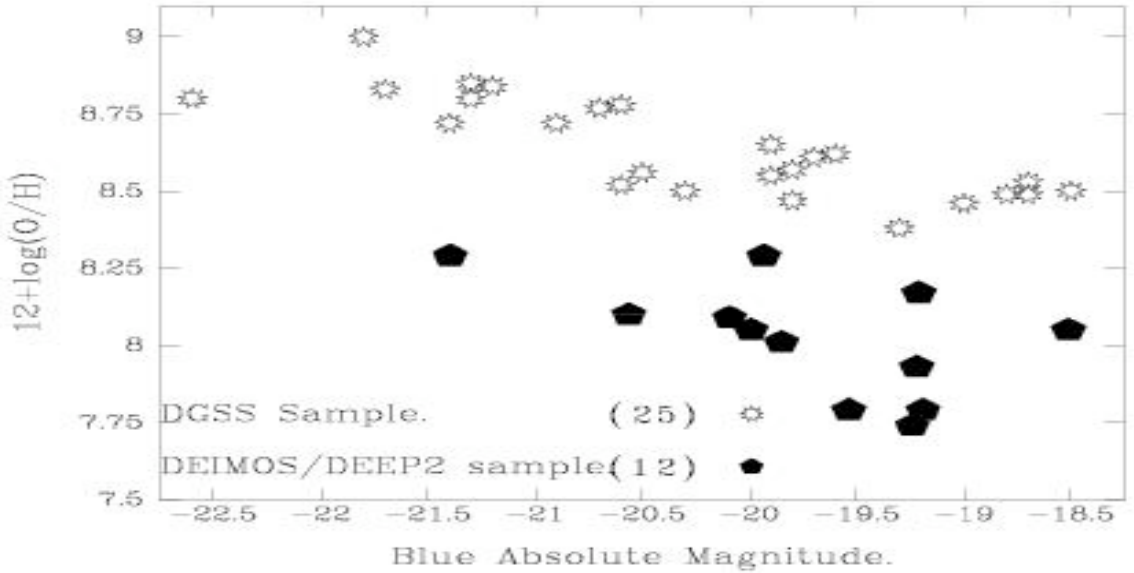
Comparison with M_B-Z evolution from DGSS results.

Some pioneering results on the evolution of the M_B-Z plane with redshift were presented in Kobulnicky *et al.*In this paper they present a hypothetical evolution of the M_B-Z relationship with z. They derived their oxygen abundances using McGaugh calibration for the upper branch using equivalent widths instead of actual line strengths. This increases the uncertainty of their calculation.

Here we present the location of our objects with respect to theirs at similar redshift.

It can be seen that our objects are of similar brightness but lower metallicities.

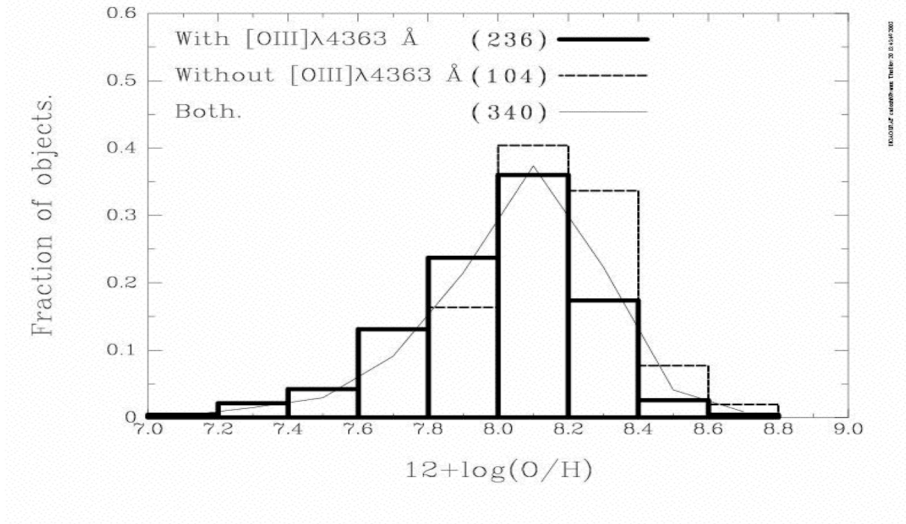


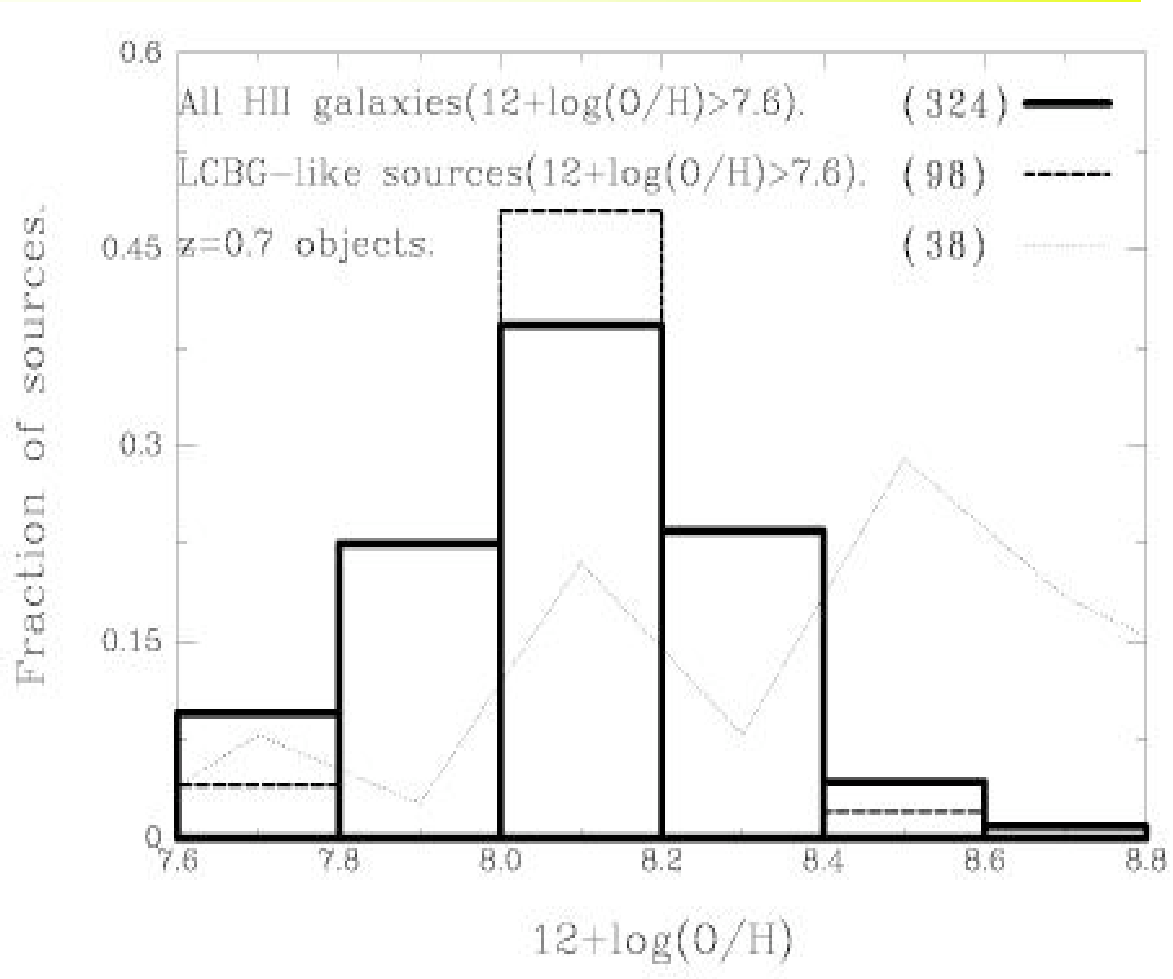


Discussion 2.

Evolution of the metallicity distribution for compact, emission line objects.

Combining the results from the local sample previously presented, the DGSS survey results plus the DEIMOS/DEEP2 objects with the 4363 line we can sketch a picture of the evolution of the oxygen abundance distribution in the last 6Gyr. The evolution is remarkably nonexistent.

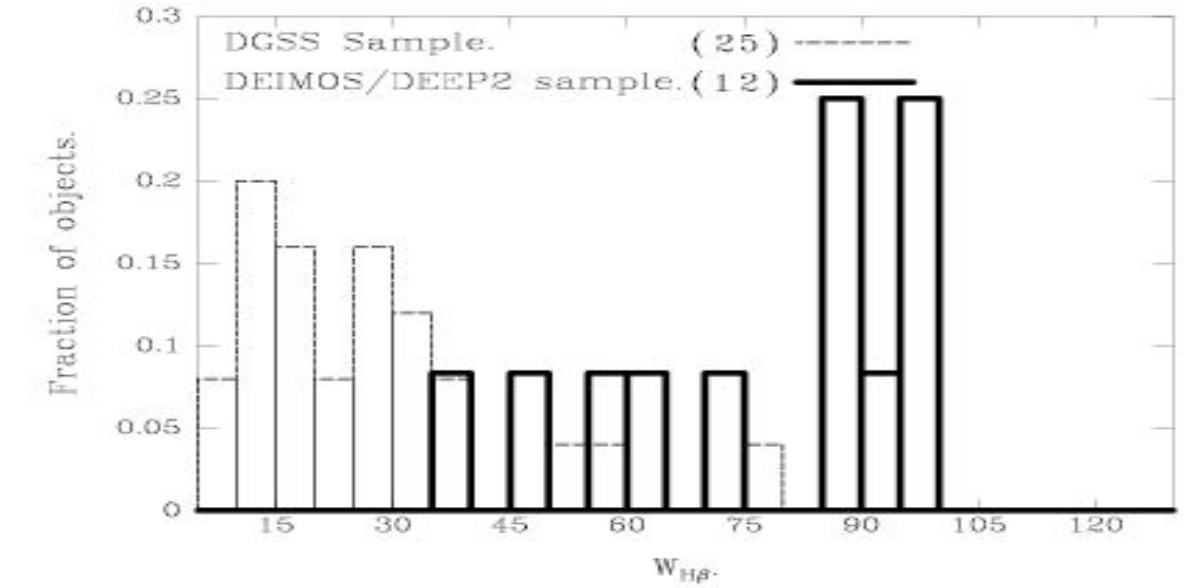


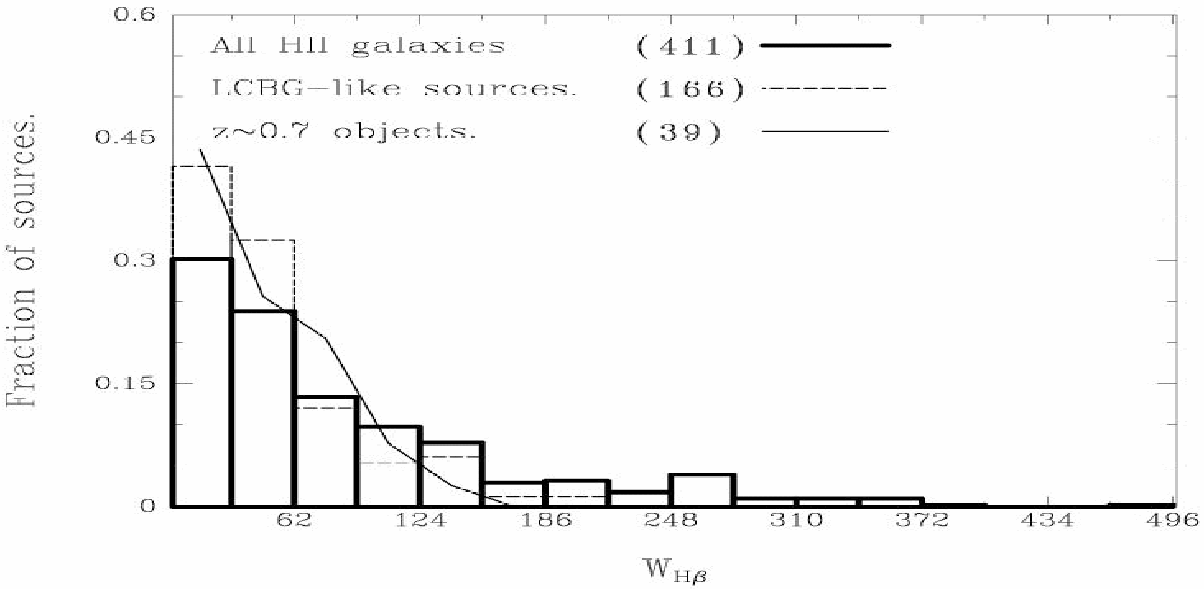


Discussion 3.

Evolution of the Wβ distribution.

Using again the results from the local sample previously presented, the DGSS survey results and the DEIMOS/DEEP2 objects with the 4363 line the distribution of Wβ is drawn. The W_ distribution of the high-z sample seems to be more similar to the LCBG-like subsample. Again, the evolution is very small. On average, the DEIMOS/DEEP2 sample presents a higher Hb equivalent width. This is observed in local HII galaxies too, where objects showing [OIII]λ 4363 show higher Hb equivalent widths.





Discussion 4.

Search for high-luminosity eXtremely Metal Poor Galaxies (XMPGs).

The oxygen abundances we have found are not uncommon in the local universe. The DEIMOS/DEEP2 objects with [OIII]λ4363 lie in the high-luminosity end of the luminosity distribution of local systems with similar oxygen abundances.M_B for local dwarf and compact systems with 12+log(O/H) ranges from -13.0 to -21.0.

We can make a *snr* analysis. In the case of average spectra (snr_γ around 10) you can only get to 12+log(O/H)=7.7 (the lowest oxygen abundance we have found) at Te=16000K. Lower metallicities require higher electron temperatures to be detected. With spectra of this quality, 12+log(O/H)=7.4 could be detected, provided a Te greater than 20000K.
With very high *snr* spectra you could see 12+log(O/H)=7.2 at Te=17000K. Still within reach for local XMPGs. **A very bright (M_B =-22) nearby (z=0.55) XMPG could, in principle, be detected with the DEIMOS/DEEP2 survey.**
These calculations have been carried out assuming that most of the oxygen is doubly ionized. This approximation is reasonable in the framework of our objects.

Local XMPGs show luminosities three magnitudes fainter than the sources we have found. No objects with properties similar to local XMPGs can be found in the DEIMOS/DEEP2 survey.
BUT WE ARE STILL SEARCHING FOR **HIGH** LUMINOSITY XMPGS...

Summary.

_The oxygen abundance distribution of compact, emission line galaxies has not changed to a great extent in the last 6Gyr. The same can be said for the distribution of Wβ.

_The search for high-luminosity (M_B~-20) XMPGs in the distant universe is still going on. The DEIMOS/DEEP2 survey can not find XMPGs of luminosities similar to local XMPGs. However, if there is an XMPG of M_B of around -21 it should be detected.

References.

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The K-correction and the conversion between AB system magnitudes and Johnson magnitudes was kindly done by Christopher N.A. Willmer.

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