FROM THE OFFICERS

The President-Elect’s Message
Vashek Vylet

Regarding the upcoming Annual HPS Meeting in Raleigh, NC, according to Jason Davis, the Program Committee Task Force Chair, we have six confirmed presentations for the Accelerator Section session. This session is scheduled for Tuesday, July 11, 9:45 – 11:45 AM. With 15 min per talk and a break, we hope to schedule the Accelerator Section meeting in the same room with a start at 11:30 AM. I will make sure it is posted on the meeting schedule once we have it confirmed. Lorraine Day is organizing the review of student papers, winners will be announced at the section meeting.
Reactor Materials Testing Laboratory at Queen’s University

The Reactor Materials Testing Laboratory (RMTL) is a new research endeavor of the Nuclear Materials Group at Queen’s University in Kingston, Ontario. It houses a proton accelerator that is used to introduce damage into materials at a microscopic scale. Studying the effects of this damage provides insight into how materials are damaged by various forces within a nuclear reactor, in particular, due to neutron radiation damage and heat. The RMTL project was originally led by Prof. Rick Holt, then the NSERC/UNENE Industrial Research Chair in Nuclear Materials. Now an Emeritus Professor at Queen’s, Holt continues to take a role in the realization and implementation of RMTL. The new project leader is Prof. Mark Daymond, who became the NSERC Industrial Research Chair in Nuclear Materials in the spring of 2012. The accelerator became operational in 2015, and final commissioning was completed in 2016.

Proton Accelerator
The accelerator at RMTL is a 4MV tandem machine capable of producing up to 8 MeV protons or 12 MeV He, useful to simulate irradiation damage and provide ion implantation studies. Materials behave quite differently in a nuclear power reactor environment than in conventional applications. These differences arise due to damage to the atomic structure of the materials caused by fast particles; in a reactor these particles are the neutrons that allow the nuclear reaction to occur. RMTL will investigate these properties by simulating this type of damage using a proton accelerator. Damage is introduced by accelerating protons to moderately high energies and directing them into target materials. This creates a process that is similar to the damage effects occurring within a nuclear reactor, allowing us to investigate how various materials respond to radiation, mechanical stress and temperature. The ultimate goal is to develop a better understanding of how materials deteriorate in a reactor, leading to the safer, longer-term use of reactors.
Materials Characterization
The laboratory includes a state-of-the-art electron microscopy suite (SEM, TEM) for analysis of materials, as well as nano-indentation testing equipment to observe the effects of radiation damage on various mechanical properties.

Scanning Electron Microscope (SEM) - The latest microscopy technology is used to generate images of surface topography and determine chemical composition at very high resolutions. Capabilities include EBSD, EDX, and in situ heating and straining.

Transmission Electron Microscope (TEM) - Passes electrons through a thin sample to examine fine details at extremely high resolutions (down to an atomic scale). TEM samples must be prepared down to less than 100 nanometers thick. The Osiris includes the following features: STEM, EDS, EELS, and in situ heating & straining.

Mechanical Testing Laboratory - Mechanical testing abilities at RMTL include in ion-beam quasi-static and creep testing at elevated temperatures, and nano- and micro-indentation from ambient to elevated temperatures.

Accelerator Radiation Safety
The radiation of primary concern at RMTL is neutron radiation produced by the proton,neutron (p,n) reaction that occurs when protons strike the target. Gamma and beta radiation is also produced during this process, though generally about an order of magnitude lower in yield than for neutrons. The maximum permissible yield at “Design Maximum”, the value for which the shielding has been calculated, is 2 x 10^{10} n/s. RMTL has two separate target rooms into which the proton beam can be directed for irradiation. These rooms are shielded with thick concrete walls and borated polyethylene. The neutron dose rate in each room is monitored during irradiation by a BF3 neutron probe that is fixed to the wall, and connected to a safety interlock system. If radiation levels exceed the design maximum threshold, the interlock system will shut down the accelerator.

Extensive testing was carried out during the commissioning phase to confirm that radiation transmission through the shielding was acceptably low. During the early stages of commissioning, comparisons were made between different models of neutron survey instruments whenever possible. We found it helpful to “borrow” instruments from colleagues in other neutron-producing facilities to make these comparisons, to evaluate how the instruments respond in pulsed neutron fields. Survey instruments by Ludlum, Eberline, Victoreen and Thermo-Scientific were compared. A nested neutron spectrometer made by DETEC was also used to measure the ambient dose equivalent and confirm the yield from commissioning targets.

Target Irradiation
A typical irradiation experiment can run continuously for several days, producing significant amounts of activated nuclear material within a target at the end of beam. Depending on circumstances, the target room may be locked out for up to ten days to allow short half-life nuclear products to decay. Once the activity has decayed to a low level, the room becomes accessible and the target material is removed. Its nuclear activity is immediately confirmed in a gamma spectrometer. If the target activity is below the compound exemption quantity for all radionuclides combined, the material can be released to the researcher for examination. Otherwise it can only be handled by qualified personnel in designated areas. The goal then at RMTL is to design experiments such that the radioactivity in the material at the end of beam is as low as reasonably achievable, while still imparting useful damage for materials analysis. This is accomplished by selecting high purity target materials, analyzing the nuclear cross sections of all constituent elements, and selecting the appropriate beam energy, beam current and irradiation time.

Present Status
At this time (April 2017) the Reactor Materials Testing Laboratory has completed its commissioning phase and is moving towards full operations. We expect to be fully operational and irradiating targets for damage studies by the end of summer 2017.
We are nearing the end of a nearly decade-long upgrade of the CEBAF accelerator that added a new experimental hall, (Hall D) and upgraded equipment in the accelerator and existing halls A, B and C. Halls A and D received the first 12 GeV beam in December 2015. By the end of March 2017 all four halls received beam as part of commissioning tests and/or physics experiments. New experiments are lined up for the restart of the experimental program this fall, with a number of experimental reviews scheduled for May and June.

Decommissioning of experimental equipment from experimental halls created large amounts of waste material. Hundreds of tons, mainly concrete and steel, were characterized and stored in the laydown area. Decommissioning of Short Orbit Spectrometer (SOS) from Hall C contributed about 330,000 lbs of concrete from the hall floor. We just cleared this concrete and it was removed from site by a subcontractor in March. In addition, shielding of the SOS contributed another ~146,000 lbs that are still on site but were released from RadCon control on April 10. This greatly reduced the amount of material held for decay in storage since 2012, with authorization from DOE. A couple of related pictures are included below.