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POSSIBLE DENSITY DETERMINATION OF THE NEBULAR COMPONENT OF CATACLYSMIC VARIABLES WITH THE N III 4641/4635 LINE RATIO

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The dependence of the N III 4641/4635 line ratio on the electron density is presented. It is shown that this ratio may be an important diagnostic tool in cataclysmic variables.

Pérez-Tijerina, Bohigas & Machorro (2001) used the Chianti code and database developed by the U.S. Nautical Observatory (Landi, 200) in order to find density and temperature sensitive line ratios in the conditions occuring in plasmas produced in pulsed laser deposition experiments for thin film deposition, *i.e.*, around 10^{18} cm^{-3} and 10^4 K. Level populations are determined considering only radiative decay and collisional excitation and de-excitation. During this inquiry they found that the N^{+2} 4641/4635 line ratio is density sensitive in three quite different regimes (see Figure 1): 10-10^4, 10^8-10^{11} and 10^{16}-10^{20} cm^{-3}.

This peculiar behavior is due to the interplay of the 20 levels included in this calculation. These permitted lines from N^{+2} have been observed in a variety of astrophysical objects, such as WR nebulae and cataclysmic variables. In order to test the utility of this line ratio as a density diagnostic tool for astrophysical plasmas, we used the spectral data produced by Mennicknet, Grenier and Tovmassian (private communication 2003) for AE Cir, a cataclysmic variable candidate. From their spectrum we found that N III 4641/4635 is between 0.73 and 1.08 (using the splot package in IRAF). From Figure 1 we find that this ratio would imply a density of $\sim 10^3$, $\sim 10^{10}$ or $\sim 10^{17}$ cm^{-3}. The density must be larger than 10^6 cm^{-3} since the O^{+2} lines at 4959 and 5007 Å are absent. On the other hand it can not be close to 10^{17} cm^{-3} since this would imply a nebular mass in the vicinity of 1 $M_{\odot}$, to large for these type of objects.

Therefore we conclude that, if the line ratio is indeed density sensitive in the physical environment of AE Cir, the nebular density must be between 4×10^9 and 2×10^{10} cm^{-3}, which implies that the nebular mass is close to 10^{-7} $M_{\odot}$. These numbers are well within what is expected in cataclysmic variables.

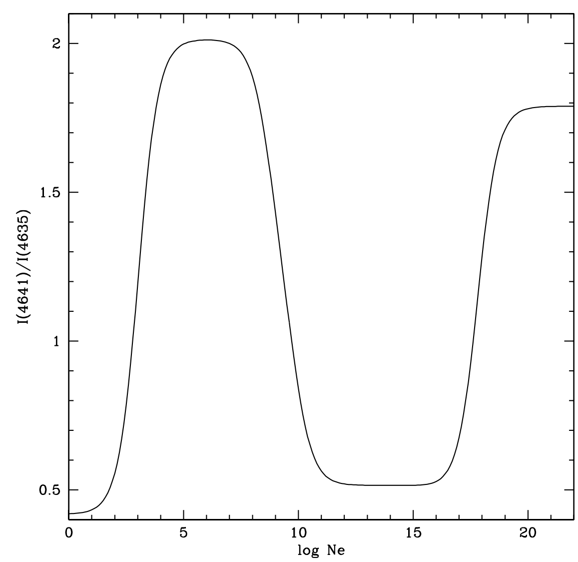

Fig. 1. N III 4641/4635 as a function of the electron density for T_e = 10,000 K

This line ratio may be an important addition to the diagnostic tool kit used to inspect large density astrophysical nebulae. However, caution is advisable until other processes capable of populating the levels from which these two lines arise, such as as recombination, radiative excitation or the Bowen resonance-fluorescence mechanism, are considered.

REFERENCES

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