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DETERMINATION OF TEMPERATURE IN GASEOUS NEBULAE

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ABSTRACT. It is shown that the K-shell photoionization of O^0 followed by the Auger effect, can be an important populating mechanism for O^{2+} metastable levels and modifies the behaviour of the [O III] line intensity ratio with electron temperature.

Key words: GASEOUS NEBULAE — ELECTRON TEMPERATURE — [O III] LINE RATIO

I. THEORETICAL RESULTS

The [O III] line intensity ratio, $R_{O\ III} \equiv$ [O III] $\lambda 4363/\lambda\lambda(5007+4959)$, is usually used as an indicator of the electron temperature of the emitting gas in planetary nebulae, H II regions and active galactic nuclei. The standard procedure is to compare the observed to the theoretical ratio obtained by solving the statistical equilibrium equations of a three (or five) - level ion. In general, to populate the levels only radiative and collisional transitions are considered. However, in gas clouds submitted to soft X-rays, K-shell photoionization of O^0 atoms can produce O^{2+} ions (Auger effect) in excited states. This mechanism can change the relative population of the O^{2+} levels, which can affect the line ratio, and so the temperature determination of the gas.

The theoretical results taking into account this effect were obtained considering a power law spectrum, with spectral index equal to 1.5, for the ionizing radiation. This radiation is characterized by the ionizing parameter and by the low energy cutoff.

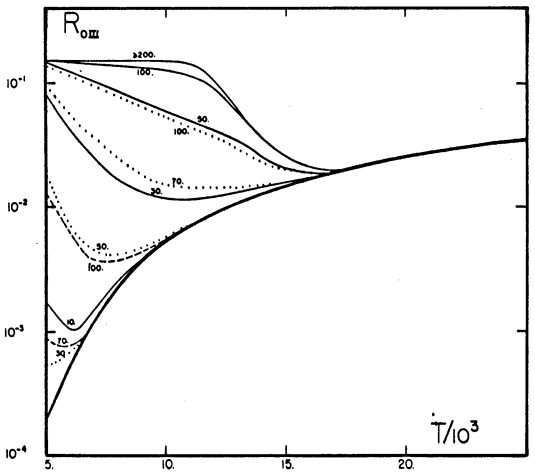

Fig. 1: [O III] line ratio versus electron temperature.

In Figure 1, the [O III] line ratio, $R_{O\ III}$, is given as a function of the electron temperature. The heavy solid line corresponds to the case where the K-shell photoionization effect is neglected. The other curves are labelled by the value of the low energy cutoff (in eV). Solid, dotted and dashed lines correspond, respectively, to anionizing parameter equal to 3×10^6, 3×10^7 and 3×10^8 cm s^{-1}

A more detailed version of this study will be published in *Astronomy and Astrophysics*.

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