

# Benchmark experiment to prove the influence of projectile excited states on the ion stopping in plasma

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In this work, we report on a precision energy loss measurement and on our theoretical study of 100 keV/u helium ions in a hydrogen discharge-plasma. Collision processes of helium ions with protons, free electrons and hydrogen atoms are ideally suited for benchmarking plasma stopping-power models. Energy loss results of our experiments are significantly higher than the predictions of traditional models, where empirical values for the effective charge state  $Z_{\text{eff}}$  are used. We obtained good agreement with our data by solving rate equations, where in addition to the ground state, also excited electronic configurations were considered for the projectile ions. Hence, we demonstrate that excited projectile states, resulting from collisions, leading to capture-, ionization- and radiative-decay processes, play an important role in the stopping process in plasma.