ELEMENTAL ABUNDANCES ON GALAXIES HOSTING TYPE Ia SNe

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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
\[
M = m - M = \log(d_L) + 5 \log(z) - 5
\]
This modulus provides the SN Ia absolute magnitude \( M \) can be established as they are supposed to be STANDARD-CALIBRATED CANDELS.

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 iron group, mainly on Ni. \( M = 2z10^5\alpha \) \( \alpha \) erg s⁻¹.
The \( \alpha \) is the burning density and on the neutron excess, which depends on the mass of its progenitor.

The maximum magnitude depends on the WD abundance of C, N, O and Fe, so we study the initial metallicity of the progenitor by analysing host galaxies spectra to see how absolute magnitudes modify.

\[
\Delta M(J) = -2.5 \log(1 + 0.075J/Z_{\text{sun}}) \approx 0.0846 \text{ mag}
\]

\[
\Delta M(K) = -2.5 \log(1 - 0.018J/Z_{\text{sun}}) \approx 0.191 \text{ mag}
\]

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-I 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),

724 have host galaxy spectra in DR9 and good light curve fit. The final sample is made up of 359 valid spectra.

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 photonization models and partially on the observational trends of abundances with intensities. The most common indicators are N2 and O3N2 parameters:

\[
N_2 = \frac{\lambda (\text{N} II)}{\lambda (\text{S} II)}
\]

\[
O3N2 = \frac{\lambda (\text{O} III, 5007\AA)}{\lambda (\text{N} II, 6583\AA)}
\]

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 aural lines in the spectra and T_e cannot be determined.

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

\[12 + \log(O/H)_{\odot} = 8.90 \pm 0.57 \text{N2} \tag{3}\]

\[12 + \log(O/H)_{\odot} = 8.73 \pm 0.32 \text{O3N2} \tag{4}\]

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 acceptable.

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 \( \Omega_m \) and \( H_0 \).

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