



Canada's national laboratory for particle and nuclear physics and accelerator-based science
Laboratoire national canadien de physique des particules, de physique nucléaire et de science fondée sur les accélérateurs

Investing in Canada's Innovation Infrastructure

2017 Pre-Budget Consultation Submission

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Executive Summary

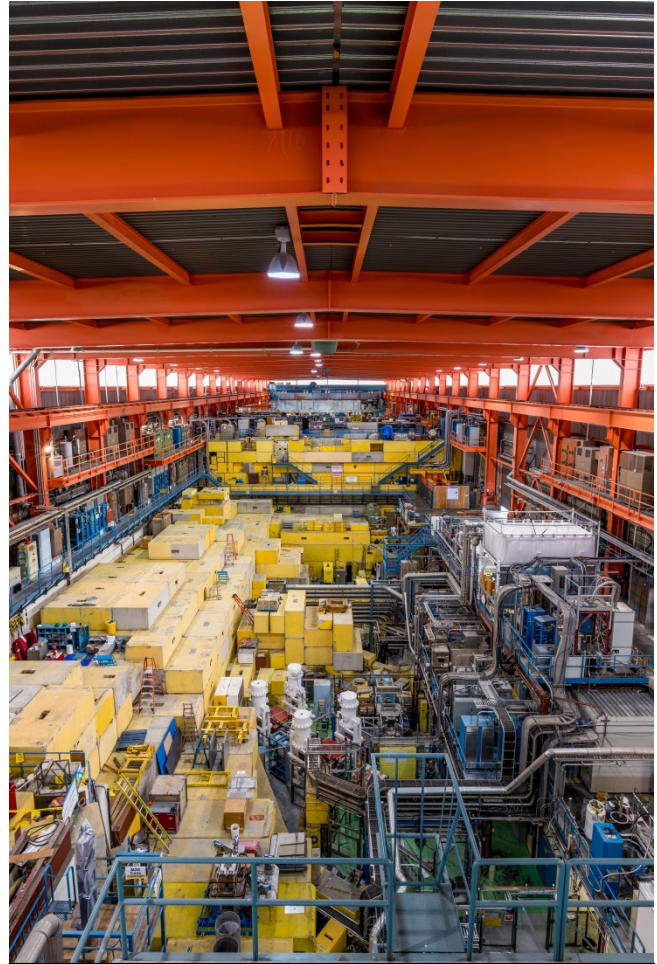
Canada's large-scale research facilities – including world-class institutions such as TRIUMF, SNOLAB, the Canadian Light Source, and many others – are foundational tools for science and innovation, essential to pushing the boundaries of what we know, and to applying that knowledge to solve societal problems. Spanning a wide range of facilities across sectors and geographical boundaries, these leading large-scale research organizations stand as shining examples of Canadian ingenuity and innovation.

Anchored in basic research missions, Canada's large-scale research facilities are platforms that support a broad range of science, applied research, commercialization, and training. Driven by science and enabled by infrastructure, the facilities cultivate clusters of talent that draw together scientists, engineers, technicians, tradespeople, and students to tackle problems that no single individual or discipline can solve independently. Within these multidisciplinary teams, the melding of ideas and diverse perspectives sparks creativity and ingenuity. Ideas evolve into innovations that benefit science, society, and business.

Federal investment is needed – now more than ever – to bolster Canada's large-scale research facilities. They are essential elements of Canada's science and innovation ecosystem, and underpin a strong and prosperous economy.

As with any enterprise, large-scale research facilities must be periodically revitalized to ensure their continued effectiveness. TRIUMF – Canada's national laboratory for particle and nuclear physics and accelerator-based science – has a track record of excellence, both in fundamental and applied research, which is a direct product of decades of investment in the laboratory's core infrastructure. In recent years, however, an extended period of budgetary stagnation has led to significant erosion of TRIUMF's critical infrastructure.

In the face of fierce global competition, this erosion has had a real and demonstrated impact on Canada's ability to innovate. At present, TRIUMF's ageing infrastructure is threatening its world-renowned nuclear medicine program – a program with a distinguished history of excellence in innovation and research. This is the basis of TRIUMF's proposal to construct the Institute for Advanced Medical Isotopes (IAMI) – a new facility that would not only renew TRIUMF's nuclear medicine program, but also significantly expand capacity beyond what is currently possible given the existing infrastructure.



TRIUMF's Meson Hall



A graduate student at work in a nuclear medicine lab at TRIUMF

Once complete, IAMI will offer unparalleled technical expertise and state-of-the-art facilities, uniting a cluster of stakeholders from across academia, industry, and government to deliver world-class breakthroughs in science and medicine. Building on the existing assets of the TRIUMF program, IAMI will enable research into new and more powerful diagnostic tools, support the development of new therapeutic treatments for cancer and other critical illnesses, and facilitate closer collaboration with industry to maximize the societal and economic benefits delivered to Canada. The facility will also

commercialize new technologies, spark entrepreneurship, innovation and job creation, and provide world-class training to future generations of talent.

IAMI offers tremendous opportunity and benefit to Canada in a critical field. TRIUMF urges the government to invest in Canada's large-scale research facilities, generating economic growth and societal benefit for all.

Leveraging Canada's World-Class Research Organizations to Create a Thriving and Innovative Economy

With global competition increasing in all sectors and markets, federal investment is necessary – now more than ever – to build Canada's research and science capacity, the foundation of a strong and innovative economy. With its diverse and well-educated population, and a network of world-class academic and research institutions, Canada is well positioned to meet the competition. One key to success is to revitalize Canada's science and innovation infrastructure to leverage this competitive advantage to generate economic growth and societal benefit for all.



A multidisciplinary team working on the TITAN experiment at TRIUMF

Canada's global edge in science is enabled by its universities and by its national network of large-scale research enterprises. Spanning a wide range of facilities across sectors and geographical boundaries, these major laboratories include world-class institutions such as TRIUMF, SNOLAB, the Canadian Light Source, and many others. These facilities are shining examples of Canadian ingenuity and innovation; they are national resources of which Canadians should be proud. Such facilities expand the frontiers of fundamental science and research, and deliver clear national benefits that include:



- attracting and retaining global talent
- training highly-qualified personnel
- inspiring the public through outreach and education
- transferring technology to society
- applying science to societal problems.

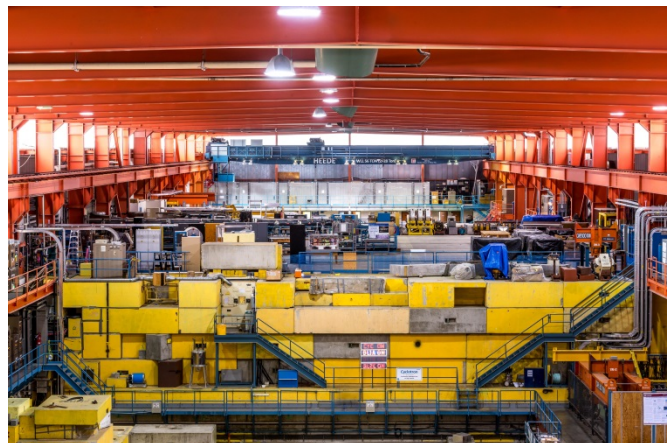
Put simply, Canada's large-scale research facilities open pathways to innovation that are not available elsewhere in the country. Infrastructure investments in Budget 2017 will help ensure that Canada extracts full value from these facilities, promoting Canadian prosperity, both now and for years to come.



A team works together to install a new experiment at TRIUMF

TRIUMF – A National Resource

TRIUMF is Canada's national laboratory for particle and nuclear physics and accelerator-based science, and also a prime example of the opportunity and capacity available within Canada's large-scale facilities. The laboratory is an international centre for discovery and innovation, advancing fundamental, applied, and interdisciplinary research for science, medicine, and business. Owned and operated by a consortium of 19 member universities from coast to coast, TRIUMF is a hub for inquiry and ingenuity that is a core pillar in the domestic innovation ecosystem, and also a central conduit for Canada's integration with the global scientific community.



Blocks shielding TRIUMF's 520 MeV cyclotron, commissioned on February 9, 1976 and delivering over 40 years of discovery for Canada

TRIUMF is home to over 500 staff and students, who together support core programs in the areas of particle and nuclear physics, accelerator research, materials science, and nuclear medicine. This broad scope provides the laboratory with the capacity to answer fundamental questions that are beyond the reach of a single Canadian institution. TRIUMF's contributions to the discovery of the Higgs particle at CERN and to the detection of neutrino oscillations at the SNO Experiment in Sudbury, ON – both Nobel Prize-winning achievements – are but two examples of the roles that laboratories like TRIUMF play in advancing fundamental science, in Canada and overseas.

TRIUMF's fundamental contribution to national prosperity comes through its role in advancing Canadian innovation. Leveraging the success of its basic science endeavors, TRIUMF has a long history of translating fundamental science research to produce innovations that benefit our country. From the transfer of superconducting technology to local industry, to the development of novel processes for the

production of life-saving medical isotopes, TRIUMF has a long history of producing economic and societal benefits for Canadians.

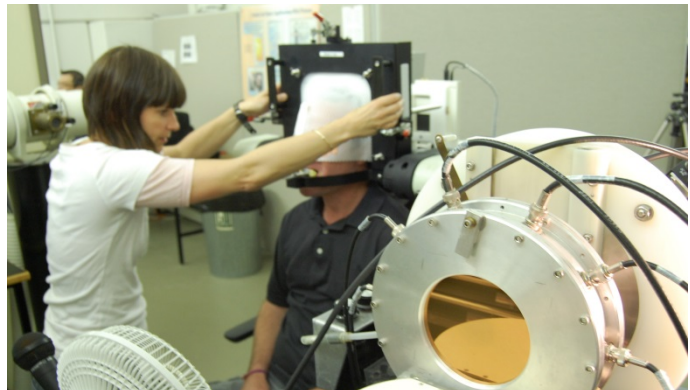
TRIUMF's track record of excellence, both in fundamental and applied research, is a direct product of decades of investments in the core infrastructure of the laboratory. Supported by a combination of federal and provincial sources, it is the foundation upon which TRIUMF's competitive advantage rests. TRIUMF's infrastructure has drawn leading talent to Canada, enabled research excellence, and served to foster economic and societal benefit in Canada.

The Need to Maintain Canada's Advantage

As with any sophisticated enterprise, large-scale research facilities must be periodically revitalized to ensure their continued effectiveness. Having endured extended periods of budgetary stagnation, many of Canada's facilities have seen significant erosion of their critical infrastructure. In a climate of fierce global competition, this has a real and demonstrated impact on Canada's ability to innovate and keep pace with global excellence.

For TRIUMF, flat operational funding from 2005 to 2015 led to a decade in which laboratory operations were placed increasingly at risk. Although recent modest increases in funding provided by the federal government allowed the laboratory to renew parts of its infrastructure, many areas are still in desperate need of attention. Of particular note, TRIUMF's ageing infrastructure is threatening TRIUMF's world-renowned nuclear medicine program.

Dating back to the 1980's, TRIUMF's nuclear medicine program has a distinguished history of excellence in innovation and research. The program has a demonstrated track record of research translation that is responsible for a number of major advances in Canadian health care, including pioneering neurological positron emission tomography (PET) imaging in Canada and also hosting the nation's only proton therapy cancer treatment centre. Most recently, the program was recognized with the 2015 NSERC Brockhouse Prize for



Preparing a patient for a proton therapy cancer treatment at the TRIUMF centre – the only such centre in Canada

Interdisciplinary Research in Science and Engineering for leading a breakthrough effort to develop and commercialize an alternative production technology for technetium-99m (Tc-99m) – a critical medical isotope currently produced at the National Research Universal (NRU) reactor in Chalk River, Ontario. This TRIUMF-led solution provides national supply security for Tc-99m, and if implemented, would prevent a repeat of the 2007 and 2009 crises that saw isotope shortages compromise patient care across the country.

Despite such accolades, TRIUMF's nuclear medicine program is facing a risky and uncertain future because of its ageing and stagnating infrastructure. Powered by a twenty-five year old medical cyclotron, TRIUMF's nuclear medicine program needs essential upgrades to allow it to continue to serve Canadians



and the wider scientific community. This is the basis of TRIUMF's proposal to construct the Institute for Advanced Medical Isotopes (IAMI) – a new facility that would not only renew TRIUMF's nuclear medicine program, but also significantly expand capacity beyond what is currently possible given the existing infrastructure.

The Future: The Institute for Advanced Medical Isotopes

Envisioned as the future of TRIUMF's nuclear medicine program, the Institute for Advanced Medical Isotopes (IAMI) will provide the infrastructure required to keep the laboratory – and by extension Canada – at the cutting edge of nuclear medicine. Leveraging \$11.0M in committed support, TRIUMF and its research partners – which include the University of British Columbia, the BC Cancer Agency, and Simon Fraser University – are requesting \$24.5M in federal and provincial support to construct this facility, which will serve as a hub to grow Canada's capacity in this important field of medicine.

Located at TRIUMF, the proposed IAMI facility will fulfil two core purposes: 1) provide clinical partners with a secure supply of Tc-99m and other short-lived isotopes, and 2) enable cutting-edge research into next-generation radiopharmaceuticals for both diagnostic and therapeutic use. To enable this dual mandate, the facility will include a new TR24 medical cyclotron, an underground vault to house the machine, multiple isotope target stations, and a suite of state-of-the-art laboratories suitable for research and production.



TRIUMF team members working in the laboratory's nuclear medicine facilities

Once complete, IAMI will offer unparalleled technical expertise and state-of-the-art facilities, uniting stakeholders from across academia, industry, and government to deliver world-class breakthroughs in science and medicine. Building on the existing strengths of the TRIUMF program, IAMI will enable the research into new and more powerful diagnostic tools, support the development of new therapeutic treatments for cancer and other critical illnesses, and facilitate closer collaboration with industry to maximize the societal and economic benefits delivered to Canada. IAMI will also commercialize new technologies, spark entrepreneurship, innovation and job creation, and provide world-class training to the future generations of talent.

IAMI stands to serve as an enduring example of the Government of Canada's commitment to support our nation's research and innovation enterprises. It will further Canada's long legacy of excellence in nuclear medicine research, and hopefully set the stage for other major investments in revitalizing infrastructure across Canada's large-scale science facilities.

If Canada is to maintain its standing as a leading force in global science – and enjoy the concomitant economic and societal benefits – the nation must invest in its large-scale research infrastructure. IAMI offers tremendous opportunity and benefit to Canada in a critical field. Conversely, without IAMI, Canada will lose significant capacity and talent in an area where it is presently a world leader.



A graduate student operates a hot cell in a nuclear medicine lab at TRIUMF

RECOMMENDATION

TRIUMF urges the government to invest in Canada's large-scale research facilities. In particular, this request seeks \$24.5 million in federal and provincial support to construct IAMI, the Institute for Advanced Medical Isotopes. IAMI will revitalize TRIUMF's nuclear medicine infrastructure, which will advance prosperity and deliver tangible economic and societal benefits to Canada.