Spectral properties of H-atom moving through classical plasma

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Hydrogen-like transitions are one of the most useful tools in plasma diagnostics. In present day research, ions moving through plasma draw considerable attention of the experimentalists [1,2]. Moving ions leave a wake as they travel through the cloud of electrons inside the plasma and this wake leaves an impression on the effective potential 'felt' by the ion. In the present work we estimate the transition rates of Balmar-lines (n = 3 to n = 2 transitions) of hydrogen ions moving through a classical plasma. In the first phase, we have formulated the potential around a moving test charge in classical plasma environment. Considering the plasma environment as a dielectric medium [3] and using the effective dielectric function [4], the potential around the moving test charge is found to be composed of following two parts: **(i)** Velocity independent exponentially screened Coulomb potential or Debye-Huckel potential. This term depends on the nuclear charge and on the screening parameter which is a function of temperature and density. **(ii)** Velocity dependent near-field wake potential. Ritz variation principle is adopted in the second phase to solve the Schrodinger equation for $2s_0$, $2p_{0,\pm1}$, $3p_{0,\pm1,\pm2}$ states of moving H-atom. The trial wave function is expanded in Slater type basis with distorted angular part [5]. The results show that the energies become more positive as the plasma electron density and ion velocity increases. The *l*-degenracy is removed due to the plasma screening and |*m*| degeneracy is lifted due to the motion of the ion. Transition rates are calculated in both length and velocity gauges. The velocity of the H-atom is such that the thermal Mach number is less than unity. For a particular density and temperature of the plasma, the transition rate gradually increases with ion-velocity.

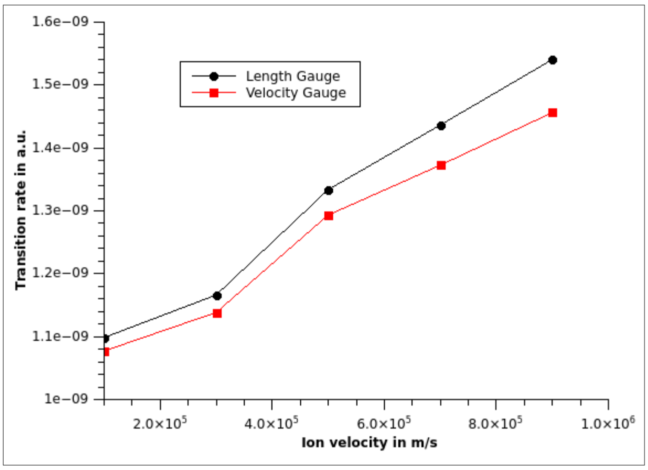

Figure 1: Variation of transition rate for the transition $2p_0 \rightarrow 3d_0$ as a function of ion velocity. The plasma electron density is 10^{21} m^{-3}.

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