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Thermalization of Suprathermal N(^{4}S) atoms in He and Ar gases.
PENG ZHANG, ALEXANDER DALGARNO, ITAMP, Harvard-Smithsonian Center for Astrophysics — The thermalization of hot nitrogen atoms in the He and Ar buffer gases is investigated. We calculate the rates of energy relaxation of fast nitrogen atoms and provide simple interpolative formulas for the N(^{4}S) thermalization rates. The method of determination of the energy relaxation rate is based on the numerical solution of the Boltzmann kinetic equation, describing the evolution of the time- dependent distribution functions of fast nitrogen atoms. The rates of energy transfer in N(^{4}S) + He and Ar collisions are determined using quantally computed differential cross sections of elastic collisions. Theoretical data on the energy relaxation of hot N(^{4}S) atoms are compared with the results of recent experiments on the thermalization of fast N(^{4}S) atoms in He and Ar buffer gases. The laboratory measurements of the Doppler shifts of the laser induced fluorescence of hot N(^{4}S) atoms provide detailed information on the time-evolution of energy distribution functions of N(^{4}S) atoms, and we employ these data for testing the theoretical predictions. Results of our ab initio calculations are in good agreement with experimental data. We report also the parameters of the simplified hard sphere model, which describes effective energy relaxation rates of hot N(^{4}S) atoms, thermalizing with initial energies between 0.05 and 5 eV in different gases.

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