INTRODUCTION

CENPA pursues a broad program of research in nuclear physics, astrophysics and related fields. Research activities are conducted locally and at remote sites. The current program includes "in-house" research on nuclear collisions and fundamental interactions using the local tandem Van de Graaff, as well as local and remote non-accelerator research on fundamental interactions and user-mode research on relativistic heavy ions at large accelerator facilities in the U.S. and Europe.

Our ^{7}Be(p,γ)^{8}B measurements have been completed and published. Three separate cross section measurements with 3 different (radioactive) targets are in excellent agreement, and determine the astrophysical S-factor to an experimental precision of $\pm$ 3% ($\pm$ 4% including theoretical extrapolation uncertainty). We have begun work on the ^{3}He$(\alpha,\gamma)^7$Be reaction, which is also very important in solar neutrino production.

The Gravity group has become a member of the LISA gravity wave detector project. The end masses of the LISA interferometer must be kept inertial at very delicate levels. An ultra-sensitive torsion balance instrument has been built to characterize small forces that may act on the end masses.

An initial broad survey of correlations and fluctuations in RHIC Au-Au and p-p collisions has been completed, revealing substantial evidence for a dissipative colored medium in central Au-Au collisions and several surprises relative to theoretical predictions. Among the findings: 1) p-p momentum distributions are precisely separated into soft and hard components, corresponding to string and minijet fragmentation respectively, which provide an essential reference for Au-Au collisions, 2) minijets in central Au-Au collisions are found to be strongly elongated along the collision axis and narrowed in azimuth, this trend being true for both angular correlations and transverse momentum correlations, and 3) the geometry of hadronization in central Au-Au collisions is demonstrated to be two-dimensional, in contrast to the previously-observed one-dimensional string fragmentation geometry in p-p.

The second phase of operation of the Sudbury Neutrino Observatory, in which salt was added to the heavy water to enhance sensitivity to the neutral-current interaction of solar neutrinos, was completed in September, 2003. An analysis of 254 live days of these data was released at the Topics in Astroparticle and Underground Physics international conference in Seattle. The new results have ruled out maximal mixing for solar neutrinos at more than 5 standard deviations, and disfavor the higher-mass "LMA-II" solution to the solar neutrino problem at greater than 99 % confidence level.

The salt has been removed from the SNO detector and 40 strings of ^{3}He counters have been installed to give SNO an event-by-event capability for discriminating neutral-current events from charged-current. Initial performance of the array is very satisfactory.

An integrated data-acquisition system has been commissioned to make possible the simultaneous collection of data from the photomultiplier array and the NCD array in SNO. The system integrates a new object-oriented realtime control and acquisition system, ORCA, with the existing SHaRC system, both developed at UW.

Design and construction of a grid to suppress backgrounds in the prespectrometer for the

KATRIN tritium beta decay experiment is nearing completion. The prespectrometer, the first module of this major new neutrino mass experiment, will be commissioned in 2004.

The emiT experiment collected over 350 million coincidences during its recently concluded data collection run at the NG-6 beamline at the NIST Center for Neutron Research (NCNR) in Gaithersburg, MD. Analysis of these data is underway, and should yield a statistical sensitivity to the time-violating coefficient "D" of 2×10^{-4}, which would exceed emiT's original design goal by about a factor of 1.5.

The source of Ultra-cold neutrons at LANL has been built, and the first production run successfully produced UCNs. We have started mounting the apparatus for measuring the beta-asymmetry from polarized-neutron decay and we expect to start taking data in October of 2004.

Using the Tandem, we have taken data that should yield the mass of the lowest T=2 state in ^{32}S to within $\Delta m/m \approx 10^{-8}$. We are currently analyzing the data and calculating systematic uncertainties.

In collaboration with the INT, we sponsored the Eighth International Workshop on Topics in Astrophysics and Underground Physics during September. This major conference is held every two years, and sponsoring such conferences is part of CENPA's mandate.

Initial exploration into the establishment of a Joint Institute for Advanced Detector Technology between the University of Washington and Pacific Northwest Laboratories received strong endorsement by the administrations of both institutions. A more detailed proposal is being pursued.

As always, we encourage outside applications for the use of our facilities. As a convenient reference for potential users, the table on the following page lists the capabilities of our accelerators. For further information, please contact Prof. Derek W. Storm, Executive Director, CENPA, Box 354290, University of Washington, Seattle, WA 98195; (206) 543-4080, or storm@npl.washington.edu. Further information is also available on our web page: http://www.npl.washington.edu.

We close this introduction with a reminder that the articles in this report describe work in progress and are not to be regarded as publications or to be quoted without permission of the authors. In each article the names of the investigators are listed alphabetically, with the primary author underlined, to whom inquiries should be addressed.

Derek Storm, Editor   Barbara Fulton, Assistant Editor

TANDEM VAN DE GRAAFF ACCELERATOR

A High Voltage Engineering Corporation Model FN purchased in 1966 with NSF funds, operation funded primarily by the U.S. Department of Energy. See W. G. Weitkamp and F. H. Schmidt, "The University of Washington Three Stage Van de Graaff Accelerator," Nucl. Instrum. Meth. **122**, 65 (1974). Recently adapted to an (optional) terminal ion source and a non-inclined tube #3, which enables the accelerator to produce high intensity beams of helium and hydrogen isotopes at energies from 100 keV to 5.5 MeV.

Some Available Energy Analyzed Beams

Ion	Max. Current (particle μA)	Max. Energy (MeV)	Ion Source
^{1}H or ^{2}H	50	18	DEIS or 860
^{3}He or ^{4}He	2	27	Double Charge-Exchange Source
^{3}He or ^{4}He	30	7.5	Tandem Terminal Source
^{6}Li or ^{7}Li	1	36	860
^{11}B	5	54	860
^{12}C or ^{13}C	10	63	860
*^{14}N	1	63	DEIS or 860
^{16}O or ^{18}O	10	72	DEIS or 860
F	10	72	DEIS or 860
* Ca	0.5	99	860
Ni	0.2	99	860
I	0.001	108	860

*Negative ion is the hydride, dihydride, or trihydride.

Additional ion species available including the following: Mg, Al, Si, P, S, Cl, Fe, Cu, Ge, Se, Br and Ag. Less common isotopes are generated from enriched material.
In addition, we are now producing a separated beam of 15-MeV ^{8}B at 6 particles/second.

BOOSTER ACCELERATOR

See "Status of and Operating Experience with the University of Washington Superconducting Booster Linac," D. W. Storm *et al.*, Nucl. Instrum. Meth. A **287**, 247 (1990). The Booster is presently in a "mothballed" state.