DNP13-2013-000431

Abstract for an Invited Paper
for the DNP13 Meeting of
the American Physical Society

Three-nucleon forces for exotic oxygen isotopes

JASON HOLT, TU Darmstadt

The oxygen isotopes, with an experimentally well established dripline ($N = 16$) anomalously close to the valley of stability, provide an ideal laboratory to study the structure of extreme neutron-rich nuclei at and beyond the limits of existence. The emergence of $N = 14, 16$ as new magic numbers and properties of the unbound ^{25,26}O isotopes pose particularly challenging benchmarks for models of nuclear forces and many-body methods aiming at a description of exotic medium-mass nuclei. At the heart of these efforts is three-nucleon (3N) forces, whose impact represents a current frontier in nuclear structure theory. I will discuss the first microscopic framework, based on chiral effective field theory and renormalization group methods, in which neutron-rich oxygen isotopes were explored from a systematic treatment of NN and 3N forces. In this approach we found that the repulsive effects of 3N forces were decisive in explaining why ^{24}O is the heaviest oxygen isotope. Furthermore, 3N forces play a key role in reproducing spectra, including signatures of doubly-magic ^{22,24}O, and unbound properties without empirical adjustments. Finally I will discuss subsequent progress in ab-initio efforts with 3N forces such as coupled cluster theory, in-medium similarity renormilazation group, and Green's function theory, where a consistent picture of the oxygen isotopic chain emerges, which is highly encouraging for first-principles calculations of exotic nuclei well into the medium mass region.