

User Services Newsletter

Volume 1 | No.1 May 2018

Welcome to the User Services Newsletter - *Jens Dilling*

It is my pleasure to introduce the new Physical Sciences Newsletter. It is meant to provide news and updates for services and developments within the Physical Sciences Division here at TRIUMF, including but not limited to our experimental on-site program of secondary beams (ie. radioactive beams at ISAC and muon beams) for fundamental and applied research. The Physical Sciences Division also provides technical services, such as experimental system developments and manufacturing; in particular, detector and data acquisition systems. In order to facilitate access and information, the [Liaison Coordinator and Scientists](#) are here to help. This issue adds news from the TRIUMF Users Executive Committee (TUEC) of the [TRIUMF Users Group](#) (TUG)

We will publish this Newsletter twice per year and hope that it will provide useful information to you. We look forward to hearing from you.

Visitor Liaison Updates

Nuclear Physics with Isotope Beams – *Martin Alcorta*

I would like to start off by first letting users know that we are here to help throughout the experimental process at ISAC, from assistance in proposal writing and safety documents, to infrastructure and technical support during experiments. We always welcome new users who wish to use existing TRIUMF facilities or to bring their own experimental equipment and can help guide them through the process.

We also want to continuously improve the user experience at TRIUMF and have therefore rolled out a new “ISAC User Beam Time Satisfaction Survey” in 2017. For the upcoming schedule, I will email the PI(s) at the completion of their experiment a link to the survey, which can be found here: <https://goo.gl/forms/mHj4PnSM87SFgqoq1>. Please keep in mind that only one survey should be filled out per experiment.

So far, the response to the survey from the user community has been impressive, having received 15 surveys which have already helped to identify some areas which need improving. In fact, as a direct result of this feedback, Science Division will meet together with members of the accelerator division involved in operations and beam delivery to help address common issues identified by several experimenters. We are still in the early stages of the feedback process and hope this is a good sign of things to come. In future newsletter releases we will let the user community know what changes have been made as a direct result of the survey.

Please continue to fill out the beam time satisfaction survey and do not hesitate to contact me for questions related to the survey process, or comments/questions on the survey itself.

Science Technology - *Thomas Lindner*

The goal of the Science Technology Department is to support the physics community in bringing their projects to reality by providing technical resources for the design, construction, and operation of experiments and other apparatus. A related goal is the development of new technologies that will be enablers of future discoveries or have the potential for applications outside physics research. The department's capabilities include detector design, simulation, electronics and mechanical design, construction, firmware and software development, and detector commissioning. These capabilities are spread across four different groups:

Instrumentation Physics, Detector Facility, Electronics Development and Data Acquisition. The Science Technology Department has successfully completed dozens of projects both on-site at TRIUMF and around the world.

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*

TRIUMF is currently in its annual winter shutdown and the CMMS group is preparing for the upcoming year of operation. The M15 and M20 μ SR beamlines operate with a nominal 7-month schedule with μ SR experiments in the Meson Hall beginning on May 9th, 2018. There will be a mini-shutdown in the beginning of October and the beam will continue until the beginning of December. μ SR experiments for the period from May 9th to September 4th, 2018 have already been scheduled. μ SR experiments in the remainder of the year will be scheduled after the summer MMS-EEC meeting, which will be held on June 4th, 2018. The next proposal deadline for the MMS-EEC is Tuesday, May 1st, 2018.

There will be reduced availability of beta-NMR in 2018 due to the delayed startup of ISAC as personnel have been shifted to tasks related to the completion of the Advanced Rare IsotopE Laboratory (ARIEL). ARIEL is TRIUMF's flagship multidisciplinary research facility and will triple TRIUMF's output of rare isotopes for research upon completion in 2022. This year we are anticipating approximately four weeks of 8 Li beta-NMR, instead of the usual five weeks, and one week of 31 Mg beta-NMR.

Developments at the CMMS:

1. A collaboration of Canadian μ SR groups (led by Jeff Sonier) and TRIUMF has received funds from the Canadian Foundation for Innovation (CFI) and matching funds from the provincial governments of British Columbia, Ontario, Quebec and New Brunswick for a \$10.7M project to redevelop the high-momentum M9B channel into one geared for μ SR research into quantum systems under extreme conditions of high pressures, high magnetic fields, and very low or very high temperatures. The beam line, to be rechristened as M9H, will be optimized to produce transversely-polarized muons at all practical momenta and thus excel at high transverse-field (TF) μ SR. To this end, the new M9H includes a new TF spectrometer based upon a 4 Tesla superconducting omnidirectional Helmholtz magnet that will accommodate a 50 mK dilution refrigerator specifically designed for high-pressure cell experimental targets (~ 2.5 GPa). M9H will also support the insertion of high-pressure liquid or gas target sample cells under extreme conditions (temperatures \leq 1000 K and pressures \leq 0.6 GPa). As part of this

project we will complete the repair of the M9 front-end, which will finally allow operation of the new M9A beam line. This beam line will have a dedicated 3 T spectrometer with APD detectors and will be optimized for rapid sample characterization. The radiation-resistant front-end quadrupoles have been sent to tender and we anticipate beam delivery to M9A at the beginning of the 2019 summer beam period.

2. The CMMS group is in the process of hiring a new member who will be associated with the Stewart Blusson Quantum Matter Institute (<http://qmi.ubc.ca>) at the University of British Columbia. This person will lead an active research program that will engage with the North American physics community and attract new users through collaborations.
3. Graeme Luke, Jeff Sonier, Rob Kiefl and Andrew MacFarlane were recently awarded a grant from the NSERC Research Tools and Instruments Grants Program for a 3He cryostat for the NuTime spectrometer. We anticipate this will be ready for user operation early in 2019.
4. An upgrade to the NMR facility capabilities is in development, to achieve up to 2 kG in-sample-plane magnetic fields and temperature down to 300 mK.
5. Research and development into establishing the use of SiPM based detectors for μ SR continues. To date, a timing resolution of about 67 ps has been achieved with a 1cm diameter muon counter delivering 16 photoelectrons to a set of 24 of SiPM detectors arrayed around its circumference.



ARIEL Update - Adam Garnsworthy

The Advanced Rare IsotopE Laboratory (ARIEL) is TRIUMF's flagship multidisciplinary research facility currently under design and construction. This world-class facility will broaden Canada's research capabilities in particle physics, nuclear physics, nuclear medicine, and materials science. A significant amount of resources is being directed towards making ARIEL a reality which is essential for keeping the project on track. Excellent progress is being made on many fronts with a number of key milestones already achieved.

A detailed update on all aspects of the ARIEL project will be given in early June as the ISAC experimental schedule gets underway. Please visit the ARIEL website at:

<http://www.triumf.ca/ariel>

Beam Development Update – Alex Gottberg and Jens Lassen

In 2017, ten target ion source assemblies were operated at ISAC [[2017 online target overview](#)]. These targets were irradiated for a total of 4530 hours with an average proton beam current of 25 μ A, enabling the delivery of 3368 RIB hours to users. Each target was carefully prepared, quality

controlled, and its performance was studied offline as well as online through yield measurements before any radioactive beam was delivered to users.

Developments aiming at increasing the intensity and availability of RIBs are at the heart of ISAC, as it is for any successful ISOL facility. Target Ion Source Development (TISD) as well as other infrastructure and beam development at ISAC are coordinated and prioritized according to proposed beams, potential impact and available resources and beamtime. In this way, delivery of 42 new isotope beams and 32 improved yields were achieved at ISAC in 2017 [[new beams in 2017](#)]. Two out of many highlights were improved yields of ^8Li achieved when rotating the proton beam on a high-power tantalum target and the observation of improved yields of ^7Be ($2 \cdot 10^8/\text{s}$) from a UC_x target, where the production dominated by multinucleon transfer reactions in ^{12}C from the excess of graphite in these targets. This opens the opportunity to operate pure carbon targets with higher specific target thickness, 10-fold proton beam intensity, higher temperature and microstructures with improved isotope release properties. All online yields together with calculated in-target production rates and other useful information can be found in the newly designed [TRIUMF Isotope Database](#). In addition, beam purification is increasingly relevant, e.g. to study isotopes that are produced with orders of magnitude lower intensity than isobaric contamination. Consequently, 2017 saw the record operation of chemically sensitive ion sources and transfer lines. TRILIS was used to deliver 2160 RIB hours, a cold transfer line was successfully employed between a SiC target and a FEBIAD ion source for the purification of He and Ne beams and an Ion Guide Laser Ion Source (IG-LIS) was used for the purification of laser-ionized europium and gallium beams from a dominant surface-ionized background of atomic as well as molecular isobars.

Offline developments are ongoing to further increase the purity of specific beams at ISAC. Laser-ionization schemes for Tm, Pr and Lu are being developed [[TRILIS](#)], and later this year we hope to test a new proton-to-neutron converter concept that is under development in a collaboration with SCK-CEN in Belgium and CERN-ISOLDE [[proton-to-neutron converter](#)]. Here, ISAC's full 100 μA proton beam will be used to produce pure and intense beams of neutron-rich fission products in uranium carbide (UC_x), where the present TRIUMF operation licence limits direct irradiations to 10 μA .

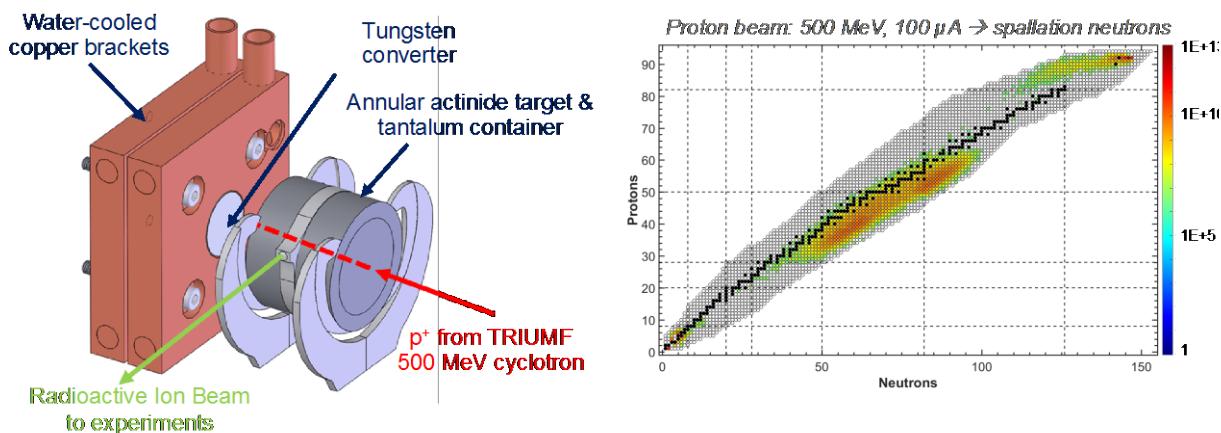


Figure 1: ISAC proton-to-neutron converter prototype for high-purity and high-intensity neutron-rich fission product beams [PhD project, Luca Egoriti].

Following the interest in increasingly exotic radioisotopes, RIB production and extraction technologies are becoming more and more sophisticated. This not only calls for development

infrastructure for innovative target materials, transfer line and ion source concepts [[OATIIS](#)], but also for improved beam detection and characterisation tools. Through collaboration with the TITAN-MR-TOF, low beam intensities and complex isobaric beam compositions become routinely accessible. Such close collaboration and interaction between the target development team and ISAC users not only allows for the opening of new avenues of TISD, but also new ideas and better channels of communication.

In general, [target material development](#) is one of the most promising avenues to increase the intensity of a specific radioisotope beam. Before ionisation, radioisotopes have to diffuse from the target material into the ion source. During this process, decay losses occur reducing the release efficiency for short-lived radioisotopes. Therefore, production rates and yields at the experiments are often orders of magnitude apart, especially for high-power targets. Losses during diffusion are proportional to the material grain size. Thus, generating finer target materials is a promising way to increase release efficiencies. High temperatures are required to achieve noticeable diffusion coefficients, which, in turn, cause rapid sintering of fine grains. Addressing this predicament, nano SiC fibres have been developed, showing remarkably reduced sintering dynamics. Its isotope release properties will be tested in 2018.

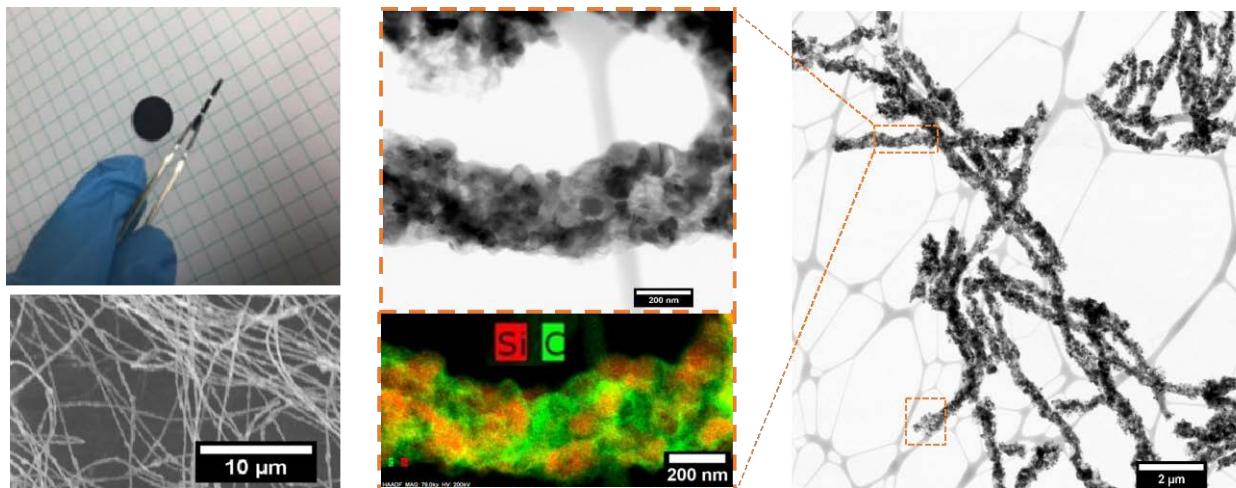


Figure 2: Newly developed SiC nano-fibre target material. Nanometric SiC is incorporated into an electrospun carbon fibre backbone that stabilizes the material and avoids sintering, even at 1600 °C. [Master project, John Wong]

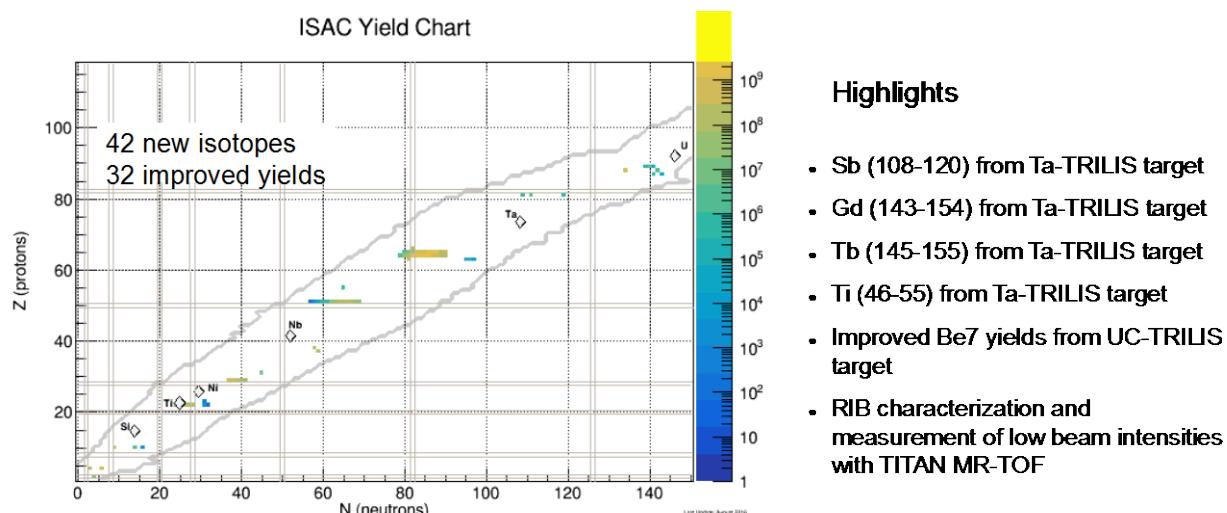
The demand for UC_x targets is increasingly high, and the limited availability of this material already has a negative impact on the ISAC beam time schedule. The significantly increasing demand for UC_x in the ARIEL era calls for the development of a new streamlined and accelerated synthesis methodology. The current process puts significant strain on the target production technical infrastructure and personnel throughout the year for production alone, which leaves no resources and time for target material developments. Not offering UC_x targets in the 2017 fall schedule therefore allowed to conduct a successful ramp-up of the UC_x target material process. As a result, the current 10-week production time for one UC_x target, could be reduced to less than one week. We hope to confirm the online performance of this material in 2018 and hence remove the current limitation in availability of UC_x targets in future ISAC schedules [[UC_x synthesis improvements](#)].

From Friedhelm Ames, ACOT April 2018:

ITE-TM4-UCx#19-LP-SIS 04/14-05/04	$^{225}\text{Ra}/\text{Ac}$ and for life science ^{94}Sr stability test source of beam instabilities in front of CSB identified ^{31}Mg to β NMR heavy Ti isotopes to Griffin in source laser spectroscopy of At
ITW-TM2-Ta#51-LP-SIS 05/05-06/01	TRILIS development for Gd and Tb heavy Ti and Sc isotopes to TITAN ^8Li to β NMR
ITE-TM4-UCx#20-LP-IGLIS 06/02-06/19	IGLIS development $^{160-166}\text{Eu}$ to GRIFFIN $^{85,86}\text{Ga}$ to TITAN
ITW-TM2-SiC#36-HP FEBIAD+CTL 06/20-07/18	^6He to IRIS ^{23}Ne to TIGRESS
ITE-TM4-Ta#52-LP-SIS 07/19-08/14	Rotating p+ beam up to 65 μA ^8Li to β NMR ^{12}Be to IRIS cyclotron rf transmission line failure
ITW-TM2-Ta#53-HP-SIS 08/14-09/11	^9Li to TUDA ^{64}Cu to TITAN ^7Be to DRAGON
ITE-TM4-UCx#21-LP-SIS 09/11-10/02	^{211}Fr , $^{90/92}\text{Rb}$ to Fr trap ^{225}Ac implantation for life science ^{92}Rb to TRINAT, $^{228,230}\text{Fr}$ to GRIFFIN $^{62-67}\text{Mn}$ to TITAN ^{80}Ga to IRIS (test) short in extraction electrode
ITW-TM2-Ta#54-HP-SIS 10/11-10/31	$^{72,74}\text{Ga}$ to GRIFFIN $^{156,158,160}\text{Er}$ to TIGRESS heaviest charge bred beam so far (23+) ^8Li to β NMR
ITE-TM4-SiC#37-HP-FEBIAD 10/31-11/21	^{14}O to GRIFFIN/GPS ^{24}Na to EMMA first radioactive beam to EMMA ^{14}O to TUDA high voltage problems low yield, ^{15}N background, mitigation $^{24}\text{Na}^{2+}$, ^{15}O to TUDA, ^{19}Ne to GRIFFIN
ITW-TM2-Ta#55-LP-SIS 11/22-12/19	^{12}Be to IRIS ^8Li to β NMR and MTV/OSAKA ^{82}Rb to Fr trap

New Beams at ISAC [from Peter Kunz]:

Online Beam Development 2017



TRILIS

TRILIS operation was made more versatile through the installation and operation of a second pump laser for the TRILIS Ti:Sa lasers. The Ti:Sa laser systems were upgraded with new intra-cavity opto-mechanics for ease of operation and improved output power.

Off-line laser development continued on developing laser ionization schemes for Tm, Pr and Lu, to further the availability of lanthanide beams – which with the help of the ion guide laser ion source (IG-LIS) can be delivered at unprecedented purity.

For co-implantation of ²²⁵Ra and ²²⁵Ac, both Ra and Ac were resonantly ionized. In order to reduce space charge effects, the lasers for Ra and Ac ionization were pumped from different pump lasers, which were offset by 50 µs, interleaving the Ra and Ac ion pulses.

The additional pump laser also allows for a more flexible TRILIS setup and laser pulse synchronization.

The first on-line yield measurements with TRILIS were done on Ti (in conjunction with the TITAN MR-TOF), Gd, Tb, Sb and Er yields with TRILIS from a Ta target were measured and made available in the on-line, up to date ISAC yield database.

^{156, 158, 160}Er was delivered by the charge state booster as a charge state ²³⁺Er ion beam for post-acceleration. A high intensity beam of ⁷Be was delivered from a UC target for nuclear astrophysics experiments. The majority of the ⁷Be production stems from the carbon.

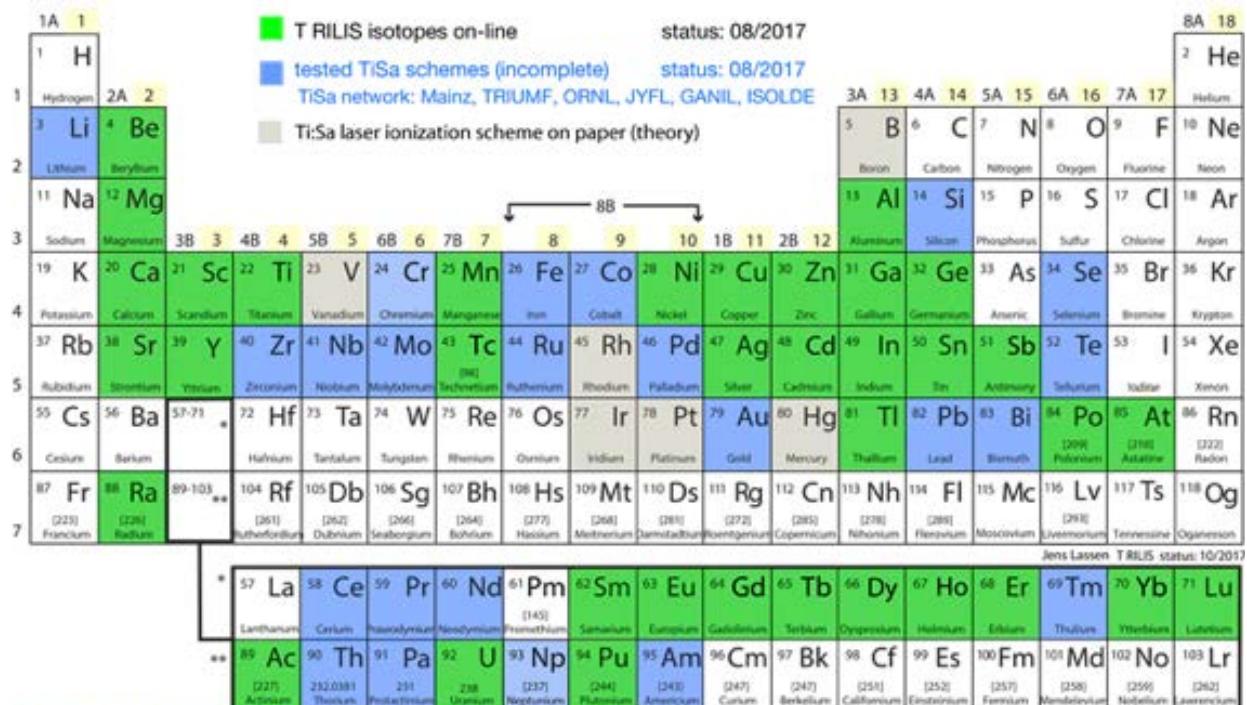
Polarized Beams Development

The Polarizer has since its inception been used to polarize radioactive ⁸Li and other alkali-metal beams for use in BNMR materials science experiments, probing nuclear structure and testing of fundamental symmetries. Recently, we have brought polarized ³¹Mg into routine production, in response to demands from the life sciences (bio-BNMR in liquid targets) and the materials sciences (CMMS) group at TRIUMF, the latter valuing the fact that as a spin 1/2 nucleus, ³¹Mg is a purely magnetic probe. A process of modernizing the laser systems and Polarizer beamline

has begun, in preparation for the greater beam time and variety of beams expected once ARIEL is running.

TRILIS operation online 2160 hours

Delivered isotopes from 15 different elements (Ac, Ra, Sr, Mg, Tl, At, Tb, Ti, Mn, Eu, Ga, Be, Cu, Er, Ca) in 19 separate on-line experiments, two of which were with the IG-LIS to produce Eu and Ga beams. The IG-LIS can now be considered a standard ion source of choice at ISAC.



http://www.triumf.info/facility/research_fac/yield.php

35 TiSa RILIS beams online (2017)

DEVELOPMENT OF A PROTON-TO-NEUTRON CONVERTER FOR RADIOTOISOTOPE PRODUCTION AT ISAC-TRIUMF

L. Egorin^{1,2}, R. Augusto², P. Brécault³, T. Day Goodacre⁴, M. Delonce⁴, M. Dierckx⁵, D. Hwangbo⁵, L. Popescu⁶, J.P. Ramos⁶, S. Rothe⁶, T. Stora⁶, A. Gottberg^{1,6}

¹TRIUMF, Vancouver, British Columbia, V6T 2A3, Canada

²Department of Chemistry, University of British Columbia, Vancouver, British Columbia, V6T 1Z1, Canada

³LMU Physics Department, Theresienstrasse 37, 80333 München, Germany

⁴CERN, CH-1211 Geneva 23, Switzerland

⁵SCK-CEN, B-2400 Mol, Belgium

⁶University of Victoria, Department of Physics and Astronomy, Victoria, V8W 2Y2, British Columbia, Canada

Introduction

In the ISOL method (Isotope Separation On Line) applied at TRIUMF, an incoming 500 MeV proton beam interacts with the target material within a tantalum container and induces the production of a variety of radioisotopes.

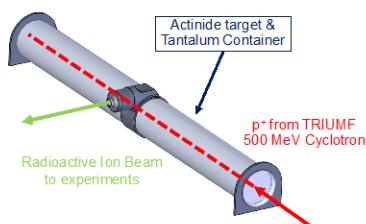
Motivation

Direct proton irradiation of **standard actinide target** materials induces the production of many radioisotopes through spallation and fission reactions. However, experiments often require much purer beams than usually provided.

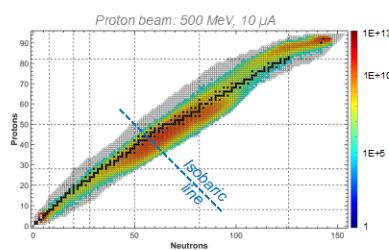
Solution

A collaboration between TRIUMF, CERN and SCK-CEN is developing a high-power proton-to-neutron converter target. It aims at reducing the contamination level of unwanted isotopes without affecting the production rate of the ones of interest

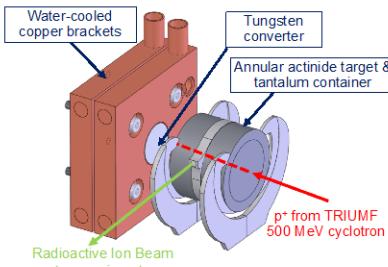
Standard Actinide target



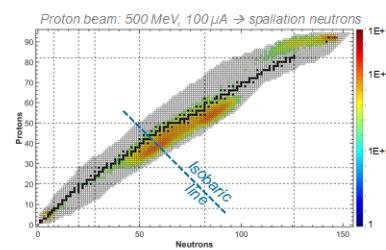
- Many nuclides are produced from the same actinide target ✓
- Experiments often suffer from **isobaric contamination** ✗
- Selective production is needed.
- Direct proton beam on target creates **cold spots** detrimental for isotope extraction ✗



New proton-to-neutron converter target



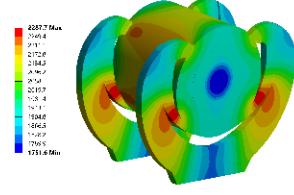
- Match or increase the standard production of neutron-rich fission fragments ✓
- Reduce by a factor 100 the contamination from neutron deficient isobaric nuclides ✓
- Avoid proton beam induced cold spots for more efficient isotope extraction ✓



Converter and Target Design

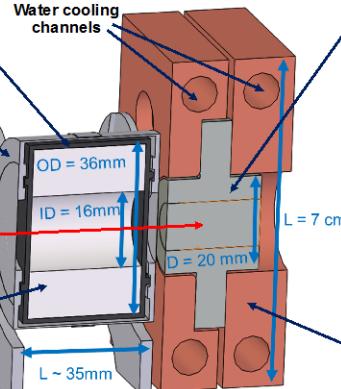
Tantalum container / heater

- Contains target material
- Heated by current of 1600 A



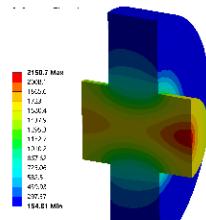
Graphite container

Cut view of figure up-top



Tungsten proton-to-neutron converter

- 7.5 kW deposited by p+ beam
- T_{max} = 2150 °C



Actinide annular target material

- Annular, no direct interaction with protons
- Neutrons induce 3E+11 fiss/s
- Minimum operational temperature = 1900 °C

Copper alloy brackets

- Clamp converter to dissipate heat
- Includes water cooling channels

Outlook

Offline target heating tests needed to validate the concept are planned for Spring 2018, while online irradiation of this target is foreseen for Winter 2018.

Acknowledgements

TRIUMF receives federal funding via a contribution agreement with the National Research Council of Canada. L.E. and A.G. acknowledge additional support from his NSERC CREATE IsoSiM fellowship. The authors acknowledge Anders Mjos and John Langrish for fruitful discussions and design ideas, Dan McDonald and Maico Dalla Valle for their support during the converter tests Peter Kunz and Friedhelm Ames for their early work on this topic.

Target and Ion Source Development for Better Beams in the ARIEL Era

C. Babcock¹, T. Day Goodacre¹, A. Gottberg^{1,2}
 TRIUMF, Vancouver, Canada
 University of Victoria, Victoria, Canada

- Goals**
- ★ Create an off-line system dedicated to target and ion source development
 - ★ Explore new opportunities for RIB production and delivery in the ARIEL era
 - ★ Test and verify that the ARIEL ion source system will meet stated requirements

Proposed OATIS Layout

OATIS can be built to mirror the ARIEL ion optics. The test stand can then be used to translate developments off-line to the on-line system.

Pre-Separator Diagnostics

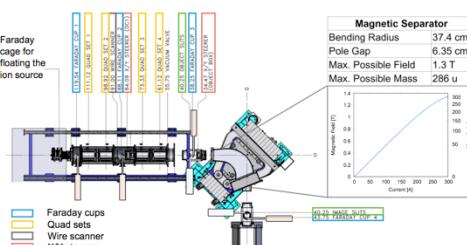
- Faraday cups with electron suppression for reading picoamps
- Wire scanners for beam positioning

Post-Separator Diagnostics

- Faraday cup
- Wire scanner
- MCP for low beam currents and time resolution
- Emittance station for beam quality diagnostics

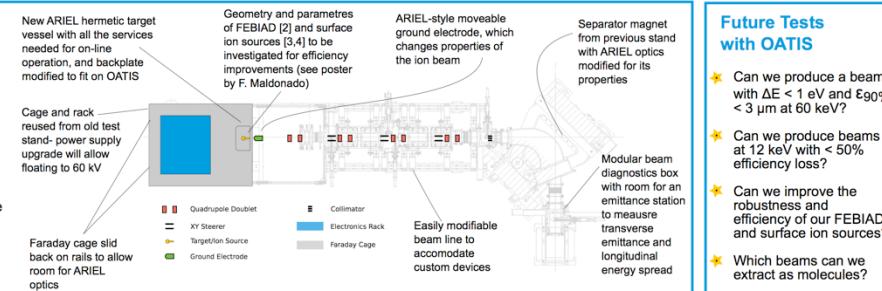
Present Test Stand Layout

Developments in this poster will be used to benefit TRIUMF's flagship facility, the **Advanced Rare Isotope Lab** (ARIEL) [1]. ARIEL is a next generation radioactive beam facility which will employ a superconducting e-linac to produce one driver beam and a proton beam as the second driver.



A previous test stand will be used as a starting point to build a **dedicated target and ion source test stand** called OATIS (Optimization of ARIEL Targets and Ion Sources).

Already present is a Faraday cage with racks, which will allow beams of energy up to 60 keV to be produced, a separator magnet for the **identification of produced ions**, a beamline, and various **ion optics and diagnostics**. Modifications are required for the test stand to function with beam currents in the picoamp range.



TRIUMF receives federal funding via a contribution agreement with the National Research Council of Canada

[1] J. Dilling et. al. eds., *ISAC and ARIEL: The TRIUMF Radioactive Beam Facilities and the Scientific Program*, Springer, 2014.
 [2] R. Kirchner and E. Roedl, *Nucl. Instr. Meth.* **133** (1976) 187-204

[3] G.J. Beyer et. al., *Nucl. Instr. Meth.* **96** (1971) 437-439
 [4] P.G. Bolson et. al., *Nucl. Instr. Meth.* **106** (1973) 83-87

4004 Westwood Mall
 Vancouver, Canada
 www.triumf.ca
 @TRIUMFLab

Discovery,
 accelerated

Increasing UC_x Target Availability at TRIUMF: Production Ramp-Up for ARIEL Era

M. Cervantes^{1,2}, P. Fouquet-Métivier³, P. Kunz^{2,4}, L. Lambert², A. Mjos², J. Wong^{2,5}, and A. Gottberg^{1,2}

¹University of Victoria, Victoria, BC, Canada, ²TRIUMF, Vancouver, BC, Canada, ³Ecole Nationale Supérieure de Chimie de Montpellier, Montpellier, France,
⁴Simon Fraser University, Burnaby, BC Canada, ⁵The University of British Columbia, Vancouver, BC, Canada.

Limitations of the Previous UC_x Production Method

ISAC beam time schedule restrictions

Currently, one constraint of the beam time schedule at ISAC is the availability of the uranium dicarbide (UC_x) targets. The existing UC_x production method is based on a 10-week long, two step material synthesis process, which allows the target team to produce a maximum of 3-4 UC_x target units a year [1].

GOAL 1: Accelerate the UC_x production method. The ISAC beam time schedule should be determined by the users' demands, and not the targets availability.

Not viable given UC_x demand at ARIEL

The new ARIEL facility will bring two additional target stations at TRIUMF: 1) AEET using electron driver beam; and 2) APTW using proton driver beam. With this new facility, TRIUMF will triple the availability of radioactive beams to be delivered to different experiments, with up to 20 UC_x target per year.

GOAL 2: Increase the efficiency of UC_x target production in order to meet ARIEL demand for up to 30 UC_x targets a year.

Resource intense UC_x target production

Approximately 10 FTE weeks are now required to produce one UC_x target unit for the experiments at ISAC. Furthermore, the availability of the technical production infrastructure is currently limited due to lengthy UC_x production process, which puts severe constraints on the development of new target materials.

GOAL 3: Reduce the manpower required for the ISAC UC_x production down to 1.5 FTE weeks, and free skilled manpower across the laboratory to work on ARIEL.

Aim - mitigate the existing limitations on the UC_x production method

New UC_x Production Method

Major advantages of the new UC_x target production method:

- Ten-fold reduction in the time required for the production of one UC_x target unit (Fig. 3 and 4),
- Reduction in manpower requirements for target production at ISAC,
- Meeting ARIEL's demand for up to 30 UC_x targets a year,
- Cleaner handling of the production target by avoiding a vapor inside conditioning step inside the online target assembly (Fig. 1),
- Potentially increased longevity of the Ta target containers (Fig. 2).

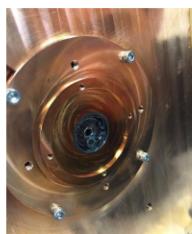


Fig. 1 Material build-up from carbide targets between ion source and extraction electrode causing electrical shortout or blockage.



Fig. 2 Post-irradiation photograph of cracked target container caused by interaction with target material.

Previous UC_x method	
Casting UO_2 , C, solvents and binders on glass	4 days
Carbothermal reduction $UO_2 + 4C \rightarrow UC_x + 2CO$ 5e-5 Torr	30 days
Casting UC_x , C excess, solvents and binders on C-foil	4 days
Manufacturing disc, loading in Ta container	1 day
Conditioning 5e-5 Torr	30 days
Total time: 10 weeks	

Fig. 3 Previous two-steps UC_x production method [1].

New UC_x method	
Casting UO_2 , C excess, solvents and binders on C-foil $UO_2 + 4C \rightarrow UC_x + 0.5C + 2CO$	4 days
Manufacturing disc, loading in C-insert	1 day
Carbothermal reduction and conditioning $UO_2 + 4C \rightarrow UC_x + 0.5C + 2CO$ 5e-5 Torr	2 day
Total time: 1 week	

Fig. 4 New one-step UC_x production method, adopted from [2].

Conclusions

The morphology and composition of the UC_x material produced using the one-step process has been analyzed with SEM and XRD. The obtained UC_x material exhibits similar structural characteristics as the UC_x produced with the conventional, two-step method. The one-step UC_x production method, however, accelerates the process by > 80%, reduces the required manpower and infrastructural resources, and is sustainable for the increased UC_x demands in ARIEL era.

Next Steps

- Validating the chemical stability of the UC_x target material produced with the new method.
- Obtaining safety approval for irradiations at ISAC.
- Validating the full thermal life cycle through the target life in bench top tests.
- Assessing the target online performance.

Acknowledgments

TRIUMF receives federal funding via a contribution agreement with the National Research Council of Canada. ARIEL is funded by the Canada Foundation for Innovation (CFI), the Provinces of AB, BC, MB, ON, QC, and TRIUMF. AG and MC acknowledge additional support from NSERC. MC acknowledges T. Day Goodacre and M. Stachura for the fruitful discussions and revision of the poster. J. Kabel from Materials Engineering, UBC, for his support with SEM and XRD experiments, and Aaron Schmidt for his technical support. The TRIUMF scintillator group and the entire ISAC controls group are acknowledged for their technical support.

References

- [1] P. Kunz et al, Journal of Nuclear Materials, 440, 110-116 (2013).
[2] A. Gottberg, NIMB, 376, 8-15 (2016).



TRIUMF

Canada's particle accelerator centre
Centre canadien d'accélération des particules

www.triumf.ca
@TRIUMFLab

4004 Westbrook Mall
Vancouver BC V6T 2A8 Canada

**Discovery,
accelerated**



Connecting to TRIUMF: Resources, Beams, and Facilities - *Ania Kwiatkowski*

The TRIUMF User Group (TUG) has been the forum by which users can liaise with TRIUMF Management for more than three decades. TUG:

- provides a formal means for exchanging information relating to the development and use of the facility,
- advises members of the entire TRIUMF organization of projects and facilities available,
- provides an entity response to the representations of its members for offering advice and counsel to the TRIUMF management on operating policy and facilities.

Underlying these purposes is the definition of a "user." A common convention, however, is a user uses beam produced by the facility. Another convention distinguishes between non-profit users and revenue-generating customers of the beam. TUG's website (<http://www.triumf.ca/triumf-users-group>) defines a user differently: a scientist or engineer "with special interest in the use of the TRIUMF facility." The TRIUMF User Executive Committee (TUEC) interprets that interest as one of TRIUMF resources, whether for regular usage or during a sustained period.

Thus, all TUG-defined users are impacted by Management's balancing of finite resources (manpower, equipment, and beam availability) during the ARIEL upgrade (<http://www.triumf.ca/ariel>), regardless of beam usage. Moreover, since Fall 2016, the TUEC chair reports on user engagement and satisfaction regularly to the Advisory Committee on TRIUMF (<http://www.triumf.ca/home/about-triumf/governance/external-committees/acot>) (ACOT). These examples highlight the need for a broad and active TUG; however, TUG membership is only about 200 persons.

For these reasons, TUEC is exploring communication across the user base and updating its charter and bylaws <http://www.triumf.ca/charter-bylaws>, documents untouched since 2005. We invite you to participate in the process. Get in touch directly with a TUEC member or email tug@triumf.ca. Come to Science Week <http://www.triumf.ca/science-week-2018> (July 16-19, 2018), where a formal discussion on TUG will be held at the Annual Group Meeting (AGM).

END

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