



ACCELERATING SCIENCE FOR CANADA

TEAM UP

CANADA'S NATIONAL LABORATORY
FOR PARTICLE AND NUCLEAR PHYSICS

BUSINESS DEVELOPMENT
REPORT 2010 - 2011







TEAMUP

The pursuit of research and innovation is an engine that fuels the economy with the creation of knowledge that fosters new jobs, develops new technologies, and opens up new markets. TRIUMF is an integral part of Canada's prowess in this area. By combining academic excellence from Canadian universities with business relevance from industrial partners, TRIUMF forges teams that actively drive the knowledge economy.

AS A NATIONAL LABORATORY, TRIUMF CONTRIBUTES TO CANADA'S COMPETITIVE ADVANTAGE.

The global scientific community sees TRIUMF as a bridge between academia and the private sector and as a model for transferring knowledge, training highly skilled personnel, and commercializing research for the economic, social, environmental, and health benefit of all Canadians.

Table of Contents

02 | Message from the Chair of the Board's Technology Transfer Committee 03 | Message from the Chair of TRIUMF's Technology Transfer Panel 04 | Irradiation Services 06 | Isotope Production and Chemistry 08 | Technical Consulting 10 | Professional Training 12 | By the Numbers 14 | Outlook 16 | Organization and Governance IBC | Acknowledgements + Selected Partners + Contact Details



Canada is very fortunate to have an array of resources, innovative people, and institutions and organizations that stand globally at the front of the leading advances of knowledge and technology.

Canada's accelerator laboratory and its international reputation draw upon the strengths of the Canadian university research community in a unique partnership with a network of global partners within the international subatomic physics community.

TRIUMF recognizes its vital role as a publicly funded institution to provide benefits to all Canadians. Building the economy, creating jobs, and bringing social, environmental and health benefits to society are important. Through a multi-pronged strategy including the launch of Advanced Applied Physics Solutions (AAPS), Inc., via the Centres of Excellence for Commercialization and Research program, TRIUMF has opened its doors to knowledge transfer and has increased the number of partnerships with businesses and organizations on a commercial basis within Canada and globally.

Nordion, Inc. supplies over two-thirds of the world's medical isotopes used for diagnosing heart disease, brain disorders, and infections. Through its facilities based at TRIUMF, Nordion provides more than 15% of Canada's exported medical isotopes; TRIUMF was also where Nordion produced its first therapeutic isotope, Palladium-103, used in prostate brachytherapy. An award-winning relationship, the combination of available expertise, facilities and licensing opportunities not only bring resources to TRIUMF and but also help Nordion to be globally competitive. With this expertise, TRIUMF has developed R&D partnerships with GE, the BC Cancer Agency, and Genome BC to name a few. TRIUMF has emerged as a world leader in advancing isotopes for science and medicine.

TRIUMF takes great pride in the development of talented expertise and the training provided to emerging young scientists. These people move into existing companies

creating value and sometimes they drive entrepreneurship through the formation of new companies. Dehnel-Particle Accelerator Components and Engineering, Inc. (D-Pace) is a TRIUMF spin-off company specializing in technologies for the field of accelerator science. D-Pace also serves the semiconductor industry in ion implantation, and other research organizations, such as the Institute of Nuclear Research in Taiwan.

TRIUMF, at the cutting edge of science, is required to develop specialized equipment that does not exist previously. Seeking out a combination of expertise and innovation, TRIUMF looked beyond its walls to PAVAC Industries, Inc. Together, they have emerged as one of the few groups worldwide that are able to manufacture ultra-sophisticated superconducting accelerator technology. PAVAC's unique capability of precision welding in a vacuum coupled with TRIUMF's expertise is generating the next generation of accelerators with applications in health care, environmental mitigation and remediation, advanced materials science, and high-energy physics.

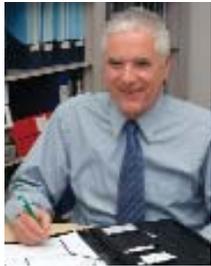
These are uncertain times, and there is a significant race underway in an increasingly competitive world for resources, innovative ideas, and talented people. TRIUMF, a jewel in Canada's scientific crown, is positioned in a unique and irreplaceable way to propel Canada forward.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Steven N. Liss'.

Steven N. Liss | Chair, TRIUMF Board of Management
Technology Transfer Committee | Vice-Principal (Research),
Queens University





As a national laboratory, TRIUMF brings together the talents and resources of Canadian resources to advance the country's science, technology, and innovation objectives.

With a solid connection to Canada's world-class university-research system and deep experience in delivering complex programs and projects on time and on budget, TRIUMF provides a unique platform for innovation, collaboration, and commercialization. Although breakthroughs and inventions are not individually predictable, a firm commitment from the leadership and staff of a laboratory make a critical difference.

A core element of TRIUMF's strategy is to team up and generate industrial partnerships that bring the business and market acumen of the real world to identify truly innovative science and technology that may be ripe for development. In many instances, TRIUMF's commercialization partner AAPS, Inc., is the right vehicle to pull together the teams to spin out new companies, license intellectual property, and/or develop products. In other cases, TRIUMF works directly with industrial and research partners to provide solutions and services.

TRIUMF's industrial partnership and business-development activities are organized around four main business lines. In each of the areas, TRIUMF has specialized expertise and equipment that attract industrial partners.

Irradiation Services: TRIUMF's accelerators provide beams of particles that can be used to probe materials to reveal their structure or bombard systems to examine their performance in elevated radiation environments. The space industry and certain segments of the high-performance electronics sector are steady customers.

Isotope Production and Chemistry: TRIUMF's research program in nuclear medicine has developed core competencies in the production of isotopes using a variety of cyclotron and target technologies. TRIUMF also has expertise in the purification, processing, and chemical synthesis that attaches the isotopes to biologically relevant

molecules for medical imaging or treatment. These capabilities are regularly in demand by the private sector.

Technical Consulting: TRIUMF's capabilities in physics, engineering, and design are often tapped in the form of short-term technical consulting arrangements. TRIUMF staff might contribute to trouble-shooting a private company's product line or provide advice in developing needed high-tech infrastructure. TRIUMF's contributions to the success of AAPS, Inc., projects fall into this category.

Professional Training: Finally, TRIUMF provides training experiences for highly skilled workers ranging from apprentices and journeyman in the technical trades to professional development of scientists and engineers through courses, workshops, and conferences.

With each industrial partnership, TRIUMF develops Canadian business in several ways. TRIUMF might provide direct technical assistance to the company on a product line or a platform for product development. Or TRIUMF might be involved with a vendor to enhance an existing product to meet an application needed for TRIUMF's research program. Finally, TRIUMF might also collaborate with a company to investigate and develop a new technology, market, or service offering.

In any of these cases, TRIUMF is firmly committed to empowering and enabling the Canadian economy. This report provides a brief update on TRIUMF's plans and performance in this area. I trust you will be as proud as I am of TRIUMF's accomplishments.

Sincerely,

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

Jim Hanlon | Chair, TRIUMF Technology Transfer Panel | Head, Human Resources and Administration





BUSINESS LINE: IRRADIATION SERVICES

Beginning in 1995 TRIUMF has built up several beam lines that provide low-intensity, energetic proton and neutron beams to simulate natural-radiation exposures either in space or terrestrial environments.

Even at low intensity, a few minutes of exposure in these beams can correspond to years of operation in space, air, or ground so that accelerated testing for errors in electronics can be carried out. Since then, TRIUMF has become recognized as a premier test site for space-radiation effects using protons. By converting these protons into neutrons, testing with neutrons is also performed.

CORE CAPABILITY

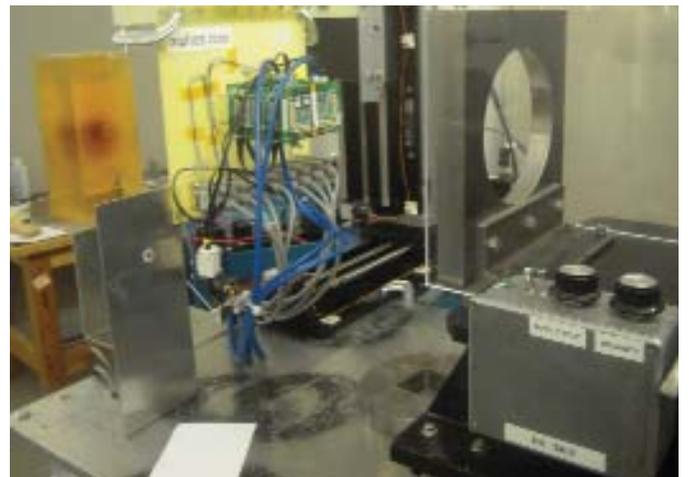
TRIUMF's Proton Irradiation Facility (PIF) and Neutron Irradiation Facility (NIF) regularly make use of three beam lines at TRIUMF. Protons and neutrons are available at energies up to 120 MeV via BL2C1, which is shared with TRIUMF's Proton Therapy Centre for the cancer treatment of ocular melanoma. Higher energies, up to 500 MeV, are available with BL1B, a testing facility truly unique to the world for both its broad range of energy and intensity. More intense neutron irradiations can be done with the TNF location at the end of BL1A. Here, the "leftover" protons from the Meson Hall are converted to neutrons at the beam dump, yielding an energy spectrum well matched to that of atmospheric neutrons, ideal for testing avionics and ground-based electronic systems, such as network and power-distribution servers, or even the latest cell-phone chips. In 2010, irradiations of electronics were also performed using electrons from the M11 and muons from the M20 channels.

GLOBAL POSITION

PIF & NIF at TRIUMF offer many competitive advantages. As a destination for testing equipment, TRIUMF is ideally situated very close to an international airport making both travel and shipping easy. TRIUMF is also accessible to international customers who may find it difficult to obtain clearance to test at other facilities such as the U.S. DOE laboratories which house national defense-related activities. The TNF neutron facility location, while limited in the size of parts it can test, has roughly 5 times the intensity available elsewhere, making it the preferred choice for many chip makers and third-party testing companies. The fact that TRIUMF runs "24/7" allows larger testing companies to be more efficient with their time and most customers comment on the level of service and the service facilities that TRIUMF has available. PIF is the only facility in the world that offers a range of both high energy and variable intensity. Alternatives to TRIUMF's facilities include Los Alamos in the U.S. for neutron tests and TSL in Sweden for protons and neutrons.

PERFORMANCE

PIF and NIF operate in careful coordination with the schedule of the main TRIUMF cyclotron and its commitment to multiple research programs. During the FY2010 fiscal year, more than two dozen customers received beams. TRIUMF's

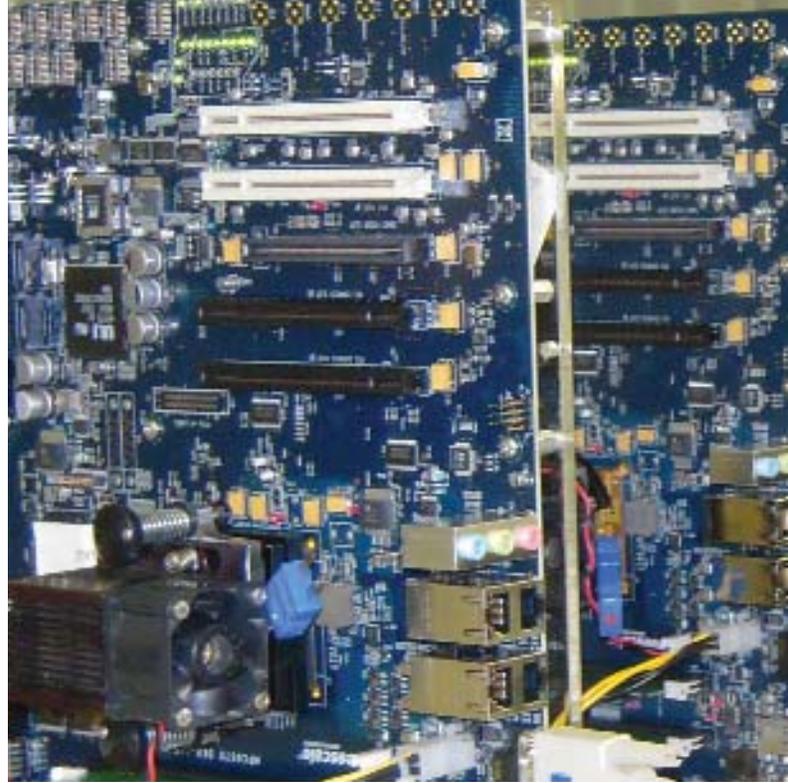


upgrade of the cyclotron's main injection line reduced overall running time but will enhance future beam delivery. Beams for TNF were not available until mid-August 2011 because of other upgrades to the cyclotron's infrastructure.

PIF & NIF has seen steadily increasing revenues since it began, with an annual average of approximately \$350k for the previous three years from paying customers and 12 to 16 shifts of beam time for scheduled experiments. In typical years, about 90 users from 25 to 30 companies in Canada, U.S. and Europe make use of the irradiation facilities. Cisco Systems is presently the largest customer while a number of Canadian space and avionics companies rely on TRIUMF radiation-effects testing for component selection and to meet contractual requirements.

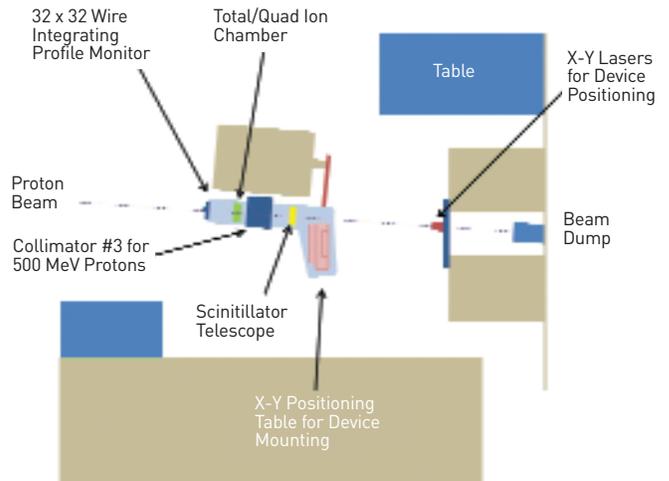
OUTLOOK

In the area of irradiation services, TRIUMF has developed a reputation for reliability and excellent support services that leads to customer confidence and repeat business. The beam-line infrastructure from the cyclotron that supply PIF and NIF is ageing and will need to be addressed in the near future; some service interruptions are expected. Additionally, the longer-term future of some of these beam lines is under discussion; present plans will supplant them for installation of the ultra-cold neutron facility in 2014-2015.



In early 2011, TRIUMF began discussions with the Canadian Space Agency to develop a framework for standardized promotion and access to the irradiation facilities. This partnership has the potential to make TRIUMF's services even more available to the Canadian space industry.

In the past, PIF & NIF has successfully collaborated with leading radiation-effects researchers, exposing TRIUMF's testing capabilities in refereed journals and at international conferences to future potential customers. Recently, a collaboration was started to explore the effects of muons on today's electronics which could lead to a future revenue stream.





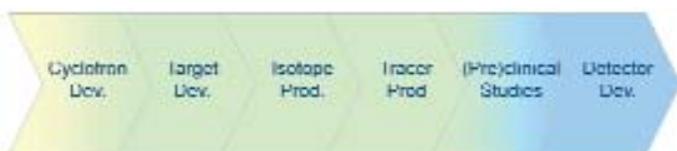
BUSINESS LINE: ISOTOPE PRODUCTION AND CHEMISTRY

Over the past 30 years, TRIUMF has developed core competencies in the production, processing, and preparation of isotopes for science and medicine.

Typically, these isotopes are produced by beams of protons (produced in a cyclotron) that bombard target materials to produce the novel isotopes. The isotopes are extracted by a combination of physical and chemical processes and then isolated for research use.

CORE CAPABILITY

TRIUMF is a world expert in the physics and chemistry of isotopes and partners with global leaders in biological applications (e.g., medical diagnosis and treatment). As an accelerator laboratory, TRIUMF has deep expertise in cyclotron design, engineering, and operation. TRIUMF has also developed a variety of novel targets that enable the production of selected isotopes in relatively high yields. The nuclear-medicine team has mastery of the chemistry used to isolate, purify, and combine the isotopes with biologically active target molecules for use by its partners.



GLOBAL POSITION

TRIUMF's nuclear-medicine team is not unique in Canada, let alone the world, nor are any of its facilities and equipment especially unusual. TRIUMF's competitive advantage arises from its combination of knowledge, skills, and abilities. TRIUMF has the expertise and the equipment to

design and operate accelerators for production of medical isotopes. And TRIUMF has 30 years of experience doing so with Nordion, Inc., in a competitive business environment. TRIUMF has the tools and talents to identify and then test new techniques for producing isotopes and can then fashion novel radiotracers using cutting-edge chemistry. Finally, TRIUMF has a network of biological and medical research partners that pioneer the application of radiotracers for understanding disease and developing new treatment approaches. It is this "one-stop shop" aspect of TRIUMF's prowess in the physics and chemistry of isotopes that make this business line it's strongest.



PERFORMANCE

TRIUMF commissioned and opened a new suite of GMP-compliant nuclear-medicine laboratories in August 2010 with the support of Western Economic Diversification Canada. In the area of isotope production and chemistry, TRIUMF's business-development activities over the past year were focused on the following activities:

- Routine and reliable operation of Nordion's three medical cyclotrons for the production of medical isotopes for sale and distribution around the world.
- Routine and reliable production of strontium-82 isotopes for Nordion's use in downstream manufacture and sale of rubidium-82 generators.
- Production of fluorine-18 isotopes for the BC Cancer Agency during maintenance periods in their production cycles.
- Collaborative research and development with Nordion, Inc., of novel radio-metal isotopes for new radiopharmaceutical products.
- Collaborative research and development with a global medical company for chemical synthesis of novel radiotracers for use in labeling and monitoring oxidative stress in the body.
- Production of silicon-32 for the U.S. Department of Energy.

TRIUMF's business activities with isotopes are developing in both the areas of isotope and target production as well as in radiotracer preparation and formulation. For instance, in terms of target production, TRIUMF has expanded its business with the University of Washington's Department of Radiation Oncology. In the early 2000s, TRIUMF prepared and delivered a target station for use in the Washington cyclotron for the production of the medical isotope astatine-211. This fiscal year, TRIUMF's ATG group developed and now sells bismuth targets to the University of Washington for their use in producing the astatine isotopes. Astatine holds great promise as a therapeutic isotope. Additionally, TRIUMF secured a contract with Battelle, Inc., and the U.S. Los Alamos National Laboratory for the irradiation and production of silicon-32 isotopes. TRIUMF leveraged its partnership with Nordion, Inc., to provide the logistics and distribution for transporting and delivering the isotopes to New Mexico.

In consultation with cyclotron manufacturers, the TRIUMF-led team is developing and benchmarking the technology for direct production of technetium using solid targets of Mo-100 metal.



OUTLOOK

In January 2011, Natural Resources Canada announced a \$6 million award to TRIUMF and its team of partners for the demonstration and optimization of technologies that would reliably produce the medical isotope technetium-99m from cyclotrons instead of the traditional nuclear-reactor route. In consultation with cyclotron manufacturers Advanced Cyclotron Systems, Inc. (ACSI), and General Electric, the TRIUMF-led team is developing and benchmarking the technology for direct production of technetium using solid targets of Mo-100 metal.

TRIUMF and Nordion expect the strontium isotope-production business to grow over the next few years. TRIUMF is examining options for upgrading its production capacity by delivering more protons on target. The nuclear-medicine group is also exploring strategic opportunities with Genome BC to develop novel radiotracers for the advance of oligonucleotide-based radiopharmaceuticals.



BUSINESS LINE: **TECHNICAL CONSULTING**

Because technical consulting for an independent company is often the first step to a deeper, longer-term relationship, TRIUMF identifies it as a core business line.

TRIUMF regularly assists suppliers and vendors with the manufacturing, assembly, and testing of products it orders. The relationships can assist the company in developing a new level of competence in their existing product lines. For instance, TRIUMF's relationship with PAVAC Industries, Inc., has blossomed from a challenging purchase order to a mutually collaborative partnership around superconducting radio-frequency accelerator technology.

CORE CAPABILITY

TRIUMF's technical, engineering, and scientific staff are in high demand as consulting resources in almost every area of its science program. TRIUMF also maintains several facilities that provide unique characterization and/or testing capabilities that are too specialized for a private company to maintain and operate.

In many situations where the consultation is part of a research project that will publicly share its results, TRIUMF provides its expertise free of charge in a collaborative manner. Often when consulted by private-sector interests, the intention is to analyze, enhance, or otherwise improve an existing proprietary process. In those cases, TRIUMF typically charges a cost-recovery fee for the time and materials of the involved staff.

GLOBAL POSITION

TRIUMF's scientific and technical talent pool has several competitive advantages. Distinct from a traditional university department, TRIUMF offers interdisciplinary expertise that spans multiple academic departments. Physicists, chemists, and engineers work alongside each other on

challenging technical projects. Other laboratories around the world have equally talented individuals; TRIUMF's specialization in isotopes for science and medicine is unique, however, and makes the laboratory in demand.

PERFORMANCE

Technical consulting in this fiscal year covered a wide variety of topics including ion-source development, radiation surveying and inspection, cyclotron operations and maintenance, isotope production, and radiotracer synthesis. Activities with AAPS, Inc., often fall into the technical-consulting category as TRIUMF staff provide scientific and engineering support to the company.

In December 2010, TRIUMF and Advanced Cyclotron Systems, Inc. (ACSI), announced a new partnership framework. This step forward brings together Canada's top manufacturer of medical cyclotrons with the deep technical and engineering expertise of TRIUMF. ACSI is based out of Ebco Industries, the company that provided key components for the construction of TRIUMF's main cyclotron in the 1970s and that commercialized TRIUMF's designs for medical cyclotrons in the 1980s and 1990s.

Under the leadership of Morgan Dehnel, D-Pace, Inc. (a TRIUMF spin-off company), has flourished as a world-wide supplier of ion-source and beam-line components and expertise. In 2007, TRIUMF and D-Pace received the

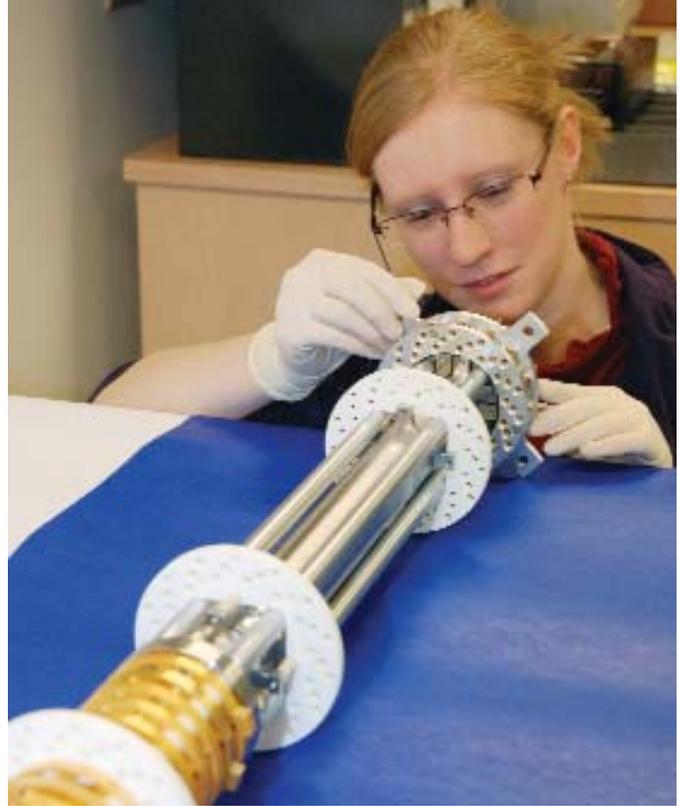


NSERC Synergy Award for industrial partnership; TRIUMF's Marcello Pavan now sits on the technical advisory board for D-Pace. During the past fiscal year, D-Pace has contracted with TRIUMF for technical consulting and access to TRIUMF's specialized ion-source test stand. In part, this work enabled D-Pace to secure an exclusive sales agreement with IBA (one of the world's largest manufacturers of medical cyclotrons) for the supply of negative hydrogen ion sources, based on licensed TRIUMF technology. The agreement was announced November 23, 2010. Yves Jongen, IBA Chief Research Officer, said, "This agreement with D-Pace is, from our perspective, a wonderful opportunity to develop a world leading technology with the support of a major manufacturer. Our intention is to further collaborate and enter into a long term relationship with D-Pace to develop our technological leadership and bring the highest performances to our customers."

For its internal research activities, TRIUMF had developed powerful software for design and modeling of beam optics within cyclotrons. In a new partnership agreement, TRIUMF recently made this software available to BEST Cyclotron Systems, Inc., a global company with offices in Richmond, BC.

In service of the Canadian particle and nuclear-physics community, TRIUMF has developed expertise and facilities for the design, fabrication, and data-extraction from particle detectors using multiple technologies. These capabilities have formed a platform for partnerships. For instance, AAPS contracted with TRIUMF for assistance in the development of scintillation-detector systems and advanced electronics for application in its development of geotomography with cosmic rays as well as to fulfill AAPS commitments to a Carleton University led project on the detection of special concealed nuclear material.

In March 2011, the world suffered from a major earthquake and subsequent tsunamis off the north east coast of Japan. One of the significant impacts was on the Fukushima-Daiichi nuclear-power plants. The power company was not able to effectively shut down and cool the hot cores of the operating reactors and radioactive materials were



released into the environment. The situation gained worldwide media attention and public concern became quite serious and intense. Although not in a fee-for-service capacity, TRIUMF provided substantial technical consulting to the mainstream media, members of the public, and federal and provincial agencies in Canada to understand and interpret the situation. In April, TRIUMF collected environmental samples (e.g., rainwater, locally farmed milk) from Vancouver and performed high-precision radiation measurements to evaluate the level of radioactive contaminants that might have accumulated locally from the Fukushima incident. The results were made publicly available and the analysis confirmed that public health risk to Western Canada was negligible.

Last but not least, TRIUMF's Applied Technology Group (ATG) is perhaps the largest source of technical consulting through its close interactions with Nordion's on-site production plant. From operations, maintenance, and upgrades to Nordion's three cyclotrons, ATG provides critical contributions to Nordion's business activities on a daily basis.

OUTLOOK

As new projects at TRIUMF demand priority attention and focus, the capacity for external consulting will fluctuate, but as TRIUMF's reputation grows and additional facilities become available on site, it is expected that the laboratory will be even more in demand.



BUSINESS LINE: PROFESSIONAL TRAINING

TRIUMF provides selected training and professional development for highly skilled workers in Canada. These activities are distinct from the role that TRIUMF plays in educating and training high-school, undergraduate, and graduate students.

CORE CAPABILITY

TRIUMF has three assets to deploy in service of professional training.

1. Top talent. Because of its world-leading research programs, TRIUMF attracts and retains some of the best scientific, technical, and engineering talent in Canada.
2. Convening power. As a global science laboratory, TRIUMF has the capacity and commensurate reputation to convene groups of influential scientists, researchers, and partners in multiple areas of research and development.
3. Selected conference & event services. TRIUMF maintains a small team that can assist with the organization, logistics, and execution of a scientific or professional conference, including the preparation of published, peer-reviewed scientific proceedings.

TRIUMF leverages these assets to organize and/or host scientific meetings. For instance scientific and technical conference topics range from the frontiers of physics to engineering practices in areas such as cryogenics or beam-

target design and manufacturing. TRIUMF also provides training experiences for professionals. For instance, within TRIUMF's machine shop, a millwright apprentice program will be in place within the upcoming fiscal year with the British Columbia Institute of Technology.

GLOBAL POSITION

What TRIUMF brings to the realm of professional training is a laboratory environment that bridges the academic and business sectors. This is the special flavour of TRIUMF: guided by a strategic plan and completing milestones on time and on budget for projects that have never been done before.

PERFORMANCE

TRIUMF organized almost a dozen different scientific conferences that not only provided valuable intellectual and professional exchanges, but also created economic impact in Vancouver with tourism and hospitality income.

TRIUMF was instrumental in the formation of the IEEE Joint Applied Physics chapter which formed in 2010 and held its first meeting on the topics of isotopes, imaging, and innovation. Dozens of high-tech workers from around Vancouver metro region came to TRIUMF to attend the inaugural meeting.

Scientific conferences generate economic impact akin to general tourism. To estimate this impact, TRIUMF uses the conservative multiplier of \$425.00 per day to calculate the economic impact of one conference visitor for one day. The following table lists the conferences hosted by TRIUMF, the number of person days spent at the conference and the net economic impact. The multiplier is a conservative estimate of the contribution to the local economy because it does not take into account the likelihood of a visitor to Vancouver or other host city spending extra days before and after the conference to visit the city and surrounding areas.



What TRIUMF brings to the realm of professional training is a laboratory environment that bridges the academic and business sectors.

Conference Title	Location	Prov	Date	Year	Delegates	Person Days
International Nuclear Physics Conference	UBC, Vancouver	BC	July 4-9	2010	696	4,176
TIGRESS Workshop 2010	TRIUMF, Vancouver	BC	July 10-13	2010	32	128
TITAN Collaboration Meeting	TRIUMF, Vancouver	BC	May 24-26	2010	29	87
CINP Workshop on Fundamental Symmetries	University of Manitoba Winnipeg	MB	July 9-10	2010	51	102
Hadron-Collider Physics Symposium	University of Toronto, Toronto	ON	Aug 23-27	2010	140	700
International Nuclear Target Development Society Meeting	TRIUMF, Vancouver	BC	Sept 13-18	2010	44	264
Cryogenic Operations Workshop	TRIUMF, Vancouver	BC	Sept 21-24	2010	41	164
5th International Conference on Laser Probing	TRIUMF, Vancouver	BC	Sept 27-Oct 1	2010	35	175
CINP Town-Hall Meeting	TRIUMF, Vancouver	BC	Sept 11-12	2010	25	50
ATLAS Canada Physics Workshop	TRIUMF, Vancouver	BC	Dec 13-16	2010	69	276
48th Winter Nuclear & Particle Physics Conference	Banff Centre, Banff	AB	Feb 18-20	2011	39	117
SUB-TOTAL						6,239
TOTAL						(\$425 / person-day) = \$2,651,575

OUTLOOK

Responding to resource constraints, TRIUMF is refocusing some of the activities in the organization of scientific conferences. Emphasis will be placed on working with outside professional teams for event management while retaining the intellectual and programmatic leadership within the core team.

TRIUMF signed a Memorandum of Understanding with Selkirk College (Castlegar, BC) in FY2010 that will be used as the framework for exploring a partnership around a

technology-training program in the Columbia Basin in partnership with D-Pace, Inc., a TRIUMF spin-off company based in Nelson, BC.

TRIUMF will also be involved in the upcoming American Association for the Advancement of Science (AAAS) conference that will be held in Vancouver in February 2012. This conference has not been on Canadian soil for 30 years and typically attracts 8,000 of the world's best scientists. TRIUMF is contributing to the local hosting activities.



BY THE NUMBERS

In fiscal year 2010-11, TRIUMF generated \$2.6M in commercial revenues. These revenues were derived from Nordion royalty payments, Proton and Neutron Irradiation facilities (PIF & NIF), and BC Cancer Agency (BCCA).

TRIUMF derives royalty income from nine Nordion products. Total royalty income reached a record level of \$1.5M. During 2010-11, TRIUMF produced and shipped to Nordion more of the medical isotope, strontium-82, than ever before. Royalties from this product alone accounted for \$0.9M. However, demand is not expected to continue at this level and future royalties are anticipated to reflect the historical pattern of earnings.

The PIF/NIF operations generated \$0.5M in revenues this past year. Revenues are derived from the charge-out of the TRIUMF facilities and services to organizations engaged in industrial and technological applications of beams. There is no charge for researchers whose interest is publishable research of radiation effects. Both facilities are designed for simulating space radiation (PIF) and ground-based (NIF) effects on electronic systems; these facilities are dependent on beam time availability.

TRIUMF has a long standing association with BCCA including a commercial relationship. Revenues of \$0.5M were generated by TRIUMF in the production of FDG on

behalf of BCCA. BCCA uses FDG for their diagnosis and treatment of cancer patients. In 2010-11, TRIUMF's production resulted in the treatment of over 3,200 patients. This is the last year from this revenue stream as BCCA has purchased its own cyclotron for the production of FDG. TRIUMF will take on a new role that provides (a) backup production capability during maintenance outages, and (b) research and development of novel isotopes and tracers.

TRIUMF also seeks to promote Canadian industry and manufacturing where possible. Other revenues of \$0.1M were generated over the year from various ad-hoc supply of goods and services. For instance, when one of the Nordion cyclotrons needed a replacement of its accelerating structures known as "dees," TRIUMF worked with Nordion to provide installation and quality assurance when the dees were procured from Ebco as part of the new framework for partnership with ACSI. Elsewhere, TRIUMF partnered closely with companies such as Bruker, Danfysik, CPI, Air Liquide, and more to procure and assist with the fabrication and quality assurance of one-of-a-kind technical systems for the ARIEL project.

TRIUMF has agreements with a number of private companies for collaborative development of new products. TRIUMF has also attracted substantial international investment to Canadian research and development programs including \$3 million from India for accelerator work related to the e-linac and \$4 million from Japan for the ultra-cold neutrons project.



FISCAL YEAR 2010-11

Sponsored Canadian Conferences	\$ 2,651,575
--------------------------------	--------------

Dollar Value of Sponsored Research

NSERC, CIHR	\$ 6,309,557
NRCAN	\$ 700,238
	\$ 7,009,795

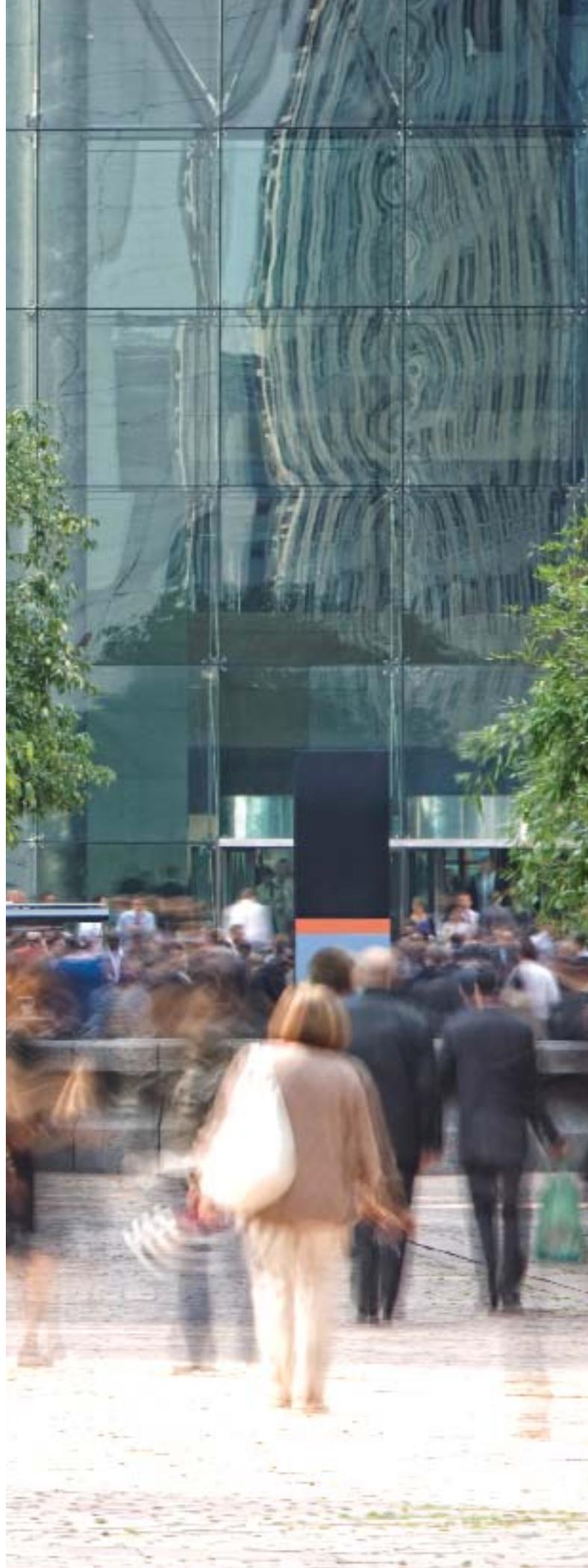
Value of TRIUMF Purchase Orders

Inside Canada	\$ 16,778,935
Outside Canada	\$ 9,130,270
Total	\$ 25,909,205

Commercial Revenues	\$ 2,628,668
---------------------	--------------

Collaborative Research

Affiliated Institutions	\$ 1,753,856
-------------------------	--------------





OUTLOOK

The business partnership between TRIUMF and Nordion Inc. (listed as NDZ on NYSE) is known by laboratories around the world as a successful example in technology transfer, and it certainly is the lab's largest model of success.

The mixing of the laboratory academic culture (TRIUMF is, after all owned by universities), and the business culture has taken time and effort to develop but it is by all measures a smooth and profitable partnership. During a period when federal and provincial governments are seeking to enhance Canada competitiveness with the best economies in the world, it is certainly the time to develop new success stories.

No area of activity at TRIUMF is evolving as quickly as our programs to realize commercialization opportunities and business partnerships. While it is hard to completely predict the future, new or rapidly expanding areas of activity are a strong indicator of from where these successes will come.

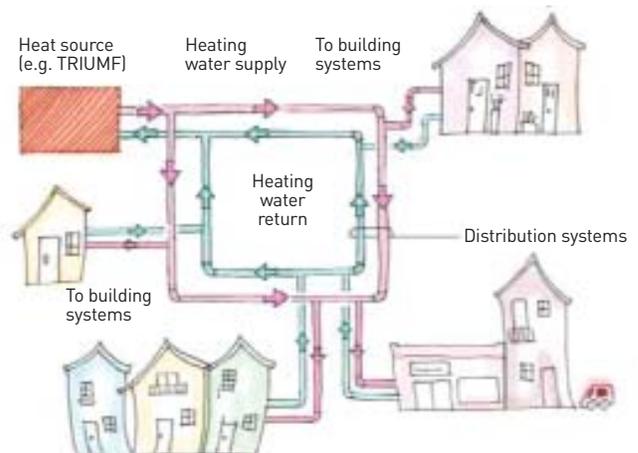
One example is a new exploration with landlord and neighbor UBC about recycling TRIUMF's cooling water to heat local residences. Another is TRIUMF's relationship with AAPS, Inc.

REDUCE, REUSE, RECYCLE... REPURPOSE COOLING WATER

By 2015, TRIUMF's cooling water system will be removing up to 10 MW of excess heat from TRIUMF's accelerators, targets, and beam lines. In a business-as-usual model, this heat would be vented to the atmosphere through traditional cooling towers.

This year, however, TRIUMF and UBC have identified a new opportunity: repurposing the excess heat from TRIUMF's research program to provide thermal energy in the local neighbourhood.

TRIUMF and UBC have agreed to jointly support the development, establishment and operation of a heat recovery and distribution system. The partnership is enabled by the unique opportunity lent by the TRIUMF facility's location on the UBC Point Grey campus, the facility's by product of excess heat in the form of warm water, and the requirement to vent this heat to the atmosphere before the water is reused. Concurrently UBC operates a sophisticated district-heating system in its academic precinct, has plans to expand its serviced area into the South Campus near TRIUMF, and is interested in diversifying its energy-source mix beyond natural gas and/or electricity with the aim of reducing GHG emissions in a cost-efficient manner. Preliminary feasibility studies are underway to explore a demonstration project that could be the first of its kind in North America.



ADVANCED APPLIED PHYSICS SOLUTIONS, INC.

Much of the focus in the last few years has been through TRIUMF's Centre for Commercialization and Research (CECR) funded by the federal Networks of Centres of Excellence agency.

This non-profit company, AAPS, has a primary mission to develop the most commercially viable technologies arising from TRIUMF but also to exploit new ideas that arise through interactions with TRIUMF's university owners and corporate partners. AAPS has its own independent Board of Directors. This governing body has been crucial to its success. A strong business-oriented Board brings needed expertise to a small company. The Board members all serve pro-bono. Thus far, AAPS has created two "high-tech" for-profit companies. Both "newcos" have significant potential for success. Initially, one aim of AAPS is to have 4-6 exciting prospects in the pipeline that could each lead to a successful company. And the threshold to create a new company is high.

When promising inventions and innovations arise at TRIUMF, AAPS is ready to assemble a collaborative team to evaluate and develop the commercialization potential and then spin-off a new company with the intellectual property. Not only has AAPS supplied direct expertise on projects where TRIUMF is developing new technology for industrial use (such as the production of the medical isotope technetium-99m using existing commercial cyclotrons), but AAPS has also challenged TRIUMF's leaderships and its staff to recognize and bring forward potentially relevant technologies for commercialization (such as geotomography using cosmic rays).

The question that must be addressed over the next year is how to proceed. AAPS' initial seed funding completes in 2013. There may be a possible extension to the program but that is not known at this point in time. TRIUMF has however drawn one conclusion. The present AAPS organization



brings a new business culture to TRIUMF that builds on what existed before. It is this business culture along with the independent Board of Directors that are two new essential components. AAPS also needs to source a steady stream of bright business entrepreneurs to connect to the private sector and investors. Fortunately the TRIUMF environment is a remarkably exciting technical backdrop and thus a magnet for smart entrepreneurs. The vision is simple...connect the sharpest entrepreneurs with the brightest scientists and engineers in a business culture, and let them perform their magic.





ORGANIZATION AND GOVERNANCE

TRIUMF is owned and operated as a joint venture by a consortium of 17 universities; core operating funds are provided via a contribution agreement through National Research Council Canada. TRIUMF's business-development activities are guided by several entities. The Board of Management's Technology Transfer Committee oversees all of TRIUMF's innovation activities and facilitates interactions with the industrial liaison offices of member universities. TRIUMF's Technology Transfer Panel manages the week-to-week operations of TRIUMF's industrial partnership activities. Finally, the TRIUMF director receives strategic advice about commercialization and market development through a Private-Sector Advisory Committee.

University Consortium

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

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

BOM Technology Transfer Committee

Steven Liss (Chair), Vice-Principal (Research), Queen's University

Ewart Blackmore, Senior Research Scientist, TRIUMF

Don Brooks, Professor of Chemistry and Associate Vice-President, Research, UBC

Jim Hanlon, Head of Human Resources and Administration, TRIUMF

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

Angus Livingstone, Managing Director, UBC Industry Liaison Office

Edward Odishaw, Chair of the Board, AAPS, Inc.

Jack Scott, President and CEO, AAPS, Inc.

TRIUMF Technology Transfer Panel

Jim Hanlon (Chair)

Ewart Blackmore, Proton Therapy Coordinator

Yuri Bylinsky, Accelerator Division

Nigel Lockyer, Director

Jozef Orzechowski, Applied Technology Group

Jack Scott (AAPS, Inc.)

Mike Trinczek, PIF & NIF Facility Coordinator

Private-Sector Advisory Committee

Henri Buijs, Senior Scientist, ABB Bomem

Dan Gelbart, co-founder and former President, Creo Products, Inc.

Pierre Coulombe, Chef de Projet, Centre de Recherche Industrielle de Québec

Alan Pelman, retired Vice President, Technology, Weyerhaeuser Canada, Ltd.

Jack Scott, President and CEO, AAPS, Inc.

Observers:

Gerry Salembier, ADM, WD

Jim Soles, ADM, BC/STED

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
- 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. These include:

Canada

Advanced Applied Physics Solutions, Inc.
Advanced Cyclotron Systems, Inc.
BC Cancer Agency
Canadian Institute for Nuclear Physics
Canadian Light Source, Inc.
Canadian Space Agency
CANARIE
Centre for Probe Research and Development
D-Pace, Inc.
General Electric
Institute of Particle Physics
Lawson Health Research Institute
Nordion, Inc.
Ottawa Heart Institute
Pacific Parkinson's Research Centre
PAVAC Industries, Inc.
Positron Emission Tomography Imaging at UBC
Selkirk College
SNOLAB

International

Argonne National Laboratory, Argonne, USA
Brookhaven National Laboratory, Upton, USA
China Institute of Atomic Energy, China
Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany
European Organization for Nuclear Research (CERN), Geneva, Switzerland
Fermi National Accelerator Laboratory, 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 Nuclear Research (INR), Russia
Istituto Nazionale di Fisica Nucleare (INFN), Italy
Japan Atomic Energy Agency (JAEA), Tokai, Japan
Japan Proton Accelerator Research Complex (J-PARC), Tokai, Japan
Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany
Lawrence Berkeley National Laboratory, Berkeley, USA
Lawrence Livermore National Laboratory, Livermore, USA
Los Alamos National Laboratory, Los Alamos, USA
National Superconducting Cyclotron Laboratory (NSCL), East Lansing, USA
Oak Ridge National Laboratory (ORNL), Oak Ridge, USA
Paul Scherrer Institut (PSI), Switzerland
Rutherford Appleton Laboratory (RAL), UK
RIKEN Nishina Centre for Accelerator-Based Science, Wako, Japan
SLAC National Accelerator Laboratory, Stanford, USA
Thomas Jefferson National Accelerator Facility, Newport News, USA
Toyota Central R&D Labs, Inc.
UT-Batelle, LLC, USA
Variable Energy Cyclotron Centre, Kolkata, India



4004 Wesbrook Mall
Vancouver, British Columbia
V6T 2A3 Canada

T | 604.222.1047

F | 604.222.1074

E | communications@triumf.ca

www.triumf.ca

Design
Serengiti Design Group
Printing
Generation Printing

Photo Credits

E. Blackmore
D. Chapman
J. Gazzarri
M. Hapke
A. Lambert
V. Simon

