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S-matrix solution of the Lippmann-Schwinger equation for regular and singular potentials

We have derived a new method based on S-matrix theory to solve the Lippmann-Schwinger equation in partial waves that can applied to both ordinary and singular potentials. The approach is based on the N/D method and in an integral equation derived from the Lippmann-Schwinger equation that allows one to calculate exactly the discontinuity of the T-matrix along the left-hand cut (which is the dynamical input of the N/D method). For an ordinary potential the method reproduces the standard results, although it can deal with short-range potentials more powerfully. For singular potentials this new method provides renormalized solutions that satisfy all the required analytical properties for a partial-wave amplitude. It again reproduces the well-established results from the Lippmann-Schwinger equation, but it also goes beyond and can provide new solutions that are necessary to reproduce phenomenology. Illustrations of the method to regular and singular potentials in nucleon-nucleon scattering will be discussed.

Mercredi 11 janv. 2017, 11h30
IPN, Bât. 100, Salle A015