Contribution ID: **76** Type: **Oral Presentation**

Transfer and breakup reactions of neutron-rich carbon isotopes described within few-body models

The study of reactions involving weakly bound exotic nuclei is an active field due to advances in radioactive beam facilities. Many of these nuclei can be approximately described by a model consisting of an inert core and one or more valence nucleons. However to properly describe some of these nuclei within few-body models, additional effects must be considered, such as deformations and possible excitations of the core. This is the case of ^{17}C and ^{19}C, which can be approximately described as a deformed core and a weakly-bound neutron.

The carbon isotopes ^{17}C and ^{19}C are studied using the novel NAMD model resulting from the combination of the Nilsson and PAMD models from [Phys. Rev. C 108 (2023) 024613]. The prposed formalism follows the Nilsson model scheme but including microscopic information of the core based on Antisymmetrized Molecular Dynamics (AMD) calculations. Different methods are considered to study the effect of including Pauli blocking of forbidden states and pairing correlations. In our calculations, the continuum spectrum of unbound states of the nucleus is discretized using the transformed harmonic oscillator basis (THO) [Phys. Rev. C 80 (2009) 054605], which has been successfully applied to the analysis of breakup and transfer reactions [Phys. Rev. Lett. 109 (2012) 232502].

The bound states wavefunctions obtained for ^{17}C have been tested by applying them to the $^{16}\mathrm{C}(d,p)^{17}\mathrm{C}$ transfer reaction, using as reaction framework the Adiabatic Distorted Wave Approximation (ADWA). The results are consistent with the data from [Phys. Lett. B 811 (2020) 135939], significantly improving the agreement by including Pauli blocking effects.
The same transfer reaction is studied also populating unbound states in the continuum of of ^{17}C. The unbound states of ^{17}C and ^{19}C are also studied in breakup reactions with protons. Our obtained wavefunctions are applied to XCDCC calculations [Phys. Rev. C 95 (2017) 044611] and the results are compared with the experimental data from [Phys. Lett. B 660 (2008) 320].

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Session Classification: Parallel session

Track Classification: Nuclear Structure, Spectroscopy and Dynamics