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CHEMICAL COMPOSITION OF THE H II REGION HUBBLE V IN NGC 6822 BASED ON VLT SPECTROSCOPY

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We have derived the chemical composition of the H II region Hubble V and compare it with those of NGC 346 in the SMC, 30 Doradus in the LMC, the Orion nebula, and the Sun.

A summary of our observational work on Hubble V is presented here, and a full account of it is presented elsewhere (Peimbert, Peimbert, & Ruiz 2005).

We have obtained the chemical composition of Hubble V in NGC 6822. This chemical composition is compared with those of other H II regions and the Sun in Table 1. We have included the following improvements over previous determinations: the consideration of the temperature structure that affects the helium and heavy elements abundance determinations, the derivation of the O and C abundances from recombination line intensities, and the determination of the helium abundance based on a large number of singlet and triplet lines of He I.

We are interested in three applications based on the abundance determinations: the determination of t^2, the comparison of the nebular abundances derived by us with the stellar abundances of supergiant stars in NGC 6822 derived elsewhere (Muschielok et al. 1999; Venn et al. 1999, 2001, 2002, 2004) and to provide accurate abundances for galactic chemical evolution models of this object (Carigi, Colín, Peimbert 2005a).

NGC 6822 is an irregular galaxy member of the local group particularly suited for chemical evolution models because its star formation history is well known (Wyder 2001), and apparently has not been affected by outflows produced by tidal effects. Therefore its chemical composition permits us to study the importance of outflows to the intergalactic medium due to star forming activities.

We derive for the first time the C/H and O/H abundances of NGC 6822 based on recombination lines.

The O/H ratio is 0.26 dex higher from recombination lines than that derived from the [O III] $\lambda\lambda$ 4363, 5007 lines and under the assumption that $t^2 = 0.00$.

There are two independent methods to determine the O/H ratio in the ISM of the solar vicinity: a) from the solar ratio by Asplund et al. (2005), that amounts to $12 + \log(\mathrm{O/H}) = 8.66$, and taking into account the increase of the O/H ratio due to galactic chemical evolution since the Sun was formed, that according to state of the art chemical evolution models of the Galaxy amounts to 0.13 dex (e.g. Carigi et al. 2005b), we obtain an O/H value of 8.79 dex; and b) the H II regions O/H value for the solar vicinity by Esteban et al. (2005) based on the O/H galactic gradient determined from O II recombination lines, that amounts to 8.77 dex, in excellent agreement with the value based on the solar abundance.

We have found that in NGC 6822 the O/H abundance ratio derived from O II recombination lines is in very good agreement with the O/H ratios derived from A type supergiants, while the O/H ratios derived from collisionally excited lines (assuming $t^2 = 0.00$) are not.

The high N/O ratio places NGC 6822 on the plateau formed by irregular galaxies in the N/O-O/H diagram, which implies that a large fraction of the N present in this object is already due to secondary production. From the O/H, C/O, and N/O values it follows that NGC 6822 is considerably more chemically evolved than the SMC. Chemical evolution models for NGC 6822 are presented elsewhere (Carigi et al. 2005a).

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TABLE 1

NGC 6822 V, NGC 346, 30 DORADUS, ORION, AND SOLAR TOTAL ABUNDANCES[a]

Element	NGC 6822 V[b]	NGC 346[c]	30 Doradus[d]	Orion[e]	Sun[f]
12 + log He/H	10.909 ± 0.011	10.900 ± 0.003	10.928 ± 0.003	10.988 ± 0.003	10.98 ± 0.02
12 + log O/H	8.42 ± 0.06	8.15 ± 0.06	8.59 ± 0.05	8.73 ± 0.03	8.66 ± 0.05
log C/O	-0.31 ± 0.13	-0.87 ± 0.08	-0.45 ± 0.05	-0.21 ± 0.04	-0.27 ± 0.10
log N/O	-1.37 ± 0.17	-1.34 ± 0.15	-1.24 ± 0.08	-1.00 ± 0.10	-0.88 ± 0.12
log Ne/O	-0.79 ± 0.09	-0.83 ± 0.06	-0.76 ± 0.06	-0.68 ± 0.08	-0.82 ± 0.09
log S/O	-1.62 ± 0.09	-1.59 ± 0.12	-1.60 ± 0.10	-1.51 ± 0.05	-1.52 ± 0.08
log Cl/O	-3.71 ± 0.10	...	-3.67 ± 0.12	-3.40 ± 0.05	-3.43 ± 0.06
log Ar/O	-2.36 ± 0.08	-2.33 ± 0.10	-2.33 ± 0.10	-2.11 ± 0.06	-2.48 ± 0.08
log Fe/O	-1.41 ± 0.10	-1.41 ± 0.10	...	-1.23 ± 0.20	-1.21 ± 0.06

[a]Gaseous abundances for the H II regions. The O and C abundances have been corrected for the fractions of these elements trapped in dust grains, see text.

[b]Gaseous abundances, values for $t^2 = 0.076 \pm 0.018$, obtained by us, with the exception of the Fe/O value that comes from stellar data (Venn et al. 2001).

[c]Dufour, Shields, & Talbot (1982); Peimbert et al. (2000); Relaño, Peimbert, & Beckman (2002); Peimbert, Peimbert, & Luridiana (2002), values for $t^2 = 0.022$. The Fe/O value comes from stellar data (Venn 1999; Rolleston et al. 2003; Hunter et al. 2005).

[d]Peimbert (2003), values for $t^2 = 0.033$.

[e]Cunha & Lambert (1994); Esteban et al. (2004), values for $t^2 = 0.024$. The O and C abundances have been increased by 0.08 dex and 0.10 dex respectively to take into account the fractions of these elements trapped in dust grains. The Cl abundance has been decreased by 0.13 dex due to an error of +1.00 dex in the determination of the Cl^+/H^+ ratio.

[f]Christensen-Dalsgaard (1998); Asplund et al. (2005).

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