Contribution ID: **55** Type: **Contributed Oral/Poster**

Description of transfer reactions with coupled-channels Born approximation

Tuesday, 12 July 2016 17:35 (20 minutes)

In order to theoretically describe transfer reactions, the distorted-wave Born ap- proximation (DWBA) is known to be a naive model and has brought about coincidence of calculated result with experimental data for some reactions. Recently, however, we have found that the DWBA is not able to be applied for some of the reactions, for instance, transfer reaction involving loosely bound nuclei, α-transfer reaction, and transfer reaction to continuum state of residual nucleus.

In these cases the coupled-channels Born approximation (CCBA), in which the breakup effects of projectile and residual nucleus are taken into account by employing the method of the continuum-discretized coupled-channels (CDCC), could be one of powerful models to obtain reasonable result.

First, we show that, for the CCBA analysis of the 8B(d,n)9C reaction, it is essentially important to consider the transfer process from (to) the breakup state of d (9C). These transfer process called the breakup transfer is never taken into account in the DWBA.
Next, the importance of the CCBA model is given for the description of the α-transfer reaction 16O(6Li,d)20Ne, in which, so far the DWBA has been failed to produce the cross section to be consistent with measured one. Our calculation greatly improves coincidence of the calculation with the data and enables us to discuss the surface distribution of the α-cluster structure of 20Ne.

Finally, how to describe transfer reaction to continuum state, such as α(d, p)5He, is presented. It is known that the integration in the transition matrix (T matrix) of such reaction does not converge. To avoid this problem, the prior form of the T matrix, for which the CCBA model is required to calculate the approximately exact wave function of the final channel, is employed.

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Track Classification: Theoretical developments of direct reactions