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Non-Adiabatic Atomic Transitions: Computational Cross Section Calculations of Alkali Metal - Noble Gas Collisions DAVID WEEKS, CHARLTON LEWIS, Air Force Institute of Technology — Optically pumped alkali lasers operate by first exciting an alkali atom from the ground $^2S_{1/2}$ state into the $^2P_{3/2}$ excited state. The alkali atom will then undergo a non-adiabatic fine structure transition from the $^2P_{3/2}$ state to the $^2P_{1/2}$ state. This establishes a population inversion between the $^2P_{1/2}$ excited state and the $^2S_{1/2}$ ground state required for the system to lase. In this type of laser, the working medium consists of alkali atoms at a fairly low partial pressure together with a buffer of noble gas atoms at a higher partial pressure. For potassium and rubidium, collisions with the noble gas atoms can cause the alkali atom to undergo fine structure transitions at a sufficiently high rate to lase. Scattering cross sections for the non-adiabatic fine structure transition between M + Ng pairs are therefore of interest and are computed for M + Ng pairs where M = K, Rb, Cs, and Ng = He, Ne, Ar. The calculations are performed with time dependent wave packet methods to first compute scattering matrix elements. A sum over scattering matrix elements for values of angular momentum J ranging from 1/2 to 501/2 is then used to compute associated fine structure cross sections. Theoretical cross sections are compared to experimental results where possible.

David Weeks
Air Force Institute of Technology

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