Jefferson Lab
Proposal Cover Sheet (Generic)

Experimental Hall: A
Days Requested for Approval: _____

Submission Date: 5/94
Other: PAC 8

☐ **New Proposal Title:**
☒ **Update Experiment Number:** E 89-003
☐ **Letter-of-Intent Title:**
(Choose one)

Proposal Physics Goals
Indicate any experiments that have physics goals similar to those in your proposal.

Approved, Conditionally Approved, and/or Deferred Experiment(s) or proposals:

Contact Person

Name: Robert Lourie
Institution: University of Virginia
Address: Department of Physics
Address:
City, State, ZIP/Country: Charlottesville, VA 22901
Phone: (804) 924-6809 **Fax:**
E-Mail: Lourie@virginia.edu

Jefferson Lab Use Only
Receipt Date: 5/94 PR 94-024
By: _____

Update of Activities relating to experiment E-89-003

Study of the Quasielastic $(e,e'p)$ Reaction in ^{16}O at High Recoil Momenta

W. Bertozzi, R. Lourie, A. Saha and L. Weinstein, Spokespersons

This is a Hall A Collaboration experiment.

There continues to be a very strong interest in the $^{16}O(e,e'p)$ reaction studies. Experiments at Saclay, NIKHEF and presently at Mainz are continuing to attempt to understand various aspects of the nuclear structure through the separation of the response functions and the study of correlations in ^{16}O and other nuclei. The data from Saclay and NIKHEF on ^{16}O show a large discrepancy in the interference response function R_{lt} for the $p_{3/2}$ state whereas for the $p_{1/2}$ state there is good agreement [L. Chinitz et al., PRL 67, 568 (1991) and C. Spaltro et al., Phys.Rev. C48, 2385 (1993)] Also, the data taken at Saclay at higher missing energies and missing momenta (p_m=300 and 500 MeV/c) display an enhancement of the momentum distribution which is indicative of nucleon correlations in the ^{16}O wavefunctions. The data from Mainz, at high missing momentum (but low momentum transfer) are as yet very preliminary, but show an increase of the momentum amplitude of the $p_{3/2}$ state over that of the $p_{1/2}$ state at high missing momenta. Due to the limitations in beam energy and experimental facilities available in all these laboratories (<850 MeV), it is difficult to effectively reach the kinematic domains necessary to make a detailed and systematic study of these investigations. As more data become available, we intend to review the experimental situation and we are prepared to modify our kinematics to maximize the effectiveness of our measurements by making use of the superior luminosity and energy of CEBAF to explore kinematic situations that are interesting and not possible at these lower energy facilities.

Calculations for Oxygen are rapidly improving and we expect that variational wavefunctions may soon be available (Wiringa and Pieper, as one example). Similarly, the MIT theory group is moving towards improving the modelling of the $(e,e'p)$ reaction (Kerman).

Experimental requirements:

This experiment requires the standard resolution for the spectrometers in Hall A (3×10^{-4} in momentum and 1 mr in angle) and a fairly well understood system.

This experiment requires only a part of all the standard equipment initially planned for Hall A. It requires the full capabilities of the two high resolution spectrometers, but does NOT require the focal plane polarimeter, the high powered cryo-target system or a polarized beam. Most of the proposed measurements can be done using the precision of the beam and magnetic spectrometers that the Hall A collaboration plans to achieve during the first year of operation of Hall A. In general it incorporates many of the experimental requirements of most of the approved Hall A coincidence program and we believe that it should be included in the first group of experiments to be performed in this series.

Spectrometers:

The construction of the spectrometers in Hall A is proceeding and many details will be presented by Dr. Nanda at the PAC meeting. This experiment requires standard resolution and a fairly well understood system. No special detectors are needed. Some of the spokespersons have specific components they are responsible for. We report briefly the progress in some of these specific areas.

Group Activities

Focal Plane Chambers:

The tracking chambers are of the vertical drift design, the same for both the electron and hadron spectrometers. A prototype of identical width as the actual chambers but of about half the length has been constructed and tested at MIT. The tests included measuring spatial resolution, wire to wire and plane to plane crosstalk, efficiency for particle detection and general features of operation such as stability and dark current. Another important test is the accuracy of the construction technique with respect to the placement of the wires. In all areas, the prototype met or exceeded the specifications required to allow the spectrometers to reach the performance needed for the most demanding experiments planned at CEBAF in terms of energy resolution and absolute precision. The design results in a very stable operation with very little dark current. All of the three hundred wires of the prototype were positioned within $\pm$ 35 microns, well within the design requirements. The actual chambers are under construction at this very moment at MIT. Delivery at CEBAF is projected to be on schedule.

The prototype chamber will be installed in the focal plane of the OHIPS spectrometer at the Bates-MIT Laboratory in summer 1994. The plan is to use the chamber with particles from the spectrometer in actual running conditions and to accumulate millions of tracks to study off-line, various problems associated with track reconstruction. These include affects of cell boundaries and the understanding of efficient algorithms that maintain track precision for position and angle. The chamber will be used in Bates experiments to improve the present angle definition as well. The experiments will provide us with experience that should allow the system installed at CEBAF to become operational in a very short time considering that it is a newly installed device with completely new acquisition code. It should be complete with analysis codes.

The MIT group has acquired though CEBAF a Hewlett Packard computer and a representative portion of the electronics that will be used with the chambers in data acquisition. In collaboration with the CEBAF scientists in Hall A the acquisition system CODA has been installed. We plan to use this system for testing the new chambers and for the development of acquisition and track reconstruction algorithms. This development should be directly transportable to the CEBAF environment and require no modifications for computer or system differences.

The MIT group played a strong role in the design of the trigger and particle identification requirements of the Hall A system and has continued its participation in a coordinating role. These systems continue to follow the requirements set early in the planning stages, will be adequate for the purposes of this experiment and are on schedule.

Targets:

The Italian group (INFN, Rome - F. Garibaldi, S. Frullani.) have undertaken the responsibility to design and construct a waterfall ^{16}O target system for Hall A and have signed an MOU with CEBAF to this effect. They have successfully implemented this target system to run at Saclay and at NIKHEF. A series of three such waterfalls will provide us with the required thickness of target while maintaining resolution. If the thickness desired for the highest luminosities (500 mg) is not available from that system, a standard thin havar walled target can be provided easily, as described in the original proposal.

Data Acquisition and analysis:

The Group at Old Dominion University intends to be involved in the development of the data acquisition code. MIT, ODU, UVA and CEBAF plan to take an active part in the analysis of the data.

Students:

The MIT group has committed to this effort two graduate students as of the class entering in the fall of 1993. We will add students to the CEBAF effort establishing about four students as the average level of commitment by 1996. Old Dominion University intends to commit a graduate student to this effort.