

# TRIUMF CANADA'S PARTICLE ACCELERATOR CENTRE

Established in 1968 in Vancouver, TRIUMF is Canada's particle accelerator centre. The lab is a hub for discovery and innovation inspired by a half-century of ingenuity in answering some of nature's most challenging questions. From the hunt for the smallest particles in the universe to the development of new technologies, TRIUMF is pushing frontiers in research, while training the next generation of leaders in science, medicine, and industry.

$$\nabla \cdot \underline{B} = 0$$

$$\nabla \times \underline{B} = \mu_0 \underline{j} + \mu_0 \epsilon_0 \dot{\underline{E}}$$

$$E = mc^2$$

$$E = h\nu$$

$$dS \geq 0$$

$$\underline{F} = m \underline{a}$$

$$\frac{\partial^2 u}{\partial t^2} = v^2 \nabla^2 u$$

## MESSAGE FROM THE DIRECTOR

For more than fifty years, the TRIUMF community has served at the forefront of scientific research. Our leadership and our contributions have pushed the frontiers of knowledge and improved lives in ways that the laboratory's founders could not have anticipated. Building on our legacy of success, we continue to chart an ambitious path forward for our science, our community, and those we serve.

Our work as science leaders is critically important, now more than ever. The world is facing a time of significant change, and we are navigating a number of obstacles that touch many aspects of our lives and our society, from climate change, through injustice and inequality, to the global COVID-19 pandemic. While TRIUMF may not be a driving force in addressing every such challenge, our contributions and influence on the world should not be underestimated.

Powered by some of the world's best and brightest, our community continues to find new and meaningful ways to put Canadian science and innovation at the forefront of the response to these challenges. We are leveraging our world-leading infrastructure, expertise, and our global networks of collaborators and partners to drive progress in key areas of our strategic vision. We continue to strengthen the bonds that connect our science across the world, from the hunt for dark matter to the leading edges of particle physics or nuclear medicine, and beyond. We are maximising the impact of our science by generating innovative opportunities and propelling them to the market and into the communities we live and work in.

Further, TRIUMF's recent restructuring from a joint venture to a non-profit corporation modernizes key elements of our organization, and strengthens our relationships with our university members. This will allow us to better fulfill our mission of serving as Canada's particle accelerator centre, empowering our efforts towards sustainability that leverage multi-disciplinarity, multi-sector collaboration, and the effective use of the nation's strategic Big Science assets.

TRIUMF's future is bright. And though collectively we face many challenges, I know that our vision – for Canada to lead in science, discovery, and innovation, improving lives and building a better world – will continue to serve us well as we navigate them together.

A handwritten signature in black ink, appearing to read 'Nigel Smith', with a stylized flourish extending to the right.

Nigel Smith

Director and CEO, TRIUMF

# WHAT DRIVES US

## OUR VISION

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

## OUR 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.

## OUR WORK



### SCIENCE AND TECHNOLOGY

TRIUMF's multidisciplinary expertise and state-of-the-art infrastructure enable the Canadian science and technology community to carry out internationally recognized cutting-edge research. Our ground-breaking discoveries drive Canada's contributions to extending the frontiers of knowledge.



### PEOPLE AND SKILLS

TRIUMF offers a unique training ground for the next generation of science and innovation leaders. We educate students at all levels, providing them with the skills needed to succeed in the knowledge economy.



### INNOVATION AND COLLABORATION

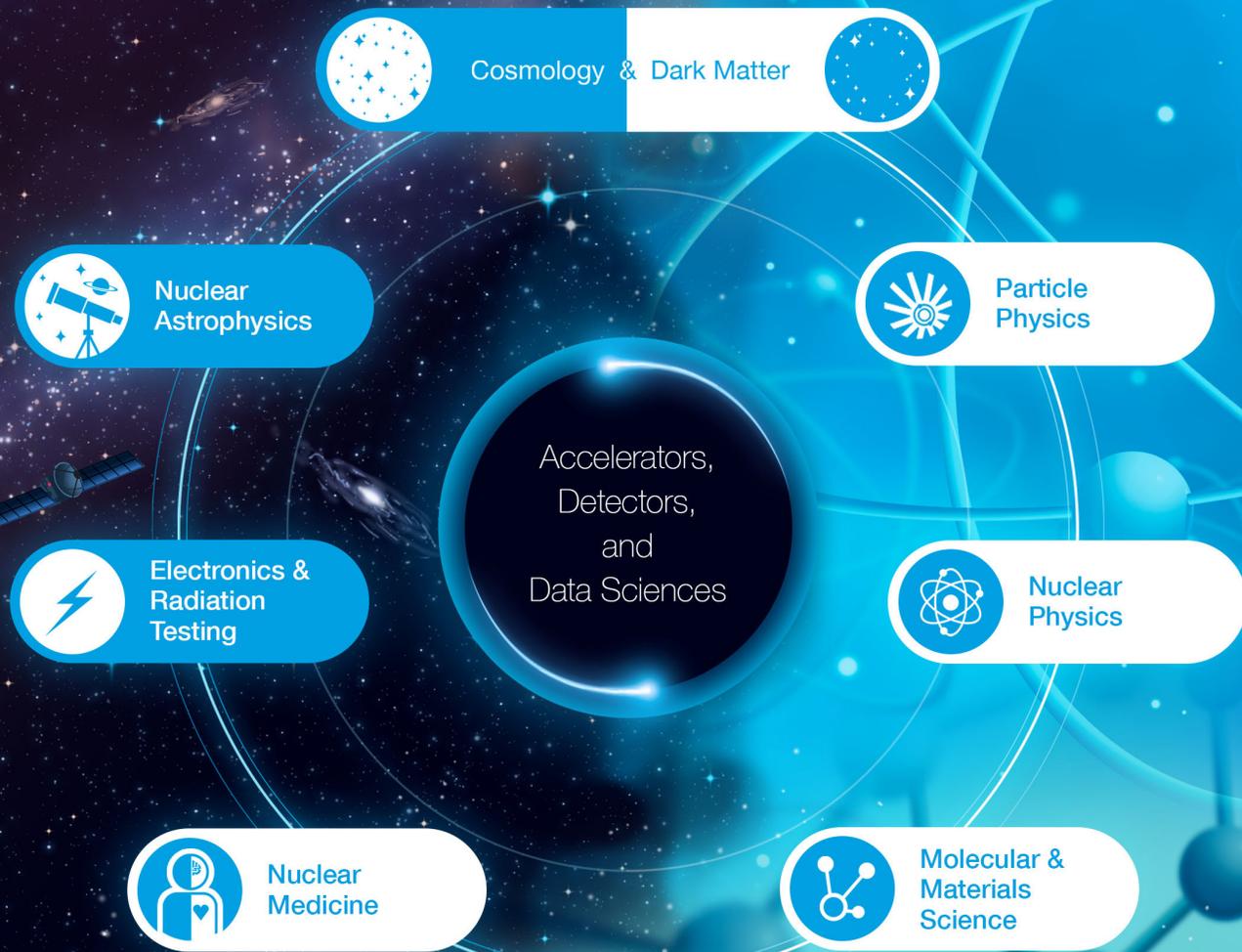
As a hub for discovery and collaboration, we link leading universities and research centres across the country and act as Canada's gateway to international big science projects.

## TRIUMF'S RESEARCH ACTIVITIES

Macro to micro: Accelerating discovery and innovation by connecting the study of the vast with the study of the very, very small

Outer Space

Inner Space



## ADVANCED RARE ISOTOPE LABORATORY (ARIEL)

The Advanced Rare Isotope Laboratory (ARIEL) will be one of the world's premiere multi-user facilities for producing rare isotopes. Powered by some of the most advanced accelerators and targets for producing and processing short-lived isotopes, ARIEL will revolutionize the study of isotopes for science, medicine, and industry. It will enable TRIUMF and its partners to pursue critical advances in the understanding of isotope production and the technologies to generate isotopes, all while shedding light on some of the most fundamental questions in science.

### ARIEL Progress

at a glance

**2010** – ARIEL receives funding and construction begins

**2014** – ARIEL brings online the world's highest-power electron-linear accelerator for rare isotope production

**2020** – First beam through CANREB and into ISAC-II experimental hall, bringing a first glimpse of ARIEL-era science

**2026** – ARIEL is expected to be completed and fully online



## INSTITUTE FOR ADVANCED MEDICAL ISOTOPES (IAMI)

Canada is home to world-leading researchers, clinicians, and industrial partners who are working to realize the benefits that medical isotopes — valuable tools for diagnosing and treating life-threatening illnesses, from cancer to dementia to cardiac disease — can bring to society. As a hub for this activity, the Institute for Advanced Medical Isotopes (IAMI) will accelerate academic research and industrial collaboration, positioning Canada as a global leader in the manufacture and study of existing and emerging medical isotopes. IAMI will synergize Canada's medical isotope ecosystem and bring together diverse partners from across healthcare, industry, and academia.

### IAMI Progress

at a glance

- The IAMI building is expected to be completed in 2022, including installation of a new TR2-24 cyclotron and laboratories suitable for radiopharmaceutical manufacturing
- IAMI is a key strategic component for the expansion of British Columbia's clinical PET program, and is envisioned to be a critical source of short-lived isotopes like fluorine-18 (F-18) and gallium-68 (Ga-68) as new diagnostic imaging centres come on-line
- In 2020, Health Canada approved cyclotron-produced technetium-99m for national implementation, boosting the availability of this critical isotopes for Canadian patients
- TRIUMF continues to build partnerships that increase production capacity for key isotopes, including PET tracers like zirconium-89 and alpha-emitters like actinium-225, a rare radioisotope that has shown great promise in clinical trials for the treatment of late-stage cancer



## TRIUMF INNOVATIONS

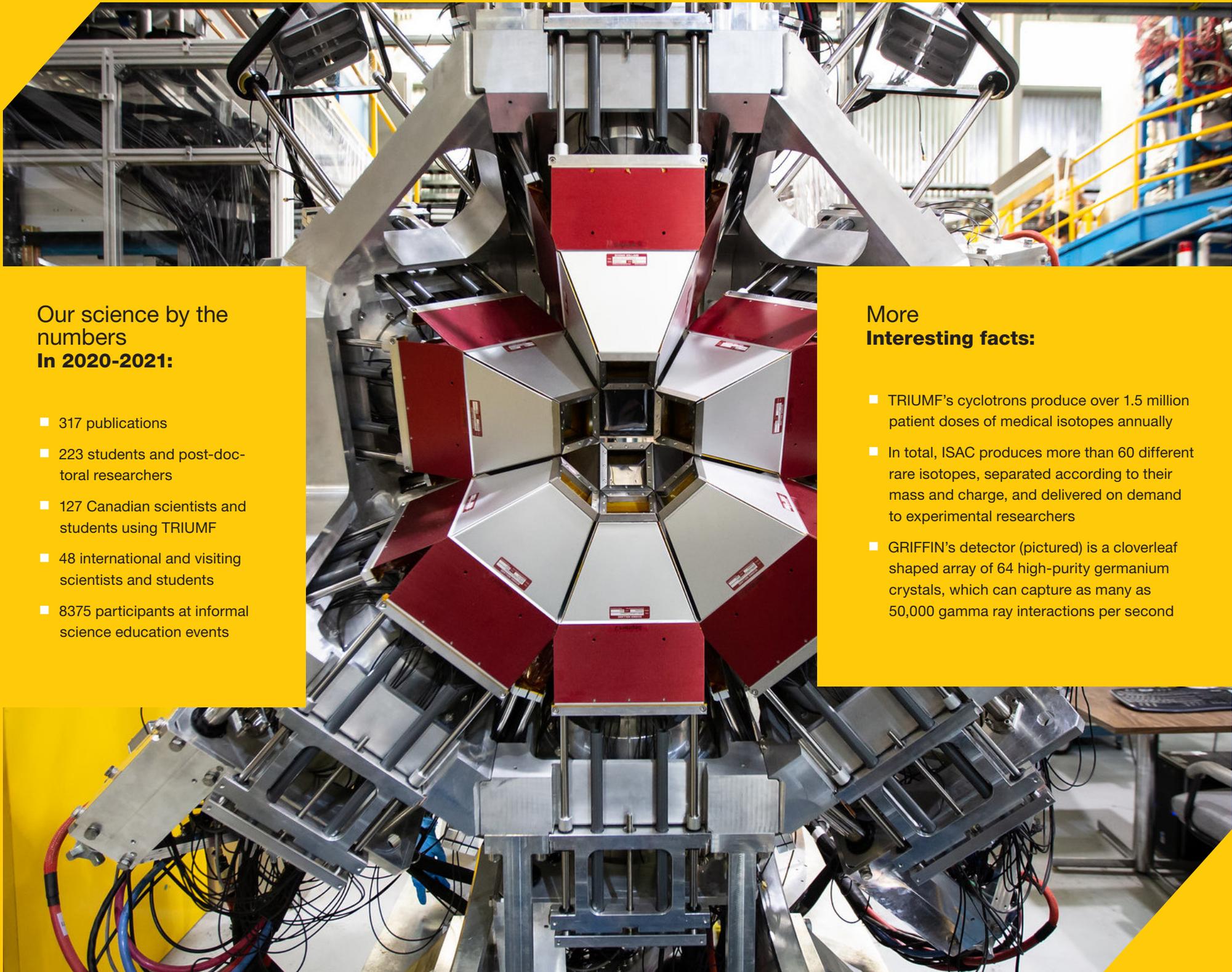
TRIUMF's network of innovators is constantly developing new tools and techniques that push the frontiers of knowledge. These scientific innovations hold immense promise for the world beyond the lab – including the marketplace. The dedicated team of technology transfer professionals at TRIUMF's commercialization arm, TRIUMF Innovations, connects scientific inventions and ideas from particle detectors to isotope manufacturing systems — and the innovators behind them — to opportunities in the private sector. TRIUMF Innovations also streamlines industry access to world-class expertise, ideas, and infrastructure across the TRIUMF network, which includes the laboratory's member universities, diverse industry partners, and international collaborators.

## TRIUMF Innovations

at a glance

- TRIUMF spin-off ARTMS Inc. is a leader in the development of novel technologies and products that enable high-quality and high-yield production of the world's most-used diagnostic imaging isotopes
- Ideon Technologies has become a world pioneer in the application of cosmic-ray muon tomography, providing x-ray-like visibility up to 1 km beneath the Earth's surface and enabling the identification of new mineral and metal deposits with precision and confidence
- TRIUMF Innovations continues to support expanded production and availability of actinium-225, a valuable but scarce isotope with tremendous promise as a cancer treatment
- TRIUMF's proton- and neutron irradiation facilities (PIF & NIF) are premier test sites for assessing radiation effects in space, air, or at ground level. Each year, approximately 195 users from about 60 companies, laboratories, and universities test electronics or materials with TRIUMF beams





## Our science by the numbers In 2020-2021:

- 317 publications
- 223 students and post-doctoral researchers
- 127 Canadian scientists and students using TRIUMF
- 48 international and visiting scientists and students
- 8375 participants at informal science education events

## More Interesting facts:

- TRIUMF's cyclotrons produce over 1.5 million patient doses of medical isotopes annually
- In total, ISAC produces more than 60 different rare isotopes, separated according to their mass and charge, and delivered on demand to experimental researchers
- GRIFFIN's detector (pictured) is a cloverleaf shaped array of 64 high-purity germanium crystals, which can capture as many as 50,000 gamma ray interactions per second



### Member Universities

University of Alberta  
University of British Columbia  
University of Calgary  
Carleton University  
University of Guelph  
University of Manitoba  
McMaster University

Université de Montréal  
Queen's University  
University of Regina  
Simon Fraser University  
University of Toronto  
University of Victoria  
York University

Discovery,  
accelerated

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