

CANADA'S NATIONAL LABORATORY  
FOR PARTICLE AND NUCLEAR PHYSICS

BUSINESS DEVELOPMENT  
REPORT 2014 – 2015

# TEAM UP



ACCELERATING SCIENCE FOR CANADA



# TEAM UP

Rounding out the fifth year of Five-Year Plan 2010–2015, TRIUMF continues to lead in science, probing the structure and origins of matter and advancing isotopes for science and medicine. Through the Network of Centres of Excellence (NCE) Centres of Excellence for Commercialization and Research (CECR) program, Advanced Applied Physics Solutions Inc. (AAPS), has worked side-by-side with TRIUMF to identify and measure the fit of commercialization and market opportunities, allowing TRIUMF researchers to remain focused on fundamental research and development, and technical activities.

# sustainability



## mission

**To make discoveries** that address the most compelling questions in particle physics, nuclear physics, nuclear medicine, and materials science

**To act as Canada's steward** for the advancement of particle accelerators and detection technologies

**To transfer knowledge**, train highly skilled personnel, and commercialize research for the economic, social, environmental, and health benefit of all Canadians

## vision

**Lead in Science:** The world sees TRIUMF as Canada's leader in probing the structure and origins of matter and in advancing isotopes for science and medicine.

**Leverage University Research:** The Canadian university research community views TRIUMF as a way to strengthen and expand their research programs.

**Connect Canada to the World:** The international subatomic physics laboratories look to TRIUMF when partnering with Canada and its research community.

**Create Social and Economic Growth:** The global scientific community sees TRIUMF as a bridge between academia and the private sector and as a model for commercialization & social impact.

## values

**Excellence** and Impact

**Collaboration** and Teamwork

**Honesty** and Transparency

**Innovation** and Relevance

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## MESSAGE FROM THE

### CHAIR OF THE BOARD'S INNOVATION AND INDUSTRIAL PARTNERSHIPS COMMITTEE



TRIUMF is a golden resource for the community. The innovations and applications stemming from its research program bring a real-world value to all of its members.

When you bring talented researchers, state-of-the-art facilities and strong leadership together, the outcomes are not just returned to the lab itself, they also reach the broader community and society as a whole. In this report, you'll read about the various activities that are undertaken by TRIUMF through its four main business lines as well as through its commercialization arm, Advanced Applied Physics Solutions Inc. (AAPS), TRIUMF's Networks of Centres of Excellence (NCE) Centres of Excellence for Commercialization and Research (CECR).

AAPS has flourished under the CECR program. Over the past year, AAPS has connected with both venture capitalist investors and business development representatives from both domestic and international firms. As a member of TRIUMF's Board of Management, I witness firsthand the value of this commercialization effort.

The laboratory is a national treasure and in my mind, TRIUMF is not just a place for great science; it is also an invaluable resource for Canadian universities. TRIUMF and AAPS help researchers develop ideas and products, connect the right investors to these opportunities and protect the intellectual property developed at TRIUMF.

AAPS has developed a clear business for the near future. Moreover, AAPS is looking to make the greatest societal impact. The decision to commercialize certain products or ideas is an undertaking dependent on a great deal of scrutiny and focus, and requires tapping into the expertise of business development professionals.

AAPS, together with TRIUMF, has an impressive five-year track record of developing, commercializing and spinning-off ideas. This year marks the final year of the NCE CECR program for AAPS. As it transitions from the program, AAPS will be a successful commercialization company of TRIUMF.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Digvir Jayas'.

**Digvir Jayas** | Chair, TRIUMF Board of Management Innovation and Industrial Partnerships Committee | Vice-President (Research and International), University of Manitoba



**MESSAGE FROM THE  
HEAD OF TRIUMF'S BUSINESS AND ADMINISTRATION DIVISION**

When it was launched in 2008 through the Network of Centres of Excellence (NCE) program, Advanced Applied Physics Solutions Inc. (AAPS) was the only CECR working with the physical sciences.



We had a lot to learn. TRIUMF already had a history of transferring technology and collaborating with industry, but how would it work within TRIUMF? How was AAPS going to be a resource for TRIUMF's member universities and other stakeholders?

In the early years, it was determined that AAPS should operate independently of TRIUMF. AAPS took on some projects that were in the infancy of development and the impact from these long-term efforts was less than anticipated.

Over the course of the CECR program, it became evident that in order to take advantage of the resources – equipment, infrastructure, and people – the two institutions must work in a complementary fashion. The "R" of research and development should take place within TRIUMF and the "D," or commercialization effort, should take place within AAPS. AAPS facilitates business transactions that include: licensing and protecting IP, sourcing external business competencies to ensure success, and maintaining a healthy environment of collaboration between the industry partner and the research environment. This is the model that we find works best.

As we continue to realize the value AAPS has to TRIUMF, we are bringing AAPS closer to TRIUMF. This means that AAPS project managers who are responsible for developing and commercializing the technology are more easily able to access TRIUMF resources, be they people or facilities, in order to be more responsive to industry demands. Research scientists and engineers see the "Big Picture" and

their impact in working with AAPS. The engagement between staff and our commercialization partners has made these endeavors more fruitful. That is integral to TRIUMF's success.

AAPS has been very successful in the last five years, creating five independent spin-offs that are still in operation today. Each has significant potential for employment in Canada, and in some cases, internationally.

It is worth noting that our accomplishments would be far less without the support we've received from the Government of Canada through the NCE program. AAPS is expected to graduate from the CECR program at the end of 2015 and successfully transition to a commercialization company within the TRIUMF enterprise. The theme of TRIUMF's Business Development Plan for 2015 – 2020 is **Delivering the Promise** and we will do this in the area of commercialization.

As a national lab – a resource for all Canadians – we must take our responsibilities seriously. Not only must we deliver world-class research, we must also deliver economic and societal impact. Working closely with TRIUMF and leveraging its resources and those of our member universities will ensure success. We are very optimistic for the future that is ahead of us.

Sincerely,

A handwritten signature in blue ink that reads "Jim Hanlon".

**Jim Hanlon** | Head, Business and Administration,  
TRIUMF | President and CEO, AAPS Inc.





## FEATURE:

# COMMERCIALIZATION IN A RESEARCH ENVIRONMENT

The study of subatomic physics has potential applications that affect the health, safety, and economic viability of Canadians in innovative and positive ways. Yet, products and services derived from the physical sciences often require long, early stage development times and access to complex and expensive facilities – increasing the risk for both innovators and stakeholders.

In 2008, the Network of Centres of Excellence (NCE) program supported the establishment of Advanced Applied Physics Solutions Inc. (AAPS) as a Centre of Excellence for Commercialization and Research (CECR). This national approach enabled TRIUMF to marshal the technical and economic resources needed to reduce risks, attract private sector investments, and bring solutions to market.

To maximize the impact of TRIUMF's research activities, AAPS:

- Collaborates with academic, government, and industry stakeholders to develop emerging technologies from research
- Develops from three technology platforms (particle accelerators, materials science, and isotopes) with applications in the areas of healthcare, safety and security, natural resources, and accelerator-driven technologies
- Commercializes advanced physics technologies and intellectual property for the social and economic well-being of Canadians.

## START-UP COMPANIES

Since its establishment as a CECR, AAPS has created successful start-up companies, developed strong partnerships with industry, and mobilized knowledge throughout its network.

To apply radioisotope expertise to a global problem, AAPS created **ARTMS (Alternative Radioisotope Technologies for Medical Systems) Products Inc.** ARTMS offers a made-in-Canada solution that will improve access to critical healthcare radioisotope diagnostics. The company will manufacture and sell

targets and accessories, enabling hospitals, clinics and radiopharmacies to reliably produce and supply Tc-99m, the world's most highly used medical isotope.

Leveraging TRIUMF's expertise in advanced detector development, AAPS created **CRM GeoTomography Technologies Inc.** CRM developed state-of-the-art muon detectors to help mining companies and geologists detect, locate and characterize dense ore bodies. CRM delivers penetrating 3D insights thereby reducing the cost and waste associated with traditional mineral exploration.

**Frontier Sonde Inc.** developed and now manufactures and sells well-logging tools to advance oil and gas surveying. The borehole technologies developed for this project may also have other applications. This has connected TRIUMF to new international partners, such as the China University of Petroleum.

**IKOMED Technologies Inc.** developed a shutter technology system to reduce radiation exposure during medical imaging procedures to patients and staff. IKOMED is expected to start production and delivery of their product within two years. IKOMED is in agreement with a number of companies for the installation of the equipment on their fluoroscopy machines.

**Micromatter Technologies Inc.** specializes in thin foil deposition technologies and manufactures specialty products for industry and scientific applications. Micromatter has developed capsulated mercury standards used to detect the presence and level of mercury in the oil harvested from the ocean, and has also developed diamond-like carbon foil technology for radioisotope production and medical devices. Customers from the US, Hong Kong, and Thailand have purchased Micromatter's standards.



## INDUSTRIAL PARTNERS

AAPS partners with industry to transfer knowledge and technology, protect patents, and develop applications.

**Advanced Cyclotron Systems Inc.**, based in Richmond, BC, designs and manufactures medical cyclotrons worldwide.

**D-Pace Inc.**, based in Nelson, BC, supplies products and services to the international commercial accelerator industry.

**Nordion Inc.**, with Vancouver operations located on TRIUMF's campus, is a health sciences company that offers more than 30 products to over 40 countries. TRIUMF has worked with Nordion for over 36 years.

**PAVAC Industries Inc.**, based in Richmond, BC, develops hybrid electron beam technology. TRIUMF and PAVAC have collaborated on superconducting accelerator technology for over a decade. Through PAVAC, Canada is now one of six countries in the world capable of industrially producing SRF cavities.

## LAUNCH PAD FOR THE NEXT FIVE YEARS

AAPS is refining its business model as TRIUMF's innovation and commercialization partner.

The business model will include a clear value proposition for TRIUMF, a strategy for marketing and communications, and a focused approach to protect the intellectual property of both TRIUMF and its partners.

AAPS will encourage an entrepreneurial culture at TRIUMF and be a portal to access TRIUMF's world-class experts, equipment, and facilities. AAPS will sell products and services, license technology, and incubate start-up companies. Through AAPS, TRIUMF will create new opportunities for Canadian companies to capture new markets, attract investments, and attract and retain highly qualified personnel.

## A GLANCE AT AAPS'S START-UP COMPANIES





## BUSINESS LINE: IRRADIATION SERVICES

Research scientists and engineers continue to battle with errors in electronic devices caused by naturally occurring ionizing radiation. Such radiation can lead to poor performance, the loss of information or control, and even failure of the device. Since 1995, TRIUMF offers irradiation services to simulate natural radiation in space or terrestrial environments.

### CORE CAPABILITY

TRIUMF's Proton Irradiation Facility and Neutron Irradiation Facility (PIF & NIF) make use of three beam lines at TRIUMF, offering irradiation services to commercial users at various energy-intensities. Protons and neutrons at lower energies are available via Beam Line 2C1; this is shared with TRIUMF's Proton Therapy Centre for the treatment of ocular melanoma. Higher energies are available via Beam Line 1B. TRIUMF's Neutron Facility NIF can produce an energy spectrum comparable to the Earth's atmosphere. This is ideal for testing avionics and ground-based electronic systems, such as network and power-distribution servers, or even the latest cell phone chips. Academic and industrial partners continue to perform the irradiation testing of electronics using muons.

### GLOBAL POSITION

TRIUMF offers competitive options for companies seeking irradiation testing for their equipment. Not only do the facilities accommodate various energy-intensity needs, but TRIUMF's operations run 24/7, so companies can be efficient with their beam time.

TRIUMF is registered with the Federal Government Controlled Goods Program, thus making the facilities available for the testing of strategic devices. This program aligns with the U.S. International Traffic in Arms Regulations program.

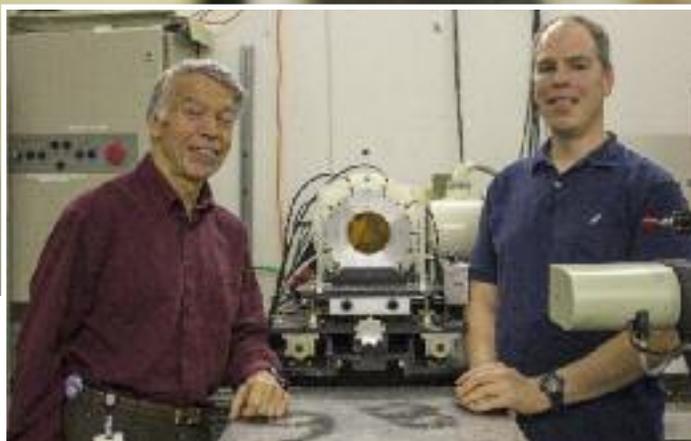
### PERFORMANCE

Companies pay TRIUMF for the right of access to beam and technical staff time in exchange for the testing or certification of their products in high radiation environments. Over 60 companies from Canada, the U.S., and Europe have made commercial use of the irradiation facilities, a total of 147 visitors during the past year. This substantial increase is due to the greater number of beam hours made available by TRIUMF and to the closing of the Indiana University Cyclotron Facility, which forced many U.S. companies to look for an alternate testing site.

With investment from Cisco Systems, TRIUMF has assembled a detector and data acquisition system to better understand the low-energy terrestrial muon spectrum. This data will help predict the role of muons in the reliability and performance of electronics. The first results are in publication. Over the next year, further data analysis and simulations will lead to final publication.

In addition to the qualification of electronics, some of the collected data is used in student theses, presented at international conferences, and published in peer-reviewed journals. Much of the research has won awards from the community both at the student and professional levels.

In FY 2012/13, BL1B was upgraded to enable higher neutron intensities. This upgrade, facilitated through AAPS and financed by Cisco Systems, resulted in greater use from users, thus tripling its income in 2014. Three companies performed muon irradiations using the M20 channel in the Meson Hall.



## OUTLOOK

Development continues using the Monte Carlo simulation package FLUKA to model the different beam lines and guide upgrades. These upgrades allow for training students and highly qualified professionals and could prove useful to customers. Staff will reevaluate an upgrade project of the TNF where FLUKA could be used to guide the design, specify the shielding, and characterize the resulting beam.

### PIF & NIF Commercial Use

	Number of Companies	Beam time
2010 / 11	39 companies	711 hours
2011 / 12	36 companies	589 hours
2012 / 13	43 companies	667 hours
2013 / 14	35 companies	580 hours
2014 / 15	64 companies	920 hours

**The organizational restructuring of AAPS vis-à-vis its more integrated position within TRIUMF provides an even more effective commercialization platform to achieve greater opportunity for Canadian industry.**

NRC Office of Audit and Evaluation and the International Peer Review Committee, 2013



## BUSINESS LINE:

# ISOTOPE PRODUCTION AND CHEMISTRY

With a focused research program and a team of talented experts in science, engineering, and technology, TRIUMF is turning research excellence into business relevance.

## CORE CAPABILITY

TRIUMF draws from its expertise in cyclotron operations, target engineering, and radiopharmaceutical production to realize extraordinary benefits. The nuclear medicine team has mastery of the chemistry and facilities needed to isolate, purify, and combine isotopes with biologically active target molecules. This enables research in world-class programs at the University of British Columbia (UBC) and the British Columbia Cancer Agency (BCCA), which utilize molecular imaging to delve into the causes, progression, and treatment complications of neurodegenerative disease and cancer. TRIUMF's isotope program applies cyclotron-produced isotopes to important conditions affecting society, such as drug addiction and mental health, Alzheimer's disease, and brain injury.

## GLOBAL POSITION

TRIUMF's competitive advantage arises from its combination of skills and abilities in isotope production and radiopharmaceutical chemistry, and from over 36 years of experience in private sector partnerships, such as with Nordion Inc., to provide life-saving medical isotopes globally. TRIUMF is developing cyclotron-based solutions to produce key isotopes in healthcare, which will allow the world to move away from an aging reactor fleet that uses highly enriched uranium. TRIUMF also trains highly qualified personnel in medical cyclotron operations and radiopharmaceutical production.

## PERFORMANCE

With support from the Natural Resources Canada (NRC) Isotope Technology Acceleration Program, a TRIUMF-led consortium demonstrated the full potential of cyclotron-based Tc-99m production in two provinces. The team, which includes UBC, BCCA, Lawson Health Research Institute, and the Centre for

Probe Development and Commercialization, won the 2015 NSERC Brockhouse Award for Interdisciplinary Research, presented by the Governor General at a ceremony in Ottawa. ARTMS Products Inc. is preparing to commercialize the technology and is connecting with potential buyers across North America, Asia, and Europe.

The Nuclear Medicine team has produced At-209 using TRIUMF's ISAC-ISOL capabilities. This led to the world's first single-photon computed tomography (SPECT) images using the isotope, created at the UBC Centre for Comparative Medicine. At-209 will serve as a model isotope for At-211 that can be used in radiotherapeutic applications for cancer treatment.

TRIUMF, BCCA, and General Electric are in collaboration to utilize a specific-purpose radiotracer to better understand 'triple-negative' breast cancer – a form of the disease with one of the poorest prognoses.

Using its TR13 cyclotron, TRIUMF produced 858 runs of medical isotopes that were delivered to local hospitals for research, including 15 runs for medical isotopes to the BCCA for the diagnosis of cancer patients.

TRIUMF regularly irradiates a variety of target materials, one of which is used to extract Strontium-82 (Sr-82) for the production of strontium generators used in cardiology imaging. Nordion purifies the Sr-82 for commercial sale and distribution. Downstream, Bracco Diagnostics Inc. uses the Sr-82 to manufacture the Cardiogen™ generators.

## OUTLOOK

Commercial demand for Sr-82 is growing. TRIUMF will be upgrading the existing irradiation facility, which will allow for an increase in Sr-82 production capability.

TRIUMF will be launching the Institute for Advanced Medical Isotopes (IAMI). IAMI will leverage the core competencies of the Nuclear Medicine program,



enable the production and development of new isotopes for novel applications, and support a future where new isotopes drive the personalized healthcare revolution. IAMI will attract new partners and talented researchers from across the academic and private sector spectrum. This will enable TRIUMF to collaborate in large and small-scale radioisotope research and development by producing known and new isotopes with the institute's TR24 cyclotron.

In consultation with Health Canada, TRIUMF and partners have received approval to proceed with a clinical trial for cyclotron produced Tc-99m. TRIUMF

will work with commercialization partners, AAPS and ARTMS, to protect and commercialize its cyclotron-based Tc-99m production technology.

With a rise in demand for new isotopes that can be used in radiotherapy of diffuse and difficult to treat forms of cancer, TRIUMF will continue to develop isotopes and radiotracers for preclinical research.

**“TRIUMF has a progressive innovation culture. From the top-down, it is peer-oriented, understanding, and competitive. It is looking at research with the intent to derive greater value and these results from TRIUMF have been fantastic.”**

Greg Caws, President and CEO, BC Innovation Council



## BUSINESS LINE: TECHNICAL CONSULTING

TRIUMF's capabilities in physics, engineering, and technical design are often tapped for short-term consulting arrangements. In some cases, AAPS's business expertise has helped to frame how TRIUMF's assets might address the needs of the private-sector partner.

### CORE CAPABILITY

In addition to irradiation of materials and isotope production and chemistry, TRIUMF has established technical prowess in the following areas:

- Advanced electronics: digital and analog
- Advanced computing for scientific and facility control
- Cryogenic technology
- Ion beam dynamics
- Mechanical design, engineering, and fabrication
- Particle and radiation detection, modeling, and shielding
- Precision magnet design, engineering, and measurement
- Superconducting radiofrequency (SRF) technology
- Vacuum technology

### PERFORMANCE

During the course of the year, TRIUMF and AAPS explored consulting opportunities with more than a dozen companies. Discussions included ion source development for medical cyclotrons, advanced magnet systems for isotope separation, detection technology for proton therapy, and transferring vacuum expertise to industry via a workshop. TRIUMF limits these activities to those that directly advance its mission.

Some examples of technical consulting include:

- The Institute for Basic Science in South Korea (RISP) worked with TRIUMF on SRF cavity processing and testing, as well as the development of a prototype SRF cavity.
- D-Pace Inc. made use of TRIUMF's machine shop for a number of work orders. For example, TRIUMF welded aluminum flanges to analyze magnet systems, performed helium leak checks and cleaning, and fabricated emittance scanner cooling plates.

- A technical research affiliate of Toyota utilized the MuSR beamline and spectrometer along with technical support to test performance of magnetic materials for high-efficiency motors.
- TRIUMF shipped scintillators to York University for the Cosmic Ray Detectors for Schools program.
- ABB Inc. requested a professional training course on the irradiation effects of electronics and materials for space applications.

Since 2004, TRIUMF and PAVAC have collaborated on SRF cavity design, fabrication, and assembly production. PAVAC is the first Canadian company to produce bulk niobium SRF cavities—and one of only a handful of companies in the world capable of manufacturing this accelerator technology, attracting attention from clients in North America, Europe, and Asia. TRIUMF's Accelerator division set up a half-day technology transfer training session on cryomodules with PAVAC in July.

### OUTLOOK

As TRIUMF's commercialization partner, AAPS will leverage TRIUMF's research program to meet opportunities presented in industry and academia. By focusing on priority areas – like natural resources (mineral exploration), healthcare (medical isotopes), safety and security (radiation detection and monitoring), and accelerator-driven technologies – this business line will produce economic and social benefits to Canadians.



“The successful 10-year relationship with TRIUMF allows for PAVAC to take a staged-growth approach in order to take on new opportunities when the timing is right.”

Ralf Edinger, President of PAVAC



## BUSINESS LINE: **PROFESSIONAL TRAINING**

TRIUMF offers opportunities to foster research training, continue career development, and create collaborations with colleagues across Canada and around the world.

### **CORE CAPABILITY**

Through its research programs, TRIUMF has subject matter experts in nuclear physics, particle physics, nuclear medicine, materials science, and accelerator physics. This leads to opportunities for training and development, and has a positive impact on the local tourism economy by attracting conference delegates.

### **PERFORMANCE**

The 5th Open Meeting for the Hyper-Kamiokande (Hyper-K) Project marked the first time this conference was held outside of Japan. TRIUMF researchers hosted the conference in Vancouver. Nearly 100 scientists from Canada, Japan, Italy, US, UK, Brazil, and other partner countries attended the meeting and encouraged global collaboration for the Hyper-K project. The meeting promoted Canada's scientific capabilities to an audience of world's leading physicists, and highlighted Canada as a premier partner in high-profile international scientific collaborations.

The Nuclear Structure 2014 conference (pictured at right) was hosted nearby on UBC's campus. This was the 15th in this series of biennial conferences organized by North American laboratories, returning to Canada for the first time since 1992. This is the premier North American conference for the field, devoted to the latest research and development in experimental and theoretical nuclear structure physics, with emphasis on the properties of nuclei at the extremes of isospin, excitation energy, mass, and angular momentum.

Over the course of a three-day workshop, world-leading researchers considered new ways of testing gravity, especially in light of recent advances in technology. Testing Gravity 2015 attracted about 100 experimentalists, observers, and theorists from across Asia, Europe, and North America.

TRIUMF's Nuclear Theory Workshop is a four-day-long series of lectures, talks, and colloquia centred around the latest results from top research institutions and universities around the world. Delegates are at the forefront of research in nuclear theory.

In September, TRIUMF and AAPS welcomed TRIUMF's member universities and research partner institutions to its second Innovations and Industrial Partnerships workshop. The theme of this workshop was "Knowledge Mobilization" with the intent to engage colleagues, discuss innovation practices, and explore opportunities for leveraging research.

### **OUTLOOK**

In FY 2015, TRIUMF will attract hundreds of global delegates for the 6th Symposium on Subatomic Physics in Victoria, BC and the 17th Conference on Superconducting Radiofrequency in Whistler, BC. Alongside the SRF workshop, TRIUMF will host an International Workshop on Future Linear Colliders and the International Accelerator School for Linear Colliders.

The Isotopes for Science and Medicine (IsoSiM) NSERC CREATE program will host its first summer school bringing students and industrial partners together.

“If you could only attend one workshop a year, it should be TRIUMF’s Theory Workshop! What started out as a small, local workshop has risen to become one of the most important scientific events of the year ... here we pre-empt all other workshops with the latest research results.”

Dr. Ruprecht Machleidt, University of Idaho





## BY THE NUMBERS

The following table describes the financial activity at TRIUMF over the past two fiscal years.

	Fiscal Year 2014-15	Fiscal Year 2013-14
Sponsored Canadian Conferences	\$ 1,146,650	\$ 814,300
Dollar Value of Sponsored Research		
NSERC, CIHR	\$ 6,672,462	\$ 6,135,227
NRCan	\$ 699,919	\$ 1,065,965
<b>Total</b>	<b>\$ 7,372,381</b>	<b>\$ 7,201,192</b>
Value of TRIUMF Purchase Orders Issued in Canada		
Inside Canada	\$ 12,941,709	\$ 23,333,779
Outside Canada	\$ 4,254,997	\$ 8,530,132
<b>Total</b>	<b>\$ 17,196,706</b>	<b>\$ 31,863,911</b>
Commercial Revenues	\$ 2,928,289	\$ 1,412,019
Collaborative Research (Affiliated Institutions)	\$ 1,566,290	\$ 2,548,271
TRIUMF House – Occupancy Rate	70.38%	69.14%
<b>TRIUMF House – Revenue</b>	<b>\$ 847,939</b>	<b>\$ 815,329</b>





## CONFERENCES

To estimate the economic impact of the conferences it attracts to Canada, TRIUMF uses the conservative multiplier of \$425.00 to calculate the economic impact of one conference visitor per day. The following table lists the conferences hosted by TRIUMF and the net economic impact.

### Between April 2014 to March 2015

Conference Title	Location	Dates	Delegates	Person Days
UCN Collaboration Meeting	Vancouver, BC	March 2014	20	60
Tri-institute Summer School on Elementary Particles (TRISEP)	Sudbury, ON	June 1-14, 2014	34	476
5th Open Meeting for the Hyper-Kamiokande Project	Vancouver, BC	July 19-22, 2014	~100	400
Nuclear Structure	Vancouver, BC	July 20-25, 2014	175	1050
PAVAC-TRIUMF SRF workshop	Vancouver, BC	July 25, 2014	15	15
3rd North American Workshop on Beta-Decayed Neutron Emission	Vancouver, BC	July 25-26, 2014	23	46
Innovations and Industrial Partnerships workshop	Vancouver, BC	Sep 25-26, 2014	20	40
Testing Gravity	Vancouver, BC	Jan 15-17, 2015	112	336
Progress in Ab Initio Techniques in Nuclear Physics	Vancouver, BC	Feb 17-21, 2015	55	275
<b>Subtotal</b>			<b>~554</b>	<b>2698</b>
<b>Total \$425/person-day = \$1,146,650</b>				





## ORGANIZATION AND GOVERNANCE

TRIUMF's business development activities are guided by several entities. The Board of Management's Innovation and Industrial Partnerships Committee oversees all of TRIUMF's innovation activities and facilitates interactions with the industrial liaison offices of member universities. The AAPS/TRIUMF Project Oversight Committee oversees the required resources for commercial projects as well as the technical support, facilitating communication to ensure projects are realized on time and on budget.

### TRIUMF University Consortium

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**Full Members:** University of Alberta, University of British Columbia, University of Calgary, Carleton University, University of Guelph, University of Manitoba, Université de Montréal, Queen's University, Simon Fraser University, University of Toronto, University of Victoria, and York University

**Associate Members:** McGill University, McMaster University, University of Northern British Columbia, University of Regina, Saint Mary's University, Western University, and University of Winnipeg

### BOM Innovation and Industrial Partnerships Committee

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**Digvir Jayas** (Chair), Vice-President (Research & International), University of Manitoba

**Edward Odishaw**, AAPS Board of Directors

**Don Brooks**, Centre for Blood Research, UBC

**Neil McLean**, Vice-President & Chief Technology Officer, AAPS

**Jim Hanlon**, Head of Business & Administration Division, TRIUMF; President & CEO, AAPS

**Ewart Blackmore**, Senior Research Scientist, TRIUMF

**Colin Jones**, Chair of the AAPS Board of Directors

### AAPS Board of Directors

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Colin H.W. Jones (Chair)

Ann Fong (Secretary)

Jonathan Bagger

Michael Burns

Pierre Coulombe

Jim Hanlon

Poul Hansen

Howard Kellough

Edward Odishaw

Peter Scott

Jack Scott

David Torgerson

Arthur Willms

Rick Schwartzburg, NCE (Observer)

### TRIUMF & AAPS Project Oversight Committee

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Jim Hanlon (Chair)

Ewart Blackmore

Yuri Bylinsky

Henry Chen

Meir Deutsch

Ann Fong

Don Furseth

Zhiyi Liu

Neil McLean

Jozef Orzechowski

Paul Schaffer

Michael Trinczek

## ACKNOWLEDGEMENTS

TRIUMF's activities are largely supported by contributions from the following organizations:

- Canada Foundation for Innovation
- Canadian Institutes of Health Research
- Genome BC
- Government of British Columbia
- Government of Canada
- Government of Manitoba
- Government of Nova Scotia
- Industry Canada
- National Research Council Canada
- Natural Resources Canada
- Natural Sciences and Engineering Research Council
- Networks of Centres of Excellence of Canada
- Western Economic Diversification Canada

## SELECTED PARTNERS

TRIUMF works with many individuals, organizations, educational institutions, and private companies to fulfill its mission. Without listing the large network of universities, these include:

### Canada

Advanced Applied Physics Solutions Inc.  
Advanced Cyclotron Systems Inc.  
Atomic Energy of Canada Limited  
ARTMS Products Inc.  
BC Cancer Agency  
BC Innovation Council  
BC Technology Industry Association  
Burnaby Board of Trade  
Canadian Association of Physicists  
Canadian Institute for Nuclear Physics  
Canadian Light Source Inc.  
Canadian Space Agency  
CANARIE Inc.  
Centre for Probe Development and Commercialization  
Dehnel Particle Accelerator Components & Engineering Inc. (D-Pace Inc.)  
Firnau-Radiochemical Consulting Inc.  
General Electric  
Institute of Particle Physics  
Lawson Health Research Institute  
LifeSciences BC  
Nordion Inc.  
Pacific Parkinson's Research Centre  
PAVAC Industries Inc.  
Perimeter Institute for Theoretical Physics  
Positron Emission Tomography Imaging at UBC  
Royal Society of Canada  
Science World  
British Columbia  
Selkirk College  
Shad Valley  
SNOLAB  
Vancouver Board of Trade  
Virtual Researcher on Call

### International

Argonne National Laboratory, Argonne, USA  
Brookhaven National Laboratory, Upton, USA  
China Institute of Atomic Energy, China  
Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany  
CERN, Geneva, Switzerland  
Fermi National Accelerator Laboratory (Fermilab), Batavia, USA  
GANIL, Caen, France  
Gesellschaft für Schwerionenforschung mbH (GSI), Darmstadt, Germany  
High Energy Research Organization (KEK), Tsukuba, Japan  
Institut des Sciences Nucléaires (ISN), Grenoble, France  
Institute for Basic Science of the Republic of Korea, Korea  
Institute for High-Energy Physics (IHEP), Beijing, China  
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Institute for Nuclear Research (INR), Russia  
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