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SPECTROSCOPIC FACTORS: MEASURABILITY AND OBSERVABILITY

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Spectroscopic factors are intensely used in the analysis of nuclear reactions. However, spectroscopic factors are absent in the rigorous theory of nuclear reactions. They arise only within the standard version of the distorted-wave Born approximation (DWBA) as a result of the replacement of a rigorous many-particle overlap function by a two-body wave function. This approach has no serious theoretical justification and is essentially a convenient method for approximate modeling of experimental data on direct nuclear reactions. Even within this approach, the accuracy of the spectroscopic factors extracted from the experimental data is low, especially in the case of the removal of composite objects, say, α-particles. Spectroscopic factors are off-shell quantities. They are not determined by the S matrix unlike on-shell quantities, such as phase shifts, binding energies, etc. It should be noted that, in contrast to spectroscopic factors, asymptotic normalization coefficients, which are currently actively used in the physics of nuclear reactions, are on-shell quantities. Spectroscopic factors are non-invariant under the unitary transformations of nuclear forces conserving the S matrix. Therefore, they are 'non-observables'which can only be defined within a special convention, like a particular form of the nuclear Hamiltonian which is used to derive or calculate them [1, 2]. Thus determining spectroscopic factors from experimental data is of rather limited value. Spectroscopic factors can be calculated in the framework of microscopic approaches. However, comparing the results of such calculations with the phenomenological values of spectroscopic factors is unlikely to provide any significant information.
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