



20-Year Vision

Topical Groups
Vision Summary slides



Vision

for Particle Physics

“All truths are easy to understand once they are discovered; the point is to discover them”

-Galileo Galilei



“Science knows no country, because knowledge belongs to humanity, and is the torch which illuminates the world”

-Louis Pasteur

Our Vision for Particle Physics

Lead Scientific Discovery

Build a strong, innovative particle physics community with a thriving on-site, national and international programs

Broker a network of university and institute partners in Canada and abroad

Perform world-class science and develop synergies with emerging areas for discovery

Lead the discoveries that change how we understand the fundamental nature of the universe

Enable Particle Physics in Canada and abroad

Create enhanced facilities for specialized expertise and infrastructure in research and development

- A detector development center
- An accelerator platform for research and beam delivery
- A computing and data science center

Enable the creativity and broad research and development that leads to discovery, in Canada and abroad

Train, Include, Inspire

Create programs that provide students and postdocs with on the job training with high engagement from both national and international partners

Bring the world to TRIUMF by expanding schools, workshop, and conference programs

Champion initiatives for equity, diversity, and inclusion, and integrate these programs in the heart of our training

Attract and develop the best talent in Canada and the world

	Now	Action	2042
Lead Scientific Discovery	<ul style="list-style-type: none"> Recognized member in national and international collaborations Footprint for local particle physics experiments is relatively small 	<ul style="list-style-type: none"> Build a strong network in Canada and abroad with joint appointments with member universities and partner institutes Attract and connect talents Develop and broaden TRIUMF's focus on key science programs 	<ul style="list-style-type: none"> Generate discoveries addressing the fundamental nature of the universe Become a leader in innovative and collaborative research in a national and global network Run a thriving on-site program engaging in new directions
Enable Particle Physics in Canada and abroad	<ul style="list-style-type: none"> Collaborator with technical capabilities in accelerator and detector construction Research and development infrastructure and expertise is in high demand but not leveraged 	<ul style="list-style-type: none"> Establish three key facilities: <ul style="list-style-type: none"> Detector development center An accelerator platform for research and beams delivery Computing and data science center for subatomic physics Allow for long-term investments in infrastructure and personnel that enhance particle physics capabilities 	<ul style="list-style-type: none"> Leverage and multiply innovation in accelerator, computing and detector development across Canada Access to centers in a transparent and regulated process that maximizes engagement Enlarged Canadian participation in ground-breaking particle physics research at home and abroad
Train, Include, Inspire	<ul style="list-style-type: none"> Mostly Canadian and local students are trained Trainees have limited opportunities to collaborate outside their area of study Limited reach of general outreach program 	<ul style="list-style-type: none"> Establish international workshop and conference program Expand academic program with online courses and summer schools Act on concrete measures for equity, diversity, and inclusion Expand communications and outreach with partners 	<ul style="list-style-type: none"> The next generation of leaders are trained in a diverse, inclusive, cutting-edge research environment A vibrant outreach programme demonstrates that science is for everyone

5 Year Horizon

20 Year Vision

TRIUMF Firmly Established As Canada's National Laboratory

Lead Scientific Discovery

Explore and lead the discoveries that change how we understand the fundamental nature of the universe

- Build a strong and innovative particle physics community with thriving on-site, national and international programs at the energy, intensity, innovation and new technologies frontiers:
 - **TRIUMF can be an intellectual center for discovery in Canada answering the big questions in our field**
- Broker a network of university and institute partners in Canada and abroad:
 - **Joint hires ensure strong connections to universities and partner institutes**
 - **Expanding geographically could increase the mandate of TRIUMF nationally and alleviate the perception that it is a Western-only laboratory**
- Perform world-class science and develop new directions in emerging areas and future technologies for discovery:
 - **TRIUMF can lead the discoveries that change the course in particle physics, fundamental science and beyond**

Enable Particle Physics in Canada and abroad

Facilitate the creativity and development that leads to discovery in Canada and abroad

- TRIUMF's accelerator, computing, and engineering capabilities are unparalleled and beyond the capabilities of a single university:
 - **These resources enable Canadian participation in international projects such as HyperK, HL-LHC and future colliders**
- TRIUMF can leverage and multiply innovation by creating broad centers:
 - **Detector development center**
 - **An accelerator platform for research and beams delivery**
 - **Computing and data science center**
- Member universities will access TRIUMF's wealth of resources through a transparent process that maximizes engagement in cutting-edge projects:
 - **Enlarged Canadian participation in ground-breaking particle physics research at home and abroad**
 - **TRIUMF can be the lever arm that strengthens developments across the nation to deliver Canadian particle physics**

Train, Include, Inspire

Attract and develop the best talent in Canada and the world

- TRIUMF will become an EDI champion by advocating for a diverse workforce:
 - **Establish concrete measures to foster diversity including ensuring that its members can access housing, transportation, and daycare**
 - **The next generation of leaders is trained in a diverse, inclusive, cutting-edge research environment**
- TRIUMF can grow its cutting edge, international research environment by expanding programs to bring the world to TRIUMF:
 - **Establish international workshop and conference center**
 - **Expand academic program with online courses and summer schools that are complementary to what universities can offer**
- A vibrant outreach programme demonstrates that science is for everyone
 - **Partnering with Canadian and international communicators can expand our impact, and help Canadians feel connected to their national lab**

Vision

for Nuclear Physics



“Never trust an atom - They make up everything”

- (unknown)

“Only nuclear power can now halt global warming.”

- James Lovelock

Our Vision for Nuclear Physics

TRIUMF is the ISOL facility of choice for worldwide Nuclear Physics research

A complete toolkit of state of the art facilities allows to perform experiments that define the field, exploring the wonders of the quantum world

TRIUMF is a trusted and valued resource for the public education of nuclear physics

We are a hub for the Canadian public to inform and communicate about nuclear physics in daily life, like solar fusion, nuclear medicine, energy...

The unique capabilities of TRIUMF's expanded Nuclear Physics Portfolio ensures research at the cutting edge

Additional personnel and new/ upgraded research infrastructure and techniques allow full exploitation of opportunities

	Now	Action	2042
Scientists	The local ISAC program is diverse but missing new ideas	Expand and maintain existing facility with unique experiments	Every inch of ISAC is full of exciting (nuclear) physics!
Public, young students	"Nuclear" has a bad connotation due to the perceived risk of radioactive contamination	Better outreach and communication of usefulness of Nuclear Physics in our everyday life	A well educated and informed public who understands that "Nuclear Physics is our friend"
Management, Scientist	Exploring new ideas is hampered by insufficient funding and missing personnel	Seek other funding sources and partners (e.g. international) and hire more scientists	New opportunities allow training of more HQP and lead to a doubling of the research output.

Vision

for Fundamental Physics
with AMO techniques at TRIUMF



Our Vision for Fundamental Physics with AMO techniques at TRIUMF

Infrastructure

Build a dedicated facility for AMO experiments. This will enable us to create new means to discover fundamental physics, building upon existing TRIUMF strengths, and be prepared to rapidly exploit new advances in AMO techniques.

Focus

Focus on fundamental physics, and enhance support for TRIUMF's highly skilled community of theorists and experimentalists.

Function as a hub for large science in Canada, while remaining agile to take advantage of new opportunities and developments.

People

Make TRIUMF a world-leading centre for research in fundamental physics using AMO techniques.

Strengthen the culture of informal collaboration between scientists, and involve scientific staff in key decision-making processes.

	Now	Action	2042
Infrastructure	<ul style="list-style-type: none"> • Aging support facilities and lack of space for new experiments • Limited office space, not conducive to collaboration between theorists, or between theorists and experimentalists 	<ul style="list-style-type: none"> • Invest in infrastructure for fundamental physics experiments using AMO techniques • Create opportunities for closer interactions to spark new ideas 	<p>TRIUMF is a leading centre for fundamental research on physics beyond the Standard Model using accelerator-based science + AMO techniques</p>
Focus	<ul style="list-style-type: none"> • AMO physics experiments to discover fundamental physics are a small piece of TRIUMF's portfolio 	<ul style="list-style-type: none"> • Enhance the focus on fundamental physics. Applied areas are essential, but an overall emphasis on fundamental physics will be a prudent investment in TRIUMF's long-term future 	<p>Discovery experiments generate new tools and techniques with real world applications and benefits</p>
People	<ul style="list-style-type: none"> • Insufficient staff to operate new RIB facilities & experiments • Increasing levels of corporatization threaten TRIUMF's flexibility and scientist-led initiatives 	<ul style="list-style-type: none"> • Hire new scientific and technical staff • Strengthen inter-personal interactions and give scientists creative freedom 	<p>TRIUMF is an attractive and supportive centre for fundamental physics.</p>

TRIUMF is a leading centre for fundamental research on physics beyond the Standard Model

Build new infrastructure for experiments and improve opportunities for collaboration

- Build infrastructure for new experiments:
 - New lab space for AMO experiments integrated with ARIEL beamline
 - Support facilities for lasers and opto-electronics
 - Dedicated research space to investigate new techniques, using RIBs for fundamental physics
 - Translate new developments in AMO and quantum information science from universities to accelerator-based facilities
- Create opportunities for stronger collaborations
 - Office space for theorists and experimentalists to interact closely
 - Common areas and collaborative spaces to strengthen interactions between disparate groups

Discovery experiments generate new tools and techniques with real-world applications and benefits

A stronger focus on fundamental science enables advances across TRIUMF

- Make fundamental science a priority
 - Develop a dedicated team of people to translate advances in AMO-based fundamental physics into impactful real-world applications
 - Strengthen connections between fundamental physics at TRIUMF and areas such as nuclear medicine and quantum information, to transfer advances in AMO techniques

TRIUMF is an attractive & supportive centre for fundamental physics

Hire new staff and build a team of motivated researchers

- Hire excellent scientific and technical staff: build research capacity to take advantage of upcoming facilities such as ARIEL and new AMO programs.
- Build a team of motivated researchers:
 - Reduce management overhead and interference in scientific decisions
 - Provide scientists with creative freedom and high-level responsibility
 - Take advantage of TRIUMF's smaller size to build a tightly-knit community of scientists, who can agilely pursue unique new directions

Vision

for Life Sciences



“Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.”

-Marie Curie

“At 11, I could say "I am sodium", and now at 79, I am gold.”

-Oliver Sacks

Our Vision for Life Sciences

Think Big

Pursue Creative, Impactful Science

TRIUMF is inherently multidisciplinary and translational, bringing together science, creativity, innovation and novel infrastructure; encouraging and inviting collaborators from around the world to answer some of life's most difficult questions.

Be Different

Apply Physics to Life

TRIUMF Life Sciences will be an engine that applies accelerator science toward the study of life – in order to derive maximum societal benefit.

TRIUMF has globally unique infrastructure, rare talent, and an innovative mindset to better life for all.

Be Bold

Train and Send Forth World-Class Talent

Creative, impactful research will be woven into the cultural fabric of TRIUMF Life Sciences; training a generation of innovative thought and technology leaders to work collaboratively across disciplines to ask tough questions and derive elegant answers.

	Now	Action	2042
Think Big: Pursue Creative, Impactful Science	<ul style="list-style-type: none"> Research and expertise are not leveraged to full potential Responding to, rather than anticipating societal challenges 	<ul style="list-style-type: none"> Mature research program to maximize time for science, with creative focus; Provide proper administrative and operations support to enable productive researchers 	A robust research program with numerous collaborations pursuing a spectrum of basic and applied research to address societal issues
Be Different: Apply Physics to Life	<ul style="list-style-type: none"> New infrastructure emerging, with significant efforts applied to rejuvenate legacy facilities 	<ul style="list-style-type: none"> Build and configure a group of facilities with timeless capabilities; Enable multidisciplinary research in a globally-unique setting 	TRIUMF is recognized as THE place to go for accelerator and isotope science to understand life at the molecular level
Be Bold: Train and send- forth world- class talent	<ul style="list-style-type: none"> TRIUMF-based scientists struggle to recruit trainees Trainees work hard to collect data from disconnected facilities and non-optimized workflow 	<ul style="list-style-type: none"> Configure program to be a rewarding, cross-disciplinary training experience across the post-secondary spectrum 	A continuous output of thought leaders trained in an inclusive, multidisciplinary and collaborative culture

Think Big – Pursue Creative, Impactful Science

TRIUMF is inherently multidisciplinary and translational, bringing together science, creativity, innovation and novel infrastructure; encouraging and inviting collaborators from around the world to answer some of life's most difficult questions.

- Build a strategic, innovative research program focused on translating basic science into applied solutions for the betterment of society
 - Ensure access to unique talent and infrastructure, TRIUMF can be a world-class centre for both basic and applied research
 - Establish the right partners and prioritization to allow research at TRIUMF to fundamentally alter our understanding of life
 - Leverage the economic benefits of applied research to fuel the exploration of new concepts and ideas
- Create a network of researchers and facilities
 - Connect with other academic, but also industry and government partners to expand TRIUMF's geographical footprint with the benefit of added infrastructure and financial resources

Be Different – Apply Physics to Life

TRIUMF Life Sciences will be an engine that applies accelerator science toward the study of life – in order to derive maximum societal benefit

TRIUMF has globally unique infrastructure, rare talent, and an innovative mindset to better life for all

- Renew and expand infrastructure to allow efficient and impactful research
 - Build TRIUMF's accelerator capabilities in isotope production, beam therapy and rare isotope research to be unparalleled and beyond the capabilities of other facilities
- Research impact can be magnified with strategic partners
 - Create a national and international network of facilities with complementary capabilities and low-barrier access to emerge with a research program that is greater than the sum of its individual parts
 - Leverage TRIUMF's unique infrastructure to build a sustainable technology translation ecosystem with public and private partners

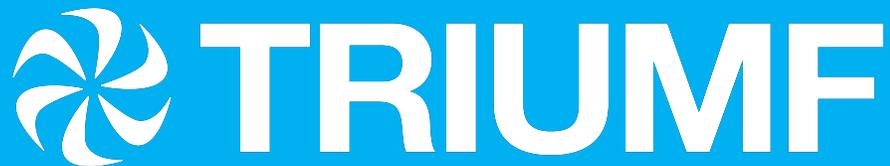
Be Bold – Train and Send Forth World-Class Talent

Creative, impactful research will be woven into the cultural fabric of TRIUMF Life Sciences; training a generation of innovative thought and technology leaders to work collaboratively across disciplines to ask tough questions and derive elegant answers.

- Foster an inclusive program that enables a diverse workforce
 - Provide administrative and operational support that allows researchers to pursue strategic research and development opportunities
 - Partner with public and private-sector partners to provide a translational pipeline for research and trainees
- Ingrain a robust training program focused on developing technology and thought leaders
 - Establish a strong recruitment program to attract talent
 - Connect with accredited institutions to enable and satisfy education goals

Vision

for Probes for Quantum Materials
and biomolecules



“More is Different”

- P.W. Anderson, Science 177, 4047 (1972).

“It is the long history of humankind that those who learned to collaborate and improvise most effectively have prevailed.”

- Charles Darwin

Our Vision for Probes for Quantum Materials and Biomolecules

TRIUMF has been and will continue to be a world-leading laboratory for molecular and materials science using a variety of probes from its accelerator-based beam facilities.

It's 45 year muon spin relaxation and 20 year beta-detected nuclear magnetic resonance program success will underpin the foundations of its future endeavours.

Engaging, educating and training the next generation of beam based material scientists for the variety of future probe techniques is critical to long term viability.

A broad initiative creating a virtual circle of collaborative inter-institutional learning and training is envisioned. Leveraging TRIUMF's core program with its Canadian and international user group will provide a springboard.

TRIUMF's wide range of scientific and technical expertise will facilitate the adoption of a variety of new probes for quantum materials and biomolecules, both on-site and externally with its partners.

The core program infrastructures have developed expertise that is very well suited to engage in a broad spectrum of beam based complimentary techniques.

	Now	Action	2042
Probes for molecular and materials science	<ul style="list-style-type: none"> • TRIUMF is a world leading muon and rare isotope facility. 	Continuing effort for maintaining, developing and expanding the probe techniques which TRIUMF already has.	TRIUMF has been and will continue to be a world-leading laboratory for molecular and materials science using a variety of probes from its accelerator-based beam facilities
Education and training of next generation scientists	<ul style="list-style-type: none"> • TRIUMF has well-established external experimenter programs for molecular and materials science. 	Continuing good collaboration between external and on-site scientists for research and education.	Engaging, educating and training the next generation of beam-based material scientists for the variety of future probe techniques is critical to long term viability.
Expertise to facilitate new probes	<ul style="list-style-type: none"> • TRIUMF has wide range of expertise in beam-based probes in molecular and materials science. 	Pursue synergy among other probes. Participation in development projects which aim for new probe facilities in Canada.	TRIUMF's wide range of scientific and technical expertise will facilitate adopting a variety of new probes both on-site and externally with its partners.

TRIUMF has been and will continue to be a world-leading laboratory for molecular and materials science using a variety of probes from its accelerator-based beam facilities.

It's 45 year muon spin relaxation and 20 year beta-detected nuclear magnetic resonance program success will underpin the foundations of its future endeavours

- Maintain, develop and expand the unique spin probes at TRIUMF well suited for molecular and materials science
 - Complete on-going beamline projects and start anticipated ones.
 - Develop new horizons of sample environments and probe spin manipulation (Pressure, high magnetic fields, low temperatures, and radio frequency fields)
 - Establish new spectroscopy methods (for example muonic X-ray elemental analysis)

Engaging, educating and training the next generation of beam based material scientists for the variety of future probe techniques is critical to long term viability

A broad initiative creating a virtual circle of collaborative inter-institutional learning and training is envisioned. Leveraging TRIUMF's core program with its Canadian and international user group will provide a springboard.

- Expand and involve more scientists who enjoy the power of probes available at TRIUMF
- Exchange human resources with universities and other institutes to foster future science at TRIUMF
 - Improve the accessibility of the probes for new scientists to participate in.
 - Collaborate with specialists in other sectors in TRIUMF to develop the next generation spectroscopy techniques.
 - Establish a scheme of human resource exchange between TRIUMF and external partners.

TRIUMF's wide range of scientific and technical expertise will facilitate adopting a variety of new probes for quantum materials and biomolecules, both on-site and externally with its partners.

The core program infrastructures have developed expertise that is very well suited to engage in a broad spectrum of beam based complimentary techniques.

- Contribute to the new probes to come in the future.
- Collaborate with complementary probe techniques – maximize the synergy among the Canadian large facilities for molecular and materials science.
 - Apply expertise which TRIUMF has, and help realize new accelerator-based research infrastructure on- and off-site.
 - Build a framework of complementary probe techniques available in Canada, to strengthen Canadian molecular and materials science.

Vision

for Accelerator Science &
Facilities



“Any sufficiently advanced technology is indistinguishable from magic.”

- Arthur C. Clarke

Our Vision for Accelerator Science and Facilities

Isotope Valley

With ISAC+ARIEL+IAMI we will greatly expand our capabilities, and establish TRIUMF as a leading global center for isotope research.

- Isotopes for physical science
- Isotopes for life science
- Isotopes to cure Canadians

Canadian Hub

We are Canada's centre of excellence in accelerator-related science and technology.

We centralize knowledge, and diffuse it through training, counsel, and collaborations.

With our always evolving expertise we remain a leader in Canada's transformation to a knowledge based economy.

Big Science — Big Tech

International collaborations are key to contribute to the most significant discoveries, attract talents, and maintain cutting-edge expertise.

We support international projects by leveraging our core knowledge and engaging Canadian industry.

We build on our strengths to serve science and invent life-changing technologies.

	Now	Action	2042
Isotope Valley	<ul style="list-style-type: none"> • ISAC • Building ARIEL • ATG/BWXT • Building IAMI 	<p>Develop the full potential of the new infrastructures.</p> <p>Leverage infrastructure to pursue new technologies/capabilities: THz, high-energy ISAC/RIB ring, ...</p> <p>Design and build next generation medical accelerators</p>	<p>TRIUMF as global center for the study and development of isotope science and applications.</p>
TRIUMF Hub	<ul style="list-style-type: none"> • Train HQP, make our teaching more accessible all across the country • We put our expertise to the service of Canadian projects 	<p>Improve our advertising strategy for the courses we teach, and the training we provide.</p> <p>Develop clear paths between Canadian accelerator related projects and TRIUMF expertise.</p>	<p>TRIUMF as central hub in Canada for teaching accelerator physics and technology with well recognized programs across broad platforms.</p>
Big Science Big Tech	<ul style="list-style-type: none"> • International collaborations • World leaders in beam physics and cutting edge technology: high-power accelerator & targets, SRF, ... 	<p>Develop/strengthen core competences while supporting Canadian science and Canadian industry through participation in key international projects like Hi-Lumi, EIC, ILC.</p>	<p>TRIUMF as key global partner with critical expertise in cutting edge technologies and key links with Canadian industry.</p>

TRIUMF as global center for the study and development of isotope science and applications.

- Develop the full potential of the new ARIEL/CANREB/IAMI infrastructures including their high-power drivers: Cyclotron & e-Linac
- Leverage infrastructure and know-how to pursue new technologies/capabilities
 - Leverage ARIEL e-Linac to develop Canadian THz source
 - Leverage SRF capability to advance ISAC post-accelerator to world leading ion energy
 - Leverage strength in beam physics to develop and implement unique low energy storage ring for neutron capture
- Design and build next generation medical accelerators
 - Develop next generation TR100 cyclotron and exploit for medical isotope production to support Canadian industry and community health

TRIUMF as central hub in Canada for teaching accelerator physics and technology with well recognized programs across broad platforms.

- Expand teaching to enhance inclusion across broad national platform.
 - Develop teaching modules with Canadian universities, CLS and provincial secondary education centers
 - Develop 'in house' workshops for hands on training
 - Train a wide diversity of HQP, all across the country.
- Develop clear paths between Canadian accelerator related projects and TRIUMF expertise.
 - Establish liaison office to bridge between Canadian projects and TRIUMF know-how

TRIUMF as key global partner with critical expertise in cutting edge technologies and key links with Canadian industry.

- Complete Hi-Lumi deliverables on crab cavity cryomodules, beam physics and wire correctors
- Establish deliverables for EIC, ILC and other large global initiatives to support and strengthen our partnership with CINF and IPP
- Develop and strengthen core competences in SRF, beam physics, and high-power accelerator and target technologies.
- Develop key relationships with Canadian industry while delivering cutting edge technology

Vision

for Quantum Technologies



People & Skills



	Now	Action	2042
New measurements	Some quantum technologies used	Continue to develop quantum technologies as part of the AMO toolkit	Cross-discipline precision measurements enabled
Detectors	Detector assembly, commissioning, operational support for running experiments	Identify technological challenges for the next generation of experiments and develop the novel quantum technologies that will enable the next generation of experimental efforts	Have made high impact contributions to new detector technologies at the center of new ground-breaking experiments
People	Engineering and technical staff to support assembly/operation of experimental hardware	Identify scientific and technical skills required to undertake the development of new experimental techniques and detector technologies; institute a development and hiring plan to meet the skills required.	TRIUMF staff at the forefront of technology and experimental innovation in international scientific endeavors; TRIUMF attractive to innovative scientific and technical staff
Quantum Computing	New Machine learning and Quantum Computing group	Develop hardware with Canada-wide collaboration to gain access to quantum computing.	Quantum leap in SAP physics with for example ab initio nuclear structure calculations possible
Exotic atoms	Competitive advantage in ability to produce and capture exotic atoms and radioactive isotopes	Develop techniques to produce, manipulate and probe exotic atoms and molecules	Host a world-leading EDM experiment or other fundamental symmetry experiment
Leadership	Leading roles in antimatter physics at CERN	Take on ambitious projects to develop and apply quantum technologies (e.g. HAICU) by leveraging TRIUMF/Canadian expertise in (anti)AMO, traps, lasers, microwaves, detectors	Dramatic improvements in symmetry tests by TRIUMF/Canadian-led experiments, e.g., CPT and Equivalence Principal tests by hydrogen vs. antihydrogen comparisons

Vision

for Scientific Computing



“I do not fear computers. I fear lack of them.”

- I. Asimov

“A classical computation is like a solo voice—one line of pure tones succeeding each other. A quantum computation is like a symphony—many lines of tones interfering with one another.”

- S. Lloyd.

Our Vision for Scientific Computing

TRIUMF will establish state-of-the-art scientific computing infrastructure and services

A coherent and focused approach to scientific computing will add tremendous value to the on-site experiments, and local research groups across the laboratory

TRIUMF will enhance its science output through the application of modern scientific computing and Machine Learning technologies

TRIUMF will train highly qualified personnel in AI, heterogeneous hardware utilization and physics simulations

TRIUMF will operate a quantum computing user facility, providing quantum computing access to academic and industry users across Canada and internationally

Research performed at the center will have transformative societal impact

Now

Action

2042

Theme 1

- Current scientific computing activities at the laboratory are somewhat fragmented
- Overall support structure not well defined
- Not keeping up with technological advances

Establish a focused and coherent approach to research computing

TRIUMF will establish state-of-the-art scientific computing infrastructure and services

Theme 2

- Modelling of the passage of particles through matter is critical to particle and nuclear physics, detector development, life sciences. Synergies currently not realized
- ML is starting to get traction in some areas of research at TRIUMF and research supported at TRIUMF but it's adoption is not widespread among the represented fields.
- Massively parallel software utilizing heterogeneous computing infrastructure is important for several core science topics at TRIUMF – however efforts in this area are not centrally supported

The establishment of a scientific computing center of excellence.

TRIUMF will enhance its science output through the application of modern scientific computing and Machine Learning technologies

Theme 3

- No publicly available academic quantum computer is currently available. Free and for-fee offerings exist from commercial vendors.
- User center providing reliable no-red-tape access to state-of-the art trapped ion quantum computer will spur research in fundamental quantum computing and quantum computing applications, including in the fields core to TRIUMF's mission.

Establishment of Trapped Ion Quantum Computing user facility

TRIUMF will operate a quantum computing user facility, providing access to academic and industry users across Canada and internationally

TRIUMF will establish state-of-the-art scientific computing infrastructure and services

A coherent and focused approach to scientific computing will add tremendous value to the on-site experiments, and local research groups across the laboratory

- Organizational changes so IT services and functions only focus on the business end of TRIUMF's operations (e.g., Mail, Web applications, documents, collaborative tools, etc.)
- Establish an on-premises advanced computing infrastructure dedicated solely to research computing, with minimal total cost of ownership and with varying capabilities to serve also the local theory group for parallel code developments
- Establish a service layer, similar to cloud computing, so users can deploy their own services within a trusted and secure framework
- Keep abreast of technological advances in the computing industry. Establish collaborative agreements with industry to gain competitive edge.
- Enhance DAQ capabilities with co-processors (such as FPGAs and GPUs) in online processing chains
- Support Tier-1 like facility operations and work in concert with NDRIIO
- Continue to collaborate on international projects, such as the Worldwide LHC Computing Grid and the European Grid Infrastructure, through which key developments and innovative technologies emerge regarding advanced networks, distributed computing, workload management, and data management.

TRIUMF will enhance its science output through the application of modern scientific computing and Machine Learning technologies

TRIUMF will train highly qualified personnel in AI, heterogenous hardware utilization and physics simulations

- Modest increase in personnel dedicated to modelling and software creation for codes used for modelling passage of particles through matter and other physical simulations.
- Gradual increase in personnel supporting AI effort. Hiring will follow a pattern where each expert has appreciation for at least one of the fields (Life Sciences, Nuclear Physics, Particle Physics, Accelerator Physics) in addition to ML expertise. Focus will be on breadth of fields represented.
- Establishment of formal model of funding the personnel via a combination of research grants and operating funds.
- Establishment of a succession of pilot projects in AI focusing on breadth of projects.
- Establishment of managed project workflow for detector or target modeling.
- Incorporation of the personnel into an excellence center.

TRIUMF will operate a quantum computing user facility, providing access to academic and industry users across Canada and internationally

Research performed at the center will have transformative societal impact

- Initial establishment of a prototype center through CFI funding with close collaboration from University partners
 - Technical and Scientific team growth
- Establishment of custom pilot projects performed using the developed infrastructure
- Maturation of the infrastructure into initial user center; Establishment of merit-based open access scheme
- Partial or full transition of the personnel into permanent positions
- Continued growth and update of the infrastructure with the feedback to the University partners developing new quantum computing machines and quantum computing methodologies.
- Continued operationalization of new quantum computers into a supported user center

Vision

for Site Development

“Build it and they will come...”

Quote from *“Field of Dreams”*

“Recognizing the need is the primary condition for design.”

- Charles Eames

“As an architect you design for the present, with an awareness of the past, for a future which is essentially unknown.”

- Norman Foster



Our Vision for Site Development

The TRIUMF campus can be reimagined and reinvented via effective **placemaking** by its community as a public space incorporating its historical legacy, unique culture and organizational identity.

Establish a site that is welcoming and inspirational attracting employees, drawing visitors from all over the world and inspiring future generations of scientists.

TRIUMF is a multi-faceted **hub** that inspires and promotes collaboration, innovation, and discovery.

Develop a site that fosters innovation and collaboration in research, education, and industry, and that engages, integrates, and nurtures relationships with our community.

TRIUMF is a **showcase** for research, science and innovation that is attractive, cohesive and sustainable.

Design a site that is thoughtfully planned and designed to be sustainable, resilient and adaptable to future needs while always heightening awareness and visibility of the research and science being conducted within.

Now

Action

2042

ATTRACT

- TRIUMF's diverse scientific portfolio is enabled by the world's largest cyclotron at Canada's multi-disciplinary particle accelerator centre
- Secluded on the southwestern corner of the UBC campus

- Conceive a landmark building on the site that **engages the broader community's curiosity** about activity behind the radiation fence
- Showcase the **cultural heritage and site significance** through an outreach/visitor center
- Establish a **'front door'** for the campus and enhance the edges
- Modernize and expand the breadth **staff amenities and facilities**

The TRIUMF campus can be reimagined and reinvented via effective placemaking by its community as a public space incorporating its historical legacy, unique culture and organizational identity.

CONNECT

- TRIUMF is a collaborative hub, known and recognized internationally for its research and innovation

- Design multi-purpose **collaboration spaces** both indoors and outdoors
- Equip a **maker and incubation spaces** for the research community, to encourage commercialization of intellectual property developed at TRIUMF and to engage the general public in our activities on site
- Improve and expand **working partnerships** with other local Vancouver universities and post-secondary institutions.

TRIUMF is a multi-faceted hub that inspires and promotes collaboration, innovation, and discovery.

DESIGN

- A utilitarian design, with facilities designed primarily for function – not form or aesthetics
- The majority of the campus plan has evolved organically, lacking a clear direction or cohesion in the current layout of buildings
- Some green building standards applied to for new buildings
- Outdated equipment and technology on site

- Construct **bold landmarks**
- Invest in **high quality workspaces**
- Incorporate **sustainability practices** into site development
- Improve **space utilization** and site flow

TRIUMF is a showcase for research, science and innovation that is attractive, cohesive and sustainable.

The TRIUMF campus can be reimagined and reinvented via effective **placemaking** by its community as a public space incorporating its historical legacy, unique culture and organizational identity.

Establish a site that is welcoming and inspirational attracting employees, drawing visitors from all over the world and inspiring future generations of scientists.

- Design a **welcoming approach** to the site ensuring it is both open and accessible
- Build a **visitors' centre** with a focus on outreach and education through interactive displays to attract visitors, translate the work conducted at TRIUMF to the public, and galvanize interest in STEM
- Increase use of **transparency, visual displays, art and technology** to help the public comprehend the work that we do, including inaccessible areas such as the cyclotron, beamlines and counting rooms, building on the virtual tour that has been recently developed by the communications team.
- Commission **publicly accessible space** for visitors, site tours and demonstrations to deepen the connection with our neighbours, UBC and Greater Vancouver communities as well as a café, meeting rooms, lecture halls, auditorium, incubation and maker spaces
- Showcase the **cultural heritage and significance** of the site using art installations incorporating old, decommissioned equipment and historical documents and photos
- Improve **staff amenities and facilities** to attract and retain top talent such as a fitness centre or daycare promoting a healthy work-life balance and employee wellness
- Invest in **collaborative, high quality work environment** that supports work-life balance to attract and retain staff and welcome users
- Redevelop the **control room**, the nerve centre of TRIUMF at the heart of all operations, as a modern, focal point of the campus as a showcase building that increases our visibility with staff, visitors, and the general public
- Reimagine the **perimeter fencing** and increase public awareness and trust in our operations and activities through education, outreach, and knowledge sharing

TRIUMF is a multi-faceted **hub** that inspires and promotes collaboration, innovation, and discovery.

Develop a site that fosters innovation and collaboration in research, education, and industry, and that engages, integrates, and nurtures relationships with our community.

- Design multi-purpose **collaboration spaces** indoors and outdoors designed to stimulate partnerships and dialogue between staff, researchers and visitors on site, including: a cafeteria, coffee shop, plaza, outdoor meeting space, lecture halls and networking spaces to host colloquia and conferences
- Equip a **maker space** and invite researchers, industry and the general public interested in STEM to use our spaces, tools and workshops exposing students, postdocs, technicians and engineers to new technologies
- Create an **incubation space** to support start-ups in commercialization of TRIUMF's intellectual property
- TRIUMF's physical site is designed will an explicit focus on inspiring and nurturing **young scientists, future leaders and innovators**
- Improve the **working partnership** with UBC, collaborating and developing the 30-year plan for the UBC's south campus
- Reimagine **accommodations for visiting researchers** and what this could look like in the future with UBC's south campus
- Plan the site with clear consideration for building the **relationship with the Musqueam Nation** through thoughtful engagement, incorporating and respecting their interests and areas of cultural significance

TRIUMF is a **showcase** for research, science and innovation that is attractive, cohesive and sustainable.

Design a site that is thoughtfully planned and designed to be sustainable, resilient and adaptable to future needs while always heightening awareness and visibility of the research and science being conducted within.

- Construct **bold landmark** buildings that are architecturally distinctive, interesting, inviting, and inspirational utilizing building height to optimize land-use space and increase the visibility and functionality of the site
- Establish a new entrance that is **inviting and welcoming** to the community
- **Consolidate** new modern structures with the older buildings on site
- Reimagine an environment with **high quality workspaces** such as offices, counting rooms and meeting rooms that encourage collaboration, are a source of pride for employees, and support and inspire innovation
- Integrate with the site's **natural** surroundings, through interior landscaping with green walls and outdoor landscaping with drought resistant plants, native plants, and bioswales for storm water management
- Incorporate **sustainability practices** into site planning, create showcase buildings that are highly efficient with retrofits to the highest standards, reducing the environmental impact of energy, water, and waste
- Partner with UBC to **utilize waste heat** as an energy source in the campus district energy system
- Advocate for increased site **accessibility**, linking TRIUMF to transportation infrastructure at UBC, including future Skytrain development
- Elevate **occupational health and safety** using technology and innovation, such as automation, controls and robotics in areas that present radiation hazards and are inaccessible during operations
- Optimize flow of the site and improve **space utilization** by creating a logical and coherent hierarchy of spaces, including multi-purpose, flexible spaces between buildings and on rooftops

Vision

for People & Skills

“Twenty years from now you will be more disappointed by the things that you didn’t do than by the ones you did do. So throw off the bowlines. Sail away from the safe harbour ... Explore. Dream. Discover.”

- Mark Twain

“When everyone is included, everyone wins”

- Jesse Jackson



Our Vision for People & Skills

A leader for cultivating equity, diversity, and inclusion (EDI) in STEM, playing host to a diverse and inclusive community that reflects Canadian society

Build a culture where equity, diversity, and inclusion are deeply embedded into the values and operating principles across all areas of the laboratory

A role model for job path and professional skills development and work-life balance through each phase of our employees' career

Develop a flexible framework to support employee development throughout their careers at TRIUMF, including support for balancing work and life commitments

A centre for innovative cross-disciplinary experiential learning and professional skills development sought after by students around the world

Equip a global network of leading researchers with dedicated teaching facilities that support a world-class skills-based education platform

A nationally recognized partner of choice with key stakeholders (across government, education, civil society, and industry) promoting public awareness of big science impacts

Create world-class facilities to enable and promote real-world impacts, provide community access and education, and contribute to the national awareness of scientific discovery

Now

Action

2042

<p>Equity, Diversity, and Inclusion (EDI)</p>	<p>TRIUMF is making incremental progress on promoting and advancing EDI within the laboratory and related communities</p>	<p>Leverage resources and partners to cultivate EDI champions embedded in all levels of the organization</p>	<p>A leader for cultivating EDI in STEM, playing host to a diverse and inclusive community that reflects Canadian society</p>
<p>Career Path Development</p>	<p>A laboratory completing its transition from a founder/employee era to a second generation phase; viewed as a good place to work with a sense of community Emerging career path development, succession planning, and family support frameworks</p>	<p>Develop a comprehensive career pathways and a thorough succession planning framework Establish models that balance career and family responsibilities at all levels of employment</p>	<p>A role model for job path and professional skills development and work-life balance through each phase of our employees' career</p>
<p>Student Training & Development</p>	<p>TRIUMF offers a cross-disciplinary experiential learning experience, with an emerging professional skills development program</p>	<p>Develop comprehensive and relevant professional skills program, including best practices for strengthening connection to TRIUMF's global researcher network Secure training centre resources where skills training and networking take place</p>	<p>A centre for innovative cross-disciplinary experiential learning and professional skills development sought after by students around the world</p>
<p>Outreach & Science Promotion</p>	<p>Limited public facilities for outreach and education and largely constrained to regional activities, but increasingly transitioning to online platforms for wider reach</p>	<p>Develop a financial strategy to support development of new outreach spaces on campus, as well as increase focus to engage at a national scale</p>	<p>A nationally recognized partner of choice with key stakeholders (across government, education, civil society, and industry) promoting public awareness of big science impacts</p>

A leader for cultivating equity, diversity, and inclusion (EDI) in STEM, playing host to a diverse and inclusive community that reflects Canadian society

Build a culture where equity, diversity, and inclusion are deeply embedded into the values and operating principles across all areas of the laboratory

- Establish a strong and robust culture of equity, diversity, and inclusion whereby these values are entrenched across all teams and levels within the organization
 - Demonstrate organizational commitment to EDI efforts by investing in staff and programming to move TRIUMF forward in its objectives
 - Position TRIUMF as partner of choice and seek out collaborations with key stakeholders to amplify TRIUMF's reach and impact
 - Monitor progress by developing datasets and KPIs to support leadership in making difficult – but informed – decisions on EDI issues
 - Build and maintain, from the top down, an organization that is accountable to its community and reflects the values it seeks to promote

A role model for job path and professional skills development and work-life balance through each phase of our employees' career

Develop a flexible framework to support employee development throughout their careers at TRIUMF, including support for balancing work and life commitments

- Provide focus and resources to establish career path development best practices
 - Invest in succession planning in support of professional development at all levels of the organization
 - Strengthen mentoring, training, and learning structure practices across the lab
 - Invest in skills-based conference and workshop networking opportunities
- Set the standard within research community for work-life balance commitments
 - Child-care options for its employees include on-site and sponsored spaces
 - Provide high-value community space and services to the staff and student body

A centre for innovative cross-disciplinary experiential learning and professional skills development sought after by students around the world

Equip a global network of leading researchers with dedicated teaching facilities to support a world-class skills-based education platform

- Have TRIUMF regarded as a premiere partnership and training facility for emerging talent and recruitment by industry partners
 - Measure, assess, and reorient professional skills training program to continually align student success criteria with academia and industry
- Campus development includes co-located spaces for training and workshops, networking, and support services
 - Campus plan includes teaching space, remote learning, networking and communal space, professional mentoring, and coaching services
 - Maximize opportunities for students to engage and connect with TRIUMF's global network of research visitors

A nationally recognized partner of choice with key stakeholders (across government, education, civil society, and industry) promoting public awareness of big science impacts

Create world-class facilities to enable and promote real-world impacts, provide community access and education, and contribute to the national awareness of scientific discovery

- Attract key partnerships, increase staff and student retention, and serve as the hub for a national outreach network
 - Invest financial resources into the development of a flagship main office building and community space (as indicated in the *25-year Campus Vision* architectural design study)
 - Expand capability for *TRIUMF Innovations* to serve as an ambassador and promotional engine of opportunity in “big science”
 - Create deeper cultural ties to the lab’s purpose to increase the value of its brand; cultivate logo and trademark recognition at a national scale

Vision

for Emerging Trends in
Convergence Research

“Merging ideas, approaches and technologies from widely diverse fields of knowledge at a high level of integration is a crucial strategy for solving complex problems and addressing complex intellectual questions.”

- Canada Foundation for Innovation



“Curiosity-driven, discovery-based explorations and use-inspired, solutions-focused innovations are indeed the double helix that makes up the DNA of the U.S. National Science Foundation (NSF).”

- Dr. Sethuraman Panchanathan, NSF Director

Our Vision for Emerging Trends in Convergence Research

TRIUMF is a hub for collaboration in convergence & HIBAR research, building on its strength in its core disciplines

Build an environment at TRIUMF and exploit our network to foster cross-disciplinary collaboration and use-inspired basic research to contribute to addressing societal and scientific grand challenges.

TRIUMF's brand is synonymous with the value of science and with science communication in Canada

Build trust in science as basis for sound decision making and generate access to STEM opportunities for all communities by leveraging TRIUMF's inspiring story and our nationwide network.

TRIUMF is a cornerstone of Canada's roadmap for large-scale research at home and globally

Establish an alliance of major research facilities and partner with universities, agencies, and government to establish a strategic framework for lifecycle support of major research facilities and international big science participation as part of Canada's response to grand challenges

Now

Action

2042

<p>Convergence Research</p>	<ul style="list-style-type: none"> • Convergence research at TRIUMF has been very successful while being mostly impromptu • TRIUMF is nimble and has broad multidisciplinary expertise and infrastructure • Lack of awareness of needs, opportunities, and partnerships inhibits strategic approach 	<ul style="list-style-type: none"> • Develop mechanisms to identify topics and partners for convergence research • Develop an environment to incentivise researchers to tackle grand challenges • Position TRIUMF in the convergence space and build partnerships • Develop clear ‘front door’ to facilitate engagement in convergence research • Facilitate in- and outward mobility across disciplines and institutions 	<p>TRIUMF will be a model of collaboration in convergence & HIBAR research, building on its strength across its core disciplines.</p>
<p>Trust in Science</p>	<ul style="list-style-type: none"> • Various social forces undermining trust in science within society • Limited reach of TRIUMF’s outreach program • Inequity in access to science and education resources 	<ul style="list-style-type: none"> • Extend engagement to communities across Canada • Expand development opportunities for educators engaged in outreach activities • Curate outreach resources from and for our members and partners. • Communicate the value of science, technology and innovation 	<p>TRIUMF’s brand is synonymous with the value of science and with science communication in Canada</p>
<p>Big Science</p>	<ul style="list-style-type: none"> • TRIUMF is a major Canadian gateway to large scale international science • Lack of national strategic approach to Big Science portfolio and facility operations, lifecycle support, and international science engagement • TRIUMF funding model lacks long term approach to infrastructure development and operations 	<ul style="list-style-type: none"> • Advocate for a national Big Science strategy and governance model • Create an association of large research facilities as an advocate for Big Science investment and stewardship 	<p>TRIUMF is a cornerstone of Canada’s roadmap for large-scale research at home and globally</p>

TRIUMF will be a model of collaboration in convergence & HIBAR research, building on its strength across its core disciplines.

Build an environment at TRIUMF and exploit our network to foster cross-disciplinary collaboration and use-inspired basic research to contribute to addressing societal and scientific grand challenges.

- Develop mechanisms to identify topics and partners for convergence research
 - Generate internal and external dialog around grand challenges
- Develop an environment to incentivise researchers to tackle grand challenges
 - Make convergence/HIBAR research part of the TRIUMF mission
 - Establish an Innovation Fund for convergence / HIBAR research
- Position TRIUMF in the convergence space and build partnerships
 - Develop strategic partnership with academic and non-academic partners on convergence/HIBAR research
 - Raise awareness of key influencers of the fact that TRIUMF is a go-to place to help solve challenging problems
- Develop clear 'front door' to facilitate engagement w/ TRIUMF in convergence research
 - Leverage TRIUMF Innovations to connect industry partners to TRIUMF researchers
 - Develop resourced "tickets" for new partners' "bench time" to provide early-stage access to expertise/facilities
- Facilitate in- and outward mobility across disciplines and institutions
 - Establish a Sabbatical & Residence Program for convergence / HIBAR research

TRIUMF's brand is synonymous with the value of science and with science communication in Canada

Build trust in science as basis for sound decision making and generate access to STEM opportunities for all communities by leveraging TRIUMF's inspiring story and our nationwide network.

- Extend engagement to communities across Canada
 - Leverage TRIUMF's nationwide network and virtual resources to connect more communities to STEM opportunities.
 - Tell our story and engage with the nation's young and inquiring minds in a variety of ways.
- Expand development opportunities for educators engaged in outreach activities
 - Work with established partners in the science communication space to develop a broad portfolio of activities and resources building on their own expertise and life experiences
- Curate outreach resources from and for our members and partners
 - Establish a "community of practice" for outreach contacts in member university and other partners
 - Build tools and cultivate communications connections that can be leveraged across our network.
 - Curate digital communications resources to link our network's research with its benefits to society.
- Communicate the value of science, technology, and innovation
 - Work with stakeholders and partners to celebrate shared successes.
 - Emphasize the role of science, data, and evidence for sound decision making
 - Collaborate with member universities, the NRC, granting councils, CFI, international partners, and industry to amplify each other's voices to tell powerful Canadian stories in science, technology, and innovation

TRIUMF is a cornerstone of Canada's roadmap for large-scale and convergence research

Establish an alliance of major research facilities and partner with universities, agencies, and government to establish a strategic framework for lifecycle support of major research facilities and international big science participation as part of Canada's response to grand challenges

- Leverage strategic partnerships to make visible contributions in response to Canada's grand challenges
 - Demonstrate how our unique large-scale research and technological capabilities as well as our extensive partner network will impact grand challenges in areas related to Energy, Environment, Health, Quantum Technologies
- Become a major advocate for a Big Science strategy and governance model in Canada
 - Engage the other Canadian Big Science Players in government relations conversation
 - Propose funding schemes that specifically leverage Big Science facilities convergence efforts
 - Develop a non-partisan “Big Science” parliamentary caucus
- Create an association of large research facilities as an advocate for Big Science investment and stewardship
 - Engage stakeholders in Big Science discussion, e.g. through a Big Science Round Table

Vision

for Innovation & Collaboration



“When you need to innovate, you need collaboration”

-Marissa Mayer

“Collaboration is key, it takes innovation and creativity to the next room”

-Shawn Lukas

Our Vision for Innovation & Collaboration

Big Science collaborations have real world impact in multiple sectors

Enhance collaboration between Big Science researchers, industry, government to use expertise and infrastructure to address challenges in multiple industry sectors

Canada has an innovative nuclear medicine ecosystem accelerating research discoveries into treatments for patients

Build a strong, innovative nuclear medicine ecosystem with infrastructure, talent, project pipeline incubation/commercialization and sustainability

The next generation of innovation leaders is trained in a multidisciplinary collaborative culture

Create national programs which provide students with training and role models with high engagement from both industry and academia on collaborative, innovative projects

	Now	Action	2042
Innovative Tech Sector researchers and companies	<ul style="list-style-type: none"> Big Science infrastructure and expertise is not leveraged to its full potential to solve societal challenges 	Establish Big Science framework for collaboration from multiple sectors of industry/government to address challenges	Big Science collaborations have real world impact in multiple sectors
Nuclear medicine researchers, companies, patients	<ul style="list-style-type: none"> Early research discoveries “die on the vine” Lack of innovative technology pipeline for industrial development 	Create an ecosystem to triage discoveries; then accelerate technologies with highest potential with focused public-private collaborations	Canada has an innovative nuclear medicine ecosystem accelerating research discoveries into treatments for patients
Young People and Trainees	<ul style="list-style-type: none"> Too few students are trained in real world skills. Trainees have limited opportunities to collaborate outside their area of study 	Provide more cross-sectoral training opportunities with public private collaborations	The next generation of innovation leaders is trained in a multidisciplinary collaborative culture

Big Science collaborations have real world impact in multiple sectors

Enhance collaboration between Big Science researchers, industry, government to use expertise and infrastructure to address challenges in multiple industry sectors

- Create a [national Big Science Collaboration Framework](#) that includes researchers, industry partners, government
 - Bring together Big Science organizations and identify key infrastructure, expertise, networks that can be leveraged to address real world challenges
 - Connect with industry and government partners to identify challenges that can be impacted by Big Science collaborations
 - Develop programs to accelerate and celebrate collaborations that effectively leverage Big Science capacity for real world impact

Canada has an innovative nuclear medicine ecosystem accelerating research discoveries into treatments for patients

Build a strong, innovative nuclear medicine ecosystem with infrastructure, talent, project pipeline incubation/commercialization and sustainability

- Build a **national Medical Isotope Innovation Ecosystem** that includes researchers, industry partners, government
 - Identify and triage early stage discoveries from nuclear medicine researchers
 - Focus and fund most promising discoveries in partnership with private sector and government
 - National and local events to build networks and facilitate collaboration
 - Build a sustainable ecosystem from bench to bedside
 - Focus on innovative, impactful new diagnostics and therapies

The next generation of innovation leaders is trained in a multidisciplinary collaborative culture

Create national programs which provide students with training and role models with high engagement from both industry and academia on collaborative, innovative projects

- Leverage successful TRIUMF training program into a national program that connects top students with innovative multi-disciplinary training opportunities
 - Partner with top industry partners to develop training opportunities that provide trainees with hands-on experience and real-world job skills
 - Provide role models/mentors from both academia and industry
 - Focus and incentivize multi-disciplinary, collaborative projects with high innovation potential