Grand challenges for Nuclear Theory and QI

NP=QCD

Many body systems in QCD
(sign problem)

Particle production,
Thermalization,
Entanglement
Floerchinger

1+1 d Schwinger

⬇

1+1 d QCD

⬇

scalar theory in
1+1 d (scattering)
3+1 thermalization
    (gauge theories
        are too difficult)

Tensor networks for
Real time dynamics ?

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pionless EFT, chiral EFT:
nuclear structure,
reactions,
nuclear/neutron matter
Dean, Roggero,Pooser

For which problem
QC has advantage
over classical methods ?

Hamiltonian Lattice QCD

Effects of truncated
Hilbert space ? Kaplan, Vertstraete
Test using classical
computing
The continuum limit ?
QCD thermodynamics in ?
Hamiltonian formulation ?

Realization:
Quantum computers, Savage,
Muschik
Cold atoms as quantum simulators,
Zohar, Meurice, Bazavov

Path forward:

Need to have a Hamiltonian LQCD community to lay theoretical groundwork
How to establish international collaboration in this area ?

Need a focus effort to study entanglement in hadronic collisions

Start exploring nuclear structure and reaction
Using hybrid variational approach

How to provide seed funding for QI in nuclear physics given the 2015 Nuclear
Physics Long Range Plan or the next Long Range Plan ?
How to turn seed funding to robust funding without negative effects of the
high priority programs outlined in 2015 Long Range Plan.

Structure of the White Paper ?