ID: 7.0d

Title: Towards a unified description of nuclear structure and reactions with coupledcluster theory

Name: Hagen, Gaute

Affiliation: Oak Ridge National Laboratory

The nuclear many-body problem is a challenging undertaking. Coupled-cluster theory presents us with an ideal compromise between computational cost on the one hand and numerical accuracy on the other hand. For this reason coupled-cluster theory is a very promising candidate for pushing the ab-initio nuclear structure and reaction program into regions of medium mas. Recently we developed spherical coupled-cluster theory for the description of ground- and excited states in the odd mass A±1 and A±2 neighbors of the closed shell nucleus with mass A. In Ref. [1] we presented the first coupled-cluster calculation of the1/2+ halo state in 17F and the 3/2+ resonances in 17F and 17O with nucleon-nucleon forces from chiral effective field theory. We found that coupling with the continuum gives a significant amount of additional binding for the low-lying states in 17O and 17F. Our calculation of the 1/2+ state in 17F agree remarkably well with experiment, and we argue that this state is insensitive to short ranged three-nucleon forces. Moreover, we have extended the coupled-cluster method to calculate one-nucleon overlap functions and spectroscopic factors of neutron rich nuclei. In Refs. [2] we computed spectroscopic factors for neutron and proton removal of the oxygen isotopes 14-28O. We found a significant quenching of the spectroscopic factors for proton removal in the neutron rich oxygen isotopes. The quenching points to strong correlations in the neutron rich oxygen isotopes coming from coupling to the scattering continuum. Our results also supports the accumulated evidence that 24O is a closed shell nucleus. This opens up the possibility for studying nuclear breakup and transfer reactions with ab-initio coupled-cluster theory. [1] G. Hagen, T. Papenbrock, M. Hjorth-Jensen, Phys. Rev. Lett., 104, 182501 (2010). [2] ÿ. Jensen, G. Hagen, M. Hjorth-Jensen, B. A. Brown, A. Gade, Phys. Rev. Lett.107, 032501, (2011).