TRIUMF Accelerator Advisory Committee
Report on Meeting #1 – 2008 April 03-04

Committee Members

Mark de Jong – Chair (CLS)
Mats Lindroos (CERN)
Sergei Nagaitsev (Fermilab)
Hasan Padamsee (Cornell)
Marco Schippers (PSI)
Charlie Sinclair (Cornell)
Yasushige Yano (RIKEN)

Introduction

The first meeting of the Accelerator Advisory Committee (AAC) was held at TRIUMF on 2008 April 03 – 04. For this first meeting, the AAC was asked to review and make comments or recommendations on the proposed upgrades of TRIUMF's accelerator facilities that are part of the new 5-year plan for 2010 – 2015 and beyond. The scope of the upgrades under review included:

- The 500 MeV cyclotron refurbishment and intensity upgrade,
- Construction of beamline BL4N,
- Development of two actinide target modules,
- Expansion of the ISAC infrastructure to provide up to three radioactive ion beams,
- Development of an electron linac photo-fission driver (e-linac), and
- Further development of superconducting rf infrastructure to support internal and external accelerator programs.

The formal charge to the committee is given in Attachment A, and the agenda for the meeting is given in Attachment B.

Overview

First the AAC would like to thank Paul Schmor and his staff for the excellent presentations and support for the meeting. All committee members appreciate the work and effort by the TRIUMF staff to ensure an interesting and constructive review.

TRIUMF is the only world-leading accelerator facility in North America that features high-quality low-energy radioactive ion beams (RIB) and high-intensity cw muon beams. The core of the infrastructure is the unique multi-beam extraction 500 MeV H-minus cyclotron. TRIUMF's user communities of particle-nuclear physics and material/life sciences using these beams are truly international and sizable.

In the proposed 5 year-plan starting from 2010, TRIUMF anticipates a further increase in users' demands for RIB. In response, TRIUMF plans to build additional RI beam production targets, expand experimental sites, upgrade the total proton beam current from 250 µA to 450 µA, and, in addition, install a MW-class 50 MeV, 1.3 GHz superconducting electron linac as an independent RIB driver for generating very neutron-rich exotic beams via uranium photo-fission. By the addition of the powerful electron driver, TRIUMF's capability will gain new dimensions. It will give users a rich opportunity to explore presently unreachable nuclear region covering hypothetical rapid-process pathway to create very heavy elements such as uranium.

The proposed 5-year plan is essential and indispensable to maintain TRIUMF a world-leading research centre of radioactive ion beams and muon beams. In addition, the proposed total construction cost of 60 M$ over 10 years is estimated to be reasonable and very cost-effective.

500 MeV Cyclotron Refurbishment and High-intensity Upgrade

It is a major success for the TRIUMF staff to continue to operate a cyclotron more than 30 years old, its beam lines and infrastructure with an availability of almost 90% in an environment with very high radiation doses. Some components, equipment and cabling are now obsolete, worn out, or deteriorating from radiation damage. Thus, to maintain and, ultimately, to improve performance, the refurbishment of old components by new and modern ones is essential.

Furthermore, TRIUMF proposes to upgrade the proton beam intensity from 250 µA to 450 µA by installing a new 5 mA H-minus source, modifying the vertical injection line, and augmenting cooling in the central region. The third main cyclotron development project is to reduce the beam intensity fluctuations associated with the simultaneous extraction of multiple beams.

The projects with the most uncertain outcomes are the intensity upgrade and the modes with three beams extracted simultaneously with demanding stability specifications.

- For the **intensity upgrade,** several experiments and studies have been done in the past. These indicate that there are no physics problems to overcome. At the injection of the cyclotron, the problems to be solved are on the technological level. About 1.5 kW of beam power will be lost in the central region, but the loss locations are spread and known. There is enough cooling capacity available in this region. Several methods to tackle the problem by adjusting the beam dynamics have been presented and, at first sight, indicate sufficient flexibility and free parameters.
- **Simultaneous extraction** of three beams has been demonstrated already several times, but achieving the new conditions and beam stability specifications needs further study. For example, the degree to which one can regulate beam energy and intensity at each of three extraction ports is not clear. The proposed studies on the stripper foil configuration will help understanding these issues and also help reduce radioactive contamination.
- **Beam losses** lead to activation, causing long waiting times to access the machine and radiation damage of components. It is not yet clear if one can increase the beam intensity without increasing the activation. The increase of intensity can only be done without compromise by increasing the total hours beam time, if the increase of the dose levels in the cyclotron is minimal. A suggestion to reduce beam losses by reducing the beam energy to 475 MeV should be studied seriously.

The AAC finds that the proposed program on the refurbishing of the cyclotron and the high intensity upgrade is realistic, and the proposed investment of 6 M$ is estimated to be reasonable. The concept, the proposed methods and actions are clear and no big physical problems are expected. Part of the activities have already been started, or are part of an ongoing program in the last years, and can be reasonably completed in the new 5-year plan.

The committee expresses its concern on the available cyclotron beam time to implement and test proposed improvements. The annual shutdowns are the only possibility for installing modifications and, after commissioning the changes, the next iteration step needs to wait until the next shutdown. This stresses the need to start the cyclotron-related projects as soon as possible, so that no valuable time is lost.

The committee also feels that the efforts to keep the quality of the current operations at a high performance level should not be underestimated. All these activities (to reduce dose, improve accessibility, fast diagnosis of problems) are a prerequisite for the future plans.

To have only one **single control room** for the different facilities on site is certainly a good idea, and should permit more effective overall operation of the facility. The committee suggests decoupling the merging of the control rooms from the modernizing of the cyclotron control system, so that no delays are caused by this huge project.

Recommendations:

- **That refurbishment needs to be done strategically, considering that access to the cyclotron for these modification works is not easy due to the residual radiation;**
- **That the refurbishment time should be more seriously scheduled in the long-term machine-time planning;**
- **That machine-study times for upgrading intensity are reasonably scheduled in the long-term machine-time planning; and**
- **That additional high-level (beam physicists) staff is needed and more beam time than the current 2 shifts/month should be allocated for cyclotron development.**

Construction of a new beam line to deliver protons to two new ISAC production targets

A new beamline, BL4N, is proposed to take beam from the cyclotron to one of two new additional target stations to be developed in the next 5-year plan. The additional of this beamline, which can operate independently from BL2A, will allow an additional source of RIB for future experiments. Initially, this beamline will operate at low current, ~10 µA, for the first actinide target. In the longer term, the beamline may eventually operate at higher current comparable to BL2A.

Recommendations:

- **That development of the test beam dump for BL4N should be a priority to be ready in 2012, a few years before the intensity upgrade scheduled in 2014.** This will permit work to proceed on reducing the intensity fluctuations in the multiple extracted beams on BL2A and BL4N to an acceptable level.
- **That completion of BL4N should continue to be a priority to be ready for the first actinide target and therefore organized in a dedicated project.**

Development of two new Actinide Target Modules

The development of a high-power actinide target for ISAC is essential for the future of the laboratory. Other ISOL facilities in world regularly operate actinide targets with direct proton irradiation at up to 10 kW of beam power, so there are clearly no showstoppers that would prevent TRIUMF from developing such a target. However, the proposed high-power photo-fission facility is a pioneering effort that would give TRIUMF a unique position as the world-leading fission-fragment facility, beside a well-earned position as the first high-power (>10 kW on the target) direct irradiation ISOL facility for non-actinide targets.

The design work for two new target stations for actinide targets has just started. The short-term objective, as described to the panel, is to complete a first conceptual design of the station for both the direct target geometry and the electron-converter geometry to enable precise costing (and estimates of manpower) and give input to the machine designers. While the design for the direct geometry appears rather straightforward, the design for the more complex photo-fission set-up is in its early stages. The design presented for the photo-fission target was only very conceptual and many open issues have still to be addressed. The yield estimates are based solely on analytical calculations. No more detailed calculations based on numerical simulations (e.g., Monte-Carlo type) of the converter-target geometry were presented to the AAC. The details of the actinide target design itself were not presented, nor were the issues of material choice and production methods. The target stations are proposed to be equipped with hermetically closed containers for the target and ion source unit to permit pre-conditioning of the target unit and prevent exposure to air and possible contamination during transport. The full remote handling system is proposed to be made more rigid than the existing ISAC system and to manage remote manipulation of both electrical and vacuum connections. The target change will be done in a special hot-cell to reduce contamination issues within the hot-cell during target change. The safety studies for the actinide target itself are well underway, with an actinide target safety analysis report already submitted to the licensing authorities. However, no pro-active work for the target station design was presented for the panel.

The AAC found that:

- The target station design team undertaking the work has a well-earned excellent reputation in the world ISOL community for high-power target station design and they certainly have all the competences needed to undertake the work ahead of them. However, additional staff is needed to undertake both a new design effort and assure the operation and development of the existing targets.
- The general concept for the target container, hot-cells and remote target handling is well thought through and based on experience from other facilities operating actinide targets.
- The conversion of electrons to photons has been studied in some detail, but no in-depth analyses of the crucial (for efficiency) issue of the converter and target geometry has been undertaken. Solutions to the many major technical challenges associated with the design could, in the worst case, result in a loss of efficiency that jeopardizes the proposed yield gains from the photo-fission approach.
- The proposed choice of liquid mercury as a converter represents major challenges for the designers. These include:
    - The necessary windows (as a mercury-vapor diffusion barrier) on the beam side require detailed studies as they will also act as converters and as the heating of the window will be important.
    - The necessary (as multiple safety barriers) windows between the target and the converter will make it difficult to have the optimum (very close) geometry and will introduce additional materials which will absorb some of the photons.
    - The activation of the mercury from the target neutrons will likely require a purification stage in the mercury loop. It will also mean that prior plans will have to be made for the decommissioning of the facility, for the solidification of the mercury and long-term storage.
- The actinide target material type will have major impact on the release efficiency of the target system.
- There is no pro-active safety-related work evident in the design work presented for the panel.
- The neutral gas diffusion of radioactive isotopes in the beam-line system from the target station has not been addressed.

Recommendations:

- **That a first full complete conceptual design of both the direct actinide target and the converter actinide target is made as soon as possible as the technical choices for the photo-fission target will have major impact on the overall design and the cost, as well as the efficiency for producing the desired neutron-rich isotopes.** The target group needs additional staff to ensure the existing target and ion source construction and development program is secure while undertaking this new design effort.
- **That pro-active safety studies should start as soon as possible and a safety specialist (not a safety officer) should join the design team as soon as possible.** These studies should include simulations of many issues, e.g., neutral gas diffusion, ventilation and vacuum issues, material and ground activation issues and neutron radiation from the target. The results should be fed back to the designers in an iterative manner, rather than as a safety study of the final design. The neutral gas diffusion in the beam-line system from the target unit and the emanation issues from the valves closing the target container must be addressed. The use of moving parts that could block the target unit in the in-position should be avoided.
- **That TRIUMF joins and/or initiates international efforts to develop new Uranium Carbide and Thorium Carbide target materials for ISOL facilities.** Potentially, there are major gains to be made from increased Uranium or Thorium content in new submicron structured target matrices with good thermal conductive and diffusion properties, which could be as important as increasing the primary beam power on the target.
- **That a major effort is made to come up with a first full conceptual design for the photo-fission converter.** A very high efficiency must be the prime objective and the team should look at all alternatives for converter design including solid converters. For the liquid mercury converter study and the investigation of possible alternatives, the AAC encourages the team to be in close contact with the EURISOL, SNS and ESS designers.
- **That TRIUMF should consider an alternative approach wherein the first target station is dedicated to the direct target, with the design of the second target station being done for dual use based on experience from the first design.** Thus, the full complexity and maintenance issues of the converter need not impede the development of the first target.

Expansion of ISAC to deliver three Radioactive Ion Beams Simultaneously

The main goal of the proposed five-year plan, which the AAC agrees with completely, is to increase significantly the number of hours with RIB on experiment targets for users. The new actinide targets, the additional extraction beamline from the cyclotron, and the e-linac are all required to increase the production of RIBs, but these also need to be delivered to the user target stations. Having multiple simultaneous means of RIB production requires a corresponding expansion of the RIB transport and acceleration systems to increase the availability to the users.

TRIUMF staff outlined the proposed plan for increasing the number and energy range of RIBs over the next ten years. This plan included the construction of additional mass separators (both medium and high resolution), RIB accelerators (RFQ2, DTL2, SCA), a second charge-state booster (CSB2), and a beam switchyard for taking beam from either actinide target to any of the three experimental areas (low-energy, medium-energy and high-energy). Part of this plan also included changes to increase the mass range of accelerated beams up to A=240 from the current limit of A < 120.

The AAC found that:

- Alternative charge breeder solutions for CSB1, such as an RFQ cooler-EBIT system, were not presented. Such a system could operate with long pulses (~1 ms) at up to 100 Hz, which would be close to CW mode for most experiments, and would address the issue of the high A/Q values from the existing ECRIS system at an early stage of the upgrade,
- The velocity matching between the charge breeder and the linac is done by adjusting the extraction voltage, which complicates multi-user operation and prolongs the set-up time,
- There is no coherent automatic beam tuning system for the beam lines to reduce the beamline set-up time, and
- There are no cryo-panels to prevent diffusion of neutral isotopes between the lower level controlled area and the higher level experimental hall.

Recommendations:

- **That the design team investigates alternative charge state boosters, such as an RFQ cooler/EBIT system operating with long pulses (millisecond pulses), at an early stage in the project to assure an optimum charge state distribution for the existing linac for all isotopes.** This would permit accelerating higher mass beams at an earlier time than the present plan allows. For the long term, the design team should be encouraged to join international design efforts, e.g., EURISOL, for new charge state boosters using, for example, a higher frequency ECR system or Arc-ECRIS systems.
- **That TRIUMF study a coherent approach to automatic beam tuning at ISAC for both steering and transverse beam matching.** A generic beam tuning system within the existing EPICS control environment could help reducing the turn over time and reduce work load on the operators. This approach may also require development of new or special beam diagnostic instrumentation to operate at the low beam intensities on ISAC.
- **That the second RFQ is placed on a high voltage platform to reduce the need of re-tuning for different A/Q setting and between experiments.**

Development of a Photo-fission Driver based on an Electron Superconducting Linac

The AAC heard presentations on the concept and layout of a superconducting electron linac (e-linac) for the fission driver. The main parameters are: 50 MeV beam energy and 10 mA average beam current, resulting in 500 kW beam power. TRIUMF proposes to accomplish this with five ILC/XFEL 9-cell cavities operating at 10 MV/m and 100 kW beam power per cavity. The gradient is modest compared to the ILC/XFEL gradient requirements, but the CW (continuous wave) operation will present challenges nevertheless. The baseline plan to deliver the beam power is to use two 50 KW input couplers per cavity, like those developed for the ERL (energy recovery linac) injector linac at Cornell.

The AAC was impressed by the concept, technical choices and the overall layout for the e-linac. The 1.3 GHz SRF (superconducting radio-frequency) technology adopted here is being used for the large XFEL (x-ray free electron laser) project at DESY, and is envisioned for use in a number of upcoming projects. The technology has been further developed for high-power CW applications as a high current injector of an ERL-based light source. Many of these developments have been factored into the conceptual design of the e-linac. Hence a large number of components are available from industry such as klystrons, input couplers, and blade tuners. Some modifications will be needed and comments on these are addressed below. The cryostat will also need to be tailored to meet the cooling needs of the cavity, input power couplers, and HOM couplers, but the underlying concepts can be adapted from the TTF (TESLA test facility) and injector linac cryomodules.

The beam specifications for the e-linac photo-fission driver accelerator are not demanding, and have been demonstrated at other laboratories. However, the requirements for the up-time and beam losses were not presented and may be challenging for operations in cw regime. Perhaps the closest comparison is the JLab IR FEL, which has demonstrated 9.1 mA average current at energies above the desired 50 MeV while operating as an ERL. However, all the e-linac presentations allude to the potential for other developments associated with this accelerator, such as the addition of a photo-emission electron source and an energy recovery/doubler recirculation loop. These future additions make some very different demands on the detailed design (e.g., vacuum, component location and spacing, HOM damping, etc.). It can be very expensive to retrofit an existing machine to meet these additional requirements – to the point where simply starting over may be the most effective upgrade path. Additional future uses of the e-linac should be identified up front if at all possible, and the system be designed and constructed to incorporate or accommodate these future applications.

It will be important to develop a prototype cryostat to prove all the concepts for the main 4-cavity cryostat. The injector cavity cryostat will be a good vehicle for this development as long as there is a strong commonality in the design.

The AAC believe that TRIUMF should assess the possible use of nine-cell SRF cavities carefully in advance. The "appeal" of the nine-cell cavity is that this is the basic design planned for XFEL and ILC. It may well be acceptable for the photo-fission driver. But the other future applications of TRIUMF's system may well require fewer cells. Demonstrating the capability, with PAVAC, to produce nine-cell cavities is fine, but it might be a wiser course to build the photo-fission driver with fewer cells per cavity (and better HOM damping than required for the photo-fission driver) to allow future applications.

The strategy for ramping up the e-linac beam current was reviewed during discussions with TRIUMF staff. There are two main approaches: start at very low CW currents and gradually raise the current to the final operating value, or use pulse modulation of the current to reduce the average intensity while keeping the peak current at the final operating value. The former approach makes demands on the operation of all beam diagnostic equipment to function over a relatively wide dynamic range, but has the virtue of keeping the temperature and thermal stresses very constant. The latter approach can allow for better diagnostics, but may cause fatigue in target windows by the modulation of the thermal stresses. The fatigue could significantly increase the risk of window failures. These effects need to be examined carefully.

Over all, the team has done a credible job in assessing the cost and manpower needed to build the e-linac over the stated timeline, and the cost estimates are reasonable.

Recommendations:

- **That the cryostat engineering and design work proceed in parallel with cavity development since this is a long effort,**
- **That priority is given to the design and prototype work necessary to validate important modifications necessary for selected components, and**
- **That a plan is developed on how to ramp up the beam power from zero to 0.5 MW, as the strategy adopted will have an impact on component**

designs in the e-linac, and possibly on the design of the windows for the photo-converter and photo-fission target.

- **That all potential future applications for the e-linac are identified, as best as possible, and the means to accommodate these applications from the outset (unless the costs are truly excessive).** The complete e-linac – both the injector and the full machine – should be modeled before settling on the design details. The codes and experience to do this modeling are readily available, and will help avoid pitfalls once the actual construction begins.

Development of Superconducting RF Technology and Infrastructure

The AAC recognizes the importance of the coupling between the e-linac technology development at TRIUMF to the future needs of the high energy particle physics accelerators, such as ILC. Expanding the TRIUMF laboratory's expertise and SRF infrastructure from low-beta technology to e-linac technology will enhance Canada's capability to make a strong contribution to the international high-energy physics (HEP) effort in the future.

There is a scarcity of qualified vendors for the high technology niobium cavities which is likely to become acute given the growing demand for cavities for upcoming projects such as the XFEL, CEBAF upgrade, ERL and light sources, and high intensity proton accelerators. Developing a technically and commercially competitive cavity vendor near TRIUMF is therefore a worthy goal. The staff at TRIUMF is well suited to carry out this job given their existing expertise in Nb quarter-wave resonator development, fabrication and processing for ISAC-II. The speed at which TRIUMF acquired and mastered this technology over the last few years is impressive and bodes well for the success of the plan presented.

There is also a coupling to other international accelerator projects such as the high intensity proton accelerator at CERN and the e-linac fission driver in India. The connection to the Indian project will facilitate the construction of the fission driver in both laboratories. The past connection between TRIUMF and CERN will help both laboratories in the future development of a high intensity proton linac at CERN.

Recommendation:

- **That consideration is given to planning for a horizontal test cryostat with a pulsed rf capability prior to the injector cryomodule prototype.** Several have already been designed and manufactured at several labs (DESY and FNAL). This capability will have favorable strategic consequences for TRIUMF's involvement with ILC development as there is a shortage of HTC capacity in the world.

General Comments and Recommendations

While some of the advance preparation materials sent to AAC members outlined the physics case for the proposed accelerator development program, no high-level physics requirements and physics milestones were presented. The AAC understands that a draft science plan was also in preparation, but was not yet ready for wider distribution. The integration of the two plans will be essential to show how the timelines for the accelerator development support the proposed science plan.

The work is distributed over many people. The AAC stresses the importance to manage the effort for the needed accelerator design, development, construction and experimental work to be handled coherently. Also the AAC stresses that the work on the cyclotron should not be regarded as unattractive, and hence lower priority, compared to the e-linac and ISAC front-end projects. It is of utmost importance that talented people are not totally absorbed by the “sexiest” projects. The cyclotron-related projects offer excellent opportunities for involving new young technicians and physicists.

The AAC also stresses the importance planning to hire new staff with sufficient time so that they can be educated by more experienced staff and get the requisite on-the-job training. The AAC notes that many large accelerator-based projects in the world are having major problems recruiting trained accelerator specialists and that the lack of such staff could be an obstacle for the proposed projects at TRIUMF.

The AAC notes that there are several major projects such SPL, ILC, EURISOL and ESS on the horizon, all of which require major developments and investments superconducting RF technology. The AAC strongly supports the development of this competence at TRIUMF and its efforts to search for opportunities to collaborate with the institutes and universities leading these projects.

Recommendations:

- **That TRIUMF prepare a set of high-level specifications of the performance of the RIB facilities and their evolution over the five-year plan and beyond.** Such specifications should contain only those parameters most relevant to the user experimental groups, and should include the planned increase in RIB availability as well as capability. These specifications would also serve as guidance to the accelerator development priorities over the five-year period.
- **That TRIUMF initiate a doctoral student program in the accelerator division to train the future recruits for the projects and develop local competence in accelerator physics and its technologies.**
- **That TRIUMF continue to look for opportunities to collaborate with the institutes and universities driving other new accelerator projects such as SPL, ILC, EURISOL and ESS.**

Attachments:

A) Charge to the Accelerator Advisory Committee

B) Agenda of Meeting #1

Accelerator Advisory Committee Meeting (AAC-2008)

April 3-4, 2008

Charge

TRIUMF's capital, operational, and development funding is provided through a "contribution" from the National Research Council (NRC) in a 5-year cycle. The new 2010-2015 5-year plan proposal is presently under construction and requires a thorough review of all its aspects before submission to NRC and the Canadian Government in September 2008.

Accelerators represent the major infrastructure of the laboratory. TRIUMF's view for science frontiers beyond 2010 calls for a substantial upgrade of the accelerator facilities. TRIUMF's Accelerator Group is developing a concept which will allow us to meet these goals. It includes:

- 500 MeV cyclotron refurbishing and high intensity upgrade;
- Construction of a new beam line, delivering protons to two additional ISAC production targets;
- Development of two new actinide target modules compatible with both proton and electron driving beams;
- Expansion of the ISAC acceleration and beam delivery infrastructures in order to provide three radioactive ion beams (RIB) to the experiments simultaneously;
- Development and construction of a photo-fission driver based on an electron superconducting (SCRF) linac;
- Further development of SCRF technology and infrastructure on site in support of an e-linac and external accelerator programs (CERN SPL, ILC etc.).

We request that the AAC review, comment on, and offer recommendations, as appropriate, on the operational requirements, on the scope of the proposed upgrade, whether the concepts and milestones adequately address the scientific needs, whether the resource estimates (both funds and labour) are in line with the project magnitude.

It is also requested that a short summary report responsive to this charge be forwarded to the Accelerator Division Head, Paul Schmor, by Monday, April 15, 2008. This report will be provided to ACOT in May and the International Peer Review in September. In addition, we request that the committee give a brief public summary of their comments.

Accelerator Advisory Committee Meeting
In the ISAC-II Conference Room

April 3-4, 2008

<u>Thursday, April 3</u>

08:30-09:00 Executive Session, Chairman: M. De Jong

<u>Information Session, Chairman: P. Schmor</u>

09:00-09:05	Welcome, AAC charge	N. Lockyer	5
09:05-09:20	TRIUMF accelerators overview	P. Schmor	12+3
09:20-09:40	Cyclotron high intensity upgrade+Beamlines	R. Baartman	15+5
09:40-10:00	Cyclotron refurbishing	Y. Bylinsky	15+5
10:00-10:20	ISAC actinide targets	P. Bricault	15+5
10:20-10:40	*Coffee Break*		
10:40-11:00	ISAC-III: new front end	R. Laxdal	15+5
11:00-11:20	E-linac: ISAC new photo-fission driver	S. Koscielniak	15+5
11:20-11:40	SRF	R. Laxdal	15+5
11:40-12:00	Accelerator Operations	R. Ruegg	15+5

12:00-12:45 Lunch

12:45-13:30 TRIUMF tour

13:30-17:00 <u>Parallel Breakout Sessions</u>

13:30-15:15	Cyclotron, Chairman: R. Baartman (M. Schippers, Y. Yano, H. Padamsee)	(ISAC-II Conference Rm)
13:30-15:15	ISAC front end, Chairman: R. Laxdal (M. De Jong, M. Lindroos, C. Sinclair, S. Nagaitsev)	(ISAC-II, Rm 223)
15:15-15:30	*Coffee Break*	
15:30-17:00	ISAC Targets, Chairman: P. Bricault (M. Lindroos, M. Schippers, Y. Yano)	(ISAC-II Conference Rm)
15:30-17:00	E-linac & SCRF, Chairman: S. Koscielniak (S. Nagaitsev, H. Padamsee, C. Sinclair, M. De Jong)	(ISAC-II, Rm 223)

17:00-18:30 Executive Session, Chairman: M. De Jong

19:00 Dinner (Committee members and presenters)

<u>Friday, April 4</u>

08:30-13:00 Executive session and report writing, Chairman: M. De Jong

10:15-10:30 Coffee Break

11:00-12:00 Presentation of Committee Draft Report to TRIUMF

12:00-12:45 Close and Lunch