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# The Compact HII Regions N11A and N88A in the LMC and SMC

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**Abstract.** Several spectra have been obtained in the 3600–10000 Å range, for the HII regions N11A and N88A in the LMC and SMC, respectively. The spectral type of their exciting star was determined and from the emission-line intensities we have derived the gas electron density and temperature, and computed the chemical abundances of He, O, N, Ne, S, and Ar. These abundances are then compared with the ones found for other HII regions in the Magellanic Clouds.

## 1. Introduction and Observations

The compact HII regions N88A and N11A, with $\mathrm{FWHM}_{H\beta} \sim 2''\!.4$ and $5''$ respectively (Heydari & Testor 1985; Kurt et al. 1995), are extremely bright and their emission line strengths enable accurate derivation of their physical conditions. A series of long- and short-exposure long-slit visible and near infrared spectra with a resolution of 1.3 - 6.4 Å were obtained during several runs at the ESO 1.5-m telescope. We determined the spectral types of the stars by comparing our spectra with those of the standards in Walborn & Fitzpatrick's atlas (1990). The nebular and stellar profiles of the HeI$\lambda$4471 line can be distinguished in our highest-resolution spectra. Physical parameters of the nebulae were determined with a five-level atom code, using the latest atomic data. The emission-line intensities were corrected for reddening using the Seaton law (Seaton, 1979). Three electron temperatures $T_e$, associated with different ionization regions in the nebulae, were computed from the line ratios [OIII] $\lambda\lambda$4363/4959+5007 ($T_e^{O3}$), [NII] $\lambda\lambda$5755/6548+6584 ($T_e^{N2}$) and [OII] $\lambda\lambda$3727/7319+7330 ($T_e^{O2}$). The electron density $n_e$ was computed from the [SII]$\lambda\lambda$6717/6731 intensity ratio. Due to a low S/N in the [NII]$\lambda$5755 line, only $T_e^{O3}$ and $T_e^{O2}$ were used to calculate the corresponding emissivities.

## 2. Results

From the Lyman continuum flux ($N_{Lyc}$), N88A and N11A should be excited by an O5 and an O6 star, respectively (Wilcots 1994; Heydari & Testor 1985). However, a single source and multiple ionizing sources cannot be distinguished with the $N_{Lyc}$ alone. From the averaged spectra we clearly see the HeII $\lambda$4541 and strong HeII $\lambda$4686 absorption lines, indicating that each nebula is ionized by a central and single star of spectral type earlier than an O5 V for N88A and O6 V for N11A. The mean $T_e$ determined from the three line ratios (see above) are

- for N11A, $T_e^{O2} = 12350$ K, $T_e^{O3} = 9210$ K, $T_e^{N2} = 11075$ K
- for N88A, $T_e^{O2} = 15570$ K, $T_e^{O3} = 13450$ K, $T_e^{N2} = 15960$ K.

The mean $n_e$, derived for N11A is 370 cm$^{-3}$ and 1110 cm$^{-3}$ for N88A. The comparison with averaged abundances derived from other regions of the SMC and LMC shows slight variations but they are generally within the errors (Table 1). However, N88A presents a systematic slight O enrichment of the gas. A more detailed analysis of these objects will be submitted soon to MNRAS.

Table 1. Element abundances in N11A and N88A in the form (12+log[N(X)/N(H)]), derived from 2″ and 4″ slit width spectra.

| Name | O | N | Ne | Ar | S | He | C(H$\beta$) | slit ″ |
|---|---|---|---|---|---|---|---|---|
| N11A-91 | 8.40 | 7.24 | 7.52 | 6.41 | 5.81 | 10.94 | 0.24 | 2 |
| N11A-97 | 8.44 | 7.19 | 7.52 | 6.29 | 6.81 | 10.93 | 0.19 | 4 |
| LMC$^R$ | 8.35± 0.06 | 7.14± 0.18 | 7.61± 0.05 | 6.29± 0.25 | | 10.95 | | |
| LMC$^D$ | 8.43± 0.08 | 6.97± 0.10 | 7.64± 0.10 | 6.20± 0.06 | | 10.92 | | |
| N88A-91a | 8.11 | 6.75 | 7.27 | 5.92 | 5.32 | 10.93 | 0.34 | 2 |
| N88A-91b | 8.12 | | 7.23 | 5.81 | 5.31 | 10.91 | 0.56 | 2 |
| N88A-91c | 8.10 | 6.50 | 7.23 | 5.77 | 5.27 | 10.92 | 0.62 | 2 |
| N88A-97 | 8.08 | 6.67 | 7.22 | 5.84 | 6.17 | 10.92 | 0.28 | 4 |
| SMC$^R$ | 8.03± 0.10 | 6.63± 0.20 | 7.27± 0.20 | 5.81±0.08 | | 10.91 | | |
| SMC$^D$ | 8.02± 0.08 | 6.46± 0.12 | 7.22± 0.12 | 5.78±0.12 | | 10.92 | | |
| N88A$^G$ | 8.09± 0.04 | 6.60± 0.34 | | | | | | |

$^D$ Dufour et al. (1982), $^G$ Garnett et al. (1995), $^R$ Russell et al. (1990)

## References

Dufour, R.J., Shields, G.A., & Talbot, R.J. 1982, ApJ, 339, 872

Garnett, D., Skillman, E., Dufour, R., Peimbert, M., Torres-Peimbert, S., Terlevich, R., Terlevich, E., & Shields, G. 1995, ApJ, 443, 43

Heydari-Malayeri, M., & Testor, G. 1985, A&A, 144, 98

Kurt, C., Dufour, R., Garnett, D., Skillman, E., Mathis, J., Peimbert, M., & Torres-Peimbert, S. 1995, Rev.Mex.AA 3, 223

Russell, S.D., & Dopita, M.A. 1990, ApJS, 74, 93

Seaton, M. J. 1979, MNRAS, 73P

Testor, G., & Pakull, M. 1985, A&A, 145, 170

Walborn, N., & Fitzpatrick, E. 1990, PASP, 102, 379

Wilcots, E.M. 1994, AJ, 107, 1338

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