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A SULPHUR ABUNDANCE GRADIENT IN NGC 300

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1. A sulphur abundance indicator

Inspired by the success of the empirical method of oxygen abundance determination through the well-known line ratio R_{23} a similar method for sulphur abundance determination is proposed. Since these elements are isoelectronic, an expression corresponding to R_{23} can be made for sulphur, simply by replacing each oxygen line by the corresponding sulphur line. We define:

$$S_{23} \equiv ([S\ II] \lambda\lambda 6716, 6731 + [S\ III] \lambda\lambda 9069, 9531)/H_{\beta}. \quad (1)$$

As two of the sulphur lines are in the far-red part of the spectrum, these have only in the recent years become available, as detector sensibility in this spectral range has been improved. A calibration of S_{23} against sulphur abundance should now enable sulphur abundance determinations in H II regions where the weak temperature sensitive line $[S\ III] \lambda 6312$ is undetectable. A search through literature for the data available for such a calibration has been made. The resulting plot is shown in Fig. 1. It seems likely that only very metal rich H II regions will be on the high metallicity branch exclusively outlined by the data from M51. Thus, a first order weighted fit for the remaining points is adopted: $12 + \log(S/H) = 6.485 + 1.218 \log(S_{23})$.

2. Observations

NGC 300 is a large, nearby (1.2 Mpc) Scd galaxy with many prominent H II regions (Deharveng et al., 1988). For the studies of sulphur abundance variations across the galactic disk, spectra of several regions with good radial coverage must be obtained in the far-red spectral ranges. To increase the number of regions observed simultaneously from what can be achieved with conventional long-slit spectroscopy a procedure to exploit the

multi object spectroscopy facility on the DFOSC instrument at the Danish 1.5m-telescope, ESO has been developed. Utilizing specially designed multiaperture plates this allows spectra of 5–10 objects over a wide field to be obtained in one exposure. For a further discussion of the feasibility of such aperture plates in abundance studies see Ryder (1995). The aperture plates are manufactured on site with a milling machine on the basis of H_{α} -exposures from the same instrument.

Two different aperture plates were used both having 8 non-overlapping slitlets with widths of $\simeq 2''.5$ and lengths between $30''$ and $60''$. This is generally sufficient for a good sampling of the sky background, which is especially important in the near-IR range where emission from atmospheric OH-lines rises strongly. With exposure times of 3000–7000 s the advantage over long-slit spectroscopy is obvious.

Figure 1. Left, the calibration of S_{23} vs. $\log(S/H)$. Right, radial variation of sulphur abundance in NGC 300

3. Results

The parameter S_{23} is calculated according to Eq. (1) for each region and plotted versus the fractional isophotal radii, ρ/ρ_0 from Deharveng et al. (1988) in Fig. 1. The uncertainty calculation for S_{23} has taking into account the uncertainty of the extinction and the estimated uncertainties of the line fluxes. A gradient in S_{23} is evident, which is converted to a sulphur abundance of: $12 + \log(S/H) = 6.97 \pm 0.14 - (1.25 \pm 0.39) \rho/\rho_0$. Furthermore we find by employing R_{23} an oxygen gradient of -0.63 ± 0.13 dex/ ρ_0 close to the value derived by Deharveng et al. (1988). For further details on the data reduction and derived results we refer to Christensen et al. (1996).

References

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