Old Dominion University
Department of Physics
Colloquium

Tuesday, April 2, 2024

"A Two-Way Communication Between High-Energy Physics and Quantum Technologies"

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Abstract:

This talk explores the exciting synergy between high-energy physics (HEP) and quantum technologies. We present results from our interdisciplinary collaboration, showcasing how quantum tools are revolutionizing our understanding of fundamental forces and vice versa.

1. Simulating the Strong Force: We demonstrate how tensor network algorithms, a powerful technique from quantum information, offer a novel approach to tackle real-time problems in lattice gauge theories (LGT), which are the cornerstone for studying the strong force (QCD). This paves the way for investigating out-of-equilibrium phenomena like dynamical string breaking, a key process in hadron formation.

2. Quantum Computing QCD: We delve into the realm of quantum simulation, exploring how quantum technologies can be harnessed to directly calculate "light-front parton correlators" - essential quantities in QCD that encode the non-perturbative (complex) behaviour of strong interactions. This opens doors to ab initio (from first principles) calculations, bypassing the limitations of traditional perturbative methods.

3. Decoherence-robust Qubits: Finally, we explore the intriguing connection between anomalous symmetries and fault-tolerant qubits. We show how the concept of anomaly, a well-established principle in HEP, can explain the remarkable resilience of certain types of qubits (0-π qubits) to decoherence, a major obstacle in building large-scale quantum computers.

Presentation: OCNPS 200 @ 3:00 pm
Refreshments: OCNPS Atrium @ 2:30 pm

All interested persons are cordially invited to attend.