INTRODUCTION

CENPA pursues a broad program of research in nuclear physics, astrophysics and related fields. Research activities are conducted locally and at remote sites. CENPA is a major participant in the Sudbury Neutrino Observatory (SNO), the KATRIN tritium beta decay experiment and the Majorana double-beta decay experiment. The current program includes "in-house" research on nuclear astrophysics 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.

We thank our external advisory committee, Baha Balantekin, Russell Betts, and Stuart Freedman, for their continuing valuable recommendations and advice. The committee reviewed our program in May, 2005.

Data-taking on the Sudbury Neutrino Observatory project ended November 28, 2006, concluding six highly successful years in which the solar neutrino problem was resolved and new neutrino properties measured. As the heavy water is being returned to the owners, the data from the final phase, during which ^{3}He-filled proportional counters were deployed in SNO, are being analyzed. A clear neutron signal is seen and significantly improved precision on the mixing angle θ_{12} can be expected.

The completion of the main KATRIN spectrometer, its very successful vacuum test and spectacular delivery to the FZK marked the the achievement of a major KATRIN milestone. The UW played a prominent role in the commissioning of the pre-spectrometer, yielding valuable lessons on Penning traps which will be applied to the main spectrometer. Following a review in November, the DOE recently announced its decision to fund the US-KATRIN proposal. This will enable purchasing of long lead-time items to begin, with forward funding assistance being provided by the University of Washington to ease funding profiles.

Our recent test of the gravitational inverse-square law showed that the law is valid at 95% confidence for length scales down to 56 micrometers. This result places a model-independent limit of 44 micrometers on the largest possible size of an extra dimension. It rules out the interpretation of the PVLAS "birefringence of the vacuum" measurement in terms of a low-mass spin-0 meson, and is inconsistent with "natural values" for the chameleon mechanism that was invented to evade experimental limits on string theory's predicted low-mass scalar particles

We have nearly completed our precision ^{3}He + ^{4}He fusion measurements, with data from counting both the prompt and the activity gamma-rays over the energy range $E_{c.m.} = 420$ - 1230 keV, and one more lower energy point to be measured. A new beamline has been constructed for our ^{22}Na destruction experiment, and the target chamber has been designed.

We finished an analysis of data that yields the branch for the $0^+ \rightarrow 0^+$ transition in ^{32}Ar, which allows an experimental determination of the isospin-breaking correction and a stringent test of calculations.

We have made significant improvements in our production of Ultra Cold Neutrons at Los Alamos, which has allowed us to measure the beta-decay spectrum from UCN at a rate of approximately 2 Hz. We expect to get a determination of the beta asymmetry to approximately 2% by the end of 2007.

We have completed a survey of minijet number and pt correlations on A-A collision energy and centrality, indicating that minijets form a strong contribution to RHIC A-A collisions although they are strongly altered in central collisions. We are now using the same analysis system to study elliptic flow on its own and relative to minijets, to reconsider its hydrodynamic interpretation and possible alternatives.

Axion Dark Matter eXperiment: We have nearly finished construction and are planning to start commissioning this summer. We anticipate the data-taking will take about a year. The collaboration has endorsed the plan to move the experiment to the University of Washington/CENPA. We plan to submit a proposal to DOE/HEP for this Phase II of the project in summer 2007 for a fall 2008 construction start.

We received DOE/NA22 funding for a large-channel-count TPC for indentification of special nuclear material. The readout electronics and software will be the responsibility of CENPA.

Two CENPA graduate students obtained their Ph.D. degree during the period of this report.

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 | Debra Nastaj, 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. Methods **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 7.5 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. Methods A **287**, 247 (1990). The Booster is presently in a "mothballed" state.