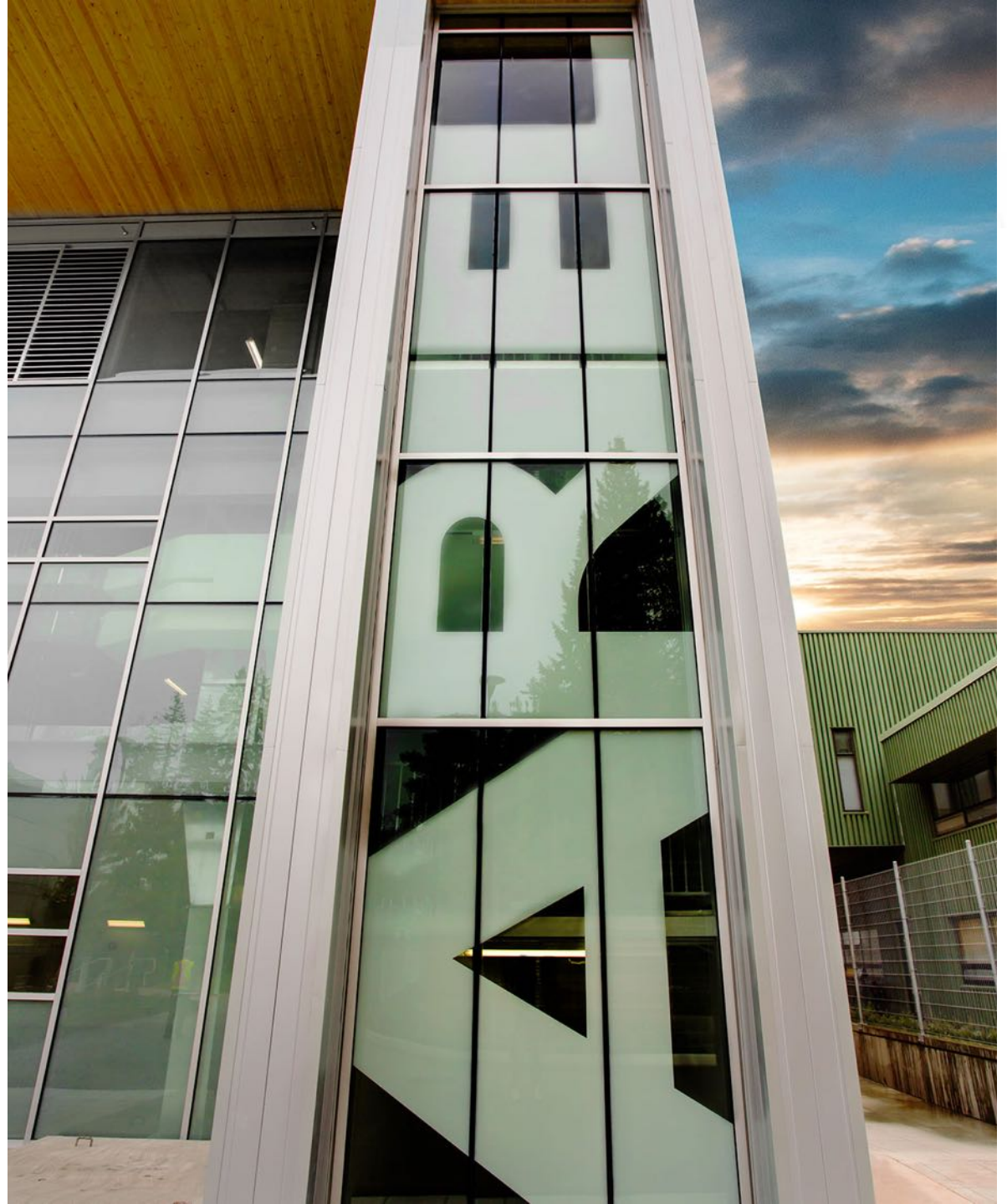




TRIUMF Report

CAP Congress
June 14, 2018

Jonathan Bagger
Director





TRIUMF

50 anniversary
anniversaire



A woman with long brown hair, wearing a dark grey cardigan and a patterned skirt, is kneeling on a yellow surface in a laboratory. She is focused on adjusting a circular metal component with a pair of pink-handled pliers. Several other similar components are scattered around her, some with pink safety caps. In the background, other people are visible, including a man in a dark blue lab coat and another in a grey sweater and jeans. The setting is a busy, well-lit laboratory environment.

TRIUMF is Canada's
particle accelerator centre

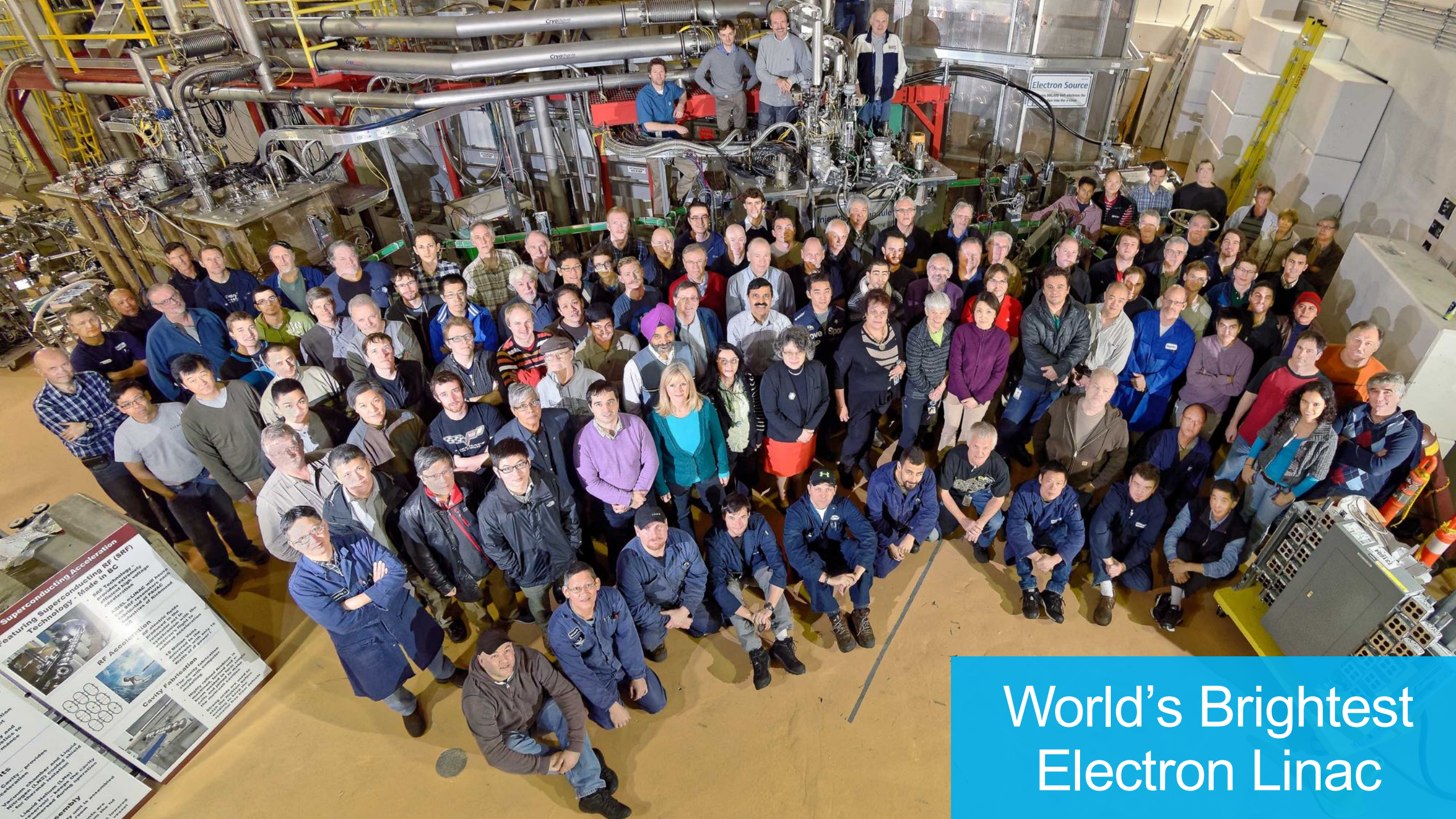
What is TRIUMF? A World-Class Laboratory

TRIUMF is a place where teams of researchers collaborate on projects that are too large and too complex for any single institution

- **TRIUMF is home to a billion-dollar multidisciplinary research infrastructure**
- **TRIUMF enables the Canadian S&T community to carry out internationally recognized cutting-edge research**



World's Largest Cyclotron



Superconducting Acceleration
Featuring Superconducting RF (SRF)
Technology - Made in BC

SRF Technology is the most advanced technology for the world's most powerful accelerators. It provides the highest energy and most efficient acceleration of particles.

RF Acceleration
SRF Technology uses superconducting cavities to accelerate particles. The cavities are made of niobium and are cooled to near absolute zero. This allows them to store energy for long periods of time and to provide a very high quality factor. The result is a very efficient and powerful acceleration system.

Cavity Fabrication
The world's most advanced cavity fabrication facility is located in Vancouver, BC. This facility is the only one in the world that can fabricate superconducting cavities for the world's most powerful accelerators. The facility is equipped with state-of-the-art machinery and is staffed by highly skilled technicians.

World's Brightest
Electron Linac

Large-Scale

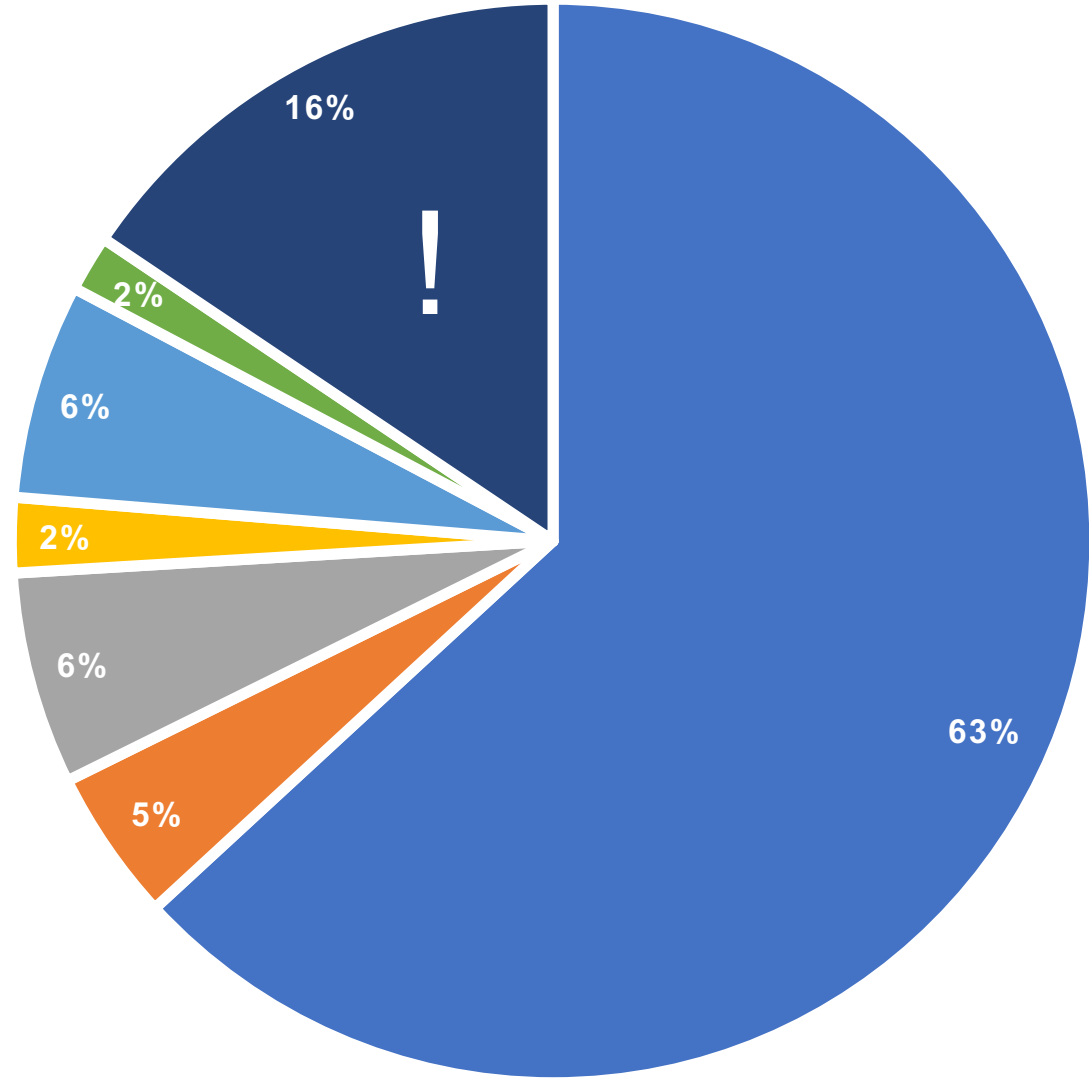
FY17/18:

\$95.2M Total Funding

76% Federal (63% NRC)

535 Employees (407 NRC)

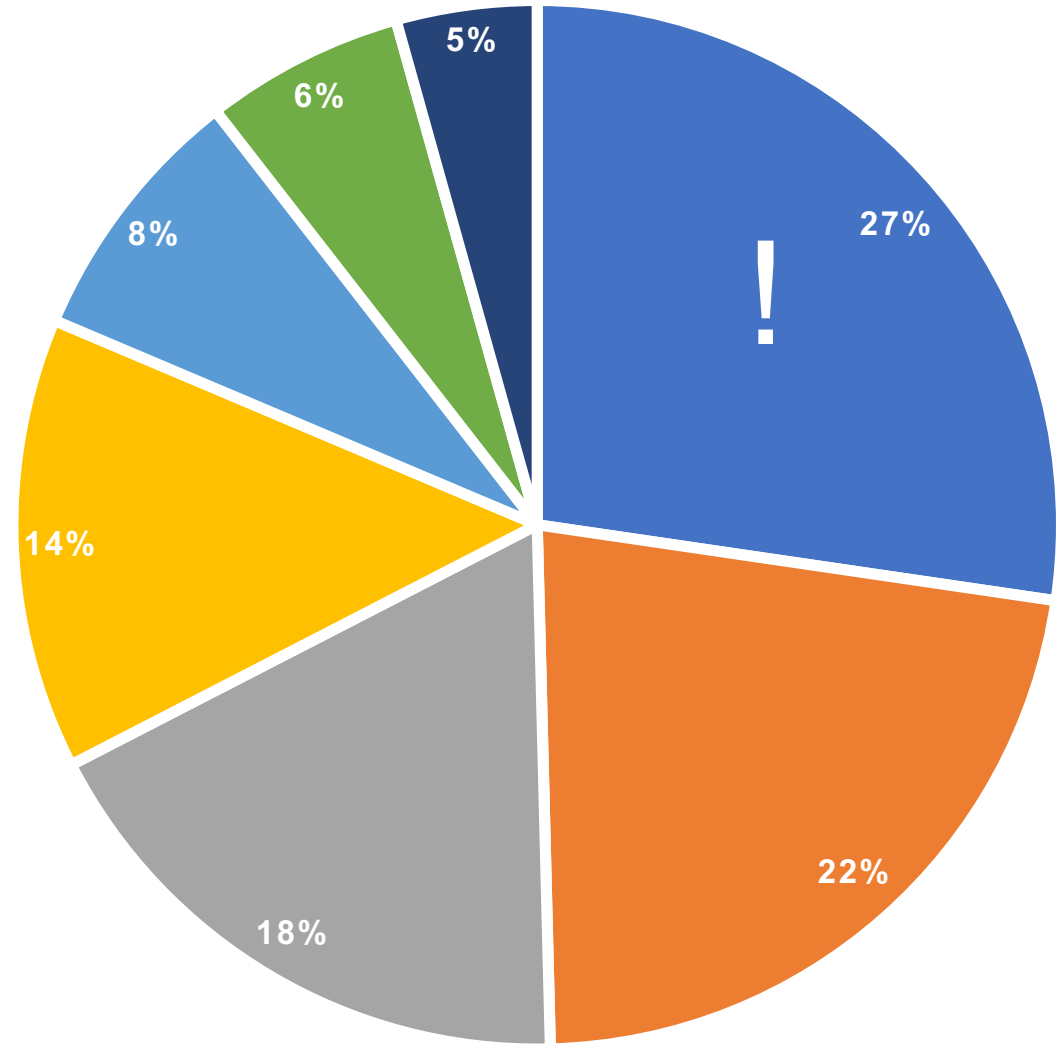
Revenue Sources (2015-2020)



- Federal- NRC
- Federal- CFI
- Federal- N SER C
- Federal- Other
- Provincial
- International
- Private Sector

Multidisciplinary

Scientific Users and Visitors by Field (FY17/18)



FY17/18:

875 Scientific Users and Visitors

- Nuclear Physics
- Irradiation Services
- Materials Science
- Particle Physics
- Life Sciences
- Theory
- Accelerator

What is TRIUMF? A Network Hub

TRIUMF links leading universities across Canada with each other and with national and international facilities around the world

- **TRIUMF is a magnet for people and ideas – for attracting, training, and retaining talent for Canada**
- **TRIUMF allows Canadians to compete at scale in the global scientific enterprise**

20 Member Universities

University of Alberta
University of British Columbia
University of Calgary
Carleton University
University of Guelph
University of Manitoba
McGill University
McMaster University
Université de Montréal
University of Northern
British Columbia
Queen's University
University of Regina
Saint Mary's University
Université de Sherbrooke
Simon Fraser University
University of Toronto
University of Victoria
Western University
University of Winnipeg
York University

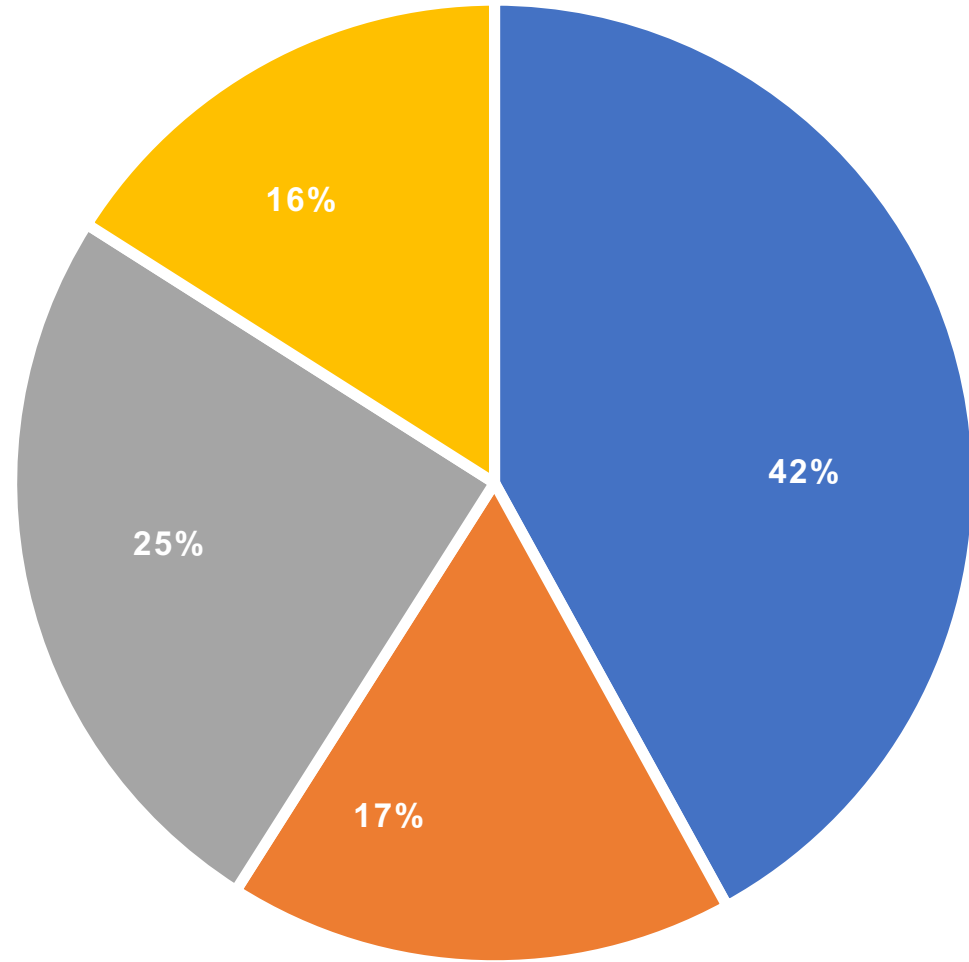


What is TRIUMF? A Global Brand

TRIUMF is unique in Canada, and known world-wide as a Canadian centre of excellence

- **TRIUMF serves as a scientific ambassador, advancing Canada's interests at home and around the world**
- **TRIUMF is a model for engagement with the commercial sector**

Scientific Users and Visitors by Region (FY17/18)



■ Canada ■ Asia ■ Americas ■ Europe

Global Destination

FY17/18:

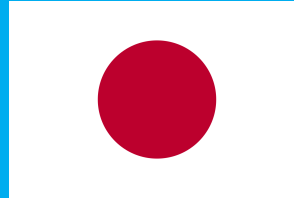
875 Scientific Users and Visitors

50+

international
agreements



CERN
Europe



KEK / J-PARC
Japan



VECC
India



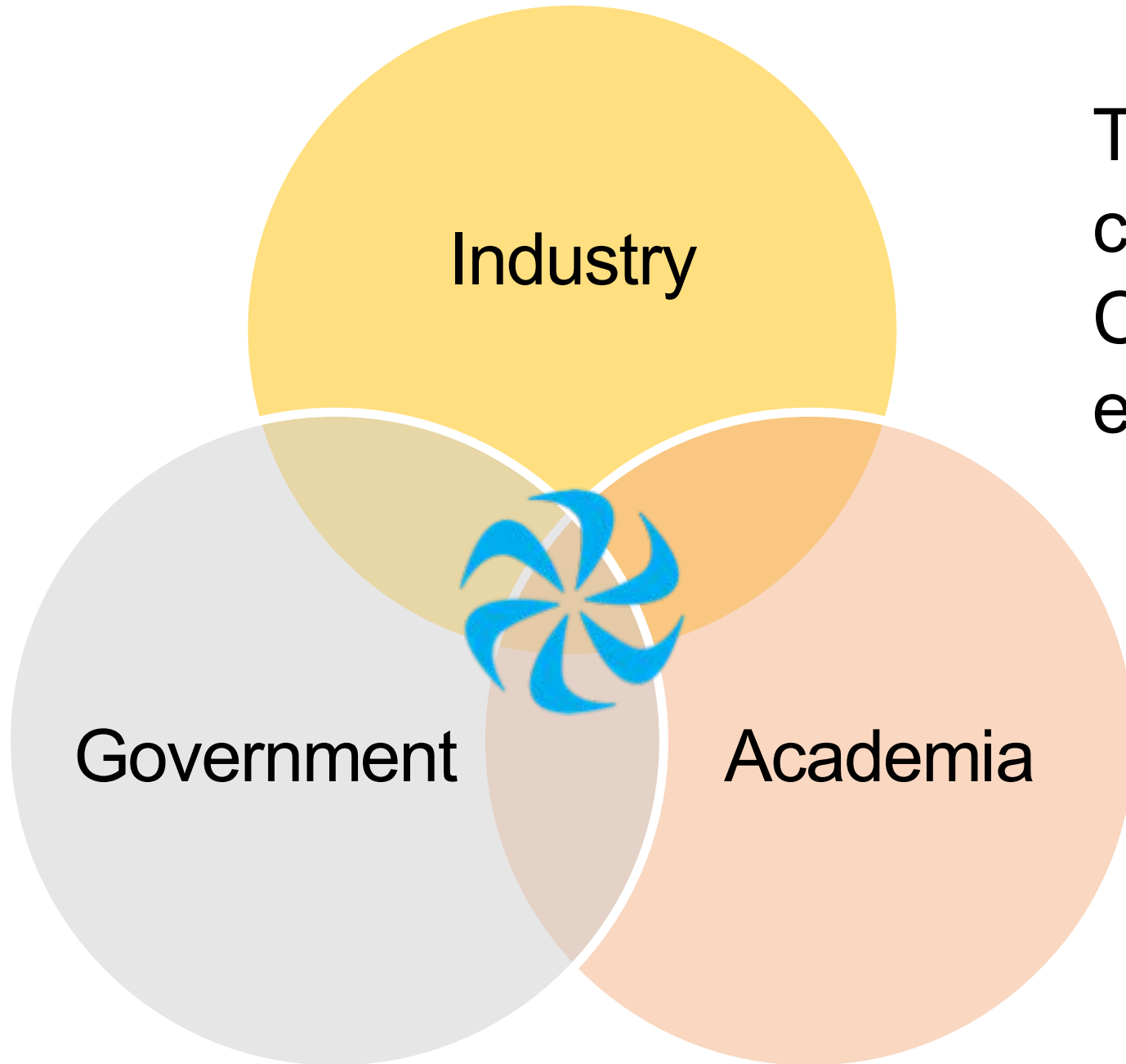
Helmholtz Association
Centres
Germany



Department of Energy
Laboratories
USA

Commercial Partners





TRIUMF plays a critical role in the Canadian innovation ecosystem

Five-Year Plan

Purpose

- Articulate TRIUMF's vision and mission
- Communicate goals and priorities for 2020-2025 & beyond
- Lay out an action plan, including a high level budget
- Secure base funding for operations

Audience

- Community
- International Peer Review Committee
- NRC
- Government of Canada

Timeline

- Consultation and internal planning through 2017
- Main themes defined Spring 2018
- Report to be released in September 2018

Consultation

- **Internal strategic planning exercises**
- **Broad community consultation**
 - Science Week 2017 and 2018
 - CAP Congress
 - Submissions to PPAC, Policy and Planning Advisory Committee

Governance

- **Executive Committee** drives planning
- **Steering Committee** oversees the process
- **PPAC** evaluates projects and commitments
- **ACOT** reviews main elements of the plan
- **Board of Management** approves the plan

Steering Committee

Jonathan Bagger

David Castle

Rod Clark

Robert Dunlop

Kathryn Hayashi

Ritu Kanungo

Oliver Kester

Suzanne Lapi

Kyle Leach

Graeme Luke

Scott Oser

Nigel Smith

Brigitte Vachon

Michelle Wong

Director

Vice President Research

Division Deputy

Former ADM (retired)

President and CEO

Professor

ALD - Accelerator Division

Associate Professor

Assistant Professor

Professor and Chair

Professor

Director

Associate Professor

Director, Research

TRIUMF

University of Victoria, Vice Chair TRIUMF Board

Lawrence Berkeley Lab, Former SAP-EEC Chair
(Industry Canada)

TRIUMF Innovations

Saint Mary's University

TRIUMF

University of Alabama, Birmingham

Colorado School of Mines, TUEC Chair

McMaster University

University of British Columbia

SNOLAB

McGill University

University of British Columbia

Writers

Strategic Plan

- **Clare Walker**
- Editor for the Naylor report and numerous Council of Canadian Academy reports

Implementation Plan

- **Ian O'Neill**
- Science-communicator-in-residence for recent ICFA meeting in Ottawa
- PhD astrophysics, science communicator, and science journalist

Facilities, Collaborations and Science Highlights

- **Jacob Berkowitz**
- Virtual Writer-in-Residence at the Institute for Science, Society and Policy at the University of Ottawa

Timeline

- January, 2017 Town Hall Meeting – ARIEL
- May, 2017 PPAC RFP
- July, 2017 Science Week
- October, 2017 PPAC Deadline
- November, 2017 PPAC Review
- December, 2017 PPAC Report
- January 15 All Hands Meeting – 50th
- February 2 Town Hall Meeting – PPAC
- February 6 Questionnaire
- February 9 FYP Steering Committee
- April 6 Board Teleconference
- April 17 Community Report
- April 18 FYP Steering Committee
- April 20 ACOT – NRC
- May 31 Board Meeting
- June 6 ACT – Interagency Review
- **June 14** **CAP Congress / Community Feedback**
- July 16-19 Science Week
 - 50th Anniversary Symposium
 - ARIEL Science Workshop
 - TRIUMF Users' Group AGM
 - FYP Steering Committee
- September Board Approval
- September Plan Release
- Late September FYP Steering Committee
 - Red Team Review
- October 2-3 Ottawa Lobbying Day
- November ACOT – NRC
- November 30 Board Meeting
- November 13-15 International Peer Review

Science Week 2018

July 16 – July 20

This year, will include

- 50th Alumni Event
- 50th Science Symposium
- ARIEL Science Workshop
- TRIUMF User's Group Annual General Meeting

Daily Highlights:

Monday, July 16 th	Tuesday, July 17 th	Wednesday, July 18 th	Thursday, July 19 th
<ul style="list-style-type: none">• 50th Anniversary Alumni Event	<ul style="list-style-type: none">• 50th Anniversary Science Symposium and Celebration	<ul style="list-style-type: none">• ARIEL Science Workshop	<ul style="list-style-type: none">• TRIUMF User's Group Annual Meeting

International Peer Review

International Peer Review Committee

Chaired by Dr. Julia Phillips,
former VP and CTO at
Sandia National Laboratories

November 13-15, 2018



Vision

Our vision is for Canada to lead in science, discovery, and innovation, improving lives and building a better world.

Mission

Our mission is to serve as Canada's particle accelerator centre. We advance isotope science and technology, both fundamental and applied. We collaborate across communities and disciplines, from nuclear and particle physics to the life and material sciences. We discover and innovate, inspire and educate, creating knowledge and opportunity for all.

Values

Excellence & Integrity

- We have a passion for excellence in all that we do.
- We are decisive, bold, courageous, and compassionate.
- We take responsibility for our actions, our commitments, and our contributions to the larger community.

Safety & Accountability

- We respect the health and safety of our workers, our visitors, and our neighbours.
- We build quality into our processes and seek continual improvement in all of our systems.
- We embrace transparency and authenticity, and hold ourselves and each other accountable.

Equity & Inclusion

- We empower our workforce and foster an inclusive work environment, enriching our science and our community.
- We value teamwork and open communication to ensure that everyone belongs and all voices are heard.
- We respect each other, take care of each other, and support the success of all.

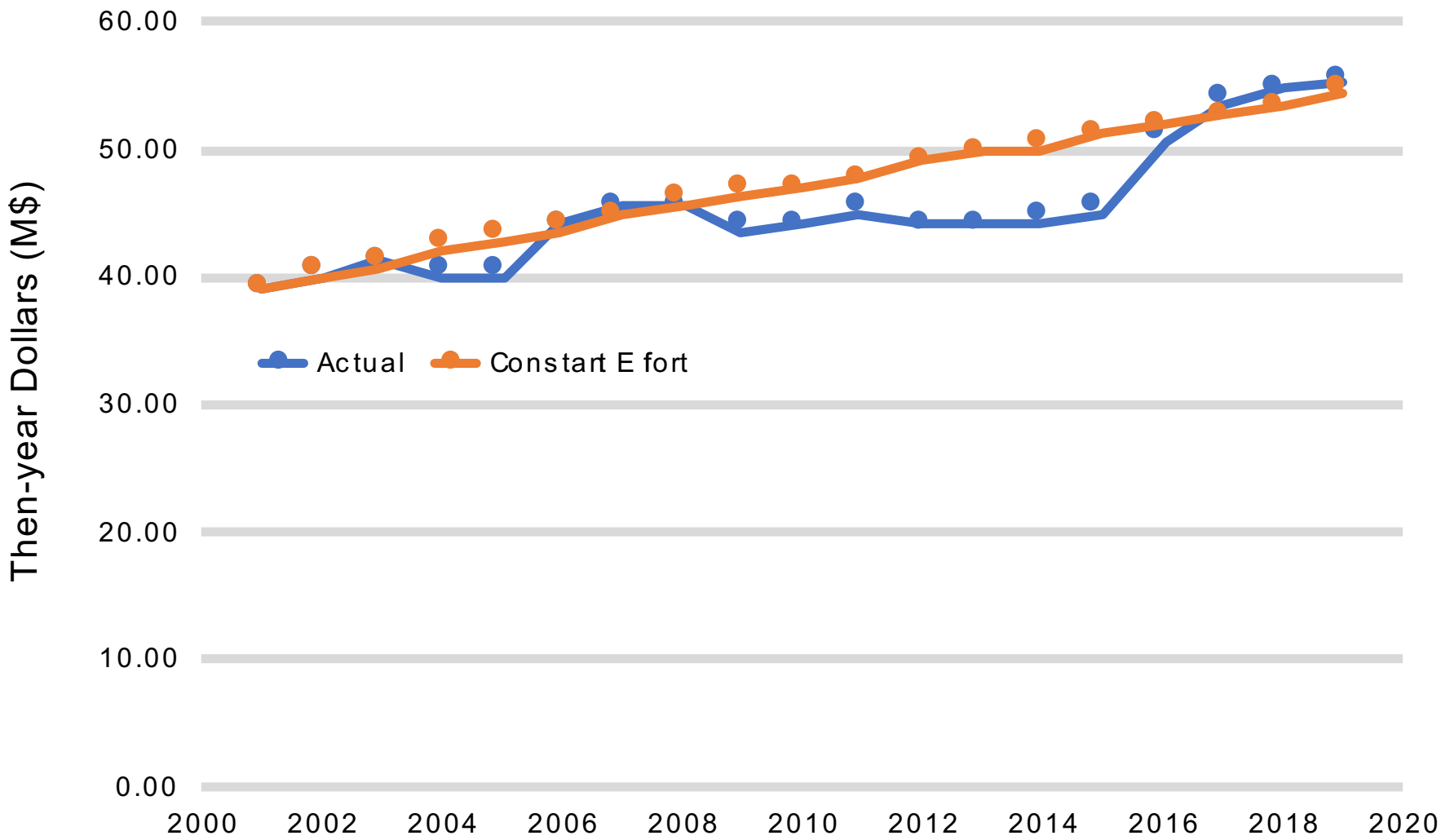
PPAC

Corina Andreoiu	Simon Fraser University	Rachid Ouyed	University of Calgary
Jean-François Arguin	Université de Montréal	Frank Prato	Western University
David Asgeirsson	TRIUMF Innovations	Jeffrey Quilliam	Université de Sherbrooke
Sampa Bhadra	York University	Ralf Schirrmacher	University of Alberta
Paul Garrett	University of Guelph	Jeff Sonier	Simon Fraser University
Darren Grant	University of Alberta	Vesna Sossi	University of British Columbia
Brigitte Guérin	Université de Sherbrooke	Hirohisa Tanaka	University of Toronto
Garth Huber	University of Regina	Manuella Vincter	Carleton University
Hae-Young Kee	University of Toronto		
Robert Kowalewski	University of Victoria (Chair)		
Alison Lister	University of British Columbia		
Andrew MacFarlane	University of British Columbia		
Juliette Mammei	University of Manitoba		
Tony Noble	Queen's University		
Rachid Ouyed	University of Calgary		

PPAC Summary

- Prioritize ARIEL and IAMI as foundational for the future of TRIUMF
- Focus on the existing multi-disciplinary, high-impact science portfolio, including strong on-site and off-site components
- Make balanced investments into core infrastructure, science support, and selected new opportunities, to maximize the benefit from ARIEL and IAMI
- Position TRIUMF for its long-term future by further developing particularly promising new ideas without affecting the efforts on ARIEL and IAMI

NRC Funding History: 2000-2020

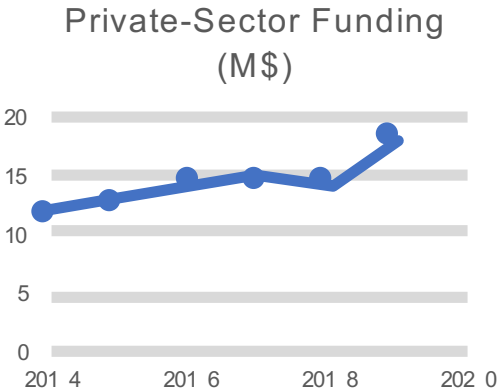
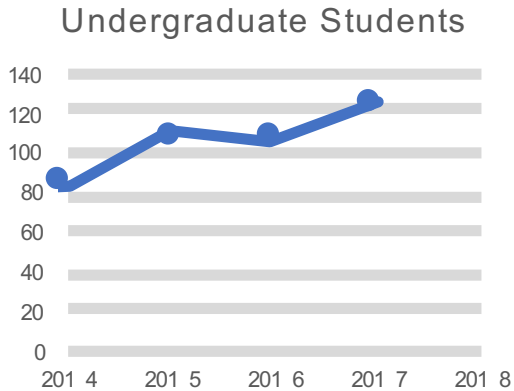
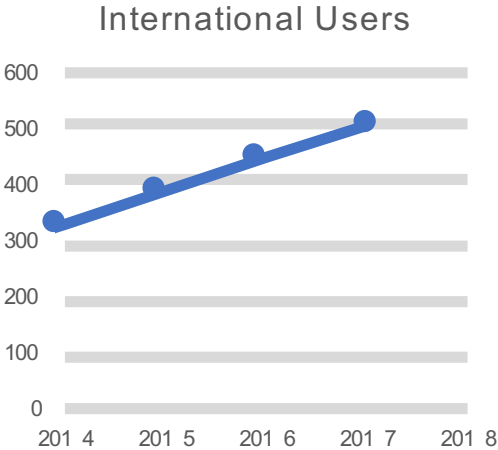
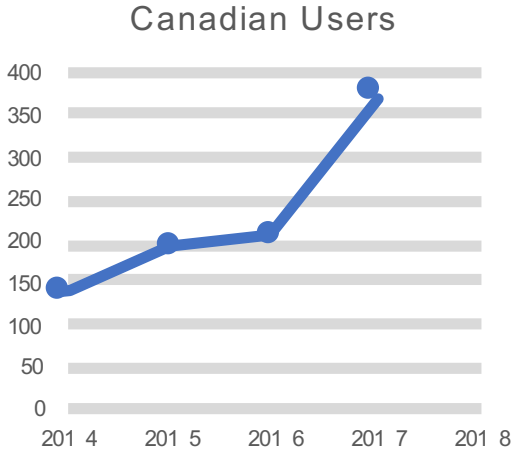


TRIUMF delivers value to Canada across three critical dimensions

- Science and Technology
- People and Skills
- Innovation and Collaboration

This funding delivered impact ...

- Science and Technology
- People and Skills
- Innovation and Collaboration



... and positions Canada to seize the moment

- World-Class Facilities
 - ARIEL and IAMI at TRIUMF
- Great Scientific Opportunity
 - Nuclear Astrophysics, Particle Cosmology, Nuclear Medicine, Quantum Materials, Data Sciences, Quantum Computing
- Canadian Values
 - Global leadership in science and technology

NRC Request

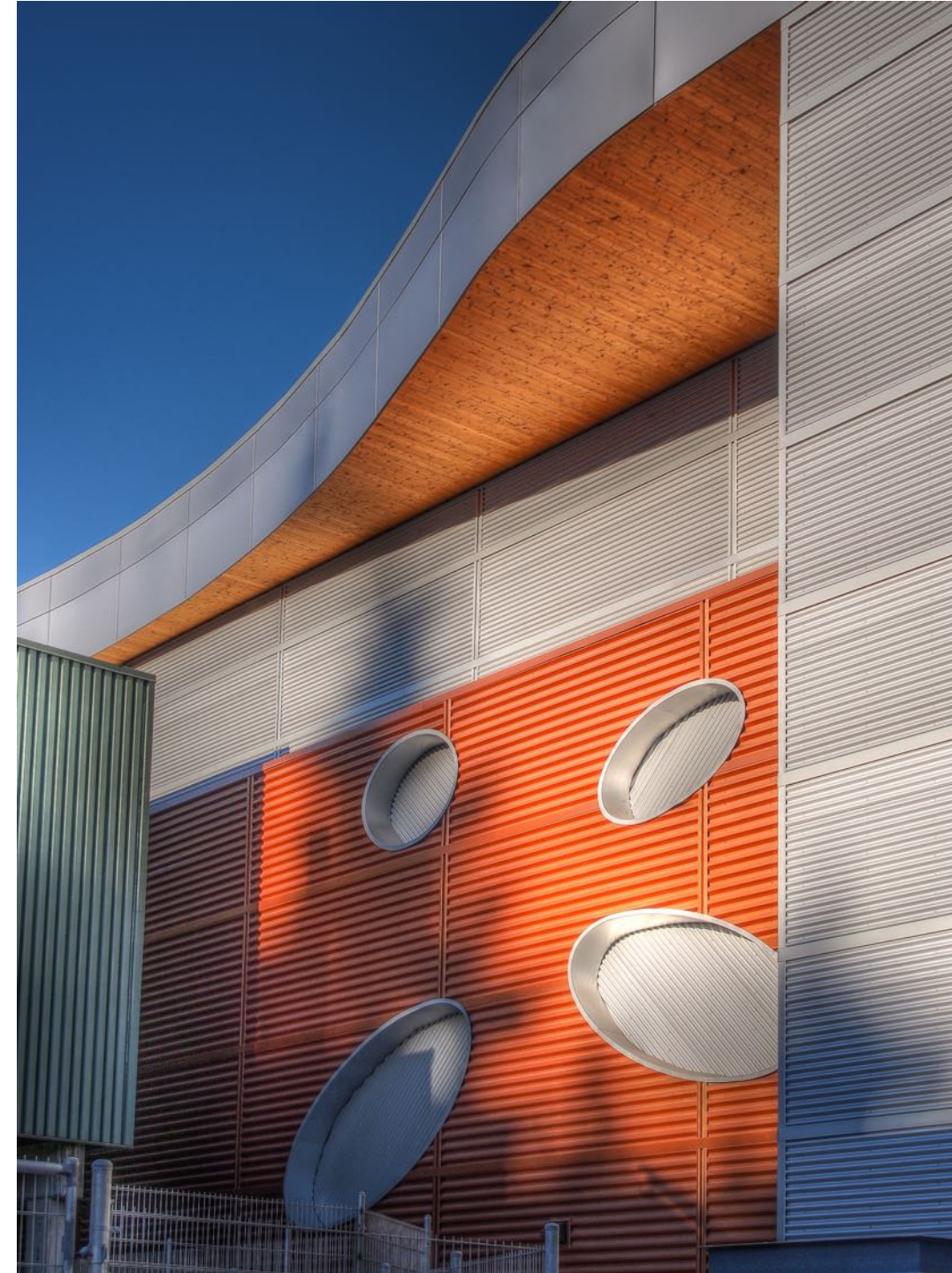
- \$320M over five years (bottom-up calculation; \$5M/year increase over inflation)
 - This investment will increase impact along all three dimensions ...
 - Science and Technology
 - People and Skills
 - Innovation and Collaboration
 - ... and position TRIUMF and Canada for decades more impact to come

Science and Technology

- Goal: Make groundbreaking discoveries across TRIUMF's multidisciplinary research portfolio
 - *Why? To strengthen Canadian leadership in science and technology*
- Goal: Reinforce TRIUMF as a globally leading particle accelerator centre
 - *Why? To make Canada a destination of choice for talent, ideas, and international partnerships*

Science and Technology

- Complete and operate ARIEL
– Advanced Rare Isotope Laboratory
 - > \$150M facility – most powerful of its type in the world
 - Supported by CFI, 5 provinces, and 21 universities
 - Will triple TRIUMF's rare isotope capabilities, enabling more science, more training, and more commercial activity



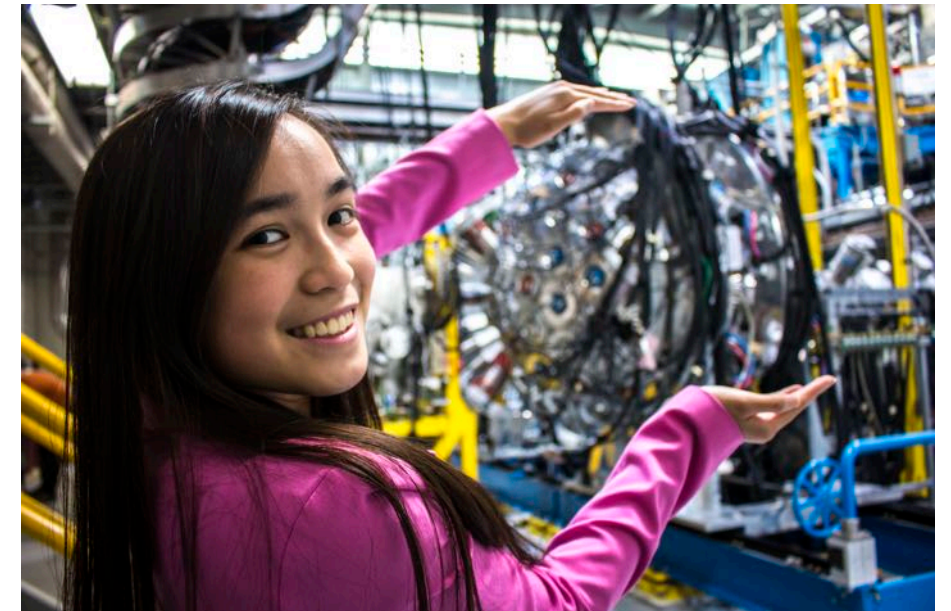
Science and Technology

- Launch IAMI – Institute for Advanced Medical Isotopes
 - > \$35M research and production facility supported by WED, INFC, British Columbia, and institutional partners
 - TR-24 cyclotron with state-of-the-art laboratories
 - Will create a global centre for nuclear medicine research and development



Science and Technology

- Strengthen TRIUMF itself
 - Ensure equity, diversity, and inclusion underpin every activity
 - Create programs to attract, retain, and develop talent
 - Renew site infrastructure to improve productivity (cyclotron, ISAC, beamlines for materials and commercial applications)



Science and Technology

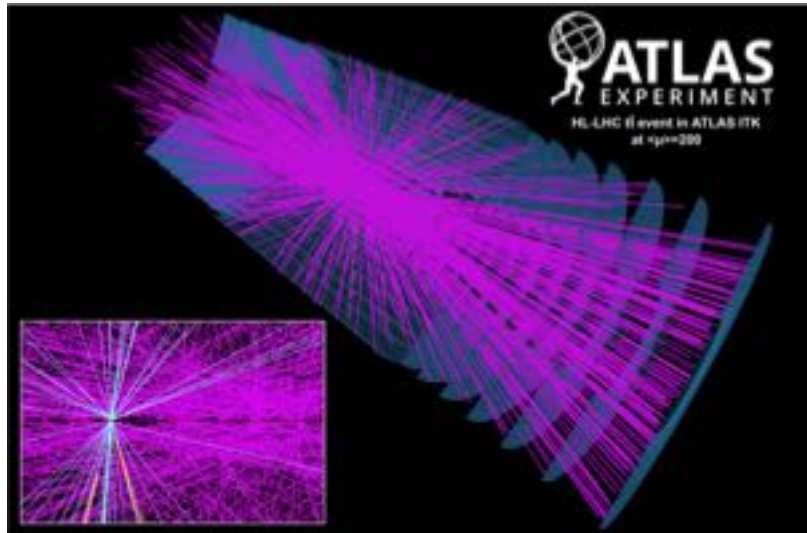
SAP Science Priorities

- Complete ARIEL and ramp science program up to full capacity (triple RIB production)
- Support high-impact science
 - On site: ISAC/ARIEL, UCN, Theory
 - In Canada: DEAP, SuperCDMS, nEXO at SNOLAB
 - Abroad: ATLAS, ALPHA, NUPRISM/HyperK/DUNE
- Make balanced investments into core infrastructure, science support, and selected new opportunities, to maximize the benefit from ARIEL and IAMI
 - ISAC, Cyclotron, BL1A, Detector Facilities, Site Master Plan
- Position TRIUMF for its long-term future by further developing particularly promising new ideas without affecting the efforts on ARIEL and IAMI
 - To be determined via community initiatives in future CFI competitions

Science and Technology

■ Nuclear Medicine

- Alzheimer's Disease
- Parkinson's Disease
- Addiction
- Traumatic Brain Injury
- Cancer



■ Quantum Materials

- UBC Quantum Matter Institute (CFREF)
- Proposed Pan Canada Laboratory for Quantum Materials and Devices

■ Data Sciences / Quantum Computing

- ATLAS – CERN
- Helmholtz Association – Germany
- Various industry partners

People and Skills

- Goal: Become a hub for interdisciplinary education and training
 - *Why? To prepare Canadians to compete in the knowledge and innovation economy*
- Goal: Inspire Canadians to discover and innovate
 - *Why? To increase access and opportunity, and strengthen Canadian society*

People and Skills

- Strengthen Canada's STEM pipeline
 - Expand TRIUMF's unique post-secondary education programs, broadening eligibility and offering a quality, hands-on, real-world experience
 - Undergraduates, Engineers in Training, Apprentices ...
 - Promote diversity and inclusion, especially women, indigenous peoples, and other under-represented minorities
 - Targeted recruiting
 - Special scholarships
 - Relationship building

People and Skills

- Strengthen Canada's STEM pipeline
 - Better prepare postdocs and graduate students for careers outside academia
 - Entrepreneurship education
 - Communications training
 - Project management experience
 - Data science training
 - Leverage partnerships to attract international students and postdocs to Canada



People and Skills

- Empower future generations of discoverers and innovators
 - Take TRIUMF's outreach program nationwide
 - Establish TRIUMF as a hub for science communication and public engagement
 - Partner with like-minded organizations to carry TRIUMF's story into communities across Canada
 - Join with the BC Digital Supercluster to use VR and other digital technologies to engage urban and rural communities
 - Offer professional development experiences to teachers, science communicators, as well as students and postdocs



Innovation and Collaboration

- Goal: Translate knowledge and discovery into innovation
 - *Why? To develop new technologies to support business-led innovation and improve the lives of Canadians*
- Goal: Increase national and international collaboration
 - *Why? To strengthen Canadian competitiveness in global discovery and innovation*

Innovation and Collaboration

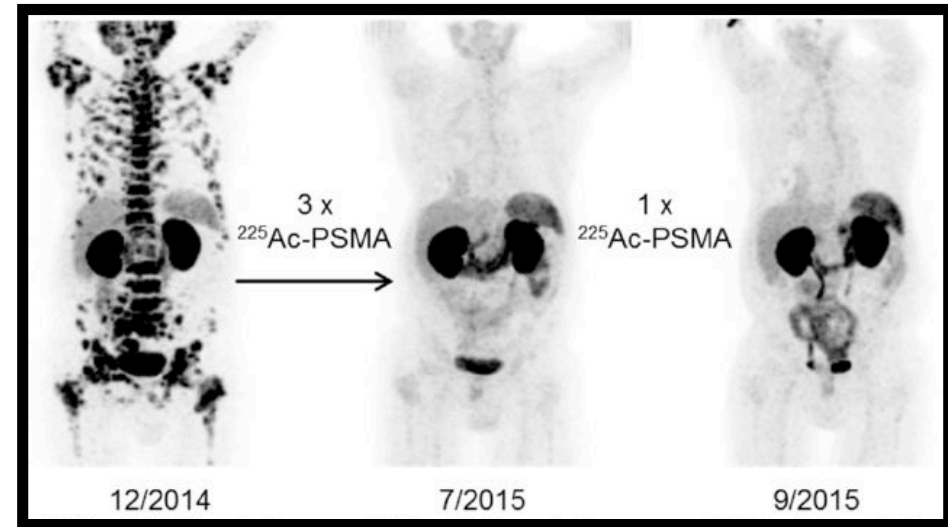
- Expand TRIUMF Innovations into a national centre for commercializing disruptive technologies that cross multiple verticals
 - Medicine and drug development
 - Materials development and testing
 - Accelerator and detector technologies
 - Mining and natural resources
 - Border security
 - Oil and gas exploration
 - Data sciences

Example: PET Rock, using PET medical isotope technologies to improve mineral processing and metal extraction



Innovation and Collaboration

Example: Alpha therapies for cancer treatment, joint venture between TRIUMF Innovations and Canadian Nuclear Laboratories. Currently in talks with Nordion, Centre for Drug Research Development, and others....



Canadian Nuclear
Laboratories



Nordion™
A Sotera Health company



CDRD

THE CENTRE FOR DRUG
RESEARCH & DEVELOPMENT

Innovation and Collaboration

- Expand TRIUMF's national and international networks
- Leverage TRIUMF's networks to create teams to solve real-world problems and deliver tangible benefits to Canadians
 - Universities
 - Sister laboratories
 - Nongovernmental entities
 - Federal and provincial governments
 - Industrial partners



TRIUMF, McMaster, Western, UBC

NSERC Brockhouse Award

Summary

- TRIUMF's \$320M plan leverages past investments by government and builds on the laboratory's strong brand and global network to deliver more top-tier science, training, and innovation to Canada
- The plan will support TRIUMF's efforts to build an equitable, diverse, and inclusive laboratory. By fully exploiting ARIEL and IAMI, it will take TRIUMF to the next level and advance Canada along all three critical dimensions
 - Science and Technology
 - People and Skills
 - Innovation and Inspiration
- The plan ensures that TRIUMF will remain a jewel of which Canada can be proud

Governor General Julie Payette



“It matters, what I have just seen in a very few minutes here at TRIUMF. I knew about TRIUMF and it still amazes me seeing you today, that you are at the very forefront of the frontier of knowledge and yet you are very practical. You are so important to help people every day and for this I hope you are very proud.”
March 22, 2018

Thank you
Merci

www.triumf.ca

Follow us @TRIUMFLab

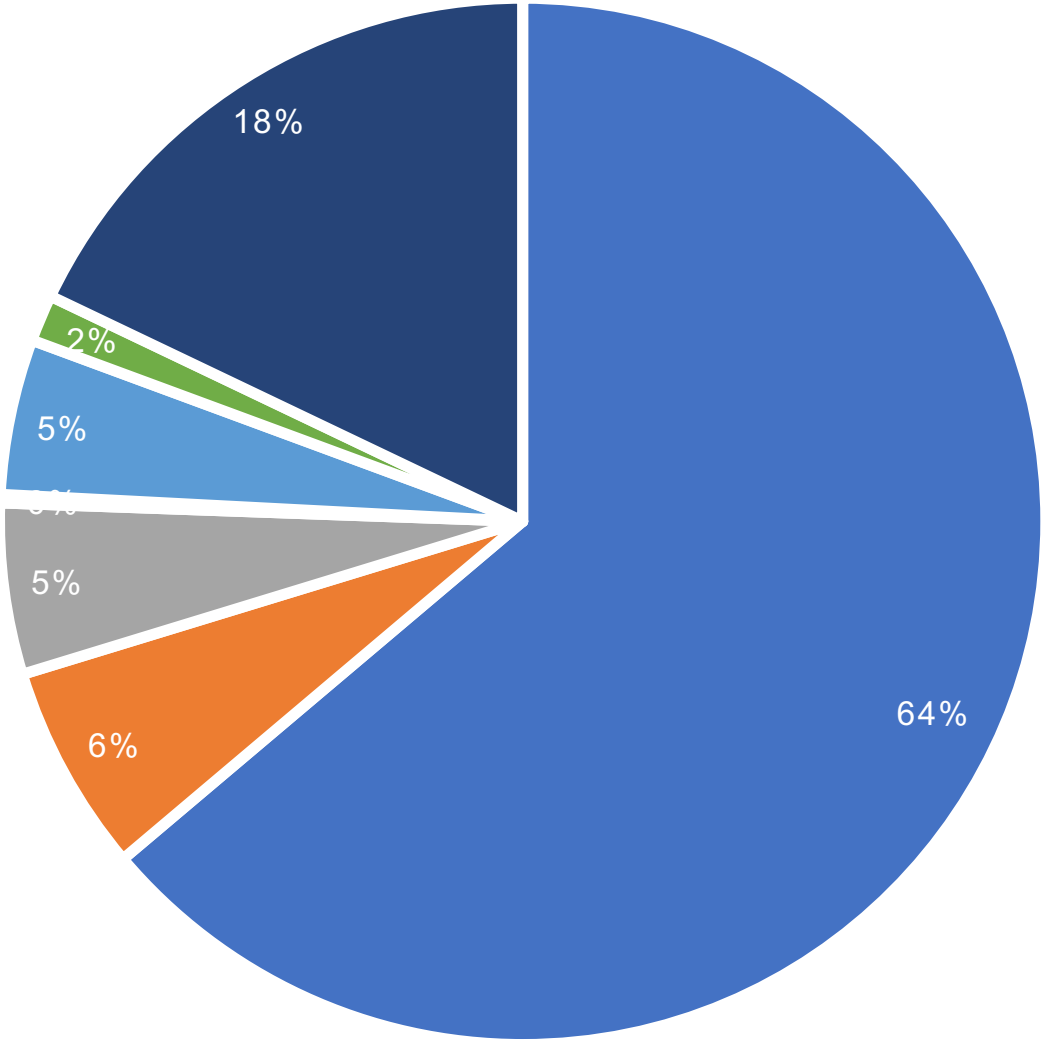


Backup

Projected Revenue by Source (2020-2025)

Does not include new contributions from province, philanthropy or business partnerships

Total: \$501M

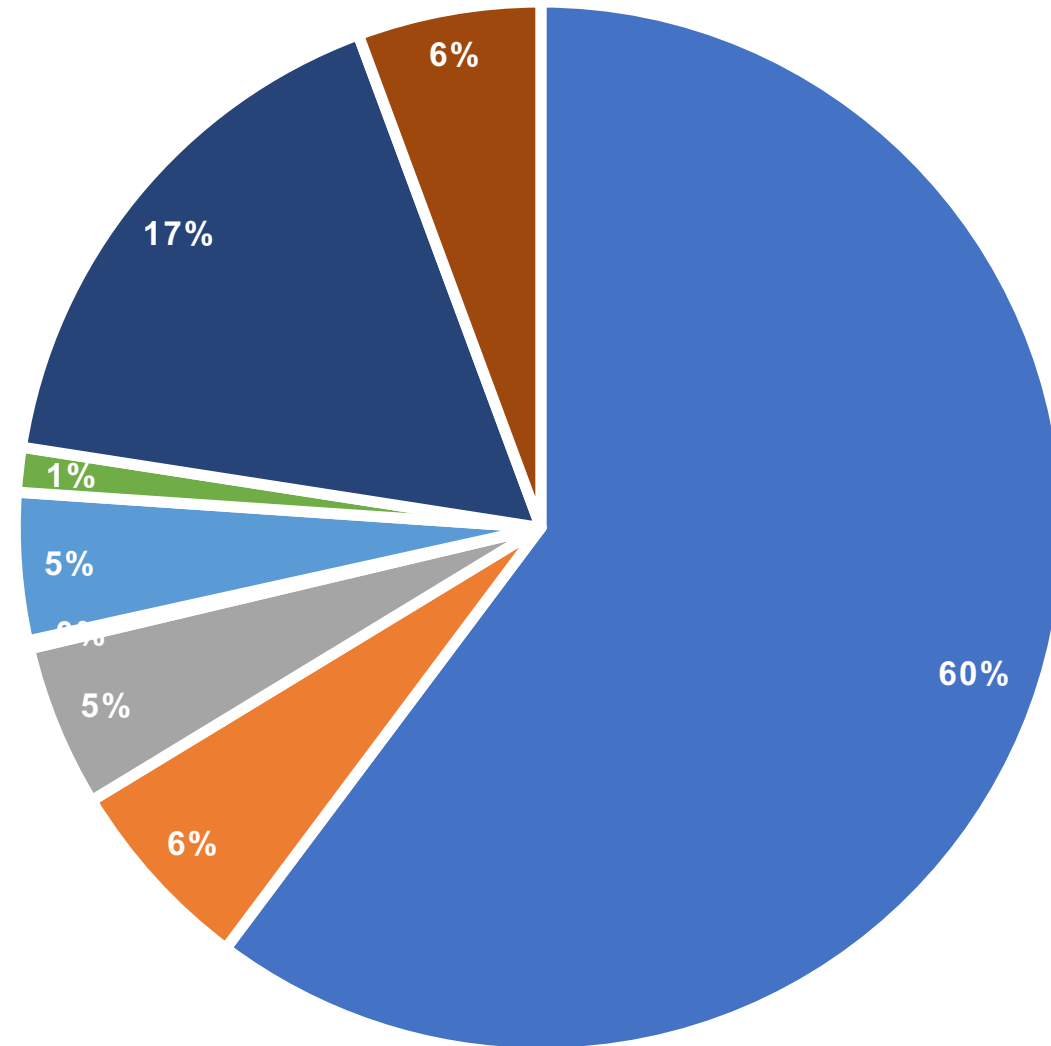


- Federal- N RC
- Federal- C FI
- Federal- N SER C
- Federal- Other
- Provincial
- International
- Private Sector

Projected Revenue by Source (2020-2025)

Includes \$30M of potential new contributions from province, philanthropy or business partnerships

Total: \$531M



- Federal- N RC
- Provincial
- Federal- C FI
- International
- Federal- N SER C
- PrivateS edor
- Federal- Other
- PrivateP osside

Projected Revenue by Use (2020-2025)

