ELEMENTAL ABUNDANCES ON GALAXIES HOSTING TYPE Ia SNe

Manuel E. Moreno Raya[1], Mercedes Mollá[1], Ángel R. López-Sánchez[2,3], Lluis Galbany[4], Aurelio Carnero[5], José Manuel Vílchez[6], Inmaculada Domínguez[7]

[1]CIEMAT, Madrid, Spain [2]Australian Astronomical Observatory, Sydney, Australia [3]MacQuarie University, Australia
[4]Departamento de Astronomía, Universidad de Chile, Santiago, Chile [5]Observatório Nacional, Rio, Brazil,
[6]Instituto de Astrofísica de Andalucía-CSIC, Granada, Spain [7]Universidad de Granada, Spain

The metallicity of the progenitor system producing a type Ia Supernova could play an important role in the estimate of the maximum luminosity of the explosion. This dependence should change the usual calibration between the light curve parameters of SN Ia and its absolute magnitude. To test this idea, we analyse the spectra from SLOAN/SDSS galaxies hosting SNe Ia, determine the emission line intensities and estimate the oxygen abundances by using well-known empirical calibrations. The final aim is to study if these abundances might have a role in the determination of the absolute magnitude of SNe Ia and in the Hubble diagram, helping to reduce the dispersion and the systematic errors, by using the metallicity dependent theoretical calibration by Bravo+2010.

1. Introduction

Supernova cosmology is based on the well-known Hubble diagram, which represents the distance of objects as a function of their redshift. The redshift is determined with high accuracy from SNe Ia spectra, and distances are given by the distance modulus $\mu = m - M$ because SN Ia absolute magnitude M can be established as they are supposed to be **STANDARD–CALIBRATED CANDLES.**

There is a theoretically predicted dependence of the SN maximum luminosity on the metallicity of the progenitor white dwarf (WD), and light curve can be used to calculate distances.

By assuming the WD mass constant, the maximum magnitude depends on the total quantity of the iron group, mainly ^{56}Ni: $L = 2x10^{43} M(^{56}Ni)$ erg s^{-1}.

The ^{56}Ni depends on the burning densities and on the neutron excess, which depends on ^{22}Ne and ^{56}Fe. ^{22}Ne depends in turn on the CNO abundance. The maximum magnitude depends on the WD abundance of C, N, O anf Fe, so we study the initial metallicity of the progenitor by analysing host galaxies spectra to see how absolute magnitudes modify.

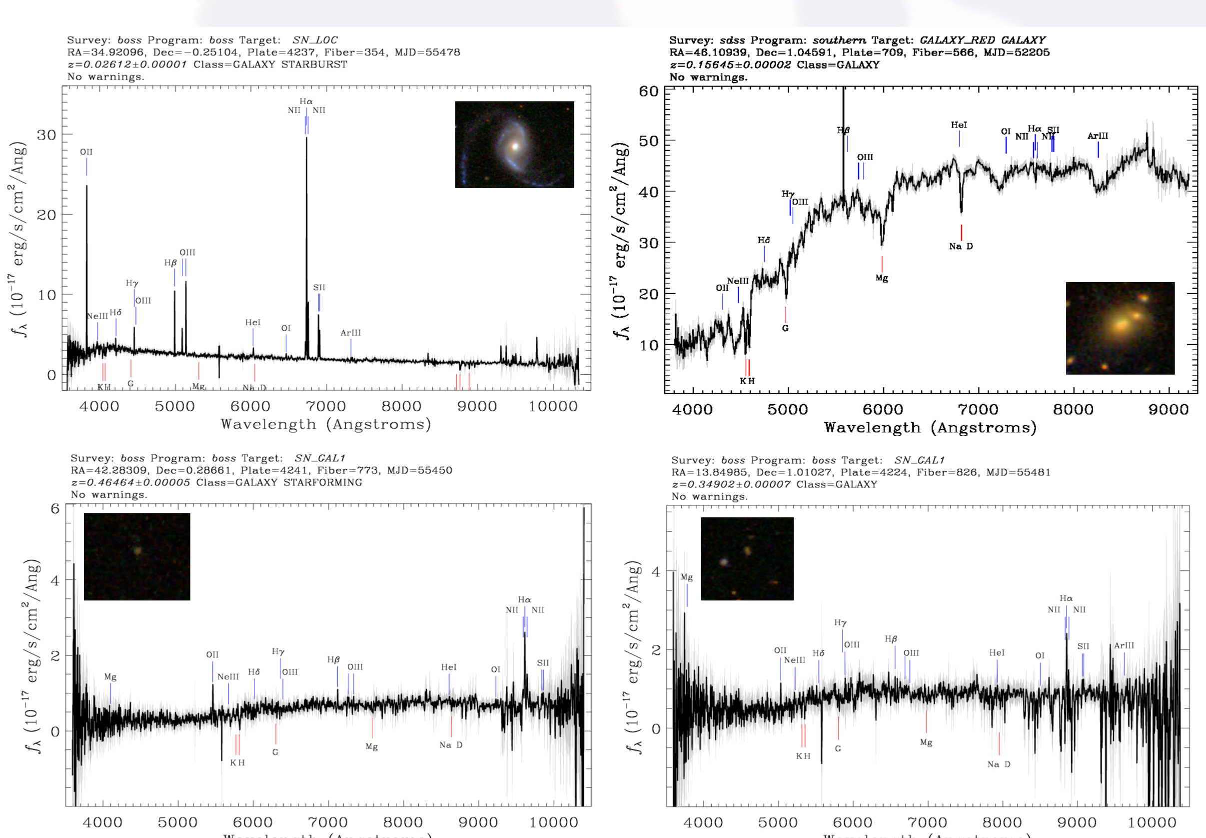
$$\Delta M_V(Z) = -2.5\log[1 - 0.075(Z/Z_{sun})] - 0.0846 \text{ mag} \quad (1)$$

$$\Delta M_V(Z) = -2.5\log[1 - 0.018(Z/Z_{sun})(1 - 0.010(Z/Z_{sun}))] - 0.191 \text{ mag} \quad (2)$$

Bravo+2010 give us these metallicity-dependent curves so we estimate the oxygen abundance for each host galaxy of the selected sample.

2. Data

We have taken a galaxy sample from SDSS–II Supernova Survey. These data have been observed with the 2.5m telescope located at Apache Point Observatory in Sunspot, New Mexico, between 2005 and 2007. Their redshifts go from 0.05 to 0.45 approximately. From a total of ~1500 SN Ia (more than 500 spectroscopically confirmed and more than 700 photometrically determined with host galaxy z_{spec}). 724 have host galaxy spectra in DR9 and good light curve fit. The final sample is made up of 359 valid spectra.



Elliptical spectra (up right) do not have emission lines. High noise spectra (down right) do not allow us to get any useful info. A good example of a spiral spectrum (up left), with all the emission lines perfectly measured. The higher redshift the galaxy is (down left), the more noise the spectrum has.

3. Analysis

We used **IRAF** to measure all the main emission lines from each spectrum, one by one manually.

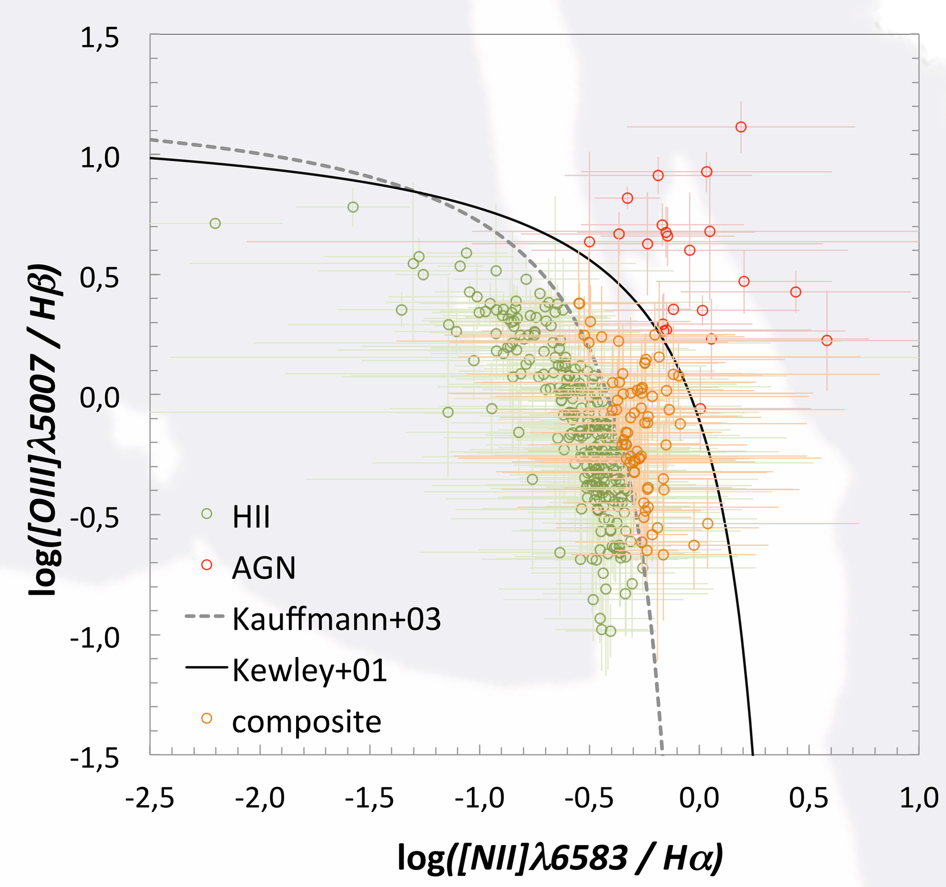
We apply diagnostic diagram (BPT) to eliminate AGN contributions, since we are only interested in HII regions.

We applied empirical calibrations, which are based in part on photoionization models and partially on the observational trends of abundances with intensities. The most common indicators are *N2* and *O3N2* parameters:

$$N2 = \log\frac{I([NII])4583\lambda}{H\alpha} \qquad O3N2 = \log\frac{[OIII]5007\lambda/H\beta}{[NII]4863\lambda/H\alpha}$$

which are used in calibrations proposed by Pettini & Pagel (2004) (Eqs. 3 and 4). We are not able to use the direct method since there are no auroral lines in the spectra and T_e cannot be determined.

4. Results



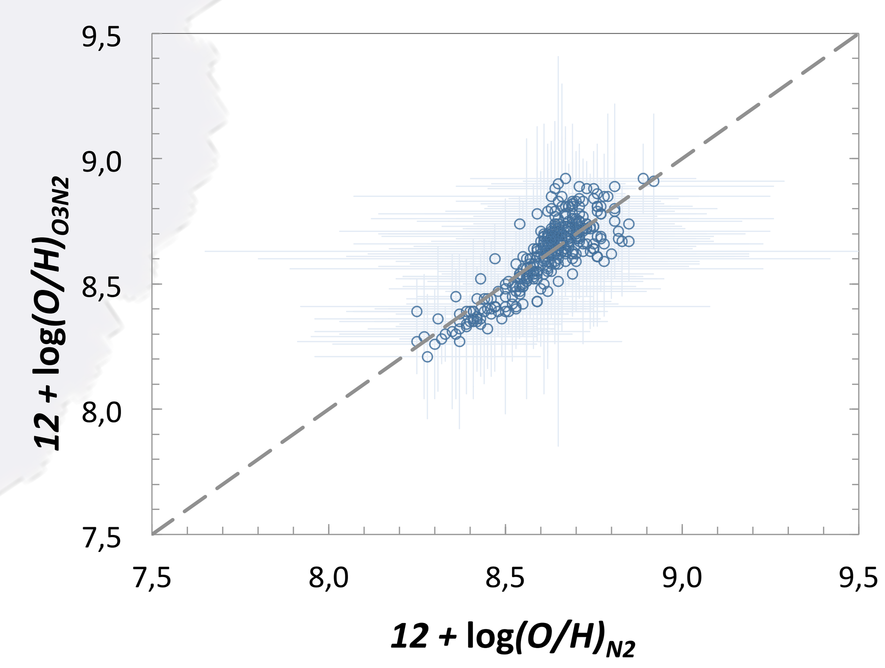
HII	Composite	AGN
268	66	22

Once we have applied the dianostic diagram we proceed to calculate the oxygen abundance

$$12 + \log(O/H)_{N2} = 8.90 + 0.57N2 \quad (3)$$

$$12 + \log(O/H)_{O3N2} = 8.73 - 0.32O3N2 \quad (4)$$

In order to check if both calibrations are consistent we plot one calibration as a function of the other one to see how they respond.

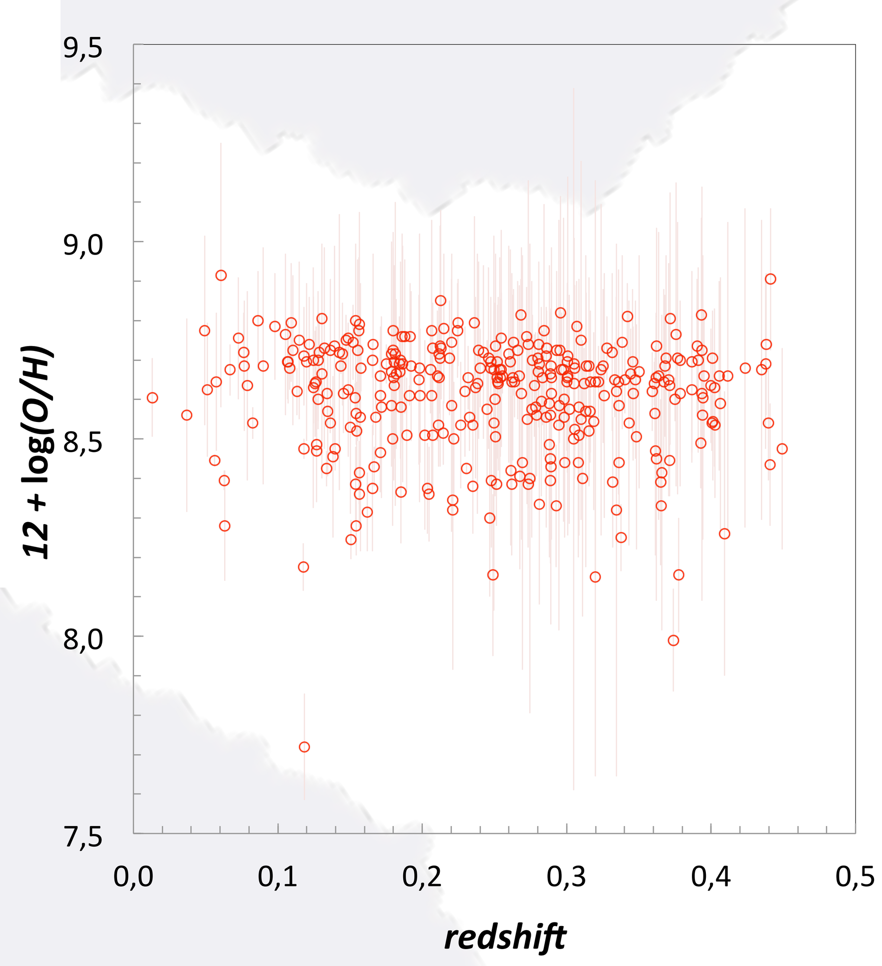


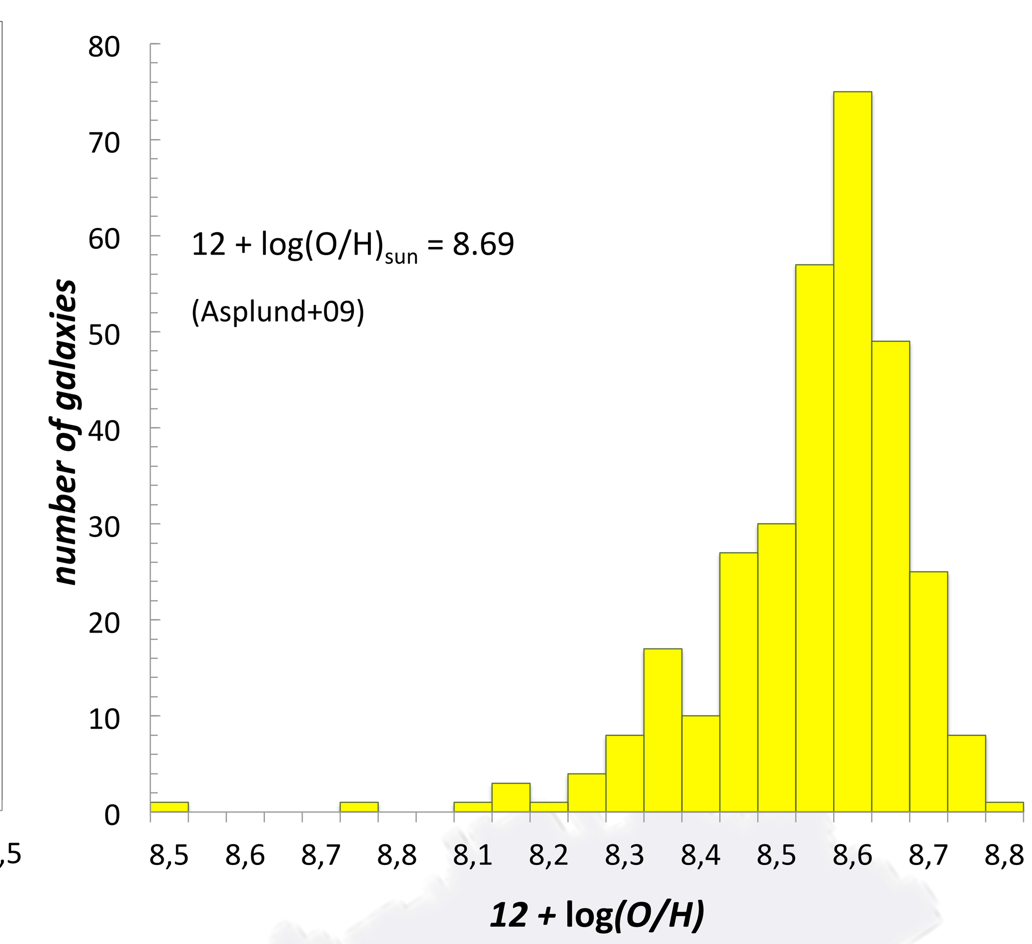
We observe that both methods are consistent and the values we obtain are acceptables.

The metallicity distribution has a peak around the solar metallicity.

There is no clear distribution in redshift, but it looks the higher the redshift is, the fewer low-metallic galaxies we are able to observe.

Furthermore, this can be an observational bias.

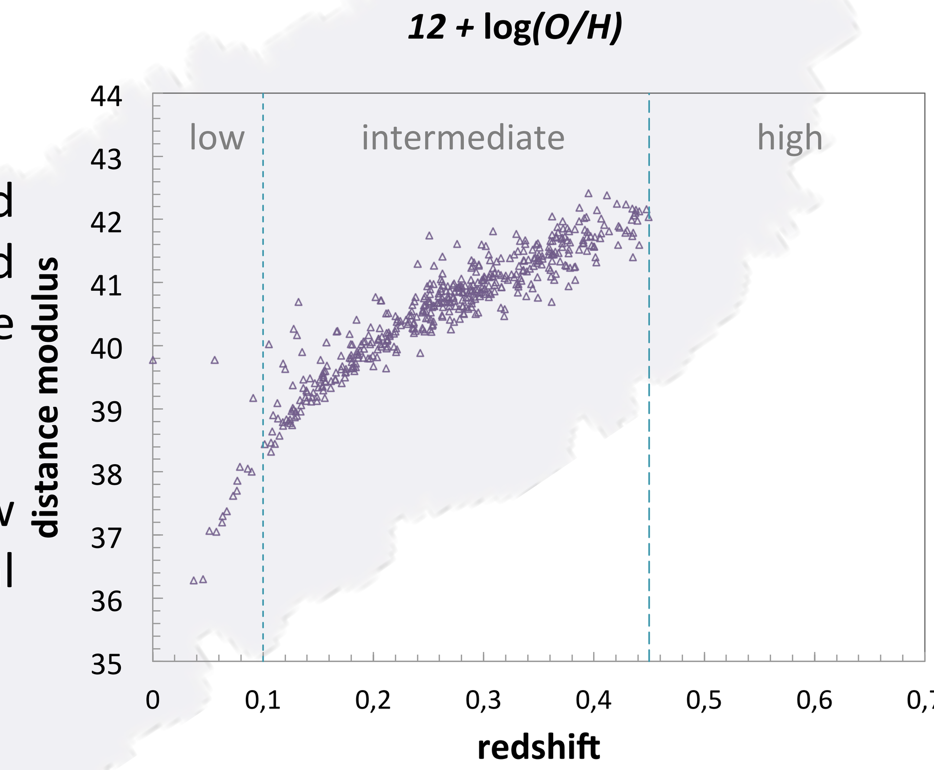




5. Further work

Apply these metallicity values to Eqs. 3 and 4 to get corrected magnitude values and see if there is a significant change in the Hubble diagram.

Complete the sample with objects at low and high redshift to get the cosmological parameters Ω_Λ and H_0.



e-mail contact:
manuelemilio.moreno@ciemat.es