§26. Quantum Effects on the Formation of Negative Hydrogen Ion by Polarization Electron Capture in Partially Ionized Dense Hydrogen Plasmas

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The quantum effects on the formation of the negative hydrogen ion (H^-) by the polarization electron capture process are investigated in partially ionized dense hydrogen plasmas. The Bohr-Lindhard method is employed to obtain the electron capture radius and the probability for the formation of the negative hydrogen ion as functions of the thermal de Broglie wavelength, Debye length, and collision energy. It is shown that the quantum effect strongly suppresses the electron capture radius as well as the cross section for the formation of the negative hydrogen ion. It is also shown that the electron capture radius decreases with increasing the collision energy. In addition, it has been found that the electron capture position is receded from the center of the projectile with decreasing the quantum effect of the plasma.

FIG. 1. The three-dimensional plot of the scaled electron capture radius $\overline{R}_C(\overline{\lambda},\overline{r}_D,\overline{E}_p)$ as a function of the scaled thermal de Broglie wavelength $(\overline{\lambda})$ and scaled Debye length $(\overline{r}_D)$ when $\overline{E}_p = 2$.

FIG. 2. The plot of the scaled electron capture radius $\overline{R}_C(\overline{\lambda},\overline{r}_D,\overline{E}_p)$ a function of the scaled thermal de Broglie wavelength when $\overline{r}_D = 50$. The solid line is the case of $\overline{E}_p = 2$. The dashed line is the case of $\overline{E}_p = 4$. The dotted line is the case of $\overline{E}_p = 6$.

FIG. 3. The three-dimensional plot of the scaled differential cross section $\overline{\sigma}_C[\equiv(d\sigma_C/d\overline{b})/\pi a_0^2]$ in units πa_0^2 for the formation of the negative hydrogen ion as a function of the scaled thermal de Broglie wavelength $(\overline{\lambda})$ and scaled impact parameter $(\overline{b})$ when $\overline{E}_p = 5$ and $\overline{r}_D = 50$.

FIG. 4. The plot of the scaled differential cross section $\overline{\sigma}_C[\equiv(d\sigma_C/d\overline{b})/\pi a_0^2]$ in units πa_0^2 as a function of the impact parameter $(\overline{b})$ when $\overline{E}_p = 5$ and $\overline{r}_D = 50$. The solid line represents the case of $\overline{\lambda} = 0.2$. The dashed line represents the case of $\overline{\lambda} = 0.4$. The dotted line represents the case of $\overline{\lambda} = 0.6$.

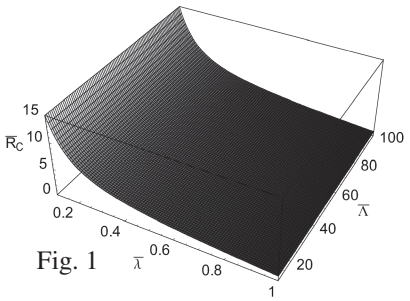

Fig. 1

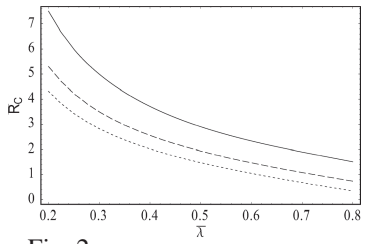

Fig. 2

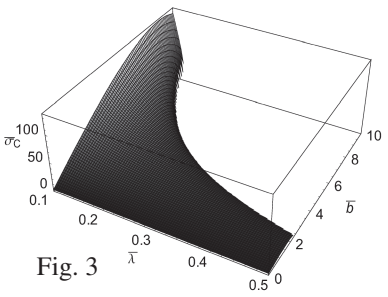

Fig. 3

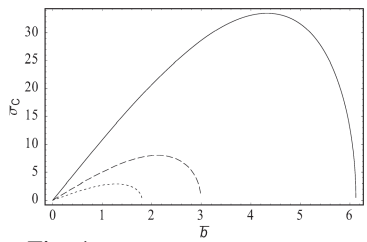

Fig. 4