

Research Statement

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We have focused all of our research activity at the Thomas Jefferson National Accelerator Facility (TJ-NAF). Our goal is to address some of the fundamental questions in nuclear physics. The facilities of Hall A at TJNAF offer a unique opportunity to investigate the nucleon and nuclear properties through a variety of reactions over a broad range of probing energy and distance scale. In the last year we have invested most of our resources in analyzing the results of the first ambitious polarized ^3He experiment in Hall A, namely experiment E94-010. It is part of the polarized ^3He program in Hall A, which includes five experiments that will explore different aspects of the spin structure of the nucleon in two regimes of QCD, the perturbative as well as the non-perturbative regime. We found it important to focus all of our efforts making this experiment successful especially given the impact it has on the scheduling of the subsequent polarized ^3He experiments. The target offers the opportunity to investigate the neutron and ^3He through spin observables. The Temple University group in collaboration with JLab has completed its commitment described in the TJNAF-Temple University Memorandum of Understanding. Experiment E94-010 ran successfully and all of the equipment needed for establishing the main magnetic field (double Helmholtz coils) and performing the polarization measurement by nuclear magnetic resonance was the responsibility of this group. Furthermore the Temple University group is taking a leading role in the analysis of this experiment. I am the Spokesperson for this experiment.

In the next two years we have chosen three physics themes to address:

1. The spin structure of ^3He (neutron) in the valence region at high Q^2 and in the resonance region at low Q^2 ; Experiment E99-117 will test the behavior of the spin structure of the neutron in the valence region (large Bjorken x region and large Q^2) taking advantage of the 6 GeV beam, whereas Experiment E97-110 will use the septum magnet which will be installed in Hall A to extend experiment E94-010 to very low Q^2 and higher excitation energies, again using the 6 GeV beam. Experiment E99-117 will take data starting June, 1st, 2001. I am Spokesperson of this experiment.
2. The investigation of the strangeness structure of the nucleon through parity violation in electron scattering; As a first search for strangeness, Jlab E91-010 experiment ran very successfully but the level of precision, although impressive compared to world experiments, still leaves open the question of the role of strangeness in the nucleon structure. One can conclude that if finite, the effects of the strange degrees of freedom are small at high Q^2 . Because up to now measurements have focussed in a high Q^2 region, it is difficult to discriminate among the existing models which predict a small effect. However guided by the Q^2 dependence of these models another search will be attempted at lower momentum transfer in experiment E99-115, where the predicted size is large and the sign of the effect is opposite in different models.
3. The Coulomb sum rule and possible modification of the nucleon form factors in the nuclear medium; This theme has been and still is a long standing problem in nuclear physics, contrary to what has been claimed recently in the literature. In light of the new experimental proof that the Effective momentum approximation is valid even in heavy nuclei, we have reanalyzed the world data and found that the quenching of the Coulomb sum rule persists. We have developed a full proposal for PAC19 to extract the transverse and longitudinal response function from light to heavy nuclei from $550 < q < 1000$ MeV in Hall A at Jefferson lab. This measurement would provide a precision two times better than the world data in the overlap region and shall cover a momentum transfer where only short range correlations would survive. The contribution of those correlations is almost model independent at high momentum transfer and cannot reach more than 10%. Our proposal has been endorsed by the Hall A collaboration and has been approved by PAC19 which met at Jefferson Lab on January 29, 2001. The proposal was ranked is A⁻ and 26 days of beam time were awarded.

During the past two years I have been actively involved with the CEBAF 12 GeV upgrade at JLab. At the end of March, 2000 we hosted an international workshop for three days to investigate the nucleon structure physics (polarized and unpolarized) in the valence quark x region. We have produced a document that describes in detail key experiments and detectors important to the CEBAF 12 GeV upgrade. I have been also part of the steering committee whose responsibility was to produce the 12 GeV upgrade physics justification document submitted to the Nuclear Science Advisory Committee.