Nuclear Theory

A direct microscopic approach to transition strengths in pre-equilibrium reactions

F. B. Guimaraes, B. V. Carlson

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We present a microscopic formalism that extends the traditional formulation of Williams, Ericson and Bloch and permits to obtain the transition strengths (TS) of pre-equilibrium nuclear reactions directly from their quantum microscopic description. We calculate the TS without resorting to the Laplace transform approach and the use of the saddle point approximation. We also analyze some problems that may appear in connection with these mathematical tools and the Darwin-Fowler approach in this case. We show that, analogously to the nuclear densities, the strengths for transitions that change the exciton number by two or leave it unchanged can be estimated microscopically as convolutions of the functions of simpler states. When using the HO basis for the Model Space we obtained important departure from the results of the exciton model (EXM), which can partially invalidate our previous analysis on the attainment of equilibrium during the PE stage. On the other hand, by using constant grid of energies for the sp-basis we were able to reproduce the results of EXM quite well in a large range of excitation energies. A new model code, TRANSNU, was developed that can be ported to traditional semi-classical codes like TNG for nuclear data evaluation.

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