

March 23, 2023

Briefing Note for the Study on Support for the Commercialization of Intellectual Property
Presented to the House of Commons Standing Committee on Science and Research

Submitted by:

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TRIUMF Innovations

Introduction:

As part of the House of Commons Standing Committee on Science and Research's study on the Commercialization of Intellectual Property, we have prepared the following brief to supplement testimony delivered at committee by TRIUMF Innovations CEO Kathryn Hayashi.

Background:

- Established in 1968 in Vancouver, TRIUMF is Canada's particle accelerator centre. The lab is a hub for discovery and innovation inspired by a half-century of ingenuity in answering some of nature's most challenging questions. TRIUMF is pushing frontiers in fundamental research, all while training the next generation of leaders in science, medicine, and industry.
- TRIUMF is owned and operated by a consortium of Canadian universities, with operations primarily supported by federal investment, for which we are highly grateful. Over the last five decades, well over a billion dollars of capital has been invested into TRIUMF, including the largest conventional cyclotron accelerator in the world and a new \$100M+ accelerator complex in final construction. Collectively the massive investment in TRIUMF has created the opportunity for many successes in Canadian science.
- TRIUMF's commercialization arm, TRIUMF Innovations, acts as a connector to the business world by providing market opportunities for applied physics-based technologies that emerge from the TRIUMF network – by streamlining access to TRIUMF's world-class expertise and infrastructure, and by connecting TRIUMF researchers and technologies to the world via industry partnerships, licensing, and business development.
- TRIUMF's work spans the entire continuum of research from fundamental science to commercialisation. TRIUMF has cultivated a hub of excellence around a core of expertise in accelerators and isotope research. From supporting Nobel-winning research to delivering life-saving breakthroughs in health and technology, TRIUMF is a major asset in Canada's high-tech landscape.
- TRIUMF is the portal through which Canada connects to CERN (EU), KEK (Japan), various Department of Energy facilities (USA), and more. Since 2019, TRIUMF has hosted over 1000 Scientific Visitors & Users from all over the world to work at our unique site.
- TRIUMF leads Canada's contribution to ATLAS, which is one of the two general-purpose detectors at the CERN Large Hadron Collider and involves several thousand researchers including over a hundred scientists at Canadian universities and at TRIUMF. in the ATLAS experiment at the CERN Large Hadron Collider (LHC) since the early 1990s.

Ongoing Work

Societal Impact

In addition to driving world-class science, TRIUMF must deliver benefit and impact to Canada in order to maintain its relevance. Recent successes include:

- Playing a leading role – in partnership with Italian and US collaborators and leveraging expertise in gas exchange systems from dark matter experiments – in an international consortium that designed and built a low-cost ventilator supplied to the Government of Canada for use in hospitals in response to the COVID-19 pandemic.

- Through support from NRCan (Natural Resources Canada), we helped address critical medical shortages resulting from the shutdown of the NRU at Chalk River, with the TRIUMF-led consortium successfully developing an alternate production process for technetium-99m. This achievement was awarded the 2015 NSERC Brockhouse Prize, and the technology has since received regulatory approval and is now commercially available through a successful venture-funded spinoff company that provides resilience against disruptions to fragile international supply chains.
- Working with partners to advance the development of new cancer fighting isotopes like actinium-225, putting Canada at the forefront of promising next generation treatments.
- Through support from the Networks of Centres of Excellence program, TRIUMF used expertise in cosmic particle detectors to develop innovative proprietary technologies for the mining sector that can provide x-ray-like visibility of mining deposits up to 1 km beneath the Earth's surface.
- Developing neutron detector expertise with General Fusion for use with their innovative fusion energy initiatives.

Stress-testing avionics and space-related technologies

TRIUMF's proton and neutron irradiation facilities provide commercial access to particle beams that simulate radiation exposures in both space and terrestrial environments, allowing telecommunications and technology companies to stress-test mission-critical components or space-bound equipment. TRIUMF Innovations plays an important role in brokering relationships between the lab and its irradiation services customers.

Providing critical medical isotopes

In partnership with BWXT Medical (BWXT), TRIUMF Innovations continues to build on TRIUMF's decades-long legacy as a key global supplier of medical isotopes. Every week, the TRIUMF-BWXT relationship supplies over 35,000 diagnostic and treatment doses of critical medical isotopes for cancer, cardiac diseases, and other illnesses.

Applying particle detectors for a greener tomorrow

TRIUMF Innovations has brought to market two companies that apply particle detection technology to improve environmental outcomes in several industries: Frontier Sonde, which uses neutron detectors to improve efficiency in oil and gas surveying; and Ideon Technologies, which uses muon detectors to reduce the cost and environmental impact of geological exploration.

Future work:

Institute for Advanced Medical Isotopes

IAMI is a state-of-the-art facility for research into next-generation, life-saving medical isotopes and radiopharmaceuticals. Located on the TRIUMF campus and leveraging over \$1.5B of existing infrastructure, IAMI will comprise an integrated series of Good Manufacturing Practices (GMP) compliant labs and a B.C.-built medical cyclotron to provide isotope security, develop and produce next-generation cancer therapies, enable local clinical trials, support cutting-edge medical research, and drive technological innovation and skills training. Including essential equipment and related infrastructure, the

IAMI project is valued at more than \$50M. Building construction is complete and fit out is underway now. Initial IAMI operations are expected to begin in late 2023.

With its fleet of particle accelerators, TRIUMF has the potential to produce world-leading amounts of Ac-225, a rare radioisotope that has shown great promise in clinical trials for the treatment of cancer. TRIUMF Innovations is working to bring Ac-225 and other life-saving therapies from bench to bedside.

Advanced Rare Isotope Laboratory

The Advanced Rare Isotope Laboratory (ARIEL) is TRIUMF's flagship multidisciplinary research facility. This world-class facility will broaden Canada's research capabilities in particle physics, nuclear physics, nuclear medicine, and materials science. ARIEL will increase TRIUMF's annual scientific productivity to 2-3 times its current level.

ARIEL is critical for understanding the properties of rare isotopes, a task that requires the unique techniques and tools this facility provides. Rare isotopes are not typically found in nature; they are created in stars as they burn or explode and are short-lived, often only existing for fractions of a second. On earth, scientists can produce rare isotopes using particle accelerators in a handful of laboratories around the world, including TRIUMF. They are powerful tools for scientific discovery with a broad range of applications from state-of-the-art medical imaging to advanced industrial manufacturing.

ARIEL's enhanced facilities will deliver unprecedented intensities of rare isotope beams, allowing for multiple, simultaneous experiments with a diversified portfolio of isotopes. This will strengthen and grow the established research programs at TRIUMF, as well as offer new avenues of investigation. For example, ARIEL will allow TRIUMF to explore future uses of electron linear accelerators (e-linacs), showcasing a Made-In-Canada, high-power superconducting e-linac that will be used to produce rare isotopes for cutting-edge research, such as in the study of the nature of stars.

The ARIEL initiative is led by the University of Victoria, with 20 additional collaborating university partners from across Canada. ARIEL is supported by contributions from the Canada Foundation for Innovation and the provinces of British Columbia, Alberta, Manitoba, Ontario, and Quebec.

Spin-Off Companies:

TRIUMF has successfully spun-off a wide variety of tech-companies. These companies, with their basis in the fundamental and applied sciences, were incubated using TRIUMF's expertise and infrastructure.

ARTMS Products is the winner of the 2017 BC Tech Association Technology Impact Award for "Most Promising pre-Commercial Technology", ARTMS is a leader in the development of novel technologies and products which enable the production of the world's most-used diagnostic imaging isotope, technetium-99m (Tc-99m). Tc-99m is used in over 80% of all nuclear medicine imaging procedures and is vital to patient care in areas such as cardiology, oncology and neurology. Typically sourced from an aging global reactor fleet, Tc-99m has been subject to significant supply disruptions in recent years.

Ideon Technologies Inc. is a spin-off from TRIUMF (Canada's national particle accelerator laboratory) and a world pioneer in the application of cosmic-ray muon tomography. Ideon has developed a discovery platform that integrates proprietary detectors, imaging systems, inversion technologies, and artificial intelligence techniques to provide x-ray-like visibility up to 1 km beneath the Earth's surface. By detecting subsurface muons and transforming the data into reliable geophysical surveys and 3D density

maps, Ideon helps geologists identify new mineral and metal deposits with precision and confidence. They drill less and discover more with Ideon – reducing cost and risk, saving time, and minimizing environmental impact. Ideon is also expanding the application of muon tomography to use-cases in oil and gas, critical infrastructure and national security.

Frontier Sonde is a provider of neutron imaging for enhanced oil and gas recovery. It leverages the nuclear and particle physics experts, material science teams, detector excellence and advanced readout technologies.

Micromatter's unique vapor deposition methods and established capabilities in diamond-like carbon synthesis create technical synergies that will accelerate research and development objectives in several key areas.

Ikomed are developers of a patented system to reduce X-ray radiation exposure to both patients and medical staff during minimally invasive surgery.

Appendix—Response to MP Dan Mazier’s Questions

Below is in response request to table information, stemming from questions raised by MP Dan Mazier during Katheryn Hayashi’s testimony on March 21, 2023.

How much money has TRIUMF received from the Federal Government for research over the last 5 years?

TRIUMF receives its core operational funding through the Federal Budget in 5-year increments through the NRC. We additionally receive project-based funding through several Federal Government funders, including the Natural Sciences and Engineering Research Council of Canada (including through the New Frontiers in Research Fund), Western Economic Development, and Infrastructure Canada.

	2021-22	2020-21	2019-20	2018-19	2017-18	Total
Total Funding	72,464,780	67,711,372	62,930,283	63,801,935	59,873,974	326,782,344

How much has TRIUMF made from licensing of IP over the last 5 years?

	2021-22	2020-21	2019-20	2018-19	2017-18	Total
Royalties	1,961,797	2,046,781	2,937,379	3,442,101	2,245,463	12,266,328
Initial license fee & Technology fee				366,194		366,194
Total	1,961,797	2,045,782	2,937,379	3,808,295	2,245,463	12,632,522

What percentage of our Intellectual Property has been transferred to Canadian and non-Canadian companies?

TRIUMF maintains ownership of its IP and only licenses IP to companies, exclusively or non-exclusively.

As at FYE 2021-22, TRIUMF had 10 patent families in its portfolio, which consists of 22 granted patents and 32 pending applications. Of the 10 patent families, five were licensed to three different Canadian companies, none to non-Canadian companies.