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Knockout to probe proton contributions to the B(E2) transition strength in the C isotopes

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The carbon isotopes represent one of the few cases where it is possible to obtain data from stability to the dripline, and to carry out no-core shell model ("ab-initio") calculations across the isotopic chain. Thus, data along the Z=6 isotopes can provide stringent constraints and tests of modern nuclear theories that aim to describe nuclear structure approaching the driplines.
One experimental observable along the C chain that provides a sensitive probe of the details of the nucleon effective interactions is the B(E2) electric quadrupole transition strength. The B(E2) can provide information on the coupling between valence neutrons and the core, and any possible effects of weak-binding, particularly where the low-lying 2^+ state has a predominant neutron excitation. In the case of the C isotopes, changes in the observed B(E2) approaching the dripline are understood in terms of a changing proton contribution, rather than decoupling of the valence neutrons from the core at ^{20}C, as was initially postulated. However, to draw final conclusions regarding the extent of any neutron decoupling, it is critical to know how the transition strength is partitioned between the protons and neutrons. Changes and uncertainties in proton occupation will dramatically influence the interpretation.
I will report on the results of an experiment at NSCL to probe the amplitude of p-shell protons in the low-lying 2^+_1 states along the C isotopic chain through proton knockout from the corresponding N isotopes. By considering the cross-sections to populate the 2^+ excited states and 0^+ ground states in the C, we are able to constrain the proton contribution to the B(E2) transition strengths, and isolate any effects arising from neutron-core coupling.

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