# Beamtime

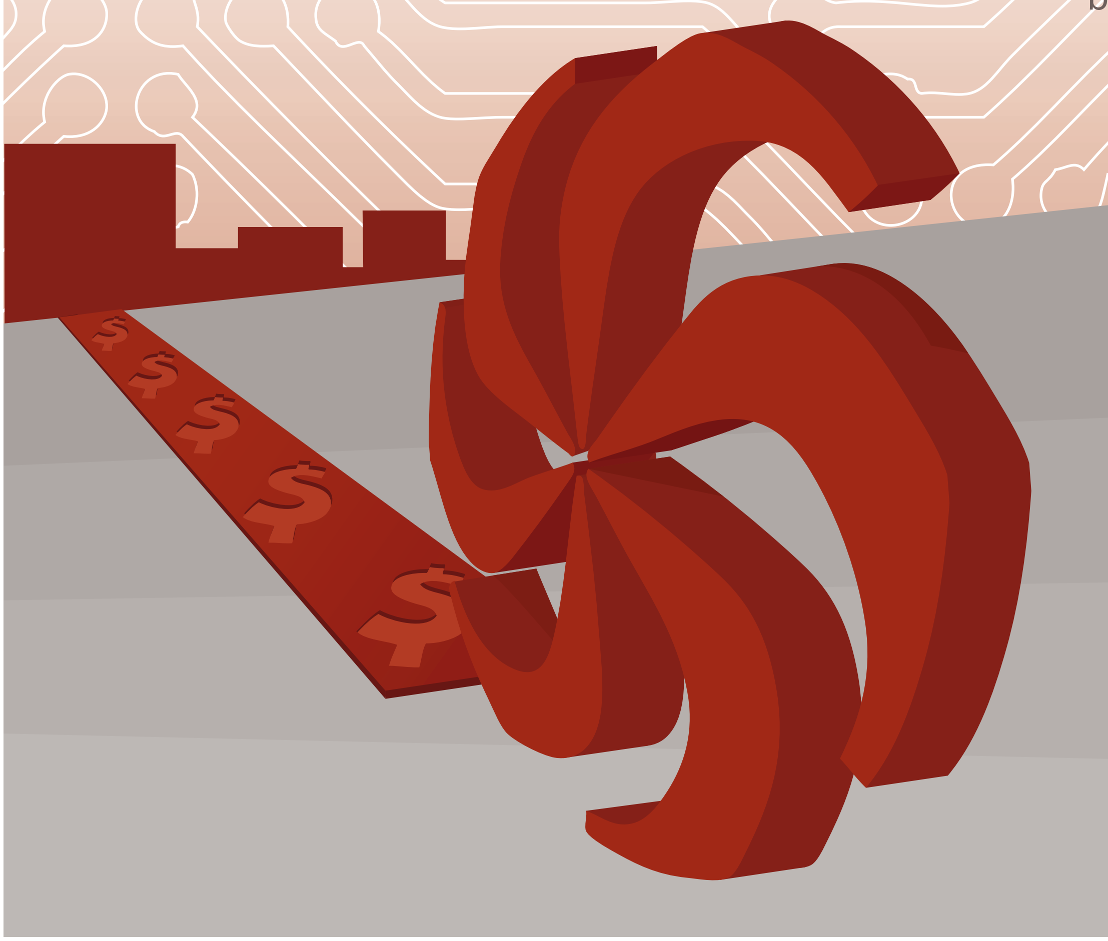
Spring 2011
Volume 9 Issue 1

TRIUMF

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

## COMMERCIALIZATION

Knowledge transfer benefitting all Canadians



# Director's Voice

## TRIUMF and Commercialization

### Driving Canadian Innovation with Commercial Partners

TRIUMF's vision is to lead in science, leverage university research, connect Canada to the world, and create social and economic growth. This issue of Beamtime is focused on that fourth part of the vision: economic growth generated by the high technology being developed at TRIUMF. This economic impact can be short term (jobs for engineers and scientists or new products), medium term (improvements on existing products such as with lower power consumption or greater performance), or long term (brand new technologies that create new markets). Ultimately, it is the promise of economic impact that makes public support for science such a high priority.

*"Science drives technology and new technology drives much of the economy."*

Science is the progression of asking and then answering questions. A posed question, when answered, leads to new questions and so on. The quest to answer these science questions, such as where are the chemical elements produced in the universe, requires new technologies, otherwise the questions would have been answered. Science drives technology and new technology drives much of the economy.

We're serious about research, innovation, and commercialization at TRIUMF. It is the combination of these activities that makes TRIUMF-and gives Canada a competitive advantage. The best research attracts the best minds and the best minds attract the best partners, and suddenly you're pushing the boundaries of technology in all directions – and I don't mean just finding new applications for duct tape and aluminum foil!

I hope you enjoy reading about the future of technology arising fromTRIUMF's team and our technology development partner Advanced Applied Physics Solutions in this issue.

• Nigel Lockyer

# AAPS and TRIUMF

## Partners in Innovation

Canada faces a challenge – how to increase domestic productivity and national competitiveness to increase our quality of life. Clearly a main driver for success must be turning scientific research into services and products needed by people, institutions, and businesses. Critical to this success includes identifying how users will value potential applications, identifying and eliminating technical risks, navigating commercialization stages, and understanding key stakeholder expectations.

Advanced Applied Physics Solutions Inc. (AAPS) exists to develop innovations from Canada's investment in applied physics research for commercial use benefitting Canada. It operates as an independent extension of TRIUMF's technology commercialization mandate, delivering commercial successes from the research and resultant technologies of TRIUMF, its partners, and related national labs. AAPS is three years through an initial five year mandate as a national Centre of Excellence for Commercialization and Research (CECR, established in 2008 with $15 million in federal funding) to identify and develop technologies, vet commercialization models and, most importantly, establish long term partnerships with industry that can bring the fruits of research into commercial use in a sustainable fashion.

AAPS is one of the few of 21 CECRs focusing on the numerous sectors of research and the economy created specifically around physical science and focused at the commercial end of the "research-to-commercial" spectrum. Our projects focus on bringing technology applications to commercial readiness either via attracting private sector investors or by reaching full revenue-generating operation. Part of AAPS' mandate is to forge and sustain partnerships of people, ideas, companies, and countries or partnerships amongst researchers, governments, and industry. TRIUMF's many existing partnerships are helping us achieve our goals.

AAPS is bringing TRIUMF technologies and expertise to multiple-market sectors, including:

- Specialized detector systems for mineral exploration and public safety uses. This includes our muon geotomography project (see Figure and *In The News* article).
- Custom isotope purification systems for medical imaging, therapeutic uses and industrial processes, built upon applications of our electromagnetic isotope separation system platform known as "MoRe".
- Custom thin film material production for research and industrial processes through our Micromatter operating division.

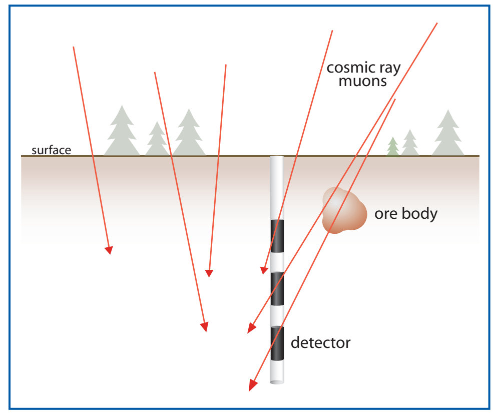



**Figure: Schematic representation of muon geotomography. Detectors underground sense the decrease in muon rate after passing through the ore body**

- Specialized radiation dose reduction systems for medical imaging uses.
- Specialized chemistry processes and systems for medical therapeutic applications.

These projects are at various stages of development with the most advanced reaching revenue-generating operation or attracting firm industry and private sector investors.

AAPS is continuing our work to ensure that our present successes are repeatable and sustainable, so that AAPS can remain part of TRIUMF's ongoing commercial contribution to Canada's global innovation leadership.

**• Jack Scott**

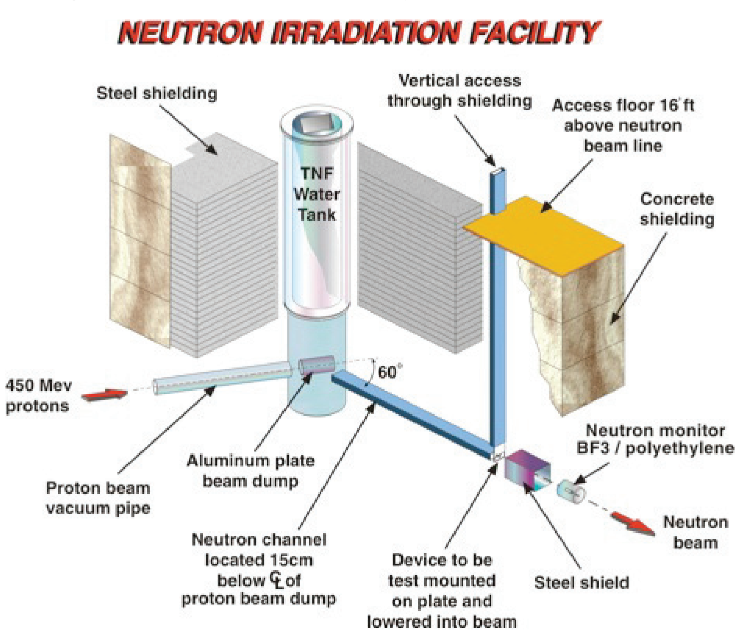
**For more: www.aapsinc.com/**

# Seeing how the chips ~~fall~~ fail

## PIF & NIF: TRIUMF's Proton and Neutron Irradiation Facilities

The technology and knowledge TRIUMF has developed while pursuing world-leading research into isotopes for science and medicine has benefitted Canadian high-tech industry for the past sixteen years. Since 1995 several beam lines have been providing low-intensity beams of protons and neutrons to simulate natural-radiation exposures in space and on earth. Just a few minutes of exposure in the Proton and Neutron Irradiation Facilities (PIF & NIF) correspond to years of operation in space, air, or ground, greatly accelerating testing for errors in electronics subject to those environments. In particular, TRIUMF is recognized as a premier test site for space-radiation effects using protons.

PIF & NIF regularly make use of three beam lines at TRIUMF: protons and neutrons are available at energies up to 120 MeV with BL2C1, also used with Proton Therapy; energies up to 500 MeV are available with BL1B, a globally unique facility with its broad energy and intensity range; and intense neutron irradiation are generated at the TRIUMF Neutron Facility (TNF) at the end of BL1A. In the latter, neutrons produced by protons stopping in the BL1A beam dump (see Figure) yield an energy spectrum similar to that of atmospheric neutrons, ideal for testing avionics and ground-based electronic systems, such as network servers or cell-phone chips. Irradiations of electronics also have been done using electrons from the M11 and muons from the M20 beam lines.




Schematic representation of the Neutron Irradiation Facility at TRIUMF

Important research is also performed using PIF & NIF. For example, research into reducing the incidence of cataracts in astronauts and pilots by examining the effects of dietary supplements is being supported by the Canadian Space Agency. Irradiating pig-eye lenses with protons and neutrons allow scientists to gauge their progress.

Commercial bookings at PIF & NIF generate revenue that helps support research activities at TRIUMF. A large fraction of the proton users are Canadian space-related companies such as MDA Corporation, while neutron users are primarily international avionics, microelectronics, or communications companies such as Boeing or Cisco. Each year about 100 users from around 30 companies or institutions benefit from PIF & NIF beams. As the size of electronics is always decreasing, the relative effect of naturally occurring radiation is correspondingly increasing, necessitating increased testing and development to mitigate against any electronic errors. PIF & NIF is ready to meet that challenge for high-tech business at home and worldwide.

• Mike Trinczek

For more: www.triumf.ca/pif-nif

Profile

# Conny Hoehr and Mike Trinczek

## TRIUMF's Youngest Power Couple

It may have taken quite the journey to get them here, but Conny Hoehr and Mike Trinczek are delighted to be working at TRIUMF. Together.

Conny was born and raised in Germany. She always wanted to know how things worked, so much so that in high school, after one too many questions about the universe from his enthusiastic pupil, her teacher pushed her to study physics. Which she did, completing her Masters and Ph.D. in Nuclear Physics at the Max Planck Institute in Heidelberg, where she met her future husband.

> *"they do not need to explain...why they were kept late at work"*

Mike has a similar story. A boy from Langley, BC, an introduction to PET scans sparked his interest in physics. This led him to the Shad Valley entrepreneurship program at the University of British Columbia for its connections to TRIUMF, hoping for the chance to spend some time here. He went on to complete a degree in Honours Chemistry at Simon Fraser University, thereafter jumping ahead straight to his Ph.D. at TRIUMF with TRINAT. He did his first postdoctoral work at the Max Planck Institute in ion trapping, where he met his future wife.

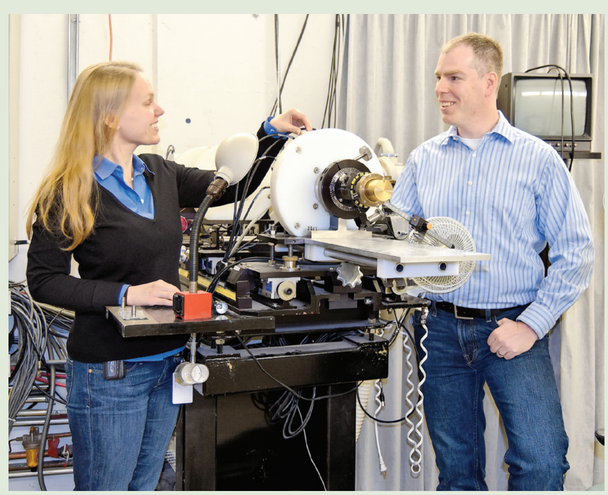
Cornelia Manuela Hoehr and Michael Charles Trinczek were married in a civil ceremony in White Rock on October 21, 2006 and then exactly six months later at a church service in Schriesheim, Germany.

Fate brought them together at TRIUMF. Mike returned home for his second postdoctoral position doing nuclear astrophysics with DRAGON. His hard work was duly recognized when he succeeded Ewart Blackmore as Coordinator for TRIUMF's Irradiation Facilities. Conny's first postdoctoral fellowship sent her to Argonne National Lab in Chicago, and her second brought her to TRIUMF with TRINAT. Shortly thereafter, she accepted a position as Coordinator of the Proton Therapy and TR-13 facilities. TRIUMF's newest power couple found home.

Despite working together on site, Conny and Mike don't see each other much. She is kept busy with TR-13 radioisotope-tracer production, target development, Quality Management System efforts, as well as Proton Therapy. Mike's work at the Irradiation Facilities has him test electronics used for spacecrafts, airplanes, cell phones, etc. to see if they can withstand the natural bombardment of protons and neutrons. Mike also works on shielding simulations for the ARIEL electron accelerator project. Happily, to the envy of most couples, they do not need to explain to one another why they were kept late at work.

Conny and Mike make a formidable duo, leading lab activities that will become increasingly important in the years ahead. They are happy to be here, together, and TRIUMF is even happier to have them.

**• Lindsay Davies**



# In The News

## TRIUMF to Tackle Isotope Crisis

On January 4, 2011, a research team ("CycloTech99") from TRIUMF, BC Cancer Agency, the Centre for Probe Development and Commercialization, and the Lawson Health Research Institute received a $6 million investment from the Government of Canada to develop and demonstrate viable production of the medical isotope Technetium-99m (Tc-99m) using cyclotron technology. Critical world-wide shortages of Tc-99m arose with the shutdown of the two highest-capacity nuclear reactors capable of producing the Molybdenum-99 (Mo-99) precursor. While these reactors are back online, uncertainty about their future remains.

Thomas J. Ruth, senior research scientist at TRIUMF and the BC Cancer Agency, is heading the team in developing technologies for producing Tc-99m in cyclotron accelerators, which already exist in major hospitals worldwide. By enabling regional hospitals to produce and distribute Tc-99m locally, widespread disruptions should disappear. Results are expected within the year.

For more: www.triumf.ca/nrcan-nisp

Geotomography scanner in the Myra Falls mine in BC

## IKOMED Technologies Inc.

Fluoroscopy is a medical imaging modality used in surgery to navigate catheters through blood vessels during minimally-invasive procedures. It exposes the patient to a series of short x-ray pulses to generate a real-time movie of the body's internal structure. The x-ray radiation exposure can be quite large and its health risks must be considered for both the patient and the medical staff.

IKOMED Technologies, Inc. is developing an innovative patented technology to reduce the patient dose during fluoroscopy-guided medical procedures by a factor of 10. Eventually this technology would be integrated into commercial fluoroscopy equipment by leading vendors such as GE, Siemens, Philips, or Toshiba. Lower radiation exposure during such minimally-invasive procedures would improve patient and medical staff health worldwide. It would also facilitate the development of more complex and lengthy fluoroscopy-guided procedures.

Advanced Applied Physics Solutions (AAPS) has been working with Vancouver-based entrepreneurs, doctors, and private investors to develop this technology. IKOMED was established in May 2011 to take this technology to market. IKOMED researchers and engineers are currently in prototype development towards clinically demonstrating the technology in 2012.

Edward Odishaw, Chair of the AAPS Board of Directors, said, "This technology is new and exciting and AAPS is proud to be financing and working with a team that spans from bench to bedside. This effort has the potential to make a significant difference for Canadian healthcare as well as deliver economic value to the Country."

**• Meir Deutsch**

For more: www.ikomed.com

## "Earthly" CT Scans attracts funding

An ingenious idea that borrows techniques from medical imaging to look for ore deposits deep in the earth enabled AAPS to attract $1.8 million in federal funding from the Western Economic Diversification office. "Muon geotomography" is a technology initiated by Prof. Douglas Bryman, long-time TRIUMF scientist and J.B. Warren Chair at the University of British Columbia, which uses an array of detectors deep underground to detect cosmic-ray muons. The underground muon flux depends on the density of the earth through which the muons pass. A grid of muon sensors work much like a CT scan and these sensors can map out in 3D regions of high density, where potentially valuable ore deposits could reside.

AAPS is completing a first round of proof-of-principle tests in collaboration with NVI-Breakwater, TRIUMF, the Geological Survey of Canada, and the BC Ministry of Energy and Mines. The funding will allow AAPS to develop and commercialize the technology.

## ACSI and TRIUMF Announce Partnership

On December 16, 2010, Nigel Lockyer, Director of TRIUMF, and Richard Eppich, CEO and President of Advanced Cyclotron Systems, Inc. (ACSI) announced a partnership to advance cyclotron and accelerator technologies and to promote the use of such technologies in providing better healthcare to all Canadians. ACSI is a leading designer, manufacturer, and installer of cyclotrons. Some of these cyclotrons are used to produce medical radioisotopes that are used in PET/CT scans, which provide accurate pre-treatment detection of cancerous tumours. An ACSI machine was recently installed and commissioned at the BC Cancer Agency.

ACSI and TRIUMF will work together to seek third-party funding on new projects that advance accelerator and cyclotron technologies. In exchange for ACSI's support in strengthening TRIUMF's public profile as Canada's premiere centre for accelerator science and technology, TRIUMF will support ACSI's efforts to design cyclotrons and sell them throughout Canada and the world. ACSI will have access to TRIUMF personnel who can provide scientific, engineering and technical assistance related to the research and development of existing and next-generation cyclotrons.

## AAPS Commercializing carbon foil technology

The Micromatter Division of Advanced Applied Physics Systems specializes in thin-film deposition technologies and manufactures specialty products for industry and scientific applications. Micromatter's diamond-like carbon foils (DLC), produced using a proprietary laser ablation process, have superior physical properties ideally suited for beam stripping in high-power particle accelerators, such as those used by Nordion for radioisotope production at TRIUMF. A new "doping" step in the manufacturing process has led to next-generation stripper foils of unrivalled quality.

Micromatter's calibration materials for X-ray fluorescence (XRF) analysis are used in hundreds of institutions world wide. Many government agencies engaged in environmental protection rely on Micromatter standards and current US air-quality analysis regulations prescribe these standards for instrument calibration. Micromatter has developed encapsulated multi-element reference samples for various applications, including monitoring gear fluids of aircraft under the US Naval Air Command.

Micromatter's R&D efforts are currently directed towards extremely light lead standards (<1 μg/cm$^2$) as audit samples for air quality monitoring, and carbon-based thin films and coatings using a recently acquired CVD system (nano/polycrystalline diamond, graphene).

• **Stefan Zeisler**

**For more:** www.micromatter.com

## Calendar

| | |
|---|---|
| **July 6, 2011**<br>TRIUMF | TUG AGM<br>TRIUMF User's Group Annual General Meeting |
| **July 7, 2011**<br>TRIUMF | ARIEL Workshop<br>1st International ARIEL Science Workshop |
| **July 8-9, 2011**<br>TRIUMF | SAP-EEC<br>Subatomic Physics Experiments Evaluation Committee meeting |
| **November 8, 2011**<br>University of Victoria | BOM<br>TRIUMF Board of Management meeting |

## Kruecken Takes Science Helm

On February 1, 2011, Reiner Kruecken joined TRIUMF as the new Head of the Science Division. He succeeds Gordon Ball, who is transitioning to an active research retirement. Kruecken brings world-wide expertise in nuclear physics to TRIUMF with familiarity of rare-isotope beam facilities worldwide and broad research interests from nuclear structure and medical applications of nuclear methods to transmutation of nuclear waste.

Kruecken was attracted to TRIUMF by the ARIEL project and quickly took the initiative, organizing an international summer workshop to develop the scientific program for ARIEL's first year. TRIUMF is lucky to have Reiner and we can look forward to many productive years together.

# Forty Years On

## June 1971: Cyclotron Building Complete and the First $H^-$ Ion Beam

During the year prior to June 1971, the most visible progress at TRIUMF was the growth of the main cyclotron building. The previous summer's 2½-month delay due to a construction industry lockout was long past, and what had been an enormous hole in the ground had been filled – first with a forest of rebar, then concrete from an endless procession of mixer trucks (25,500 cubic yards in total). Finally the walls were crowned with the steel superstructure and roof. The two 50-ton cranes were also installed and working by June – in time for the imminent arrival of the first magnet sector from Québec.

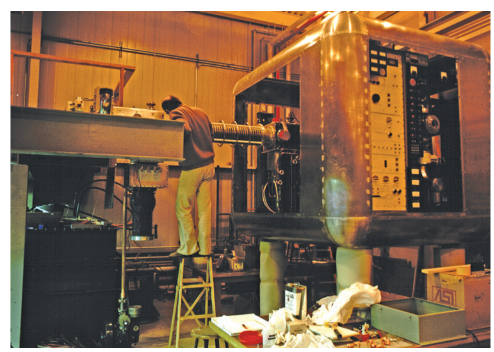
In this period, more major equipment and building contracts were awarded: cyclotron erection (Cana Construction), magnet power supply (Systron-Donner), radiofrequency power supplies (Continental Electronics) and radiochemistry annex (Commonwealth Construction). Around 90% of the 1,970 contracts went to Canadian companies. Notable personnel additions included Gerardo Dutto, David Gurd, Don Heywood and Pat Sparkes. TRIUMF's first Ph.D. was awarded to Robin Louis by UBC for his studies of beam dynamics in the cyclotron's central region.

On the Central Region Model, the desired vacuum of 3 x $10^{-7}$ Torr had been reached, and the RF Group achieved their goal of 100 kV on the resonators in February 1971. Following this the magnet was installed and field measurements begun. The $H^-$ ion source had arrived from the Cyclotron Corporation in October and was soon producing a 2.3 mA beam – the first particle beam at TRIUMF. The source was then tested at 300 kV and construction of the injection line started. Things were moving along!

**• Mike Craddock**

A forest of rebar grows around the cyclotron vault (February 1971).

Skeleton of the Proton Hall (April 1971).



Bruno Duelli adjusting the CRM injection line.

**To obtain Beamtime by PDF, sign up for the new TRIUMF-publications mailing list at: http://lists.triumf.ca/mailman/listinfo/triumf-publications**

Editor: Marcello Pavan
Production: Dana Giasson

Beamtime is available online at:
http://www.triumf.ca/home/multimedia/newsletter

Inquiries or comments to: newsletter@triumf.ca



4004 Wesbrook Mall
Vancouver, BC V6T 2A3
Canada

+1 604 222 1047 telephone
+1 604 222 1074 fax

www.triumf.ca

TRIUMF

TRIUMF is funded by a contribution through the National Research Council of Canada.

The province of British Columbia provides capital funding for the construction of buildings for the TRIUMF Laboratory