

### The Intellectual Merit of the Proposed Activities

The ISU group has an established research record in several ongoing fundamental physics programs at Jefferson Lab. These programs include nucleon spin structure and resonance studies, analysis of vector meson and hyperon photoproduction from experiments g8b and g13a/b, analysis of precision  $\pi^0$  photoproduction data from the PrimEx experiments, and precision measurements of parity violating electron scattering from the  $Q_{weak}$  and MOLLER experiments. In Support of the Jefferson Lab 12 GeV upgrade, the ISU group is currently constructing and testing the CLAS12 Region I drift chambers at ISU. In addition, Dr. Tony Forest and Dr. Philip Cole are co-spokespersons on approved 12 GeV Hall B experiments PR12-06-109 and PR12-09-003, respectively. Dr. Cole is presently focused on comprehensive measurements of vector meson and hyperon photoproduction employing linearly polarized photons to improve our understanding of the underlying symmetry of the quark degrees of freedom in the nucleon, the nature of the parity exchange between the incident photon and the target nucleon, and the mechanism of associated strangeness production in electromagnetic reactions. Dr. Dan Dale is a spokesperson of the PrimEx Collaboration which is focused on a high precision measurement of the  $\pi^0$  lifetime as a test of the QCD chiral anomaly plus corrections. This measurement provides a stringent test of the fundamental predictions of quantum chromodynamics in the confinement scale regime. Dr. Dustin McNulty is the simulation subgroup leader of the Hall A MOLLER experiment and is actively engaged in both development and use of the simulation to design and prepare for the experiment. This work includes spectrometer design and optimization, collimation and acceptance studies, and background assessment and correction strategies. MOLLER utilizes parity violation in Moller scattering to perform an ultra-precise measurement of the weak mixing angle in search of physics signatures beyond the standard model. Dr. Forest is a  $Q_{weak}$  collaborator leading an effort (LOI-03-105) to probe the QCD symmetry breaking effects observed in hyperon decay measurements via the parity violating asymmetry in the  $N \rightarrow \Delta$  transition. This measurement will determine the low energy constant  $d_\Delta$  and provide crucial data necessary for the  $Q_{weak}$  background event correction.

### Broader Impacts of the Proposed Activities

In addition to the scientific program described here, this proposal represents a major effort in the area of educating future scientists. The present shortage of graduate students in experimental and theoretical nuclear physics is having a detrimental impact on our national laboratories and facilities which possess a plethora of data but limited manpower for analyzing and disseminating the information. The Idaho State University Department of Physics is comprised of twelve tenure track faculty, all of whom have research interests which are in some way connected to nuclear physics and are in a position to directly address the shortage of graduate students. With its on campus accelerator and detector laboratories, the Department focuses on experimental and applied physics, giving students a strong hands-on educational experience. ISU's physics program is relatively new and rapidly growing. Last year, ISU physics faculty brought in approximately \$8 million in external research funds. Its Ph.D. program, established in the Fall of 2005, presently has approximately 30 students with an additional 15 students pursuing research at the M.S. level.

The PI's are further strengthening the ISU graduate program by recruiting high-caliber students from Latin America. Latin America is an under-tapped intellectual resource. The Intermediate Energy Nuclear Physics Group has strong ties to Colombia and has attracted four talented graduate students into nuclear physics at ISU; three are working on JLab-related projects and one graduated in late 2009 and is now an Assistant Professor in Bogotá, Colombia. The activities delineated within this proposal will provide another avenue through which the program can continue to solidify this mutually beneficial bridge of collaboration among countries in the Americas.