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Chemical abundances of the H II regions NGC 5461 and NGC 5471 in M 101, derived from echelle spectrophotometry

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Abstract. We present high resolution spectroscopic data of the two giant extragalactic H II regions NGC 5461 and NGC 5471 in M 101. We calculate the physical conditions in the two nebulae with a large number of diagnostics, and determine their chemical abundances by applying ionization correction factors (ICFs) to the observed ionic abundances. The comparison of the ICFs based on photo-ionization models (Luridiana & Peimbert 2001; Luridiana *et al.* 1999) to those computed following the prescriptions by Mathis & Rosa (1991) shows large discrepancies for several elements, including nitrogen, neon and chlorine.

1. Introduction

NGC 5461 and NGC 5471 are two giant extragalactic H II regions, located in the spiral galaxy M 101 (NGC 5457). Here, we present results obtained with high-resolution spectroscopic data of both H II regions covering a wide spectral range, from near-ultraviolet to near-infrared. The observations were carried out with the 2.1m telescope of the Observatorio Astronómico Nacional in San Pedro Mártir, Baja California, Mexico, in June 1996.

2. Results and discussion

Table 1 lists our results for the physical conditions of the two nebulae, comparing to those by Torres-Peimbert *et al.* (1989). The derived chemical abundances are listed in Table 1. In both regions, the densities obtained from the forbidden lines are considerably higher than the rms densities, implying strong density fluctuations with typical values of 0.01 for the filling factor. In NGC 5471

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Table 1. Physical conditions and chemical abundances in NGC 5461 and NGC 5471

quantity	NGC 5461		NGC 5471	
T_e(O II)	10400±500	9500 ±900	14200 ±900	13100 ±2000
T_e(S II)	8000 ±1600	9500 ±1100	10000 ±3200	12700 ±2400
T_e(N II)	8700 ±700	8500 ±550	10800 ±2300	10800 ±1700
T_e(O III)	8500 ±500	9300 ±250	13000 ±500	13400 ±250
T_e(S III)	9000 ±800	—	12100 ±800	—
n_e(O II)	150 ±60	—	90 ±70	—
n_e(S II)	130 ±90	234	70^{+100}_{-70}	186
n_e(Ar IV)	—	—	1350^{+1150}_{-920}	—
n_e(rms)	14.2	14.8	10.4	10.6
Y	0.285 ±0.011	0.264 ±0.007	0.257 ±0.010	0.241 ±0.007
12 + log O/H	8.52 ±0.10	8.39 ±0.08	8.10 ±0.08	8.05 ±0.05
log N/O	−0.64 ±0.12	−1.13 ±0.06	−1.23 ±0.10	−1.33 ±0.06
log Ne/O	−0.44 ±0.12	−0.68 ±0.06	−0.73 ±0.10	−0.63 ±0.06
log S/O	−1.46 ±0.11	−1.69 ±0.08	−1.57 ±0.10	−1.67 ±0.08
log Cl/O	−3.54 ±0.20	—	−3.67 ±0.20	−3.30 ±0.16
log Ar/O	−2.35 ±0.12	−2.21 ±0.08	−2.38 ±0.15	−2.25 ±0.08
ref.	1	2	1	2

References: (1) this work; (2) Torres-Peimbert *et al.* 1989.

n_e(Ar IV) $\gg n_e$(O II), probably indicating that the main ionizing stars are still located in a region denser than the average. In this region we derive a number ratio WR/O $= 40/530 \simeq 0.075$.

The ICF(N^+) and the ICF(Ne^{++}) for NGC 5461 derived from the photoionization model of Luridiana & Peimbert (2001) are both a factor of two higher than the ones derived by Mathis & Rosa (1991). Further analysis is needed to understand the origin of this discrepancy. For NGC 5471, comparison between the predictions by Mathis & Rosa (1991) and the model by Luridiana *et al.* (1999) highlighted sensible discrepancies in the case of chlorine and argon. The origin of these discrepancies requires further study. More details can be found in Luridiana *et al.* (2002).

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