TRIUMF

Canada's national laboratory
for particle and nuclear physics
and accelerator-based science

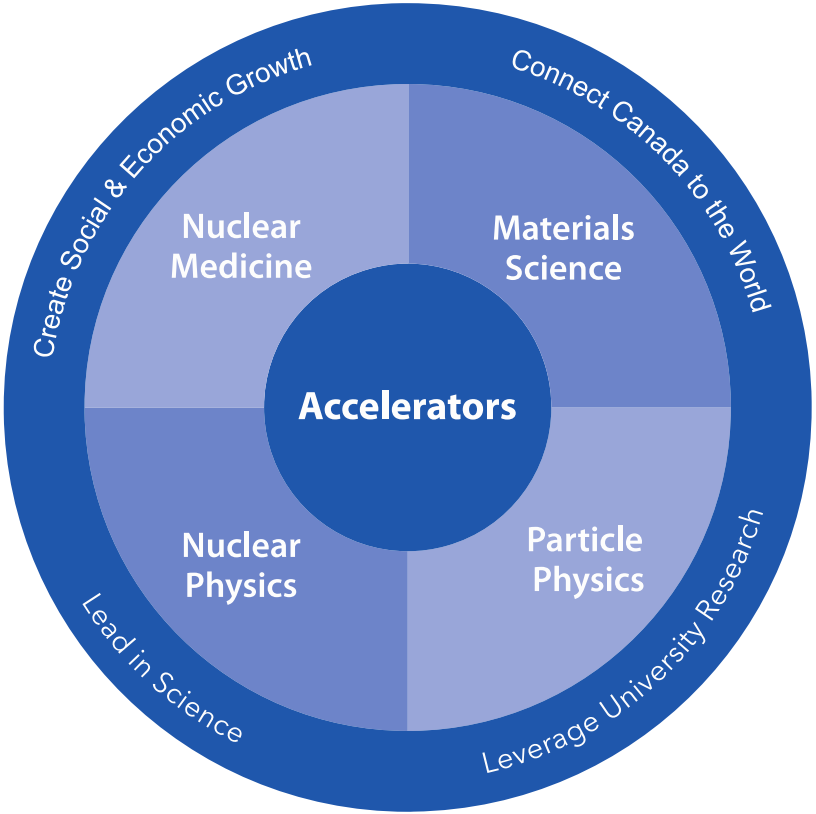
Introduction to TRIUMF

Dr. Reiner Kruecken
Deputy Director

January 04th, 2016

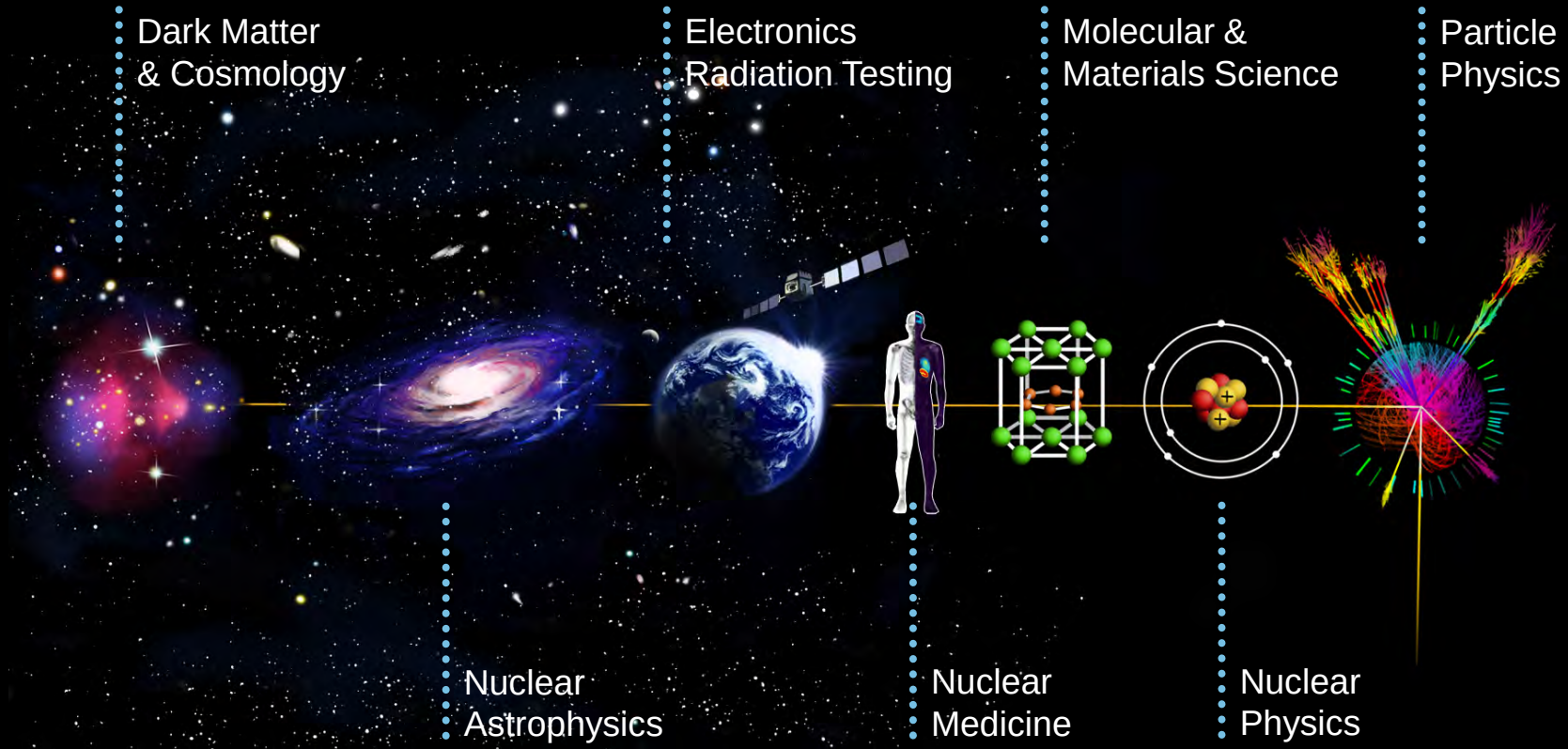
TRIUMF was founded in 1968 and has delivered nearly 50 years of science and innovation for Canada

A National Resource

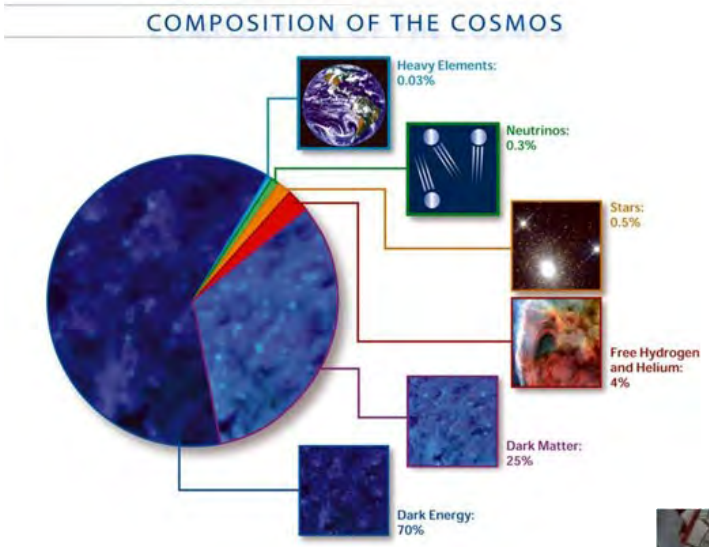


In 2012, the Council of Canadian Academies ranked physics and astronomy to be among the top six fields in which Canada excels globally. As Canada's national laboratory for particle and nuclear physics, TRIUMF is key to this success.

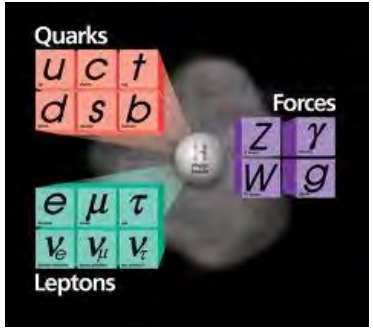
TRIUMF's Research Program

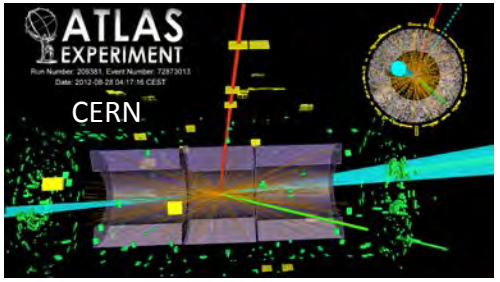


Particle Physics



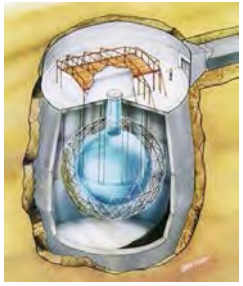
Standard Model



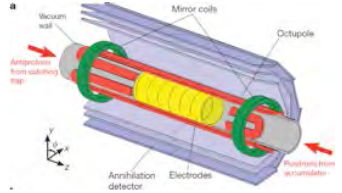


Neutron EDM w. UCN at TRIUMF

DEAP Dark Matter detector at SNOLAB



SNO neutrino detector at SNOLAB

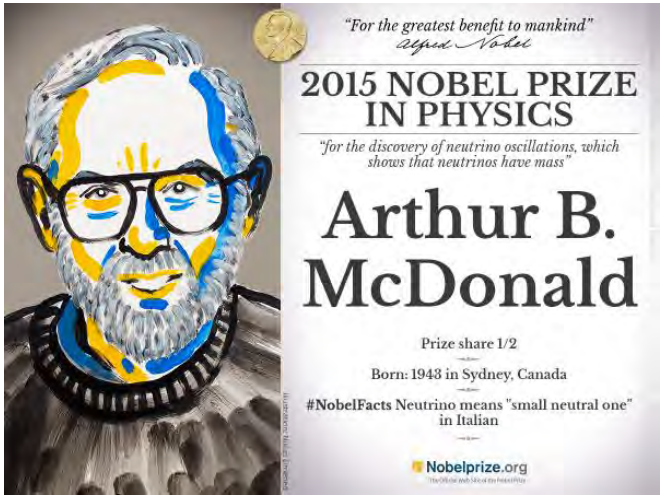


ALPHA Anti-Hydrogen Trap at CERN

Highlight: Nobel and Breakthrough Prizes

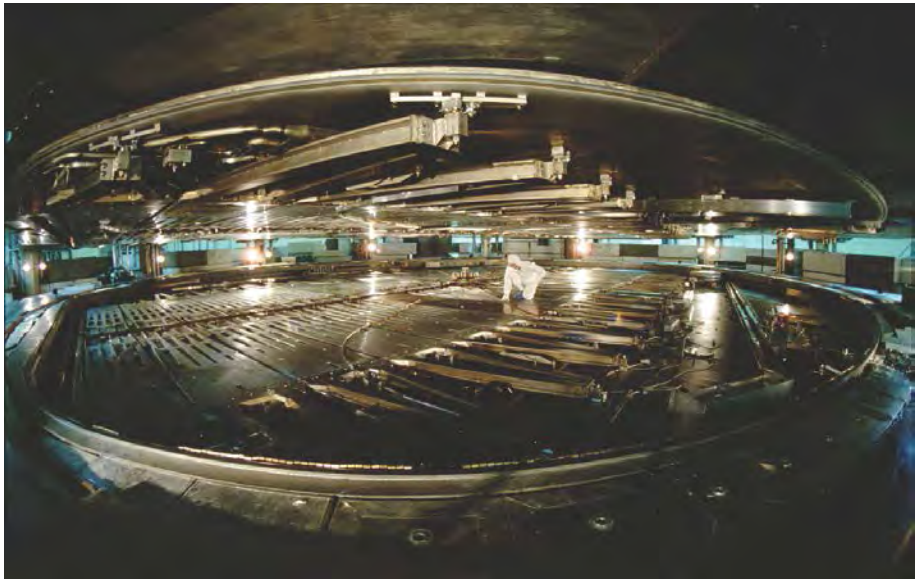
TRIUMF supported the SNO collaboration for which Art McDonald won the 2015 Nobel Prize in Physics

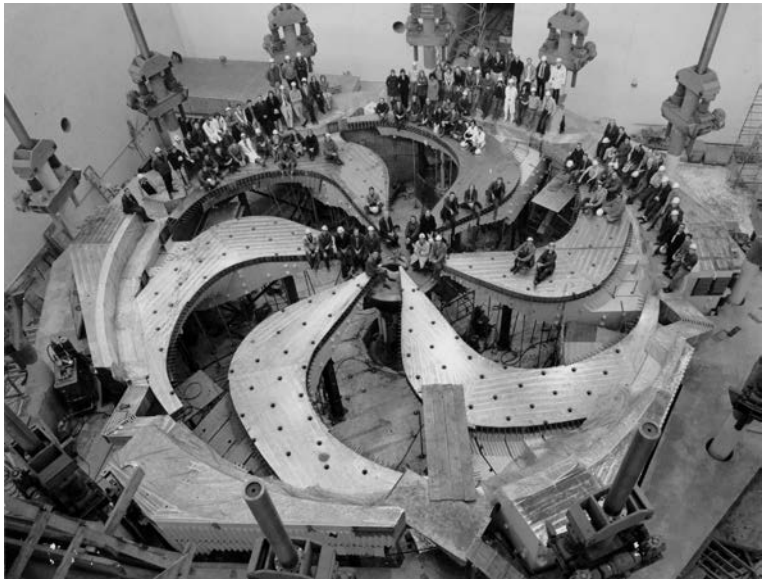
- TRIUMF contributed expertise and key components to the project
- A number of TRIUMF researchers were collaborators on the Nobel-winning paper



TRIUMF shared in the 2016 Breakthrough Prize in Fundamental Physics through its significant involvement in the SNO and T2K experiments

The Heart of TRIUMF





TRIUMF is home to the world's largest cyclotron

- In operation for 40 years
- Designated *IEEE Historical Engineering Milestone* in 2011

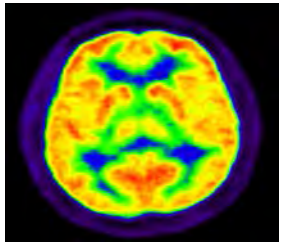
TRIUMF is a particle accelerator facility that specializes in isotopes for science, medicine, and business

What is a particle accelerator?

- Particle accelerators produce high energy particles that are directed to targets where they create isotopes

What are isotopes?

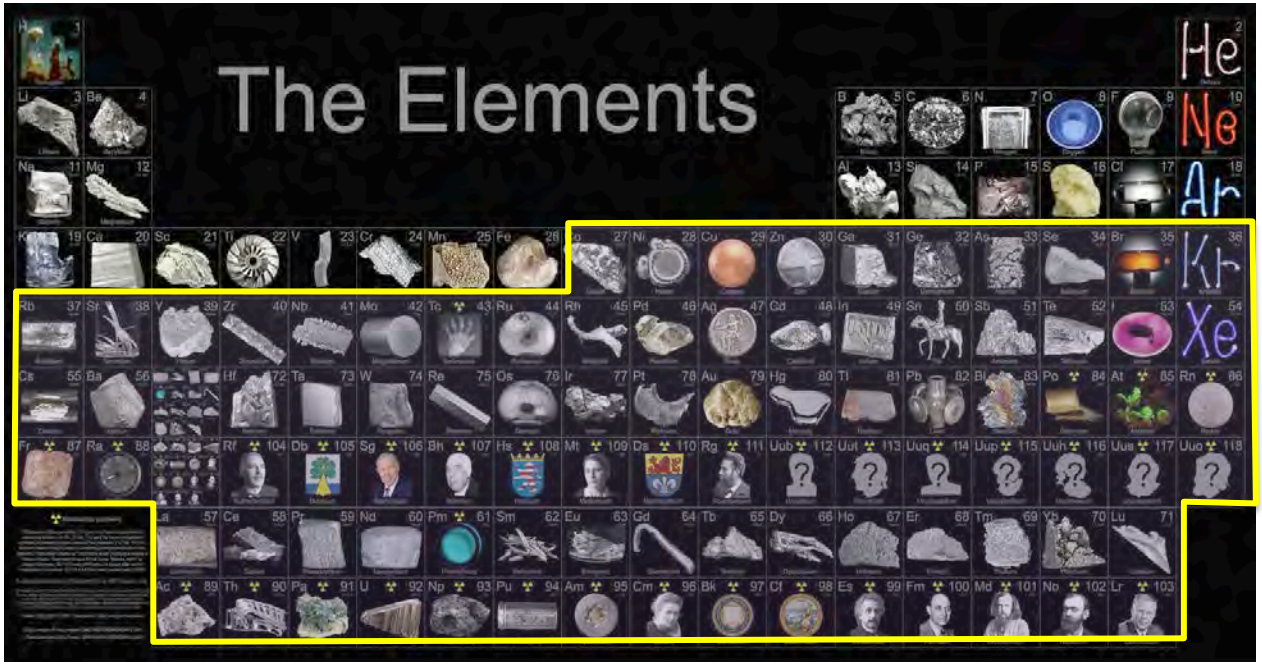
- Isotopes are variations of chemical elements with special physical properties. At TRIUMF radio(active)-isotopes are produced by particle accelerators.



What are the applications of isotopes?

- TRIUMF uses isotopes to answer fundamental questions about the structure of matter and the origins of the universe
- TRIUMF also develops isotopes for nuclear medicine and the characterisation of materials – both with important commercial applications

What is the origin of the elements?



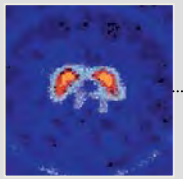
Each heavy atom in our body was built and processed through ~100-1000 star generations since the initial Big Bang event!

Atomic nuclei are the heart of matter and the fuel of stars

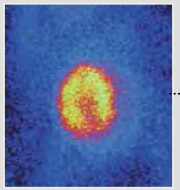
We are all made of star dust !

Nuclear Medicine

- A medical isotope is a short-lived radioactive ingredient used in radiopharmaceuticals which are administered to patients
- Through radioactive decay, energy is emitted and captured with a special camera to reveal images of metabolic function in the body (SPECT, PET)
- Also used to deliver targeted radiation therapy to tumours

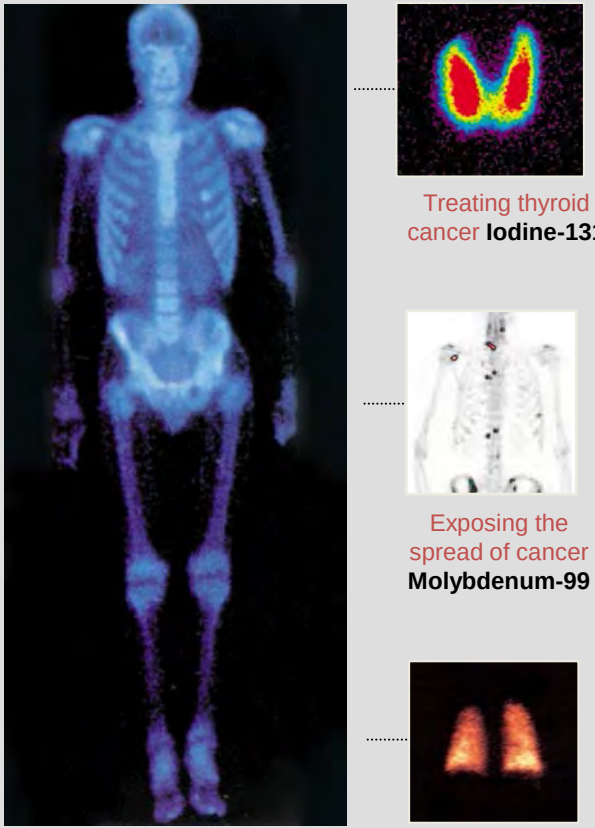


Diagnosing brain disorders
Fluorine-18



Accurately diagnosing heart attacks and disease
Molybdenum-99

Scanning bones for infection
Molybdenum-99



Treating thyroid cancer **Iodine-131**

Exposing the spread of cancer
Molybdenum-99

Imaging the lungs for blood clots
Xenon-133

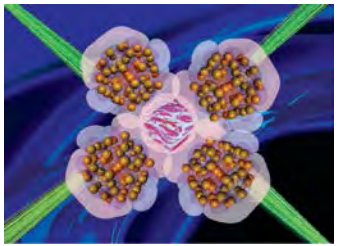
Magnetic properties in materials and at interfaces

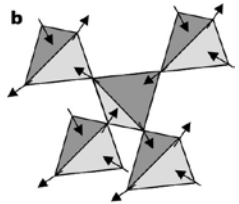
Muon Spin Rotation (MuSR)

- Muon as Probe of bulk magnetism
  - New superconductors
  - New semiconductors
  - Lithium diffusion in battery materials
- Muonium Chemistry
  - Hydrogen atom kinetics
  - Green chemistry
- Muoniated Free Radicals
  - Gen IV reactor chemistry

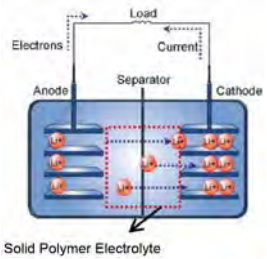
betaNMR

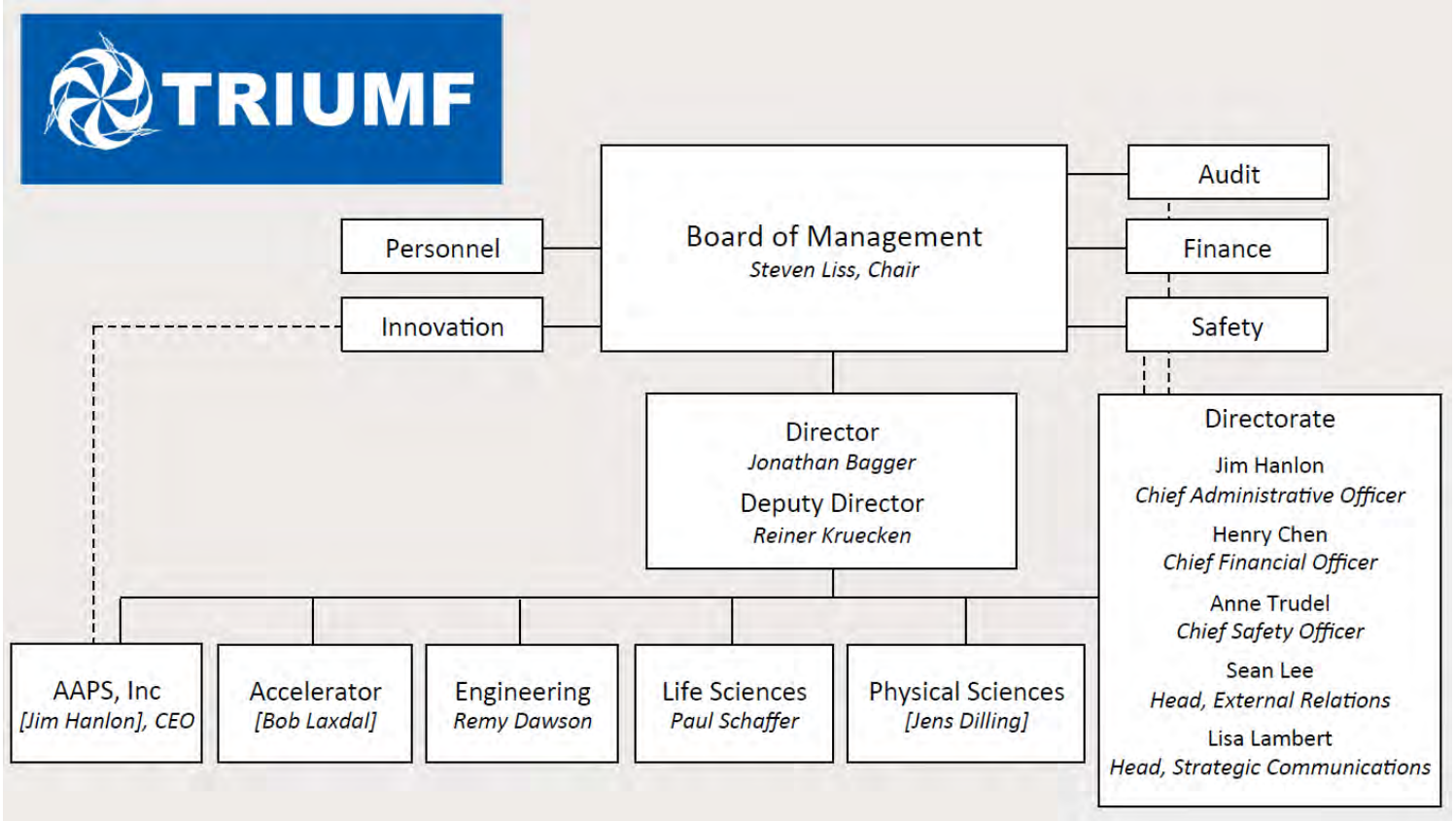
- Magnetic properties of
  - at interfaces
  - on surfaces
  - in thin films
- nanometer depth resolution





Spin ice




TRIUMF
Board of Management
Steven Liss, Chair
Personnel
Innovation
Audit
Finance
Safety
Director
Jonathan Bagger
Deputy Director
Reiner Kruecken
Directorate
Jim Hanlon
Chief Administrative Officer
Henry Chen
Chief Financial Officer
Anne Trudel
Chief Safety Officer
Sean Lee
Head, External Relations
Lisa Lambert
Head, Strategic Communications
AAPS, Inc
[Jim Hanlon], CEO
Accelerator
[Bob Laxdal]
Engineering
Remy Dawson
Life Sciences
Paul Schaffer
Physical Sciences
[Jens Dilling]

Over 5 Years, TRIUMF has:

Delivered
40 500
hours of
isotope beams
for research

Published
1300
scientific
papers

Trained
500+
highly qualified
postdocs & students

Designed &
fabricated
3300+
technical &
engineering
systems

Provided more than
30 000
informal science
experiences to
the public

A National Resource

HIGHLY QUALIFIED PERSONNEL

350 staff

150 students & post-doctoral researchers

500+ scientist & student researcher visits per year

KNOWLEDGE

86% of Canada's subatomic physics research involves TRIUMF

INTERNATIONAL ENGAGEMENT

50+ international agreements & partnerships

BUSINESS

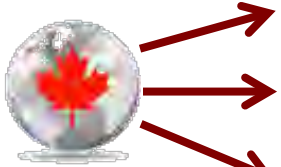
$1B in economic activity in last decade

Technology Commercialization

In 2008, Advanced Applied Physics Solutions, Inc. (AAPS), TRIUMF's commercialization arm, was established as a Center of Excellence for Commercialization and Research (CECR)

- AAPS will exit the CECR program by the end of 2015

AAPS
Advanced Applied Physics Solutions



License and transfer technology

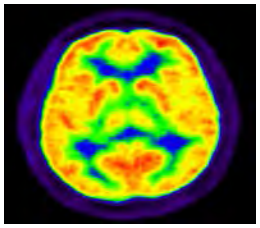
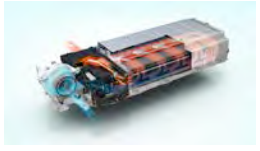
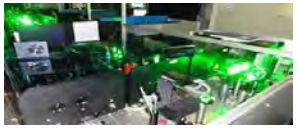
Incubate start-ups

Sales of products and services

Compared to other international subatomic physics laboratories, TRIUMF is ahead of the curve in commercialization and industrial engagement

- AAPS has launched 5 companies over the last five years: IKOMED, Micromatter, Frontier Sonde, CRM Geotomography, and ARTMS

UBC/TRIUMF CREATE Program: IsoSiM

Production	Processing	Applications	
			Medicine
			Environment
			Materials
			Universe

German partners:

GSI HELMHOLTZ CENTRE FOR HEAVY ION RESEARCH

GERMAN ELECTRON SYNCHROTRON DESY

HELMHOLTZ-ZENTRUM BERLIN (HZB) FOR MATERIALS AND ENERGY

MAX PLANCK INSTITUTE (MPI) FOR SOLID STATE RESEARCH

ALFRED WEGENER INSTITUTE FOR POLAR AND MARINE RESEARCH

LABORATORY FOR PRECLINICAL IMAGING AND IMAGING TECHNOLOGY, SIEMENS FOUNDATION

GE GLOBAL RESEARCH MUNICH

www.isosim.ubc.ca

Program components

NSERC CRSNG IsoSiM Isotopes for Science and Medicine TRIUMF UBC

Interdisciplinary Training	Skills Development	Industrial Internships	International Research Experience
Graduate Course Research Projects	Isotope applications Professional Skills (UBC,Mitacs)	ACSI, PAVAC, Dept. Fisheries & Oceans, Nordion, Lorax, AAPS, GE Health	**Germany** Helmholtz, Max Planck, Siemens Foundation, GE Global Research

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TRIUMF: Alberta | British Columbia | Calgary | Carleton | Guelph | McGill | Manitoba | McMaster | Montréal | Northern British Columbia | Queen's | Regina | Saint Mary's | Simon Fraser | Toronto | Victoria | Western | Winnipeg | York

Enjoy your time at TRIUMF!!

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