

Theoretical cross sections for rotationally and electronically inelastic and elastic processes in electron-HF scattering

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In this work, we present a comprehensive set of theoretical cross sections for electron collisions with hydrogen fluoride (HF), including elastic scattering, momentum transfer, rotational excitation, electronic excitation, and ionization. The calculations are based entirely on first-principles methods and employ a combination of the UK R-matrix approach, rotational frame transformation, Born approximation, and Binary-Encounter Bethe techniques. Uncertainties are estimated for all recommended datasets.

Hydrogen fluoride is an important species in plasma-processing environments, particularly in fluorine-containing plasmas used for etching and semiconductor manufacturing. Accurate cross sections for electron-HF collisions are essential for plasma modeling, yet experimental and theoretical data remain scarce. The results reported in this manuscript help fill this gap by providing a consistent and extensive database suitable for plasma kinetics and transport simulations.

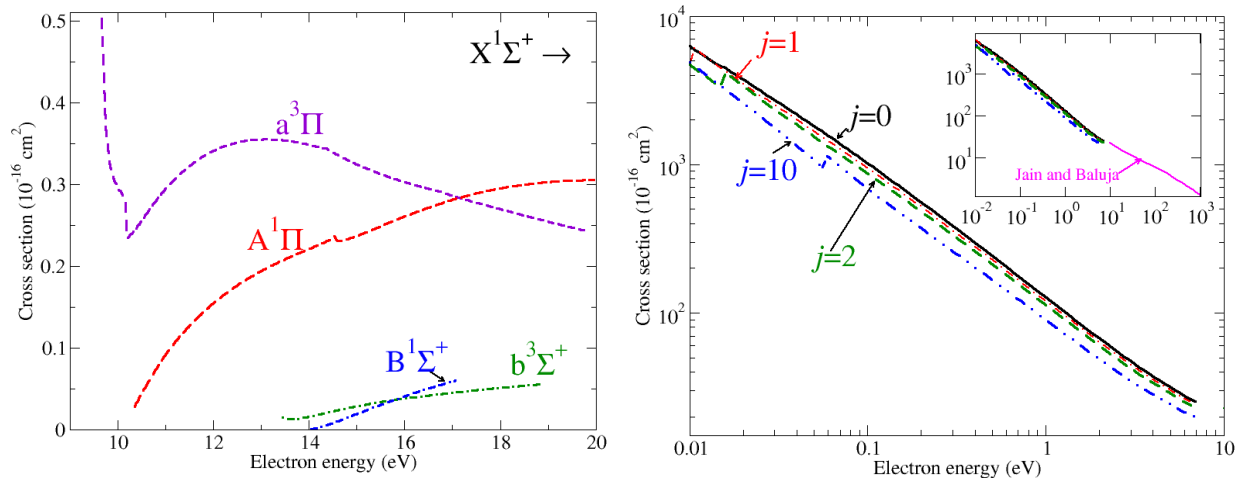


Figure 1. Left panel: Cross sections for electron-impact excitation of the four lowest excited electronic states of HF from the $X^1\Sigma^+$ ground electronic state. Right panel: Total cross section for energies below the threshold for the lowest electronic excitation, computed for the ground vibronic level $X^1\Sigma^+(v=0)$ for several different initial rotational states, $j=0, 1, 2$, and 10 . The inset compares the present results with previous calculations.

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