Anomalous asymptotics of radial overlap functions for bound systems of three or more particles

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All transfer reactions and radiative capture nuclear-astrophysical reactions at low energies measured so far are analysed using a reaction theory that contains overlap functions between the wave functions of the target and residual nuclei. These overlaps are assumed to have an asymptotic form determined by the separation energy of the transferred (or radiative captured) cluster and such an assumption is incorporated into all reaction codes. We point out that although this asymptotic form is dominant for the majority of the transfer reactions and the nuclear-astrophysical radiative capture reactions, for some cases the overlap function has anomalous asymptotic behavior. This behavior originates from virtual decays of the complex nucleus into intermediate channels and, mathematically, is generated by contributions from the singularities of the triangle Feynman diagram and the generalized triangle diagram containing a loop. In the present work, these contributions are investigated in detail and expressions are derived for the strengths of the anomalous terms taking spin variables and the Coulomb effects into account. We present specific examples of nuclear vertices with anomalous asymptotics and discuss their application for peripheral nuclear processes.

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