PHYSICS COLLOQUIUM

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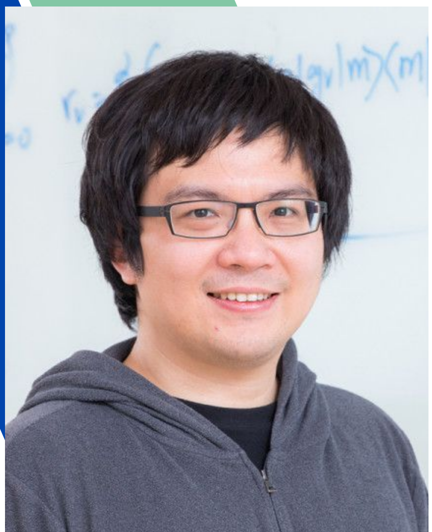

Nucleon Structure from Quantum Chromodynamics

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The origin of matter is one of the longest standing mysteries that have captured the human imagination. The modern description of particle and nuclear physics hypothesizes that our matter filled universe must have resulted in the underlying physical processes favoring the preservation of matter over antimatter during the initial formation of our universe. This mechanism is attributed to the fundamental breaking of particle and antiparticle symmetry in physics beyond the Standard Model. One source of asymmetry is hypothesized to reside in the neutrino sector, and intense international efforts are being pursued to observe this phenomena in neutrino scattering experiments. Precise interpretation of experimental observations benefits from a Standard Model prediction of how nuclear matter interacts with neutrinos. The modern theory governing matter and their properties is the theory of the strong interaction, quantum chromodynamics (QCD). In this talk I will discuss a QCD calculation of the nucleon form factor at zero momentum transfer, which is related to how a neutrino at rest interacts with a single proton or neutron, followed by current progress on the calculation of the proton radius which is related to the slope of the form factor. Together the calculations paves a novel way forward towards a precise determination of the nucleon form factor up to momentum transfer relevant for neutrino scattering. I will end the talk by discussing future milestones and challenges as we work towards calculations for nuclear physics starting from QCD.