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Peripherality of nuclear-dominated breakup reactions

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The development of radioactive-ion beams in the mid-80s has enabled the exploration of the nuclear chart far from stability. This technical breakthrough has led to the discovery of nuclear structures unobserved at the bottom of the valley of stability: shell inversion, halo nuclei etc. [1] At the heart of these discoveries are nuclear reactions used to probe the structure of short-lived nuclei. Breakup reactions, inclusive or exclusive, have been extensively used to study the single-particle structure of nuclei far from stability [2]. In particular, spectroscopic factors have been systematically inferred from knockout reactions on light targets, viz. ^{9}Be or ^{12}C. Unexpectedly, these values differ significantly from shell-model predictions [3]; they also do not agree with spectroscopic factors obtained from single-nucleon transfer measurements [4]. To try and understand these differences, we study systematically the sensitivity of nuclear-dominated breakup reactions to the projectile wave function [5,6,7,8]. Contrary to the common belief, these reactions remain quite peripheral, in the sense that they probe mostly the tail of the single-nucleon overlap wave function. More precisely, the knockout cross section scales very well with the rms radius of the projectile wave function, and not the square of its norm, i.e. the spectroscopic factor [8]. Since this is true for both loosely- and deeply-bound nucleons, this result may explain the systematic disagreement between various reaction probes. It also suggests a new method to infer the neutron radius of nuclei far from stability.

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Collaboration

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