

Quantum Statistical Mechanical Formulations of Three-Body Problems via Non-Local Potentials

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Abstract : In this paper, we present a quantum statistical mechanical formulation from our recently analytical expressions for partial-wave transition matrix of a three-particle system. We report the quantum reactive cross sections for three-body scattering processes $1 + (2,3) \rightarrow 1 + (2,3)$ as well as recombination $1 + (2,3) \rightarrow 2 + (3,1)$ between one atom and a weakly-bound dimer. The analytical expressions of three-particle transition matrices and their corresponding cross-sections were obtained from the three-dimensional Faddeev equations subjected to the rank-two non-local separable potentials of the generalized Yamaguchi form. The equilibrium quantum statistical mechanical properties such partition function and equation of state as well as non-equilibrium quantum statistical properties such as transport cross-sections and their corresponding transport collision integrals were formulated analytically. This leads to obtain the transport properties, such as viscosity and diffusion coefficient of a moderate dense gas.

Keywords : statistical mechanics, nonlocal separable potential, three-body interaction, faddeev equations

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