Approximate field–theoretic method of describing scattering and production processes of composite particles by asymptotic in– and outgoing Bethe–Salpeter states*

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Abstract

Following the LSZ–reduction technique total scattering and production cross sections and related observables usually are calculated from truncated connected Green functions, i.e. in terms of matrix elements of the Dyson operator between asymptotically free in- and outgoing one-particle states. As in nature for many processes the in– and outgoing asymptotic states are found to be bound states of microscopic degrees of freedom (like baryons and mesons consisting of quarks and gluons or nuclei consisting approximately of nucleons and mesons), the LSZ–concept is extended to bound asymptotic states described by Bethe–Salpeter amplitudes. As a result a very powerful compact relativistic method is developed to describe intermediate and high energy scattering and production processes of composite systems in a microscopic, perturbative way which obeys all requirements of Lorentz-covariance, spin-statistics and causality. The nonrelativistic reduction of the expressions obtained is straight forward.
The method is used to write down amplitudes for various reactions of composite systems at low, intermediate and high energy physics under investigation in present literature in a relativistic field theoretic way. The task is now to determine the various Bethe-Salpeter amplitudes involved by numerical or analytical methods and to extract information by comparison of observables which are calculable by the production amplitudes with the experiment.

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