Metallicity estimates with SDSS-DR6

M.A. Lara-López[1], J. Cepa[1,2], A. Bongiovanni[1], H. Castañeda[1], A.M. Pérez García[1], M. Fernández Lorenzo[1], M. Póvic[1], M. Sánchez-Portal[3]

Abstract We present a study of the metallicity of 20268 galaxies from the Sloan Digital Sky Survey - Data Release 6 (SDSS-DR6) using the R_{23} method, and derive analytical calibrations from several metallicity-sensitive line ratios: [N II] λ6583/Hα, [O III] λ5007/[N II] λ6583, [N II] λ6583/[O II] λ3727, [N II] λ6583/[S II] $\lambda\lambda$6717, 6731, [S II] $\lambda\lambda$6717, 6731/Hα, and [O III] $\lambda\lambda$4959, 5007/Hβ. We have performed the study for the resdshift interval (0.04-0.1) for all the Sloan survey release. This is the first part of a more complete work which aims to study the metallicity dependances of the star-forming galaxies in the Local Unvierse.

1 Sample selection

The data analyzed in this study are drawn from the SDSS-DR6. We select the sample galaxies in the redshift interval z=(0.04-0.1). A redshift z $>$ 0.04 ensures a covering fraction $>$ 20% of the galaxy light into the 3 arcsec of the SDSS optical fiber, according to Kewley et al. (2005). From this, we have selected a sample of star-forming galaxies using diagnostic diagram criteria given by Kauffmann et al. (2003). Petrosian r magnitudes of the sources are in the range $14.5 < r < 17.8$ mag, leaving 20268 galaxies, as show in the Figure 1.

[1]Instituto de Astrofísica de Canarias, 38200 La Laguna, Spain, e-mail: mall@iac.es,
[2]Departamento de Astrofísica, Universidad de La Laguna, 38205 La Laguna, Spain,
[7]Herschel Science Centre, ESAC/INSA, Madrid, Spain.

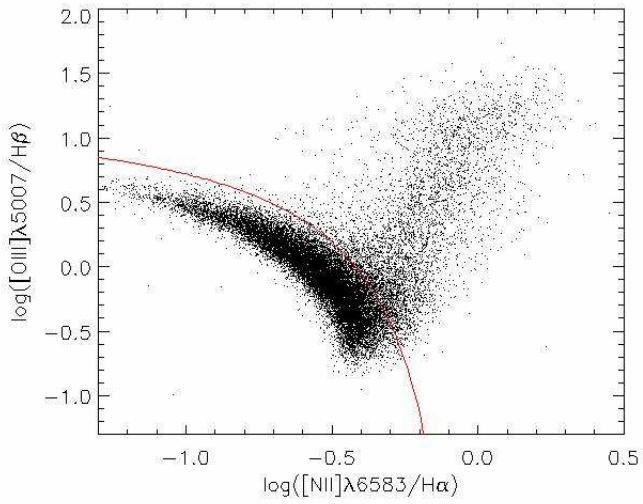

Fig. 1 the [O III] λ5007/Hβ vs.[N II] λ6583/Hα diagnostic diagram for SDSS galaxies. Solid line represents the Kauffmann limit for starburst galaxies.

2 Underlying absorption and dust extinction correction

The emission–line fluxes were corrected by dust extinction and underlying absorption by an iterative method. First, we estimate the absorption equivalent width of Balmer emission lines according to McCall et al. (1985)

$$W_{abs} = \left[\frac{\mathrm{I(H}\alpha)}{\mathrm{I(H}\beta)}\frac{\mathrm{F(H}\beta)}{\mathrm{F(H}\alpha)} - 1\right]\mathrm{EW(H}\alpha), \quad (1)$$

where I(Hα)/I(Hβ) is 2.86 at 10000K (Osterbrock 1989), and F(Hα) and F(Hβ) are de Hα and Hβ line fluxes.

The extinction corrections of the galaxy sample were derived using the Balmer line ratio Hα/Hβ, assuming case B recombination.

$$\mathrm{C(H}\beta) = \frac{1}{f(\lambda)}\log\left[\frac{\mathrm{I(H}\alpha)}{\mathrm{I(H}\beta)} \Big/ \frac{\mathrm{F(H}\alpha)}{\mathrm{F(H}\beta)}\right],$$

where F(λ) correspond to the reddening curve, un this case, we use Cardelli et al (1989), with R_v=3.1

3 Corrected fluxes

Once we have obtained the reddening coefficient for each galaxy of our samples, we proceed to estimate the corrected fluxes using $F_{corr}(\lambda) = F(\lambda)10^{0.4}A_{\lambda}$, with:

$$A_{H\beta} = 2.5\, C(H\beta)$$
$$A_{[NII]\lambda 6583} = 1.747\, C(H\beta)$$
$$A_{H\alpha} = 1.758\, C(H\beta)$$
$$A_{[OIII]\lambda 5007} = 2.403\, C(H\beta)$$
$$A_{[OIII]\lambda 4959} = 2.433\, C(H\beta)$$
$$A_{[OII]\lambda 3727} = 3.303\, C(H\beta),$$

calculated from a prescription given by Cardelli et al. (1989)

4 Metallicity estimates

In order to obtain metallicities for our galaxy sample, we used the R_{23} method, introduced by Pagel et al. (1979), adopting the calibration given by Tremonti et al. (2004):

$$12+\log(O/H) = 9.185 - 0.313x - 0.264x^2 - 0.321x^3,$$

where $x = \log R_{23}$.

With this metallicity estimates, we have represented valid relationships using various secondaty indicators vs. $12+\log(O/H)_{R23}$, as shown in the Figure 2, from left to right and from up to down, N2 vs $12+\log(O/H)_{R23}$, O3N2 vs $12+\log(O/H)_{R23}$, and the [N II]/[O II], [N II]/[S II], [S II]/Hα, [O III]/Hβ indicators vs. $12+\log(O/H)_{R23}$, respectively.

These relations are in agreement with those obtained by Liang et al. (2006). Particularly, the[N II]/[O II] vs $12+\log(O/H)_{R23}$ relation gives the smallest scatter for the sample and it will help us to obtain promising calibrations in the work yet to come.

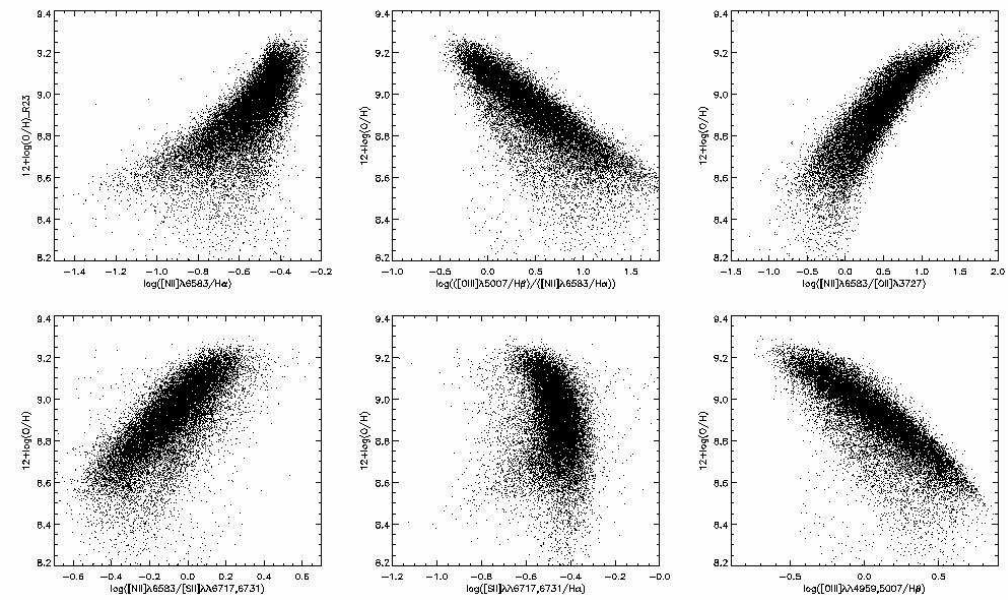

Fig. 2 Relations between 12+log(O/H)$_{R23}$ and several metallicity–sensitive strong–line ratios.

References

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