TRIUMF User Newsletter

Volume 3 | No.3 October 2020

In this Issue:

A Message from the Deputy Director, Research –

Reiner Kruecken reinerk@triumf.ca

Dear Friends and Colleagues, with fall being here, I wanted to take the opportunity to provide you with an update on various TRIUMF's activities.

TRIUMF continues to follow provincial and federal guidance, framed in particular by the "Restart Plan" put forward by the Province of British Columbia (BC), which aims to keep social interactions at <60% of normal to keep hospital loads manageable until a viable treatment or vaccine is developed for COVID-19. The Province continues to encourage work from home to limit workplace "contact number and intensity", and, when on-site activity is necessary, to reduce employee interactions, e.g. by using staggered shifts or work hours and by forgoing in-person meetings. With an apparent second wave of COVID under way in many regions including B.C., we continue to monitor the situation actively.

Currently, TRIUMF's has ramped up its on-site activities with site occupancy of approximately 40-45%. Guided by occupancy limits for the various areas of the laboratory, medical isotope production, beam delivery to ISAC and the Meson Hall, as well as research and infrastructure projects are progressing. We also had the opportunity to welcome back a small number of local and out-of-province users to experiments. The new beam schedule for the fall has just been released and you will see that we continue to prioritize the health and safety of staff and users while enabling cutting-edge, EEC approved science. It is important to recognize that for the foreseeable future significant constraints on the number of users on site will endure. The situation for international users remains uncertain and for the rest of the year we do not anticipate being able to welcome short term users from abroad. Below you will find more details on the ongoing activities as well as progress reports on ARIEL, CANREB, IAMI and the Meson Hall.

I also wanted to make you aware of some other activities of interest to the TRIUMF community.

- The Canadian subatomic physics community has initiated its planning exercise for the next subatomic physics long range plan 2022-2026 (https://subatomicphysics.ca/) and both IPP and CINP are in the process of preparing briefs and are engaging the community via Town Halls.
- TRIUMF has started to embark on a 20-year vision exercise, which was kicked-off at this summer's virtual Science Week, with record attendance. We will reach out to the community soon for the initial *Visioning and Listening* phase which will last through Spring 2021.
- TRIUMF has just launched a call for proposals for the next round of the CFI Innovation Fund (IF) with a submission deadline of January 31, 2021 for Project Initiation sheets.

On behalf of all of TRIUMF, I would like to extend our best wishes to you and your families during these trying times. Thank you for your continued support and your patience. When you have an opportunity to come to TRIUMF, please do so with full consideration of your own health and that of everyone around you.

Thank you and all the best,

Volume 3 | No.3 October 2020

Nuclear Physics with Isotope Beams – *Martin Alcorta*

malcorta@triumf.ca

This has been a quiet year at ISAC due to the COVID-19 related delays, with stable beam delivery starting in July. The radioactive beam program had its program begin in late August, with delivery to three different low energy experiments with great success. While the experiments with TITAN, GRIFFIN, and TRILIS were set up and carried out by local personnel, the facilities reported that remote shift-taking by users not able to travel to TRIUMF worked very well.

We continue to send out user satisfaction surveys to completed experiments, and I want to thank all the spokespersons who have completed these surveys. The feedback (both positive and negative) we receive helps us continuously improve.

Science Technology - *Thomas Lindner*

lindner@triumf.ca

The goal of the Science Technology Department is supporting the physics community in bringing to reality their projects by providing technical resources for the design, construction, and operation of experiments and other apparatus.

The Midas DAQ framework has been developed jointly by the TRIUMF DAQ group and collaborators at PSI. MIDAS is used for many experiments done at TRIUMF. MIDAS has recently undergone significantly modernization. A new Python interface has been developed which gives access to all the core Midas tools, and includes a framework for writing pythonic Midas clients and frontends. For C++ code, a simpler way to access the ODB (experiment configuration) is now provided, which works like a map while sync-ing changes with the main Midas server. Finally, the webpages used for accessing and configuring DAQ systems continue to adopt more powerful and user-friendly web technologies. At TRIUMF, many experiments use a Programmable Pulse Generator (PPG) at the heart of their DAQ systems. A new framework has been developed to simplify development and support for such experiments. The framework provides the core logic for compiling and running PPG routines while scanning different experimental variables and reading out data at the appropriate times. The experiment-specific code is thus limited to writing a few lines of configuration code and providing plugins for any unique hardware devices. This new framework has already been deployed for the EBIT, MPET and CPET traps in TITAN, and will soon be deployed for the BNMR and BNQR experiments.

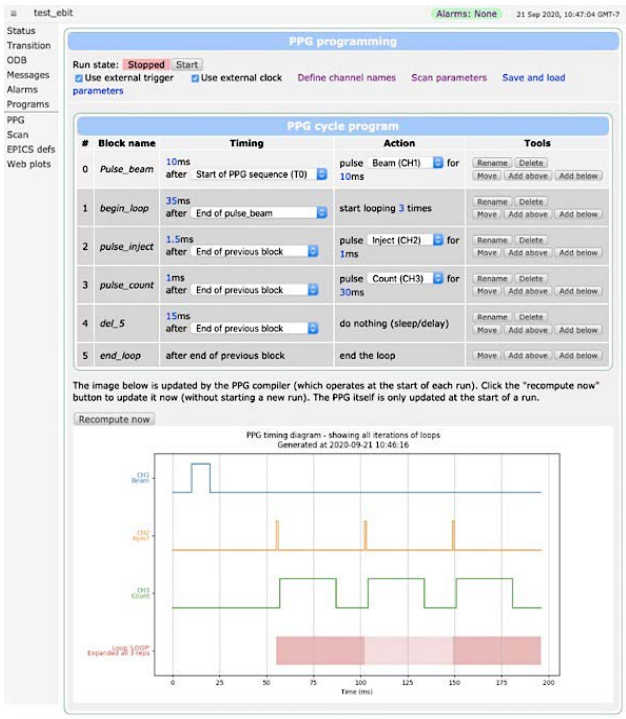

Figure 1 Programmable Pulse Generator interface.

One of the tools provided by the framework is a powerful PPG compiler built using the new Python Midas tools, which can be programmed from a custom webpage.

Further details on the different services provided by the department and the procedure for requesting assistance is provided on the following website: http://www.triumf.ca/science-technology.

Centre for Material and Molecular Science - *Iain McKenzie* iainmckenzie@triumf.ca

The COVID-19 pandemic has resulted in the available beam time for μSR and βNMR being reduced by about 50% compared with a regular year. In spite of this, there have been significant developments at the CMMS, and we have been able to support experiments run by local users and by remote users, who have collaborated with local users and CMMS staff. Remote running has been challenging but has been valuable to our users to allow the continuation of their research programs.

The repair of the M9-T2 front-end has been completed successfully. This repair will enable us to complete and commission the M9A beamline, which should become available to users in late 2021, and is an important milestone in the construction of the high-momentum M9H beam line. The M9A surface muon beam line with the new, dedicated 3T spectrometer with APD detectors will be optimized for rapid sample characterization with user-friendly operation.

We will be holding an MMS-EEC meeting in January 2021 as usual, but it will be a virtual meeting. The important dates for this meeting are listed below.

- Call for Proposals: Thursday, November 12th, 2020
- Submission Deadline: Wednesday, December 9th, 2020
- MMS-EEC: Monday, January 18th and Tuesday, January 19th, 2021

We are proceeding on the assumption that the COVID-19 pandemic will still be affecting travel in 2021. Experiments that will be run remotely must involve CMMS facility members who will change samples during office hours, troubleshoot and give guidance about running remotely. Restrictions for the remotely run experiments would apply, including the following:

- No complicated sample handling. i.e. We will be unable to deal with loose powders or air-sensitive samples.
- No complicated experimental setups or procedures. We will be unable to perform labour-intensive procedures such as accurately zeroing the magnetic field in the DR or setting up experiments with external stimuli (currents, RF etc.). Please note that we will be accurately zeroing the magnetic field at the beginning of the DR block and will group all the experiments requiring accurate zero field at the beginning of this period. If you need to apply a magnetic field, your experiment may be split into two parts.

Remote running be will be limited to 1/3 of the available time due to the demands it places on CMMS facility staff. Please discuss your experiment with a collaborating CMMS facility scientist prior to submitting your proposal. If you are unsure who to contact please discuss your proposal with the CMMS user liaison, Dr. Iain McKenzie (iainmckenzie@triumf.ca), and he will be able to direct you to the appropriate person.

M11 Beam Testing – *Isabel Trigger*

itrigger@triumf.ca

The detector test facility at M11 had a quiet year due to a combination of COVID and some vacuum issues; however, now that vacuum repairs have been completed on BL1A, M11 is available for users once again. M11 provides users with a low-rate (hundreds of Hz to kHz) mix of pions, muons, positrons and (a few) protons at selectable momentum ranges up to about 380 MeV/c, and is generally used for testing particle ID, time of flight or other properties in detectors being developed for off-site facilities. Users with proposals for M11 are invited to submit them to an upcoming Subatomic EEC.

Please contact Isabel Trigger for the exit survey link for users completing their beam time.

Proton and Neutron Irradiation Facilities (PIF & NIF) – *Camille Belanger-Champagne*

cbchampagne@triumf.ca

The Proton and Neutron Irradiation Facilities (PIF & NIF) at TRIUMF continue to provide access to multiple low-intensity beam lines for radiation testing of electronics and materials with proton and neutron beams. Higher-energy protons are available on BL1B (480 and 355 MeV) while lower-energy protons are available on BL2C (105 and 63 MeV extracted beams, other energies available with degraders). Neutrons with an atmospheric-like energy spectrum are available at the TNF facility, located at the end of BL1A, or by converting the BL1B and BL2C proton beams into neutron beams.

During the 2020 shutdown, the first phase of the BL2C magnet power supplies replacement was completed, in coordination with STF, to ensure the continued reliable operation of the beamline - the rest of the BL2C magnet power supplies will be replaced during the 2021 shutdown. BL1B was available for an extended period in May-June 2020 while BL1A maintenance work was ongoing. The PIF & NIF team took this opportunity to gather detailed beam properties data for the proton and neutron beams on BL1B over the whole operational beam parameter range using an SRAM-based dosimeter developed in collaboration with the University of Waterloo.

PIF & NIF user operations resumed in July with internal TRIUMF users and for passive irradiations were no users need to come on site. Access to PIF & NIF has been very valuable for some of the TRIUMF ATLAS hardware upgrade groups. Through PIF & NIF they were able to access a fully-fledged radiation test facility for electronics while the CERN accelerator complex is in shutdown. The first out-of-province users visited in early September with great success. Last of the facilities to come online this year, TNF started operations in mid-September and is now ready for users.

More information about PIF & NIF, including detailed beam specifications, availability, and scheduling, is available at: https://www.triumf.ca/pif-nif.

Life Sciences – *Cornelia Hoehr*

choehr@triumf.ca

The Life Sciences Division at TRIUMF pursues both fundamental and applied research and development under three core pillars: studies and applications with ions beams, nuclear chemistry, and the application of isotopes to understand life at the molecular level. The division currently has two major flagship projects, the Institute for Advanced Medical Isotopes (IAMI) and Ac-225 for targeted cancer therapy, described below. Experiments needing access of the Life Sciences resources are

reviewed via the Life Sciences Projects Evaluation Committee (LSPEC): https://www.triumf.ca/research-program/planning-experiments/how-submit-proposal/lspec-process

IAMI

Building on TRIUMF's 30-years of experience in nuclear medicine and life sciences research, the Institute for Advanced Medical Isotopes (IAMI) will be a major part of TRIUMF's Life Sciences program for research into next-generation medical isotopes and radiopharmaceuticals.

Figure 2 Concrete being poured for the B2 level of the new IAMI building during mid-October 2020.

Construction has resumed in June 2020 after a period of redesign. Currently, the concrete for the B2 level which will house the TR24 cyclotron is being poured. Once finished, the building will have 2 levels below ground for the accelerator and associated infrastructure, and three levels above ground. The ground floor will house GMP radiochemical laboratories, as well as quality control labs, material receiving, shipping and storage. The two upper levels will contain some office spaces and various building services such as mechanical and electrical support utilities.

TRIUMF expects the building to be completed in the summer of 2022, after which commissioning activities will take place. Operations are expected to start in 2023 and will allow exciting new research in Life Sciences.

Targeted Alpha Therapy with A-225

An alpha-emitting isotope with a short half-life, actinium-225 can be combined with a protein or antibody that specifically targets and kills cancer cells; the cancer-specific molecules seek out and destroy preferably cancer cells while leaving the surrounding healthy tissue unharmed. With a short half-life of just ten days, the actinium then decays without significantly accumulating in a patient's body. Known as targeted alpha therapy (TAT), this form of treatment has shown exciting potential in early studies with prostate cancer patients for whom conventional cancer therapies have not worked.

After having demonstrated the Ac-225 capabilities at TRIUMF in 2019, the Life Sciences division has assembled a team to work towards the production of Ac-225 in clinically relevant quantities. A first test irradiation and processing run is scheduled for later in 2020.

In addition, we are exploring the isotope Ac-226, which can be used as an imaging radionuclide to the therapeutic Ac-225, forming a theranostic pair. The main challenge and limitation are that Ac-226 can only be produced in few ISOL facilities around the world, including the ISAC facility of TRIUMF.

In September 2020, our TRIUMF Life Sciences Division, and Accelerator Division team collaboratively performed the first-ever successful collection and isolation of ^{226}Ac. The isotope was produced in a uranium carbide target at the ISAC rare ion beam facility. Mass 226 of the ion beam was separated and collected at the ISAC implantation station. At the end of the beam after 32 hours collection, around 25 MBq ^{226}Ac was accumulated. New implantation strategy based on depositing the ion beam in a layer of salt (NH_4Cl) sublimated on the surface of the implantation target. This enables simple recovery by adding water and minimizes the presence of stable impurities which may affect future radiopharmaceutical application. More than 95% of ^{226}Ac was recovered.

ARIEL Update - *Adam Garnsworthy*

garns@triumf

ARIEL will be a next-generation rare-isotope beam facility utilizing the Isotope-Separation-OnLine (ISOL) method for beam production. The ISAC facility first brought rare-isotope beam science to TRIUMF over twenty years ago and continues to be the world's highest-power ISOL facility. While the next-generation fragmentation facilities such as RIKEN, FRIB and FAIR offer exciting research prospects, ISOL-produced rare-isotope beams are ideally suited for world-leading research in nuclear structure, nuclear astrophysics and fundamental symmetries. ARIEL will ultimately triple the number of beam hours available for science with the addition of two new target stations; one for photo-fission using electrons from the eLINAC, and one served by a new proton beamline, plus a symbiotic target dedicated to medical isotope production. There are so many exciting opportunities for development of new rare-isotope beam species, higher intensities, cleaner beams and longer experiment running periods which will enable a whole host of new discoveries. Upon completion ARIEL will be the world's most powerful ISOL complex and the only purpose-built multi-user rare-isotope facility.

A major milestone has been achieved over the summer for the ARIEL-II and CANREB projects where radioactive beam from the ISAC production target was transported through the new ARIEL beamlines into the CANREB EBIS, stripped of electrons into a high charge state, and then characterized using the ARIEL Yield Station. This is a wonderful achievement requiring a large number of newly commissioned devices to all function together and the resulting efficiency for beam transport was very good. Congratulations to the whole team who worked on designing, fabricating, installing, and commissioning CANREB! The team is now focusing on optimization of the charge-breeding infrastructure and procedures with the goal to next accelerate beam from CANREB using the ISAC accelerator chain.

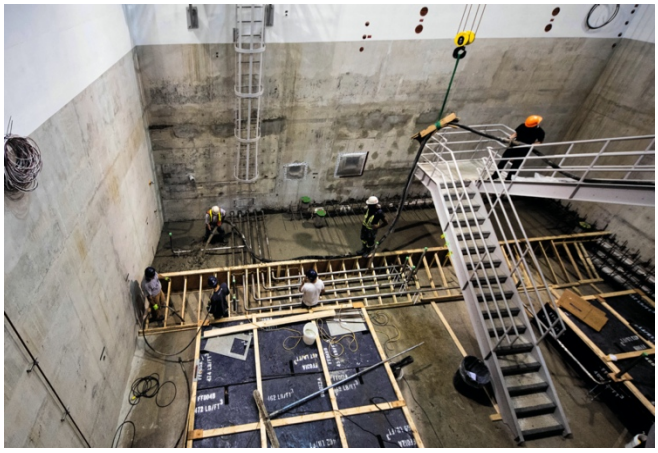

Figure 3 Overhead view of concrete shielding being poured into the ARIEL Target pit.

Progress is being made all across the AREIL-II project. The installation of the first of four layers of shielding has now been completed in the ARIEL target pit. More than 120 technical design reviews have already been successfully completed ensuring that we will have the highest-quality infrastructure and equipment. Preparations of the laboratory that will house the target ion source acceptance (TISA) test stand is well underway and the equipment is beginning to be installed. TISA is a full mock-up of the ARIEL target station frontend except for the driver beam and radiation shielding. It will be used for detailed scrutiny of all component designs and later for ion source development activities. There are many more exciting highlights forthcoming in the next few months.

Please visit the ARIEL website at: http://www.triumf.ca/ariel

Beam Development Updates – *Alexander Gottberg, Jens Lassen, and Friedhelm Ames*

gottberg@triumf.ca, lassen@triumf.ca, ames@triumf.ca

ISAC Target and Ion Sources

Shutdown activities and ISAC target hall maintenance work had been suspended from March to May 2020. This time has been used to catch up on several development and design projects for ISAC infrastructure refurbishment and increased RIB intensity, purity and availability.

The first target this year was based on a new polyphasic and porous carbon technology and was scheduled as a development target to limit the impact on User Groups in case of potential start-up problems after the long shutdown and at reduced staff availability. During first ramp-up of the proton beam at the ISAC West Target Station (ITW), the beam profile monitor (2A2M19) did not respond properly. After thorough initial troubleshooting, the proton beam Entrance Module was moved to the hot cell, where the monitor was found severely damaged by the proton beam. Further investigation revealed that heat damage had propagated along conductors to even destroy connectors and wires in the module. Consequently, the entire diagnostics unit was replaced which involved over 10 different groups at TRIUMF. The quick completion of this task was only possible due to great teamwork, collaboration, and a true can-do attitude that we often experience at TRIUMF when it comes to re-establishing user beam conditions after a failure. Finally, beam could be delivered again safely to ITW in mid-September. Experiments on the new carbon target had to be postponed to the ISAC fall beam schedule.

Previous license restrictions limiting the proton beam on UC_x targets to 10 μA have been lifted. As a result, development shifts investigating the effects of higher proton beam currents are ongoing. These shifts are used to determine the ability of the target material to handle the increased proton beam current and to investigate the production improvements expected for different isotopes under operating conditions. Running 20 μA on UC_x targets is by now a regular occurrence. As our operating experience with these higher currents grows, we will be able to offer more options to users.

Time has also been invested to testing the target module high-voltage performance under proton beam irradiation. Recent tests have confirmed the success of several incremental design improvements leading to increased module reliability at high bias voltages. After some further test shifts, we will inform users on the HV bias capabilities users can expect. Hopefully this will be a first step towards relaxing the beam energy limits some experiments had to deal with. In addition, the information gathered from the HV test shifts contributes to our understanding that a re-design and replacement of the chase that delivers the HV services from the top to the bottom of the target module (Service Tray) will be required on all modules in order to

Figure 4 Repair of the 2A2M19 proton beam monitor – teamwork with COVID-19 measures. Pictured: Aaron Schmidt and David Wang

approach full HV bias functionality. The Target Module 3 refurbishment project under way aims to develop processes and hardware for the first Service Tray replacement in ISAC's history. This TM3 refurbishment is progressing well. The old Service Tray has been removed and is being stored in a custom containment box. The design of the replacement Service Tray is ready for final review. Simulations show its HV performance will be a drastic improvement over the current design. There is considerable complexity involved in installing an entirely new design into an existing module which cannot be accessed hands-on; however, processes have been developed for this and will be tested using a simplified test piece in the next two months. These refurbishment efforts have become possible through the availability of the additional ISAC target hall hot cell.

Figure 5 For the first time in ISAC history, a Service Tray is being extracted from a target module (here TM3) inside the ISAC target hall. The new Service Tray will provide better mechanical and electrical performance.

Recent target/ion source developments led to the completion of three MSc. theses this spring. Part of the thesis work included the development of materials that can sustain higher proton-beam power at ISAC and ARIEL, as well as Cr and Pb ionization scheme developments. The new Cr laser ionization scheme was successfully applied for beam delivery of Cr 55-61 with beam intensities from $5x10^5$/s down to $2x10^2$/s respectively.

Additional new RIB's from TRILIS were Np-238g at 10^3/s and Fe-63, 65-67, 68 at beam intensities ranging from 7 x 10^5/s, 1.3 x 10^4/s - 1.0 x 10^3/s, to 62/s. These yields allowed for successful completion of precision mass measurements with MR-TOF.

Details of specific isotope yields can be viewed in the classic yield database at https://mis.triumf.ca/science/planning/yield/beam as well as a new version of the on-line yield database https://yield.targets.triumf.ca by P. Kunz. This new version of the classical ISAC yield database has added features such as in target production simulation data for various target materials and driver beam energies.

Figure 6 TRILIS development team behind the ISAC laser table (from left): Jens Lassen, Jekabs Romans (now PhD student at KU Leuven), Maryam Mostamand (now post doc at CERN ALPHA-g), Ruohong Li. Not pictured MSc. students Romina Schulz and Julius Wessokek (both TU Darmstadt).

ISAC Beam Delivery

The main accomplishments during this year's shutdown were:

- Major maintenance and upgrades to the offline ion source (OLIS) terminal and beamlines. This is a first step in refurbishing ISAC beam lines installations over the next few years, aiming to boost reliability and preparing the systems to be implemented with modern beam tuning tools, which will eventually be necessary to simultaneously serving three experiments after the completion of ARIEL.
- Installation, testing and commissioning of new beam line sections for the connection of CANREB/ARIEL systems
- Infrastructure upgrades for the operation of a target with proton to neutron converter.

Target operation and RIB delivery to experiments was delayed due to COVID-19 laboratory closure. A further delay was caused by cyclotron and beam diagnostics problems in beam line 2A. This led to the cancellation of a scheduled development run of a graphite target. Beam operation at ISAC started with a uranium carbide target on August 26, followed by a tantalum target in September/October.

Highlights of the operation so far are, a successful delivery of ^{34}Al to the GRIFFIN experiment, heavy Fe isotopes to TITAN and the commissioning of the CANREB charge state breeding system.

CANREB commissioning was done in two phases, first with a suite of different isotopes from OLIS and in early September with radioactive Na, Rb, Cs, and In isotopes. This beam time was also used to commission the new ARIEL yield station. Although the system is not operating at it's full design capacity yet, charge breeding efficiencies are already similar as with the existing ECR based ISAC charge state booster.

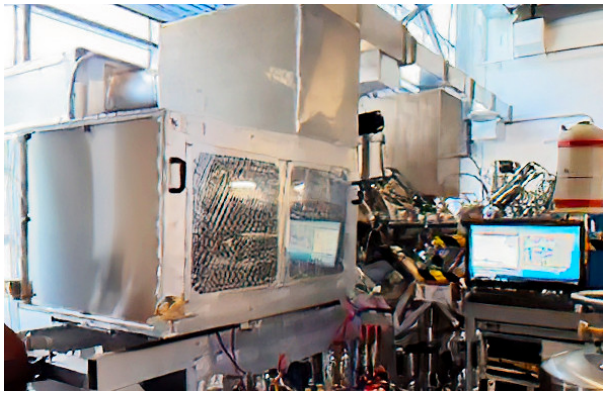

Figure 7 View of the CANREB-EBIS from the north west.

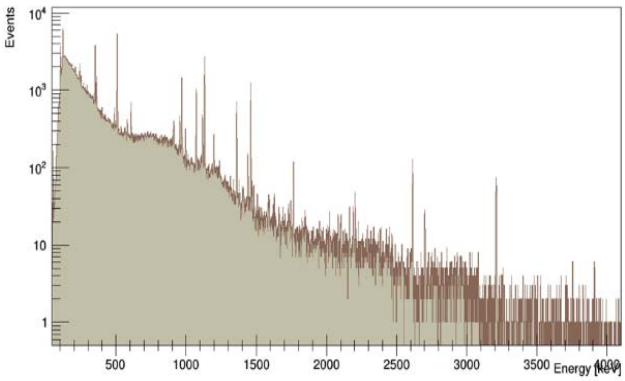

Figure 8 Gamma spectrum of highly charged 124Cs/In2 at new ARIEL yield station.

Beam Schedule Update - *Chris Ruiz*

ruiz@triumf.ca

ISAC

Due to the unique nature of the operating conditions this year, we have developed the Fall 2020 ISAC schedule based on experiments or beam development activities that were either originally planned in Schedule 138 but which had to be cancelled for operational reasons, or were originally *requested* but not scheduled. In doing so we also limited the scope to experiments which are considered able to be run successfully with on-site/local support and execution in combination with components of remote running (where possible). This is given the current quarantine restrictions on international travelers and TRIUMF's COVID-19 Return to Site regulations. All considerations were weighted with SAP-EEC priorities.

CMMS

The majority of the fall μSR (muon spin rotation/relaxation/resonance) schedule and all of the fall βNMR schedule have been filled with experiments that had originally requested time in Schedule 138. Some small openings in the fall μSR schedule have been filled with rapid access proposals. For the whole of Schedule 139, the DR spectrometer will be installed on M15 and the LAMPF spectrometer will be installed on M20D

Winter Subatomic Physics Experiment Evaluation Committee (SAP-EEC) cancelled

Beam time at ISAC in 2020 has been substantially affected by multiple schedule changes and restrictions directly related to the COVID-19 pandemic. Therefore, it was decided to cancel the Winter (January 2021) SAP-EEC meeting. Instead, the regular series of bi-annual SAP-EEC meetings will be reinstated starting with a special meeting in Spring 2021. At that meeting we will focus on re-examining those High-Priority experiments that had reached the end of their 3-year time window without the opportunity for beam-time due to scheduling, COVID-19 restrictions, or other issues. This approach will ensure that high-quality experiment proposals, of which our users and collaborators have put a lot of effort into preparing, all have available opportunities to proceed towards measurements in the next years with fair treatment despite the extraordinary circumstances that 2020 presented that have held them back.

We also want to give students at TRIUMF the best opportunity to advance their beam-time related degrees, which may have been adversely affected by the lack of beam-time and access this year. Thus, we will also open the Call for Submissions to the SAP-EEC in 2021 to students of Canadian collaborators of our experimental facilities, or local students, who have beam-time proposals that are required to advance their degrees in a timely fashion.

This has been endorsed by the Chair of the SAP-EEC, Prof. Marialuisa Aliotta.

TRIUMF Users Group Update – *Caterina Ramogida*

cramogida@triumf.ca

What are TUG and TUEC and how do you become a member?

The TRIUMF Users Group (TUG) is an organization whose members (Users) have a special interest in the use of TRIUMF's facilities for the purpose of conducting research, developing technology, utilizing resources (e.g., equipment) or interacting with personnel. Becoming a member of the TRIUMF Users Group is free and is open to all TRIUMF users in all TRIUMF disciplines. We encourage everyone who is not yet a TUG member (including students and postdocs, theorists, and experimentalists!) to sign up to the mailing list at: http://lists.triumf.ca/mailman/listinfo/triumf-user

The TRIUMF Users Executive Committee (TUEC) for 2020, as elected by the TUG membership were:

- Caterina Ramogida, Simon Fraser University, Chair
- Gerald Gwinner, University of Manitoba, Chair Elect
- Gwen Grinyer, University of Regina, Past Chair
- Maxime Brodeur, Notre Dame, Member
- Sarah Dunsiger, TRIUMF, Member
- Blair Jamieson, University of Winnipeg, Member
- Isabel Trigger, TRIUMF, Member

TUEC is rounded out by TRIUMF Liaison, Marcello Pavan

TUG AGM 2020

We would like to thank everyone for their participation in the first ever totally virtual TUG Annual General Meeting (AGM) that was held on August 21st 2020 as part of Science Week. Along with a management round table Q&A session, we were also able to successfully pass a vote on a new TUG Charter and Bylaws (vide infra).

Other Updates from 2020

The Executive Committee has been working hard this year on several aspects aimed to help improve the TRIUMF User's experience including:

- Participating/observing in Advisory Committee on TRIUMF (ACOT) meetings held biannually
- Working with the new User's office to improve access and streamline the visitor process
- Regular meetings with management to discuss issues affecting users and solutions
- Implemented updates to the Charter and Bylaws of the TRIUMF User's Group

For any TRIUMF user-related questions, concerns or suggestions please feel free to contact TUEC at any time by sending an email to tug@triumf.ca. We want to hear from you!

Thank you to our outgoing TUEC members

We sincerely wish to thank Gwen Grinyer for all of her hard work and dedication to serving our users community over the past three years in her roles as TUEC Chair Elect (2018), Chair (2019), and Past Chair (2020). We also want to thank outgoing TUEC members Blair Jamieson and Sarah Dunsiger for their two years of service as members of TUEC.

END

If you have any questions or concerns regarding the contents of this newsletter, please contact: marcello@triumf.ca