ADVANCES IN SELF-CONSISTENT GREEN'S FUNCTION CALCULATIONS OF MEDIUM MASS ISOTOPES

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The computational effort required by Self-consistent Green's function theory (SCGF) scales smoothly with increasing particle number. At the same time, the theory naturally yields information on the spectral distribution of correlated particle and hole states inside the medium. As such, SCGF is the method of choice for ab-initio investigations of medium mass nuclei and to learn how their structure evolves toward the driplines. This talk will review recent results from nuclear interactions based on chiral perturbation theory and on lattice QCD simulations.

Ab-initio SCGF results for standard chiral interactions have confirmed the role of three-nucleon forces (3NF) in determining the dripline behaviour of isotopes from N to F [1] and from Ar to Ti [2]. At the same time, the lack of saturation led to a refit of chiral interaction to correctly predict nuclear radii (NNLOsat). I will discuss new SCGF results for Oxygen isotopes and for the pf shell up to the Ni chain. The NNLOsat predicts correct radii near the valley of stability but with a tendency to deviate for neutron rich isotopes. Correspondingly, the spectral function distribution is improved with respect to traditional chiral interactions.

The method exploited by the Hadron to Atomic nuclei form Lattice QCD (HALQCD) collaboration consists in extracting the nucleon-nucleon interaction from lattice simulations and then using it for ab-initio calculations of large nuclei. The numerical accuracy of SCGF theory with these (hard) potentials is sufficient to draw conclusions on binding for nuclei up to ^{40}Ca. The HALQCD approach predicts a curious evolution of the nuclear chart with respect to the variation of quark masses, with isolated islands of binding being generated first when the physical quark-mass limit is approached from above [3].

REFERENCES

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