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Coupled-clusters and quantum computing[1]

THOMAS PAPENBROCK, Univ of Tennessee, Knoxville

This talk presents predictions from coupled-cluster calculations of rare isotopes and first results from quantum computing an atomic nucleus.

Rare doubly-magic nuclei play an important role because they determine the structure of entire regions in the nuclear chart. In recent years, the computation of rare isotopes such as ^{48,52,54}Ca, ^{78}Ni, and ^{100}Sn and their neighbors – based on interactions from effective field theories of quantum chromodynamics[2] and using controlled approximations only[3] – led to predictions for neutron skins[4] and the evolution of shell structure in isotopes of calcium[5], nickel[6], and tin[7].

Quantum computers promise to reduce the computational complexity of simulating quantum many-body systems from exponential to polynomial. Very recently, quantum computing devices have started to solve small scale, but real-world many-body problems in chemistry and magnetism[8]. This talk presents the quantum computation of the deuteron via cloud servers[9]. This is a first step towards scalable nuclear structure computation on a quantum processor unit via the cloud, and our results shed light on how to map scientific computing applications onto nascent quantum devices.

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