



Canadian Research Infrastructure – lessons learnt and future directions

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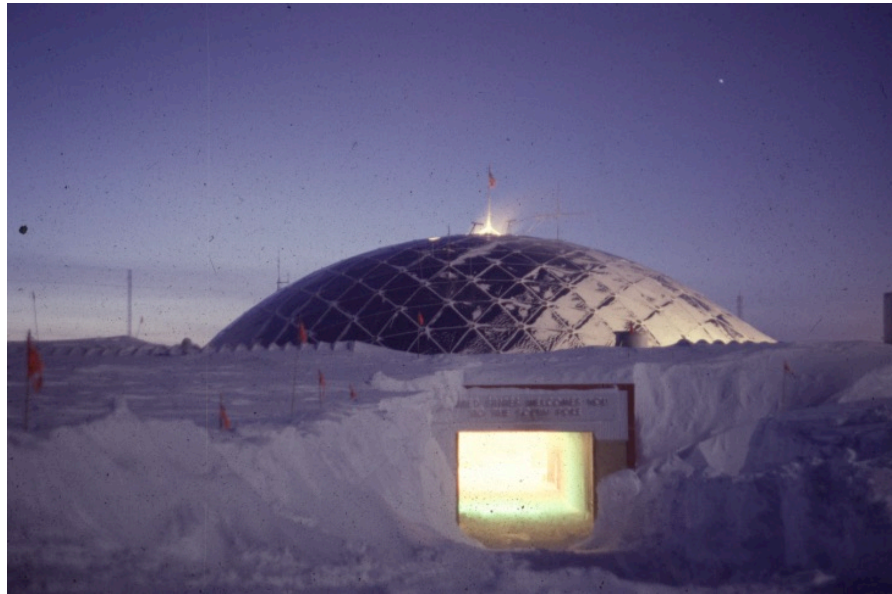
Personal lessons in infrastructure

- PhD @ Leeds: PeV gamma-ray astronomy (South Pole, +3km, -71°C)
- Imperial College / STFC RAL: Dark matter searches, Boulby salt/potash mine (UK, -1.1km, $+25^{\circ}\text{C}$)
- SNOLAB 2009: Deep underground facility (Canada, -2.1km, $\pm 40^{\circ}\text{C}$)



Personal lesson: Antarctic infrastructure

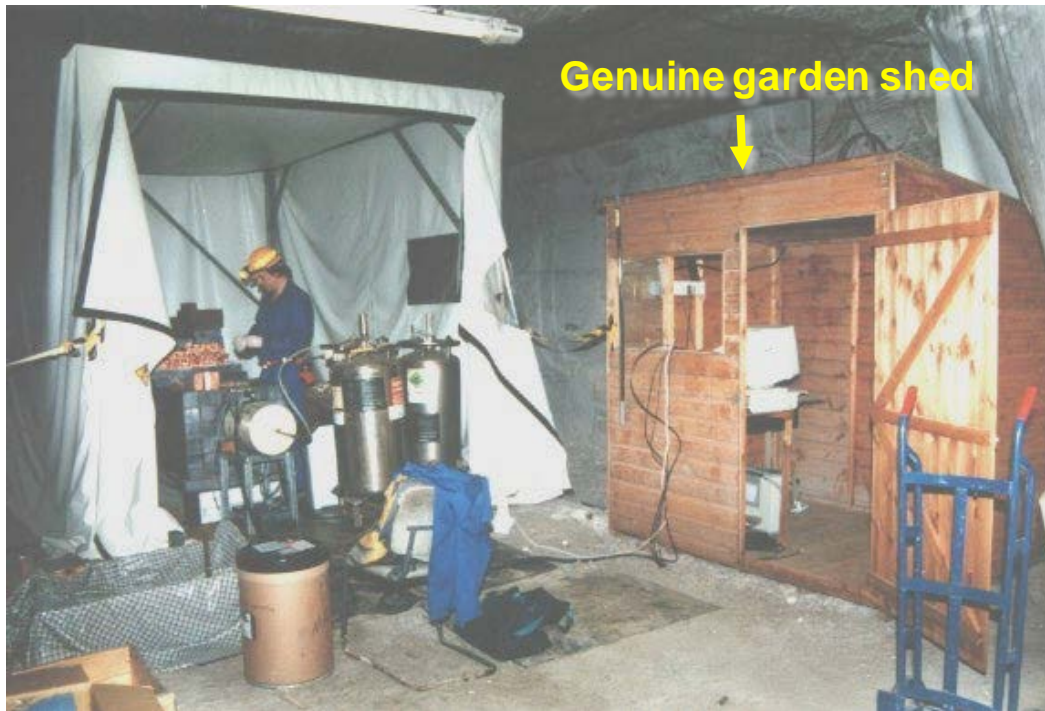
- Looking for sources of PeV cosmic rays
 - Built telescope as part of small team in 1987/88 (“wintered”)
 - Results Inconclusive
- Lessons: safety/PPE; team dynamics are essential; having backup plans and solid risk management is essential



Personal lesson: Boulby laboratory

- Working salt/potash mine @1100m
- Personal lessons: PPE/Safety essential, team-work essential across diverse groups, common goals for facility
- Infrastructure needs to be appropriate to the programme, resourced appropriately and requires constant maintenance (Boulby-II had a 10 year lifespan)

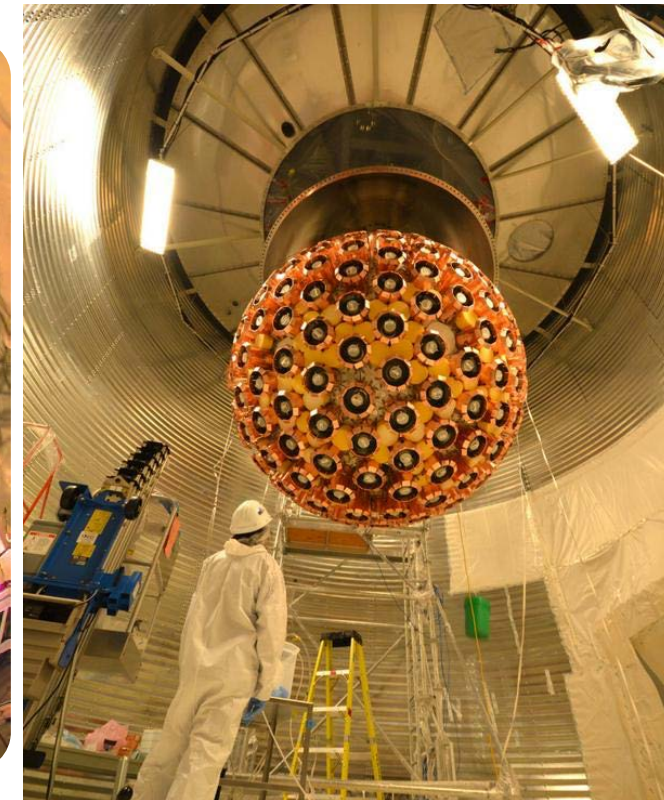
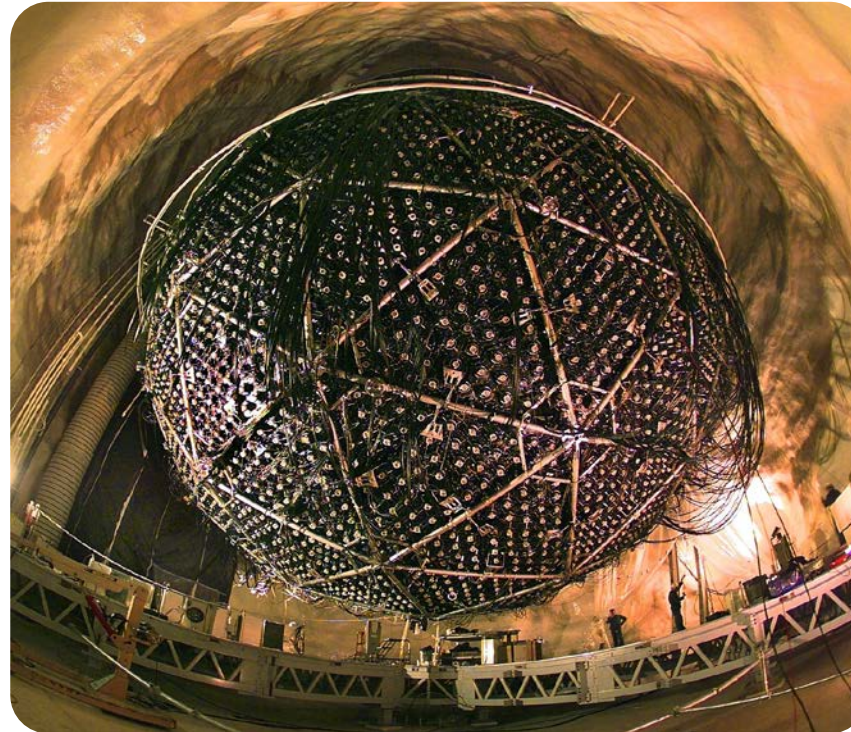
Early Infrastructure 1993 (and early NJTS)



Upgraded Infrastructure 2001

Personal lessons: SNOLAB Facility

- Developed from the original SNO detector to develop Canadian international facilities
- Managed as a joint venture between five Canadian Universities (Alberta, Carleton, Queen's, Laurentian, Montréal)
- Funded through CFI MSI programme and Province
- Operated in the Creighton nickel mine, near Sudbury, Ontario, hosted by Vale Ltd.
- Personal lessons:
 - Strong governance support and oversight (accountability)
 - PPE/Safety structures
 - Regulatory compliance environment (mines, construction, manufacturing)
 - Diverse teamwork essential
 - Operational excellence
 - Infrastructure maintenance
 - Deliberate talent development



What is TRIUMF?

TRIUMF is Canada's particle accelerator centre. We are a world-class hub of research, education, and innovation that is home to ~600 staff and students

Founded in 1968 by the University of British Columbia, Simon Fraser University, and the University of Victoria*, TRIUMF is a central component of Canada's research ecosystem

* ...and university of Alberta before the ink was dry





 **TRIUMF**

Discovery, accelerated.

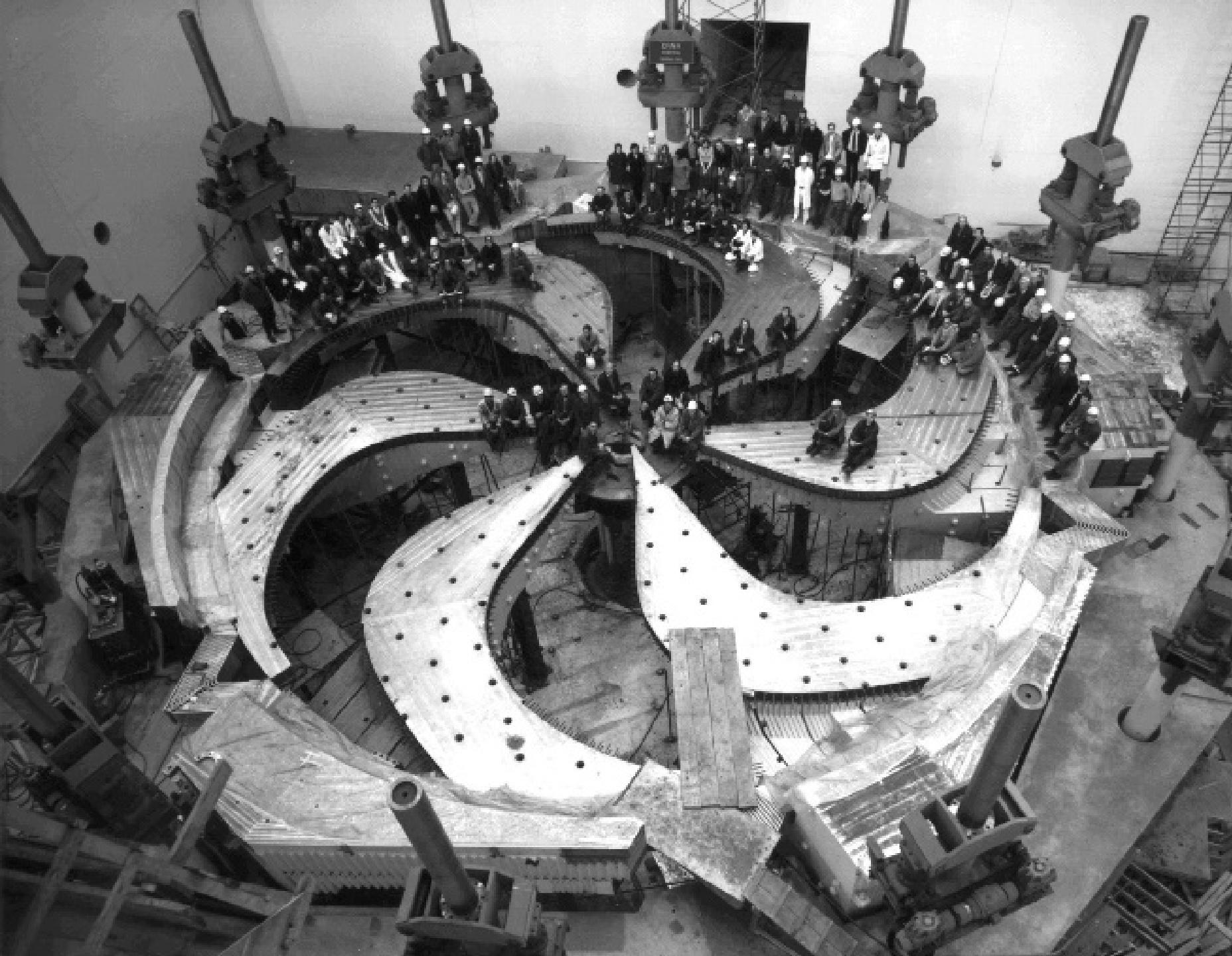
Our multidisciplinary community uses TRIUMF's world-class accelerator infrastructure to drive leading-edge research that delivers impact in **science, medicine, and industry, positioning Canada as a world leader.**

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
University of Waterloo
Western University
University of Winnipeg
York University





The 520 MeV H⁻-cyclotron

Largest Cyclotron
in the world:

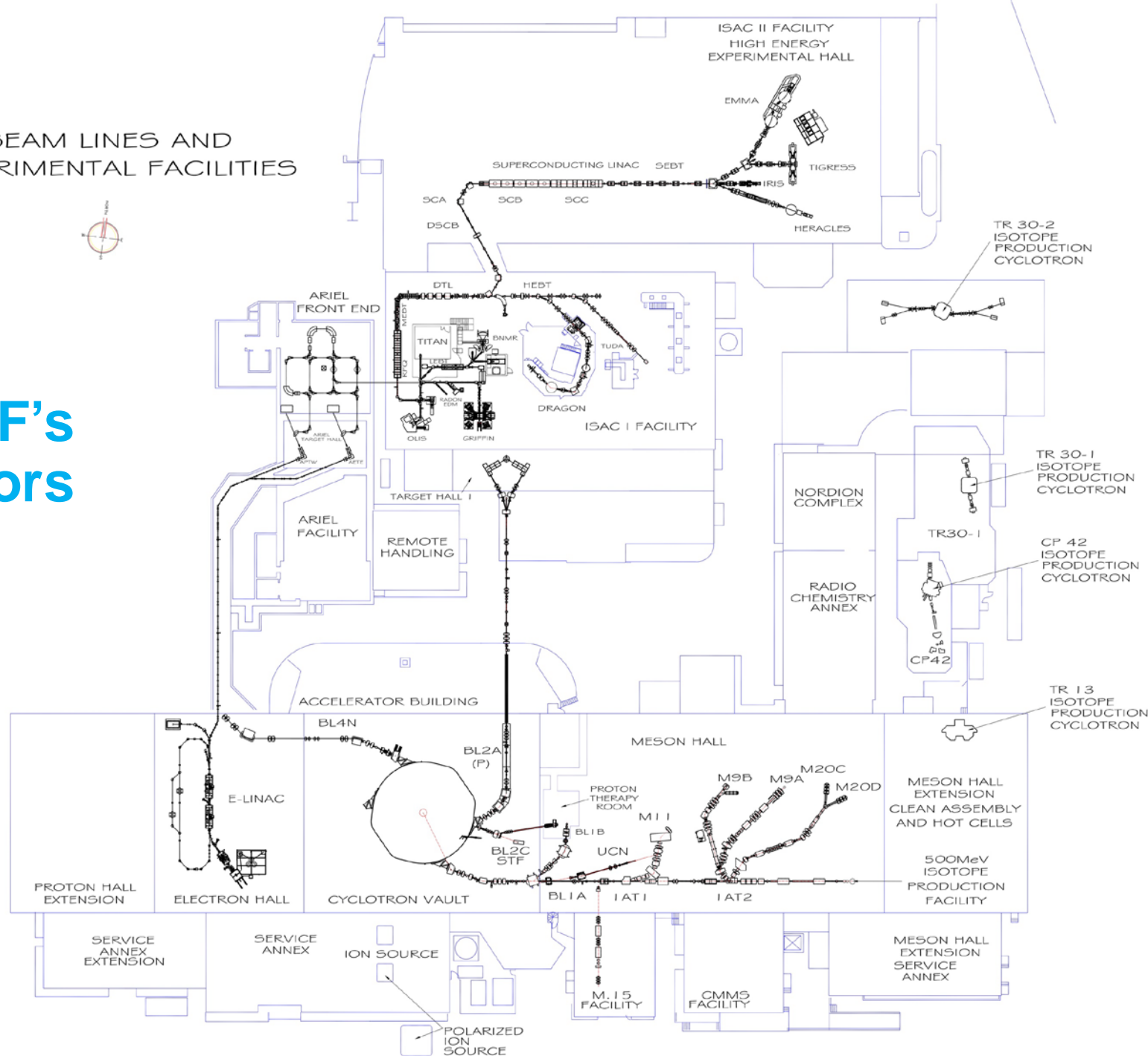
D = 18 m

Magnet weight
4000 t

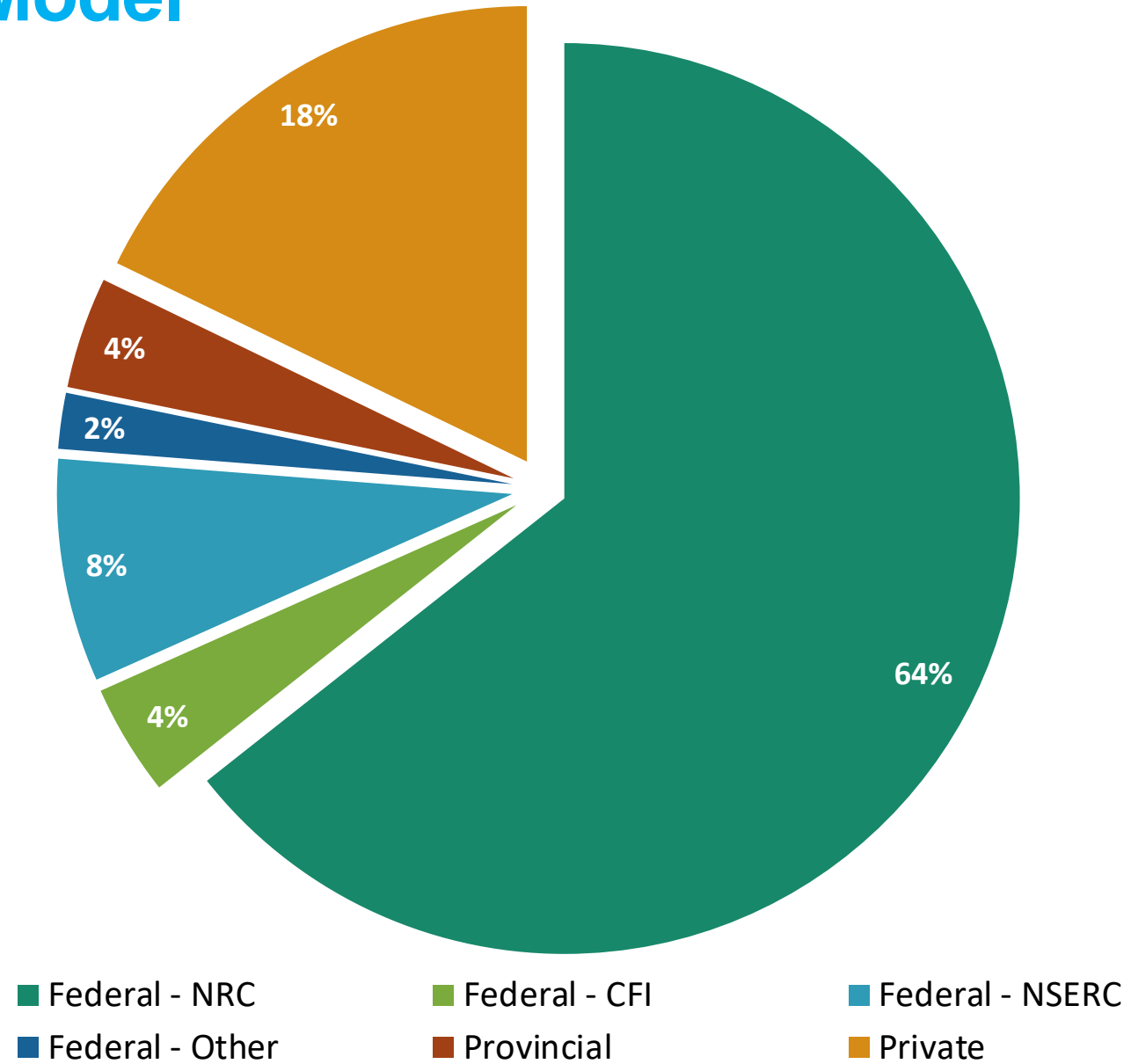
Coil current:
18500 A

TRIUMF's Accelerators

BEAM LINES AND EXPERIMENTAL FACILITIES



TRIUMF Funding Model



What does TRIUMF do?

TRIUMF's work spans the 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

Research areas expanded in recent 20-year vision to include green and quantum technologies as areas of focus.

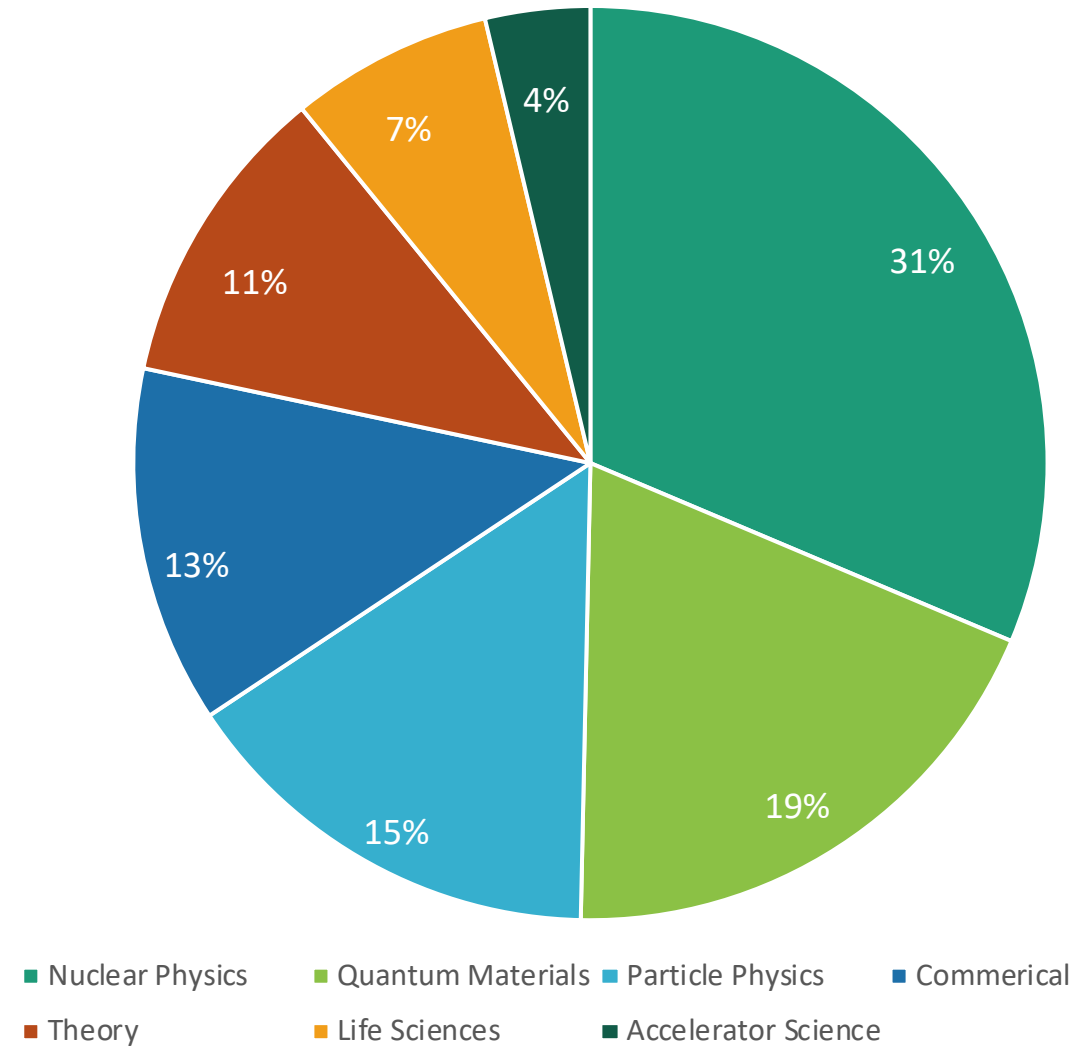


Multidisciplinary

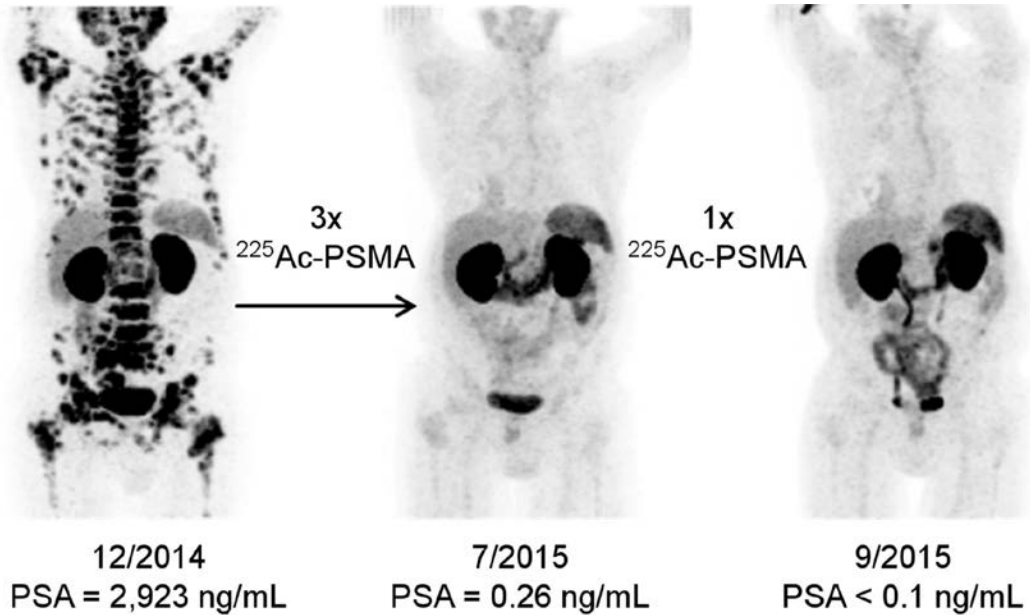
In 2019*, TRIUMF welcomed 1186 scientific users and visitors to the site

* As the last full year before the outbreak of the COVID-19 pandemic, these values are most representative of TRIUMF's community

Scientific Users and Visitors by Field

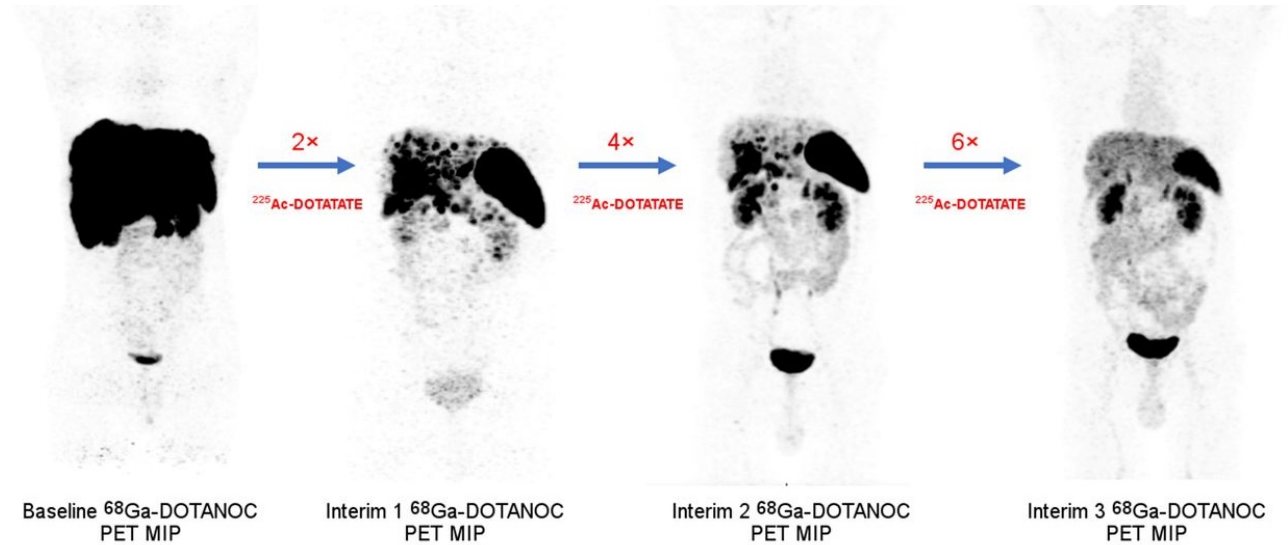


Targeted Alpha Therapy with Actinium-225 (^{225}Ac)



^{68}Ga -PSMA/ ^{225}Ac -PSMA imaging and therapy of prostate cancer patients

Kratochwil, et al. *J Nucl Med.* 2016; 57: 1941-1944.



^{68}Ga -DOTANOC/ ^{225}Ac -DOTANOC imaging and therapy of pancreatic cancer patients

Ballal, et al. *J Nucl Med.* 2023, 64: 211-218.

Therapeutic potential is promising but much work required to establish isotope supply and personalized dosimetry

Lessons learnt

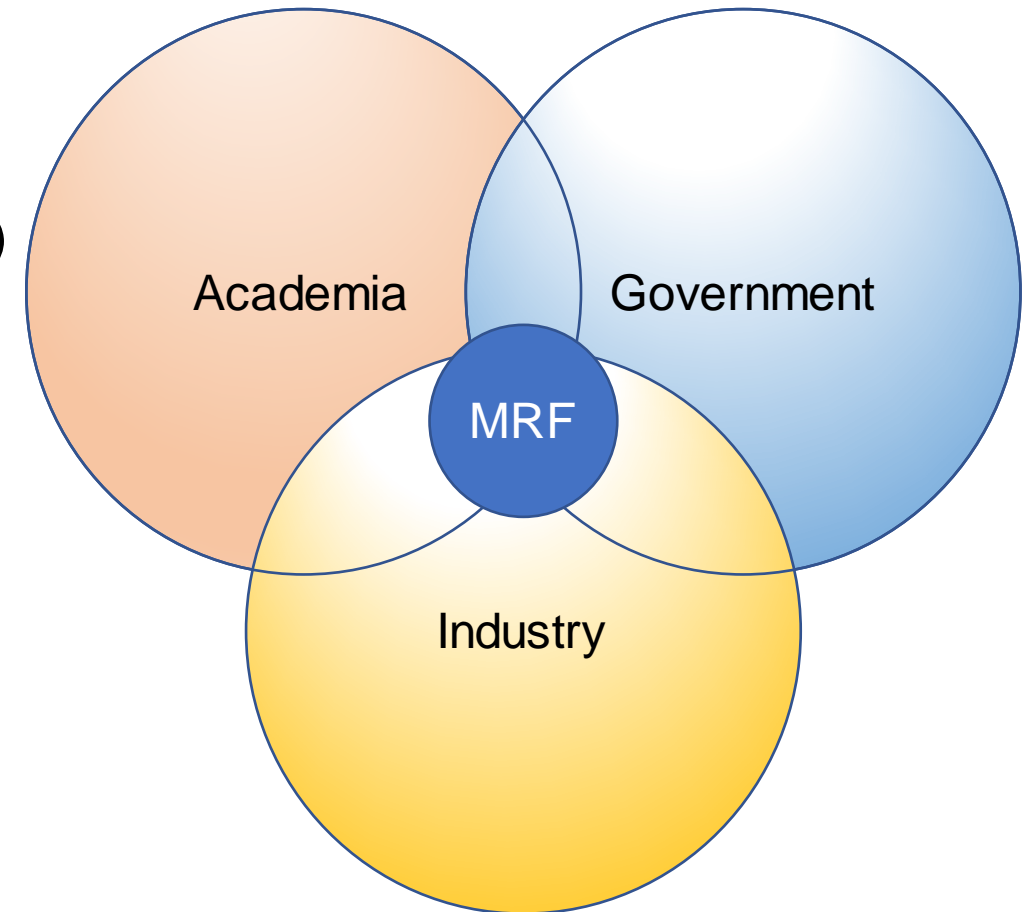
MRF are National Assets for Canada, operating on the international stage

- Canada is unique in approach to academic MRF (very bottom-up) – GOGO; GOCO; COCO
 - Benefits in flexibility and research community engagement; challenges at scale
- Many models exist in Canada for MSI/MRF, so mileage may vary
- Fundamentals are actually very similar, facilities rely on people and providing support structures and enabling staff and users to excel (within accountability requirements)
 - Appropriate governance for the scale of project
 - Appropriate oversight for the scale of investment (preferably one stream!)
 - Risk management, especially on core infrastructure
 - Operational excellence (don't cut back on this when times are hard)
 - Nurture talent and embrace the pipeline
 - Demonstrate relevance
 - Build diversity of teams and structures
 - Do great science
- But you can only punch above your weight for so long...

Future Directions – arguments that land

MRF are National Assets for Canada, operating on the international stage

- Oft forgotten as a component of research ecosystem
- Development of essential and sought-after expertise in key strategic areas (e.g. accelerator-based technology)
- Driving attraction, training, and retention of diverse world-class talent; creating national pipeline
- Return on existing investment in infrastructure
- Delivers clear socio-economic return: IP creation, spin-offs, (improving health outcomes for the treatment of cancer, green mining, etc.)
- Provides resilience on a national scale for technological capabilities (covid and ^{99}Tc examples)
- Delivery of world-leading and Nobel-winning science
- All party support (narrative changes)



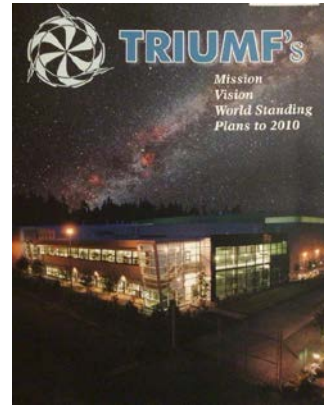
Case study: TRIUMF funding

Previous requests followed NRC-led process
Requests delivered flat-flat support, with additional funds from ad-hoc engagement



5-Year Plan 2005 – 2010:

- Targeted funding: \$276.9M
- Funding received: \$222.3M



5-Year Plan 2010 – 2015:

- Targeted funding: \$328M*
- Funding received: \$222.3M



5-Year Plan 2015 – 2020:

- Targeted funding: \$290M
- Funding received: \$267.3M**



5-Year Plan 2020 – 2025:

- Targeted funding: \$320M
- Funding received: \$292.7M***



* This request included funding for several projects that would later be supported through the CFI Innovation Fund, including ARIEL and the ATLAS Tier-1

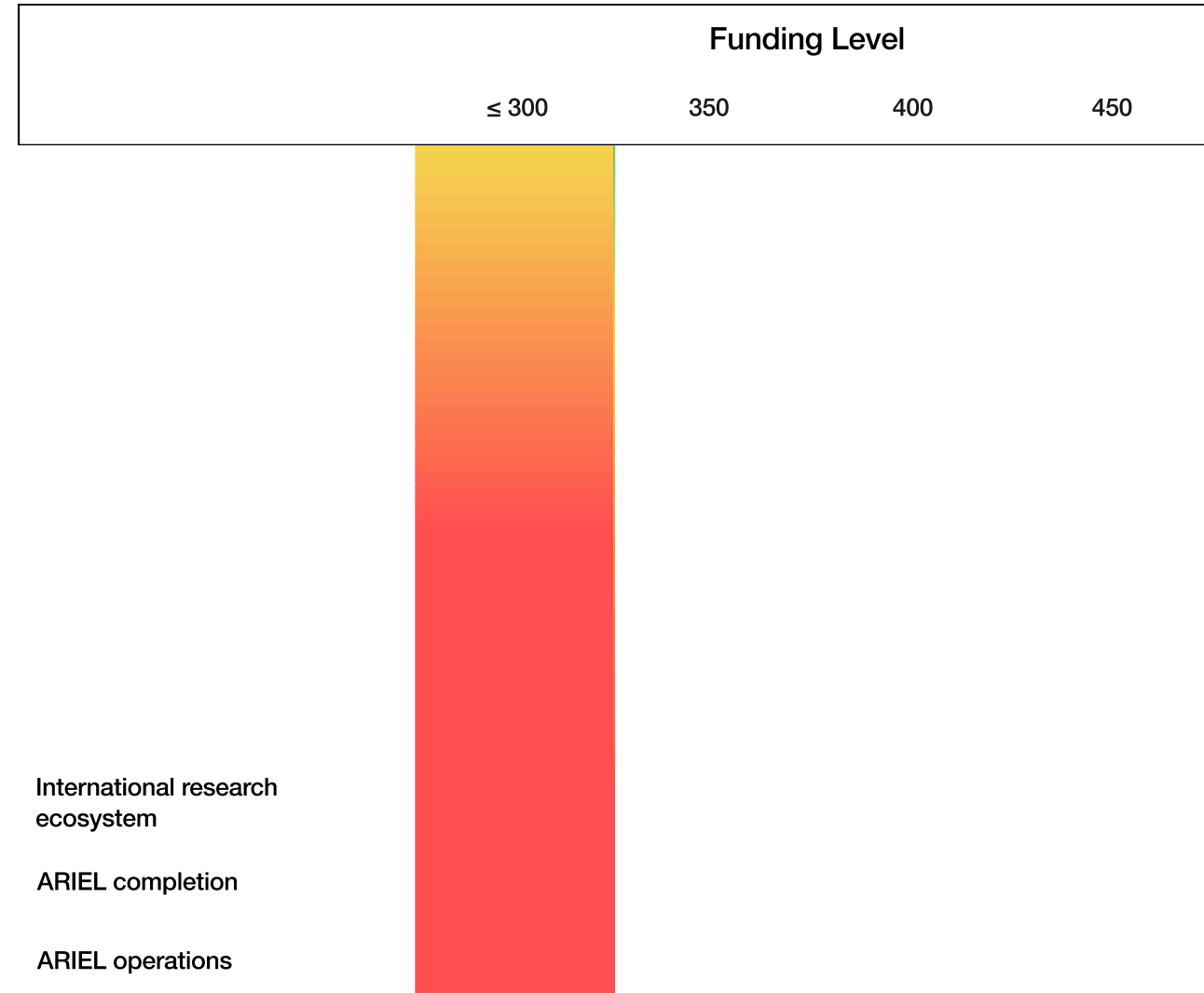
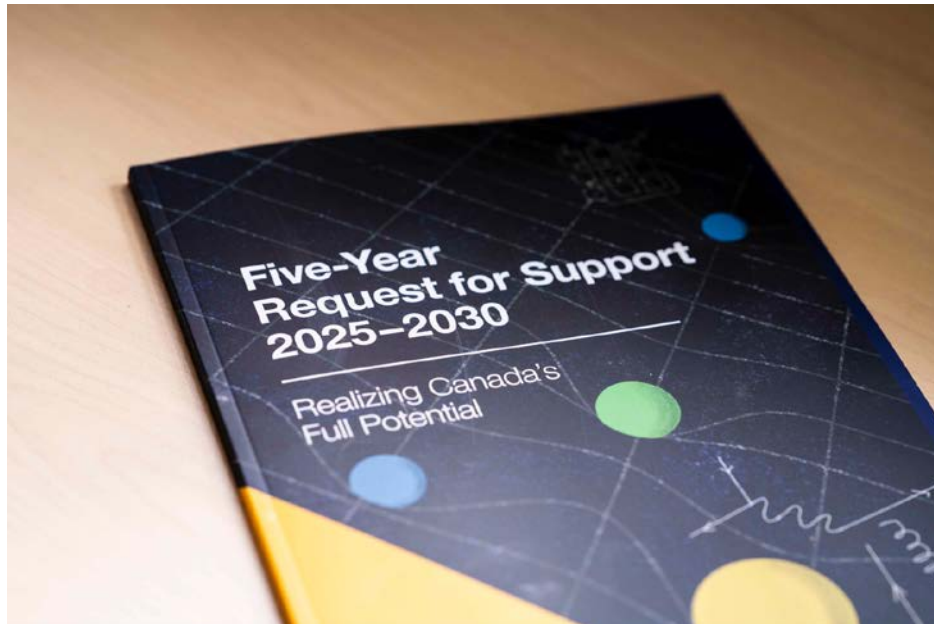
** This funding was allocated in two tranches beginning with an initial \$222.3M commitment in 2014, followed by a \$45M supplement in 2015

*** Finance Canada arrived at this value by starting with the flat-flat amount of \$267.3M and adding a one-time increase of ~\$25M for critical capital projects and deferred maintenance

(Major) change in approach

The five core themes supporting this request are:

1. Delivering new infrastructure for science impact
2. Ensuring operational excellence
3. Training the diverse talent of tomorrow
4. Refurbishing legacy facilities
5. Evolving TRIUMF's program towards the future



TRIUMF on the Hill – Meetings with Members of Parliament



Call to action

MRF are National Assets for Canada, operating on the international stage

- There have been great examples and stories today of how MSI are excellent in all the areas the government cares about
- A compelling narrative exists, though greater coordination is likely needed
- Slicing existing funds can only take us so far, we need to secure additional support from governments of all flavour
 - Move from proposal to existing programmes to creating new programmes
 - The ISED driven MRF framework is one such potential approach
- To do so requires engagement from all stakeholders, and a coordinated messaging
- We all need to support CFI and ISED in being able to demonstrate the benefits of MRF/MSI ecosystem in Canada – one that is integrated, connected and efficient
- University engagement is critical, as is industry
- It takes effort, but is required to maximise benefit to Canada of the substantial investment
- We do great science and have major impact for Canadians. Let's give CFI and ISED the best possible advantage in articulating this