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Three-nucleon force contribution to the distorted-wave theory of (d,p) reactions

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In the last two decades rapid advances have been made in the implementation of the three-nucleon force (3NF) in nuclear structure calculations and its importance for various nuclear properties has been demonstrated. However, another large branch of nuclear physics –direct nuclear transfer reactions - is still based exclusively on Hamiltonians with two-body interactions only. These reactions are studied experimentally in many radioactive beam facilities, such as ISOLDE (CERN), RIKEN (Japan) or TRIUMF (Vancouver), to provide an important source of knowledge about single-particle nuclear structure and, more recently, to serve as a testing ground for ab-initio theories, in which the 3NF is often included.
In this talk I will present the first calculations of the 3NF contribution to the distorted-wave theory of (d,p) reactions [1]. I will discuss the qualitative difference between this contribution and the contribution from two-nucleon force only. This difference arises because of a new type of nuclear matrix elements which nuclear structure theory never dealt with before. I will discuss the challenges of the 3NF treatment in the distorted-wave theory and present a few (d,p) cross sections for double-magic nuclear targets calculated in the distorted-wave Born approximation using the contact 3NF whose strength has been fixed by the chiral effective field theory at the next-to-next-to-leading order. Introducing a 3NF into distorted-wave theories will pave the way to a consistent comparison of spectroscopic factors, calculated in ab-initio theories with 3NF, with those deduced from experiments with the help of reaction theory in which 3NF are included as well.

References:
[1] N.K. Timofeyuk, Phys. Rev. C, in press (2018)

Selected session

Nuclear structure and dynamics

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