7 Accelerator and Ion Sources

7.1 Ion sources, injector deck and accelerator crew training

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There was no significant development for our injector deck or its direct extraction ion source (DEIS) or its sputter ion source (SpIS). The image ion gauge controller on the injector deck was replaced.

CENPA relies on trained accelerator crews to assist our experimenters and assure a second head and pair of hands for everyone's safety (a two-person rule while operating the Van de Graaff and ion sources). Our policy is that all graduate students paid out of our DOE contract become competent accelerator operators. Two decades ago all incoming graduate students were trained by senior graduate students with great experience gained from many hours operating the machine for their own and others experiments. More recently the staff have come to supervise training as more graduate students work on non-accelerator projects.

Furthermore, the demands of research projects at other locations require weeks or months of time away from CENPA and so current graduate students crew for only two years. This leaves fewer graduate student crews here at any given time. We now must rely more heavily on paid undergraduate hourlies who often train during their second year at the university and typically give us at least two years of service. Most years we have at least one senior member of these undergraduates who can assist with some training while honing his skills as a teacher as well as his technical skills running our Van de Graaff and ion sources. As a backup when questions arise we have an extensive operations manual of over 150 pages which is revised at least yearly. As a further source of help some staff member is generally available by phone evenings, nights and weekends.

This past year two undergraduates and three graduate students have completed training. Another undergraduate and two graduate students are in training now. We also have four senior crews: two undergraduates who graduate this spring and two graduate students who will complete their two years of service soon. Finally, there are several older graduate students who take an occasional shift.

We expect crews to exercise good judgment and demonstrate competence in the following six areas: 1) sputter ion source (SpIS/860) startup, and tuning with the injector deck elevated to the low energy cup including switchover from the direct extraction ion source (DEIS) and installation of a new pellet; 2) DEIS startup, and tuning with the deck elevated to the low energy cup including switchover from SpIS/860 and installation of a new gas bottle and gas manifold pump/purge; 3) single-ended Van de Graaff operation with TIS startup and tuning from high energy cup to flap including use of nmr and energy stabilization; 4) tandem Van de Graaff startup and tuning of some beam from an injector deck ion source through the tandem to the flap including use of diagnostics and debugging of vacuum and interlock problems; 5) production of high radiation beams and proper safety and use of the CENPA radiation protection system; 6) documentation with crewsheets and the logbook of basic tuning data, plus logbook and email documentation of problems encountered.

7.2 Van de Graaff accelerator operations and development

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The tandem was entered 13 times this year. The terminal ion source (TIS) and the foil stripper were exchanged during three openings as were spiral inclined field tube #3 and the KN straight tube. The terminal computer was repaired during one tank opening and its fiber optic telemetry link was replaced. The tube gradient was changed during three openings. Idler bearings or charge pickup wheels were replaced during four openings. The RF source was serviced during two of the entries and terminal vacuum leaks were repaired during another two of the entries. The machine was entered three times to repair sparking problems from broken components in the column resistor string.

The nylon flange which holds the permanent solenoid magnets to the terminal ion source had been stressed and heated for years. It was warped to the extent that the vacuum joint at the bottom of the bottle would no longer seal reliably. This flange was replaced with a much stouter one made from G-10 fiberglass.

A rugged power supply scheme using adequate transient suppression and potted power supplies was installed last year[1] in the electrostatic deflector supply assembly. The same 24 VDC potted supply was installed in the terminal computer. These worked successfully since September 2004 with only one problem. The 24 VDC power supplies were working right at their current limits and would occasionally trip off. These would have to be powered down to restart. We replaced both of these with supplies of much greater current capacity.

The new GVM circuit utilizing a balanced demodulator was calibrated at higher voltages this year. The old calibration was done at about 3 MV terminal voltage because we were running single ended at the time. The new calibration was done at 7.5 MV terminal voltage and found to be within 2 kV of the previous calibration. The GVM is linear from 0 V to 10 MV. It has been used successfully with a 77 keV $^{4}He^{+}$ (69 kV terminal) beam and a 61.8 MeV $^{16}O^{+6}$ (8.8MV terminal) beam.

The high energy Faraday cup was repaired and the low energy turbomolecular pump was replaced this year. Clogged flow switches associated with the analyzing magnet, the switching magnet, and the low energy turbo were cleared or replaced. The 24 inch chamber on the right 30° beamline was completely refurbished to be used as a general purpose scattering chamber. The x-rays produced in the spiral inclined field tube #1 region now occur only in bursts while increasing the terminal voltage beyond about 6.5 MV but the level has been substantially reduced. The tandem and accelerator tube were at one time conditioned up to 8.8 MV this year.

During the 12 months from April 1, 2005 to March 31, 2006 the tandem pellet chains operated 2201 hours, the SpIS 431 hours, and the DEIS 409 hours. We did no molecular research using the deck only this year.

[1]CENPA Annual Report, University of Washington (2005) p. 88.

7.3 Physical plant maintenance, repairs and possible upgrade

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Our facility consists of three structures: the Van de Graaff building, the Cyclotron building, and the Cyclotron Shop building. Last year 313 work requests were placed for our structures: 154 for Van de Graaff, 98 for Cyclotron, and 61 for Cyclotron Shop. Maintenance and repairs to these are financed out of the University's indirect costs.

Of these 313 work requests, 306 were covered by contract overhead. Of these 306 requests more than half, 179, were placed by physical plant personnel as preventive maintenance. Another 36 requests were placed by physical plant staff who noted items in need of repair during routine inspection or preventive maintenance. CENPA staff placed 91 of these work requests for repair of failed or failing items.

The remaining 7 requests by CENPA staff hired services: transportation of the Department of Physics and Astronomy scissor lift needed here several times for research installations and repairs, recycling of refrigerant (freon) from research equipment, and estimation for replacement and planning purposes. These services cost $2,146.

As the result of decommisioning our superconducting linac booster some years back we now have 70 tons of excess chiller capacity plus reserve electrical power equal to several times our current peak usage. This cooling and power are available for modest costs of piping chilled water, running wires and conduit, plus purchase and installation of necessary fan coils and fire alarm upgrades. We already host Metate, a Beowulf cluster of 64 processors, for the Departments of Astronomy and of Medicinal Chemistry[1] (see Sec. 8.2). Recently the Institute for Nuclear Theory and the Department of Physics inquired as to CENPA's capacity to host a cluster of 250 to 500 processors (which we are able to do with the modest type of improvements listed above). The College of Arts and Sciences has expressed an interest in placing several small clusters at our facility and paid for budgetary engineering and estimation services.

[1]CENPA Annual Report, University of Washington, (2005) p. 86.