State-Selective Electron Capture in Ne^{10+} + H(1s) Collisions

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Collisional data for highly charged projectiles like Ne^{10+} are important for astrophysical and fusion plasma research. We study electron capture and ionisation in fully-stripped neon ion collisions with ground-state atomic hydrogen using the two-centre wave-packet convergent close-coupling (WP-CCC) method over the energy range from 1 keV/u to 2 MeV/u. The calculated total electron-capture cross section agrees very well with the molecular and atomic orbital close-coupling calculations at low and intermediate energies. However, our results slightly overestimate the experimental results by Meyer *et al.* [1], and underestimate the measurements by Panov *et al.* [2] available only below 10 keV/u. At higher energies, where there are no measurements, the results also agree well with the classical trajectory Monte-Carlo results. Partial nl-resolved electron-capture cross sections, important for fusion plasma diagnostics, have also been calculated for final states up to $n = 10$, where n and l are the final state principal and angular momentum quantum numbers, respectively. The results for the dominant channels are generally in good agreement with the atomic-orbital close-coupling calculations. However, by using a finer energy grid, we detect pronounced oscillations in the state-selective cross sections for $n \geq 8$ at energies below 10 keV/u. Our results for the total ionisation cross section differ from previous close-coupling calculations. However, they are overall in good agreement with the latest classical trajectory Monte-Carlo results. Previous WP-CCC calculations for collisions of fully-stripped beryllium [3] ions with atomic hydrogen suggested that the maximum principal quantum number of bound states $n_{\max}$ on the projectile centre required for convergence was roughly equal to the charge of the incident ion. However, we find this not to be the case for highly-charged ions, such as Ne^{10+} [4]. All the results reported in this work have converged within a few percent over the entire energy range mentioned above. To maintain such accuracy, in the most challenging intermediate energy region we had to set $n_{\max} = 15$. In particular, at 100 keV/u the n-resolved cross section peaks at $n = 7$ and then drops towards 0 very slowly with increasing n. Therefore, to achieve convergence in the total electron-capture cross section within a percent, we had to increase $n_{\max}$ to 23.

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