Notre Dame Science
Department of Physics

BUILDING NUCLEONS AND NUCLEI FROM QUARKS AND GLUE: NUCLEAR PHYSICS RESEARCH AT JEFFERSON LAB, NOW AND IN THE 12 GEV ERA

Colloquium

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Wednesday, May 2, 2012 – 4:00 P.M. NSH 118
(Refreshments at 3:30 P.M. NSH 202)

The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab provides a unique tool for the study of atomic nuclei by providing intense, cw beams of polarized electrons with energies of up to 6 GeV. For over a decade now, CEBAF has supported a broad range of nuclear physics research aimed at addressing key questions in the field, such as: how nucleons are constructed from the quarks and gluons of QCD; how the strong force arises from the underlying QCD quark-quark interaction; and where the conventional description of nuclei based on nucleons interacting via the nuclear force breaks down. More recently, another major line of research has emerged that is testing the Standard Model through very high precision experiments at low energies. The broad outlines of this research will be reviewed, and examples of results from recent experiments will be presented.

A project is now underway to enhance CEBAF's research capabilities by doubling its beam energy to 12 GeV and constructing an expanded suite of scientific instrumentation. An overview of the project and its status will be presented. Finally, the new science that will become feasible upon completion of this upgrade now will also be discussed. It includes: the study of hybrid mesons, which involve excited states of glue, to explore the nature of quark confinement; dramatic improvements in our understanding of the QCD structure of the hadrons through both the extension of our knowledge of their parton distribution functions to high $x_{Bjorken}$, where they are dominated by underlying valence quark structure, and a program of nucleon "tomography" via measurements of the Generalized Parton Distributions (GPDs); a broad program of experiments in the physics of nuclei that aims to understand the QCD basis for the nucleon-nucleon force and how nucleons and mesons arise as an approximation to the underlying quark-gluon structure; and precision tests of the Standard Model through parity violating deep inelastic and Møller scattering.

All interested persons are cordially invited to attend.