

§15. Recommended Data on Proton-Ion Collision Rate Coefficients for Fe X – Fe XV and Fe XVII – Fe XXIII Ions

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Proton-ion collisions are important for excitation between fine structure levels of the ground states or metastable states of ions in high-temperature low density plasma. In the present work we evaluate atomic data for proton-induced excitation transitions in Fe X – Fe XV ions (M-shell ions)¹⁾ and Fe XVII – Fe XXIII ions (L-shell ions)²⁾ with the help of different theoretical methods. For the most cases atomic data were obtained by semi-classical methods and quantum treatments were done for a few cases (FeXIII, FeXIV, and FeXXI). Evaluated data are fitted to a simple analytical formula with 7 parameters, which can describe dependency of the excitation rate coefficient on proton temperature in wide temperature range:

$$C_{ij}(T_p)[\text{cm}^3\text{s}^{-1}] = 10^{-10} p_1 \exp(-(p_2/T_p)^{p_3}) \frac{(T_p/p_6)^{p_7}}{1+(T_p/p_4)^{p_5}} \quad (1)$$

The values of the parameters are determined by fitting of the analytic formula to selected numerical data.

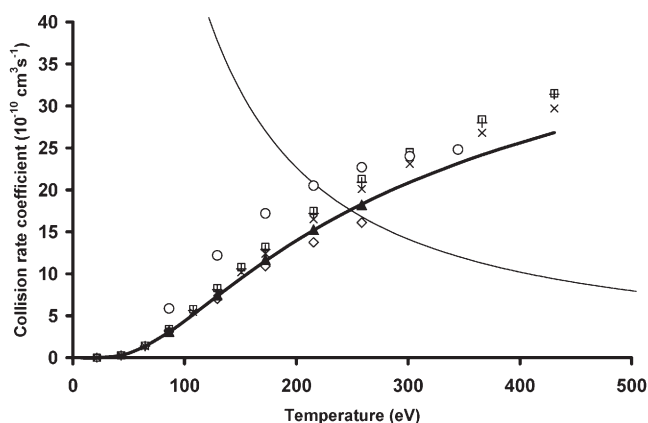


Fig. 1. Proton collision excitation rate coefficients for transition $3s^2 3p^2 P_{1/2} - ^2 P_{3/2}$ in Al-like Fe ions (Fe XIV): solid line – formula (1), \circ – data [3], \blacktriangle – data [4], $+$ – data [5], \diamond – data [6], \square and \times – data [7] for different methods of consideration of small impact parameter region; thin solid line – electron rate coefficient of [8].

By comparing of proton collision excitation rates with electron ones it is shown that proton impact excitation processes may be important for Fe X, XI, XIII-XV ions and some transitions of Fe XVII – Fe XXIII ions at the higher temperature region. The results obtained can be used for plasma kinetics calculations and for the development of spectroscopy methods of plasma diagnostics.

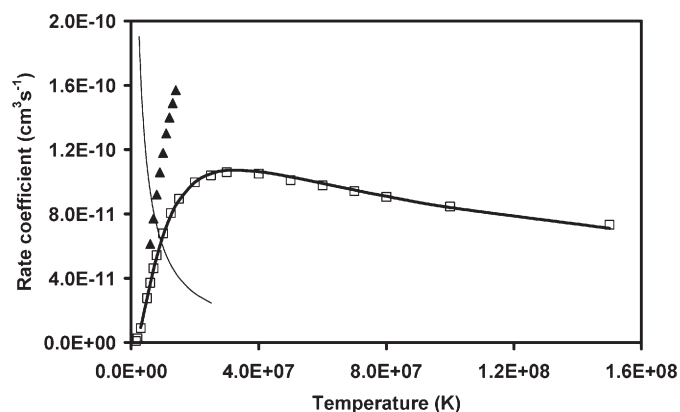


Fig.2 Collisional excitation rate coefficients for transition $2s^2 2p^2 ^3 P_1 - ^3 P_2$ in C-like Fe ions (Fe XXI): solid thick line – formula (1) for protons, solid thin line – electrons [9], \blacktriangle data [10], \square – data [11].

References

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