Contribution ID: **165** Type: **Oral**

From neutron-nucleus interactions to (d,p) cross sections

Tuesday, 14 May 2019 15:00 (20 minutes)

Deuteron-induced reactions have a long and fruitful tradition in nuclear physics as an experimental tool for spectroscopy. They have been extensively used to study in detail the single-particle nature of the low-lying spectrum of the nuclear quantum many-body system. Standard reaction theory describing the direct population of sharp bound states have been very successful in extracting detailed structural information from the experimental data, in the form of spin, parities, spectroscopic factors, etc., of the populated bound states. The advent of high intensity exotic beams have granted experimental access to weakly bound systems with a Fermi energy close to the neutron-emission threshold, where the role of the continuum becomes important. Within this context, new theoretical developments are called for, such as a reaction framework able to account for the population of resonant and non-resonant states of the continuum, adapted to the associated structure description of the target-neutron interaction. Aside from paving the way
to the description of (d,p) reactions in exotic loosely bound nuclei in terms of state-of-the-art neutron-target interactions, such a framework can also be used to describe the formation of a compound nucleus in the neutron+target channel. The formalism presented here is thus also an important theoretical ingredient for the use of (d,p) reactions as surrogates for neutron capture processes.

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Session Classification: Session IX (Parallel Session)