Galaxy Evolution across the Hubble Time
Proceedings IAU Symposium No. 235, 2006
F. Combes & J. Palouš, eds.

doi:10.1017/S1743921306006843

Methods to Calibrate Oxygen Abundances of Star-Forming Galaxies and the Recent Results from the Large Sample of SDSS Galaxies

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Abstract. Using a large sample of ∼40,000 star-forming galaxies selected from the SDSS, we derive oxygen abundance calibrations from strong-line ratios, such as [N II]/Hα, [O III]/[N II], [N II]/[O II], [N II]/[S II], [S II]/Hα, and [O III]/Hβ. The derived analytic calibrations cover a quite wide range of metallicity, from 12+log(O/H)= 7.1 to 9.3. These calibrations can be used as calibration references for the future studies about metallicities of star-forming galaxies.

Keywords. galaxies: abundances, evolution, ISM, spiral, starburst

The basic methods to estimate oxygen abundances of star-forming galaxies are the T_e-, R_{23}-, P-method, and some other strong emission-line ratios, including [N II]/Hα, [O III]/[N II], [N II]/[O II], [N II]/[S II], [S II]/Hα, and [O III]/Hβ. We select 37,478 metal-rich star-forming galaxies (with 12+log(O/H)>8.4) from the SDSS-DR2, 531 metal-poor galaxies from the SDSS-DR4 with their [O III]4363 detected at greater than 5σ, and 164 metal-poor galaxies and H II regions from literature with their T_e measurements. Analytical abundance calibrations of the linear least squares and/or 3(or 2)-order polynomial fits from the strong-line ratios of these samples are obtained, which can be used as calibration references in the future studies. The observed relations are consistent with the photoionization models of Kewley & Dopita (2002). Fig.1 shows the observed relations of the sample galaxies, the derived analytic calibrations, and the comparisons with models.

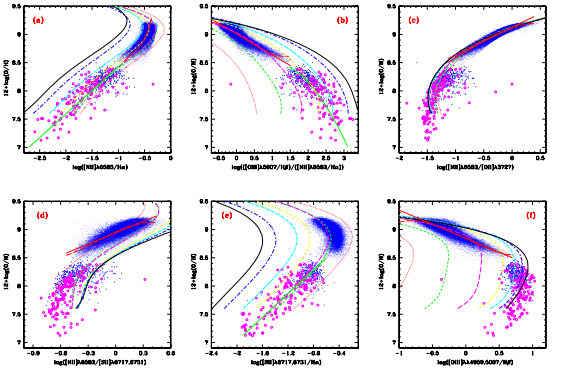

Figure 1. Analytic calibrations (linear least-squares and 3(or 2)-order polynomial fits) of strong-line ratios for oxygen abundances from the large sample of SDSS galaxies (the blue points; the circles are from literature). The seven model lines are taken from Kewley & Dopita (2002, ApJS, 142, 35). See Liang *et al.* (2006, ApJ, astro-ph/0607074) and Yin *et al.* (2006,A&A, submitted) for more details.