The TRIUMF Newsletter

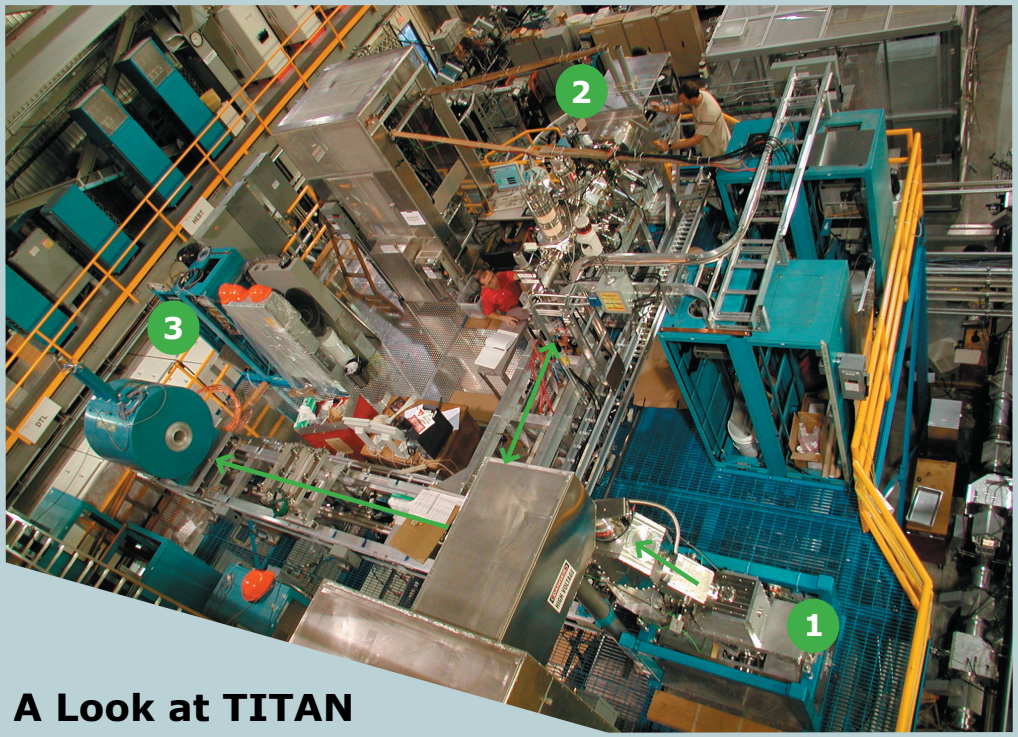
News from Canada's National Laboratory for Particle and Nuclear Physics

DIRECTOR'S NOTES

During the last few months two particular ISAC milestones have been passed: the first experiment using two detectors of the TIGRESS array and the first on-line 100 μA proton bombardment of a target producing radioactive beams. The experiment with the TIGRESS detectors involved projectile Coulomb excitation of radioactive beams. The quality of the data taken was excellent, so this gives great confidence for future ISAC-TIGRESS experiments. The development of high powered targets to operate stably for several weeks at 100 μA proton bombardment means that ISAC can now produce some of the most intense radioactive beams. However, the knowledge needed to identify target material, composition and matching ion sources that operate stably at such high powers to produce a particular isotope is still in its infancy, so a continuing development effort will be needed to expand the range and intensities of ISAC radioactive isotope beams.

Canada, through TRIUMF, has over the last few years designed and built various components for the new Large Hadron Collider (LHC) accelerator at CERN. In addition Canadian universities in collaboration with TRIUMF have contributed to substantial components for the ATLAS detector – one of two multi-purpose LHC experiments. These TRIUMF-Canada construction projects have now been successfully completed and so the Canadian community, like many others, looks with great anticipation to the first LHC collisions in 2007. The enormous data that will be generated by these collisions is truly awe inspiring and has demanded a world-wide network of high power computing centres to deal with this data challenge. The distributed computing infrastructure will be at different levels with ten so called Tier 1 national centres at the highest level. I am very pleased to report that the Canada Foundation for Innovation (CFI), along with other funding sources, is providing support for one of these national centres to be built at TRIUMF. This is a very important development for the Canadian particle physics community. Particle physics projects can have a very long time span, so even though first data from the LHC has still to come, world-wide planning is actively being pursued for the new International Linear Collider (ILC) project. The Canadian community and TRIUMF were most pleased to host the VLCW06 collider workshop where many of the issues relating to this ambitious project were discussed. With so much potential to address some profound scientific questions, this is an exciting time for the whole subatomic physics community.• *Alan Shotter, TRIUMF Director*

For more information on TRIUMF Projects, visit the TRIUMF website at: http://www.triumf.info



A Look at TITAN

The TITAN (TRIUMF Ion Trap for Atomic and Nuclear science) is being commissioned and prepared for the first experiments early in 2007. Using short-lived exotic ions from ISAC, TITAN will carry out precession experiments of unprecedented accuracy for atomic mass measurements, laser and X-ray spectroscopy, and for double-neutrino double-beta decay experiments. The photo shows TITAN highlighting the Radio-Frequency Quadrupole (1) that accepts the ISAC beam, the EBIT (2), recently delivered to TRIUMF from the Max-Planck-Institute for Nuclear Physics in Heidelberg, Germany, and the superconducting 4 Tesla magnet forming the core of the Penning trap (3). TITAN has six approved high priority experiments, and is encouraging further collaborations. More information on http://www.triumf.ca/titan

Anatoli Zelenski Wins 2006 Veksler Award

Anatoli Zelenski, a former ion source physicist at TRIUMF now at the Brookhaven National Laboratory (BNL), has won the prestigious 2006 Veksler Award from the Russian Academy of Sciences. The award recognizes outstanding achievements in "the development of high-intensity polarized ion sources for high energy accelerators", work which Zelenski performed largely at TRIUMF. His award is shared with Alexander Belov of the Institute for Nuclear Research (INR) in Moscow.

Dr. Zelenski earned his physics Ph.D. from the INR in 1986 for developing one of the world's first working optically pumped polarized ion sources (OPPIS). At TRIUMF between 1990 and 1999, Zelenski and collaborators perfected a high-intensity OPPIS 100 times more intense than previously possible. Their heroic efforts were primarily for the successful proton-proton parity violation experiment from 1994 to 1999.

With collaborators at BNL and KEK, Dr. Zelenski helped construct at TRIUMF a pulsed source for the Relativistic Heavy-Ion Collider at BNL that produced very high beam currents and polarization simultaneously. Zelenski commissioned it in 1999 after his move to BNL's Collider-Accelerator Department. Beam intensities that were no longer limited by the polarized source marked a major milestone in accelerator spin physics, earning Zelenski's developments recognition worldwide.• *Phil Levy*

WHAT'S INSIDE

FIRST TIGRESS EXPERIMENT A SUCCESS

After three years of development, accelerated radioactive ion beam from ISAC was delivered to the new TIGRESS gamma-ray spectrometer for the first time in August 2006. Dubbed the "Hubble Telescope of nuclear physics" by Science Director Jean-Michel Poutissou, the TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer (TIGRESS) will be the world's most powerful gamma-ray spectrometer of its type when completed. TIGRESS is a next-generation gamma-ray spectrometer for ISAC being developed by an international team led by physicists from TRIUMF and the University of Guelph and represents the latest is a series of large arrays based on germanium detector technology originally pioneered in Canada at the Chalk River Laboratories.

For the first TIGRESS experiment (E1058) with radioactive beam from ISAC, two of the advanced TIGRESS gamma-ray detectors were combined with custom digital electronics designed and constructed at Université de Montréal, a target chamber constructed at the University of Rochester, and an inner silicon detector array ("Bambino") developed at Lawrence Livermore National Laboratory. Following a week of commissioning with stable ^{21}Ne (neon) beam, a beam of the radioactive isotope ^{21}Na (sodium) was accelerated to 1.7 MeV/u by the ISAC-I accelerator and delivered to the TIGRESS experimental setup on the ISAC-I zero-degree beamline (Fig. 1). Here Coulomb excitation of the ^{21}Na nuclei in a titanium foil was studied. Beam intensities up to 5×10^6 ion/s were delivered and the beam quality and stability were spectacular, resulting in a clean Coulomb excitation gamma-ray spectrum for ^{21}Na with negligible contamination by 511 keV photons from the positron decay of the radioactive beam (Fig.2).

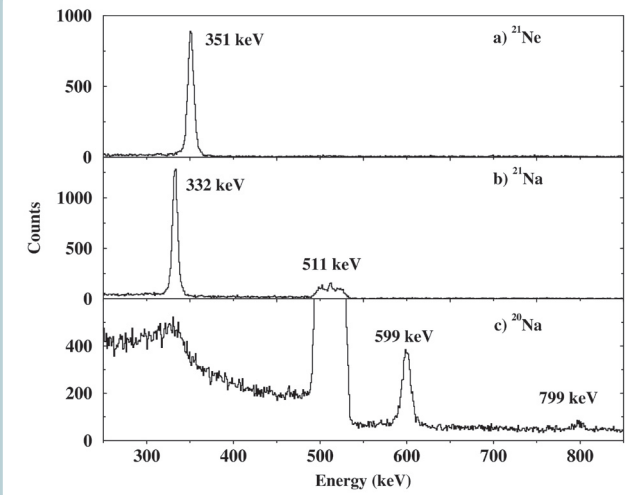


Figure 2. First online gamma-ray spectra from TIGRESS. Gamma rays are shown from the Coulomb excitation of a) a stable beam of ^{21}Ne, b) a radioactive beam of ^{21}Na, and c) a beam of the proton-dripline nucleus ^{20}Na, each accelerated to 1.7 MeV/u by the ISAC-I accelerator. Only a basic Doppler-shift correction has been applied to these online data.

The integrated TIGRESS and Bambino systems performed flawlessly in this first radioactive beam experiment, which was completed successfully in less than one week of beam time. With the same setup, the TIGRESS collaboration then pursued the more challenging study of the proton-dripline nucleus ^{20}Na, important in the breakout of the CNO cycle in explosive astrophysical environments via the ^{15}O(α,γ)^{19}Ne(p,γ)^{20}Na reaction chain. An accelerated beam of ^{20}Na at 1.7 MeV/u with up to 5×10^6 ions/s was delivered to TIGRESS and clean Coulomb excitation spectra for the first two excited states of ^{20}Na were obtained in less than one week of beamtime (Fig. 2c). Analysis of these data are ongoing, and will provide the first measurements of transition matrix elements in the astrophysically important ^{20}Na nucleus.

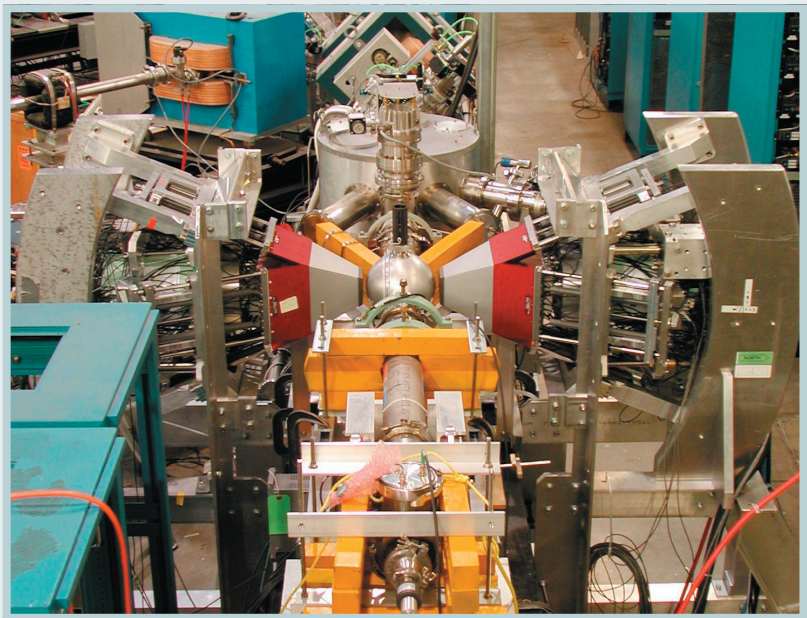


Figure 1. Setup for the first TIGRESS experiment with accelerated radioactive ion beam on the ISAC-I zero-degree line in July/August 2006.

The successful completion of the first radioactive beam experiments with all TIGRESS subsystems fully integrated represents a major milestone for the project. TIGRESS, currently midway through its installation phase funded by a 6-year $8.06M award from the Natural Science and Engineering Research Council (NSERC), will now move to the ISAC-II facility where it will form the centerpiece of the experimental program with the higher-energy accelerated beams from the new ISAC-II superconducting linear accelerator.•

Carl Svensson

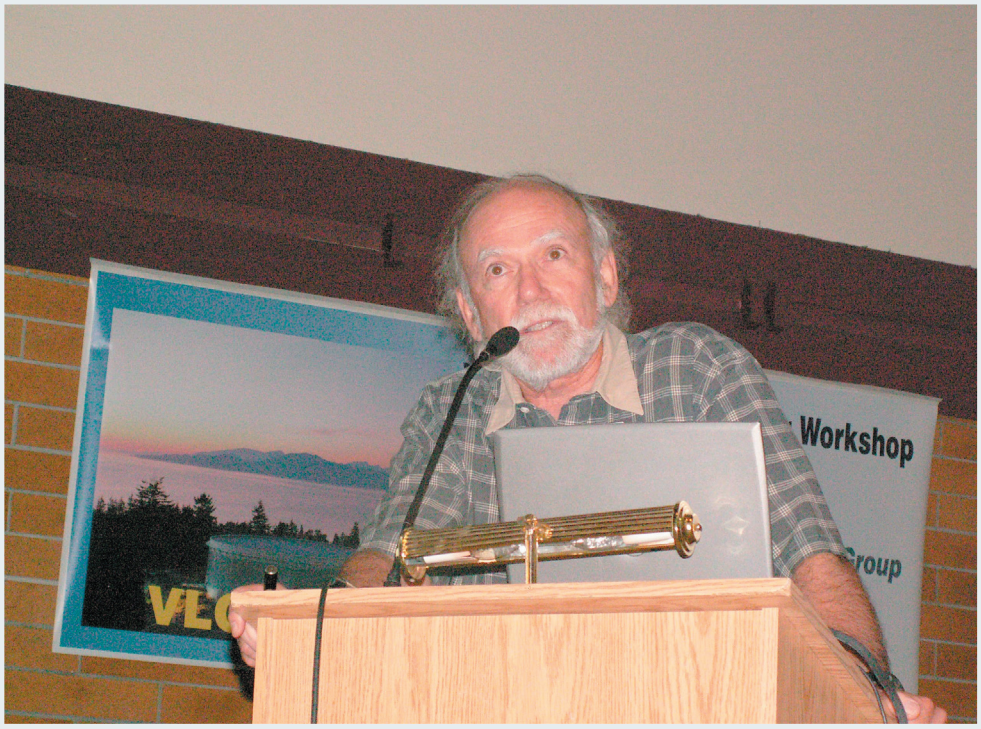
VANCOUVER LINEAR COLLIDER WORKSHOP 2006 (VLCW06)

The Vancouver Linear Collider Workshop (VLCW06) attracted nearly 300 participants to a four-day workshop 19-23 July. It was hosted jointly by the American Linear Collider Physics Group (ALCPG) and the International Linear Collider (ILC) Global Design Effort (GDE), and organised by TRIUMF on the campus of the University of British Columbia, VLCW06 The two 15 km long linear accelerators will collide 500 GeV electron and positron beams to make precision measurements on the Higgs boson and its couplings to the other fundamental particles in the Standard Model.

The workshop programme ranged from very practical issues such as cost estimates for the ILC, to the latest theoretical physics developments. The broad programme is the result of concerted efforts to bring the detector/physics and accelerator communities closer together. Fermilab's Joe Lykken kicked off VLCW06 by giving his version of the physics case for the ILC: to discover the secrets of the Terascale, to shed light on "dark matter", and to reveal the ultimate unified theory. These themes were elaborated in the ALCPG plenary sessions, including detector physics, precision measurements, connections to the LHC and even cosmology.

The GDE portion of the meeting focused on preparations for the Reference Design Report (RDR) and had large participation - about 200 scientists and engineers. Participants reported progress on the accelerator design, as well as success in obtaining a first complete set of costing data for most components of the baseline machine. Accelerator developments included (i) confirmation that a main linac following the earth's curvature can contain emittance growth almost as well as a laser-straight linac; and (ii) dangerous electron cloud effects could be suppressed by using clearing electrodes, which might allow reducing the number of positron damping rings.

The Town Hall Meeting, held mid workshop, gave participants an opportunity to voice their concerns over selecting detectors, siting decisions and costs. Project leader Barry Barish explained how the costing engineers are comparing scenarios in order to develop a number that will not hinder the project. Barish also commented that "the civil part of the site (costs) for the host country will not be that different for each region."



Dr. Barry Barish, Director of the International Linear Collider Global Desisn Effort, addresses the gathering at the Vancouver Linear Collider Workshop.

In closing out VLCW06, Barish declared that the RDR and DCR drafts are on track to be released in early 2007. The next steps will be to validate component costs, investigate areas where costs appear high, and to look at design changes that might significantly reduce costs. The GDE will next meet in Valencia, Spain on 6-10 November, 2006.

The role of the ALCPG & GDE was to prepare the workshop programme and its content. All other logistic aspects of the meeting were the responsibility of TRIUMF. Not only were there essentially two parallel meetings coming together for joint plenaries and the Town Hall, but the plethora of physics and accelerator working groups and satellite meetings provided the challenge of finding up to 18 simultaneous meeting rooms of various sizes, equipping them with audio-visual equipment and wireless internet and the occasional international phone service. The closure of UBC food services on evenings and weekends added extra complexity to the provision of catering. Nevertheless, it is fair to say that TRIUMF and the UBC Almer Mater Society conference services rose to the challenge, and the workshop ran even more smoothly than its TRIUMF organisers had hoped.

Workshop Outcomes

The ILC physics and detector communities will create a "Detector Concept Report" (DCR) that will describe the physics motivation and capabilities of the ILC. It will include chapters on the detector concepts, technologies and associated R&D programme needed to bring the experimental program to reality.

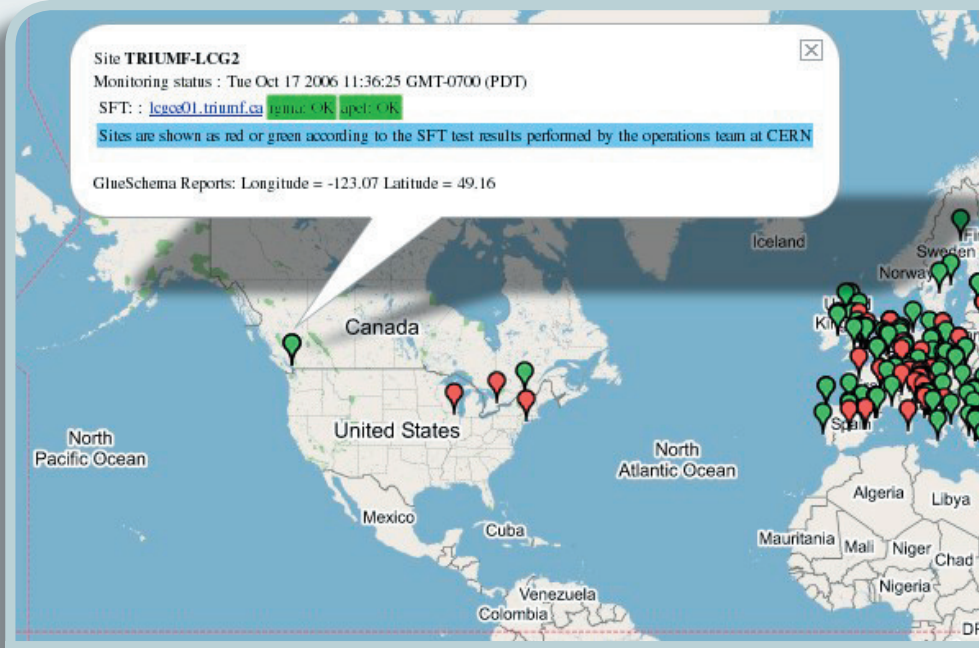
The present design of the ILC has been guided by a document that is now three years old. With intervening developments, it is time to reactivate the ILC parameter group and to perform a new parametric analysis of cost to performance (science potential) for the key parameters used for the design (energy, luminosity, etc), and analyses of the importance and trade-offs for the discrete parameters (like the number of interaction regions, positron polarisation, etc). •

Shane Koscielniak (TRIUMF)

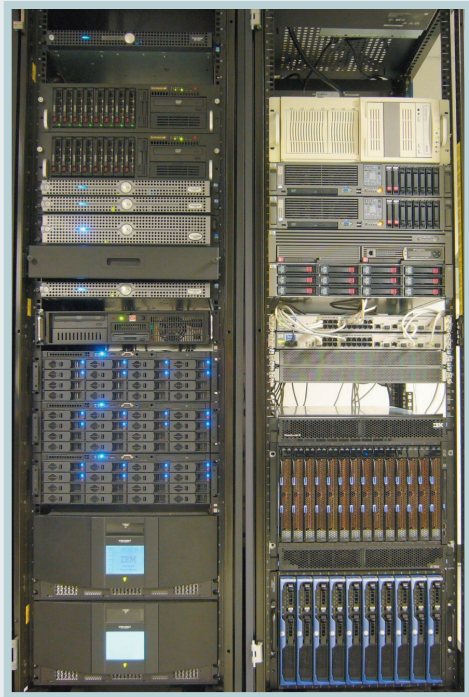
ATLAS TIER-1 FACILITY SECURED FOR TRIUMF

TRIUMF is part of the world's most advanced network and computing grid as it is hosting Canada's "Tier-1" computing centre for the huge ATLAS particle physics experiment at CERN's Large Hadron Collider (LHC) particle accelerator complex. Funds for the centre in the amount of $10.5M ($8.0M in capital, $2.5M in operating) have been secured by a consortium of Canadian universities from the Canada Foundation for Innovation through its Exceptional Opportunities Fund program, while an additional $4.0M grant request from the BC Knowledge development Fund (BCKDF) is pending. TRIUMF's centre will be one of only 10 of its kind in the world for the ATLAS experiment.

The ATLAS experiment at the LHC will collect 3-4 PB (1 PB, or petabyte = 1 million gigabyte) of data for each year of its operation, when fully commissioned. Secondary data sets resulting from event reconstruction, reprocessing and calibration will result in an additional 2.5 petabytes for each year of data taking. This requires massive computing resources in both CPU and storage (disk & tape media) that cannot be aggregated into a single centre. They will therefore be distributed and accessed internationally within the Worldwide LHC Computing Grid (WLCG). Eleven such centres are currently being developed and deployed around the world to serve all LHC experiments. By the year 2010, the computing resources at TRIUMF will consist of about 5000 of today's CPU's, 2.5 PB of disk storage, and 2 PB of tape storage. The computing centre will be housed in the ISAC-II building and will require extensive infrastructure work in order to bring power, cooling and networking to the centre. The overall power requirements are close to 0.5 MW and various cooling solutions are being explored.



LHC Computing Grid Monitoring and Site Functi



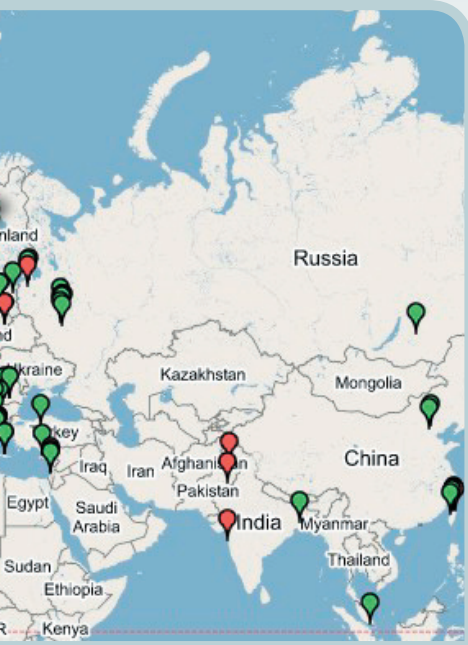
Tier-1 prototype as presently used for ATLAS production and Service Challenges

About $250,000 of computing equipment was bought in the last 2 years in order to have a fully functional and well established Tier-1 prototype, thus providing high visibility to TRIUMF worldwide. Although presently of modest size, Grid services, computing and storage capacities are being continuously provided for ATLAS Monte Carlo production and the Computing System Commissioning (CSC) exercise. TRIUMF is also actively and successfully participating in intensive Service Challenge activities, which are aimed at testing the robustness of LCG baseline services, storage and networking in order to ensure readiness of all the sites for LHC start up in the fall of 2007. Currently two dedicated 1 Gbit/s lightpath links between TRIUMF and CERN are being used. The links are provided by CANARIE. For the longer term a 10 Gbit/s link is being commissioned with completion expected for November of this year; this is done in collaboration and with the support of HEPNET and CANARIE.

The hardware will be acquired gradually and the tendering process for the first large purchase will start this fall. It is expected that a vendor will be selected by January of 2007, and that hardware delivery, installation, and deployment for production will occur in the late Spring. Meanwhile the infrastructure work will be done in parallel.

In terms of personnel, there are currently 3 FTE's at TRIUMF dedicated to the Tier-1 development and operations. Three positions have been advertised recently to help with the deployment, maintenance and operation of various database, storage and networking solutions. The new personnel will be hired this fall.•

R. Tafirout, M. Vetterli



ional Tests

ISAC ACHIEVES 100 µA OPERATION

The ISAC facility at TRIUMF was designed in 1995 to operate with 100 µA proton beam from the TRIUMF H^- cyclotron at 500 MeV. This gave ISAC a considerable advantage over other ISOL-based exotic ion beam facilities. At the beginning of ISAC the targets were limiting operation to proton beam current of only few micro Ampère. Target development allowed us to progressively increase the proton beam intensity on target. Over the last 5 years we typically use 30 to 70 µA of 500 MeV protons to produce radioactive species by spallation and other reactions. On June 8, 2006,100 µA was put on target for the first time, fulfilling the initial ISAC design goal for proton current.

The target used consisted of 525 25-µm-thick tantalum metal foils in a holder configured for high-power operation. In this configuration, cooling fins installed along the length of the target tube increase the target's emissivity to 92% that of a Planck blackbody, greatly improving the radiative cooling of the target under vacuum. Standard ISAC targets, lacking these fins, are limited by temperature to a few tens of µA. The high-power target configuration, developed at TRIUMF by the ISAC RIB Development group, allows operation at higher proton currents without overheating the target material or holder and is essential for operation beyond about 40 µA [1]. While high-power targets have been used since 2004, this was the first used with the full 100 µA beam current that can be delivered down beamline 2A.

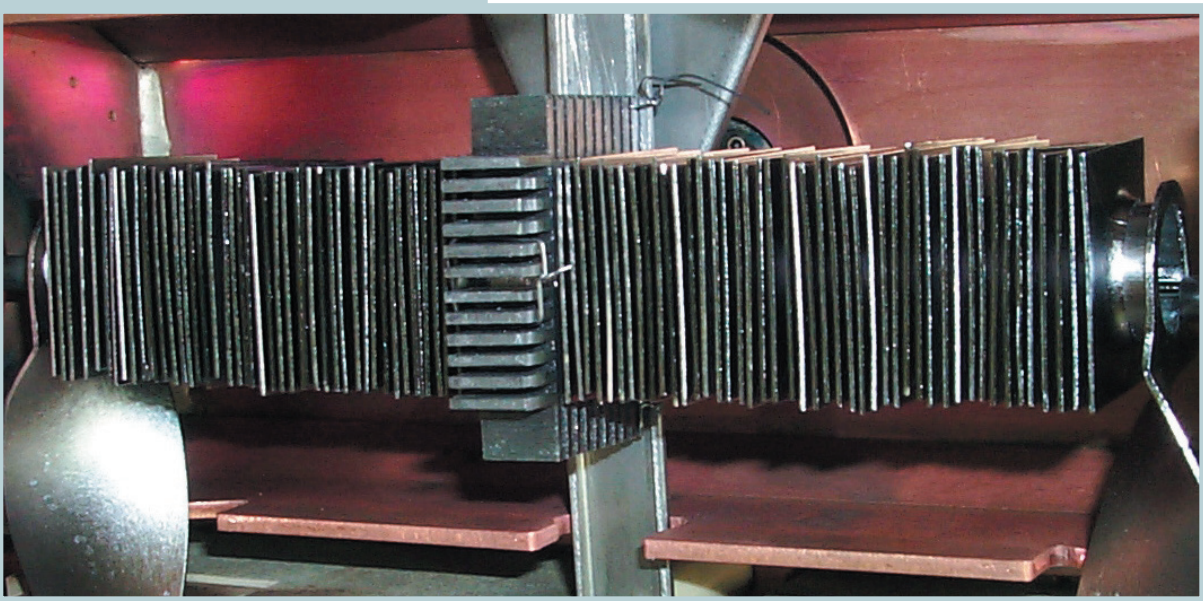
The target was used to deliver the very neutron-rich nucleus ^{11}Li to E1023, a pilot study of ^{11}Li + ^{70}Zn fusion headed by Prof. Walter Loveland and Dr. A.M. Vinodkumar from the Department of Chemistry of Oregon State University. This study involved irradiating thin, enriched ^{70}Zn foils with beams of ^{9}Li and ^{11}Li and observing the resulting As or Ge evaporation residues after radiochemical separation. The goal was to ascertain whether the two-neutron-halo nucleus ^{11}Li fuses directly with the target material or first breaks apart into two neutrons and its core ^{9}Li nucleus before fusing. To study this process, the fusion excitation functions for both ^{9}Li on ^{70}Zn and ^{11}Li on ^{70}Zn need to be measured. A first paper on the results of the sub-barrier fusion of ^{9}Li with ^{70}Zn has already been prepared [2]. "This milestone in proton intensity is of great value to the scientific community who look to TRIUMF to produce very intense beams of important radioactive nuclei," commented Prof. Loveland.

The ISAC RIB development group is now making progress on other types of target material, such as development of carbide targets that are supported onto a carbon sheet that allows a better heat transfer. We are now able to operate those carbide and refractory metal foils targets using the high power target oven described above up to 100 µA.•

Pierre Bricault

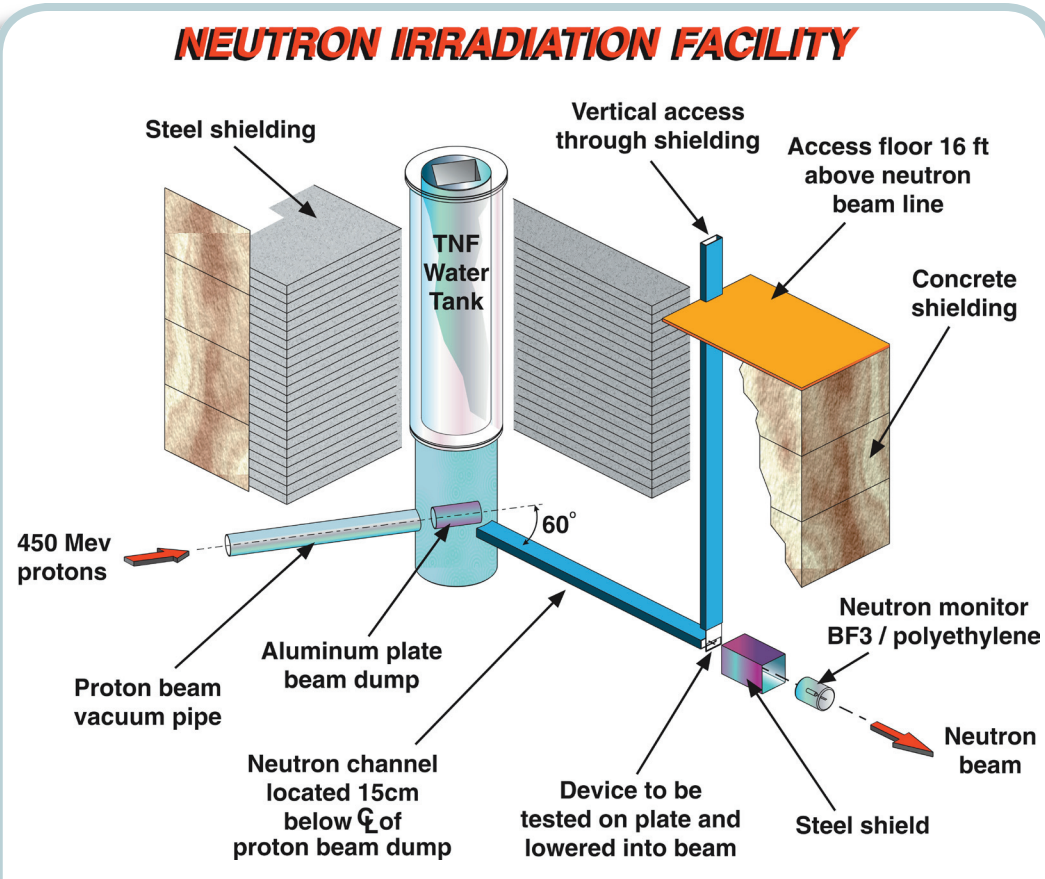
[1] P. Bricault et al., Nucl. Instr. and Meth. in Phys. Res. B 204 (2003), 319.
[2] W. Loveland et al., submitted to Phys. Rev. C.

Side view of the new high-powered ISAC production target. The fins effectively dissipate the heat produced by the 100 uA proton beam hitting the target.



NEUTRON IRRADIATION FACILITY HELPS INDUSTRY SOAR TO NEW HEIGHTS

Each year, leading organizations in the aeronautic and space industry travel to TRIUMF to have their electronic equipment tested in preparation for launching them into the sky and beyond. Atmospheric radiation, caused by cosmic rays from space interacting with Earth's atmosphere, consists of neutrons and other particles that can interfere with the functioning of electronic devices. TRIUMF's Neutron Irradiation Facility (NIF) offers a neutron beam that simulates exposure to atmospheric radiation, and can thus be used for testing avionics and ground-based electronic systems. Radiation testing is especially important for aircraft designers and manufacturers, as aircraft are becoming increasingly dependant on automated systems.



Arrangement of the high flux neutron testing facility at the proton beam dump.

The neutrons are produced by an intense proton beam from TRIUMF's 500 MeV cyclotron striking an aluminum beam stop immersed in a tank of cooling water. The beam of neutrons is then directed to the testing station. At the testing station, the test object is lowered into the path of the neutron beam and irradiated to simulate atmospheric radiation exposure. During irradiation, the electronic devices are tested for what are called soft errors or single event upsets. These errors are the dominant radiation responses. Very sensitive devices can fail or latch in an inoperable state. Some devices suchas Power MOSFETs may fail destructively.

The NIF has an energy spectrum matched to the atmospheric neutron spectrum, and can simulate the radiation effects of ten years of atmospheric exposure in a matter of minutes! The facility's neutron flux, or the number of neutrons per square centimeter per second passing through a material, is comparable to that at the Los Alamos Neutron Science Center (LANSCE) in New Mexico. The neutrons produced at TRIUMF have energies up to 400 MeV, with the additional feature that thermal neutrons from the water moderator are also present. TRIUMF and Los Alamos are the only two facilities in North America that offer such a wide range of neutron energies.

Ever since the NIF's first customer in May 2003, there has been increasing commercial demand for beam time at the facility. Recent NIF customers include Sandia National Laboratories (USA); Boeing (USA); a collaboration involving BAE Systems (UK), QinetiQ (UK), and AerotechTelub (Sweden); and two third-party companies testing devices for large electronic device manufacturers. Revenue generated from commercial bookings of the NIF helps support research activities at TRIUMF. The NIF is a prime example of the successful transfer of technical knowledge to benefit both Canadian science and industry.

In addition to providing calibrated neutron beams, TRIUMF also offers proton beams at its Proton Irradiation Facility (PIF), which are used primarily for space applications. Consultation on radiation effects testing and assistance in carrying out radiation qualification measurements are available at both facilities. Although there is an hourly charge for commercial users, there is no charge for researchers whose work has been approved by TRIUMF's Experimental Evaluation Committee. •

Ewart Blackmore

For more information see website:
http://www.triumf.ca/pif/

TRIUMF Canada's National Laboratory for Particle & Nuclear Physics
Technology Transfer Bulletin
January 2005
vol. 8 issue 1

For more information about Applied Science at TRIUMF, visit the Technology Transfer website at:

http://www.triumf.info/public/tech_transfer/tech_transfer_5.php

TUEC NEWS

The TRIUMF Users Group (TUG) held the 1'st Annual Summer User Group Meeting at TRIUMF on July 26 – 27. The goal of the meeting was to twofold; to have progress reports from the major collaborations working at TRIUMF, and to initiate TUG input into the TRIUMF Five Year Plan (5YP) process. Both aspects of the meeting were very successful.

While the 2010 – 2015 time period would appear to be far off, the 5YP must be ready for submission by 2008, thus necessitating immediate action. A decision was made to form 12 Working Groups, with their chairs forming the body of the TUG Long Range Planning Committee. Presentations of the initial results of the Working Groups will be made at the December AGM on Wednesday Dec. 6. A short 5 page (max.) brief from each of the Working Groups will be circulated in late November so Users can provide input and meaningful discussion.

The charge to these Working Groups is: "To provide a summary of the major accomplishments achieved in the past 5 years, to give an outline of the physics or vision of their facility for the 2010 – 2015 period, and state what resources they will need to achieve their physics goals or facility vision." The Working Groups and their chairs are:

Theory	Byron Jennings
ISAC	Jens Dilling and Pierre Bricault
High energy physics	Chris Oram
Accelerators	Shane Kosielniak
Molecular and Materials Science	Jess Brewer
Detectors	Fabrice Retiere
Life Sciences	Tom Ruth
Neutrino Physics	Akira Konaka
SNOLAB	Jean-Michel Poutissou
Offsite Infrastructure	Des Ramsay
High Performance Computing	Reda Tafirout
Communications	Marcello Pavan
TUG LRPC	Paul Garrett

The chairs will be asking many of you to be a member of a Working Group or to provide input on your vision of research for TRIUMF in the 2010 – 2015 period. TUG members are strongly encouraged to contact members of the LRPC to provide input, and to participate in the December 6th AGM. •

Paul Garrett, TUEC Chair

To join TUG or contact TUEC members, please visit the TRIUMF Users' Group website at: http://www.triumf.ca/tug/

OUTREACH NEWS

This summer saw new intiatives being added to established ones as the TRIUMF Outreach program continues to grow and mature. One of our more successful programs is the TRIUMF High School Fellowship, run in cooperation with the BC Innovation Council, where about a hundred of the top physics students in B.C. vie for a chance at a $3000 award and a six-week work term at TRIUMF. This year the Technology Transfer Office generously agreed to sponsor a second student, and so TRIUMF welcomed both Aidan Chatwyn-Davies and Elizabeth Du (see figure). Aidan worked with the Applied Technology Group on heat-transfer simulations while Elizabeth worked on an ISAC experiment on the TUDA beamline.

After several years, TRIUMF has finally entered into the arena of portable cosmic-ray detectors (CRD) for schools. We have taken delivery of two next-generation cosmic-ray detector electronic modules from the University of Alberta. With money from the Vancouver Foundation and the Canadian Society for Senior Engineers, TRIUMF helped fund their development, resulting in a much smaller and cheaper model. These modules are slated for installation in Vancouver schools, or local science centres. Coincidentally, the new modules arrived while TRIUMF hosted its first Quarknet workshop for 10 teachers from across BC, who spent two days assembling small table-top CRDs, taking cosmic-ray shower measurements, and analyzing the data. The Workshop was a great success and there is hope that it will be repeated in the near future.

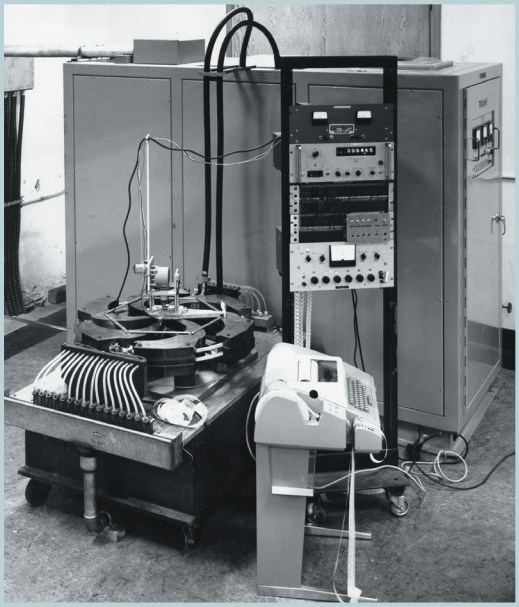
The popular Saturday Morning Lecture Series continues on the third Saturday of the month starting November 18, and once again TRIUMF is investigating broadcasting the lectures to other centres across BC like the Herzberg Institute near Victoria.•

Marcello Pavan

High School Fellowships: http://www.bcinnovationcouncil.com/programs/scholarships.php
Quarknet: http://quarknet.fnal.gov/
Saturday morning lectures: http://www.triumf.info/public/students/lectures.php

High School Fellowship winners Aidan Chatwyn-Davies and Elizabeth Du (centre and centre-right) accept their awards from their supervisors Stefan Zeisler (centre-left) and Barry Davids (right), respectively, and TRIUMF Director Alan Shotter (left). Aidan and Elizabeth each received a $3000 prize and spent a six-week term doing research at TRIUMF. The Fellowships are sponsored by TRIUMF and the Technology Transfer Office, and are adminstered by the BC Innovation Council.

FORTY YEARS ON - TRIUMF IN 1966



Model magnet, power supply and field measuring equipment. Note the flat magnet sectors (echoing the 1966 design) and the punched paper tape for data storage.

As mentioned in the last issue, the newly-formed TRIUMF Study Group had spent the Fall of 1965 compiling their initial *Report on the TRIUMF Project*, and early in January 1966 it was submitted to the Atomic Energy Control Board – AECB being at that time the agency responsible for funding nuclear physics research at Canadian universities. In April this effort was rewarded by a grant of $100,000 from Ottawa, making it possible to hire staff and purchase equipment for model studies to better define the design parameters and costs.

The first TRIUMF employee (in July) was Joop Burgerjon, who brought a wealth of relevant experience from his time building cyclotrons in Amsterdam, Pretoria and Winnipeg. One of his first contributions, characteristic of his elegant engineering, was the design of the TRIUMF logo, neatly symbolizing the cyclotron's unique capability of providing several extracted beams at different energies. In September he was joined by Ed Auld, newly returned to Vancouver with a Ph.D. from Southampton, to work on the cyclotron magnet design, with Mike Haines as an assistant. The loan of a 1/20-scale model magnet by Reg Richardson and his UCLA colleagues (ever-helpful consultants) and the purchase of a 150-kW, 3000-A power supply enabled a complete test setup to be assembled by the end of the year. Orbit studies of the sensitive central region were also begun with the help of a computer analyst, David Scott. Additional expertise on mechanical design and the building and site requirements was provided by Terry Creaney, Joe Kilpatrick et al. of Shawinigan Engineering, who also compiled the cost estimate - $22 million in 1966 dollars (at least $140 million today) for the initial facility.

The net result of everyone's efforts was the *TRIUMF Proposal and Cost Estimate*, edited by Erich Vogt and Joop Burgerjon, submitted to AECB in November. The most substantial change from 1965 was to go for a full 100-µA meson "factory" rather than a 20-µA "workshop". This required a larger machine, the 500-MeV orbit radius rising from 230″ to 271″, and more magnet weight, from 1470 to 2800 tons – but still modest compared with the eventual values! Also, there was to be only one extracted beam, with all experiments accommodated in one hall, but that changed as well. The site proposed was on the other (West) side of Wesbrook Mall, at the corner with South Campus Road.

A crucial advance in 1966 was the informal involvement of the University of Alberta. Several members, led by John Warren's old students, Jack Sample and Croy Nielsen, joined the TRIUMF Study Group, and the *Proposal* included a statement from the UoA's Board of Governors approving in principle the university's participation in the consortium. It's interesting to note that one of the conditions set was that "The name of the project would need to reflect the University of Alberta's place as a founding partner". I recall giving a talk in Toronto at that time entitled "The TRIUMF-AL Project" – but somehow the suggestion didn't catch on!•

Mike Craddock

Important Upcoming Dates

∗ see insert

BOM	TRIUMF Board of Management Meeting	Dec 1	TRIUMF
SAPEEC	Subatomic Experiments Evaluation Committee Meeting	Dec 4-5	TRIUMF
TUG*	TRIUMF Users Group Annual General Meeting	Dec 6	TRIUMF
MMSEEC	Molecular and Materials Science Experiments Evaluation Committee meeting	Dec 7-8	TRIUMF
ACOT	Advisory Committee on TRIUMF Meeting	Dec 8	TRIUMF
LSPEC	Life Science Projects Evaluation Committee Meeting	Jan 25-26, 2007	TRIUMF
WNPPC	Winter Nuclear and Particle Physics Conference	Feb 16-18, 2007	Banff
LLWI	Lake Louise Winter Institute	Feb 19-24, 2007	Lake Louise
ECT	Workshop on "Experiment -- Theory Intersections in Modern Nuclear Structure"	April 23-27, 2007	Trento, Italy
CAP	CAP Congress - University of Saskatchewan	June 17-21, 2007	Saskatoon

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TRIUMF Beam Schedule

The current TRIUMF beam schedule is available on the Web at:

https://admin.triumf.ca/docs/eec/

Users should subscribe to the automated update notification to receive notice of changes which may be required during the period already scheduled.

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