TRIUMF

Status of TRIUMF

Nigel Smith,
Executive Director
& CEO

May 10, 2023

TRIUMF continues to deliver major progress on many fronts…

- Major progress on science programmes, infrastructure and platforms, including substantial progress on IAMI and ARIEL, domestic and international science projects
- Substantial engagement of TRIUMF in international community planning (esp. DOE NP and the Electron Ion Collider and neutrino-less double-beta decay programmes)
- Governance structures continue to engage well, with evolution of terms of reference underway and review of TRIUMF Innovations governance structure completed
- Substantial workload during the reporting period from our quinquennial evaluation review by the NRC Office of Audit and Evaluation. Completion of the review by the NRC international Peer Review Committee over several days, including engagement across the entire laboratory
- Increased occupancy of TRIUMF and interactions between team members, as COVID protocols relaxed sufficiently to allow tours of the facility

Footnote: ✓ shows actions addressing ACOT recommendations (see tracker)

…yet we have faced some major challenges

- Major pivot required over the reporting period to focus on refresh of the Licence Condition Handbook (LCH). Required to ensure LCH reflects current operations fully, without reliance on Protocol for development work (as was previously used), and to ensure currency of documentation
  - Major project for the operations and safety teams including update of primary TRIUMF Safety Analysis Report, and >20 infrastructure documents and safety analysis reports
  - Rework ongoing, but successful to allow restart of driver operations, TR-13 life sciences programme, and TR-30 high current irradiation for medical radioisotope
  - Additional refresh expected in the Fall, to transition to a more risk-based approach to compliance with licence conditions
- Close programme management to optimise use of resources and programme delivery; includes additional resources to ARIEL from TRIUMF reserve and focus on $25M projects; Recruitment and staff retention challenges continue in several areas as TRIUMF remains somewhat uncompetitive
- Continued discussion with ISED and NRC on the MRF framework for the support of Major Research Facilities in Canada

Peer Review Committee Feedback

- Positive answers to all questions they are being asked
- Really supportive of the science programme, recognising we could do even more if we had additional resources; Very complimentary regarding our science and accelerator programmes, our role in national and international programmes, and how we ‘punch above our weight’
- Areas for improvement exist. Recognise that we are stretched with resources, need to improve our EDI systems, develop our programme management, research security, tell our story more widely, and reduce substantial oversight load from internal and external stakeholders

Theme(s)	Question for PRC
Scientific Excellence	1. To what extent is TRIUMF a platform for scientific excellence, including in its: a. knowledge creation (e.g., scientific publications, technology development) b. connector role (i.e., extent to which Canada’s participation in TRIUMF connected Canada to the world in TRIUMF-related fields) c. infrastructure
Relevance	2. Is TRIUMF focusing on the right areas to stay relevant to the TRIUMF community and beyond?
Capabilities	3. To what extent does TRIUMF have the capacity, competencies and facilities needed to achieve its objectives moving forward?
Governance	4. To what extent is the governance of TRIUMF (e.g., committees, policies, and controls) effective / efficient? Are there any efficiencies to be gained? (taking into account the Canadian environment and system)

NRC Evaluation Status

The evaluation process is nearing its conclusion

NRC Evaluation Preliminary Results

- User Survey
  - *TRIUMF Lead: Marcello & Sean*
  - *Status: Complete*
- NRC Bibliometric Study
  - *TRIUMF Lead: Reiner & Sean*
  - *Status: Complete*
- NRC OAE Interviews
  - *TRIUMF Lead: Various*
  - *Status: Complete*
- NRC OAE KPI Data Collection
  - *TRIUMF Lead: Marcello & Sean*
  - *Status: Complete*
- NRC OAE Document Gathering
  - *TRIUMF Lead: Sean*
  - *Status: Complete*

Socio-Economic Impact Report

- Data collection
  - *TRIUMF Lead: Benedicta & Kathryn*
  - *Status: Complete*
- Interviews
  - *TRIUMF Lead: Various*
  - *Status: Complete*
- Case studies development and review
  - *TRIUMF Lead: Various*
  - *Status: Complete*

Peer Review

- Constituting Committee
  - *TRIUMF Lead: N/A*
  - *Status: Complete*
- Agenda and Logistic Planning
  - *TRIUMF Lead: Sean & Aneet*
  - *Tiger Team oversight*
  - *Status: Complete*
- Report drafted
  - *TRIUMF Lead: N/A*
  - *Status: Complete*

Final Evaluation Report

- Report review
  - *TRIUMF Lead: Leadership Team*
  - *Status: Complete*
- Release
  - *TRIUMF Lead: N/A*
  - *Status: Pending with NRC*

Growing the TRIUMF Network

Seven new Members added in Q4 22/23, bringing total membership to 21 universities from coast-to-coast.

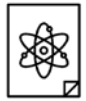
Member Universities

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

Governance Updates

- As previously reported, the amalgamation of TRIUMF Accelerators Inc and TRIUMF INC occurred as planned on July 1st, 2022. This allows TRIUMF INC to assume all liabilities of TAI which was effectively a shell to hold our CNSC license
- The Joint Venture between the universities, which was the previous ownership and operations model, is in the process of being wound down. A Minor insurance matter is being concluded
- As already noted, TRIUMF has increased it member count to 21 Member. The seven new universities that have joined were former Associate Members of the Joint Venture and all have joined the new structure, agreeing to take on liability for TRIUMF
  - A call for additional new members (which now includes technical universities) has also launched, and at least 3 additional institutions have expressed interest
- Work is already beginning towards preparation for the next AGM (September 27, 2023), with a number of new approvals and processes being required due to the new structure maturing, as well as the fact that the 5-Year Plan proposal will need Member approval to be finalized

2020-25 NRC KPIs

Target	2020/21	2021/22	2022/23	2023/24	2024/25
 published scientific papers 285 (CY) Source: Marcello	317	285	247	PENDING	PENDING
 highly qualified personnel trained 156 (FY) Source: Marcello	223	301	275	PENDING	PENDING
 Canadian scientists & students using TRIUMF 206 (CY) Source: Marcello	127	90	330	PENDING	PENDING
 Canadian scientists & students participating in research abroad through TRIUMF 195 (CY) Source: Marcello / Directors	224	224	243	PENDING	PENDING
 international visiting scientists & students 392 (CY) Source: Marcello	48	97	294	PENDING	PENDING
 informal science experiences to the public 15,000 (FY) Source: Stu	8,375	10,327	10,780*	PENDING	PENDING
 commercial revenues $3.0M (FY) (net) Source: Finance	$5.4M ($3.3M net)	$7.6M ($5.1M net)	$8.5M ($4.6M net)	PENDING	PENDING

**This includes views from TRIUMF's YouTube channel but not views from TRIUMF-supported influencers and visitor videos which totaled over 2.1M in FY22/23*

CNSC Update

Change in Regulatory Landscape

- Very different regulatory expectations from even a year ago.
  - 10-year licence renewal in July 2022
  - Direction from commission to CNSC staff in license renewal was to ensure close oversight of TRIUMF and process
- Recent investigation report on operational alignment with our Licence Condition Handbook raised 4 NNCs and 8 recommendations, responses in development.
- Significant change in how development work is undertaken
  - TRIUMF has a Protocol for Irradiation of New Materials which allowed development work to be undertaken, assuming ‘production’ work would then be incorporated into the Licence Condition Handbook
  - CNSC moving to a more formal approach (for the time being) for development work outside the Licence Condition Handbook, requiring permission or inclusion.

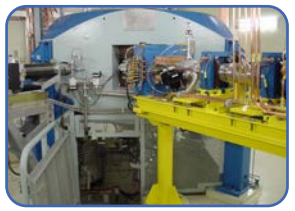
Restart Philosophy

- Updates to the Licence Conditions Handbook are priority driven, to ensure we restart science programmes as soon as possible
  - CNSC is agreeable to a phased approach. We require formal written approval, i.e. a memo, but updates to the Licence Condition Handbook will be ‘batch’ driven quarterly.
- For systems already described in the Licence Condition Handbook, approach shared with CNSC is to provide updated documentation prior to restarting systems
- For systems and parameters outside the Licence Condition Handbook envelope, we will not be performing work until permissions are given (e.g. UCN beam line, Th irradiation, etc.) There is a grey zone which we will need clarity on.
- Second iteration of the Licence Condition Handbook will be needed following this iteration, to shift to a risk-based process-driven approach for development work (i.e. show TRIUMF processes are solid and safe). CNSC are on-board with this approach.
  - Update to management system and procedures will continue through 2023

Current Status

TR13 Cyclotron

- Updated Safety Analysis Report submitted in Feb/March
- Approval granted to operate
- Some further SAR updates required by Sep 30th before LCH is updated



ATG TR30 Cyclotrons

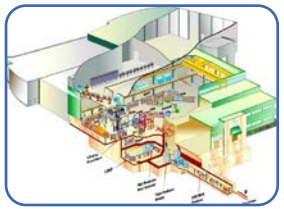
- Currently operating per the LCH
- Approval granted to operate TR30-2 at 300μA for Ga-Ni targets
- TRIUMF will submit similar data for TR30-1 for approval

520MeV Cyclotron and Beamlines

- TRIUMF “TSAR” : thorough review and update, submitted to CNSC on Apr 24
- Beam injection within current LCH limits authorised by ED for May 1st
- IPF and Th target SAR updates planned for June

E-linac

- E-linac/ARIEL SAR updated and submitted Apr 28
- Normal operations are authorised by ED within Class II license limits



ISAC

- ISAC-I and ISAC-II SARs - thorough review & update
- Planned for submission mid-May
- Normal ISAC operations will resume in June within LCH limits

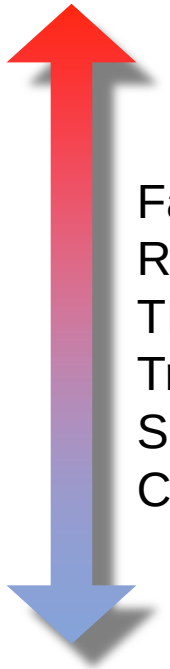
Board Review of CNSC Comments

- Recent CNSC inspection report had commentary questioning senior management decisions and process around nuclear safety and facility operations
- Board of Governors has instigated an independent review to assess the commentary in the CNSC report.
- Steering group struck (Heather Kleb, Rob Thompson, Corina Andreoiu, Chris Heysel)
- This group will coordinate an independent review, aiming to complete by mid-June for the Board meeting scheduled at that time
- Several TRIUMF staff will be interviewed for this review

COVID-19 Update

COVID-19 Update

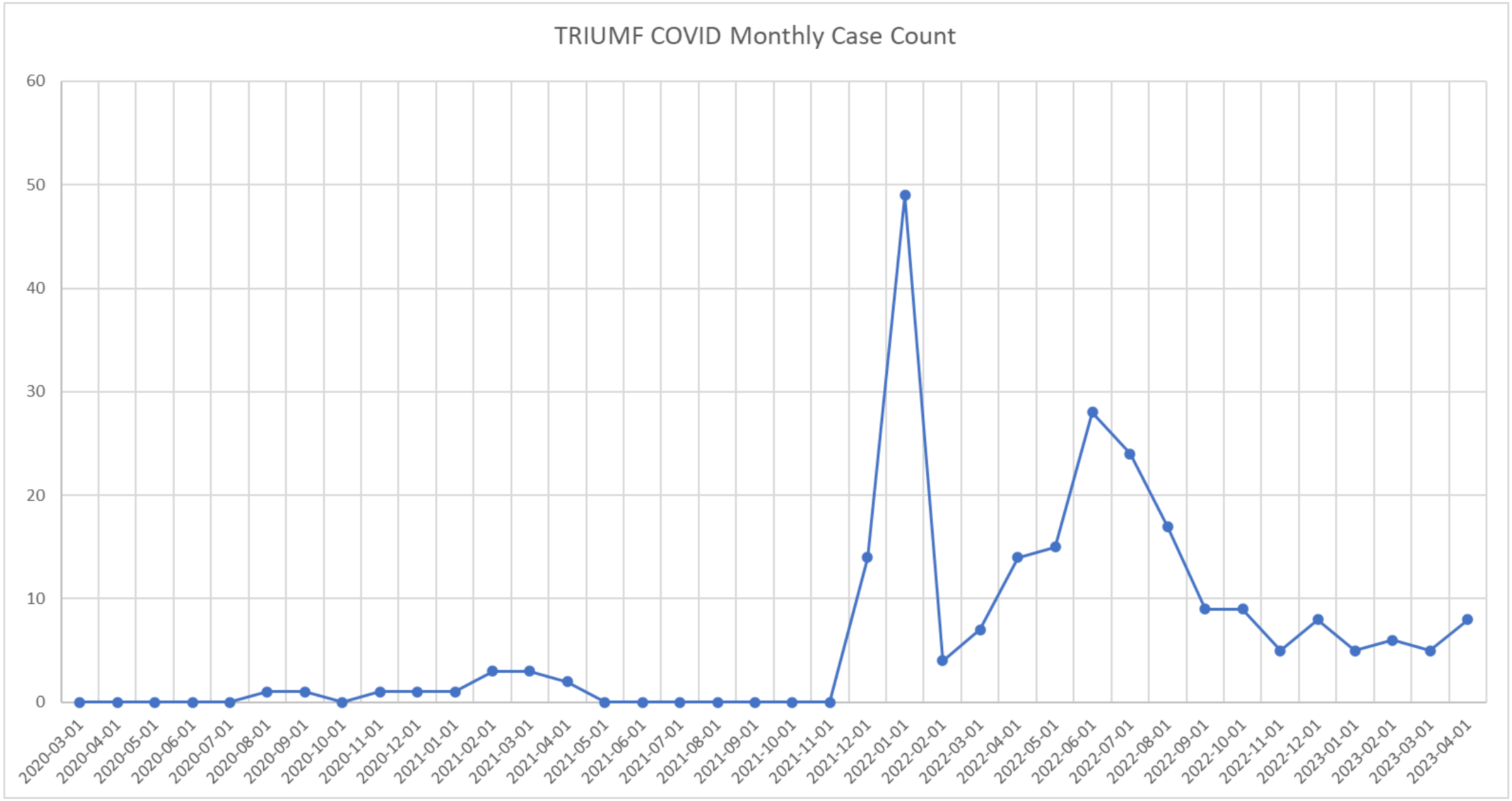
- TRIUMF has taken and will continue to take a measured, safety-first approach to deciding which measures to put in effect.
- Layers of COVID measures (order may change based on variants)
  - Site Occupancy Restrictions – Essential Staff only
  - Site Occupancy Restrictions – Remote Work recommendation
  - Room Occupancy Limits
  - Mandatory Mask Usage / Mask Recommendations
  - Vaccination Policy (site)
  - Vaccination Policy (staff)
  - Restricting Public Events
  - Restricting Friends and Family Tours



Factors:
Regulations
TRIUMF Cases
Transmission
Severity
Community

Current state

COVID-19 Update



COVID-19 Update

- Since September 2022, TRIUMF has been averaging less than 10 COVID cases per month
- Site occupancy has been averaging ~400 persons
- Masks are a personal choice
- Vaccination mandate remains in place for TRIUMF appointees only
- Events, conferences, and public tours have resumed
- TRIUMF protocols require at least five days absence prior to returning from a COVID positive test

Space Development

TRIUMF Space Committee

Purpose

- Review and provide guidance on space usage, renovation, and development needs at TRIUMF
  - Offices, workspaces, storage, assembly, manufacturing, and research areas
- Participate and provide input into long term site use and development planning
- Receive space requests and provide space usage recommendations to the Leadership Team to review and approve

Membership

- Facilities – Adrian Lee
- Physical Sciences – Mark Hartz
- Life Sciences – Cornelia Hoehr
- Accelerator Division – Marco Marchetto
- Visitors and Students – Marcello Pavan
- Projects and Infrastructure – Michael Trinczek

Will bring in others to consult and advise as needed.

TRIUMF Space Committee

What are we currently working on?

- Refurbishing and creating more office spaces – Trailer Ff
  - New carpeting and furniture
  - Painting
  - Networking upgrade
  - HVAC, lighting and window replacement
- 30 total space created - 24 students moved in May 8, 2023
  - Remaining space will be ‘hot-desk’

TRIUMF Space Committee

Space Request Process

- TRIUMF Space Committee has created a space request form to be submitted for requests for all space types
  - Space Committee reviews requests in the context of other requests, current space usage, and future planning and together with the requester provides recommendations and/or solutions
  - Putting together formal process to review and document recommendations
- Reviewed and recommended approval for HAICU, ISAC II Laser Lab

5-Year Plan Proposal Update

Context: A Changing Canadian System

- As previously noted, discussions are underway between multiple stakeholders on the future framework for federal support of Canadian Major Research Facilities
  - Innovation, Science and Economic Development Canada (ISED), NRC, funding councils and foundations, Universities, Facilities, Chief Science Advisor…
  - This is being undertaken within non-disclosure agreements
  - Incorporates previous discussions held with current government (inc. submissions to Naylor review)
  - Implications for TRIUMF are substantial and directly impact the development of the five-year plan

Context: A Changing Canadian System

- The newly released “Advisory panel report on federal research support system” or Bouchard Report was released and late may and is supportive of ISED’s efforts to build a new MRF ecosystem and expectation are that a new system will be established (at least in a nascent form) by the end of FY 23/24

- Further to the efforts with ISED, TRIUMF has also been engaging with House of Commons’ Standing Committee on Science and Research (SRSR)
  - A planned study and tour of Big Science facilities in Canada is on-hold following the committee having appointed a new chair, but TRIUMF is hopeful that it – in cooperation with other facilities – can bring attention back to the topic

5-Year Plan Proposal

- We are working with NRC and ISED to determine the approach for the next 5-year funding renewal for TRIUMF, and subsequent funding
- Aim to secure funding in Budget 2024 to give us one year runway
- Process still in flux, likely to be similar to process as last time, but with full engagement from NRC, TRIUMF, ISED
- Development and dissemination of proposal for completion this Fall
- Work on the Major Research Facilities programme continues with other major research facilities in Canada and ISED team

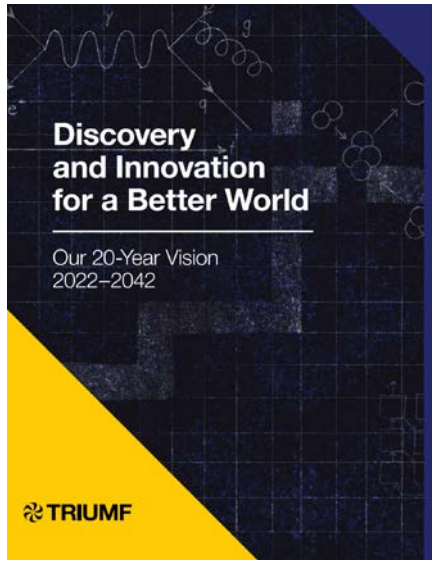
5-Year Plan Proposal

- Using work completed on the 20-year vision (20YV) – and the sub-atomic community long range plan – as input to the proposal development, along with input from Divisions
- Various funding scenarios now being constructed, priorities as defined in 20YV, to highlight the science, innovation and infrastructure developments possible over the 5-year period
- Timeline for proposal development:
  - Feb - April: Divisional input to proposal, initial costing and scenario planning (underway)
  - May: ACOT discussion and input on concepts / draft proposal
  - June: Science Council / Board meeting discussion and input
  - Late July / Early August: Science week discussion and community input
  - July / August: Science Council input
  - September: TRIUMF Board and AGM, approval of final proposal
  - October: Agency Committee on TRIUMF approval to take forwards to Finance
  - Fall / Winter: Socialization with government, MPs, universities (high level visits already underway)
  - Post-Budget: Development of funded implementation plan with community (i.e., five-year strategic plan)

5-Year Plan Proposal

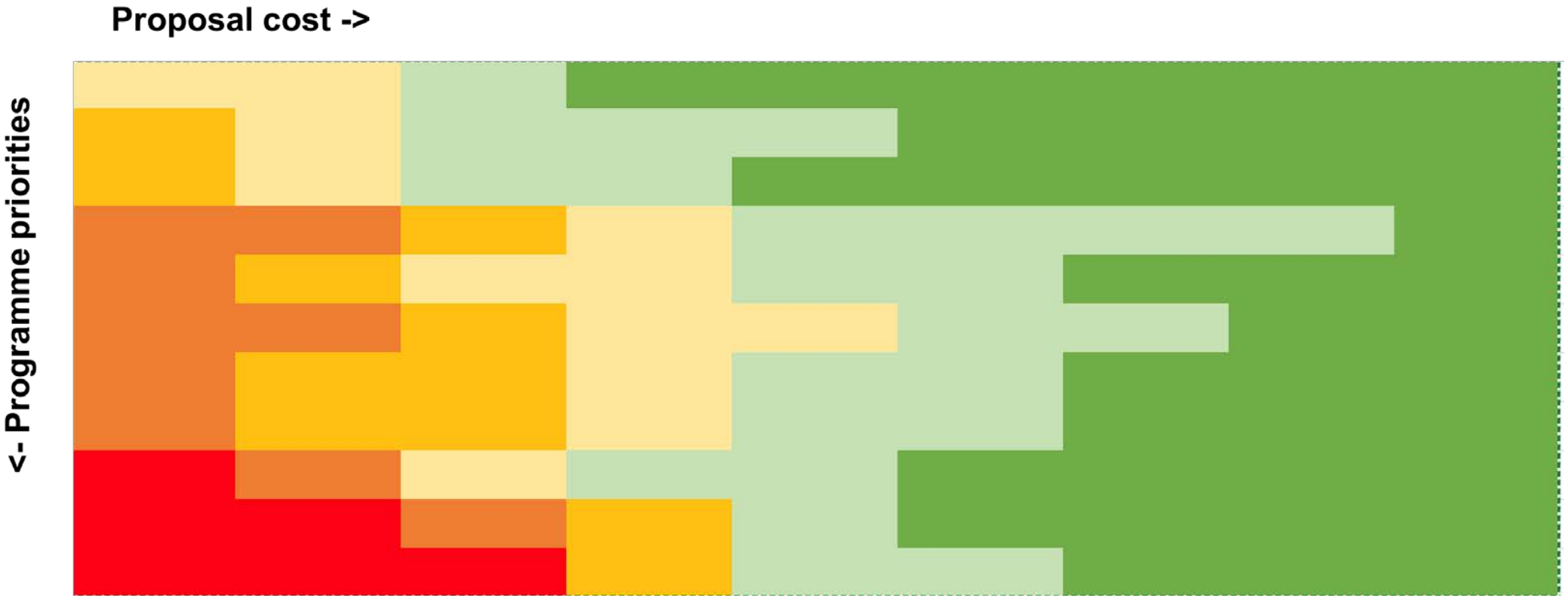
The 5-Year Plan will be positioned as the beginning of implementation of what was set out in the 20-Year Vision; however, the extent that TRIUMF can deliver on this is dependant on funding

In an optimal position, TRIUMF will pursue the full breadth of the vision, but if resource constraints emerge, the focus will require an entrenchment towards TRIUMF's core functions and expertise



5-Year Plan Proposal

- Scenario planning looking at science and infrastructure requirements in 20-year vision, requirements for staffing and recruitment/retention, operations of new infrastructure, deferred maintenance, operational excellence
- Mapping ranges of requests to these requirements underway



Status of TRIUMF

Status of TRIUMF

1. **Science & Technology**
2. **People & Skills**
3. **Innovation & Collaboration**

Science & Technology – ARIEL

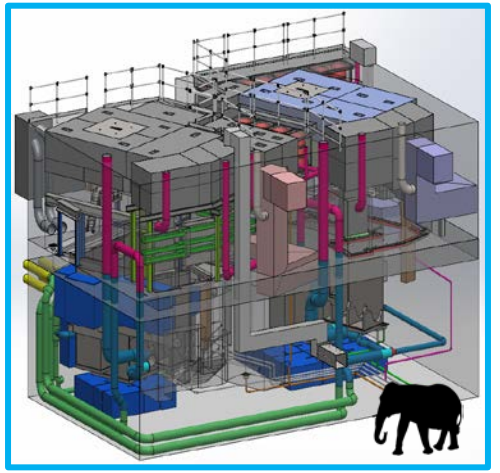
ARIEL Status and Project Highlights

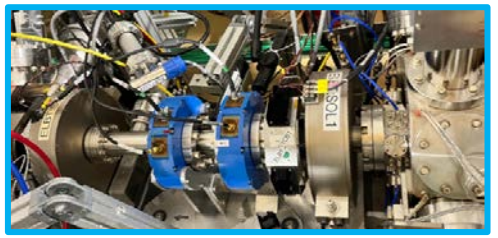
Recent Achievements:

- Targetry and RIB systems protype testing completed
- Hot cell completed.
- Proton and electron beam production proven
- Target station shielding construction:
  - Levels 1-7 completed (most complex)
  - Levels 8-9 design completed
  - Levels 10-11 design progressing (simple)
- CANREB EBIS HV improvements successful
  HRS commissioning on track to reach design performance.
- Full cost and schedule evaluation completed. Project is now funded and resourced until completion within the next 5YP

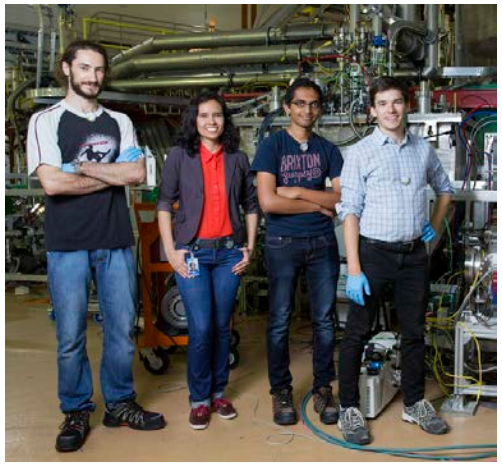
Planned Dates:

- 2023: CANREB back in user operation
- 2026: first beam from AETE
- 2027: first beam from APTW
- 2028: first therapeutic isotopes from ARIEL





Science & Technology – ARIEL




Supporting the ARIEL Program Towards Completion

Cost and schedule review – outcome, requests and actions

- Total ARIEL integrated work over the full project (2013 - 2026): 480 FTE years (within initial projections).
- Current level of FTE availability below request, due to operations and refurbishment priorities.
- Additional 15 FTE and $5.7M required to complete project on time (2026/27)
- Requests supported by Board of Governors and granted by Senior Leadership; ramp-up and re-baselining in progress

Greater support and visibility of the project at all levels

- Increased support from Senior Leadership
  - Regular alignment between Program and Executive Director.
  - Status discussed at weekly senior management meetings
- International advice through ARIEL Scientific Steering Committee (ASSC)

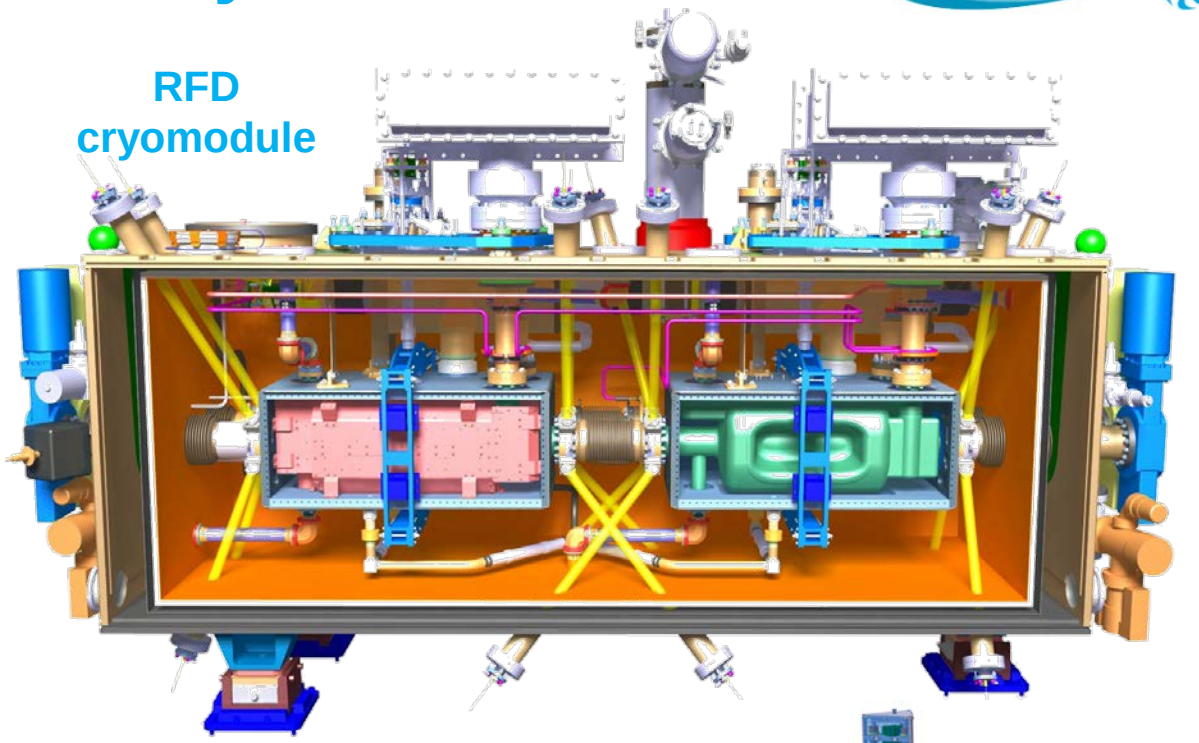
Science & Technology – High-Luminosity-LHC

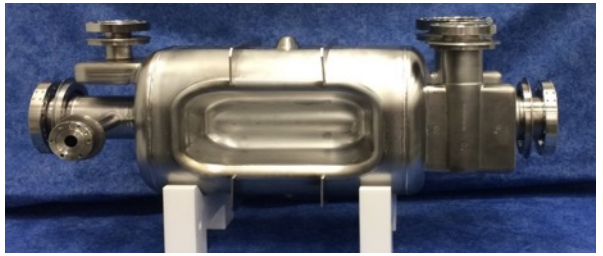
- CERN will install a crab cavity cryomodule upstream and downstream of each interaction region, ATLAS and CMS, in each ring
- The crab cavities give transverse skewing of the bunches to increase the luminosity
- TRIUMF is producing five cryomodules housing two crab cavities per cryomodule as a Canadian contribution to the Hi-Lumi project

Science & Technology – High-Luminosity-LHC

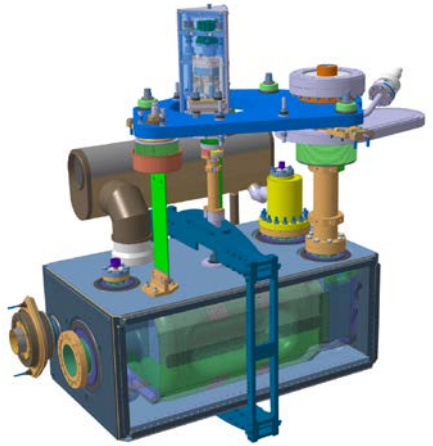
- TRIUMF to receive and qualify 10 RF Dipole (RFD) cavities from USA
- TRIUMF to assemble and qualify 5 cryomodules as an in-kind contribution to CERN
- TRIUMF has initiated procurements for the prototype cryomodule (TCM0) and to receive first cavities in late 2023
- Series production CMs will follow in 2024-2025

RFD cryomodule





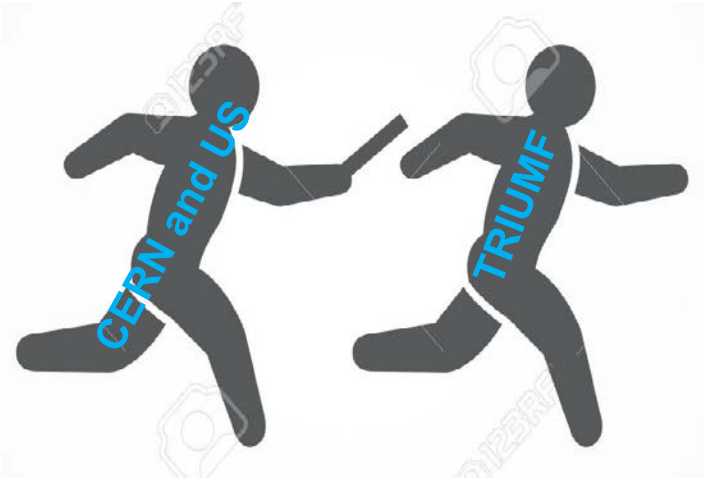
RFD Crab Cavity

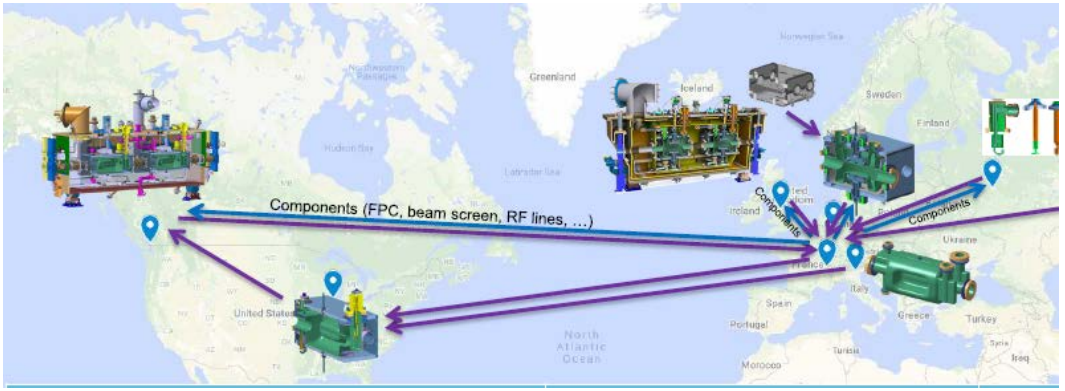


Fully Dressed cavity system

Science & Technology – High-Luminosity-LHC

- The funding for the deliverables was written into the present NRC contribution agreement spanning from April 2020 to March 2025
- Due to COVID, design completion at CERN, cavity delivery from the US and project end dates have slipped by two years
- TRIUMF is still waiting final sign off from CERN for major cryomodule design packages
- The first cavity for TCM0 from the US is not expected until late this year
- As such spending on key components is delayed with respect to original estimates
- TRIUMF's challenge will be to procure all components before the end of the present FYP

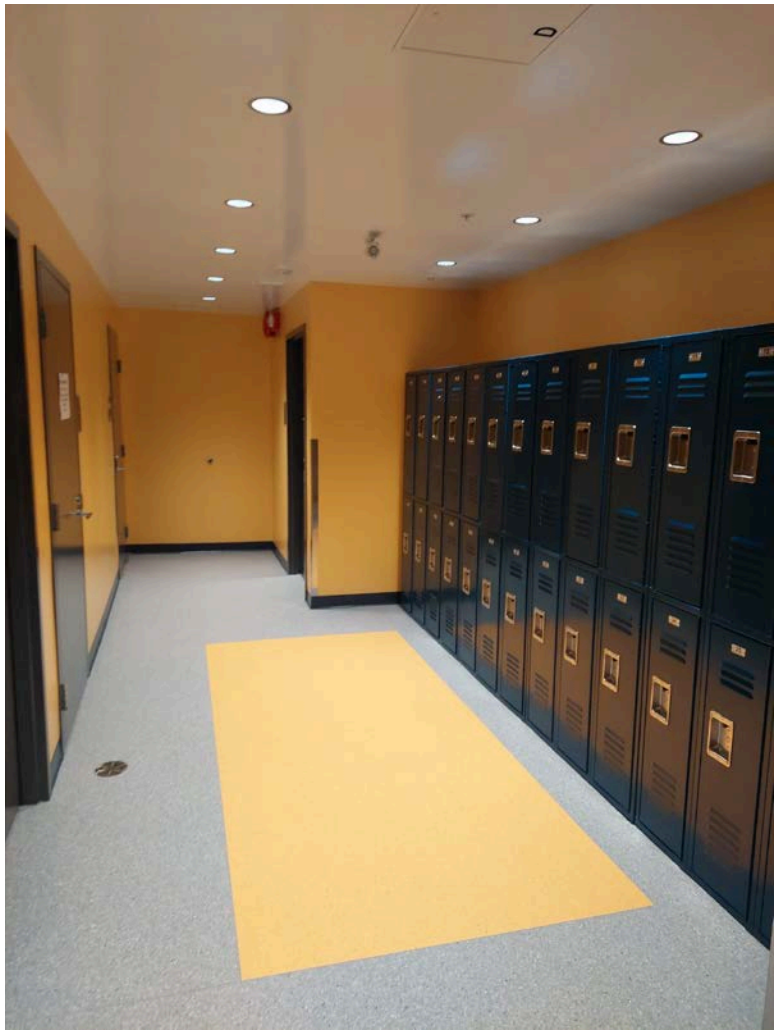




Science & Technology – IAMI

- Building completed since July 2022
- Building commissioning ongoing (some deficiencies/warranty items remain to be resolved)
- LEED application in preparation
- TR24 and target station are being installed

Science & Technology – IAMI



Phase 2 Construction

Tenant Improvement detailed design underway to

- Add an additional cyclotron and control room
- Outfit one hotlab and QC spaces for provincial FDG supply

Conversation continue with the Government of British Columbia about building out the remaining labs, but year-end funding was not received

Science & Technology – IAMI

Next Steps

- Hotcell installation
- CNSC commissioning license application
- Base-lining of commissioning schedule
- Agreements for Phase 2 with tenant

Budget

- Individual subprojects are above budget
- Some contingency funds still available

STATUS OF TRIUMF

1. **Science & Technology**

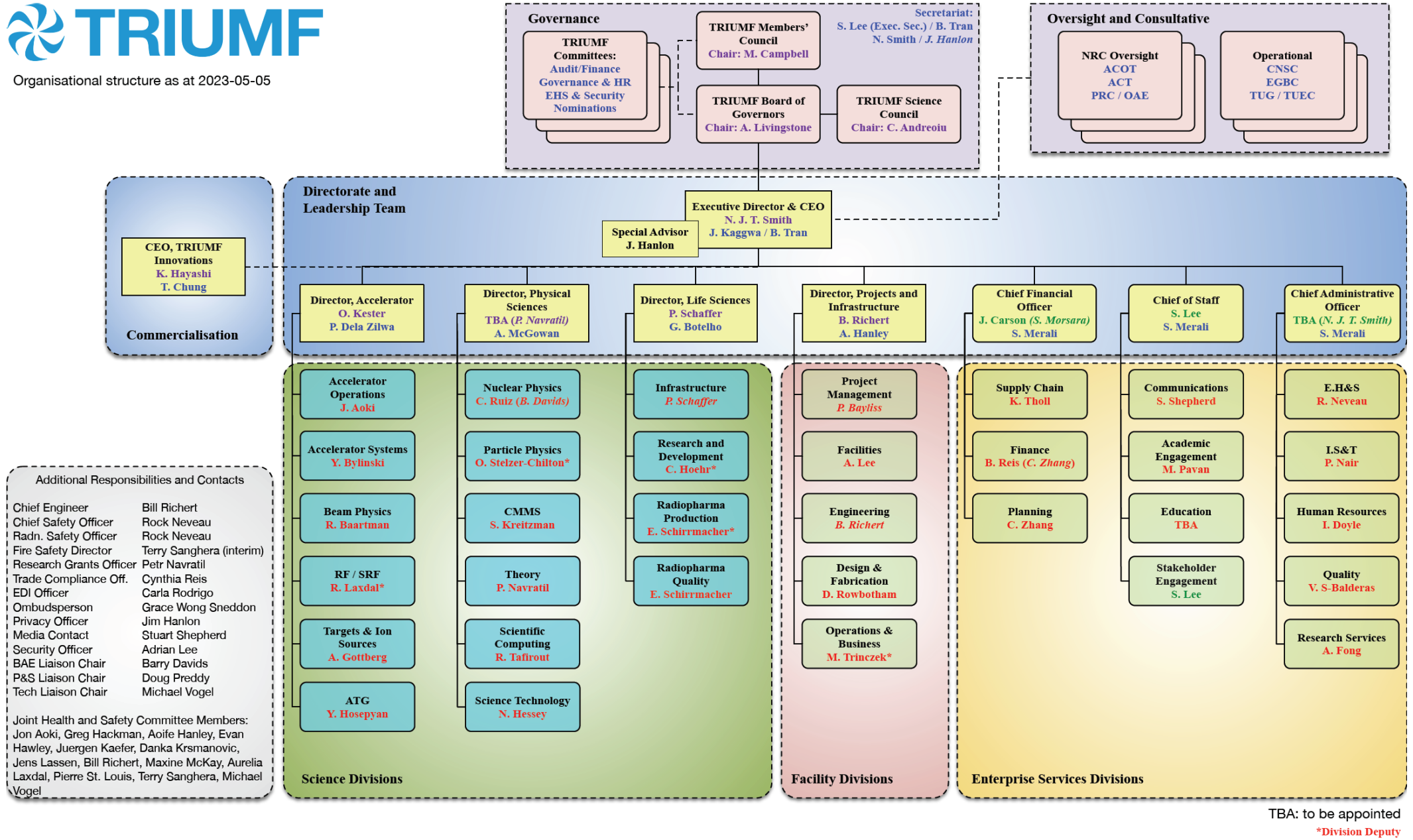
2. **People & Skills**

3. **Innovation & Collaboration**

People and Skills

TRIUMF

Organisational structure as at 2023-05-05



Additional Responsibilities and Contacts

Chief Engineer	Bill Richert
Chief Safety Officer	Rock Neveau
Radn. Safety Officer	Rock Neveau
Fire Safety Director	Terry Sanghera (interim)
Research Grants Officer	Petr Navratil
Trade Compliance Off.	Cynthia Reis
EDI Officer	Carla Rodrigo
Ombudsperson	Grace Wong Sneddon
Privacy Officer	Jim Hanlon
Media Contact	Stuart Shepherd
Security Officer	Adrian Lee
BAE Liaison Chair	Barry Davids
P&S Liaison Chair	Doug Preddy
Tech Liaison Chair	Michael Vogel

Joint Health and Safety Committee Members: Jon Aoki, Greg Hackman, Aoife Hanley, Evan Hawley, Juergen Kaefer, Danka Krsmanovic, Jens Lassen, Bill Richert, Maxine McKay, Aurelia Laxdal, Pierre St. Louis, Terry Sanghera, Michael Vogel

TBA: to be appointed

*Division Deputy

People & Skills

TRIUMF Staff Count							
	NRC			Non-NRC			
31-Mar-23	Continuing	Term	TOTAL	Continuing	Term	TOTAL	TOTALS
Administration & Professional	56	9	**65**	1	0	**1**	**66**
Board Appointed Research Scientist	46	0	**46**	1	0	**1**	**47**
Engineering & Applied Science	72	5	**77**	12	10	**22**	**99**
Technical	20	0	**20**	4	1	**5**	**25**
Technical Certified	127	1	**128**	29	4	**33**	**161**
Management	61	0	**61**	6	0	**6**	**67**
Executive Management	8	0	**8**	0	0	**0**	**8**
Postdocs & RAs	0	6	**6**	0	45	**45**	**51**
Graduate Students	0	2	**2**	0	47	**47**	**49**
Faculty Joint Appointment (50% FTE)	0	0	**0**	0	5	**5**	**5**
TOTALS	**390**	**23**		**53**	**112**		
	Total NRC		**413**	**Total Non-NRC**		**165**	**578**
Undergraduate Students - Fiscal 22/23	NRC		**35**	Non-NRC		**87**	**122**

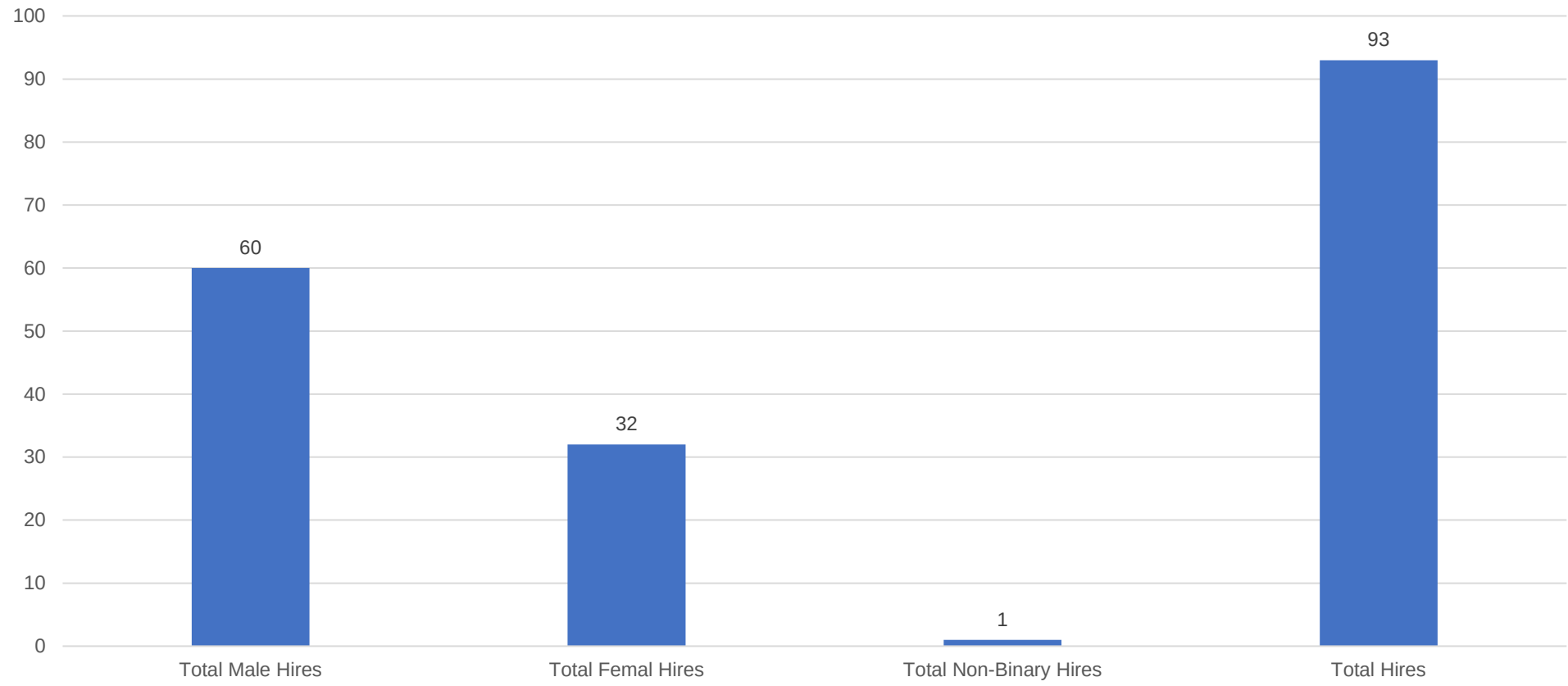
September 30, 2022 Figures

- NRC supported positions – 400
- Non NRC supported positions – 162
- Total – 562

As noted at the last meeting, the staffing data has been segmented slightly differently that previously presented, now aligning with TRIUMF's HR job families and the reporting generated by the Workday system

People & Skills

TRIUMF Hiring Statistics in FY 22/23



People & Skills – Recruitment Updates

Chief Information Officer

- New CIO in place since last meeting – Pradeep Nair
- Over 30 years in IT, with over 20 years leading cross-functional teams
- Career spanning multiple industries – biomedical research, higher ed, broadcast & film, professional services, and gaming
- Over 15 years leading information security initiatives, including in healthcare and higher ed environments
- Most recently Managing Director, Advancement Services at the University of British Columbia
  - Served as vice-chair for the UBC Enterprise Architecture Review Board
  - Also a long-standing member of the Information Security Standards review committee

People & Skills – Recruitment Updates

Key Staffing Updates

Chief Financial Officer

- TRIUMF's CFO is currently on medical leave, and the Acting CFO began parental leave in late March
- Shavi Morsara was recruited in March to serve provide six-month support as the Interim CFO
  - CPA, CGA and a seasoned professional specializing in strategic planning, budgeting & forecasting

People & Skills – Recruitment Updates

Chief Administrative Officer

- Recruitment undertaken by professional recruitment firm: Leaders International
- Process complete; at negotiation stage

Director, Physical Sciences

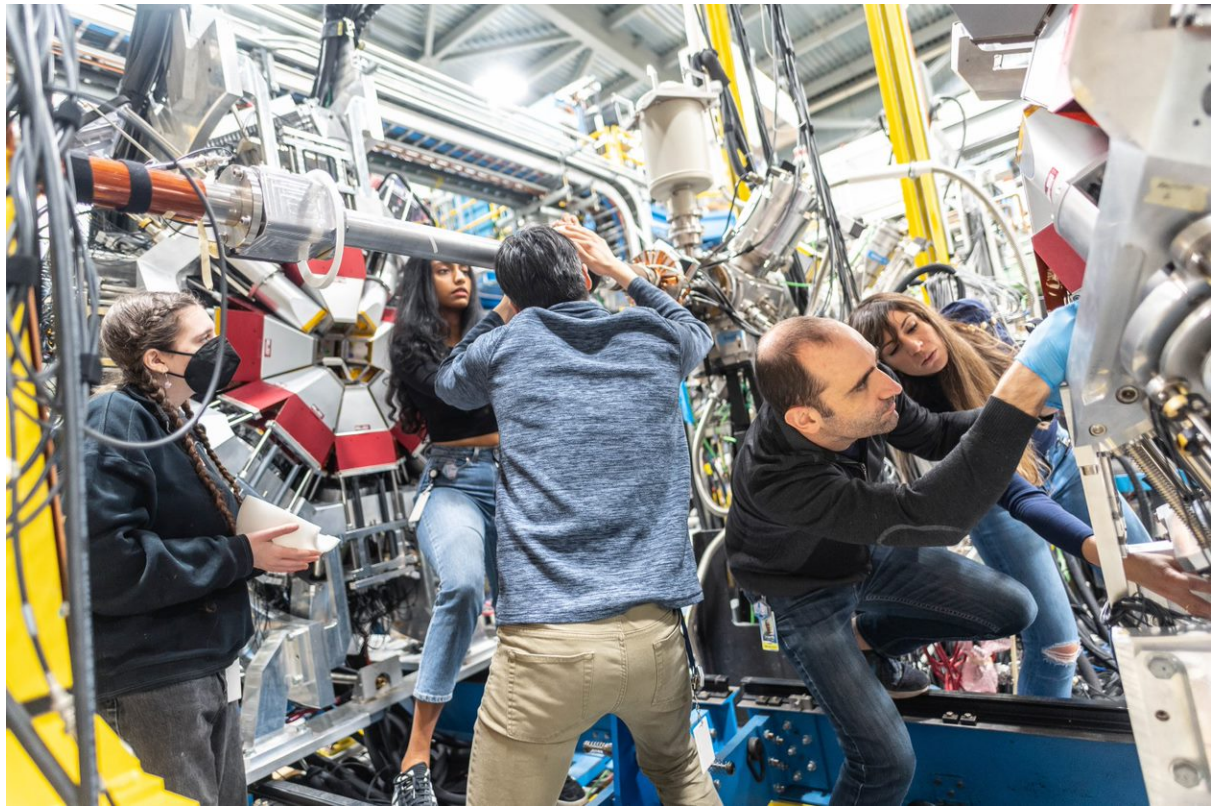
- Hiring process resumed after CAO process concluded; Committee formed:
  - Manuella Vincter (Carleton) chairing search committee
  - Sampa Bhadra (York, Neutrinos)
  - Corina Andreiou (SFU, Nuclear)
  - 3x Leadership Team
  - 2x BAE (Barry, Sarah)
  - GAPS Representative
- Recruitment plan assessed with EDI and HR lens, committee meeting to follow

People & Skills – Student Program

TRIUMF's undergraduate co-op program has returned to normal recruitment, with all positions returning to in-person only, though hybrid arrangements are permitted where warranted

In the winter term, TRIUMF piloted a new "dual intake" recruitment strategy to boost uptake of students onto non-traditional areas at the lab (e.g. admin, technicians, operations). The effort appears successful, with approximately 76 students (a new record!) hired for the summer term

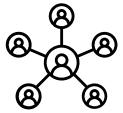
TRIUMF is on track to reach our target of 150 undergrads/year by end of 2024



People & Skills – Equity, Diversity and Inclusion

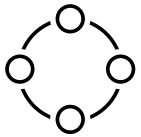
TRIUMF's EDI objectives were completed and released in late 2022; these form the basis around which the forthcoming EDI Action Plan will be based

Enhance equity through transparent policies and procedures



Promote and retain diversity through talent attraction and professional development

Foster an inclusive workplace culture through training and community engagement



Establish a framework for truth and reconciliation at TRIUMF

The EDI Action Plan is complete and undergoing approvals; it will be released to the TRIUMF community shortly

People & Skills – Communications

Paused since March 2020, in-person public outreach effort have begun to ramp up in 2023, with the laboratory hosting numerous student groups and supporting various outreach events in the first five months of the year

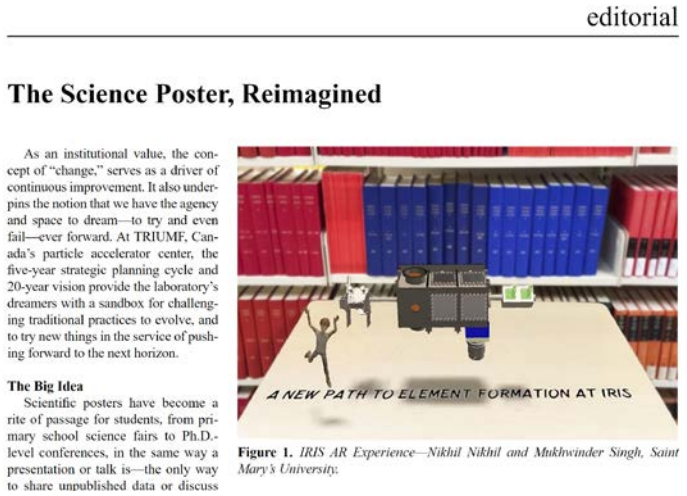
As of April, TRIUMF has also restarted its public tour program with at least 2 tours available per week. Supported with trained guides from TRIUMF's Graduate and Postdoc Society, the program has seen tremendous uptake, with all available tour slots currently booked up through the summer

People & Skills – Communications

Nuclear Physics News: Editorial feature

- Jesse Abney, Monika Stachura, and Oliver Stelzer-Chilton collaborated to write an editorial piece describing their work using virtual reality (VR) to reimagine the traditional science poster, using 2022 Science Week as a case study

https://www.tandfonline.com/doi/full/10.1080/10619127.2023.2168098



editorial

The Science Poster, Reimagined

As an institutional value, the concept of "change," serves as a driver of continuous improvement. It also underpins the notion that we have the agency and space to dream—to try and even fail—ever forward. At TRIUMF, Canada's particle accelerator center, the five-year strategic planning cycle and 20-year vision provide the laboratory's dreamers with a sandbox for challenging traditional practices to evolve, and to try new things in the service of pushing forward to the next horizon.

The Big Idea

Scientific posters have become a rite of passage for students, from primary school science fairs to Ph.D.-level conferences, in the same way a presentation or talk is—the only way to share unpublished data or discuss

Figure 1. *IRIS AR Experience—Nikhil Nikhil and Mukhwinder Singh, Saint Mary's University.*

Figure 3. *ATLAS AR Infographic.*

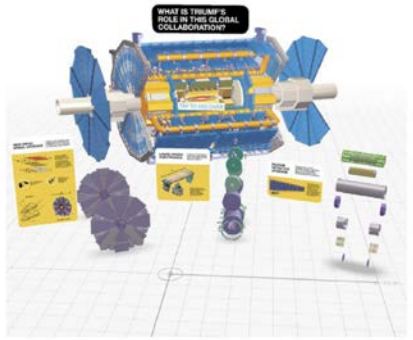


Figure 2. *ATLAS AR infographic inside Adobe Aero ATLAS Experiment © 2023 CERN. Reprinted with permission.*

Social Media Collaboration

- In December 2022, TRIUMF collaborated with YouTube influencer Tom Scott to feature TRIUMF's Life Sciences program and its "rabbit line" to UBC Hospital
- This video has received more than 1.5M views since its release

https://www.youtube.com/watch?v=eMTZvA8iFgI

Firing radioactive stuff at high speed under city streets

1.5M views • 3 months ago

Tom Scott

@TomScottGo

5.83M subscribers

People & Skills – Communications

TRIUMF continues to review and improve its communication practices, building on the insights gained from the 2022 internal communication evaluation. Recent progress includes:

- Establishing KPIs for internal communications monitoring
- Making substantial changes to lab-wide meetings
  - Senior Management Meeting – Soliciting user feedback to improve the benefit impact of the weekly meeting
  - Reworking the monthly “Town Hall” meeting into a new “All Hands” format that is now mandatory for all staff and resident students to attend. The first meeting was held in late April and had peak attendance of nearly 500
- Initiations of updates to TRIUMF’s communications plans, beginning with the Internal Communications Strategy

People & Skills – External Relations

In pursuit of advancing strategic priorities (particularly in advance of the next 5-Year Plan proposal), TRIUMF continues to engage key stakeholders. Recent engagement include:

- Jonathan Wilkinson, Federal Minister of Natural Resources
- Selina Robinson, BC Minister of Post-Secondary Education and Future Skills
- Brenda Bailey, BC Minister of Jobs, Economic Development and Innovation
- Nipun Vats, Assistant Deputy Minister (Science and Research) – Innovation, Science, and Economic Development Canada
- Olaf Andreas Kjelsen, Ambassador of Switzerland to Canada
- Alfredo Martínez Serrano – Ambassador of Spain to Canada

STATUS OF TRIUMF

1. **Science & Technology**

2. **People & Skills**

3. **Innovation & Collaboration**

Innovation & Collaboration

Summary of Highlights for FY 2022/23:

- Revenues increased 26% ($12.7M to $16.0M), net income increased 12% (from $6.6M to $7.4M)
- Canadian Medical Isotope Ecosystem SIF Contribution Agreement for $35M in funding to be completed early May 2023
- TRIUMF/BWXT Ac-225 successfully delivered to global pharma customer, Bayer
- Fusion $3.5M Ac-225 (second milestone of Phase 2) achieved and payment received
- Fusion $1M Ac-225 production milestone delayed from Aug 2021 to FY2023/24.
- Successful collaboration with General Fusion moving to next phase
- New technology pipeline activities in green technologies identified
  - ADS for cleaner nuclear power
  - Photon Detectors for water and air quality monitoring
  - Dual Fluid MOU re: small modular reactor component testing
- New chelator license signed with Alpha9 Therapeutics (repeat customer same terms)
- Patent portfolio growth in number of active granted patents (28 vs 22 in prior year)

Innovation & Collaboration

Highlights for FY 2022/23:

- **Federal SIF for $35M Contribution from SIF Stream 5 Program for Canadian Medical Isotope Ecosystem (CMIE) approved by ISED Minister Champagne**
  - Contribution Agreement target completion May 2023
  - TRIUMF Innovations is the funded co-lead (with CPDC)
  - TRIUMF scheduled to receive $1.2M in FY2023/24
  - $5M in matching funding available for new medical isotope innovation projects. Call for proposals in Fall 2023.
  - Complements activities the federal New Frontiers in Research Fund medical isotope proposal

Innovation & Collaboration

Growing List of Active Projects and Partnerships

Additional Science Highlights

Science & Technology – Accelerators

First results from new `beta-SRF' facility at beta-NMR

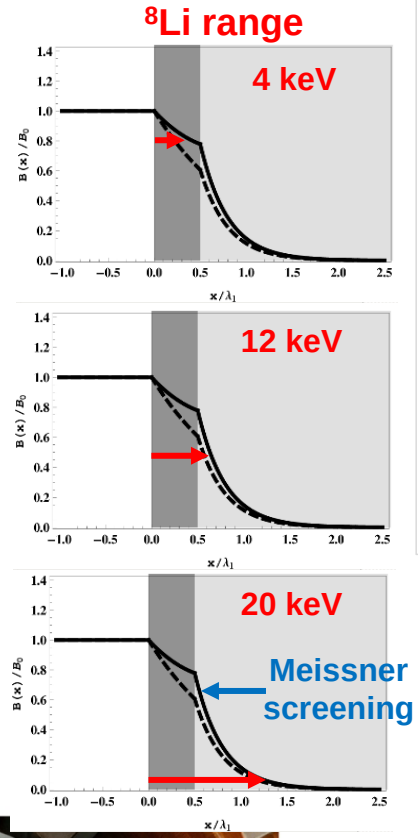
- Unique facility in the world for depth profiling materials in parallel magnetic fields up to 200mT – SRF regime
- First results show clear differences in the Meissner screening between a baseline sample and an oxygen doped sample
- O-doped sample has a longer penetration depth but better high field screening compared to baseline

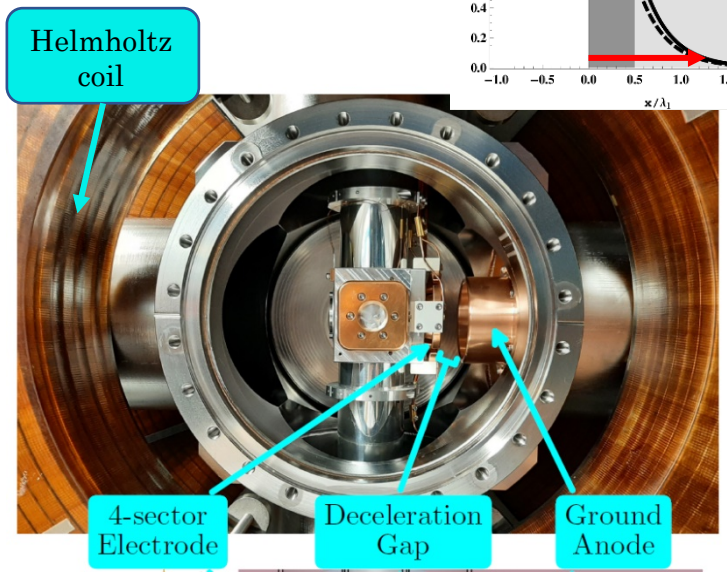
First paper

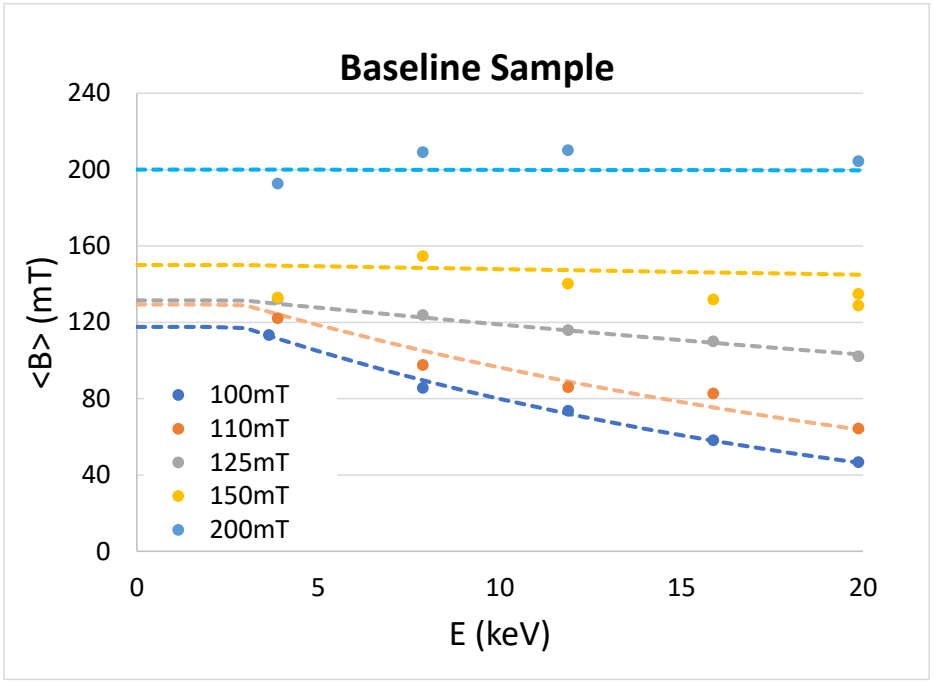
https://doi.org/10.1063/5.0137368

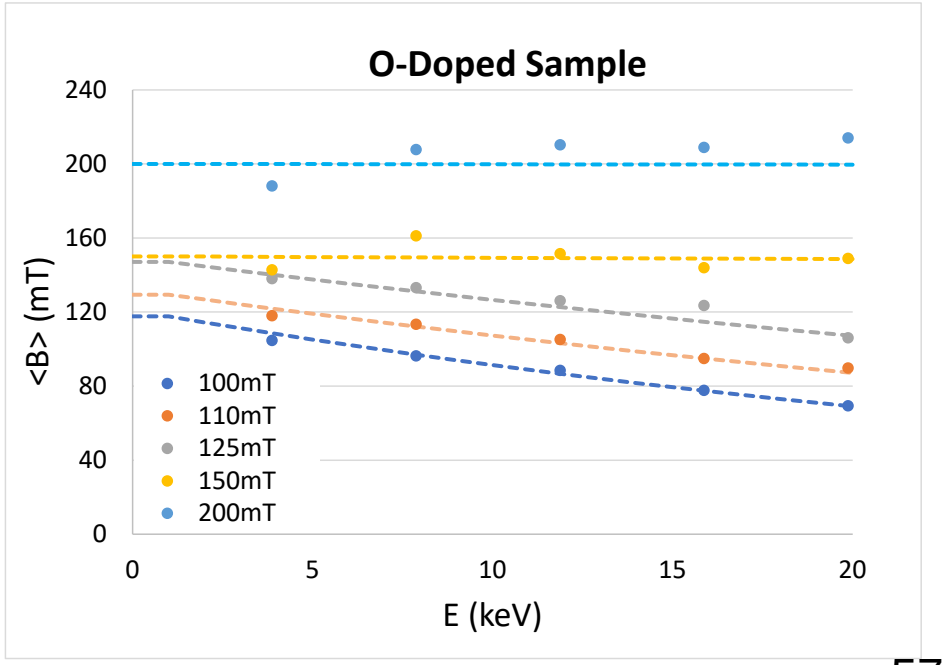
A New High Parallel-Field Spectrometer at TRIUMF's β-NMR Facility

E. Thoeng, R.M.L. McFadden, S. Saminathan G.D. Morris, P. Kolb, B. Matheson, M. Asaduzzaman, R. Baartman, S.R. Dunsiger, D. Fujimoto, T. Junginger, V.L. Karner, S. Kiy, R. Li, M. Stachura, J.O. Ticknor, R.F. Kiefl, W.A. MacFarlane, and R.E. Laxdal, *Rev Sci Instrum* 94, 023305 (2023)





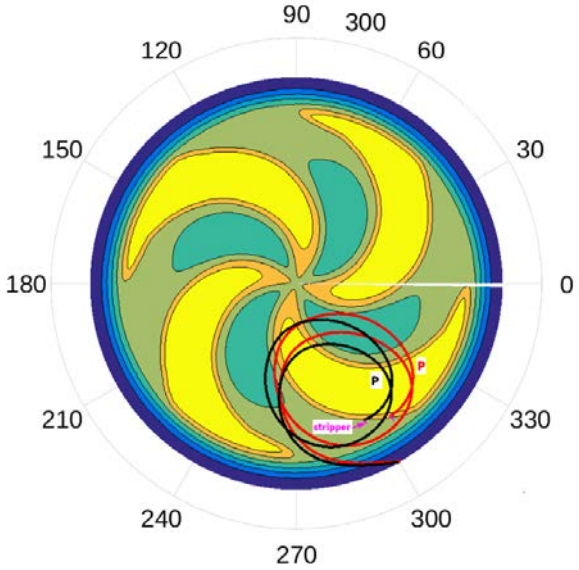


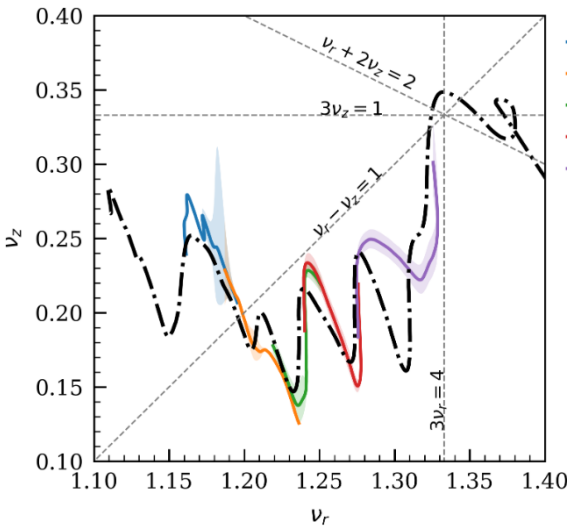


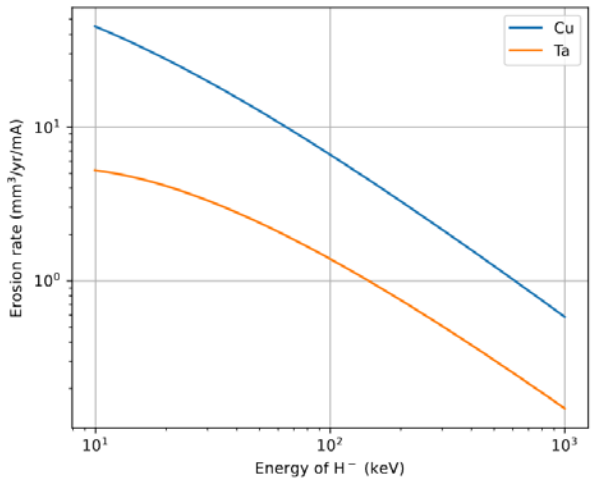
Science & Technology – Accelerators

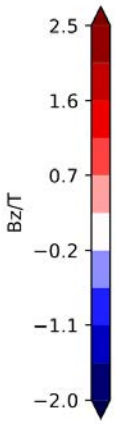
Special Beam Dynamics Issue on Cyclotrons International Committee for Future Accelerators

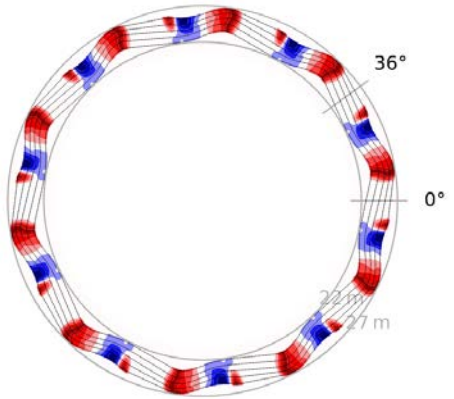
- TRIUMF Beam Physics Department Head, Rick Baartman, was invited by the beam dynamics subgroup to coordinate and edit a special issue on cyclotrons' energy and intensity limits.
- 15 peer-reviewed papers were published in Journal of Instrumentation, of which 8 from TRIUMF, reinforcing TRIUMF as a center of excellence for cyclotron physics and beam dynamics.
- Contributions from the TRIUMF teams to the newsletter included: future high-energy and high-power cyclotrons, exploration of fundamental intensity limits, constant-tune cyclotrons, H_2^+ and H_3^+ beam acceleration and stripping extraction, etc.

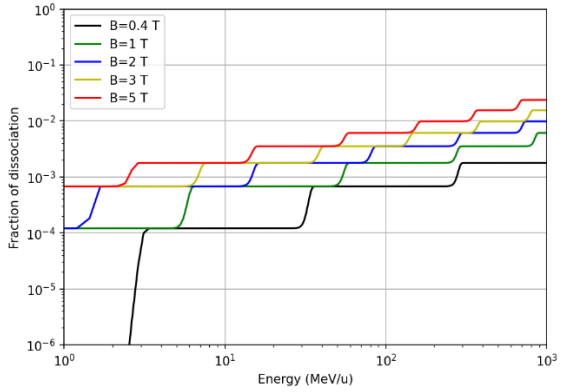








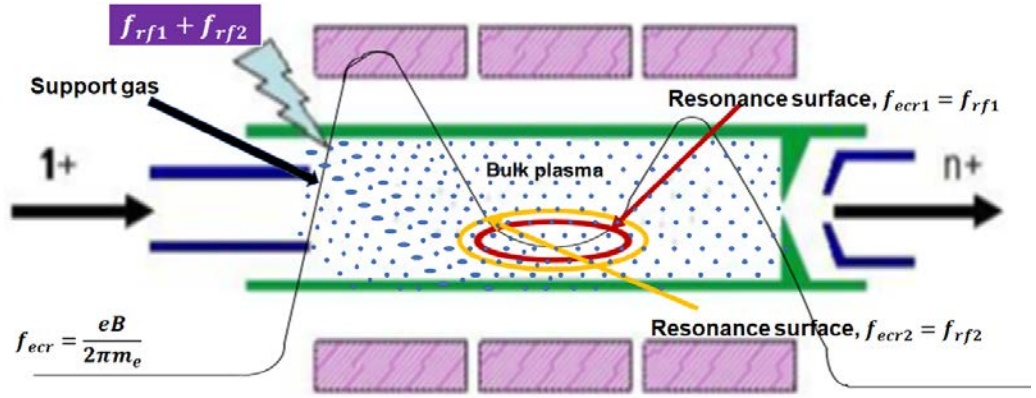


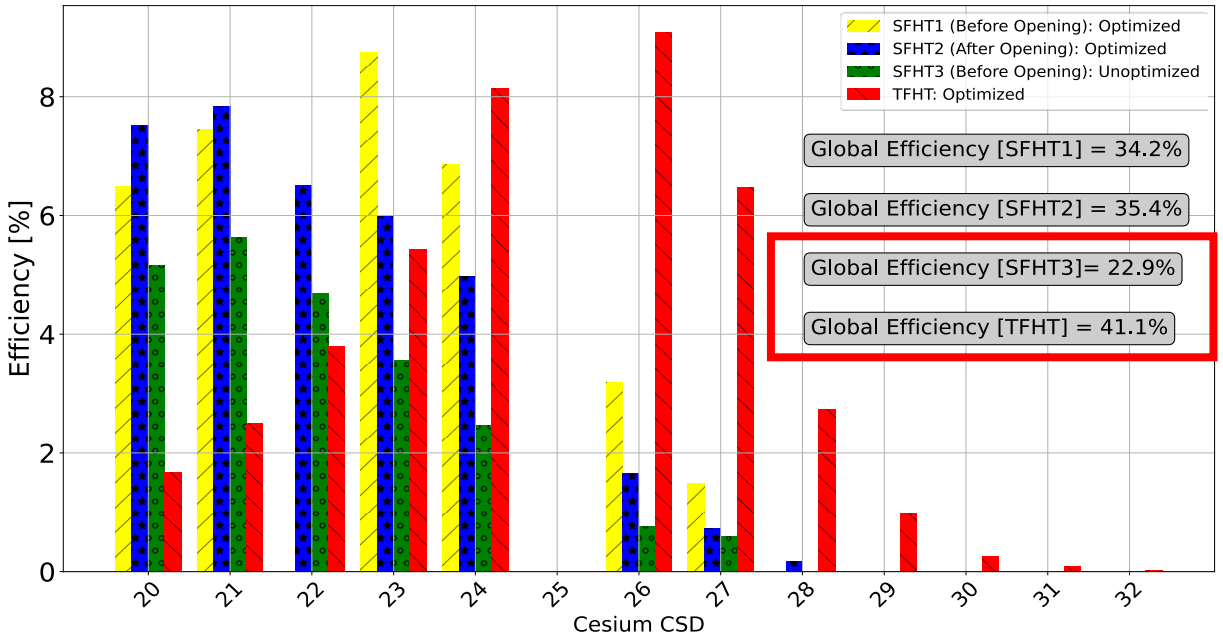


(b) Total dissociation of all state at B = 1, 2, 3 and 5 T

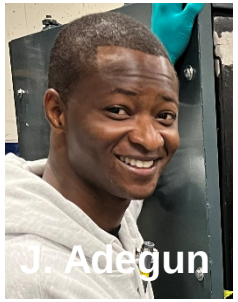
Science & Technology – Accelerators

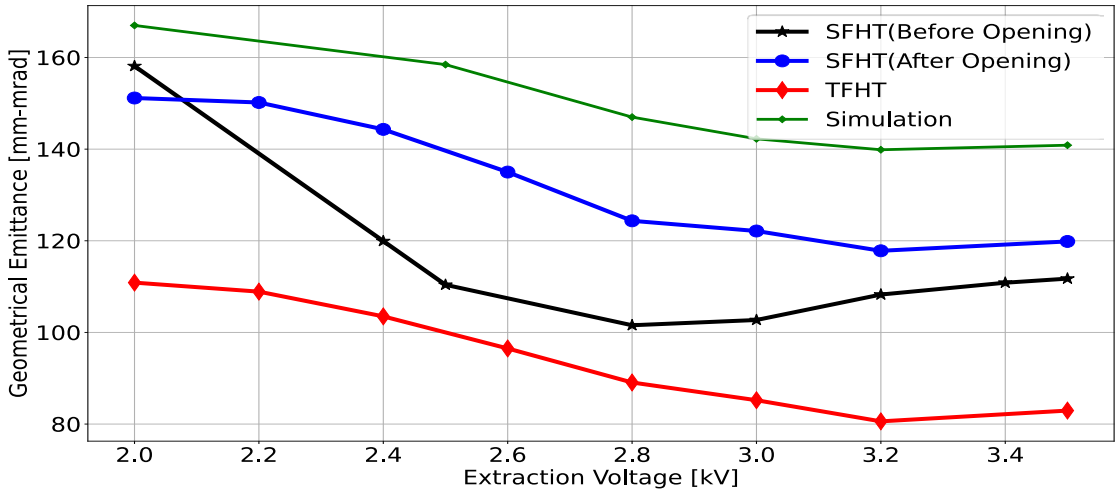
TRIUMF Charge State Booster (CSB) improvements





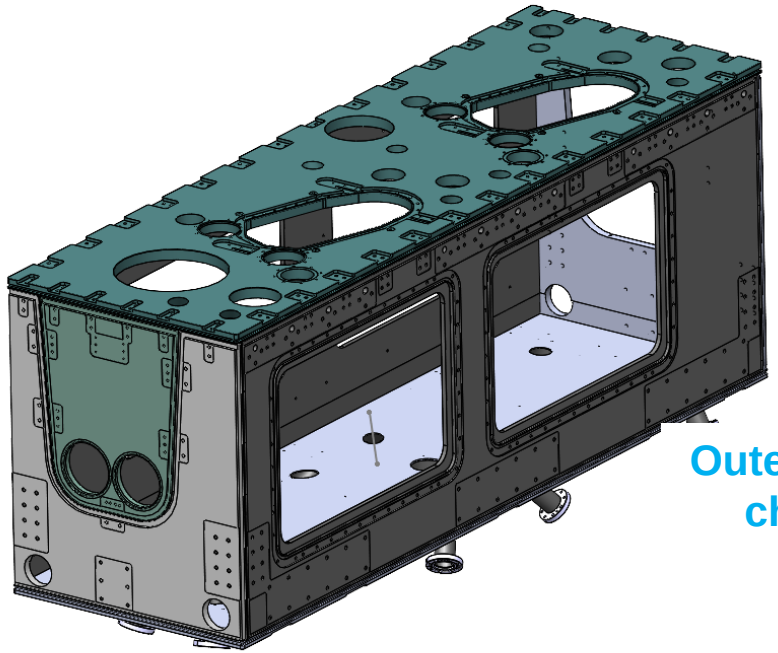
- The CSB is a 14.5 GHz Electron Cyclotron Resonance Ion Sources (ECRIS) that uses microwave plasma heating and magnetic confinement to produce highly charges ions.
- Increase of charge breeding efficiency by implementing two-frequency heating (TFHT)
  → provides two resonance heating zones
- Optimized all beam transport, ion extraction system and the charge state separator via detailed modeling and benchmarking via beam tests.



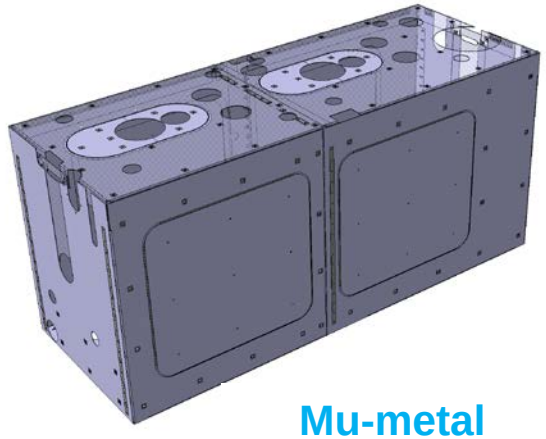


Science & Technology – Accelerators (HL-LHC)

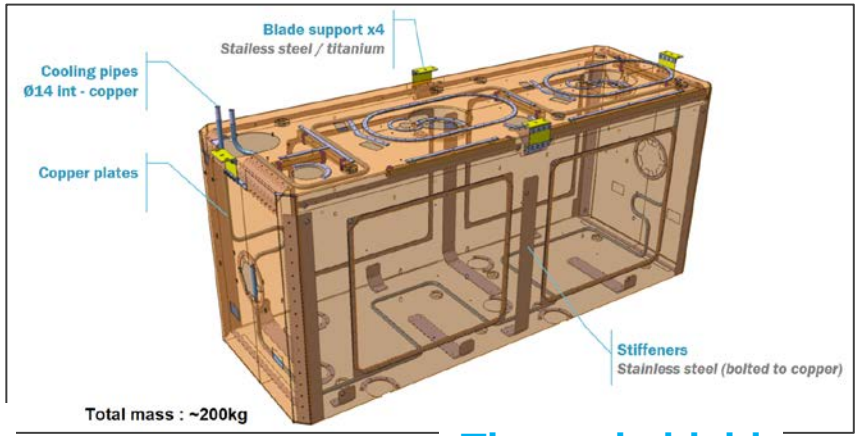
- Tender for Outer Vacuum Chamber (OVC) released
- Next procurements (mu-metal and thermal shield) in the queue
- Clean room infrastructure upgraded
  - Upgraded clean room diagnostics and garments
  - Upgraded cavity testing infrastructure



Outer vacuum chamber



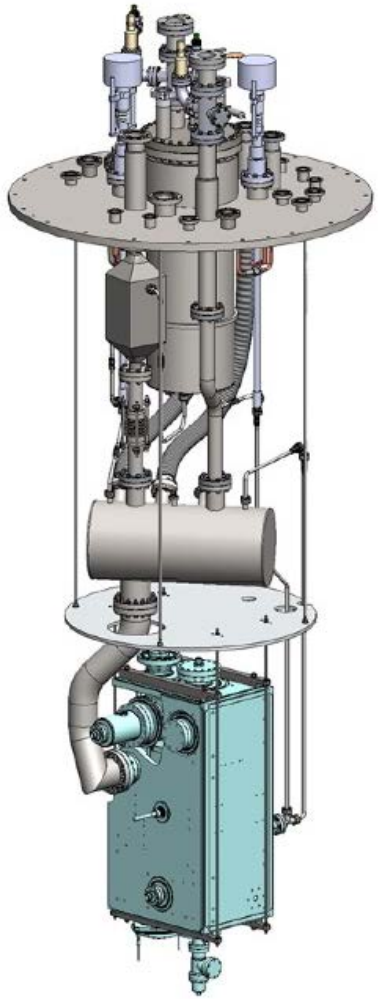
Mu-metal



Thermal shield

Science & Technology – Accelerators (HL-LHC)

- TRIUMF multi-purpose test cryostat upgraded to allow qualification of RFD cavities at 2K
- New insert tested and meets specification
- Upgraded 2K pumping capacity
- Ready for qualifying US cavities at 2K



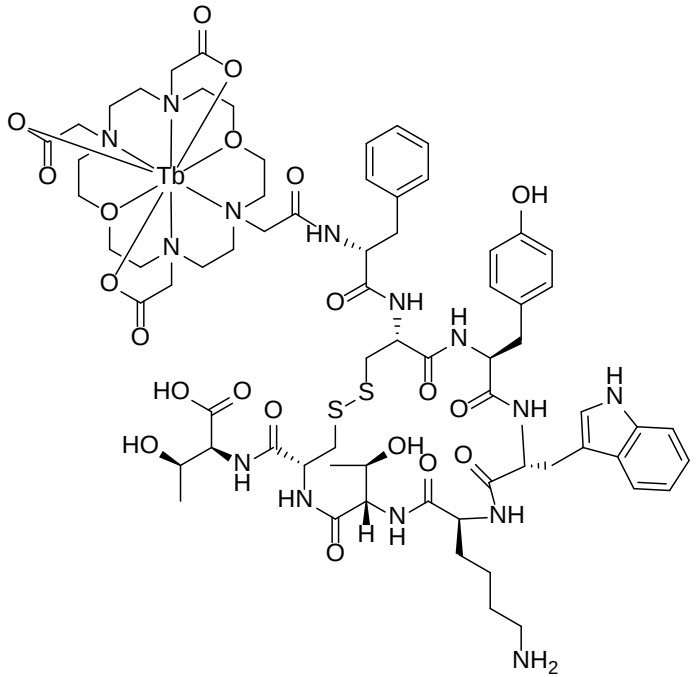
4K/2K vertical test unit

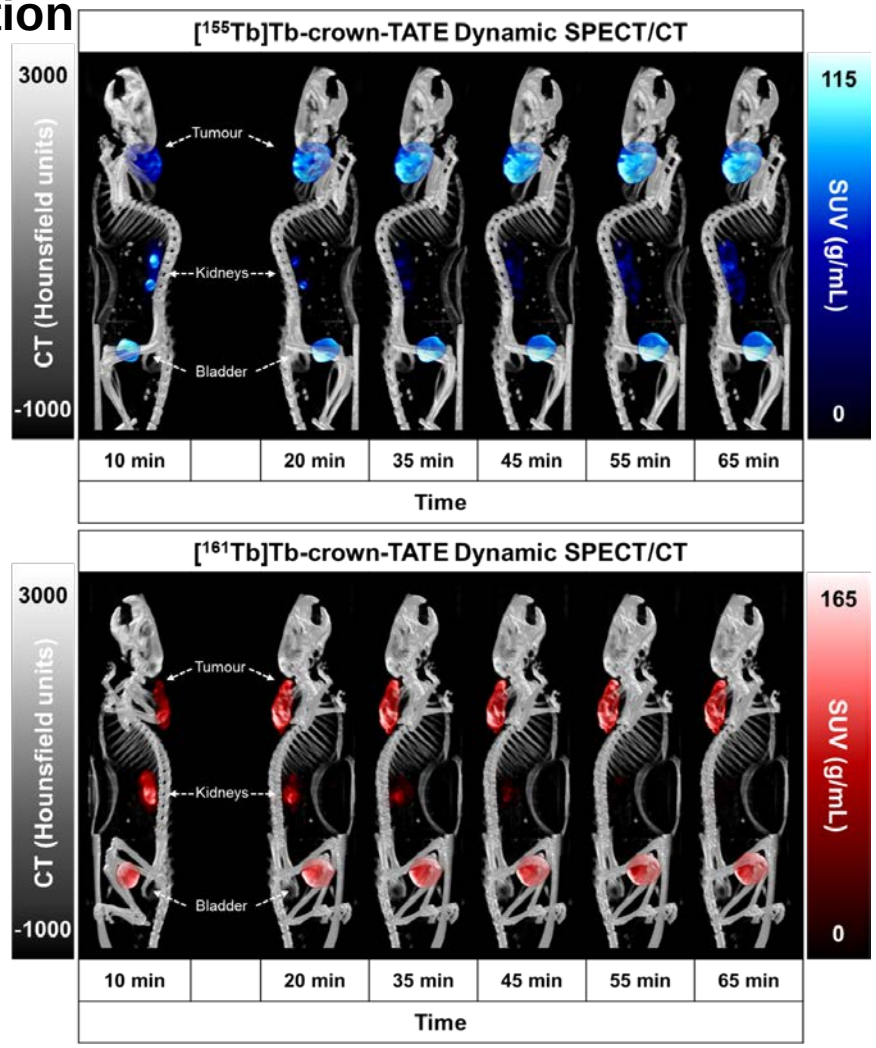
Science & Technology – Life Sciences

TRIUMF continues development of novel therapeutic isotopes

[$^{161/155}$Tb]Tb-crown-TATE: in vivo SPECT imaging and biodistribution

- Theranostic isotope development: ^{155}Tb (SPECT imaging or Auger therapy); ^{161}Tb (SPECT imaging or β-therapy)
- TRIUMF produces ^{155}Tb in ISAC; ^{161}Tb obtained from SCK CEN; animal studies completed in collaboration with BC Cancer, UBC
- TRIUMF-developed chelator and radiopharmaceutical (see structure below) targeting neuroendocrine (pancreatic) tumours (NETs)
- Results show high tumour uptake and low uptake in normal tissues and organs



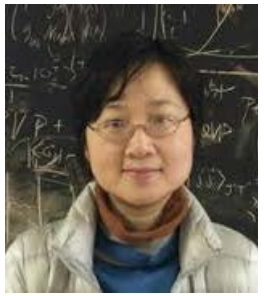


SPECT imaging of ^{155,161}Tb in AR42J (pancreatic) tumour mice

Bio beta-NMR: Optical Pumping of Ac^+ Isotopes

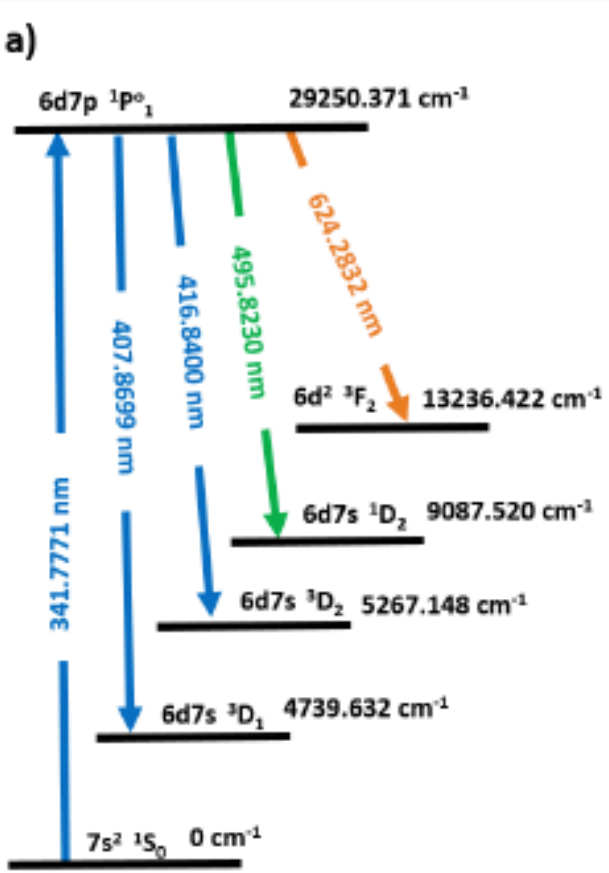
Interdivisional endeavor:

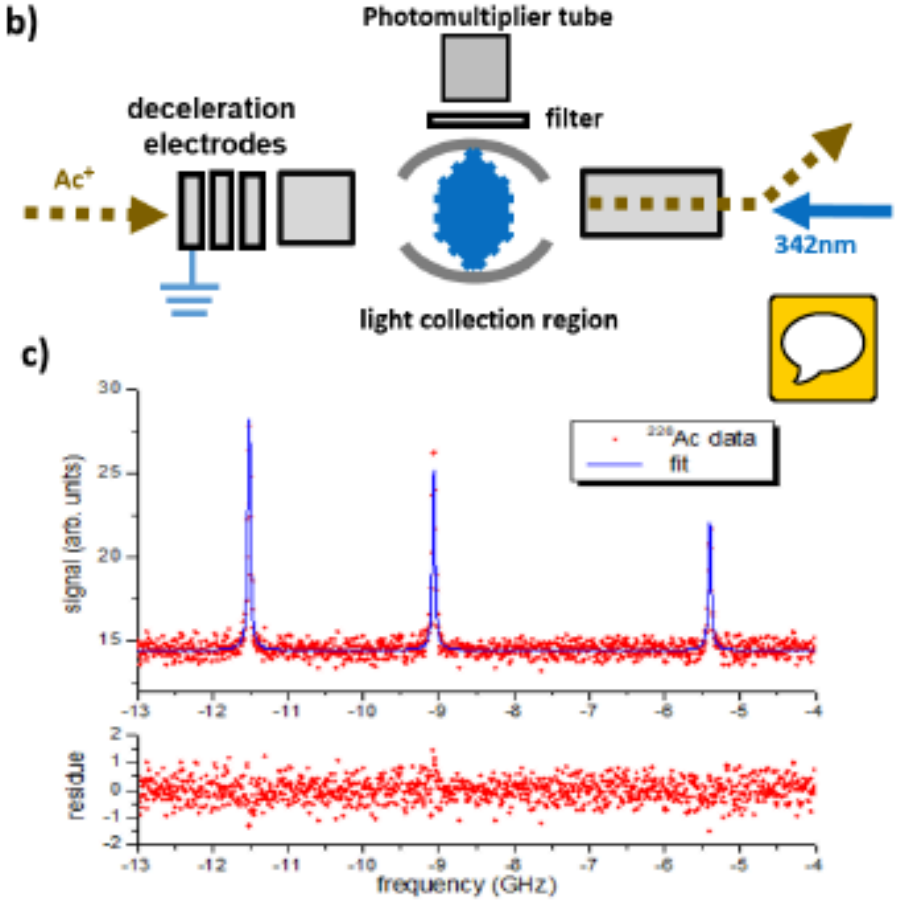
M. Stachura
Life Sciences Div.



R. Li
Accelerator Div.

A. Teigelhoefer
Physical Science Div.



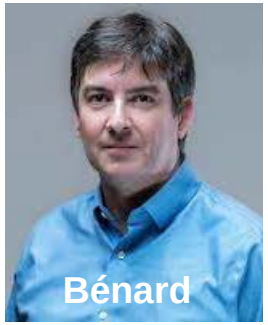


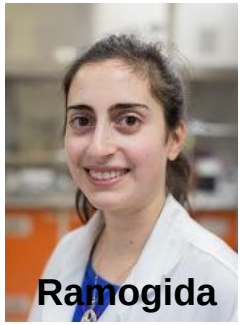
R. Li et al., Recent upgrades and developments at TRIUMF's laser nuclear-spin-polarization facility. NIM B, under revision

Science & Technology – Life Sciences

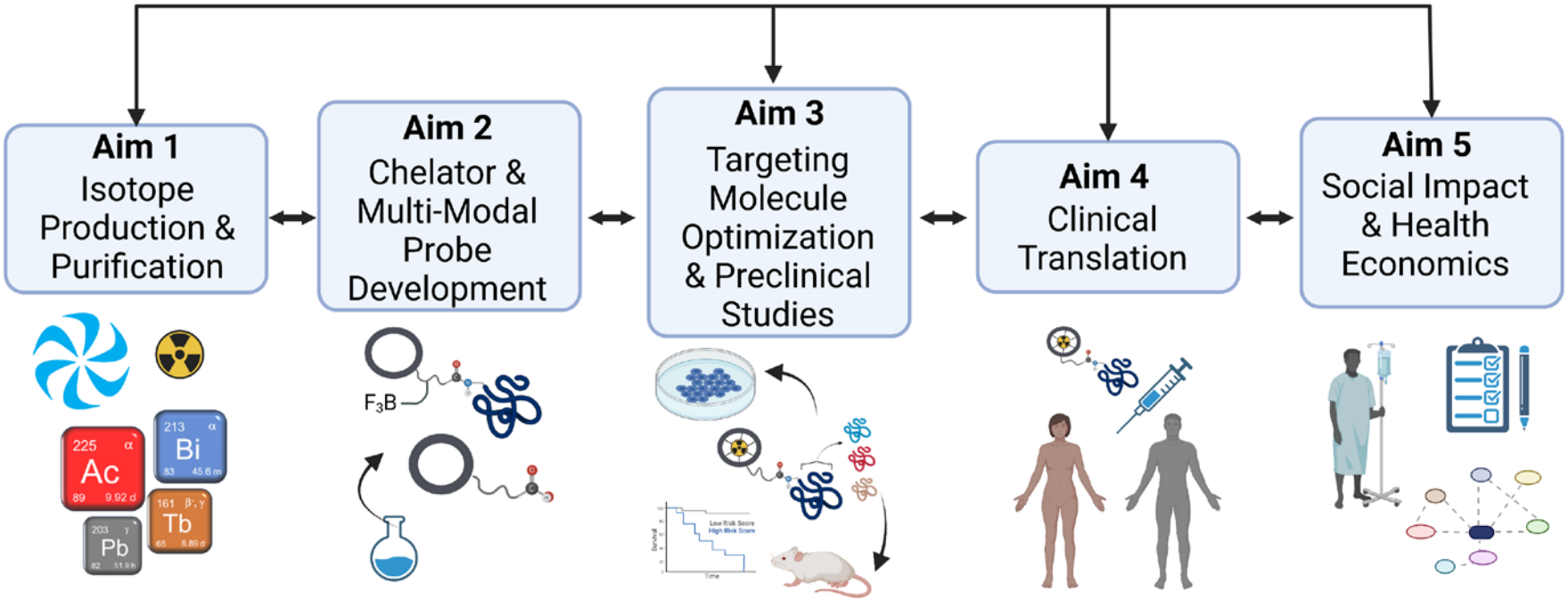
Looking Ahead: NFRF-Transformation

Rare Isotopes to Transform Cancer Therapy





- **Awarded:** $23.7 mil over 6 years
- Nominated PI: F. Bénard (UBC/BC Cancer); co-PI: Ramogida (SFU/TRIUMF)
- TRIUMF Team: Hoehr, Radchenko, Schaffer, Yang
- Utilizes 520 MeV, 24 MeV, 13 MeV cyclotrons to produce a portfolio of isotopes



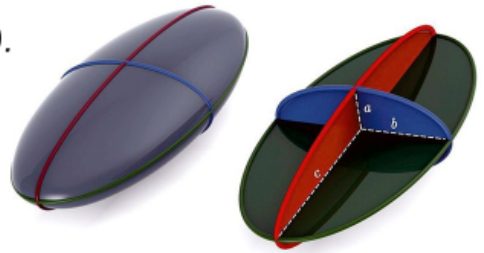
National partners:

UBC · BC Cancer · Western · TRIUMF · SFU · University of Alberta · Université de Sherbrooke · BC Children's Hospital · Université Laval · University of Toronto

Science & Technology – Nuclear Physics

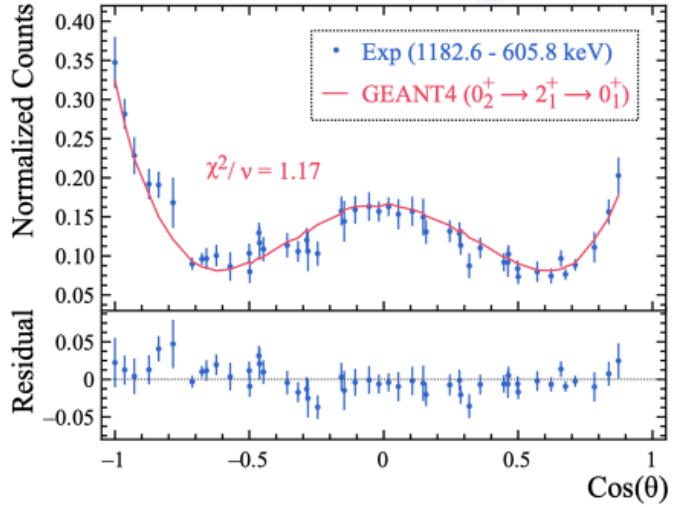
First Evidence of Axial Shape Asymmetry and Configuration Coexistence in ^{74}Zn: Suggestion for a Northern Extension of the N = 40 Island of Inversion

M. Rocchini, P.E. Garrett, M. Zielińska, S.M. Lenzi, D.D. Dao, F. Nowacki, et al., Phys. Rev. Lett. 130, 122502 (2023).

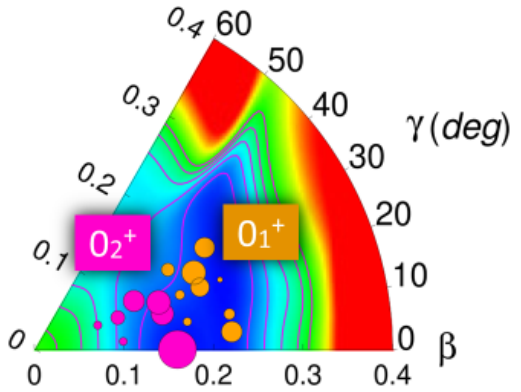


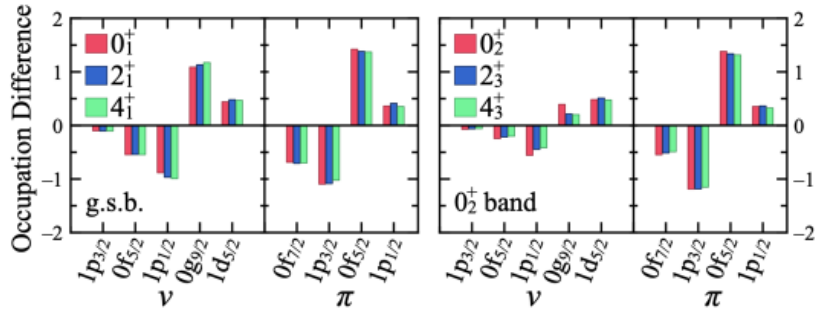
- ^{74}Zn investigated at GRIFFIN following ^{74}Cu β decay
- γ-γ angular correlation analysis ⟹ Firm spin assignments for 2_2^+, 3_1^+, 0_2^+, 2_3^+ states
- Two new transitions observed ⟹ $2_3^+ \longrightarrow 0_2^+$ and $2_3^+ \longrightarrow 4_1^+$
- From measured γ-ray branching and *E2/M1* mixing ratios for transitions de-exciting the 2_2^+, 3_1^+, 2_3^+ states ⟹ Relative B(*E2*) values
- A rotational-like structure appears at low energy in ^{74}Zn

A shore of the N = 40 "island of inversion" appears to manifest above Z = 26, previously thought as its northern limit in the chart of the nuclides



- New microscopic Large-Scale Shell-Model calculations
  - Shapes of individual states
  - Wave-function compositions
- The ground state is found to have enhanced
- axial shape asymmetry (triaxiality)
- Configuration-coexisting 0_2^+ state





Science & Technology – Nuclear Physics

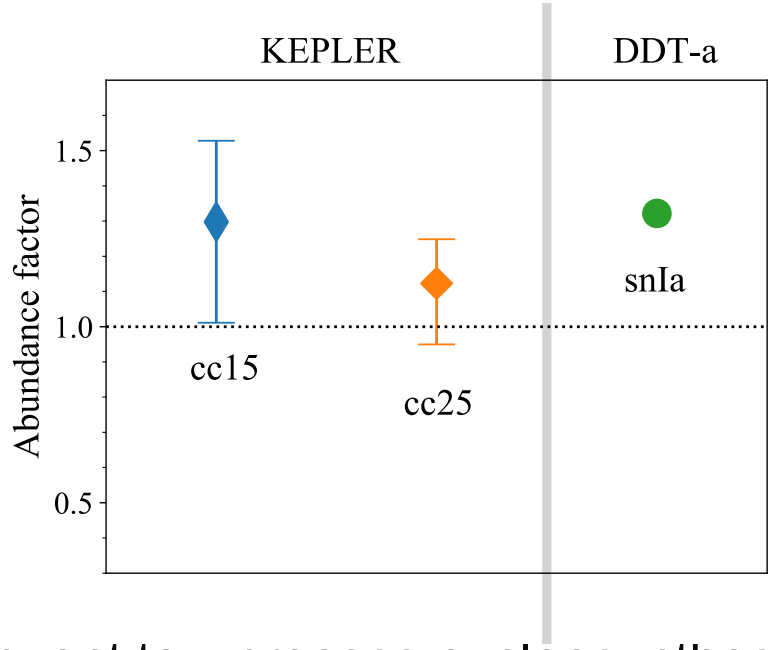
New EMMA-TIGRESS Paper

PHYSICAL REVIEW C **107**, 035803 (2023)

Cross sections of the ^{83}Rb$(p,\gamma)^{84}$Sr and ^{84}Kr$(p,\gamma)^{85}$Rb reactions at energies characteristic of the astrophysical γ process

M. Williams,[1,2] B. Davids,[1,3] G. Lotay,[4] N. Nishimura,[5,6] T. Rauscher,[7,8] S. A. Gillespie,[1,*] M. Alcorta,[1] A. M. Amthor,[9] G. C. Ball,[1] S. S. Bhattacharjee,[1] V. Bildstein,[10] W. N. Catford,[4] D. T. Doherty,[4] N. E. Esker,[1,†] A. B. Garnsworthy,[1] G. Hackman,[1] K. Hudson,[1,3] A. Lennarz,[1] C. Natzke,[1,11] B. Olaizola,[1,‡] A. Psaltis,[12,§] C. E. Svensson,[10] J. Williams,[1] D. Walter,[1,13] and D. Yates[1,14]

[1]*TRIUMF, Vancouver, British Columbia V6T 2A3, Canada*
[2]*Department of Physics, University of York, Heslington, York YO10 5DD, United Kingdom*
[3]*Department of Physics, Simon Fraser University, Burnaby, British Columbia V5A 1S6, Canada*
[4]*Department of Physics, University of Surrey, Guildford GU2 7XH, United Kingdom*
[5]*Astrophysical Big Bang Laboratory, CPR, RIKEN, Wako, Saitama 351-0198, Japan*
[6]*Nishina Center for Accelerator-Based Science, Wako, Saitama 351-0198, Japan*
[7]*Department of Physics, University of Basel, Klingelbergstr. 82, CH-4056 Basel, Switzerland*
[8]*Centre for Astrophysics Research, University of Hertfordshire, Hatfield AL10 9AB, United Kingdom*
[9]*Department of Physics and Astronomy, Bucknell University, Lewisburg, Pennsylvania 17837, USA*
[10]*Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1, Canada*
[11]*Department of Physics, Colorado School of Mines, Golden, Colorado 80401, USA*
[12]*Department of Physics and Astronomy, McMaster University, Hamilton, Ontario L8S 4L8, Canada*
[13]*Department of Astronomy and Physics, Saint Mary's University, Halifax, Nova Scotia B3H 3C3, Canada*
[14]*Department of Physics and Astronomy, University of British Columbia, Vancouver BC V6T 1Z4, Canada*



- Measurements of cross section of ^{83}Rb(p,γ)^{84}Sr reaction relevant to γ process nucleosynthesis in supernovae carried out with TIGRESS and EMMA in ISAC-II by a TRIUMF & University of Surrey (UK) collaboration; astrophysical modelling by Swiss and Japanese collaborators
- The amount of ^{84}Sr produced in supernovae is enhanced in model calculations based on the EMMA-TIGRESS measurement by 12-32% for different models with respect to previous theoretical estimate; all experimental and theoretical uncertainties included in error bars
- Models: core collapse supernovae of 15 and 25 solar masses (left) & double detonation of a Chandrasekhar-mass white dwarf (right)

Science & Technology – Nuclear Physics

New Doppler Shift Lifetimes Facility Paper

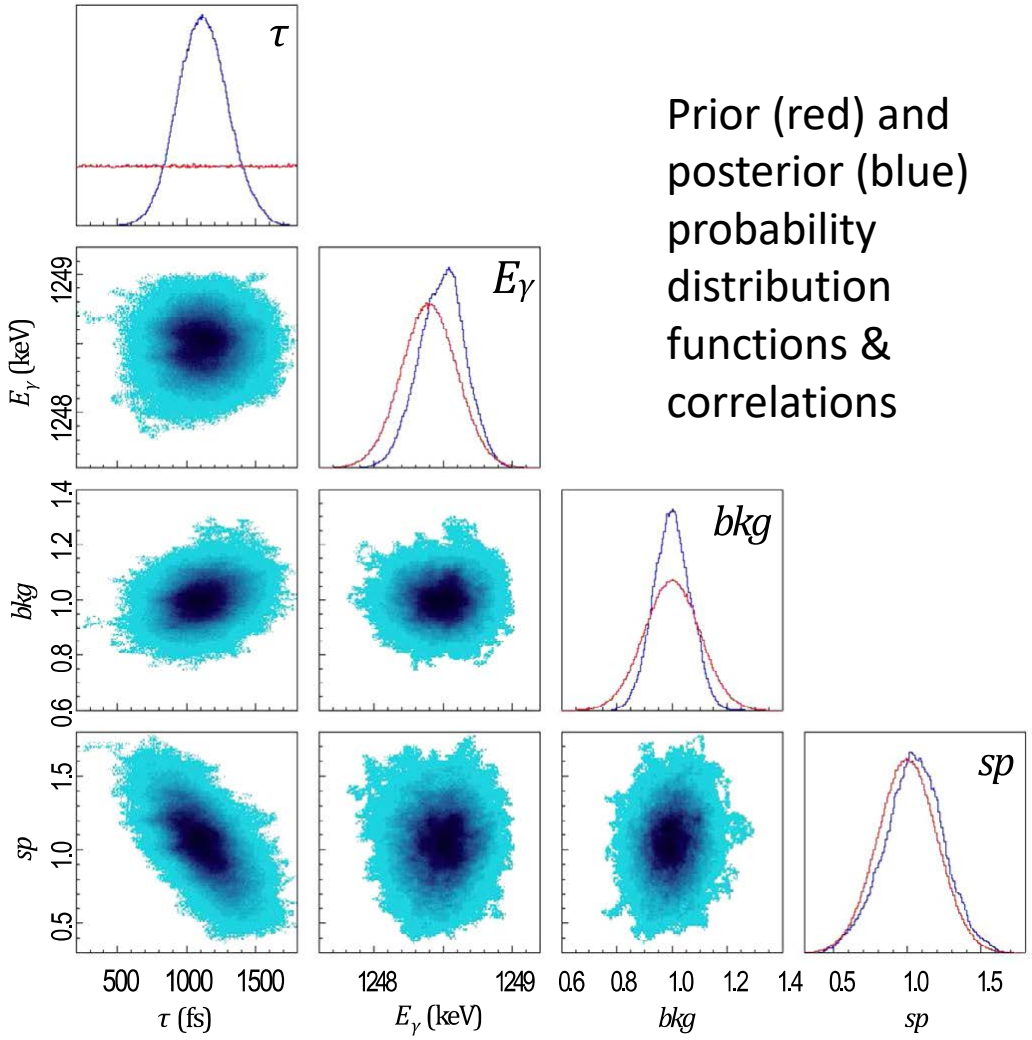
Physics Letters B 839 (2023) 137801

Contents lists available at ScienceDirect

Physics Letters B

journal homepage: www.elsevier.com/locate/physletb

L.J. Sun, C. Fry, B. Davids et al.

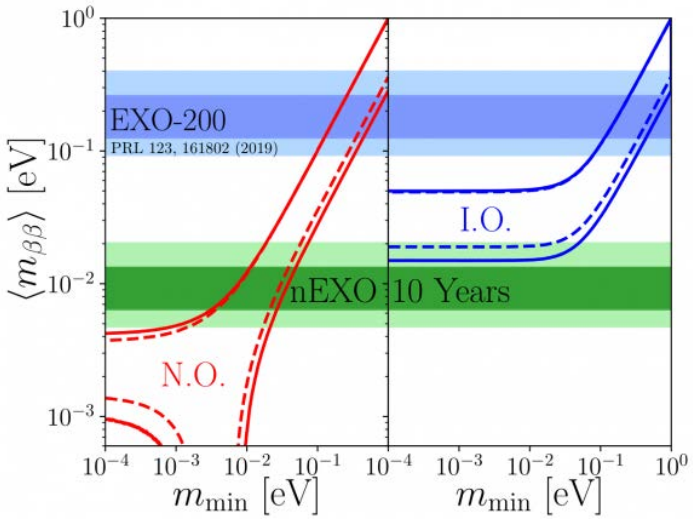


Prior (red) and posterior (blue) probability distribution functions & correlations

- Measurements of lifetimes of excited nuclear states relevant to nuclear reaction rates in classical nova explosions carried out with GRIFFIN detectors at the DSL facility in ISAC-II by a TRIUMF & Michigan State University collaboration
- Modern Bayesian statistical analysis techniques applied to γ–ray lifetime data obtained via the Doppler shift attenuation method for the 1st time
- Enables reliable quantification of systematic uncertainties in multidimensional, correlated parameter space

Neutrinoless double beta decay experiment nEXO

- nEXO collaboration published a paper in the EPJC on VUV SPM
  - Effort lead by TRIUMF SciTech dept
  - Lead author Giacomo Gallina



nEXO

TRIUMF engagement in the project increasing

Eur. Phys. J. C (2022) 82:1125
https://doi.org/10.1140/epjc/s10052-022-11072-8

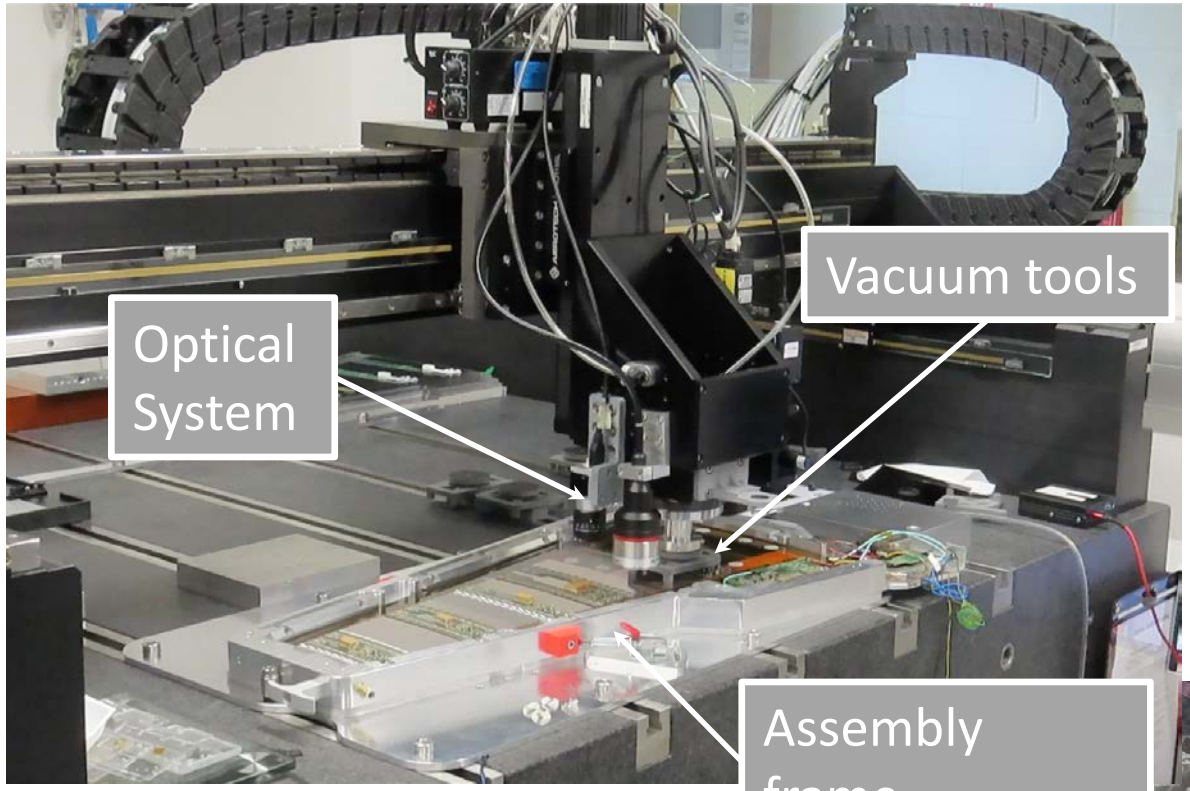
THE EUROPEAN PHYSICAL JOURNAL C

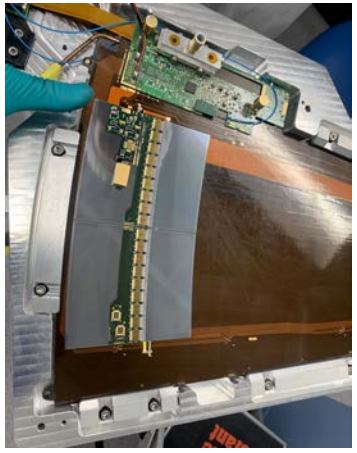
Regular Article - Experimental Physics

Performance of novel VUV-sensitive Silicon Photo-Multipliers for nEXO

G. Gallina[1,35,a], Y. Guan[2,36], F. Retiere[1], G. Cao[2,36,b], A. Bolotnikov[3], I. Kotov[3], S. Rescia[3], A. K. Soma[4], T. Tsang[3], L. Darroch[5], T. Brunner[1,5], J. Bolster[6,37], J. R. Cohen[6], T. Pinto Franco[6], W. C. Gillis[6], H. Peltz Smalley[6], S. Thibado[6], A. Pocar[6], A. Bhat[7], A. Jamil[7,35], D. C. Moore[7], G. Adhikari[8], S. Al Kharusi[5], E. Angelico[9], I. J. Arnquist[10], P. Arsenault[11], I. Badhrees[12,38], J. Bane[6], V. Belov[13], E. P. Bernard[14], T. Bhatta[15], P. A. Breur[16], J. P. Brodsky[14], E. Brown[17], E. Caden[5,18,19], L. Cao[20], C. Chambers[5], B. Chana[12], S. A. Charlebois[11], D. Chernyak[21], M. Chiu[3], B. Cleveland[18,19], R. Collister[12], M. Cvitan[1], J. Dalmasson[9], T. Daniels[22], K. Deslandes[11], R. DeVoe[9], M. L. di Vacri[10], Y. Ding[2], M. J. Dolinski[4], A. Dragone[16], J. Echevers[23], B. Eckert[4], M. Elbeltagi[12], L. Fabris[24], W. Fairbank[25], J. Farine[12,18,19], Y. S. Fu[2,36], D. Gallacher[5], P. Gautam[4], G. Giacomini[3], C. Gingras[5], D. Goeldi[12,40], R. Gornea[12], G. Gratta[9], C. A. Hardy[9], S. Hedges[14], M. Heffner[14], E. Hein[26], J. Holt[1], E. W. Hoppe[10], J. Hößl[27], A. House[14], W. Hunt[14], A. Iverson[25], X. S. Jiang[2], A. Karelin[13], L. J. Kaufman[16], R. Krücken[1,28,39], A. Kuchenkov[13], K. S. Kumar[6], A. Larson[29], K. G. Leach[30], B. G. Lenardo[9], D. S. Leonard[31], G. Lessard[11], G. Li[2], S. Li[23], Z. Li[8], C. Licciardi[12,18,19], R. Lindsay[32], R. MacLellan[15], M. Mahtab[1], S. Majidi[5], C. Malbrunot[1], P. Margetak[1], P. Martel-Dion[11], L. Martin[1], J. Masbou[33], N. Massacret[1], K. McMichael[17], B. Mong[16], K. Murray[5], J. Nattress[24], C. R. Natzke[30], X. E. Ngwadla[32], J. C. Nzobadila Ondze[32], A. Odian[16], J. L. Orrell[10], G. S. Ortega[10], C. T. Overman[10], S. Parent[11], A. Perna[18], A. Piepke[21], N. Pletskova[4], J. F. Pratte[11], V. Radeka[3], E. Raguzin[3], G. J. Ramonnye[32], T. Rao[3], H. Rasiwala[5], K. Raymond[1], B. M. Rebeiro[5], G. Richardson[7], J. Ringuette[30], V. Riot[14], T. Rossignol[11], P. C. Rowson[16], L. Rudolph[5], R. Saldanha[10], S. Sangiorgio[14], X. Shang[5], F. Spadoni[10], V. Stekhanov[13], X. L. Sun[2], A. Tidball[17], T. Totev[5], S. Triambak[32], R. H. M. Tsang[21], O. A. Tyuka[32], F. Vachon[11], M. Vidal[9], S. Viel[12], G. Visser[34], M. Wagenpfeil[27], M. Walent[18], K. Wamba[26], Q. Wang[20], W. Wang[21], Y. Wang[2], M. Watts[7], W. Wei[2], L. J. Wen[2], U. Wichoski[12,18,19], S. Wilde[7], M. Worcester[3], W. H. Wu[2], X. Wu[20], L. Xie[1], W. Yan[2], H. Yang[20], L. Yang[8], O. Zeldovich[13], J. Zhao[2], T. Ziegler[27]

Science & Technology – Particle Physics



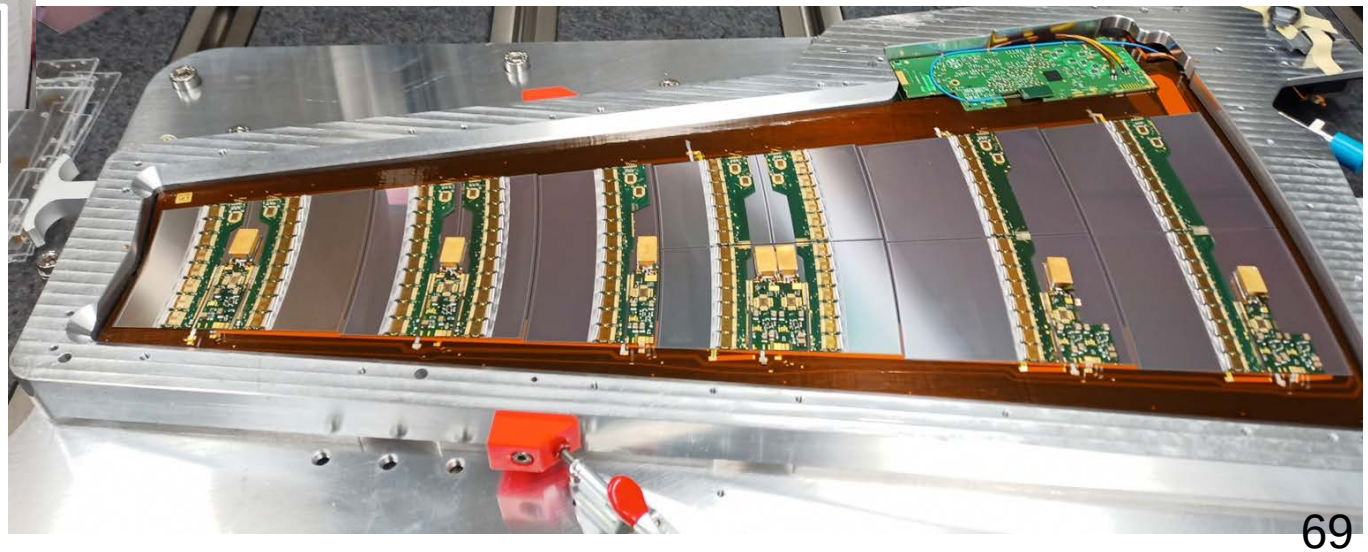


- Single module PPB petal assembled at special request
- Sent to DESY for system test Preparation and readout (FELIX) development at NIKHEF

ATLAS-ITK

ITk Petal assembly milestone

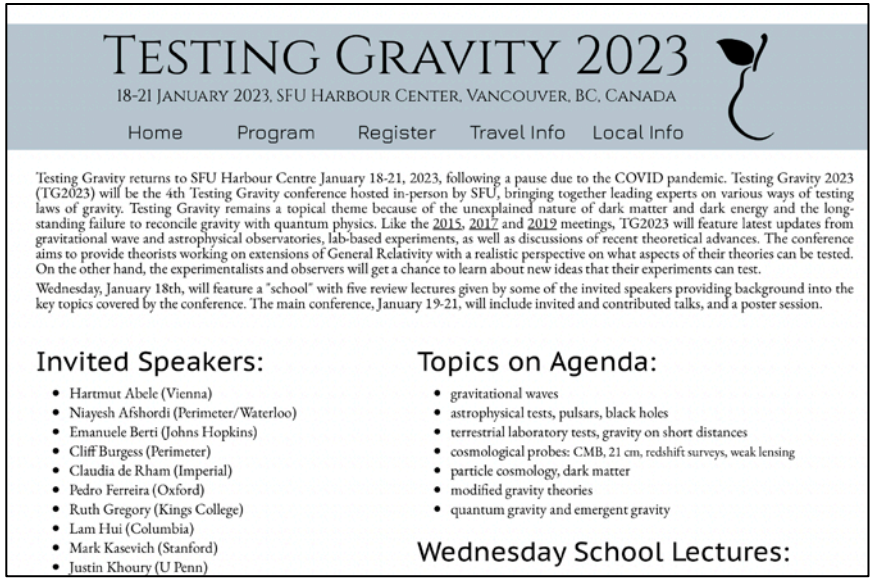
- Assembly of three petals recently
- First Pre-Production A (PPA) petal in ATLAS
- Vancouver/Canada is first ITk EC site to qualify
  - Automated loading using robotic gantry
  - All placements within specification ±50µm
  - Exercised full Canadian production workflow
  - Assembly of first PPB petal in preparation



Science & Technology – Particle Physics

ALPHA

- Helped organization of Testing Gravity Conference at SFU Downtown, Jan 18-21, 2023
- Collaboration meeting at U. Brescia, Italy, Feb 2-4
- Discussion with Frederic Sirois (Montreal) on HiTc superconducting magnet R&D for HAICU
- CERN new year reception, Jan 30
- Physics Colloquium at U Manitoba this week
- ALPHA-g first data being analyzed



TESTING GRAVITY 2023

18-21 JANUARY 2023, SFU HARBOUR CENTER, VANCOUVER, BC, CANADA

Home Program Register Travel Info Local Info

Testing Gravity returns to SFU Harbour Centre January 18-21, 2023, following a pause due to the COVID pandemic. Testing Gravity 2023 (TG2023) will be the 4th Testing Gravity conference hosted in-person by SFU, bringing together leading experts on various ways of testing laws of gravity. Testing Gravity remains a topical theme because of the unexplained nature of dark matter and dark energy and the long-standing failure to reconcile gravity with quantum physics. Like the 2015, 2017 and 2019 meetings, TG2023 will feature latest updates from gravitational wave and astrophysical observatories, lab-based experiments, as well as discussions of recent theoretical advances. The conference aims to provide theorists working on extensions of General Relativity with a realistic perspective on what aspects of their theories can be tested. On the other hand, the experimentalists and observers will get a chance to learn about new ideas that their experiments can test.

Wednesday, January 18th, will feature a "school" with five review lectures given by some of the invited speakers providing background into the key topics covered by the conference. The main conference, January 19-21, will include invited and contributed talks, and a poster session.

Invited Speakers:

- Hartmut Abele (Vienna)
- Niayesh Afshordi (Perimeter/Waterloo)
- Emanuele Berti (Johns Hopkins)
- Cliff Burgess (Perimeter)
- Claudia de Rham (Imperial)
- Pedro Ferreira (Oxford)
- Ruth Gregory (Kings College)
- Lam Hui (Columbia)
- Mark Kasevich (Stanford)
- Justin Khoury (U Penn)

Topics on Agenda:

- gravitational waves
- astrophysical tests, pulsars, black holes
- terrestrial laboratory tests, gravity on short distances
- cosmological probes: CMB, 21 cm, redshift surveys, weak lensing
- particle cosmology, dark matter
- modified gravity theories
- quantum gravity and emergent gravity

Wednesday School Lectures:

CERN new year reception

ALPHA collab meeting in Brescia U.

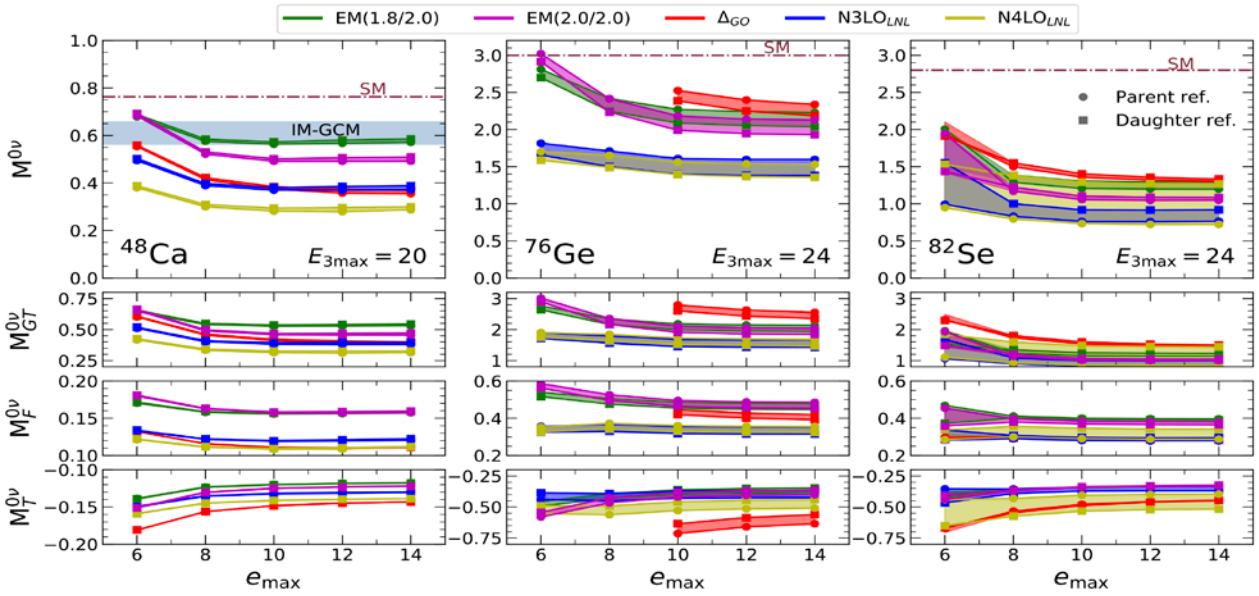
Science & Technology – Theory

Neutrinoless double beta decay & muon capture on nuclei – theory insights

Nuclear theory needed to extract the neutrino mass from the neutrinoless double beta decay half-life measurements

Ab Initio 0νββ Decay: ^{48}Ca, ^{76}Ge and ^{82}Se

Results with 5 different input hamiltonians to study uncertainty from interaction choice.

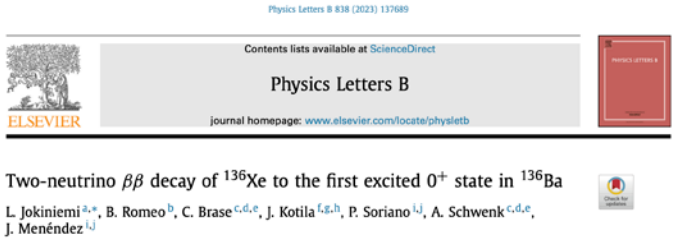


New calculations of 0$\nu\beta\beta$ matrix elements improving on 2021 PRL

PHYSICAL REVIEW LETTERS **126,** 042502 (2021)

***Ab Initio* Neutrinoless Double-Beta Decay Matrix Elements for ^{48}Ca, ^{76}Ge, and ^{82}Se**

A. Belley, C. G. Payne, S. R. Stroberg, T. Miyagi, and J. D. Holt



Physics Letters B 838 (2023) 137689

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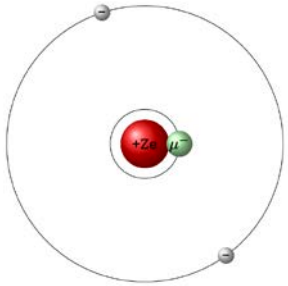
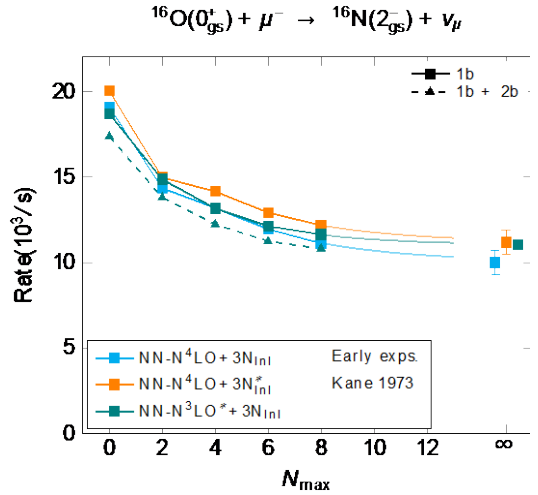
Two-neutrino $\beta\beta$ decay of ^{136}Xe to the first excited 0^+ state in ^{136}Ba

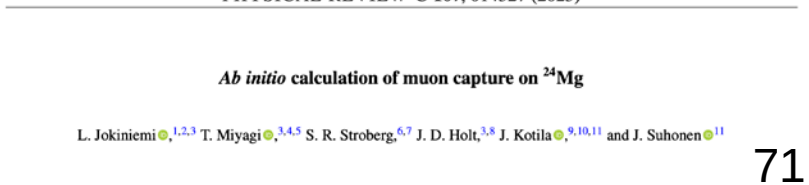
L. Jokiniemi, B. Romeo, C. Brase, J. Kotila, P. Soriano, A. Schwenk, J. Menéndez

μ capture calculations validate 0$\nu\beta\beta$ predications - related physics





Published (^{24}Mg) and ongoing (^{16}O) *ab initio* calculations



PHYSICAL REVIEW C **107,** 014327 (2023)

***Ab initio* calculation of muon capture on ^{24}Mg**

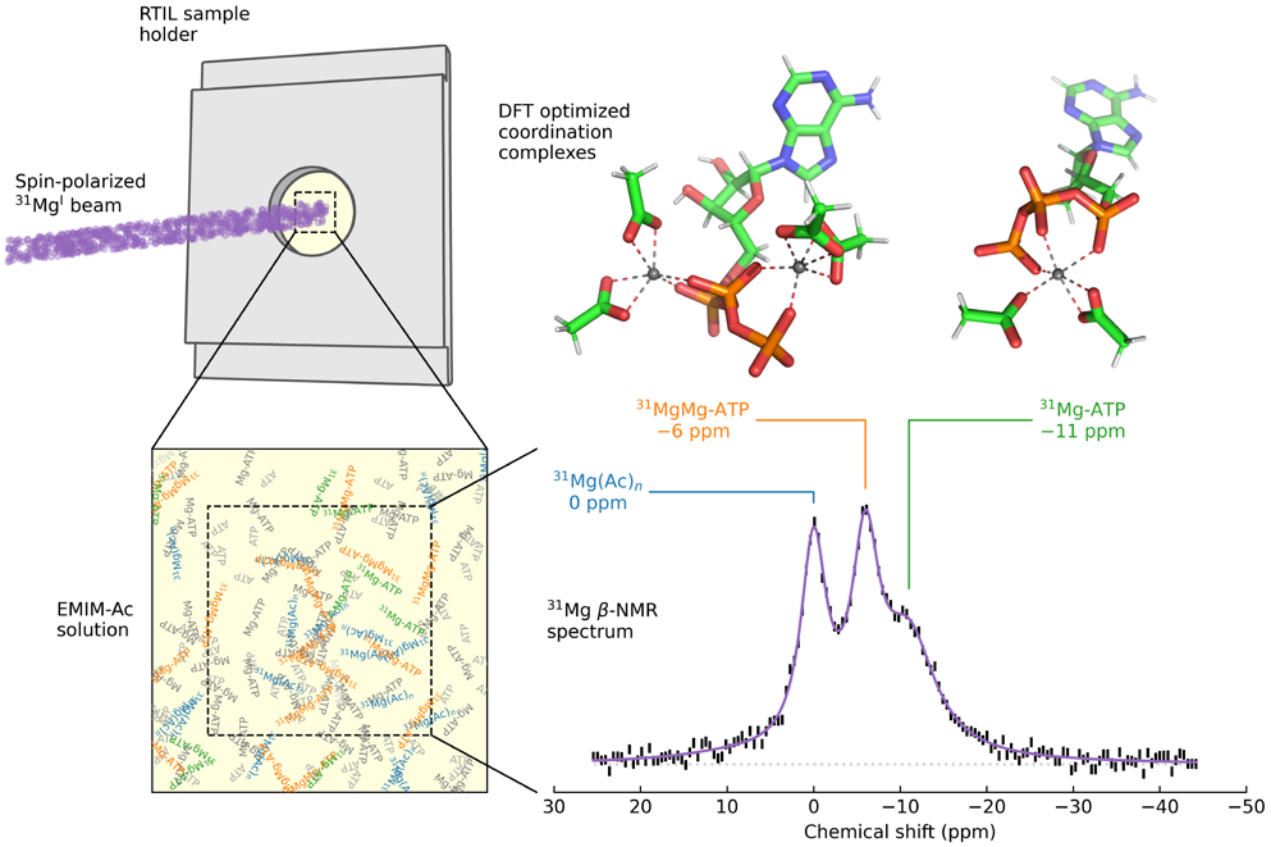
L. Jokiniemi, T. Miyagi, S. R. Stroberg, J. D. Holt, J. Kotila, and J. Suhonen

Science & Technology – Materials Science

R. M. L. McFadden, D. Szunyogh, N. Bravo-Frank, A. Chatzichristos, M. H. Dehn, D. Fujimoto, A. Jancsó, S. Johannsen, I. Kálomista, V. L. Karner, R. F. Kiefl, F. H. Larsen, J. Lassen, C. D. P. Levy, R. Li, I. McKenzie, H. McPhee, G. D. Morris, M. R. Pearson, S. P. A. Sauer, R. K. O. Sigel, P. W. Thulstrup, W. A. MacFarlane, L. Hemmingsen, and M. Stachura

Angewandte International Edition Chemie

Magnesium(II)-ATP Complexes in 1-Ethyl-3-Methylimidazolium Acetate Solutions Characterized by ^{31}Mg β-Radiation-Detected NMR Spectroscopy

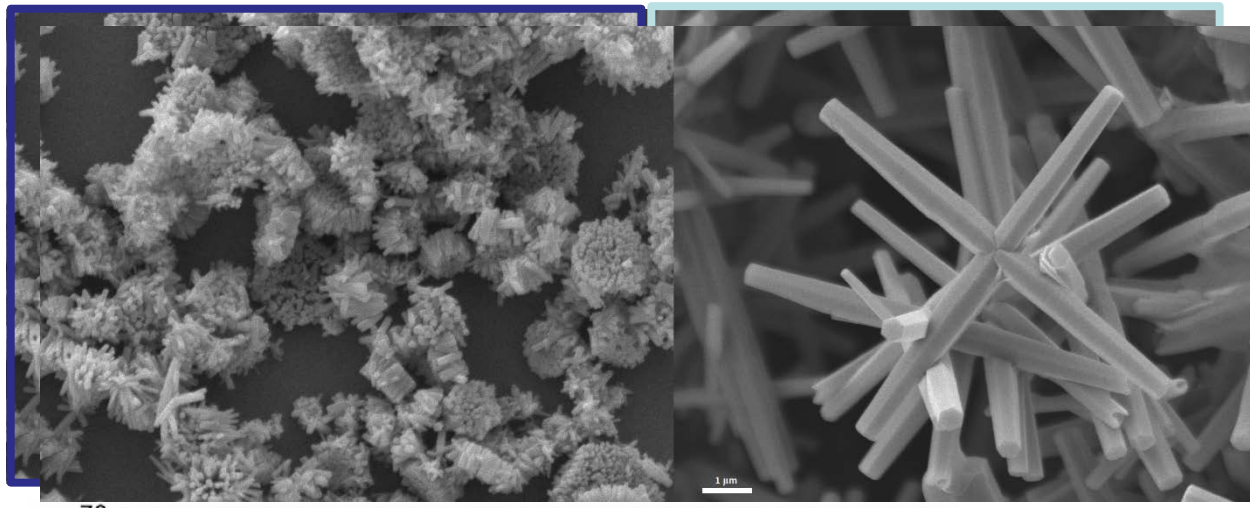


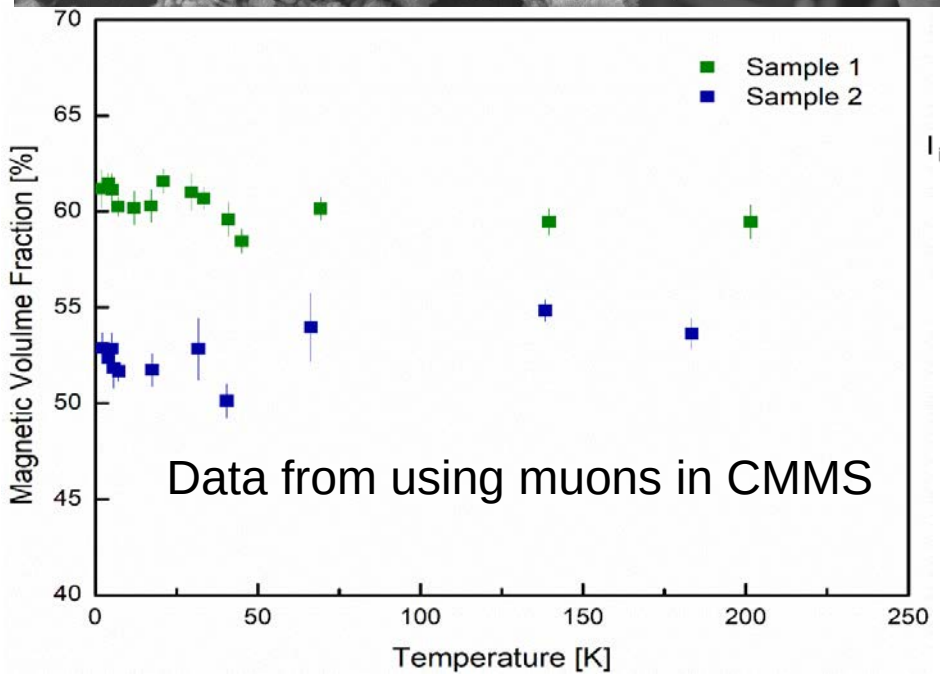
- This highlight showcases a novel use of β-NMR spectroscopy to study coordination chemistry in solution.
- The resonance of the spin-1/2 β-emitter ^{31}Mg reveals distinct Mg^{2+} binding modes with the biomolecule adenosine triphosphate (ATP).
- The measured chemical shifts are in good agreement with quantum chemical calculations, confirming their assignment.
- This work constitutes an important advancement towards the application of β-NMR spectroscopy in *biochemistry*.

Science & Technology – Materials Science

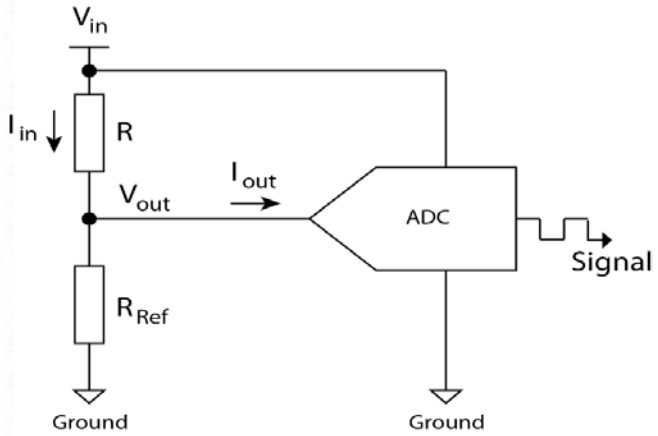
(-g**k** N, -850 G**)**

(-g**k** N, 0 G)





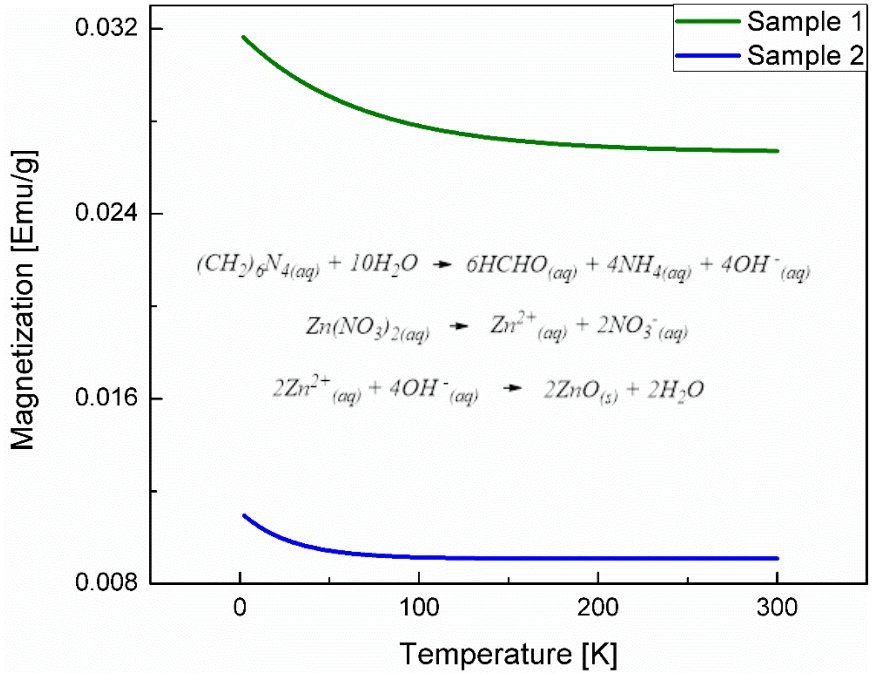
Data from using muons in CMMS



Apply these materials in biosensing

C. Landry; *et al*. *Nanomaterials* **2022**, *12*, 184. https://doi.org/10.3390/nano12020184

Basic science at CMMS/TRIUMF nourished nanomaterial innovations



Most important result:
CMMS data when used along with lots of other characterization techniques helped us to solve the puzzle of why with magnetic field and gravity, we could change the magnetic properties of an otherwise inherently diamagnetic material. This resulted in developing biosensors for different pathogens based on the control of magnetic properties.

TRIUMF

Thank You!

Merci!

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