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Muonium formation in collisions of positively charged muons with hydrogen and helium atoms

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Muonium formation in muon-hydrogen ($\mu^+ - \mathrm{H}(1\mathrm{s}^1)$) and muon-helium ($\mu^+ - \mathrm{He}(1\mathrm{s}^2)$) charge-exchange collisions is considered at intermediate and high impact energies, from 10 keV to 1 MeV. The prior form of the three-body boundary-corrected first Born approximation (CB1-3B) [1] is used for calculations of the state-selective total cross sections Q_{nl} for single-electron capture into $1s$, $2s$ and $2p$ final states of the (μ^+, e) systems. In the helium targets case, the frozen-core approximation and the independent particles model were used. In the frozen-core approximation the non-captured (passive) electron is assumed to occupy the same orbital before and after capture of the active electron, while in the independent particles model the passive electron is included only through a shielding of the original nuclear charge of the target. The state-summed total cross sections Q_Σ for electron capture into all the final states are obtained by applying the Oppenheimer (n^{-3}) scaling law [2]:

$$Q_\Sigma = Q_{1s} + 1.616(Q_{2s} + Q_{2p}).$$

Unfortunately, no measurements are available, so that the calculated results are compared with the theoretical results which were obtained by applying the three-body continuum distorted wave (CDW-3B) method [3].

References

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