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ON THE IONIZING SOURCES OF HII REGIONS

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The most commonly used method for deriving the effective temperature of the ionizing stars of H II regions was conceived by Zanstra (1931). This method has some difficulties because it assumes that the nebula is opaque to the Lyman continuum photons emitted by the stars and requires integrated fluxes in recombination lines. In the case of leakage of ionizing radiation the Zanstra method underestimates $T_{\rm eff}$. Kennicutt et al. (2000) present a list of other methods and discuss their main problems. Usually, emission lines from high ionization species are needed. The goal of this work was to obtain an effective temperature indicator free of the problems of the other methods and that could be easily used.

We calculated with the *CLOUDY* photoionization code (Ferland 2001) a series of models for H II regions ionized by single stars of different effective temperatures in the range corresponding to main sequence O stars. The Kurucz's models of stellar atmosphere were used as shape of the ionizing radiation. The nebula was considered as a static sphere with an inner radius of 10^{17} cm. The presence of grains was taken into account and we adopted different chemical compositions. We found that the index $\Re$ could be used to estimate $T_{\rm eff}$. This index has the advantage of not requiring weak lines. Besides it is independent of the geometry of the nebula. However, $\Re$ is dependent on the electron density as shown in Fig. 1. Errors in $T_{\rm eff}$ of the order of 3 000 K could be produced if the dependence of $\Re$ on the electron density is neglected.

We also considered the more realistic case of H II regions ionized by stellar clusters. We used the *STARBURST99* population synthesis program of different ages and upper stellar mass limits. We found that the index $\Re$ is primarily dependent on the effective temperature of the hottest star in the cluster. We also considered the statistical use of $\Re$ for estimating the ages of the ionizing clusters of H II regions.

As a check, we used our models to fit diagnostic diagrams for 50 H II regions in the Magellanic Clouds whose spectral data were available in the literature. We have derived the effective temperatures of the ionizing stars and the ages of some H II regions with the use of the index $\Re$. The results were compatible with those obtained from other methods.

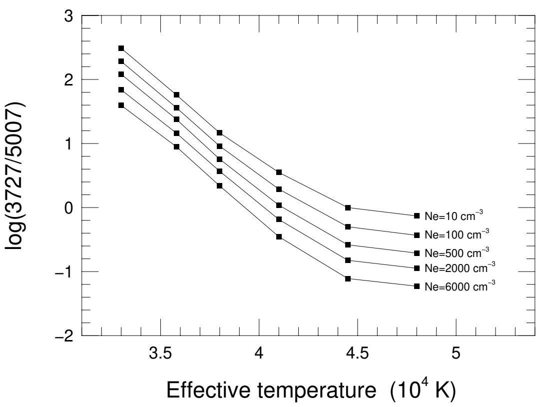

Fig. 1. $\Re$ vs $T_{\rm eff}$ for electron density $N_{\rm e}$ varying from 10 to 6 000 cm^{-3} and a mean value of the chemical composition of the Magellanic Clouds.

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