A collisional radiative model for the argon ion system with strong excitation saturation

A COLLISIONAL RADIATIVE MODEL FOR THE ARGON ION SYSTEM WITH STRONG EXCITATION SATURATION

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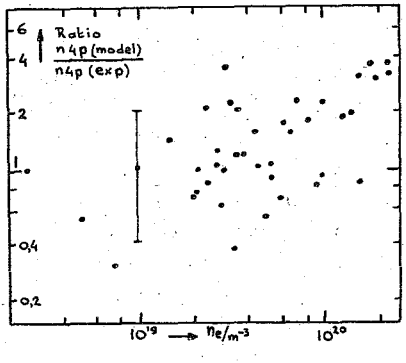
This C.R. model study of the argon ion system comprises 40 n_e-T_e conditions measured with Thomson scattering with $n_e = 2.10^{18} - 2.10^{20} m^{-3}$, $T_e = 2.5\text{-}4.8$ eV, and n_{4p}/g_{4p} densities of $5.10^{11} - 6.10^{13} m^{-3}$. It appears from the measurements that the 4p group (^3P core), e.g. the $^2D_{5/2}$ level, shows strong saturation for $n_e > 2.10^{19} m^{-3}$; from this value the 4p density increases proportional to n_{Ar^+} and not proportional to $n_e \cdot n_{Ar^+}$. This implies a strong deexcitation to groups higher than 4p; paths to ^1D and ^1S core states (3d", 3d', 4s", 4p') are essential to obtain the needed total deexcitation rate of $\langle \sigma v_e \rangle \simeq 10^{-11} m^3 s^{-1}$ at $T_e \simeq 3.5$ eV. In previous models [1,2] in which only coupling between ^3P core states was considered, the deexcitation is underestimated and one finds excitation saturation at much higher n_e, see e.g. ref. 1 : $n_e > 5.10^{22} m^{-3}$. The excitation paths to the other core states and to 5p, 4f etc. have been added to our model described in ref. 2 ; a first attempt of this work can be found in ref. 3. For the moment, the further deexcitation from states higher than 4p is stimulated by large ionization rates. The resulting agreement between experiment and model is fair (see the figure) in view of the scatter caused by small uncertainties in T_e (see error bar for $\frac{\Delta T_e}{T_e} = 15\%$).



The ratio of 4p model densities and 4p experimental densities as a function of the electron density n_e for 40 (n_e,T_e) conditons.

1. T. Fujimoto, Jap. J. Appl. Phys., 11 (1972) 1501.
2. B.F.M. Pots, B. van der Sijde and D.C. Schram, Physica 94C (1978) 369.
3. B. van der Sijde, B.F.M. Pots, D.C. Schram, Proc. 14th ICPIG, ed. J. de Phys. C7 (1979) 23.