O^{++} Relative Abundance in IC 418 from Permitted Lines

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Two multisite campaigns devoted to HD 35914, the variable central star of IC 418, have been performed (Handler *et al.*, 1996). In the second one, many spectra of the star were obtained during five nights on November 1994. The Echelle REOSC spectrograph and a 1024 × 1024 Tektronix CCD detector, attached to the 2.1m telescope at the Observatorio Astronómico Nacional in San Pedro Mártir, México, was used then. The north-south diameter of the nebula was included in the 20 spectra taken the night of November 18 (184–minute total exposure). The spectral coverage and reciprocal resolution was 4300 Å to 7350 Å and about 0.16Å/pix, respectively. The projected slit size was $1'' \times 26''$, approximately.

We extracted and coadded 8 pixels at either side of the central star. This included most of the nebular diameter, except for the central third part. The resulting twenty 2D spectra were flux calibrated with the standard star η Hya and averaged. The [OIII] (4363, 4959, 5007) and OII (4642, 4649 of multiplet 1, in LS coupling) lines, as well as all the HeI and HI lines in the observed spectral range, were measured with Gaussian fitting routines. The HeI and HI lines were used to compute the reddening correction applied to the observed $log[(F(\lambda/F(H\beta)]$ relative fluxes. This way we obtained values of $log[(I(\lambda/I(H\beta)]$ of -2.15, -.037 and +0.09 for the [OIII] lines, and -3.54 and -3.31 for those of [OII], respectively. The error is 0.05 dex for lines 3000 times weaker than $H\beta$ in our composite spectrum. Lines as weak a as $10^{-4}F(H\beta)$ can be detected in most of the observed spectral range.

From the above data we determined the following O^{++} relative abundances:
$log\ [N(O^{++})/N(H^{+})] = -4.04$, from the [OIII] lines and
$log\ [N(O^{++})/N(H^{+})] = -3.95 \pm 0.05$, from those of OII.
The discrepancy, though small, can by attributed to temperature fluctuations in the nebula. The corresponding RMS parameter needed to reconcile both relative O^{++} abundances is $t^2 = 0.018 \pm 0.01$. Indeed the temperature fluctuations in IC 418 must be very small and practically inexistent. This result is consistent with the low ionization degree in IC 418, and with its lack of observable shock fronts or clumps (e.g. Ballick 1987).

REFERENCES

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