Surface-integral formulation of scattering theory

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We formulate scattering theory in the framework of a surface-integral approach utilizing analytically known asymptotic forms of the two-body and three-body scattering wavefunctions. This formulation is valid for both short-range and long-range Coulombic interactions.

New general definitions for the potential scattering amplitude are presented. For the Coulombic potentials, the generalized amplitude gives the physical on-shell amplitude without recourse to a renormalization procedure. New post and prior forms for the Coulomb three-body breakup amplitude are derived. This resolves the problem of the inability of the conventional scattering theory to define the post form of the breakup amplitude for charged particles. The new definitions can be written as surface integrals convenient for practical calculations. The surface-integral representations are extended to amplitudes of direct and rearrangement scattering processes taking place in an arbitrary three-body system. General definitions for the wave operators are given that unify the currently used channel-dependent definitions. This work has been published as review in Annals of Physics March 2009, online address: doi:10.1016/j.aop.2009.02.003.