



Department of Physics Colloquium

April 22, 2024



3:00 PM

Exploring the Structure and Dynamics of Matter in High-Energy Collider Experiments at Brookhaven National Laboratory

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Scattering experiments have played an important role in our current understanding of the world around us. This field aims to answer profound questions such as the origin of the proton mass and spin. Numerous experimental results have contributed in the last decades to test and explore the field theory among quarks and gluons, known as Quantum ChromoDynamics (QCD). In contrast to the physics at large distance scales (e.g., atomic, molecular, and nuclear), the mass of the proton originates predominantly in the interactions among its constituents rather than in the bare masses of the constituents themselves. The strong force that confines quarks inside the proton leads to abundant gluons and quark-antiquark pairs. Those are crucial silent partners in matter, making dominant contributions to our visible universe.

High energy polarized $p + p$ collisions at the Relativistic Heavy-Ion Collider (RHIC) provide a unique way to probe the proton spin structure and dynamics using well-established scattering processes. The production of jets and hadrons is the prime focus of gluon polarization studies. The production of $W^{-(+)}$ bosons at provides an ideal tool to study the spin-flavor structure of the proton.

I will summarize the final 'textbook-style' results concerning the spin structure and dynamics of quarks and gluons obtained by the STAR experiment at RHIC, along with future plans under the leadership of the Temple University NUPAX (NUclear-PARTicle eXperiment) group. I will conclude the colloquium with a brief discussion of the status and plans for the US-based Electron-Ion Collider facility to be realized at Brookhaven National Laboratory, including remarks about the overall project status, the current ePIC detector design, and the anticipated timeline. This program has provided and continues to provide outstanding research opportunities for students and postdoctoral fellows at Temple University, generously funded by the Department of Energy.

This colloquium will be held in-person, in SERC 116