



# Update on TRIUMF

Nigel Smith,  
Executive Director & CEO

CINP-IPP Joint Session  
2025-06-12



TRIUMF is located on the traditional, ancestral, and unceded territory of the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

TRIUMF's home has always been a seat of learning.



# TRIUMF Research Programme

- TRIUMF community research programme components shown at right (from our 20-year vision)
- TRIUMF has had a recent NRC ACOT (Advisory Committee on TRIUMF) review, which reviewed the science programme
- Slides from the three science divisions are appended to this talk, showing the breath of the research underway...
- ...ACOT continues to evaluate our collective research as world class



# ACOT Debrief - message from chair

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TRIUMF Staff and Students,

The Advisory Committee on TRIUMF very much enjoyed our visit last week and would like to thank you all not only for the work that went in to preparing for and executing our visit, but also for the work you do every day. TRIUMF is an important facility in the international scientific landscape and clearly the crown jewel in Canada's research enterprise. You all have made significant progress toward building ARIEL and preparing for new science opportunities with IAMI, while maintaining your cutting-edge research in physical sciences, life science and technology.

You have a large challenge ahead of you as you position TRIUMF and Canada for even greater scientific achievements in the coming years, but you are up to the task. The scientific and technical talent throughout the ranks, as well as your leadership's capabilities were very evident to us. We look forward to following your progress and celebrating your achievements.

Thanks again for all you do,

Sherry Yennello (for ACOT)

# **TRIUMF Five-year Implementation Plan**

# Budget 2024 Outcome - Request <sup>6</sup>

- As noted last year, TRIUMF received ~\$400M for operational support in budget 2024, starting April 2025
- This was reduced from the requested \$450M, which has impact on what we can deliver
- We are now in this funding cycle

## Five core themes of the request:

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

	Funding Level			
	≤ 300	350	400	450
Operational excellence	Yellow	Green	Green	Green
IAMI	Orange	Light Green	Green	Green
Facility utilization	Orange	Yellow	Light Green	Green
Domestic research ecosystem	Red	Yellow	Light Green	Green
Site maintenance	Red	Orange	Yellow	Green
Talent and training	Red	Orange	Yellow	Green
Major deferred maintenance (BL1A/substation)	Red	Orange	Yellow	Green
Innovation & commercialization	Red	Orange	Yellow	Green
International research ecosystem	Red	Orange	Yellow	Green
ARIEL completion	Red	Orange	Yellow	Green
ARIEL operations	Red	Orange	Orange	Green

*Heat map visualizing various funding-level scenarios, including those of reduced funding from the \$450M request*

# Implementation Plan scenarios

- ARIEL and IAMI completion re-affirmed as primary objective of the next five-year plan
- Three scenarios were evaluated, with substantial input from community, university members, Board of Governors, NRC, etc:
  1. Returning to an eight-month operational cycle for ISAC, delaying operations of IAMI into the next five-year period and effectively deferring ARIEL construction and operations well beyond existing five-year plan
  2. A single extended shutdown of the main accelerator for a year in 2026 to complete ARIEL construction as defined by the CFI criteria. This allows focus on ARIEL during that period without distraction (and will require rigour), yet obviously impacts ISAC and CMMS, and medical isotope production
  3. The status quo of longer shutdowns over the next four/five years to provide some spare capacity for ARIEL construction. This implies continued six month shutdowns, which impacts science and medical isotope production - this is actually closer to the scenario put to government
- (Fourth scenario of securing an additional \$50M operation funds viewed as unachievable)

# 5-year plan scenario considerations

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Less +ve	<span style="background-color: yellow; width: 15px; height: 10px; display: inline-block;"></span>
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More -ve	<span style="background-color: red; width: 15px; height: 10px; display: inline-block;"></span>

	<b>Scenarios</b>		
	1 (Defer ARIEL/IAMI; 8-month cycle)	2 (Extended Shutdown)	(Delay ARIEL/IAMI; 8-month cycle)
<b>Non-negotiable elements</b>			
Compensation	✓	✓	✓
Deferred Maintenance	✓	✓	✓
Operational Excellence	✓	✓	✓
<b>Considerations</b>			
Position TRIUMF for next 5YP			
Maintain domestic scientific userbase / excellence			
Maintain international scientific userbase / excellence			
Talent Development (also 'compensation' above)			
Complete and operate ARIEL			
Complete and operate IAMI			
Complete BL1A Refurbishment			
Financially secure - operations & capacity			
Medical isotope production			
Manage reputation with users			
Maintain reputation with international collaborators			
Manage reputation with government			
Manage reputation with business partners			

# Implementation Plan Core Deliverables

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- **Deliver science from the Advanced Rare Isotope Laboratory (ARIEL)**
  1. Deliver 5000 hours of radioactive isotope beam to ISAC by the 2029 operational year
  2. Ensure ARIEL is ready for Gate-4A in the TRIUMF project management process by 2027
- **Complete and operate the Institute for Advanced Medical Isotopes (IAMI)**
  3. Initial operations of the IAMI facility in 2026
- **Refurbish key infrastructure and systems**
  4. Replacement of key components of Beamline 1A, supporting material sciences and isotope production, during planned shutdown periods

# NRC Contribution Agreement Schedule B

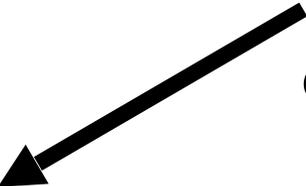
## SCHEDULE B

### Funded Activities

The following activities shall be undertaken by TRIUMF or its controlled entities, in alignment with the financial information in Schedule C.

1. TRIUMF commits to following core deliverables:
  - (a) Ensuring ARIEL is ready for Gate-4A in the TRIUMF project management process in 2027
  - (b) Delivery of 5000 hours of radioactive isotope beam to ISAC in the 2029 operational year
  - (c) Initial operations of the IAMI facility in 2026
  - (d) Replacement of key components of Beamline 1A, supporting material sciences and isotope production, during planned shutdown periods

**Core deliverables now threaded through CA, 5YIP, governance groups, community discussions...**



2. TRIUMF will support the Canadian scientific community by providing access to its experimental facilities as well as technical and scientific support. TRIUMF will provide support for:
  - (a) On-site science: RIB nuclear physics; quantum materials & technologies; life sciences; theoretical subatomic physics; UCN/nEDM.
  - (b) Off-site collaborative research, and science projects (ATLAS; HL-LHC; ALPHA; Hyper-K; DBD)
  - (c) Science operations undertaken as part of the Institute for Advanced Medical Isotopes (IAMIs)
  - (d) Other on- or off-site science initiatives undertaken using resources provided under this Contribution Agreement.
3. TRIUMF or its Controlled entities or Affiliates, will undertake activities to commercialize TRIUMF's research and technology activities for the benefit of Canada, in alignment with the provisions of the Contribution Agreement and in particular with the provisions set out in Article 5 regarding Security, Article 9 regarding Intellectual property and Article 10 regarding Traceable Economic Benefit.

**...but we are also committing to support as broad a science and innovation programme as possible**



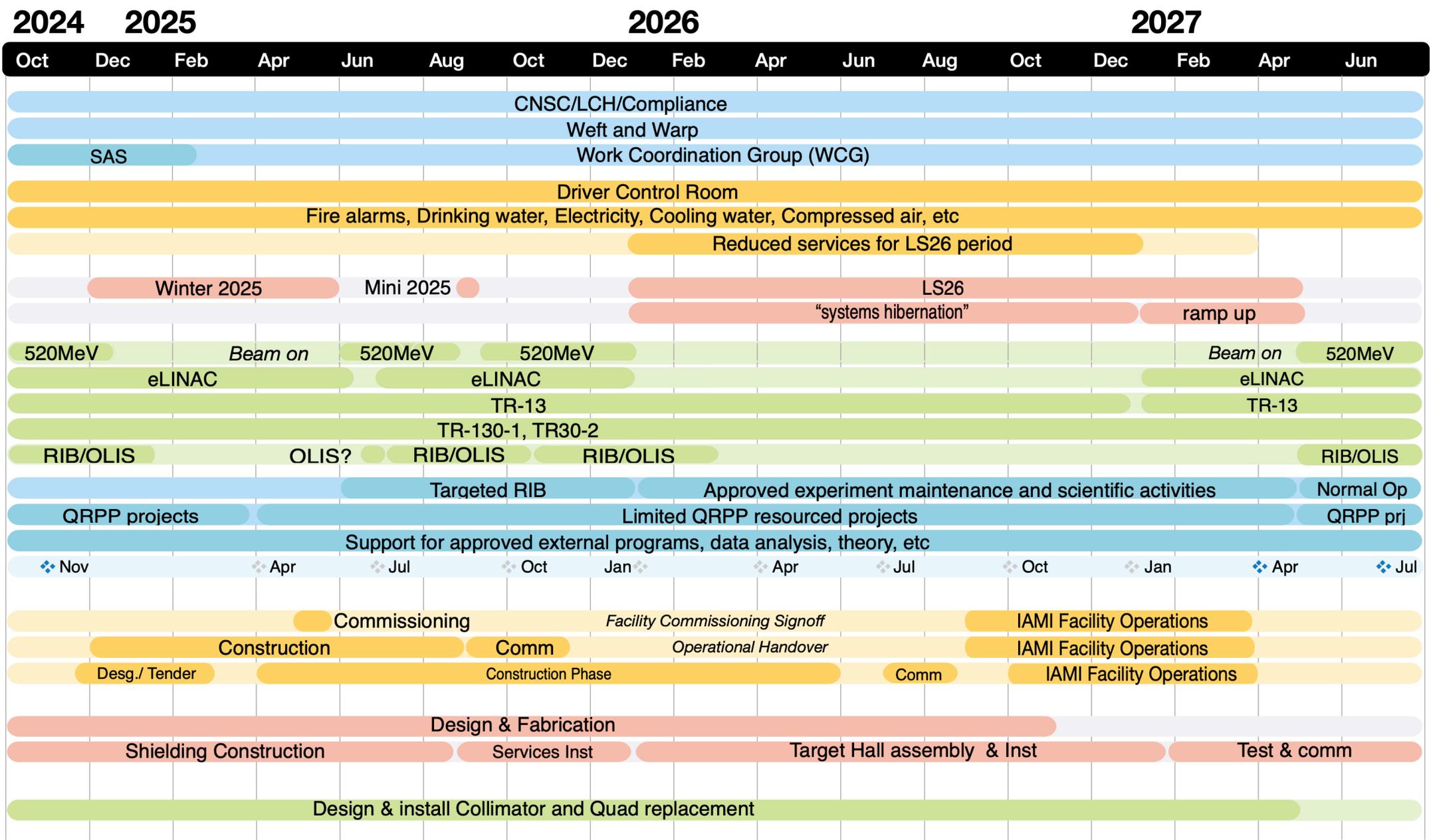
# Long shutdown planning

# Long Shutdown 2026

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- Planning for the long shutdown of the main cyclotron is now completed
  - Project plans for the three main infrastructure are geared towards the long shutdown
  - Quarterly Review of Project priorities reworked to ensure priority projects will be delivered
  - Core work packages for ARIEL and IAMI are distributed, identifying critical facility groups
  - 2025/27 operational cycles defined to ensure students and postdocs secure required data for graduation
- Oversight structure is defined and in place through the Leadership Team and Project Management Oversight Group

**LS26 High Level Timeline**



# QRPP redesign for resource simplicity

## QRPP Project Rankings April-June 2025

NRC Contribution Agreement Priorities				Other Projects Approved for QRPP			Non-Conflicting Projects		
Core priorities Take precedence for resources				Can request resources at QRPP. Resources allocated AFTER core priorities			Can Proceed - no conflicts with P&I (including Engineering), ACC, and limited resources from Core Service Report status at QRPP, can't request resources		
Core Priority	PRJ #		Description	Strategic Priority	PRJ #	Description	PRJ #	Description	
1	PRJ_442_cor	IAMI	IAMI Construction	1	PRJ_481	Replacement of ISIS horizontal beam line	PRJ_579	Weft and Warp	
1	PRJ_527		IAMI – BCC Build-out	2	PRJ_406	Expanding Muon Beam Facilities at TRIUMF (M9H)	PRJ_495	Cyclotron refurbishment	
1	PRJ_550		IAMI Phase 2	3	PRJ_538	Darklight	PRJ_539	Compact accelerator based neutron sources	
2	PRJ_342	ARIEL	ARIEL-II Program Management, Licensing and Documentation	4	PRJ_517	Asset and Workflow Management System	PRJ_582	Digital Ecosystem Rebuild	
2	PRJ_353		ARIEL-II Target stations	5	PRJ_557	TRIUMF Cyclotron Control System	PRJ_508	Site Card Access System Replacement	
2	PRJ_179		ARIEL-II BL4N	6	PRJ_412	Upgrade of TRIUMF Radiochemistry for brain imaging at the DM Cer	PRJ_461	IWCD	
2	PRJ_424		ARIEL-II Target Hall Infrastructure	7	PRJ_526	225 Ac Production via 226 Ra(p,2n)	PRJ_462	DarkSide-20K	
2	PRJ_405		Cancer Treatment with Therapeutic Radionuclides	8	PRJ_407	UCN project management	PRJ_532	PONE	
2	PRJ_363		ARIEL 1.5	9	PRJ_553	UCN Source	PRJ_562	Ultra fast detector for neutron spectroscopy	
2	PRJ_354		ARIEL-II Separator & front end	10	PRJ_555	nEDM Experiment	PRJ_87	M9 upgrade	
2	PRJ_358		ARIEL-II CFS	11	PRJ_455	CERN HI-LUMI CMs Fabrication and Assembly	PRJ_150	3T Spectrometer	
2	PRJ_487		ARIEL-II Hot Cells	12	PRJ_573	Radmol Lab Renovation (NRC funded portion)	PRJ_453	ATLAS Phase-2 Upgrade LAr FE	
2	PRJ_374		e-Linac Development	13	PRJ_372	On-Line Ion Source I2	PRJ_537	Photosensor for Hyper-K	
2	PRJ_355		ARIEL-II Laboratories	14	PRJ_473	E-linac test bed for high intensity THz radiation	PRJ_401	ATLAS ITk Upgrade	
2	PRJ_310		CANREB Studies	15	PRJ_552	HAICU	PRJ_569	PENeLOPE Cryogenic Commissioning	
3	PRJ_568		BL1A	BL1A Contribution to Site-Wide Waste Management	16	PRJ_483	New CRM System	PRJ_567	PIONEER next generation pion decay
3	PRJ_560			BL1A Refurbishment				PRJ_549	Detectors for environmental monitoring
								PRJ_580	TIIGR, Therapeutic Isotope Imager with Gamma Rays
							new	SEAQR, Sensor for Environment Analysis with single Quanta Resolu	

### Hibernated Projects (on hold)

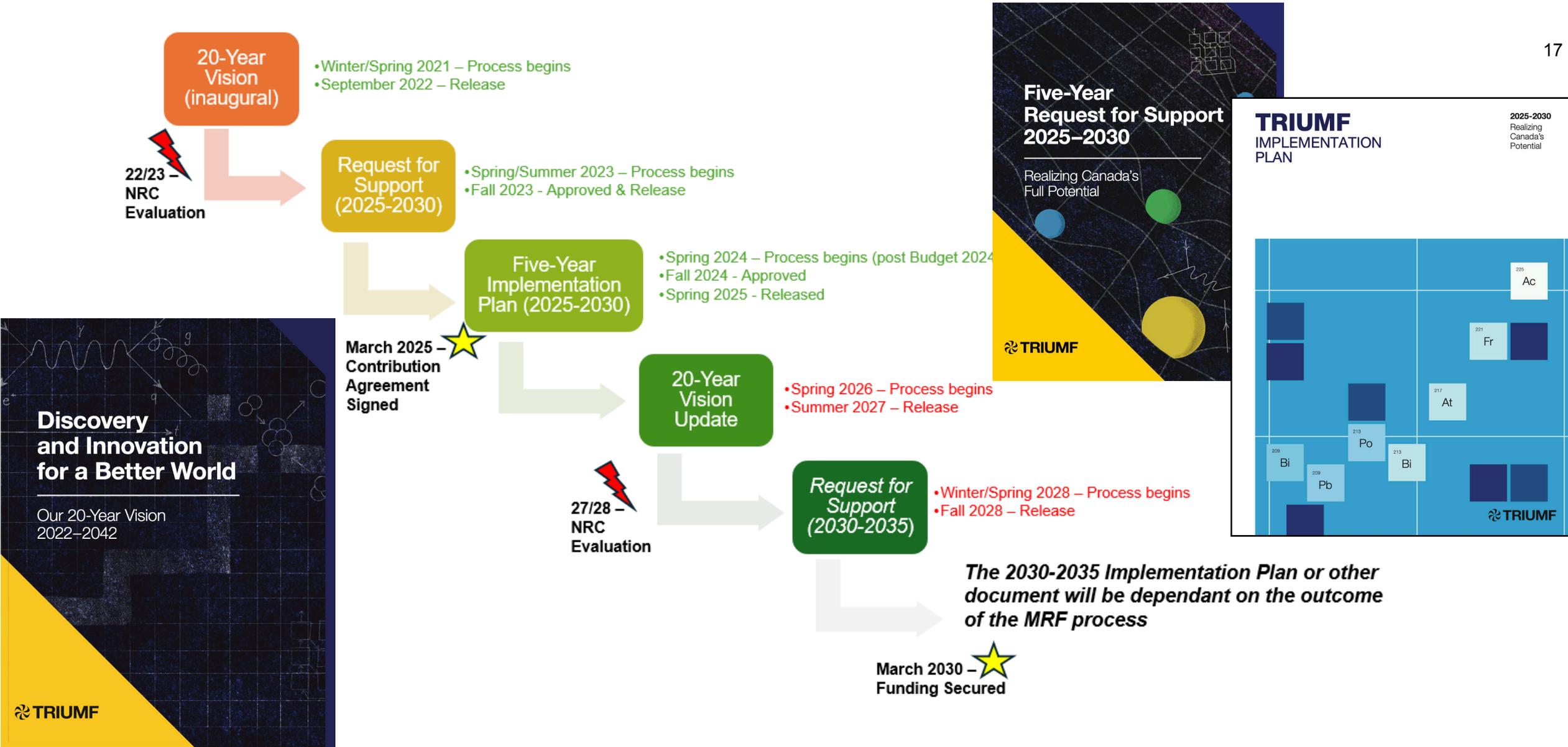
PRJ_535	nEXO	PRJ_545	STF Station Upgrade	PRJ_513	ME141 Replacement
PRJ_502	Target Waste Packaging System	PRJ_559	IPF High Power Upgrade	PRJ_480	Replacement of cooling tower units
PRJ_492	Upgrade and refurbishment of the Cyclotron RF System	PRJ_514	Production of radioactive molecules in an RFQ gas-reaction cell	PRJ_558	Copper Active LCW Corrosion Project
PRJ_416	Target Module 3 Refurbishing	PRJ_528	Separation methods for medical isotopes from thorium carbide tar	PRJ_572	Capacity Management in Workday
PRJ_497	Rare Isotope Beam Delivery Development	PRJ_482	RCA1 Nuclear Ventilation Upgrade	PRJ_534	Laboratory for fundamental symmetries and radioactive molecules
PRJ_496	ISAC Target Hall Consolidation	PRJ_509	Rabbit Line Replacement	PRJ_464	POLARIS
PRJ_494	ISAC TRILIS upgrade	PRJ_476	Routine 225Ac target processing capabilities and product developr	PRJ_488	TRIUMF future dosimetry
PRJ_493	ISAC LINAC RF System Refurbishing	PRJ_457	Infrastructure Upgrades for Alpha Emitter Production		

**Next strategic planning cycle  
starts in Spring 2026**

# TRIUMF Strategic Planning Cycle

- The introduction of a 20-year Vision process allowed TRIUMF to move to a new model for strategic planning, which provides clarity on a funded programme of work
- The 20-Year Vision provides governance, community and laboratory engagement to discuss potential options for the future TRIUMF direction. Will be refreshed quinquennially.
- The 5-Year Request for Support builds a detailed proposal for federal operational support which will allow the first steps in the 20-Year Vision. One-off document(s).
- Following funding being awarded, the 5-Year Implementation Plan builds a funded programme of work, aligned with the 20-year Vision and the 5-year request for Support. This allows clarity of objectives given the funding available.
- The objectives within this 5-year Implementation Plan have been encoded into the Contribution Agreement in this cycle.

# TRIUMF Strategic Planning Cycle



# **Lessons from the five-year request for support for LRP**

# Lessons learnt from 5-year RfS

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- Communications 101: know your audience, and who the target for all documents is (for us, that was actually Finance, through ISED, PMO, PCO, ...)
- Provide details relevant to the audience... two pager brief for political engagement, request for support summary or full document for ISED (depending on level), detailed spreadsheets for Finance
- Engage all stakeholders along the way (for us it was the community, university leadership, NRC, funding agencies, ...)
- Sequencing the Vision, Request for Support, Implementation worked well to allow message to evolve for stakeholders...
- For the LRP - who is the audience? If it's NSERC we are just slicing a fixed pot; we should make the objective to grow NSERC/CFI support so it's ISED and Finance...

# What aspects of request resonated?

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- Key messages that resonated over last two years are still relevant
  - National resilience: couched around COVID and MVM production, but now even more relevant; development of HQP, intellectual capability, SAP as an engine for innovation and science
  - International, multidisciplinary research: cementing Canada in the international research ecosystem
  - Mission-driven: linking the work we do naturally to the broader mission the government has
    - note that the science itself was not the key selling point
- Good luck to the SAP LRP team - this is vital work at a really important time!



Thank You  
Merci  
Hay ce:p q̇ə

[www.triumf.ca](http://www.triumf.ca)  
[@TRIUMFLab](https://twitter.com/TRIUMFLab)



# Accelerator Division Update

Oliver Kester

Director, Accelerator Division

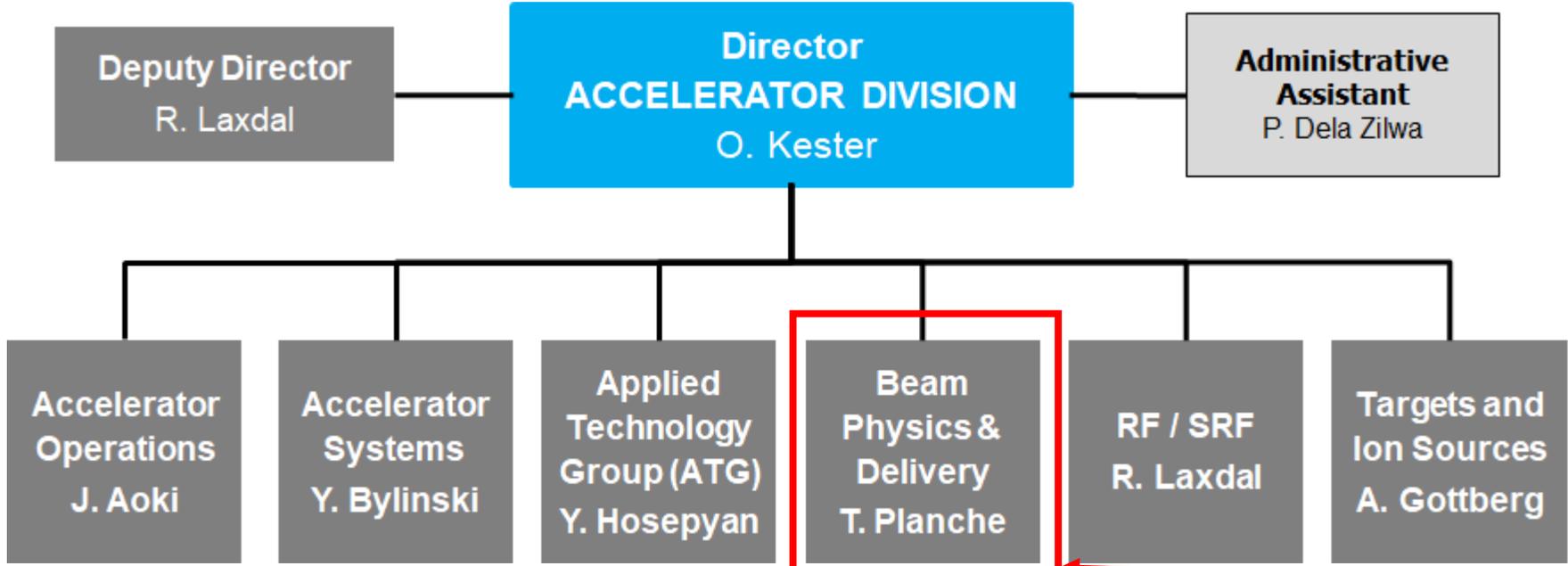
ACOT #57, Spring Meeting,  
April 28-30, 2025

April 28, 2025

## Topics:

- Accelerator operations update
- Status of projects of the last 5 Year Plan (5YP)
- Refurbishment in the new 5YP - BL1A project
- ARIEL project update

# Update: Structure of the ACC Division



Responsible for:

- Accelerator Operation Driver and RIB accelerators
- Operation Life Science Division cyclotrons

- Vacuum
- Cryogenics
- Power Convertors
- Beam Instrumentation
- Accelerator Engineering Physics and Beam lines

- Operations of Medical cyclotrons for BWXT
- Operation of the Solid State Facility (STF) and Isotope Production Facility (IPF)

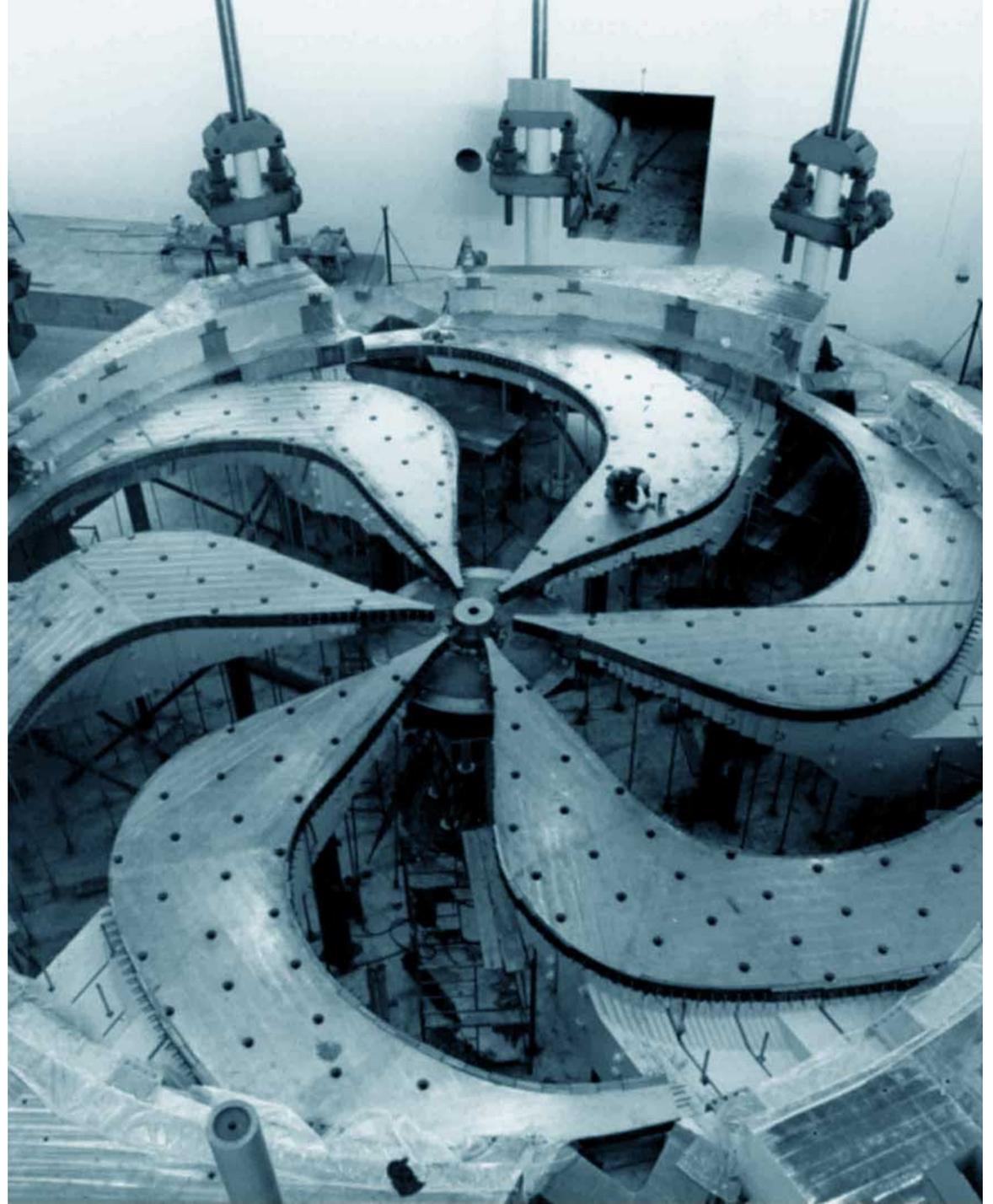
- Beam optics simulations
- Beam line and accelerator design
- Beam Delivery
- ARIEL e-linac
- Automatic Beam Tuning and machine learning for beam tuning

- High Power RF
- Low Level RF
- Superconducting RF
- Cavities

- Laser Application
- High Power Target systems
- Remote Handling
- Target and target station technology development

<b>Beam Physics and Delivery</b> T. Planche		
<b>Accelerator Development</b> F. Ames	<b>Accelerator Research</b> Y.-N. Rao	<b>Beam Delivery Coordination</b> B. Schultz
<b>Stable Sources</b> K. Jayamanna		

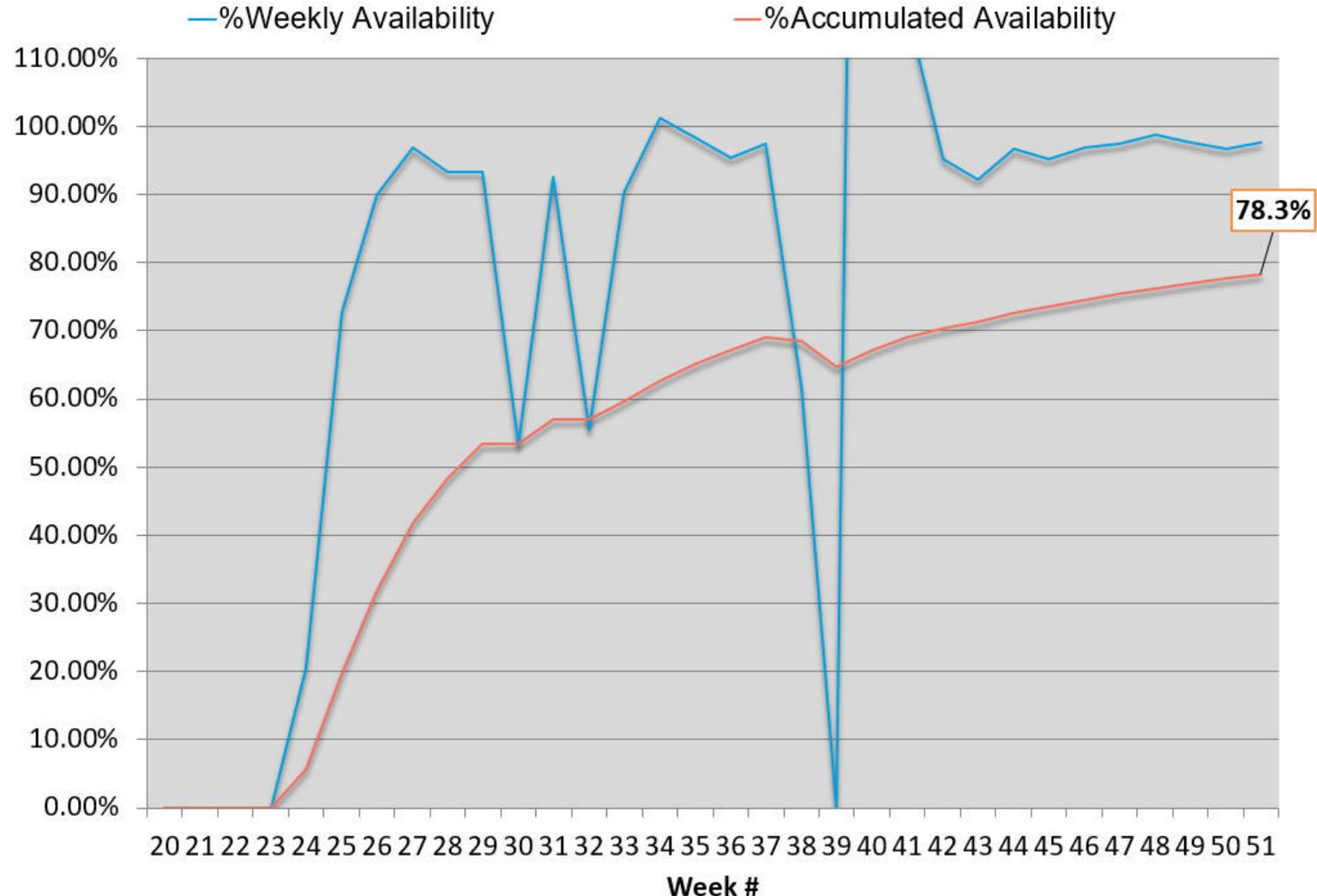
# Accelerator operations update



# Overview of 2024 Operations – Driver Beam Delivery

- Cyclotron availability this year was the lowest it has been in the past 25 years.
- The milestone (initially May 2nd) for cyclotron available → on May 24th.  
Various issues:  
Resonator latching mechanism failures, misalignment of the resonators, and vacuum leaks upon closing of the lid → full lid down sequence was completed 3 times.
- Other major events:
  - RF conditioning and related RF issues. In week 22, the **IPA tube socket** was damaged requiring extensive repairs.
  - Warmup of the Linde-1630 cryo-generator in week 30 due to a power bump.
  - RF matching and diagnostic issues in week 32 that required extensive tuning for stability
  - A second full warmup of the **Linde-1630** in week 38 due to two PLC modules failure led to early start of mini-shutdown.

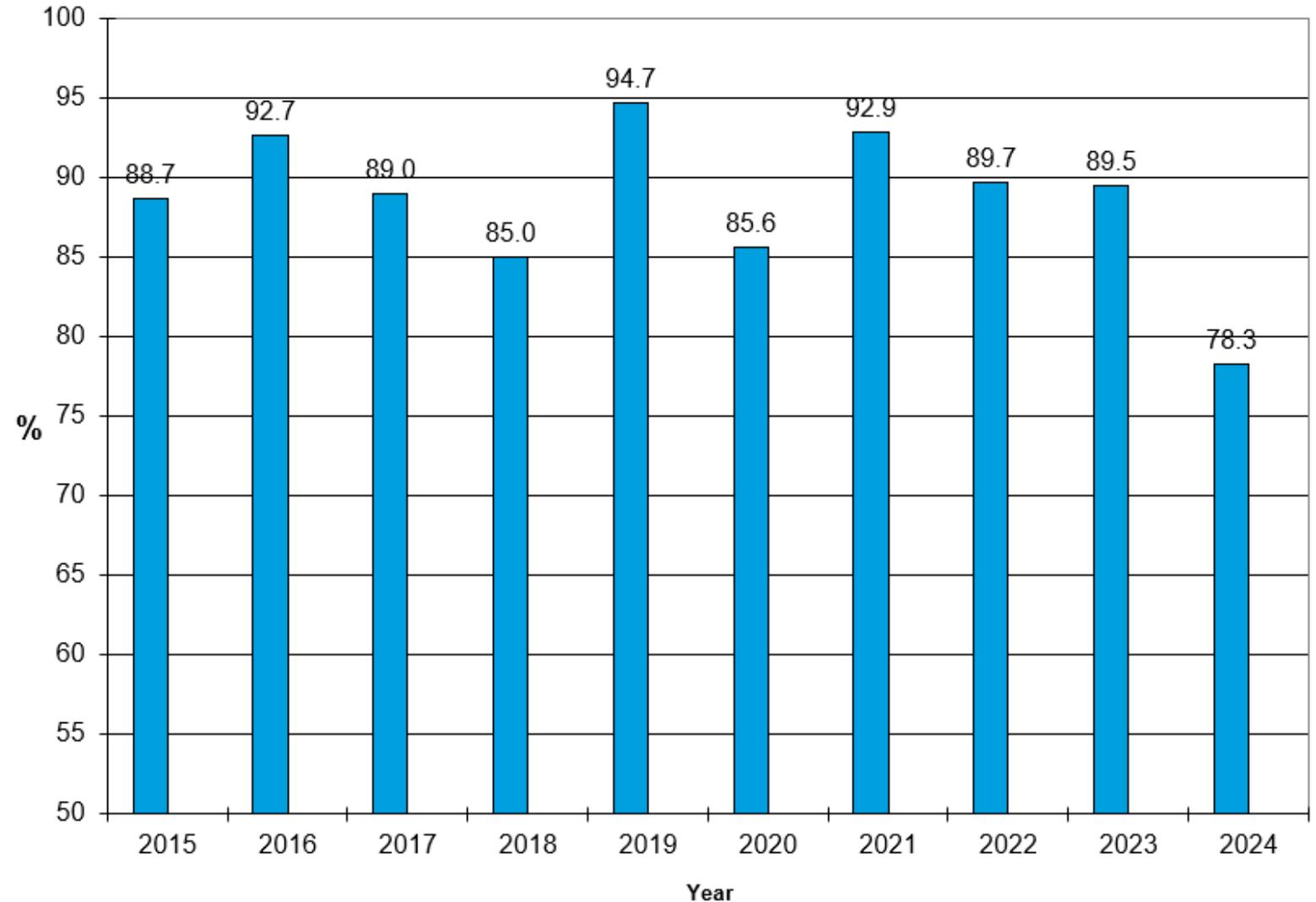
2024 Cyclotron Availability (%)



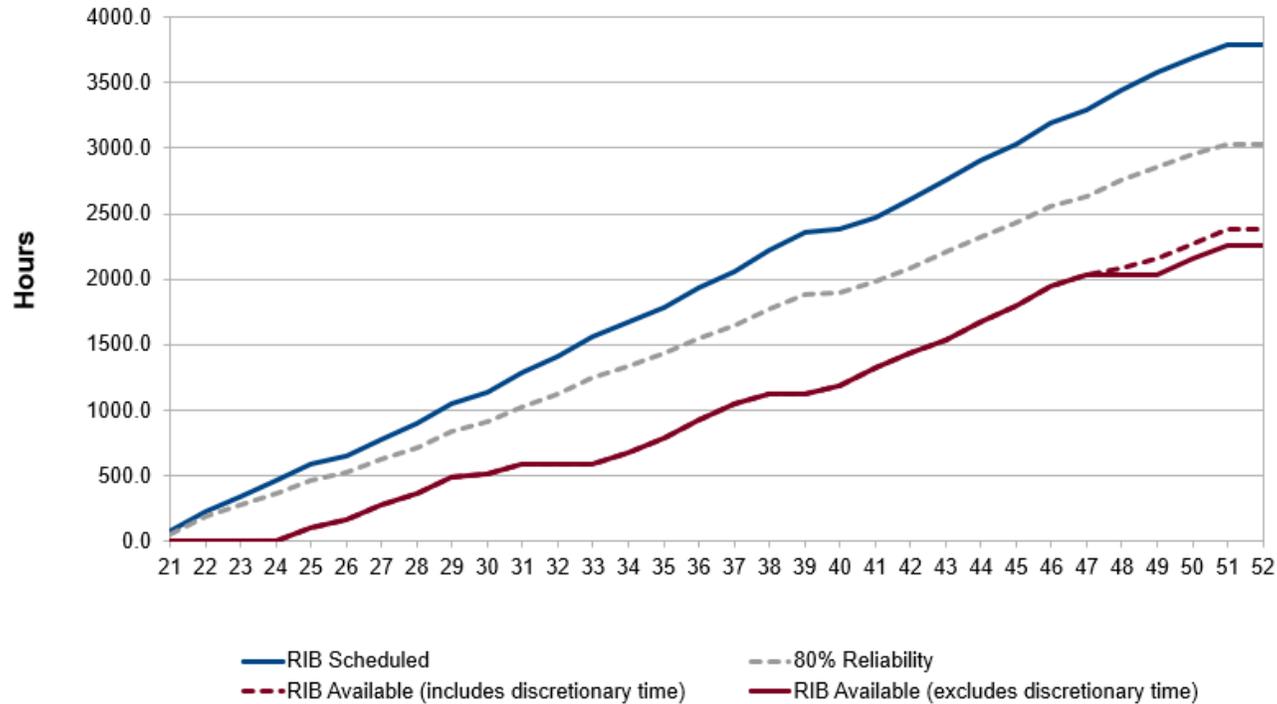
# Overview of 2024 Operations – Cyclotron Annual Delivered Hours

System	Downtime (hrs)
RF	674.0
Vacuum	123.2
Site Power	45.1
Controls	27.5
Magnet Power Supplies	19.6
BeamTrips	18.7
IonSource	16.5
Inflector	8.6
RFControls	8.1
Diagnostics	7.3
ElectrostaticBeamlines	3.5
Targets	2.1
HumanFactors	1.1
Safety	1.1
Services	0.5
	956.6

Cyclotron Availability (%) 2015 - 2024



ISAC RIB Availability - Schedules 146 and 147 (2024)  
Experiments and Development



- The cyclotron delay did offset the RIB availability.
- First year with scheduled machine development periods for Model-Coupled Accelerator Tuning (MCAT) and machine learning.
- Also 30 hours ISAC RFQ amplifier and controls issues

Total 2024 Targets and Ion Sources (TIS) downtime 500 hrs (% 62 of total RIB downtime)

The major contribution to TIS downtime last year was the failure of the FEBIAD target ion sources:

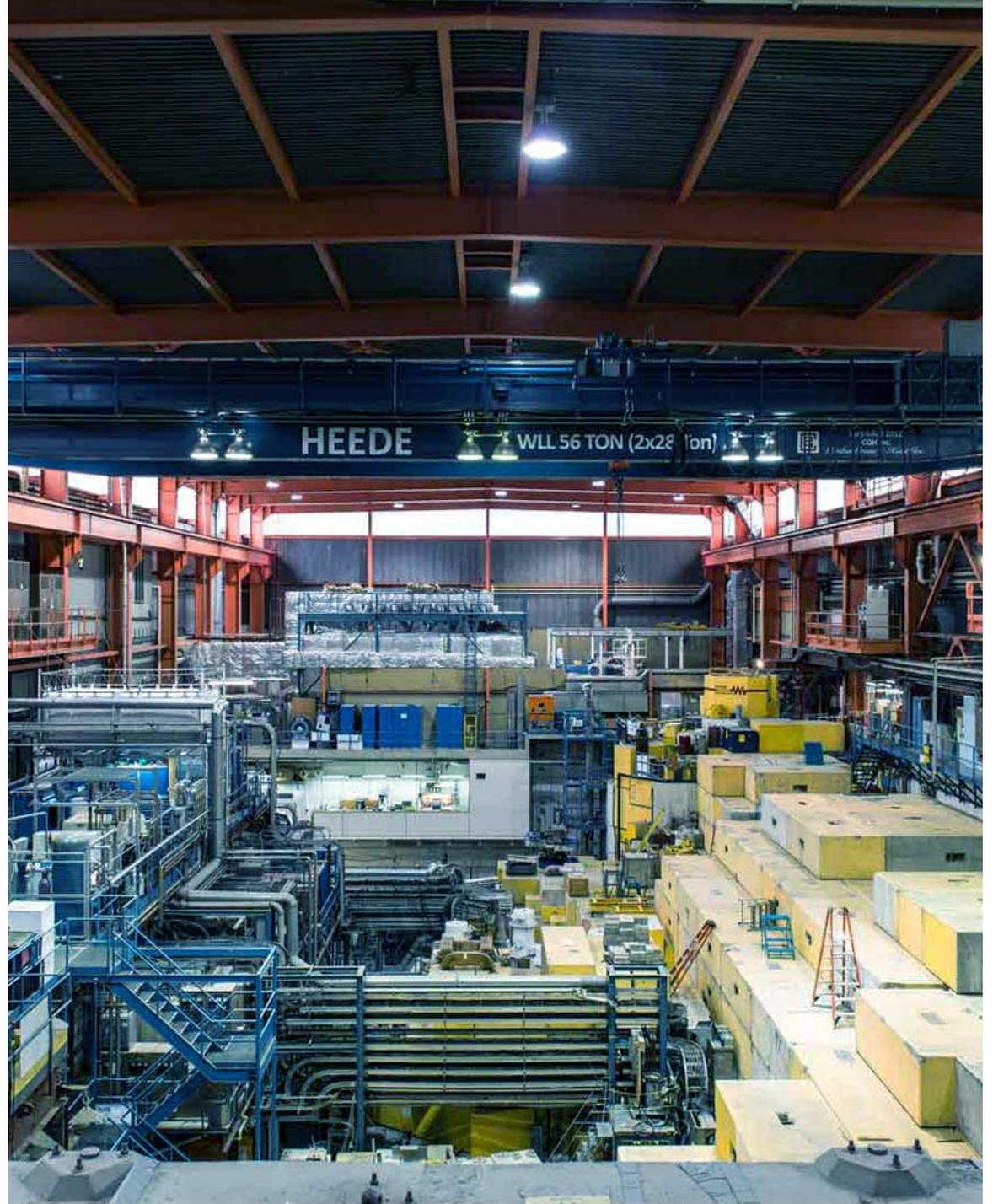
- Heater voltage limit issue
- HV issues
- Yields from IGLIS below the threshold

Number	Target Type
3	UCx
2	Ta
1	SiC
3	TiC

## Operation outlook 2025

- Budget forecast and allocation focused on MRO, ARIEL and BL1A. Significant reduced refurbishment funds outside of BL1A due to front loading of ARIEL budgets.
- Maximized beam delivery and priority for student thesis work - delivering high-priority EEC-approved experiments.
- Reduction of cyclotron maintenance and beam development to provide > 7 months of beam. OLIS operation – facility coordinator (FC) not on call, but additional staff is seconded.
- Some high risk / high gain target ion source combinations (including FEBIAD). In case of target failure or low yields, no firefighting activities  
→ target ion sources crew is moved to the ARIEL project.
- Work coordination group will support beam delivery and project work in 2025 also in preparation of the LS26.
  - BL2A beam delivery May 22
  - BL1A beam delivery June 3

# Status of projects of the last 5 Year Plan (5YP)



# Refurbishment activities

Outcome of the \$25M complement activities (need Gate 4B review):

## Cyclotron:

- RF system and remote handling systems refurbishment projects have been completed.
- New horizontal injection line will be completed by the mid of May, the new injector I2 by the end of the year.

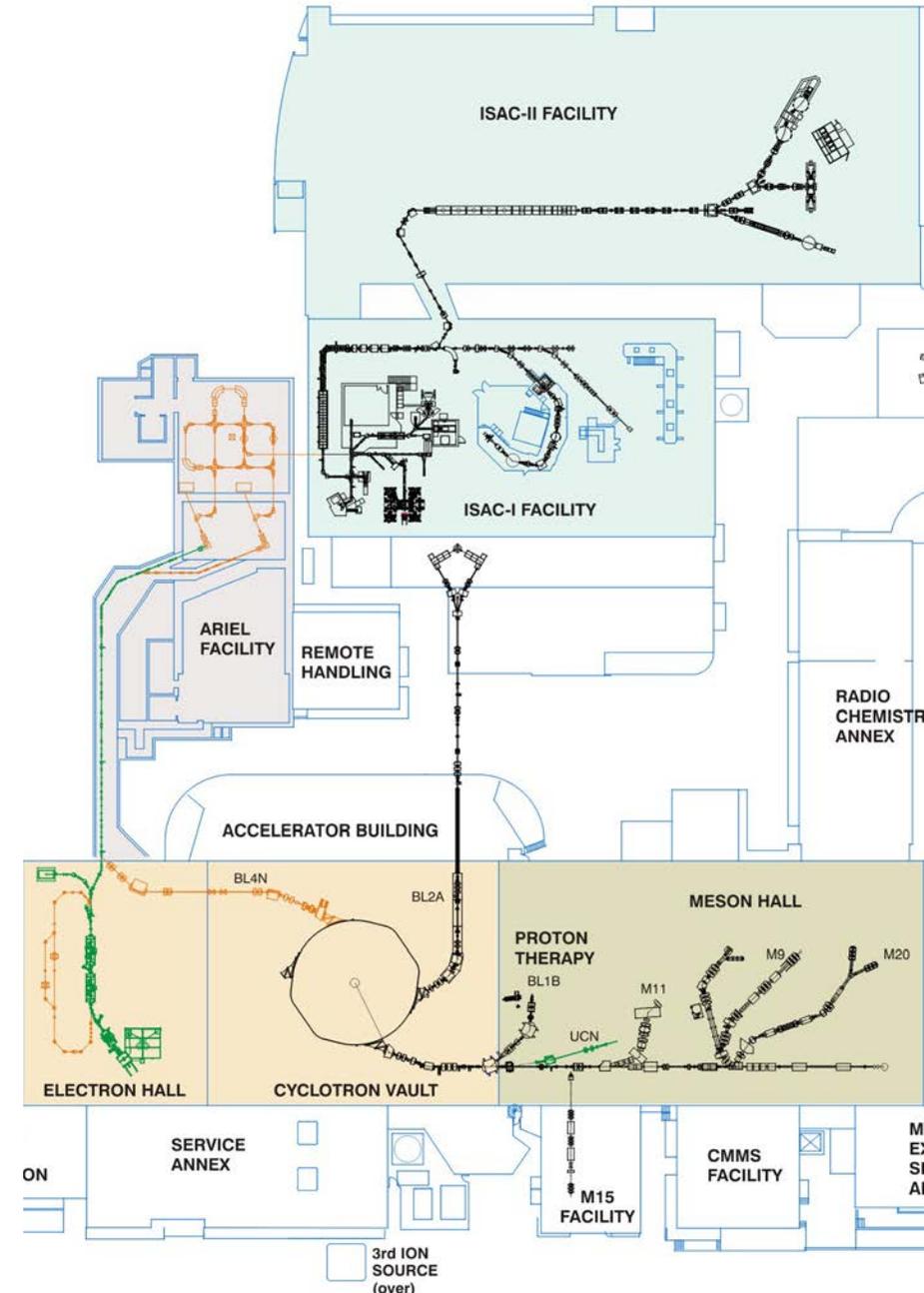
## ISAC:

- Target hall infrastructure, Target Module TM 3 refurbishment and laser ion source (TRILIS) projects have been completed.

In this 5YP the cyclotron refurbishment, cyclotron control system upgrade, and the RIB delivery improvements will continue.

One of the new project in an early stage → Replacement of the Intermediate Power Amplifier (IPA) of the cyclotron.

The system has caused major downtime in the last two years.



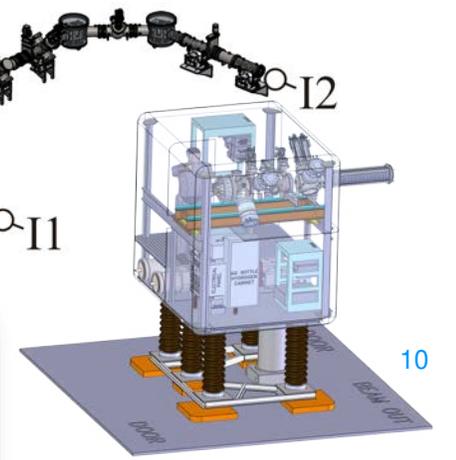
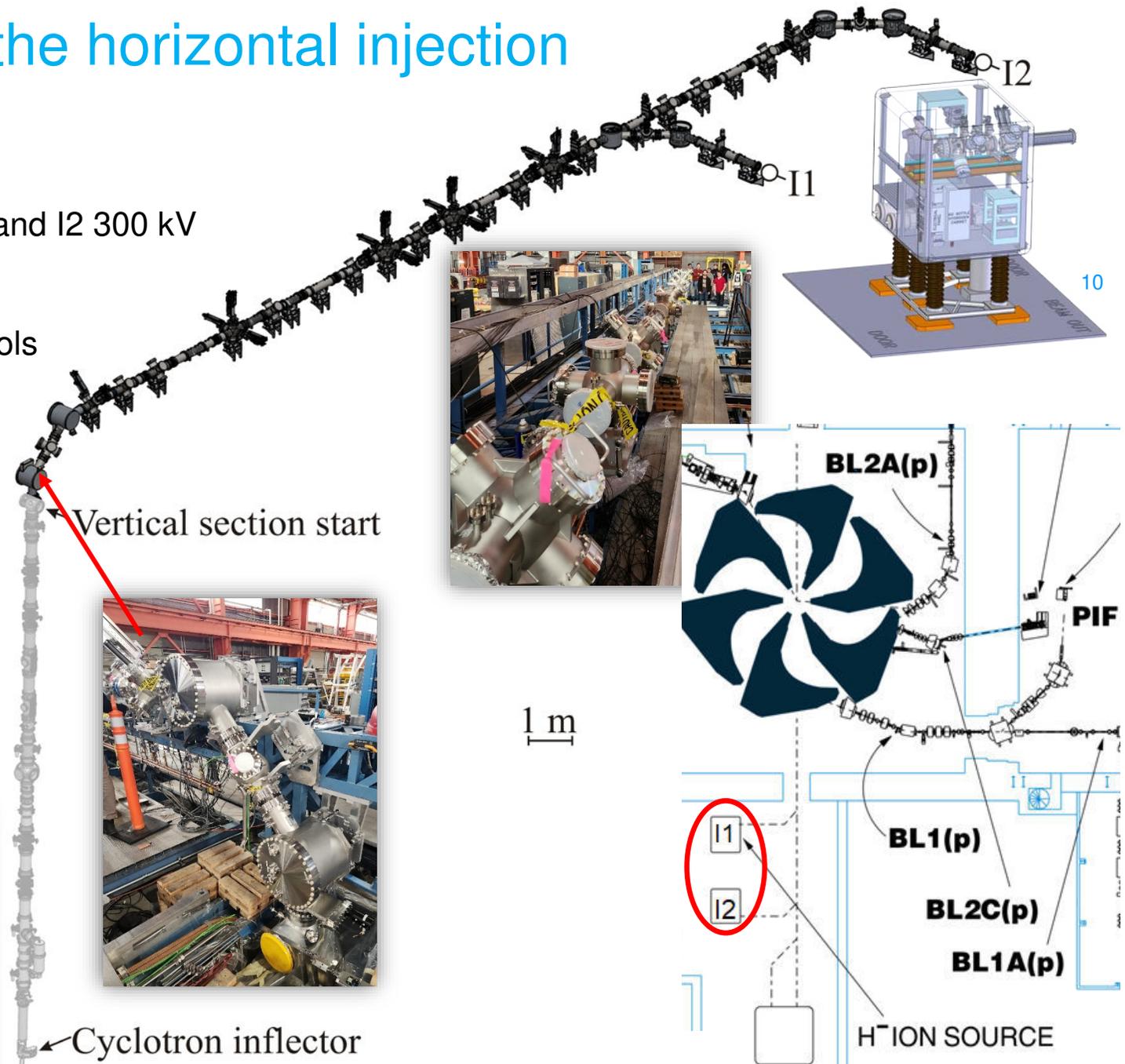
# Replacement of the horizontal injection beamline

## Scope:

- Cyclotron horizontal injection beamline from the I1 and I2 300 kV terminals to the start of the (new) vertical section
- New vacuum boxes, diagnostics, vacuum system, stray field compensation, optics, buncher and controls

## Status:

- Beam line installation completed
- Beam diagnostics monitors calibrated and installed
- Electrical and mechanical services completed, all cables are installed and connected
- EPICS controls commissioning is in progress
- **Vacuum is established and first beam sent through for beam line commissioning**



# TRIUMF New injector I2

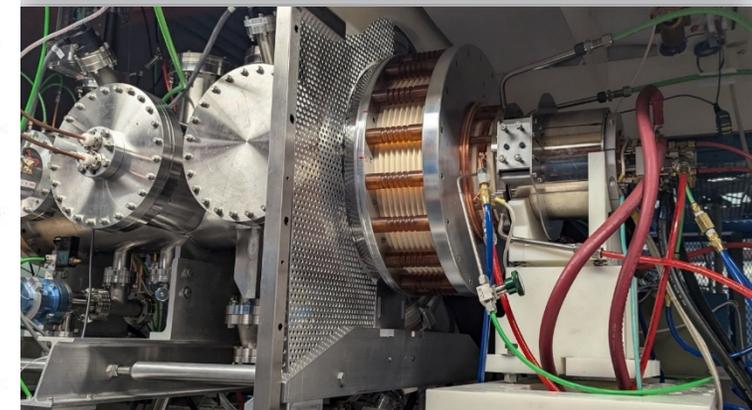
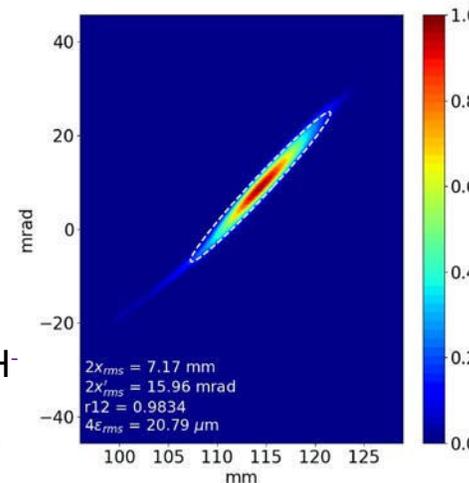
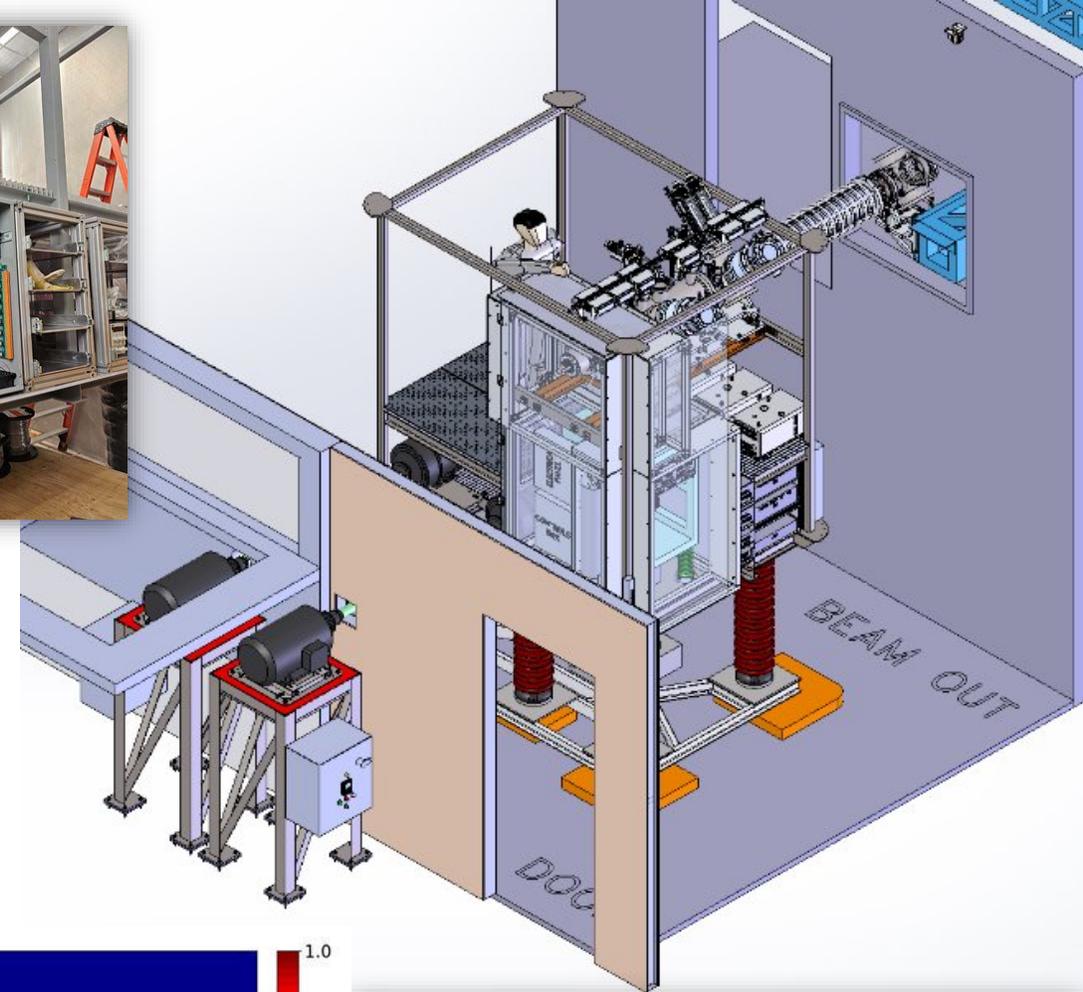
## Scope:

New ion source, new 300 kV terminal and all services

## Status:

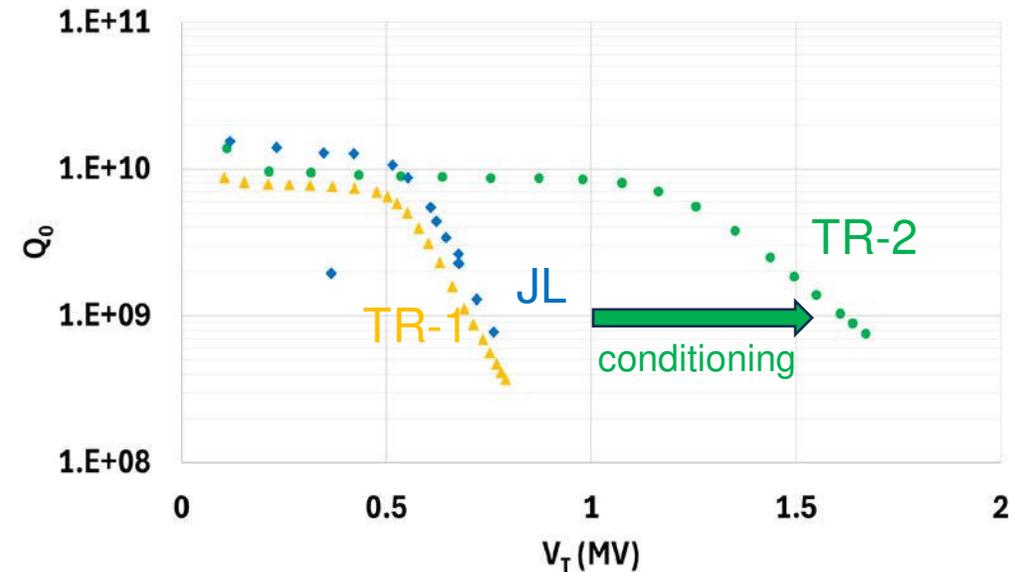
- Almost all fabrication is completed and all vacuum boxes assembly and testing completed
- Ion source is ready, beam measurements done at I3 test stand
- Most of the components are installed in the terminal or ready for installation:
  - Motors, generators, HV-transformers, power supplies, vacuum pumps, acceleration column, diagnostic chamber, gas system etc.
- Most of diagnostic assembly completed (last items to be installed)
- I2 beam transport section mostly installed (and aligned)
- Electrical services installation ~40% completed
- Mechanical services installation ~20% completed
- Controls ~50% ready

Demonstrated at test stand: H<sup>-</sup> emittance at 1 mA:  
20.8  $\mu\text{m}$  (design goal: 20  $\mu\text{m}$ )

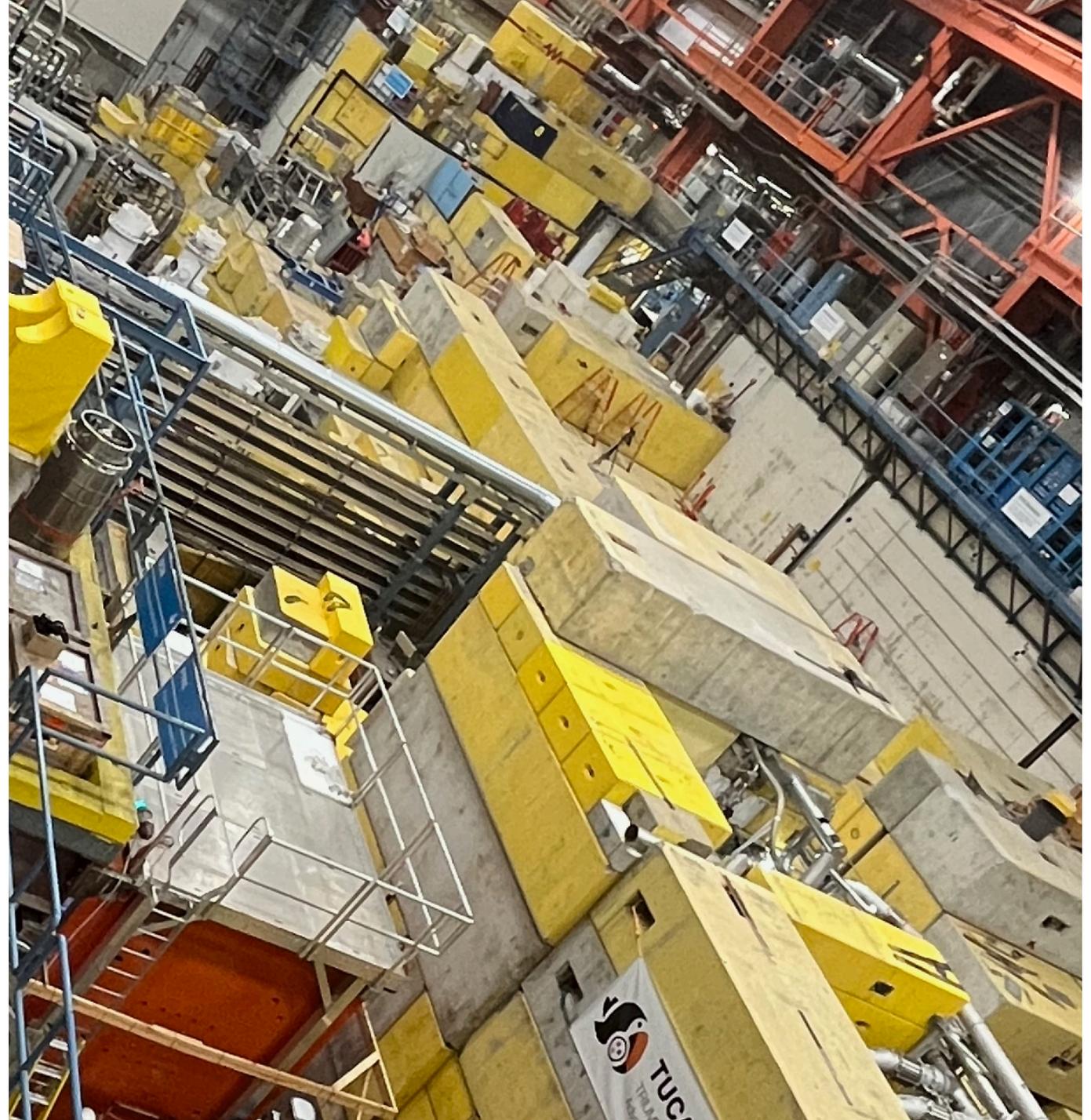


# HL-LHC crab cavity cryomodule project status

- All money has been committed, and parts will be received before June 30, as required by the funding agreement
- First prototype RFD cavity was received from JLab and requalification test completed and 110% successful – all new test infrastructure worked well!  
Warm and cold measurement results matched all JLab results → the cavity was then conditioned to a higher performance – ready for series testing!
- New clean room commissioned and cryomodule assembly equipment prepared.

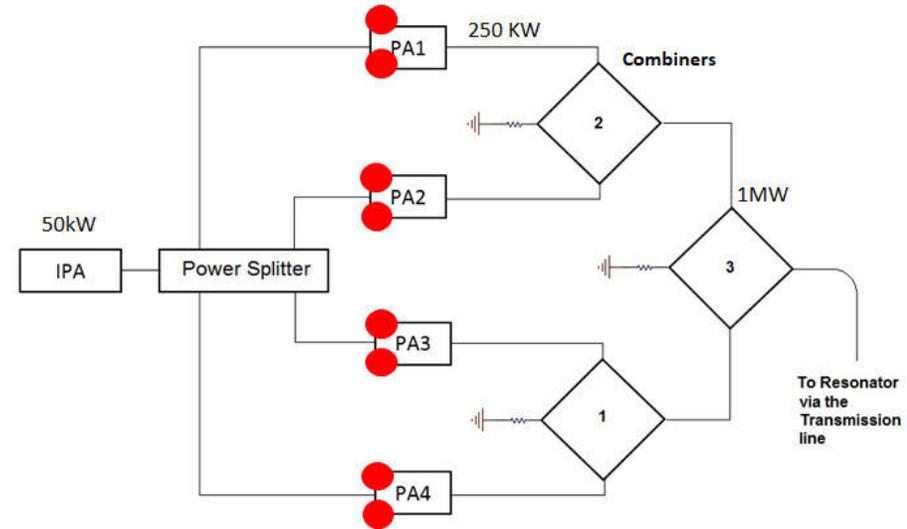


# Refurbishment in the new 5YP - BL1A project



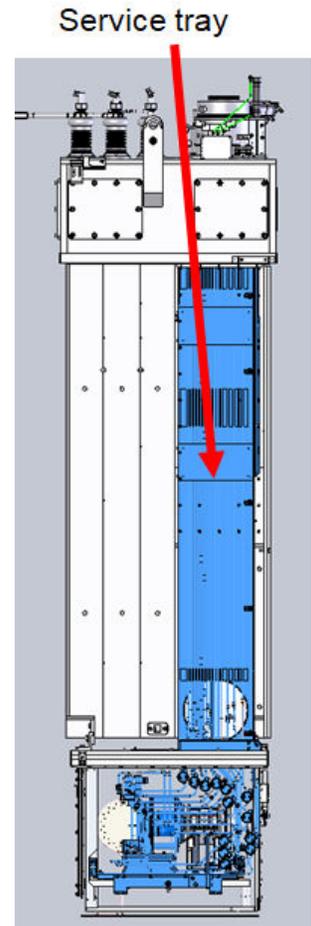
# Accelerator refurbishment in 2025-2030

- Cyclotron RF reliability improvement  
→ short term Intermediate Power Amplifier (IPA)
- Cyclotron Control System (CCS) upgrade (short term)  
→ TRIUMF Control Centre (end of the 5YP)
- BL1A refurbishment (major deliverable)



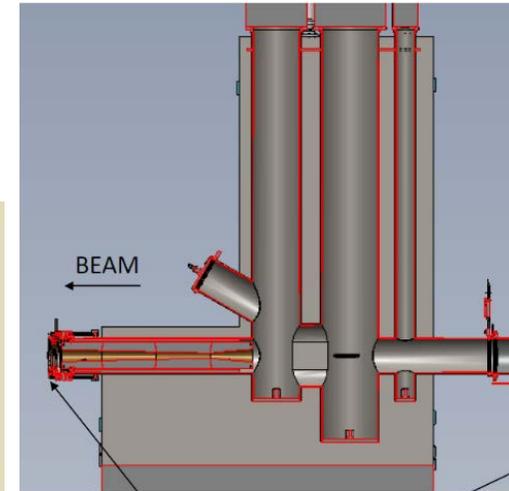
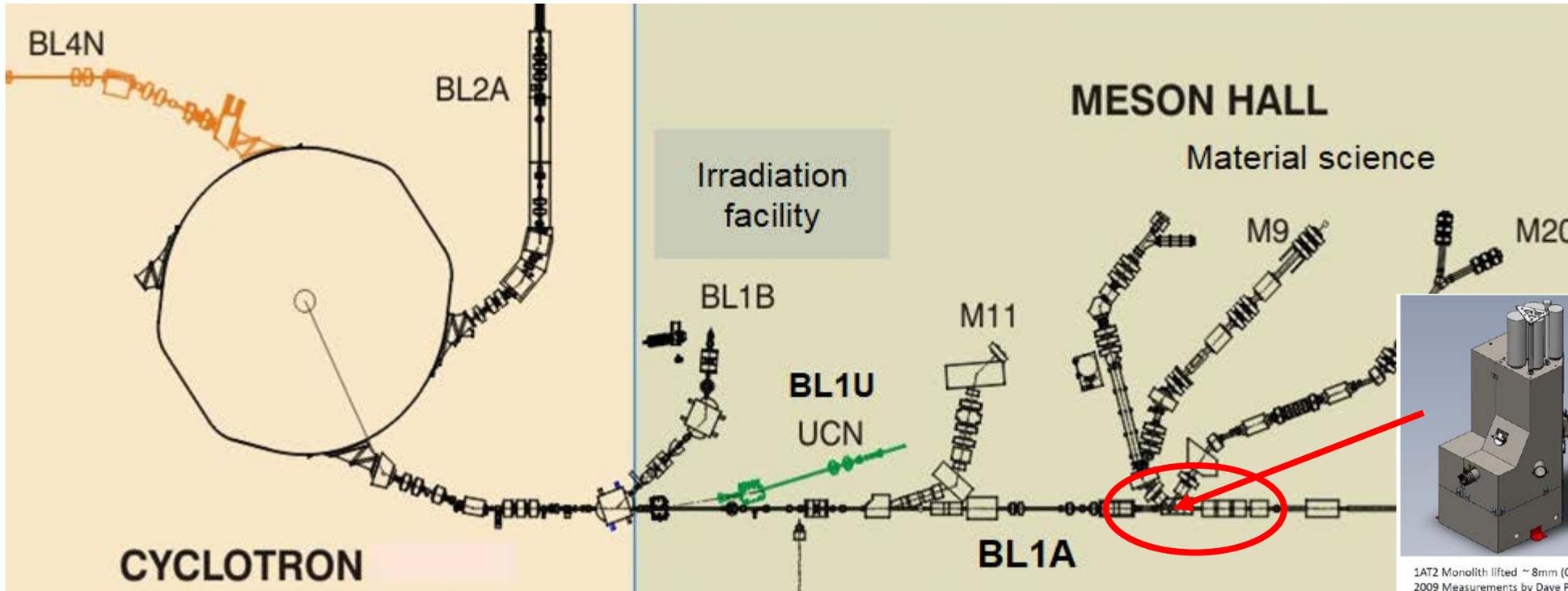
From 2027 on (preparation for higher beam intensity operation):

- Replacement of old BL2A and 1A power supplies
- Cyclotron (Inflector upgrade, beam instrumentation, cryopumps and preparation of LINDE-1630 cryoplant replacement) and further Cyclotron RF refurbishment
- Remote handling infrastructure, waste disposal preparation and tooling
- ISAC target module (TM) 2 and 4 refurbishment
- ISAC-I RF system (Solid State Amplifiers and LLRF)
- RIB delivery improvements including upgrade of beam diagnostics and ion sources
- TRIUMF resonance laser ion sources TRILIS upgrade

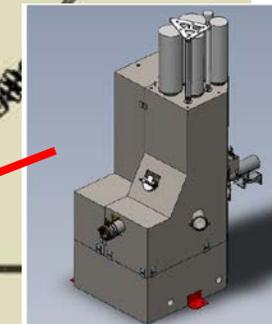


## Redefined refurbishment project

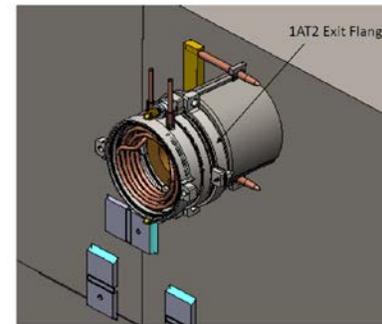
1. Removal and onsite storage of old T2 collimator and Triplet Quadrupoles
2. Build of new replacement collimator and associated remote handling tools
3. Purchase of 3 or 4 new quadrupole magnets, and build of necessary vacuum chamber, alignment stands, etc.
4. Installation of new collimator and new quadrupole lenses and new shielding if required to accommodate new magnets
5. Integration and commissioning of new components (including cooling, beam diagnostics, controls, power supplies, etc.)



Down-stream Collimator Flange



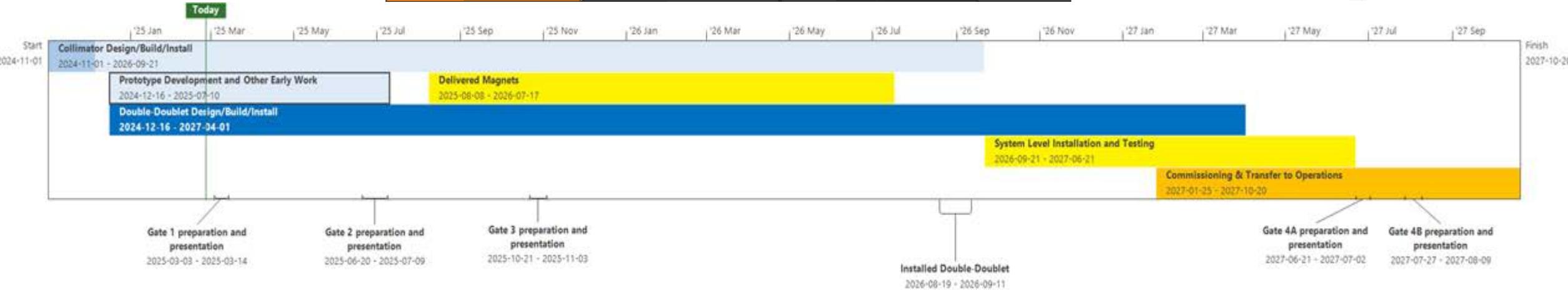
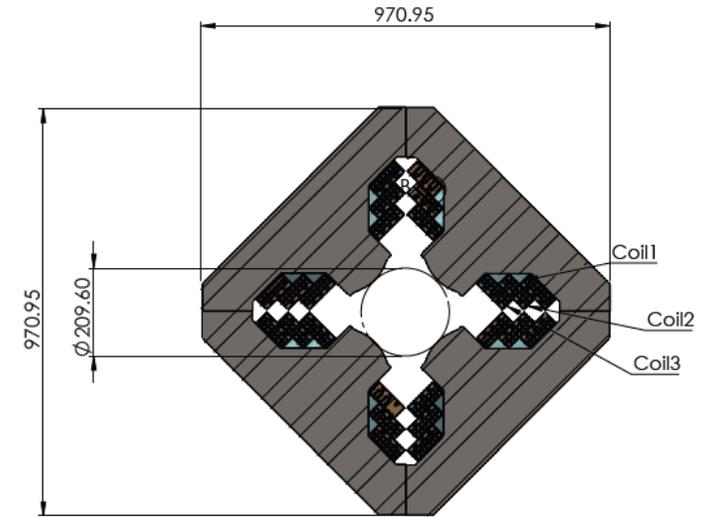
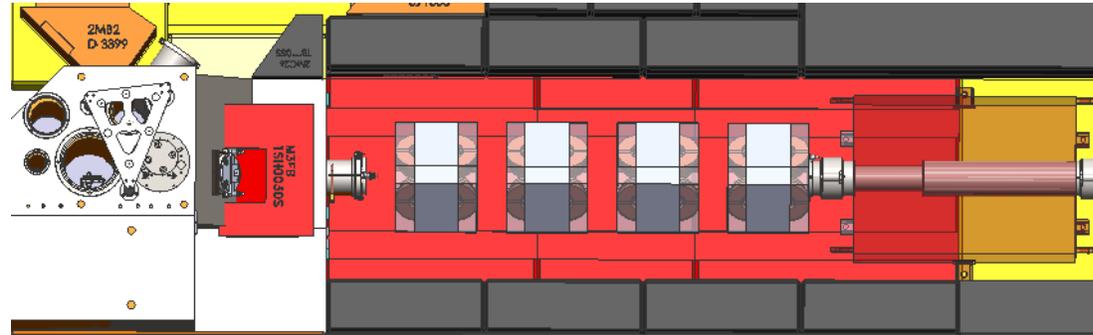
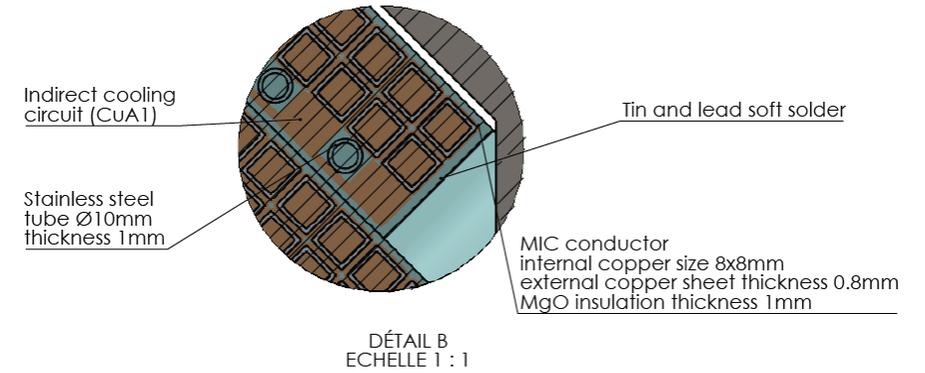
1AT2 Monolith lifted ~8mm (0.314")  
2009 Measurements by Dave Pearce.  
Compare to current measurements.



Collimator-B lifted ~0.30"  
2009 Measurements by Dave Pearce.  
New measurements to be taken.

# Triplet replacement

- Radiation hard magnets: mineral insulated conductor (MIC), indirect cooling of conductor in lead-tin solder  
→ reduced clogging of cooling water channels
- Looking to both options, double doublet and triplet – two vendors are contacted for quotes.
- Beam optics simulation including the collimator will be completed soon and the quadrupoles will be order afterwards.

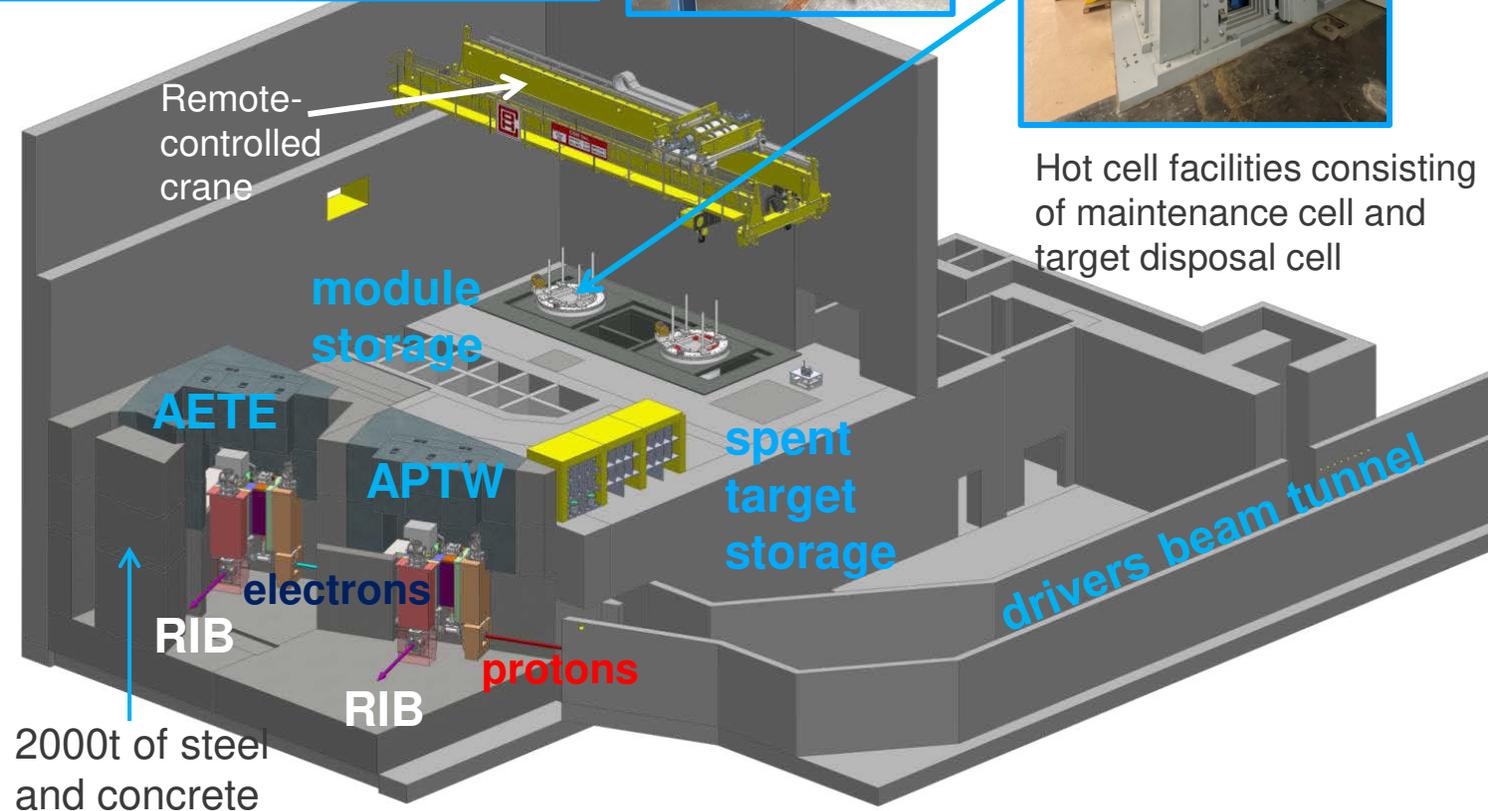
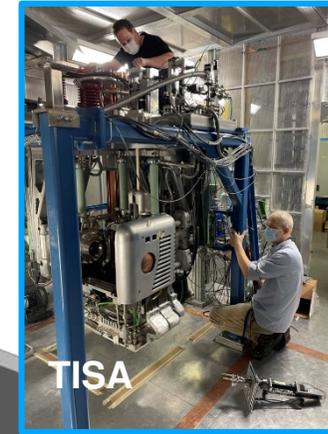


# ARIEL project update



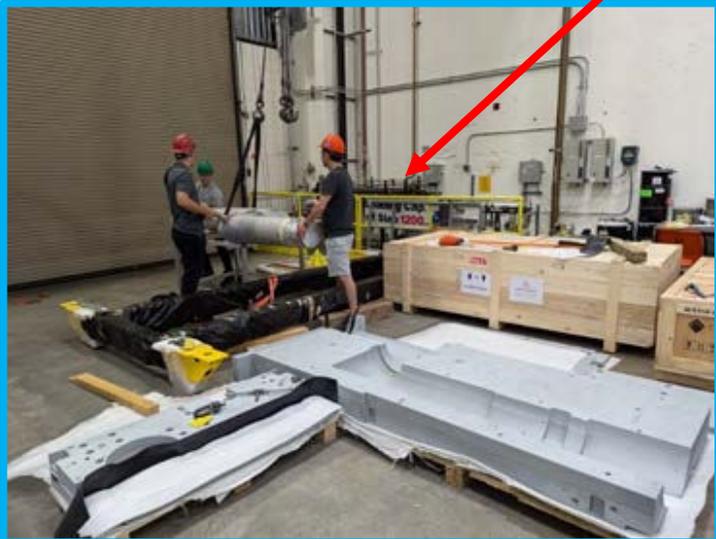
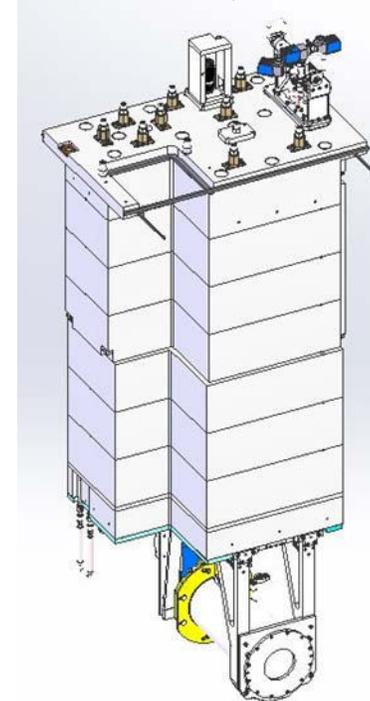
# Completion of the ARIEL project

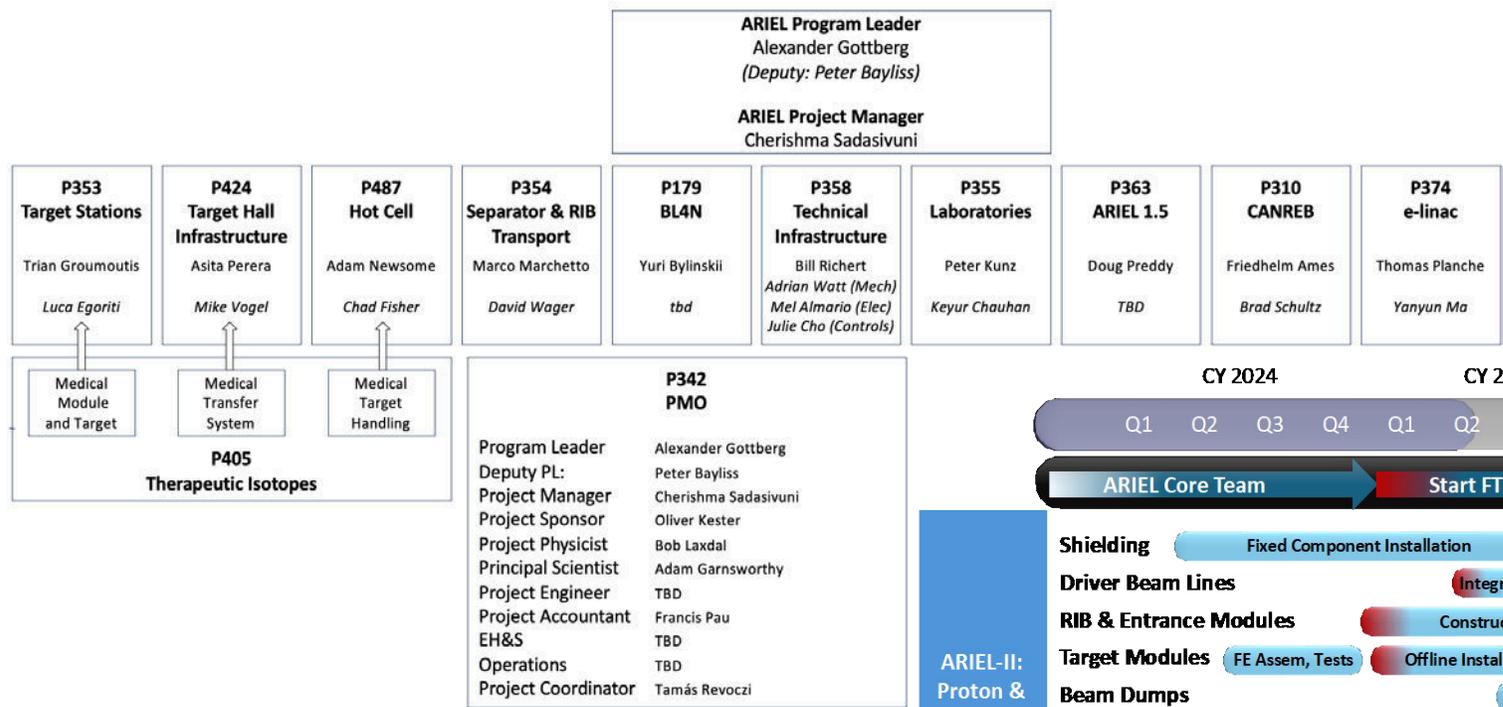
- Requires the target hall infrastructure for both stations (shielding, target building infrastructure, gas handling, HV infrastructure, vacuum systems)
- Target and RIB modules and beam dumps including the medical target and transfer system
- Beam line 4 North (BL4N) and the electron beam line and the integration, testing and commissioning of all systems
- Required for the ramp up in operation :
  - Spent target decay storage vault
  - Target production infrastructure (laboratories)
  - Offline target acceptance stand – TISA completion
  - HV infrastructure for APTW
  - E-linac upgrade to full performance
  - CANREB operation (EBIS, RFCB and HRS)



# Recent progress highlight

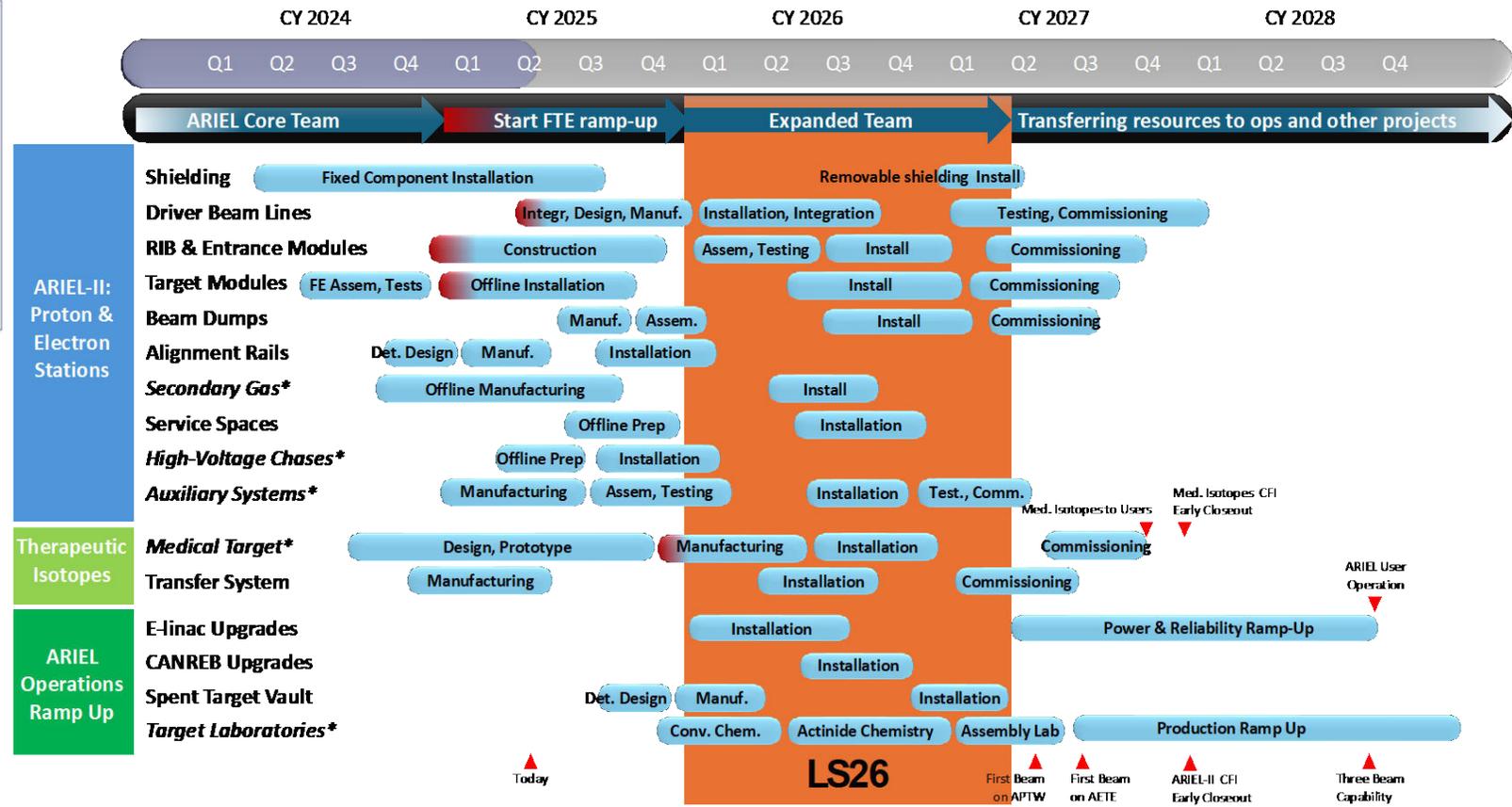
- Hermetic target vessel (HTV) assembly completed; TISA rebuilt, and services connected.
- **Target & Ion source front end** assembled in the lab and aligned; APTW Target Ion Source Front End assembly complete and placed into hot cell for remote handling validation tests.
- Major progress on the other sub-systems: Target module, Converter module, AETE Gamma dump, AETE support structure cooling panels, medical module.
- Target Pit shielding construction & concrete pours – more layers completed
- RIB transport modules – staging (in ISAC-I) and assembly readiness





Three major components:  
 The ISOL target stations and beam lines, the medical target system and ARIEL operation ramp-up (with e-linac, CANREB, target labs, etc.).

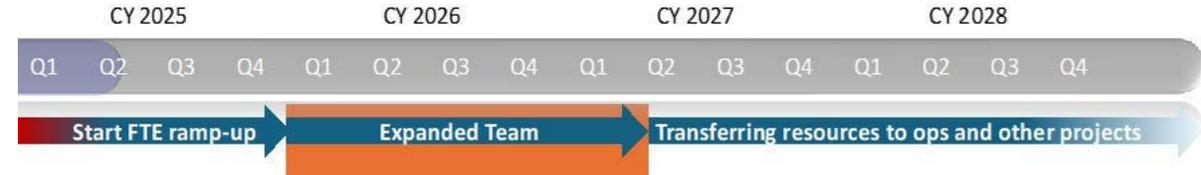
Accelerated timeline through additional focus and resources in **LS26**, the ARIEL project team is planning to complete the installation of all major systems and infrastructure in early 2027 achieving commissioning readiness later in CY2027.



# ARIEL project planning status

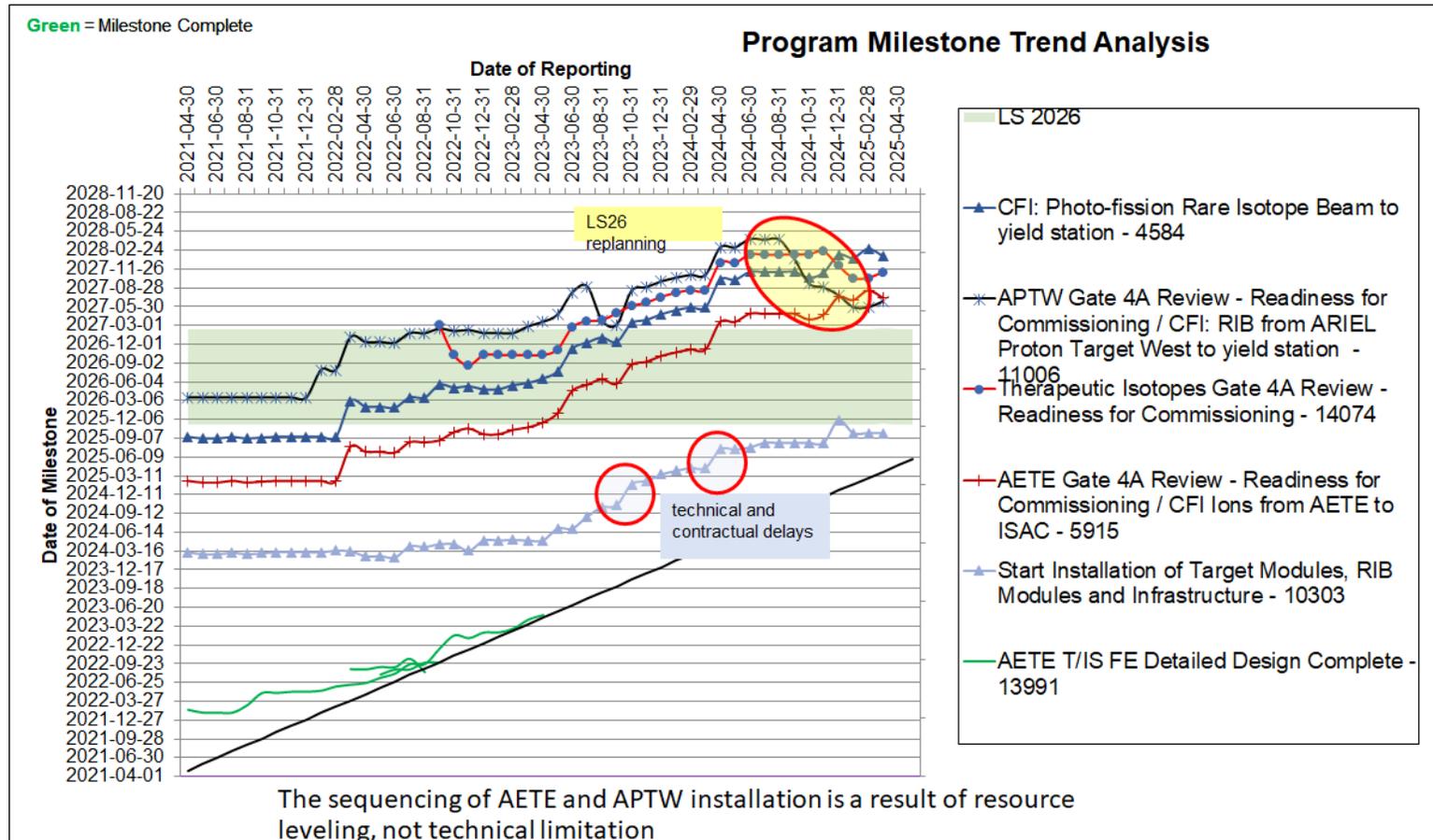
## Resources:

- LS26 will release TRIUMF staff from normal operational duties to work on the completion of ARIEL
- In preparation for 2026, a number of groups and departments outside the core ARIEL team have taken ownership of Design, Build, Procurement, Assembly and Installation for subsystems or equipment.
- Adds approximately 35 additional staff to the ARIEL team



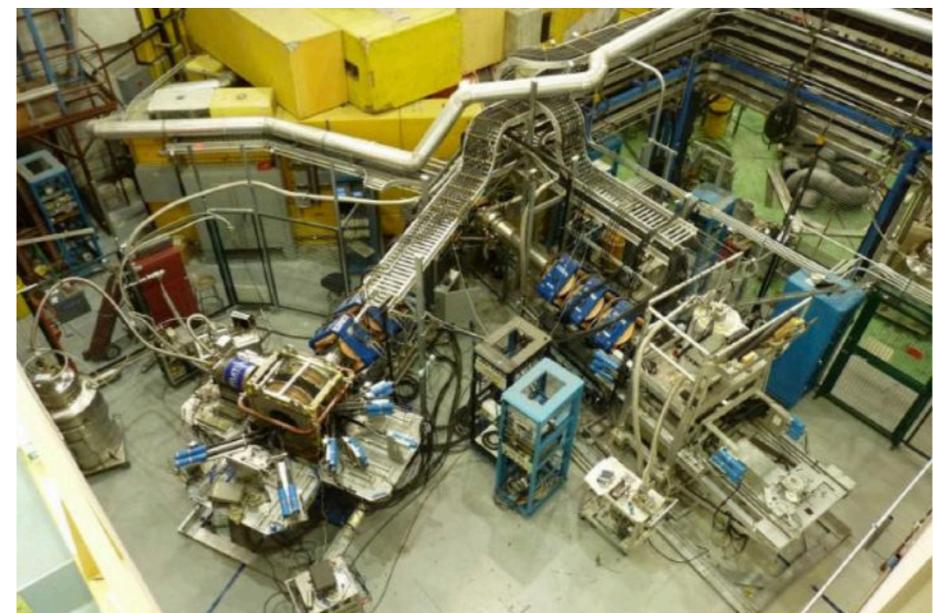
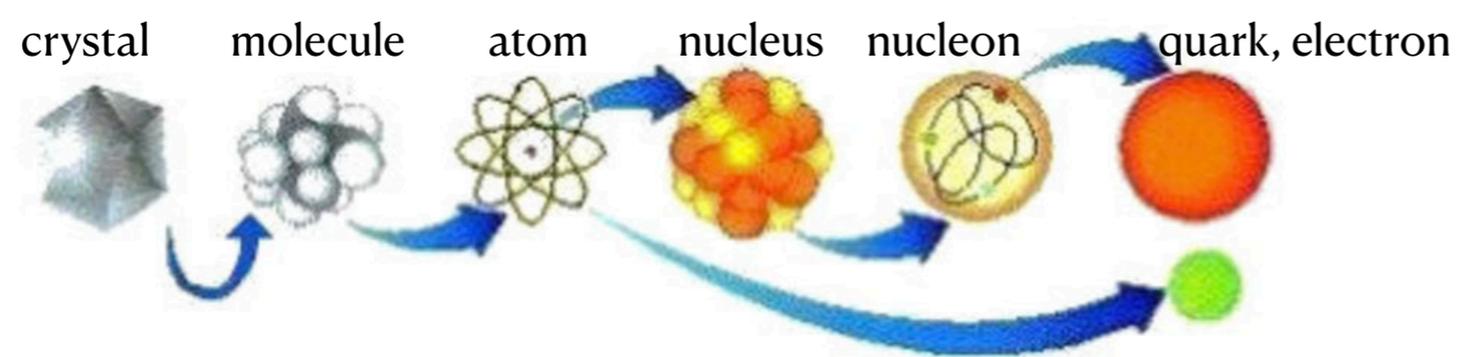
## Budget:

- Budget planning completed and TRIUMF's contribution is implemented in the budget forecast for the whole 5-year plan.
- Budget also accounts for the ramp-up of beam operation to achieve 5000 hours RIB delivery in 2029.



# Physical Sciences Division Updates

Rituparna Kanungo  
Director Physical Sciences



# PSD Organization Chart and Personnel update

**Centre for Molecular  
& Material Sciences  
(CMMS)**

Head : S. Kreitzman

**Nuclear Physics**

Head : C. Ruiz

**Particle Physics**

Head : O. Stelzer

**Theory**

Head : P. Navratil

**Scientific  
Computing**

Head : R. Tafirout

**Science  
Technology**

Head : F. Retiere

**ARIEL Experiment  
Operations**

Head : M. Alcorta

◆ A new Department, ARIEL Experiment Operations, has been created by restructuring the Nuclear Physics Department.



# PSD Organization Chart and Personnel update

**Centre for Molecular  
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Head : S. Kreitzman

**Nuclear Physics**

Head : C. Ruiz

**Particle Physics**

Head : O. Stelzer

**Theory**

Head : P. Navratil

- ◆ A new Board Appointed Employee (BAE) Research Scientist has been hired in the Particle Physics Department for the TRIUMF Ultracold Neutron Project (TUCAN).

**Noah Yazdandoot from PSI joining TRIUMF in August 2025**

**Scientific  
Computing**

Head : R. Tafirout

**Science  
Technology**

Head : F. Retiere

**ARIEL Experiment  
Operations**

Head : M. Alcorta

- ◆ A new Department, ARIEL Experiment Operations, has been created by restructuring the Nuclear Physics Department.



# FYP Implementation Plan : 2025 beamtime priorities

- ◆ Prioritize graduate students (GSRA and GSV) needing data from TRIUMF experiments to graduate.
  - ➔ Nuclear Physics : All (7) students & more, needing data have beamtime scheduled.
  - ➔ CMMS : All (1) student needing data has beamtime scheduled.
- ◆ Prioritize scheduling EEC approved High Priority experiments.
  - ➔ RIB shifts scheduled /requested (Nuclear Physics): 362 / 886 **40% RIB scheduling capacity**
  - ➔ Stable Beamtime shifts scheduled (Nuclear Physics) : 336
  - ➔  $\beta$ NMR shifts scheduled / requested (CMMS) : 92 / 96 (96%)
  - ➔  $\mu$ SR shifts (CMMS) scheduled / requested (until summer): 539 / 764 (70%)
  - ➔ UCN shifts scheduled / requested (Particle Physics): 115 / 155 (74%)
- ◆ Prioritize scheduling of ACTAR experiments (MOU with France - CNRS IRL)
- ◆ At least one experiment scheduled for each beamline facility.



# Physical Sciences contributions to ARIEL & BL1A refurbishment

## Science Technology

- ❖ Target gas systems (Detector group)
  - 7 different sub-projects
- ❖ Electron beam raster system (DAQ and electronics development groups)
- ❖ Machine protection system (Conceptual development group)

## Nuclear Physics

- ❖ Simulations for dose rates from ARIEL targets (J. Behr)
- ❖ Work on CANREB EBIS and RFQ (A. Kwiatkowski)
- ❖ Work on CANREB/ARIEL High-resolution separator (C. Ruiz & A. Lennarz)
- ❖ ARIEL test stand related to mass marker development (S. Malbrunot)

## ARIEL Experiment Operations

- ❖ e-LINAC machine protection system (M. Alcorta)

## Scientific Computing

- ❖ Automated RIB beamline tuning (W. Fedorko)

## CMMS

- ❖ Leading the coordination of BL1A refurbishment (S. Kreitzman)



# CFI proposals submitted for IF2025 with TRIUMF as partner

Canada Foundation for Innovation (CFI) funds large infrastructure, 40% CFI funds + 60% matching funds from partners

- ◆ ATLAS-Tier-1: Simon Fraser University lead; \$13.4M → Particle Physics
- ◆ RadMol : University of British Columbia lead; \$17.3M → Nuclear Physics
- ◆ TUCAN: University of Winnipeg lead; \$24M → Particle Physics
- ◆ **ALPHA-Next Gen**: University of Calgary; \$16.7M → Particle Physics
- ◆ CanFINDD: Simon Fraser University lead; \$8.1M → Particle Physics
- ◆ **EIC - SRF**: University of Manitoba lead; \$31.7M → Accelerator Physics

Results expected in late 2025

- Infrastructure to be located in Canada
- Infrastructure to be located Offshore

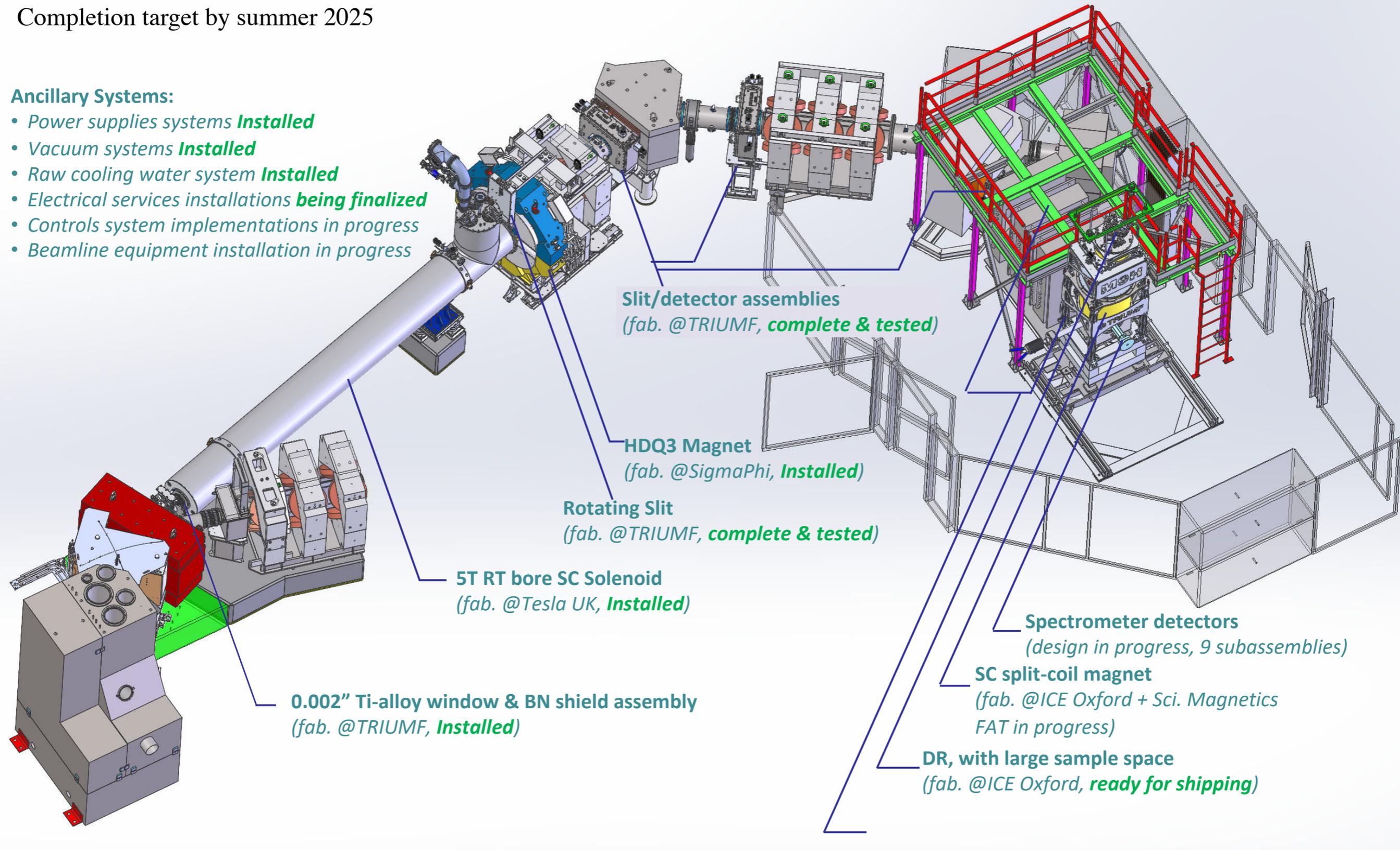


# CMMS : M9H beamline project update

Completion target by summer 2025

## Ancillary Systems:

- Power supplies systems **Installed**
- Vacuum systems **Installed**
- Raw cooling water system **Installed**
- Electrical services installations **being finalized**
- Controls system implementations **in progress**
- Beamline equipment installation **in progress**



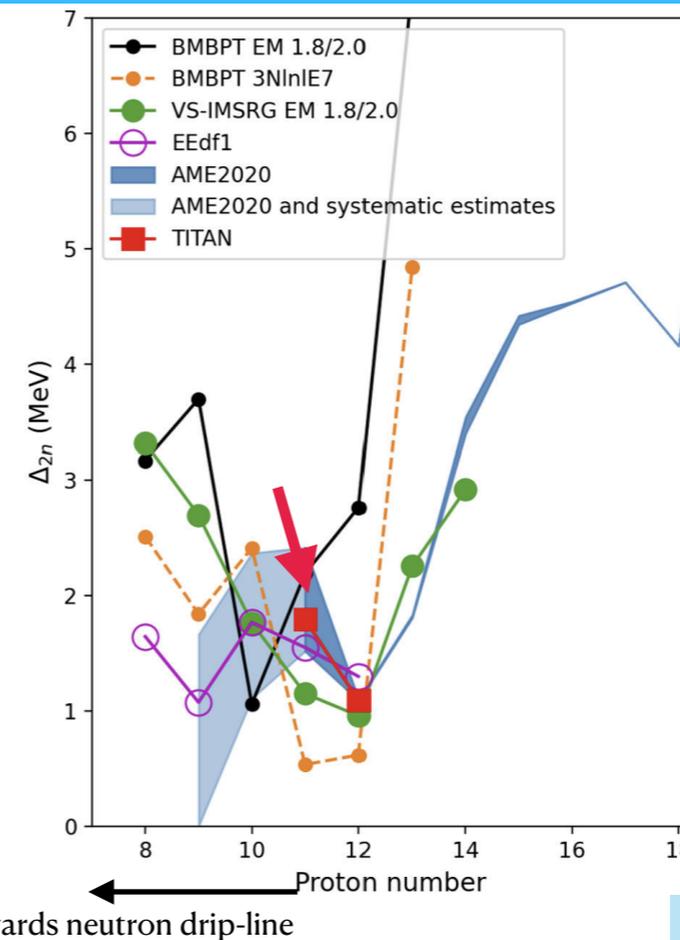
### New (ms) isomer state discovered in $^{32}\text{Na}$

PHYSICAL REVIEW LETTERS **134**, 052503 (2025)

#### Refined Topology of the $N=20$ Island of Inversion with High Precision Mass Measurements of $^{31-33}\text{Na}$ and $^{31-35}\text{Mg}$

E. M. Lykiardopoulou,<sup>1,2</sup> C. Walls,<sup>1,3</sup> J. Bergmann,<sup>4</sup> M. Brodeur,<sup>5</sup> C. Brown,<sup>6</sup> J. Cardona,<sup>1,3</sup> A. Czihaly,<sup>1,7</sup> T. Dickel,<sup>8,4</sup> T. Duguet,<sup>9,10</sup> J.-P. Ebran,<sup>11,12</sup> M. Frosini,<sup>13</sup> Z. Hockenbery,<sup>1,14</sup> J. D. Holt,<sup>1,14</sup> A. Jacobs,<sup>1,2</sup> S. Kakkar,<sup>1,3</sup> B. Kootte,<sup>15</sup> T. Miyagi,<sup>1,16</sup> A. Mollaebrahimi,<sup>1,4</sup> T. Murboeck,<sup>4</sup> P. Navratil,<sup>1,7</sup> T. Otsuka,<sup>17,18</sup> W. R. Plaß,<sup>4,8</sup> S. Paul,<sup>1,19</sup> W. S. Porter,<sup>5</sup> M. P. Reiter,<sup>6</sup> A. Scalesi,<sup>9</sup> C. Scheidenberger,<sup>8,4,20</sup> V. Somà,<sup>9</sup> N. Shimizu,<sup>21</sup> Y. Wang,<sup>1,2</sup> D. Lunney,<sup>22</sup> J. Dilling,<sup>1,2,23,24</sup> and A. A. Kwiakowski<sup>1,7</sup>

- New record for shortest half-life of RIB in MR-TOF



$N = 20$  shell gap  $\Delta_{2n}$  increases from minimum at  $^{32}\text{Mg}$  towards  $^{31}\text{Na}$  enhanced to unbound  $^{28}\text{O}$ ?

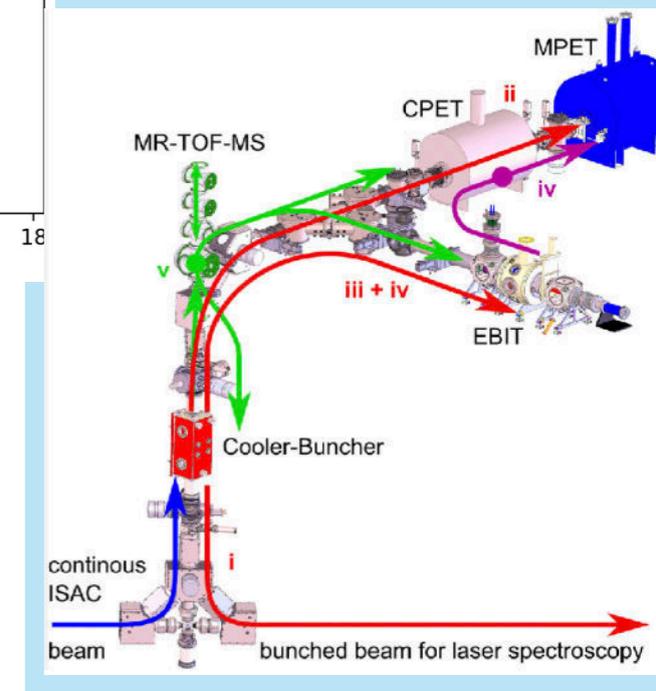
### Masses of neutron-rich Sn isotopes for explosive stellar burning

Precision mass measurements reveal low neutron pairing in tin beyond  $N = 82$  and its impact on stellar nucleosynthesis

A. Mollaebrahimi,<sup>1,2,\*</sup> C. Walls,<sup>3,2</sup> T. Dickel,<sup>4,1</sup> T. Miyagi,<sup>5,6,7,8</sup> A. Sieverding,<sup>9,10</sup> C. Andreoiu,<sup>11</sup> J. Ash,<sup>2</sup> B. Ashrafxhani,<sup>12,2</sup> I. Belosevic,<sup>2</sup> J. Bergman,<sup>1</sup> C. Brown,<sup>13</sup> T. Brunner,<sup>14</sup> J. Cardona,<sup>3,2</sup> L. Egoriti,<sup>2</sup> G. Gelinas,<sup>12,2</sup> G. Gwinner,<sup>3</sup> Z. Hockenbery,<sup>14,2</sup> J. D. Holt,<sup>2,14</sup> A. Jacobs,<sup>15,2</sup> S. Kakkar,<sup>3,2</sup> B. Kootte,<sup>3,2</sup> J. Lassen,<sup>2</sup> E. M. Lykiardopoulou,<sup>15,2</sup> S. Malbrunot-Ettenauer,<sup>2,16</sup> G. Martínez-Pinedo,<sup>4,5,17</sup> S. F. Paul,<sup>2</sup> W. R. Plaß,<sup>4,1</sup> M. P. Reiter,<sup>13</sup> A. Ridley,<sup>2</sup> C. Scheidenberger,<sup>4,1,17</sup> R. I. Thompson,<sup>12</sup> Y. Wang,<sup>15,2</sup> M. E. Wieser,<sup>12</sup> and A. A. Kwiakowski<sup>18,2</sup>

Submitted to Physical Review Letters

Enabled by p2n converter target



Schematic of TITAN setup

- First measurements of  $^{136-138}\text{Sn}$
- Flatter  $S_{2n}$  trend pushes expected neutron dripline and r-process path

First constraint on the neutrino wavepacket from  $e$ -capture decay of  ${}^7\text{Be}$ 

**BeEST - Beryllium Electron-capture with Superconducting Tunnel junctions**

nature

Article

# Direct experimental constraints on the spatial extent of a neutrino wavepacket

<https://doi.org/10.1038/s41586-024-08479-6>

Received: 5 April 2024

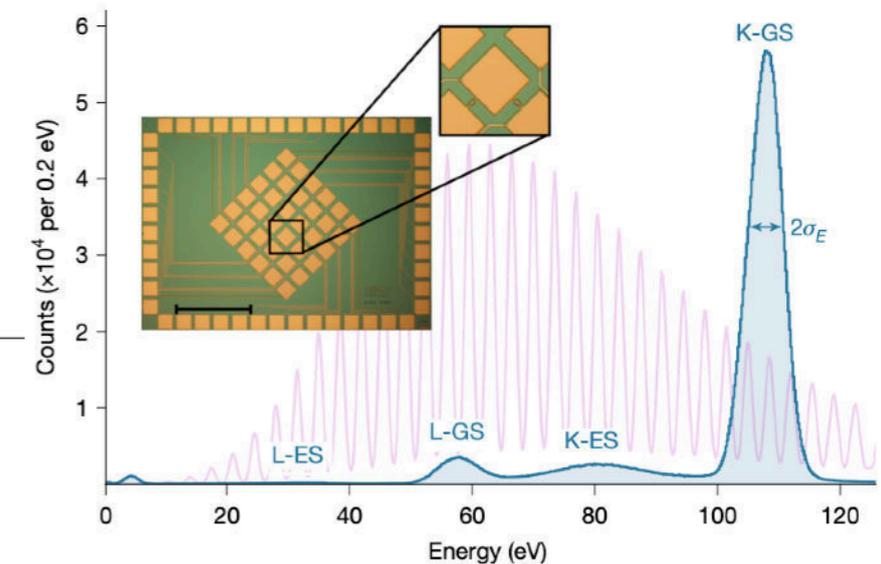
Accepted: 3 December 2024

Published online: 12 February 2025

Open access

 Check for updates

Joseph Smolsky<sup>1</sup>, Kyle G. Leach<sup>1,2</sup>, Ryan Abells<sup>3</sup>, Pedro Amaro<sup>4</sup>, Adrien Andoche<sup>5</sup>, Keith Borbridge<sup>1</sup>, Connor Bray<sup>1,6</sup>, Robin Cantor<sup>7</sup>, David Diercks<sup>8</sup>, Spencer Fretwell<sup>1</sup>, Stephan Friedrich<sup>6</sup>, Abigail Gillespie<sup>1</sup>, Mauro Guerra<sup>4</sup>, Ad Hall<sup>7</sup>, Cameron N. Harris<sup>1</sup>, Jackson T. Harris<sup>9</sup>, Leendert M. Hayen<sup>10</sup>, Paul-Antoine Hervieux<sup>5</sup>, Calvin Hinkle<sup>1</sup>, Geon-Bo Kim<sup>6</sup>, Inwook Kim<sup>6</sup>, Amii Lamm<sup>1</sup>, Annika Lennarz<sup>3,11</sup>, Vincenzo Lordi<sup>6</sup>, Jorge Machado<sup>4</sup>, Andrew Marino<sup>1</sup>, David McKeen<sup>3</sup>, Xavier Mougeot<sup>12</sup>, Francisco Ponce<sup>13</sup>, Chris Ruiz<sup>3</sup>, Amit Samanta<sup>6</sup>, José Paulo Santos<sup>4</sup>, Caitlyn Stone-Whitehead<sup>1</sup>, John Taylor<sup>1</sup>, Joseph Templet<sup>1</sup>, Sriteja Upadhyayula<sup>3</sup>, Louis Wagner<sup>2,3</sup> & William K. Warburton<sup>9</sup>



**Fig. 2 | The STJ array of the BeEST experiment and precision energy measurement.** The measured  ${}^7\text{Li}$  recoil spectrum with the four peaks described in the text for 20 h of data from the single STJ pixel shown in the inset. The L-ES peak is barely visible because of its weak population probability. The measured uncertainty of the K-GS peak is shown, and is conservatively extracted as the upper limit on the inherent energy width of the recoil,  $\sigma_{N,E} \leq 2.9$  eV, through the procedure described in the text. The comb of the peaks from the calibration laser spectrum (violet) is also shown for comparison. The small bump in the spectrum at 4 eV results from a non-prompt, decay-induced process, the source of which is still under investigation. Scale bar, 1 mm.

Constraining the neutrino wavepacket by precisely measuring the energy width of the recoil daughter nucleus emitted in the electron capture decay of  ${}^7\text{Be}$ .

The  ${}^7\text{Li}$  energy spectrum is measured to high precision by directly embedding  ${}^7\text{Be}$  into a high-resolution superconducting tunnel junction that is operated as a cryogenic sensor.



# Nuclear Physics : re-accelerated beams



## EMMA + TIGRESS

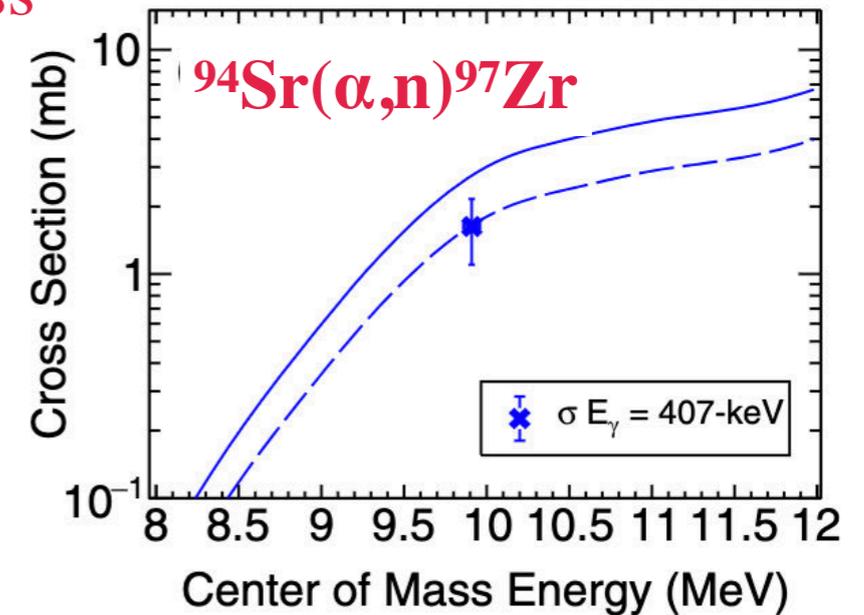
### First ( $\alpha, n$ ) cross section measurements for weak $r$ -process

PHYSICAL REVIEW LETTERS 134, 112701 (2025)

Editors' Suggestion

#### First Measurement of a Weak $r$ -Process Reaction on a Radioactive Nucleus

M. Williams<sup>1,\*</sup>, C. Angus<sup>2,3</sup>, A. M. Laird<sup>3,2</sup>, B. Davids<sup>2,4</sup>, C. Aa. Diget<sup>3,2</sup>, A. Fernandez<sup>5</sup>, E. J. Williams<sup>2</sup>, A. N. Andreyev<sup>3</sup>, H. Asch<sup>4</sup>, A. A. Avaa<sup>2</sup>, G. Bartram<sup>1</sup>, S. Chakraborty<sup>2,3</sup>, I. Dillmann<sup>2</sup>, K. Directo<sup>2</sup>, D. T. Doherty<sup>1</sup>, E. Geerlof<sup>2</sup>, C. J. Griffin<sup>2</sup>, A. Grimes<sup>2</sup>, G. Hackman<sup>2</sup>, J. Henderson<sup>1</sup>, K. Hudson<sup>4,2</sup>, D. Hufschmidt<sup>5</sup>, J. Jeong<sup>6,2</sup>, M. C. Jiménez de Haro<sup>5</sup>, V. Karayonchev<sup>2,†</sup>, A. Katrusiak<sup>2</sup>, A. Lennarz<sup>2,7</sup>, G. Lotay<sup>1</sup>, B. Marlow<sup>2</sup>, M. S. Martin<sup>4,‡</sup>, S. Molló<sup>8,2</sup>, F. Montes<sup>9</sup>, J. R. Murias<sup>2</sup>, J. O'Neill<sup>1</sup>, K. Pak<sup>6,2</sup>, C. Paxman<sup>1,§</sup>, L. Pedro-Botet<sup>8,2</sup>, A. Psaltis<sup>10</sup>, E. Raleigh-Smith<sup>2,||</sup>, D. Rhodes<sup>2</sup>, J. S. Rojo<sup>2</sup>, M. Satrazani<sup>11</sup>, T. Sauvage<sup>12</sup>, C. Shenton<sup>1,2</sup>, C. E. Svensson<sup>13</sup>, D. Tam<sup>4</sup>, L. Wagner<sup>2</sup> and D. Yates<sup>2,14</sup>



Novel  $^4\text{He}$  target

Measured cross sections are smaller than predicted by TALYS calculations

## IRIS

### $^{93}\text{Kr}(d,p)^{94}\text{Kr}$

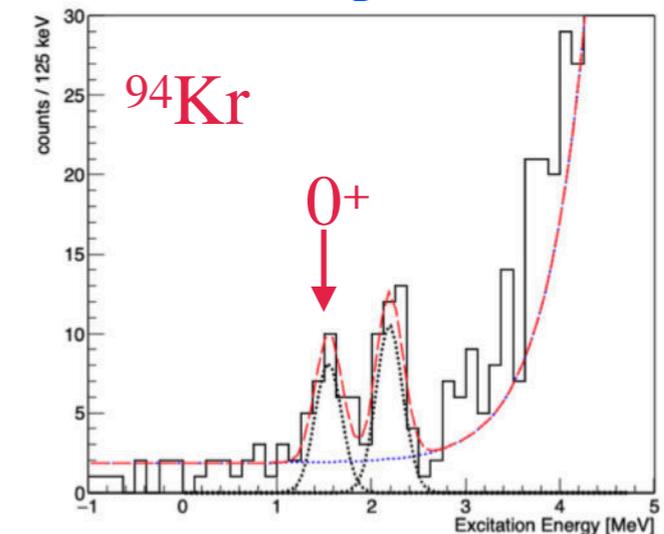
### First observation of $0^+$ excited state in $^{94}\text{Kr}$ signalling co-existence of different shapes

Transfer reaction measurement with only 200 pps enabled by IRIS solid  $\text{D}_2$  target

Letter Phys. Lett. B 862 (2025) 139352

#### Signature of $0^+$ excited state and shape coexistence in $^{94}\text{Kr}$ through $^{93}\text{Kr}(d,p)^{94}\text{Kr}$ reaction

D. Walter<sup>a,b</sup>, R. Kanungo<sup>a,b,\*</sup>, M. Holl<sup>a,b</sup>, S. Roy-Garand<sup>a</sup>, B.S. Hu<sup>b</sup>, J.D. Holt<sup>b</sup>, M. Alcorta<sup>b</sup>, C. Andreoiu<sup>c</sup>, S. Bhattacharjee<sup>b</sup>, A.A. Chen<sup>e</sup>, A. Chester<sup>b</sup>, D. Connolly<sup>b</sup>, B. Davids<sup>b,d</sup>, N. Esker<sup>b</sup>, F. Garcia<sup>c</sup>, S. Gillespie<sup>b</sup>, G. Hackman<sup>b</sup>, S. Ishimoto<sup>f</sup>, R. Krücken<sup>b,g</sup>, P. Jassal<sup>a</sup>, J. Laroche<sup>a</sup>, J. Liang<sup>e</sup>, B. Olaizola<sup>b</sup>, A. Psaltis<sup>e</sup>, J. Smallcombe<sup>b</sup>, I.J. Thompson<sup>h</sup>, C. Waterfield<sup>a</sup>



## ❖ TRIUMF

- **TUCAN** : ultra cold neutrons for neutron electric dipole moment
- **DarkLight** : X17 dark boson search via electron scattering

## ❖ CERN

- **ATLAS** : Precision Higgs and Standard Model measurements
- **ALPHA** : Antihydrogen experiments for matter-antimatter
- Detector R&D (DRDs)



**2025 Breakthrough Prize in Fundamental Physics awarded to the CERN LHC experiments : ALICE, ATLAS, CMS and LHCb.**

**Congratulations to the ATLAS Canada team!!**

## ❖ KEK/J-PARC

- T2K/Hyper-K : Neutrino oscillation - search for CP violation

## ❖ PSI

- PIONEER :  $e-\mu$  universality test

## ❖ SNOLAB

- nEXO :  $0\nu\beta\beta$  search with  $^{136}\text{Xe}$
- SuperCDMS : Low mass dark matter detection from elastic scattering with nuclei



# Particle Physics : TRIUMF - TUCAN

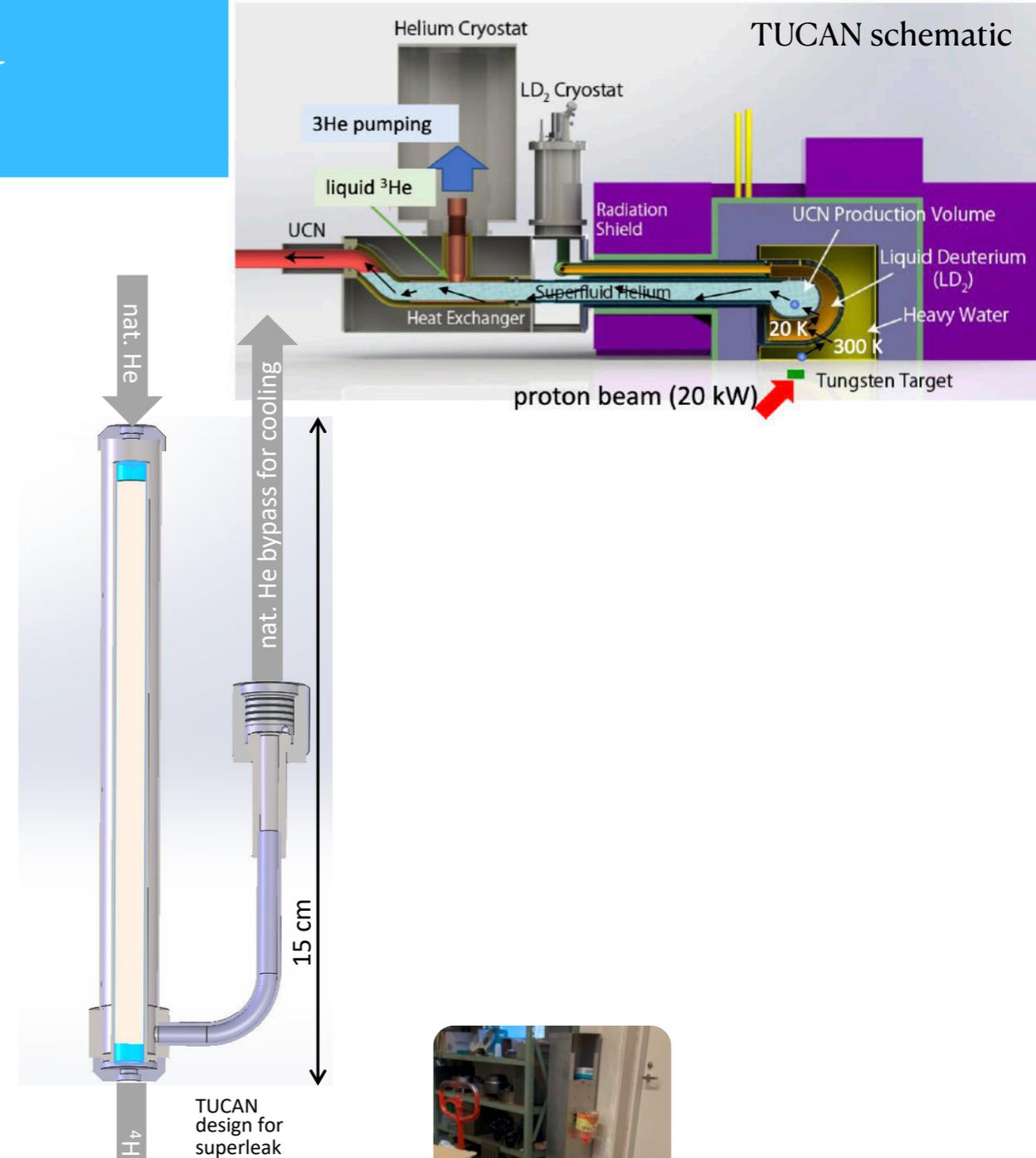
## Towards first UCN production

Highest priority: **cleaning isopure helium-4** from air contamination

- **new GM freeze-out purifier** from Japan
- bulk cleaning using the TUCAN source cryostat in progress
- manufacturing our own **superleak**
  - isotopic purification of natural helium down to around  $10^{-11}$  of  $^3\text{He}$  using **superfluid fountain effect**
- **concept design complete**
- manufacturing and first testing planned at KEK

## Towards operation of $\text{LD}_2$ moderator

- **$\text{LD}_2$  cryostat** is being assembled in Japan
- **$\text{LD}_2$  purifier** on its way from KEK to TRIUMF
- GM cryocooler compressors installed
- request for quote for pressure piping for **deuterium exhaust** ongoing
- **nuclear extraction duct** design is being finalized, materials on order



D<sub>2</sub> heat exchanger



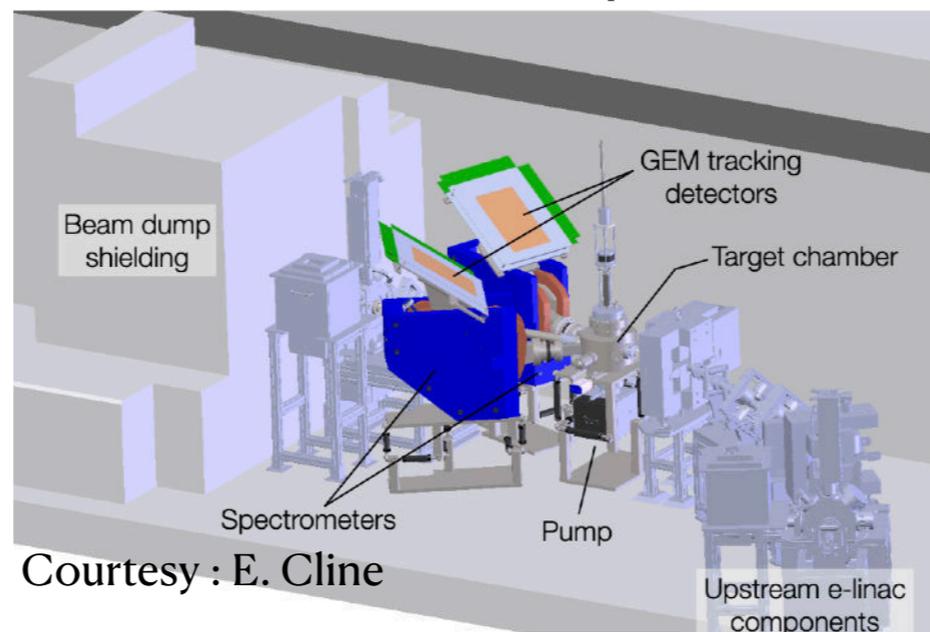
# Particle Physics : TRIUMF - DarkLight

- ◆ Magnetic field mapping is in progress for the dipole spectrometer magnets
- ◆ Scattering chamber and stands shipped from MIT to TRIUMF
- ◆ The remaining two GEMs are on track to arrive from Hampton University
- ◆ DAQ development for the GEMs at TRIUMF is progressing
- ◆ Trigger assembly is well underway

Spectrometer magnet

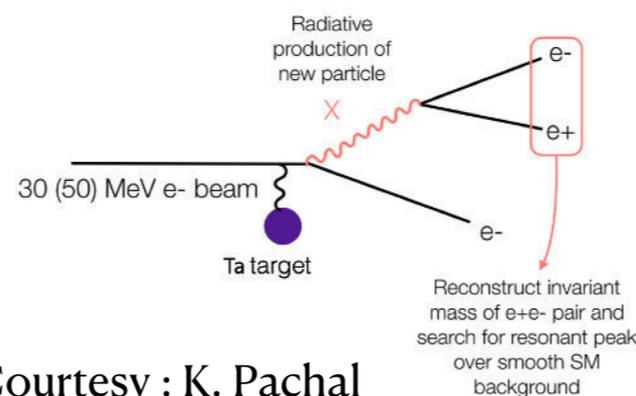


Model of setup

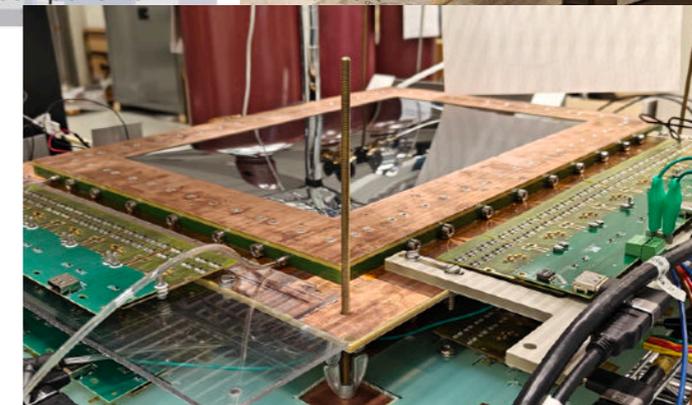


Courtesy : E. Cline

Scattering Chamber



Courtesy : K. Pachal



GEM

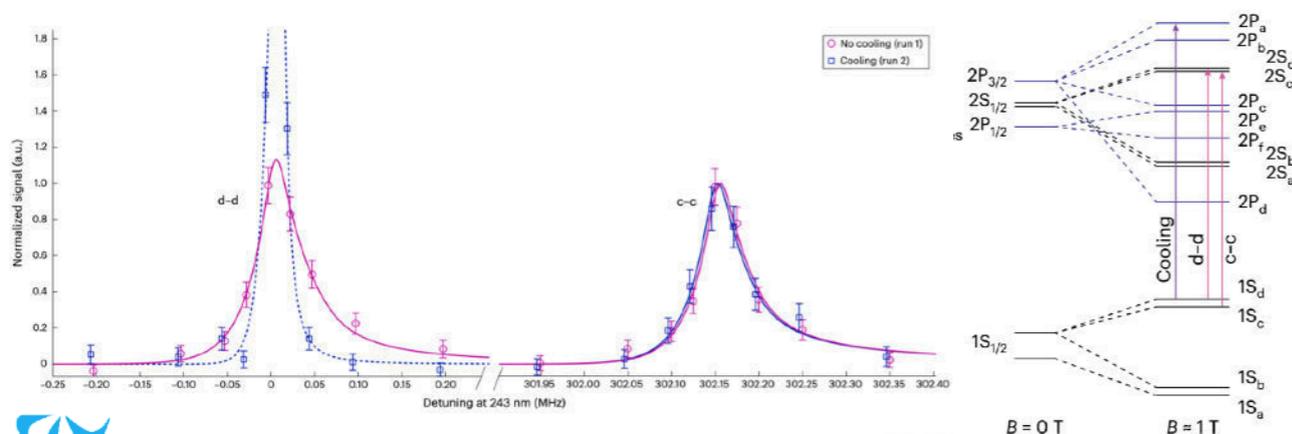


## ATLAS

- More than 2400 ATLAS ITk sensors probed at SFU/TRIUMF.
- SFU/TRIUMF team delivered two mitigation strategies for sensor cracking.
- Closing of ATLAS started, new Small Wheels moving back to position. First stable beams expected on May 3, 2025.

## ALPHA

- Determine the 2S hyperfine splitting in antihydrogen. Comparing results with those obtained in hydrogen constrain the charge–parity–time-reversal symmetry (CPT)-violating coefficients in the standard model extension framework
- AD/ELENA antiproton beam resumes May 5, 2025



### Characterization of pre-production petals for the ATLAS Inner Tracker strip detector

M.J. Basso on behalf of the ATLAS ITk collaboration

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[Journal of Instrumentation, Volume 20, January 2025](#)

[Topical Workshop on Electronics for Particle Physics](#)



## nature physics



Article

<https://doi.org/10.1038/s41567-024-02712-9>

# Precision spectroscopy of the hyperfine components of the 1S–2S transition in antihydrogen

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Check for updates

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# Science Technology : Single photon detectors

## Quantum yield in Silicon

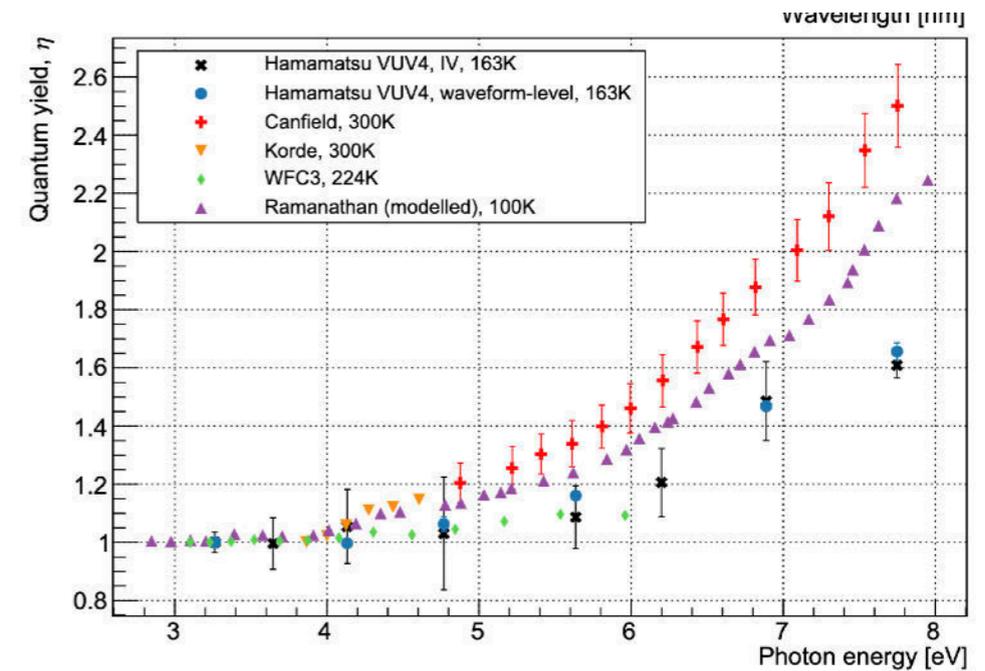
Eur. Phys. J. C (2025) 85:214  
<https://doi.org/10.1140/epjc/s10052-025-13883-x>

THE EUROPEAN  
 PHYSICAL JOURNAL C

Regular Article - Experimental Physics

### Measurements of the quantum yield of silicon using Geiger-mode avalanche photodiodes

Harry Lewis<sup>1,a</sup>, Mahsa Mahtab<sup>1,b</sup>, Fabrice Retière<sup>1,c</sup>, Austin De St. Croix<sup>1,2,d</sup>, Kurtis Raymond<sup>1,e</sup>,  
 Maia Henriksson-Ward<sup>1,f</sup>, Nicholas Morrison<sup>1,2,g</sup>, Aileen Zhang<sup>1,3,h</sup>, Andrea Capra<sup>1,i</sup>, Ryan Underwood<sup>1,j</sup>



UV sensitive SiPMs → Probability of UV photon in a silicon crystal. The measured quantum yield values are lower than previous reports. → impacts sensitivity of low-mass dark matter search

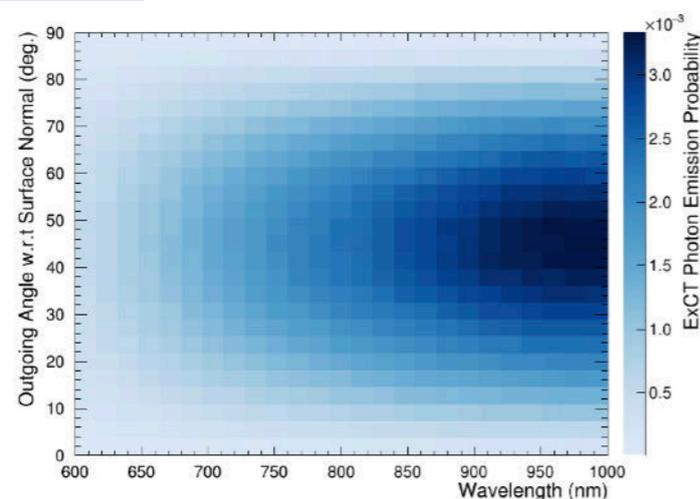
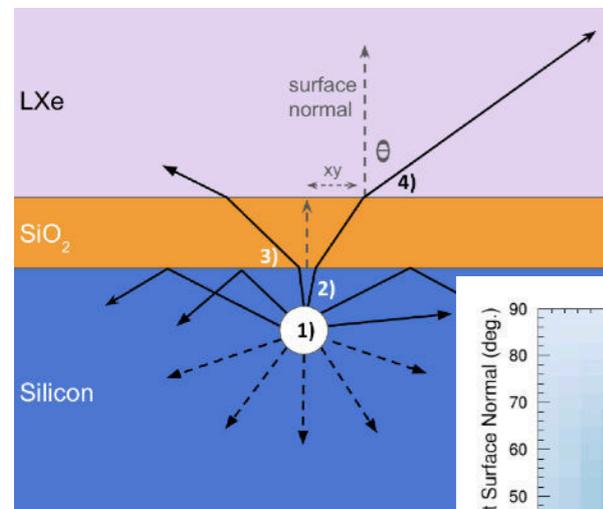
### Light-only-Liquid Xenon Experiment (LoLX)

### External cross talk (ExCT) from SiPM in Liquid Xe detector

### Characterization of external cross-talk from silicon photomultipliers in a liquid xenon detector

D. Gallacher<sup>1,a</sup>, A. de St. Croix<sup>2,6,b</sup>, S. Bron<sup>2</sup>, B. M. Rebeiro<sup>1</sup>, T. McElroy<sup>1</sup>,  
 S. Al Kharusi<sup>1,c</sup>, T. Brunner<sup>1</sup>, C. Chambers<sup>1,2</sup>, B. Chana<sup>3</sup>, Z. Charlesworth<sup>2</sup>,  
 E. Egan<sup>1</sup>, M. Francesconi<sup>5</sup>, L. Galli<sup>5</sup>, P. Giampa<sup>2</sup>, D. Goeldi<sup>3</sup>, S. Lavoie<sup>1</sup>,  
 J. Lefebvre<sup>4</sup>, X. Li<sup>2,8</sup>, C. Malbrunot<sup>2,1,7</sup>, P. Margetak<sup>2</sup>, N. Massacret<sup>2</sup>,  
 S. C. Nowicki<sup>1</sup>, H. Rasiwala<sup>1</sup>, K. Raymond<sup>2</sup>, F. Retière<sup>2</sup>, S. Rottoo<sup>1</sup>, L. Rudolph<sup>1</sup>,  
 M. A. Tétrault<sup>4</sup>, S. Viel<sup>3</sup>, N. V. H. Viet<sup>4,d</sup>, L. Xie<sup>2</sup>

European Physical Journal C (accepted)



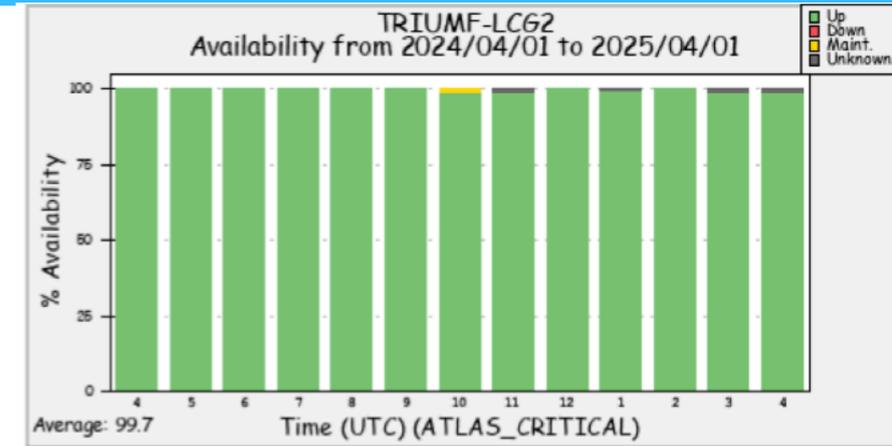
- Neutron Emission Spectrometer with General Fusion  
On track for detector operation in 2026
- Underwater ranging (LIDAR) with Envisioning Labs  
On track for proof of concept system completion in June 2025
- Single Photon Air Analyzer with SenseNet
  - EUREKA Resilience grant submitted
  - Proof of concept work system with digital single photon detector chip from Heidelberg (Peter Fischer) to be completed in 2025
- Early forest fire detection modality assessment with SenseNet  
New MITACS Elevate grant submitted



# Scientific Computing : ATLAS Tier -1 Centre

## ATLAS Tier-1 Centre

- ❖ High reliable availability of distributed computing operations (Data processing, storage, user analysis)
- ❖ 2024 - special funding award secured from the Digital Research Alliance of Canada & the BC Government. This is bridging support until CFI IF2025.
  - o \$4.05M (capital for equipment and operations)



## Quantum computing and Machine Learning

- ❖ Leading improvements to automated tuning of RIB beamlines with **BOIS (Bayesian Optimisation for Ion Steering)** w/ ACC
- ❖ **Quantum-assisted generative AI**
  - \*For calorimetric simulation @ATLAS @ HL-LHC
    - o Published [EPJC](#) (Letter)
- ❖ **ML applications for science projects**
  - \*ALPHA ; JHEP in review
  - \*Water Cherenkov
  - \*Real-time ML on FPGAs for triggering @ATLAS
- ❖ Multi-disciplinary high **societal impact projects** - cross divisional
  - \*TIIGR: Therapeutic Isotope Imager with Gamma Rays
    - o Progress in detector concepts and image reconstruction methods

Eur. Phys. J. C (2024) 84:1244  
<https://doi.org/10.1140/epjc/s10052-024-13576-x>

THE EUROPEAN  
PHYSICAL JOURNAL C



Letter

### CaloQVAE: Simulating high-energy particle-calorimeter interactions using hybrid quantum-classical generative models

Sehmimul Hoque<sup>1,2,a</sup>, Hao Jia<sup>3,b</sup>, Abhishek Abhishek<sup>4,6</sup>, Mojde Fadaie<sup>1</sup>, J. Quetzalcoatl Toledo-Marín<sup>4</sup>, Tiago Vale<sup>4,5</sup>, Roger G. Melko<sup>1,2,c</sup>, Maximilian Swiatlowski<sup>4</sup>, Wojciech T. Fedorko<sup>4,d</sup>



## Nuclear Physics

PHYSICAL REVIEW LETTERS **134**, 012501 (2025)

### Ab Initio Strategy for Taming the Nuclear-Structure Dependence of $V_{ud}$ Extractions: The $^{10}\text{C} \rightarrow ^{10}\text{B}$ Superallowed Transition

Michael Gennari<sup>1,2</sup>, Mehdi Drissi<sup>1</sup>, Mikhail Gorchtein<sup>3,4</sup>, Petr Navrátil<sup>1,2</sup> and Chien-Yeah Seng<sup>5,6</sup>

Phys. Lett. B 860 (2025) 139189

Contents lists available at ScienceDirect



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Physics Letters B

journal homepage: [www.elsevier.com/locate/physletb](http://www.elsevier.com/locate/physletb)



Letter

### Ab initio calculation of the $^3\text{He}(\alpha, \gamma)^7\text{Be}$ astrophysical S factor with chiral two- and three-nucleon forces

M.C. Atkinson<sup>a,\*</sup>, K. Kravvaris<sup>a</sup>, S. Onaoli<sup>a</sup> and P. Navrátil<sup>b</sup>



### Mass measurements of neutron-rich nuclides using the Canadian Penning Trap to inform predictions in the $r$ -process rare-earth peak region

D. Ray<sup>1,2,\*</sup>, N. Vassh<sup>3,†</sup>, B. Liu<sup>4,2</sup>, A.A. Valverde<sup>1,2</sup>, M. Brodeur<sup>4</sup>, J.A. Clark<sup>2,1</sup>, G.C. McLaughlin<sup>5</sup>, M.R. Mumpower<sup>6</sup>, R. Orford<sup>7</sup>, W.S. Porter<sup>4</sup>, G. Savard<sup>2,8</sup>, K. S. Sharma<sup>1</sup>, R. Surman<sup>4</sup>, F. Buchinger<sup>9</sup>, D.P. Burdette<sup>2</sup>, N. Callahan<sup>2</sup>, A.T. Gallant<sup>10</sup>, D.E.M. Hoff<sup>10</sup>, K. Kolos<sup>10</sup>, F.G. Kondev<sup>2</sup>, G. E. Morgan<sup>2,11</sup>, F. Rivero<sup>4</sup>, D. Santiago-Gonzalez<sup>2</sup>, N.D. Scielzo<sup>10</sup>, L. Varriano<sup>2,8,‡</sup>, C.M. Weber<sup>12</sup>, G. E. Wilson<sup>11,2</sup> and X.L. Yan<sup>13</sup>

<sup>1</sup>Department of Physics and Astronomy, University of Manitoba, Winnipeg, MB, R3T 2N2, Canada

<sup>2</sup>Physics Division, Argonne National Laboratory, Lemont, IL 60439, USA

<sup>3</sup>TRIUMF, 4004 Wesbrook Mall, Vancouver, BC V6T 2A3, Canada

arXiv: 2411.06310 - submitted in PRC

### Motivations for Early High-Profile FRIB Experiments

B. Alex Brown<sup>1</sup>, Alexandra Gade<sup>1</sup>, S. Ragnar Stroberg<sup>2</sup>, Jutta Escher<sup>3</sup>, Kevin Fosse<sup>4</sup>, Pablo Giuliani<sup>5,6</sup>, Calem R. Hoffman<sup>7</sup>, Witold Nazarewicz<sup>1</sup>, Chien-Yeah Seng<sup>5,8</sup>, Agnieszka Sorensen<sup>9</sup>, Nicole Vassh<sup>10</sup>, Daniel Bazin<sup>1</sup>, Kyle W. Brown<sup>11</sup>, Mark A. Caprio<sup>2</sup>, Heather Crawford<sup>12</sup>, Pawel Danielewicz<sup>1</sup>, Christian Drischler<sup>13</sup>, Ronald F. Garcia Ruiz<sup>14</sup>, Kyle Godbey<sup>5</sup>, Robert Grzywacz<sup>15</sup>, Jeremy W. Holt<sup>16</sup>, Hiro Iwasaki<sup>1</sup>, Dean Lee<sup>17</sup>, Silvia M. Lenzi<sup>18</sup>, Sean Liddick<sup>11</sup>, Rebeka Lubna<sup>5</sup>, Augusto O. Macchiavelli<sup>19</sup>, Gabriel Martínez Pinedo<sup>20,21,22</sup>, Anna McCoy<sup>5,23</sup>, Alexis Mercenne<sup>24</sup>, Kei Minamisono<sup>1</sup>, Belen Monteagudo<sup>25</sup>, Petr Navrátil<sup>10</sup>, Ryan Ringle<sup>1</sup>, Grigor Sargsyan<sup>3,5</sup>, Hendrik Schatz<sup>1</sup>, Mark-Christoph Spieker<sup>4</sup>, Alexander Volya<sup>4</sup>, Remco G. T. Zegers<sup>1</sup>, Vladimir Zelevinsky<sup>1</sup> and Xilin Zhang<sup>5</sup>

arXiv:2410.06144; accepted for publication in JPG

## Particle Physics

PHYSICAL REVIEW D **111**, 075002 (2025)

### Probing lepton number violation at same-sign lepton colliders

Carlos Henrique de Lima<sup>1,\*</sup>, David McKeen<sup>1,†</sup>, John N. Ng<sup>1,‡</sup>, Michael Shamma<sup>1,2,§</sup> and Douglas Tuckler<sup>1,3,||</sup>

<sup>1</sup>TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia V6T 2A3, Canada

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PHYSICAL REVIEW D **111**, 015021 (2025)

### Sign of gauge-Higgs boson couplings at future lepton colliders

Carlos Henrique de Lima<sup>1,\*</sup> and Douglas Tuckler<sup>1,2,†</sup>

<sup>1</sup>TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia V6T 2A3, Canada

<sup>2</sup>Department of Physics, Simon Fraser University, Burnaby, British Columbia V5A 1S6, Canada

PHYSICAL REVIEW D **111**, 015044 (2025)

### Dark matter from dark glueball dominance

David McKeen<sup>1,\*</sup>, Riku Mizuta<sup>1,2,†</sup>, David E. Morrissey<sup>1,‡</sup> and Michael Shamma<sup>1,§</sup>

<sup>1</sup>TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia V6T 2A3, Canada

<sup>2</sup>Department of Physics and Astronomy, University of British Columbia, 6224 Agricultural Road, Vancouver, British Columbia V6T 1Z1, Canada

Canadian Journal of  
Physics

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### Dark matter candidates and searches

Nassim Bozorgnia<sup>a,b</sup>, Joseph Bramante<sup>c,d,e</sup>, James M. Cline<sup>f</sup>, David Curtin<sup>g,h</sup>, David McKeen<sup>h,i</sup>, David E. Morrissey<sup>h,j</sup>, Adam Ritz<sup>k</sup>, Simon Viel<sup>l,m</sup>, Aaron C. Vincent<sup>c,d,e</sup>, and Yue Zhang<sup>c,i</sup>