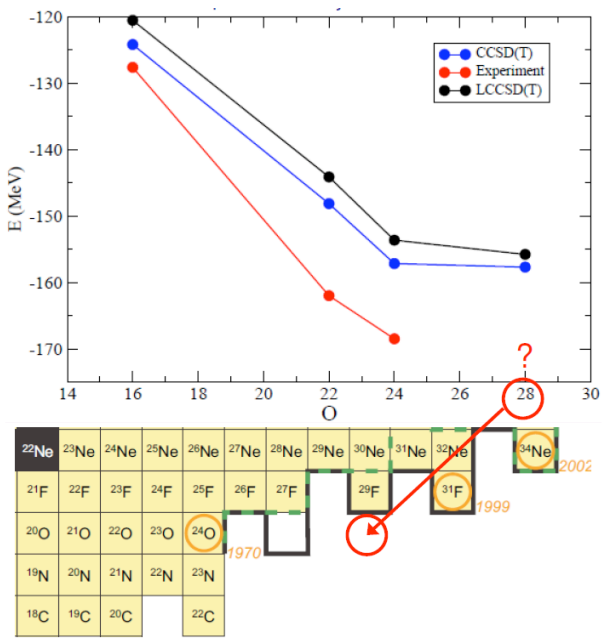
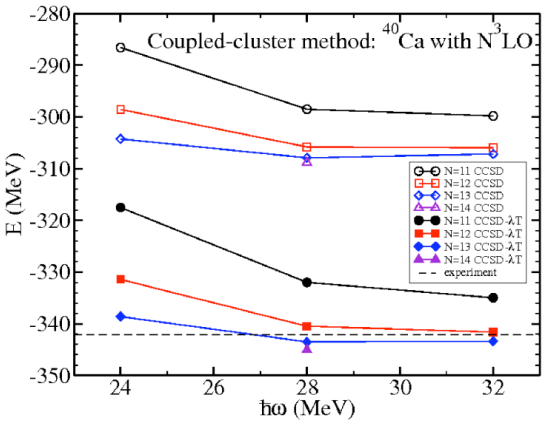
Ab-initio calculations of medium-mass and drip-line nuclei



The neutron drip line is not yet known for oxygen isotopes – to date, ^{24}O is the heaviest known bound oxygen isotope. The cross sections for the production of even more neutron-rich isotopes fall off rapidly with increasing number of neutrons. This is an opportunity for theoretical first-principle calculations to make predictions. Within the coupled-cluster method, we start from modern nuclear interactions that are rooted in quantum chromo dynamics. The calculations are computationally expensive and performed on ORNL's supercomputers. [1]



Employing the coupled-cluster method and modern nuclear interactions that are rooted in quantum chromo dynamics, we are presently able to compute benchmark nuclei such as ^{40}Ca. The extension of ab-initio methods to medium-mass and heavy nuclei enables us to validate more phenomenological methods. Future calculations for neutron-rich nuclei such as ^{78}Ni will enable us to guide experiment. [2]

References

[1] "Complex coupled-cluster approach to an ab-initio description of open quantum systems," G. Hagen, D. J. Dean, M. Hjorth-Jensen, and T. Papenbrock, Phys. Lett. B656, 169 (2007).
[2] "Medium-mass nuclei from chiral nucleon-nucleon interactions," G. Hagen, T. Papenbrock, D. J. Dean, and M. Hjorth-Jensen, Phys.Rev.Lett.101, 092502 (2008).