Argonne NATIONAL LABORATORY

PHY Seminar

Physics Division Seminar

Michael Bishof

Physics Division, Argonne National Laboratory

Quantum Simulation of Nuclear Physics

Host: Peter Mueller

Monday, March 2, 2020 – 203, R150, 3:30 PM

Quantum computers are poised to have a transformational impact on nuclear physics because they present an opportunity to overcome classical computation's inability to solve significant problems (e.g., the quantum many body problem, hadronization, and the nuclear matter equation of state). Current quantum devices have demonstrated rapid progress and now contain around 50 non-error-corrected qubits with limited connectivity. However, universal quantum computers capable of arbitrary calculations are many years away and are unlikely to reach the scale necessary to calculate hard problems in quantum chromodynamics (QCD) in the near future.

To accelerate the impact of quantum information science on nuclear physics we plan to develop a quantum simulation apparatus tailored to address quark-level effective field theories of QCD. In contrast to a quantum computer, which maps a problem to a set of gates performed on quantum bits, quantum *simulators* gain insight into quantum systems by manipulating the experimental system to behave like the system being studied. In this talk I will review current state-of-the art quantum devices and recent work using these systems that are relevant to nuclear physics. I will also describe the system we plan to build, our unique approach to quantum simulation, and how our proposed project harnesses the strengths of Argonne National Laboratory and surrounding universities to advance both nuclear physics and quantum information science.