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Insights on many body degrees of freedom in (p,pN) reactions

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The signature of the coexistence between single-particle, cluster and collective degrees of freedom of nuclei in reactions is a timely issue.
These rich aspects of the nuclear structure have been standardly described by simple shell models, cluster and collective structure models respectively.
Ultimately, the complexity associated to the coexistence traces back to the bare NN and NNN interactions which induce important NN correlations in nuclear medium, such as short ranged and tensor ones.
We shall reveal recent insights on aspects of many body degrees of freedom in the reaction mechanism for nucleon knockout from a stable/exotic projectile in the collision with a proton target.

We shall present a comprehensive analysis of (p,pN) reactions in inverse kinematics at around 400 MeV/A covering the mass range $A \leq 12$ and including
Lithium, Beryllium, Carbon and Boron isotopes [1,2]. Total cross sections are calculated using
the many-body {\it ab initio} Quantum Monte Carlo fully correlated wave functions generated with the NN Argonne V18 and the NNN Urbana X (AV18+UX) potentials [3]
and merged into the Faddeev/Alt-Grassberger-Sandhas (F-AGS) [4] reaction formalism, which allows a consistent and simultaneous treatment of all channels, providing an exact solution of the three-body scattering problem for an assumed three-body Hamiltonian. A comparison with available data measured at GSI [5] will be shown.

Additionally, we shall present kinematically semi-inclusive and fully exclusive cross sections for $\{^{12}\mathrm{C}(p,2p)\}$ in direct kinematics at 100 MeV/u, assuming a dynamical excitation of the ^{11}B core during the scattering process
[6]. We use a generalized F-AGS with channel coupling,
where the fragment excited states are generated from a rotational model.
The results will be compared with available data measured at the IUCF
where the ^{11}B final state can be in the ground and any of the low lying negative parity states $\{3/2^-, 1/2^-, 5/2^-, 3/2^-_2\}$ [7]. These experiments show a strong population of the 4.44 MeV $(5/2^-)$ state which cannot be understood from a dominant single-particle knockout with an inert core.

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[4] E.~O. Alt, P. Grassberger, and W. Sandhas, Nucl.~Phys. {\bf B2}, 167 (1967).
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Collaboration

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