Over 99% of the known mass of the universe is composed of two particles: the proton and the neutron. Collectively known as the nucleon, they are the basic building blocks of all atomic nuclei. However, these 'basic' particles themselves possess a complex substructure. Our understanding of this structure has benefited greatly from a program of electron-nucleon scattering spanning many decades, which indicates that the nucleon consists of point-like quarks and gluons. The latter serves as mediators of the strong interaction that holds the quarks together, and it is this force which is ultimately responsible for nuclear binding. One of the driving goals of nuclear physics is to characterize the fundamental properties of the nucleon to allow comparison with theory. Only then can we obtain a quantitative understanding of the nucleon's substructure, ultimately providing a description of atomic nuclei from first principles.

Nucleon spin structure is characterized by two dimensionless functions known as g_1 and g_2. Precise measurements of both these quantities are needed for a complete understanding of spin-dependent properties. I am primarily interested in reactions where the momentum transfer Q^2 of the electron scattering process is small. The wavelength of the electro-magnetic probe is inversely proportional to the momentum transfer, so when Q^2 is small, the full volume of the nucleon is probed and the interactions among constituents can not be ignored or treated perturbatively. In this complex 'long distance' region, the nucleon spin structure functions (SSF) become notoriously difficult to derive from first principles. However, insight has been gained by testing fundamental sum rule predictions which govern the behavior of their moments. Some of these, such as the Bjorken sum rule, provide direct tests of Quantum Chromodynamics, while others such as the extended GDH, and the Burkhardt-Cottingham (BC) sum rules allow us to test some of the underlying assumptions inherent in the theory. As one of the fundamental spin observables of the nucleon, precise knowledge of the SSF at low Q^2 has broad ranging impact, and is needed for disciplines as diverse as Lattice Gauge calculations to atomic physics.

My research program centers on measurements at Thomas Jefferson National Laboratory. I serve as spokesman for **E08-027** which is scheduled to run in 2011. This experiment will provide the first precise measurement of the proton's g_2 structure function at low Q^2. This data will address several interesting open questions. For example, existing neutron data supports the BC sum rule, while previous proton measurements were found to be inconsistent with the sum rule prediction. Even more compelling, it was found that state-of-the-art chiral perturbation theory calculations exhibit a significant discrepancy with the longitudinal-transverse polarizability δ_{LT}^n. Measuring the proton polarizability is a crucial step in resolving this puzzle. Finally, lack of knowledge of the g_2^p structure function at low Q^2 is one of the leading uncertainties in hydrogen hyperfine splitting calculations.

My other major commitment is as co-spokesperson of **E06-017**, which is part of the EG4 rungroup. EG4 measured the proton and deuteron spin structure function g_1 at low Q^2. Three students are performing their PhD work on this experiment. In addition, UNH Research Associate Sarah Phillips recently began to analyze the deuteron quasielastic data with an ultimate goal of providing the first high quality deuteron polarized cross sections and asymmetries in this region.