Spectroscopic factors and Asymptotic Normalization Coefficients

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Experimental studies of exotic nuclei are in fast development and it is crucial to ensure the accuracy of the tools used. For many years, nuclear reactions have been one of the major tools to extract structure information [1]. This structure information comes often in the form of a spectroscopic factor (SF). SFs are predicted by shell model and relate to the norm of the overlap function of the nucleus under study (for example $< \Psi_A(I)|\Psi_{A-1}(J) >$, of a state I in nucleus A with a state J in nucleus $A-1$) [2]. Also, one can learn specifically about the tail of the overlap function, through the asymptotic normalization coefficient (ANC). The ANC has an immediate connection to astrophysics, since it is directly related to the capture rate at zero relative energy [3].

The factorization of the cross section in terms of a SF and the reaction component is very convenient and is typically used. This assumes a given radial dependence of the overlap function, which is not well known. It turns out that, as different reactions generally probe different parts of the overlap function, the extracted SFs can differ significantly. Another way of looking at the problem is through the consistency between ANCs and SFs [4].

Transfer reactions are usually assumed to be surface peaked. However at low energy these can be completely insensitive to the interior of the overlap function ($<$ 10 MeV/u). Even at 20 MeV/u, these reactions are still dominated by the asymptotic contribution of the overlap function, and thus, it is very important to pin down the ANC correctly [5].

Breakup reactions are only sensitive to the asymptotic properties [6]. These come in through the ANC but also through the final state phase shifts. Nevertheless, a representation in terms of multiple components of the wave function can hold important information about the relative weights of various orbitals in the asymptotic region [7].

In this talk, recent studies on transfer and breakup reactions will be discussed. These illustrate some inconsistency problems one faces when comparing reactions that are completely peripheral versus others that contain a significant contribution from the interior. In conclusion, a connection to the present experimental programs will be made.

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