Title:
Nuclear Forces from Quantum Chromodynamics

Abstract:
A century of coherent experimental and theoretical investigations have uncovered the laws of nature that underly nuclear physics.
Quantum Chromodynamics (QCD) and Quantum Electrodynamics (QED), both quantum field theories with a small number of precisely constrained input parameters, dominate the dynamics of the quarks and gluons - the underlying building blocks of protons, neutrons, and nuclei.
While the analytic techniques of quantum field theory have played a key role in understanding the dynamics of matter in high energy processes, they encounter difficulties when applied to low-energy nuclear structure and reactions, and dense systems.
Expected increases in computational resources into the exa-scale during the next decade will provide the ability to determine a range of important strong interaction processes directly from QCD, with quantified uncertainties, using the numerical technique of Lattice QCD.
This will complement the nuclear physics experimental program, in particular FRIB at MSU and the JLab 12 GeV program, and in partnership with new thrusts in nuclear many-body theory, these combined experimental and theoretical efforts will enable unprecedented understanding and refinement of nuclear forces and, more generally, the visible matter in our universe.
In this presentation, I will discuss the state-of-the-art Lattice QCD calculations of quantities of interest in nuclear physics, progress that is expected in the near future, and the anticipated impact.