Dissertation Proposal

Computational Science Research Center

San Diego State University

University of CA, Irvine

Quantum Monte Carlo Calculations of $n + {}^3\mathrm{H}$ Scattering

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2:30 pm
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A long-standing goal in nuclear physics is the unified computation of bound and unbound nuclei in a single framework based on realistic nucleon-nucleon interactions. Quantum Monte Carlo (QMC) technique have a successful history of accurately computing bound states; until recently, QMC methods have seen very little progress in computing unbound states. My main objective is to conduct the first coupled-channel scattering calculations in the Green's function Monte Carlo (GFMC) method. I will do this in a computation of scattering observables for the neutron-triton ($n + {}^3\mathrm{H}$) system. This work will build on calculations of the same system I have already carried out in the variational Monte Carlo (VMC) method. Wave function from those calculations will provide starting points from which GFMC can project out essentially exact wave functions. The routines for nucleon-nucleus scattering exist today in the standard GFMC computer code but have only been used for the $n + {}^4\mathrm{He}$ system. I will compute single-channel cases in $n + {}^3\mathrm{H}$ using the existing code. Complete calculations of the neutron-triton system require dealing additionally with three sets of coupled channels; this will require extending the GFMC code to impose separate boundary conditions in different channels of the same wave function. The surface amplitudes of the wave function encode information that determines the scattering observables in coupled channels, which I will obtain using the integral relations and the routines for computing them that I developed previously in the VMC context. I will perform the calculations described using several representations of the nucleon-nucleon interaction. This will include potentials used in benchmark calculations from the literature and the new generation of local chiral interactions. Calculations using the chiral potentials should help guide the future development of potentials in that framework.

Advisors: Kenneth Nollett