



**TARA**

TRIUMF Alumni & Retirees Association

## **TARA Annual General Meeting, Thursday November 17, 2016**

TARA Executive present: Andy Hurst, Corrie Kost, Roy Moore, Jean-Michel Poutissou, Dana Giasson.

Attended by about 30 other TARA members.

Notes taken by AH.

The meeting was held in the TRIUMF Conference Room starting at 14:45 (following a presentation of the [retiree and group medical and dental benefit plan](#) administrator at 13:05 – 13:20, and tour of TRIUMF 13:30 – 14:30).

### ***Meeting notes from the 2015 AGM.***

The notes were distributed for review and approval, and were approved after the membership report.

### ***Report from TARA's Chair.***

Jean-Michel commented that 2019 will be the 50<sup>th</sup> anniversary of the first funding (and ground breaking ceremony?) of TRIUMF. A number of activities will be planned to mark the occasion. The work of writing the TRIUMF history has been passed on from Erich Vogt and Mike Craddock and is now in the hands of Marcello Pavan. Anyone of the TARA members who may have early photographs or videos of note, should contact Corrie Kost to have them included in the archives.

Brian Evans noted the recent passing of Jack Nelson, who was one of the first technicians, and longest serving. Jack started at U-Vic in 1968, and was active in many projects and contributed significantly to social activities at TRIUMF.

It was also noted that 50 new (younger faces) have been hired recently.

One of the active files on the TARA executive agenda is the investigation of making anti-virus software available to TARA members. The TRIUMF support of a/v s/w is excellent – Discussions are still underway.

We also hope to have TARA announcements included on the main TRIUMF website.

TARA is negotiating with TRIUMF administration to make business cards available for the TARA executive.

TARA is pursuing the possibility of having some connections to the UBC retiree activities.

### ***Report on TARA membership.***

Roy Moore reported that there are 127 active TARA members. A printed list was provided. The information is also on the website.

There are six new members: Mike Adam, George Clark, Peter Harmer, Len Ho, Theresa Lowe, Robert Openshaw.

We have lost contact with five others: Rick Burke, Dan Harrison, Christopher Owen, Klara Pelzer, Lane Wilson.

The Alumni email addresses can be found on the webpage. It is suggested that TARA members set up a TARA login account (for access to internal documents).

### ***Nomination and selection of new TARA executive for 2017.***

All of the existing members have agreed to continue. As there were no new volunteers, the current executive is approved by acclamation..

***Suggestions or other business from membership.***

No suggestions or other business.

The meeting was adjourned at 15:10, followed immediately by four presentations from TRIUMF and AAPS staff. The presentations are provided on the TARA website.

**TRIUMF Lab Overview** (Jens Dilling for Reiner Kreuken). 15:10 – 15:30.

**TRIUMF Physical Science** (Jens Dilling) 15:30 – 15:55.

**TRIUMF Life Science** (Connie Hoehr). 15:55 – 16:05.

**AAPS Overview** (Don Furseth). 16:05 – 16:20.

At 16:20 the presentations ended and TARA members adjourned to a reception with invited staff in the Hot Spot cafeteria.

The presentation slides are appended.



# Retiree Benefit Plan Review & Update



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# Agenda

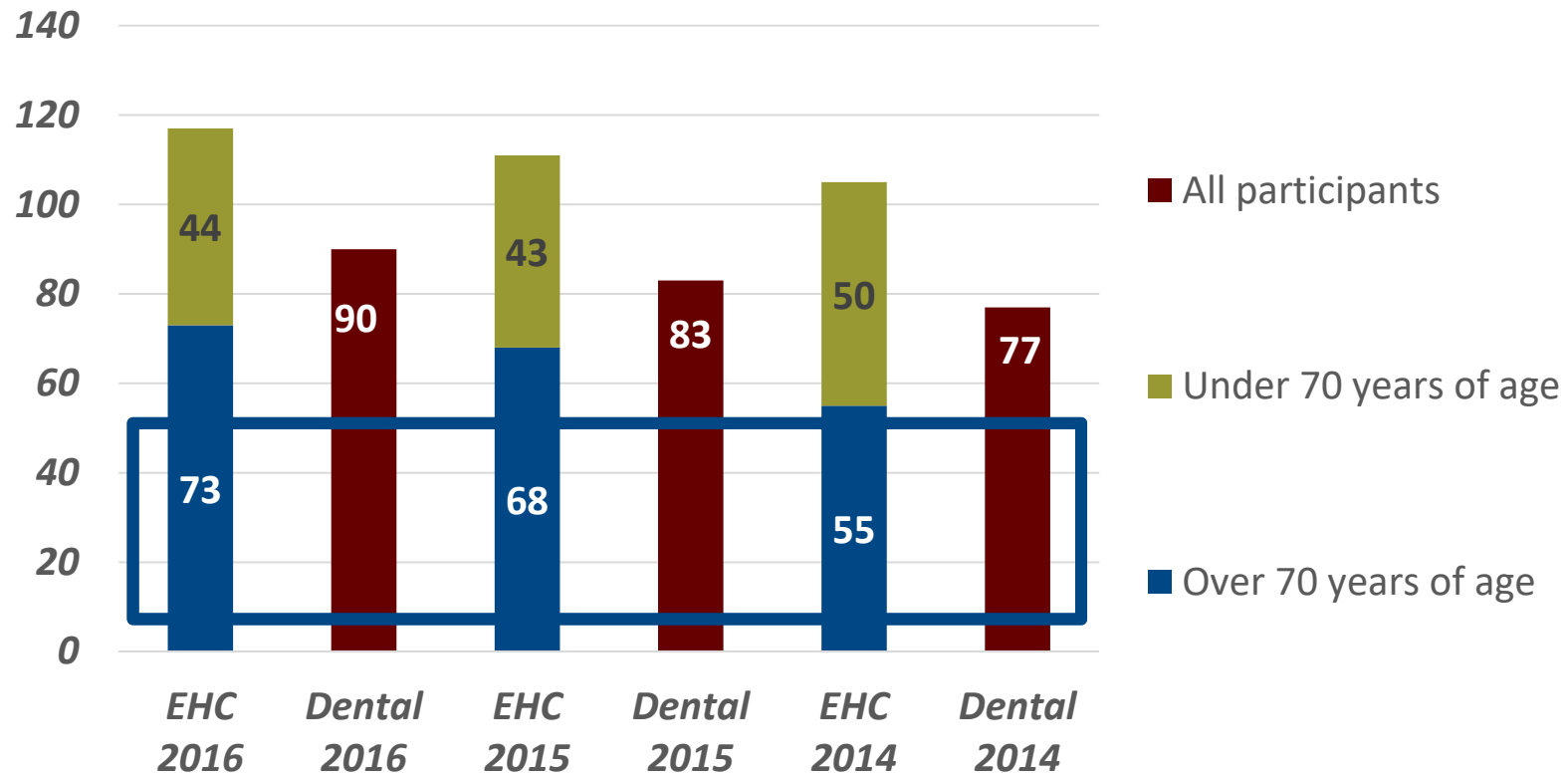
- Welcome
- Structure of the Retiree Plan
- December 1, 2016 Renewal
  - Extended Health & Dental Plan Participation
  - Claims Experience
  - Top 10 Drugs
- Pacific Blue Cross Pharmacy COMPASS
- Out-of-Country Medical Insurance
- Question & Answer



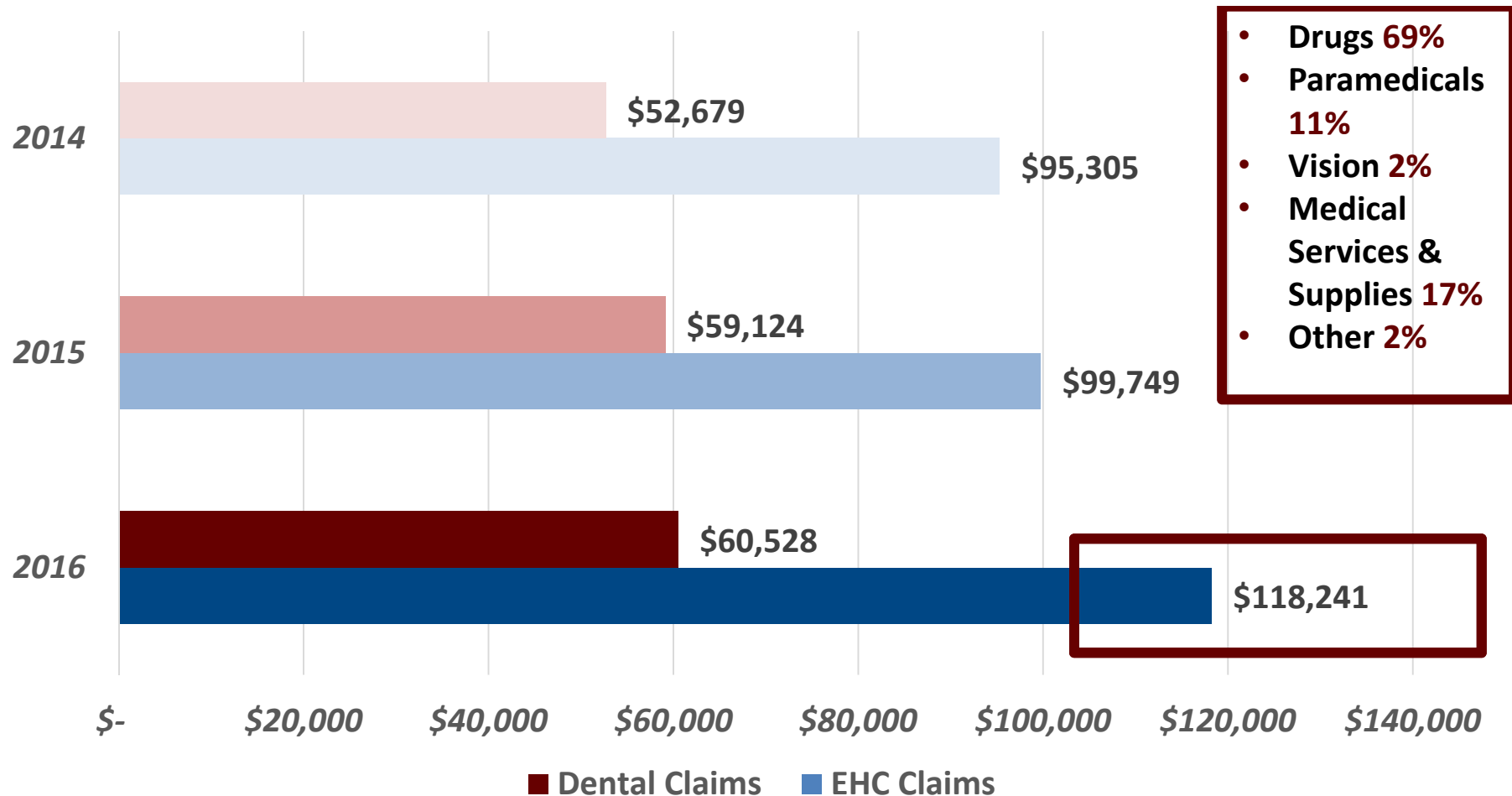
# TRIUMF Retiree Plan

- Underwritten by Pacific Blue Cross (PBC)
  - Not-for-profit
  - Lowest expense factors
  - CARESnet and Pharmacy COMPASS
- Extended Health and Dental Care Benefits
  - Two policies: 69 years & under **AND** 70 years & over
  - Coverage level under both policies is the same, however different EHC rates
  - Single, couple and family coverage

# TRIUMF Plan Participation

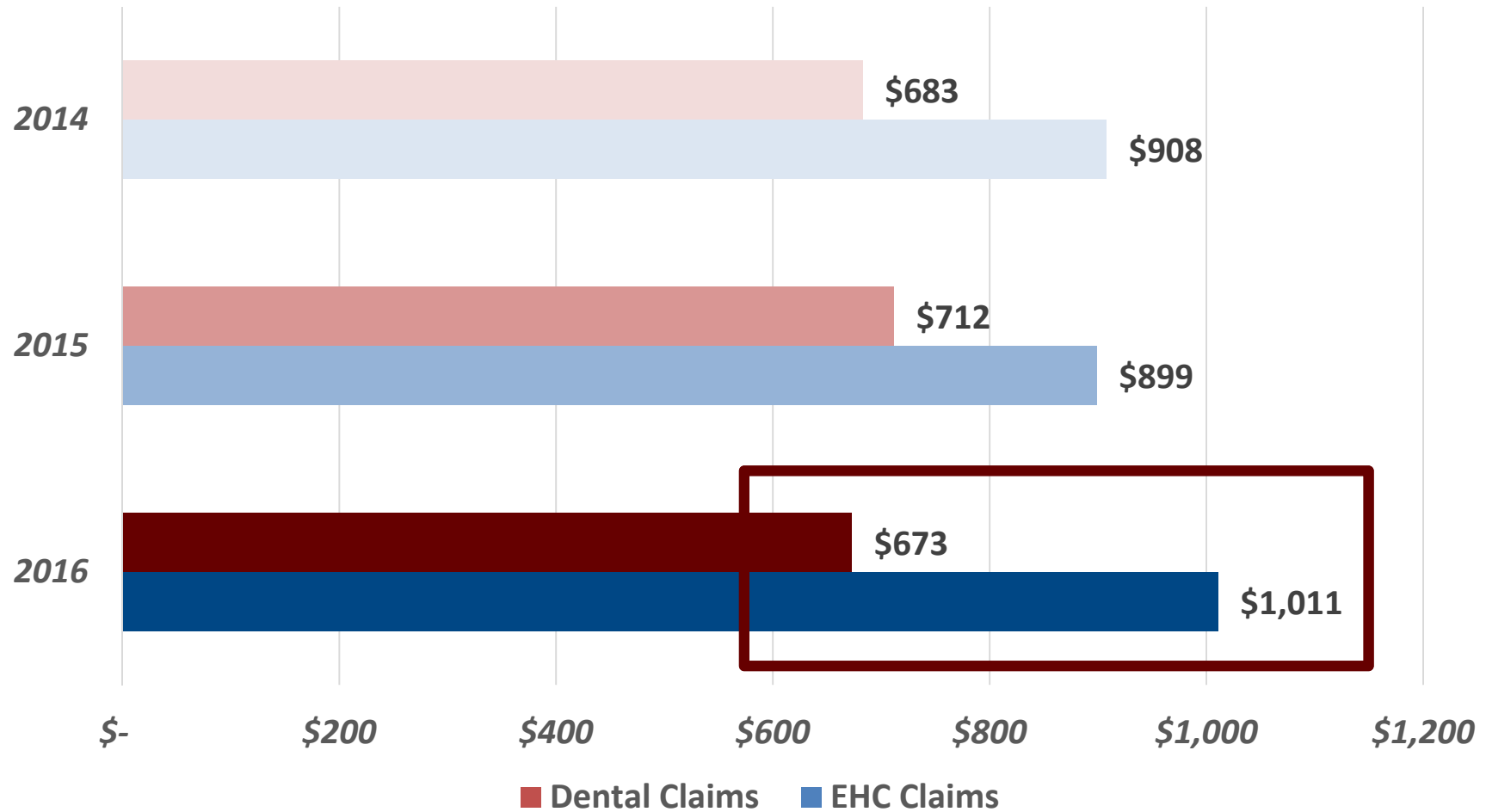


# EHC and Dental Claims Experience





## EHC and Dental Claims Average Paid/Retiree



# Top 10 drugs

Rank	Drug Name	Therapeutic Category	Total Paid 2016
1	Xarelto	Blood & Blood Forming Organs	\$2,296
2	Crestor	Cardiovascular	\$1,955
3	Prolia	Musculo-Skeletal	\$1,623
4	Apo-Levocarb	Nervous System	\$1,434
5	Renagel	Various	\$1,415
6	Cymbalta	Nervous System	\$1,137
7	Humira	Inflammatory Conditions	\$1,015
8	Brilinta	Blood & Blood Forming Organs	\$1,009
9	Lipitor	Cardiovascular	\$981
10	Losec	Alimentary Tract	\$848

**Total Top 10**


**\$13,712**

**Total All Drugs**

**\$81,106**

# Pacific Blue Cross - COMPASS

**Pharmacy**  
**COMPASS**



Home


Price Near Me

Price at My Pharmacy

FAQ

Drug Name (or DIN):

LIPITOR

 What is a DIN?

Strength:

80 mg

Pharmacy Location:

Broadway E, Vancouver, BC, Canada

Update Search

Average price at pharmacies close by

Pharmacy	Location	Average Price Per Pill	Generic Equivalent	Dispensing Fee
WAL-MART PHARMACY	3585 GRANDVIEW HWY	NO DATA	\$0.45	\$10.00
DRUGSTORE PHARMACY	3185 GRANDVIEW HWY	\$2.71	\$0.47	\$9.99
SUNSET PHARMACY	3818 SUNSET ST	\$2.56	\$0.45	\$9.10
SAVE-ON-FOODS PHARMACY	4399 LOUGHEED HWY	\$2.65	NO DATA	\$10.00
LONDON DRUGS	4567 LOUGHEED HWY SUITE 400	\$2.65	\$0.47	\$9.60

# Pacific Blue Cross - CARESnet

[Home](#)[Find a Plan](#)[Advice Centre](#)[About Us](#)[Contact Us](#)[Sign In](#)

[Pacific Blue Cross Home](#) > CARESnet Login

Discounts  
on  
Health  
& Wellness



Exclusive  
member savings

[Learn More](#)

## CARESnet Sign-In

Policy \*



ID Number \*



Password \*

☒ Member ☐ Spouse

[Sign In](#)

By signing in, you agree to the [terms](#)  
and [conditions](#) in our legal notice.

[Register for access](#)

[Forgot your password?](#)

[Take a tour](#)



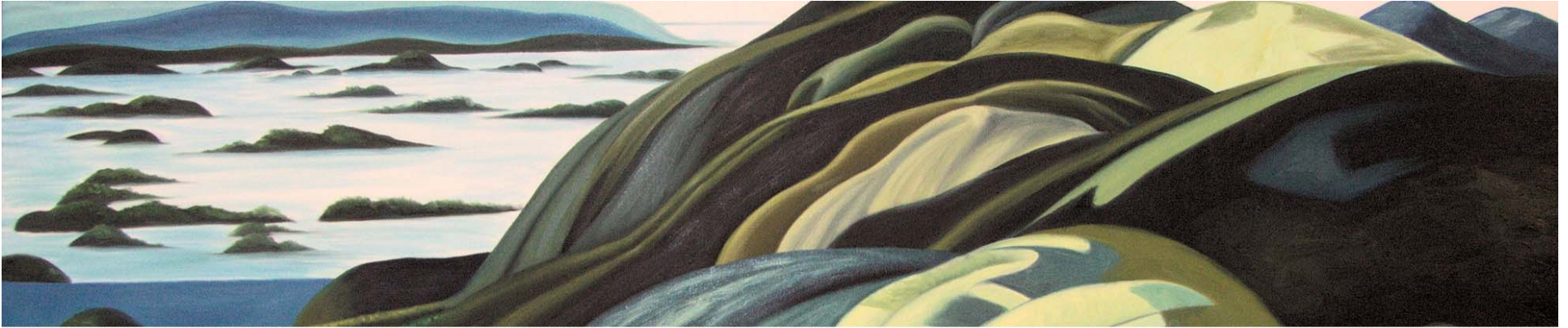
# Renewal Recap

- PBC uses past experience as an indicator of future experience. The carrier applies a trend factor (11.1% EHC and 8.8% Dental) to set rates.
  - New Dental Fee Guide 3.3% increase
  - Paramedical practitioners charging more for services
  - High cost of prescription drugs
- EHC premiums require an inflationary adjustment up to **9.9%** depending on policy and coverage type.
- Dental rates reduce by **-4.4%**
- Our negotiations save **\$4,040 over 12 months** compared to the carrier's original request.
- The price impact per Retiree varies based on coverage level.

# Out-of-Country

- Your current Emergency Out-of-Country benefit amount is \$50,000 per calendar year (60-day trip duration). This benefit amount is included in the EHC lifetime maximum of \$100,000.
  - Out-of-Country benefit amount is below recommended coverage level
  - Benefit amount cannot be increased for non-active employees due to the associated risk
- **Options?** Remove this benefit from your plan. Removing this benefit lowers the associated risk and premium.





# Question & Answer

Jim Dehoney, President & Founder  
Carol Fyffe, Account Manager





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

# State of TRIUMF

TARA  
November 17, 2016

Reiner Kruecken  
Deputy Director



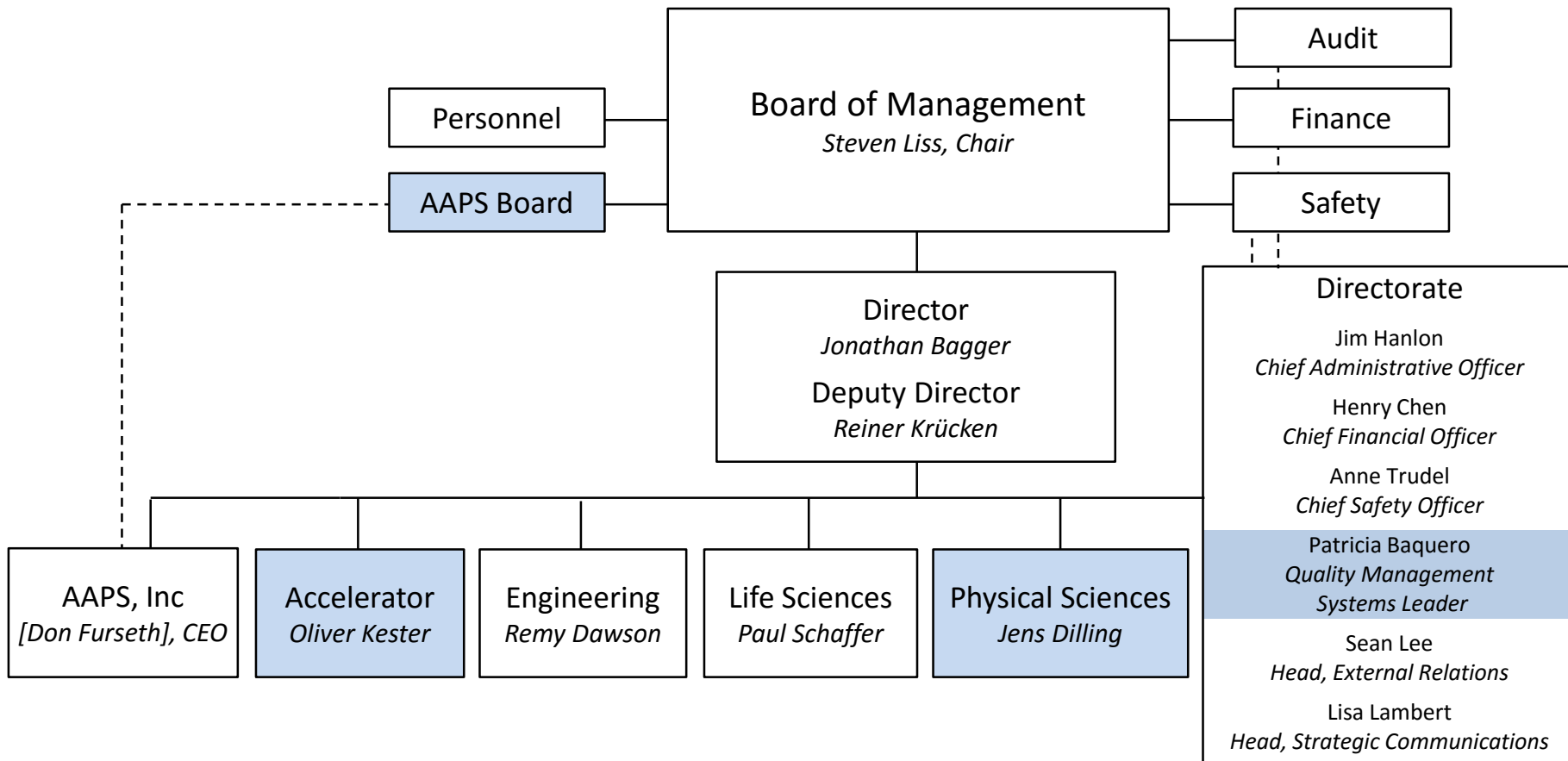


1. Operate safely and effectively
2. Produce world class science
3. Connect TRIUMF to the world



1. Operate safely and effectively
2. Produce world class science
3. Connect TRIUMF to the world







Jens Dilling  
ALD, Physical Sciences



Oliver Kester  
ALD, Accelerators

## BAE Hires

– Beatrice Franke, UCN



– Nigel Hessey, ATLAS



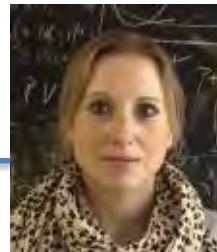
– Valery Radchenko, Radiochemistry



– Ania Kwiatkowski, ISAC Ion Traps



– Monika Stachura, Life Sciences

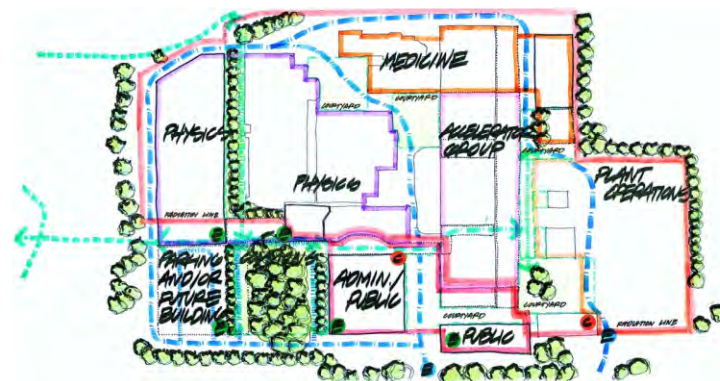


- TRIUMF and UBC have completed their site master plan
- Implementation is underway



## TRIUMF FACILITIES MASTER PLAN

26 October 2016



Prepared by Facilities Planning | UBC Infrastructure Development  
In collaboration with Campus & Community Planning

1. Operate safely and effectively
2. Produce world class science
3. Connect TRIUMF to the world

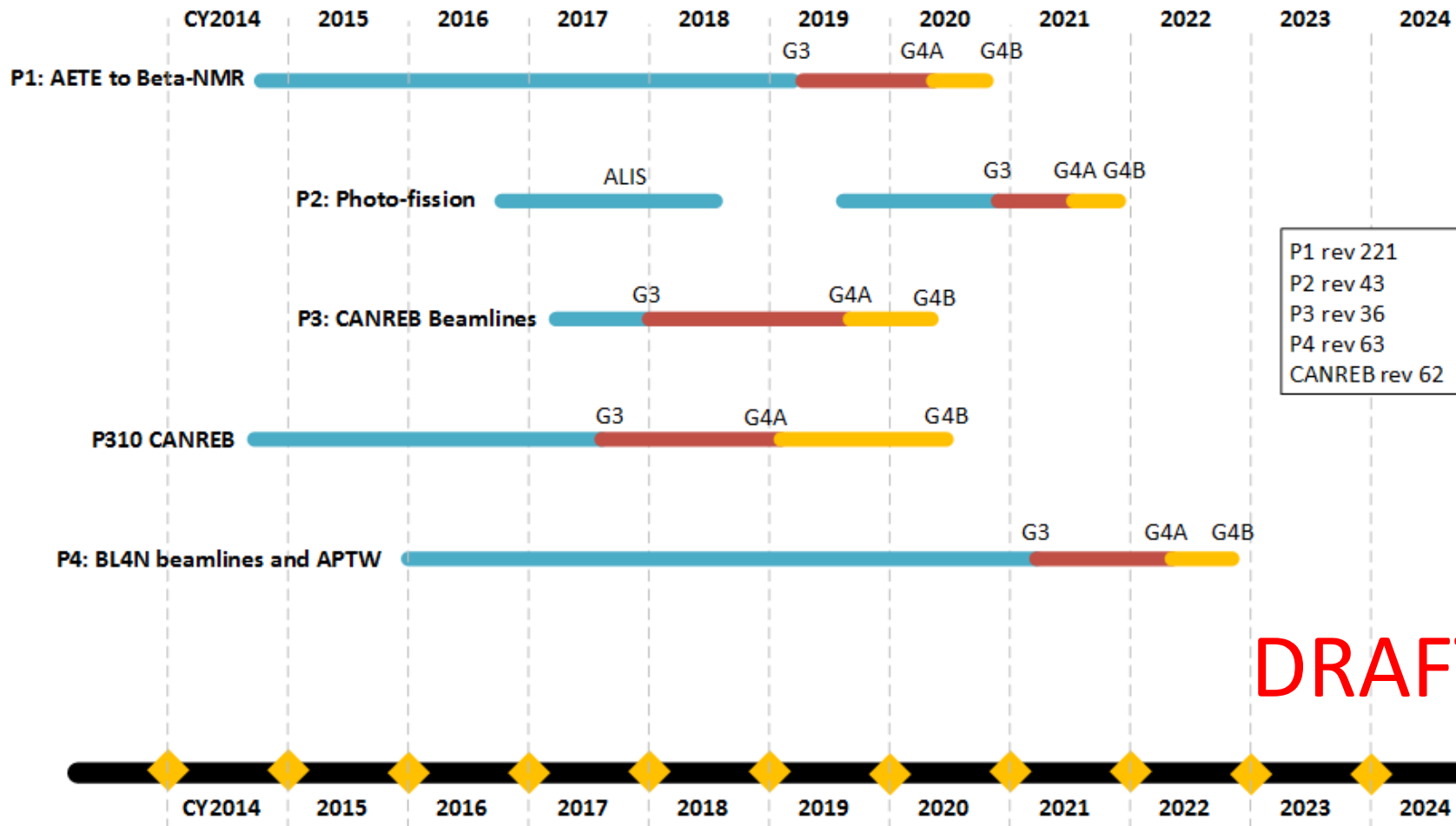




- ARIEL-II Project
  - Funding secured
    - CFI + 5 provinces + TRIUMF
    - CFI finalization process under way
  - Project Management of all ARIEL related projects has been integrated
  - Project plans being finalized
    - Targets are being designed
    - Documents are being prepared
  - Operations model under study
    - Reliable ISAC operations are essential to ARIEL's success
      - ➔ ISAC refurbishment plan





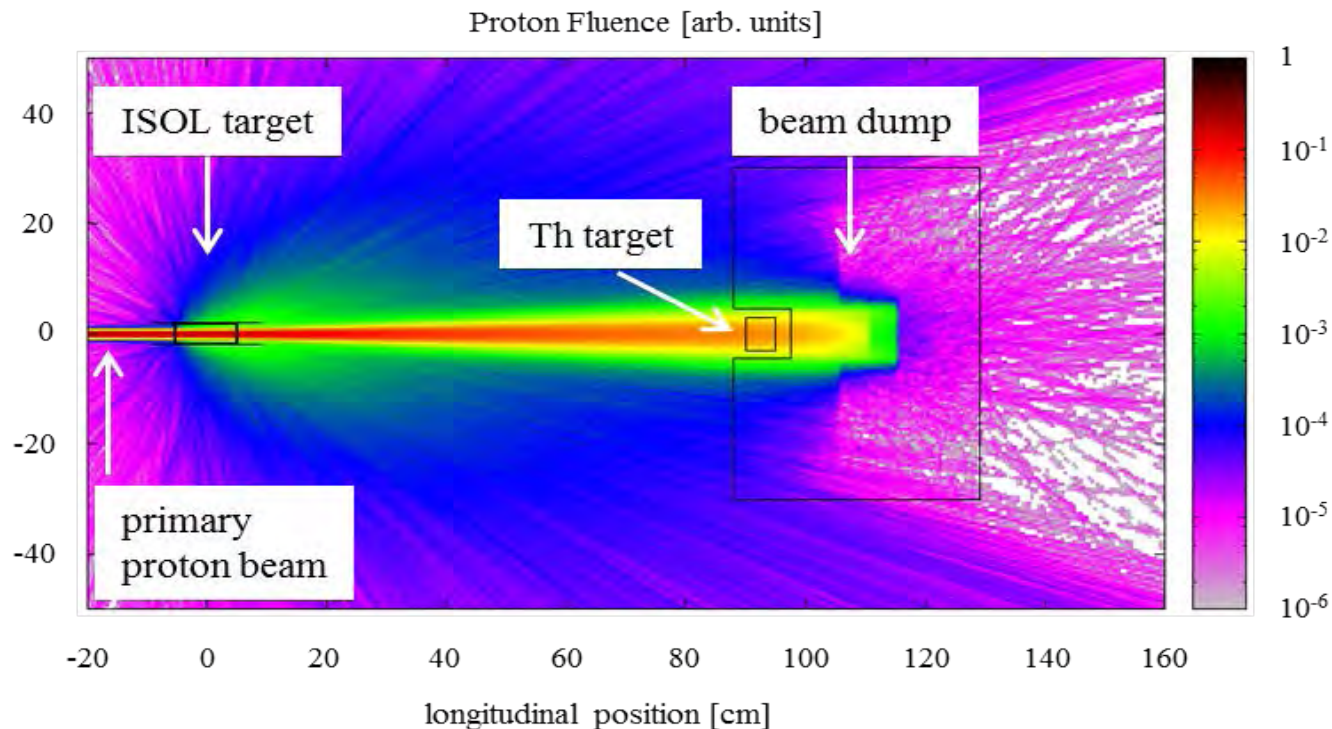


- TRIUMF Life Sciences is entering a critical period; ageing infrastructure is putting the current program at risk
- Work continues on the planning of the Institute for Advanced Medical Isotopes (IAMIs)
- IAMIs facility schematic design is complete
- Funding discussions are ongoing – with a goal of securing funding by the end of the fiscal year



### IAMI Founding Partners





Canadian Nuclear  
Laboratories

Laboratoires Nucléaires  
Canadiens



U.S. DEPARTMENT OF  
**ENERGY**

## CFI 2017 Innovation Fund Proposal: ARIEL Symbiotic Target



- Scientists

- Akira Konaka – 2016 CAP-TRIUMF Vogt Medal
- Jens Dilling – 2016 APS Francis Pipkin Award
- Makoto Fujiwara – Elected APS Fellow
- Pierre Savard – Elected APS Fellow



- Students

- Sebastien Rettie (UBC) – NSERC Vanier Scholarship
  - Supervisor: Oliver Stelzer-Chilton
- Alexander Held (UBC) – Marie Skłodowska-Curie Fellowship
  - Supervisor: Oliver Stelzer-Chilton



Michael Craddock  
(1936 – 2015)

Michael Craddock  
Award for Advanced  
Students in  
Accelerator Science



1. Operate safely and effectively
2. Produce world class science
3. **Connect TRIUMF to the world**



## Canada's Innovation Agenda

We're committed to making Canada a global innovation leader—  
and we want to hear from you!

[Submit my innovative idea →](#)

Or share it on social media:



## CANADA'S FUNDAMENTAL SCIENCE REVIEW

TRIUMF contributed to several federal consultations that took place over the summer and fall







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

# Thank you! Merci!

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

Follow us at TRIUMFLab





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

# Physical Science Division TARA-November 2016

Jens Dilling  
Associate Laboratory Director  
Physical Sciences Division

November 17 2016

# Nuclear physics department

***Nuclear Physics - J. Dilling***

***Deputy - J. Behr***

J. Behr

A. Kwiatkowski

M. Pearson

I. Dillmann

T. Brunner (McGill)

B. Davids

J. Dilling

M. Alcorta (P&S)

M. Good (tech)

C. Ruiz

A. Garnsworthy

S. Georges (tech)

G. Hackman

D. Muecher (Guelph)

***ARIEL @PSD***

**Principle Scientist**

A. Garnsworthy

**MPS:**

M. Alcorta (P&S)

D. Bishop (P&S)

L. Doria (P&S)

S. Yen

**CANREB:**

J. Dilling

**L. Graham (PDF)**

M. Pearson

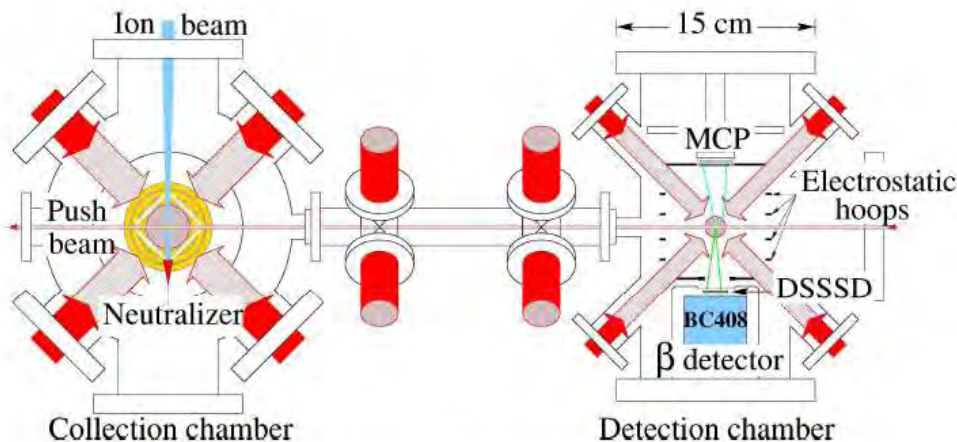
**B. Barquest (PDF)**

Execute and support nuclear physics experiments at ISAC (and ARIEL) or complementary studies at other RIB facilities

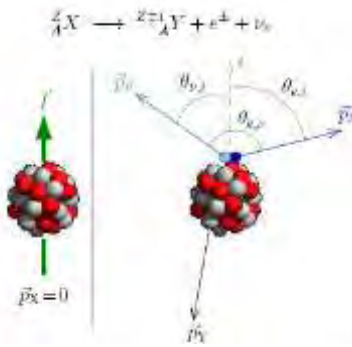
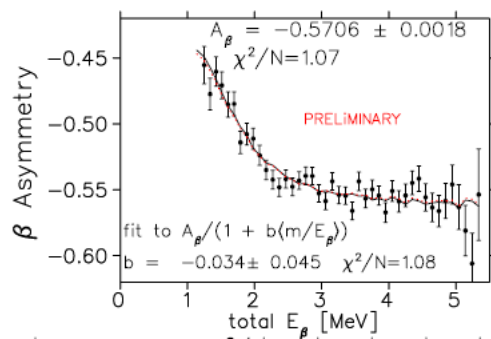
Nuclear Structure

Nuclear Astrophysics

Test of Fundamental Symmetries



Traps provide a backing-free, cold ( $\lesssim 1$  mK), localized ( $\lesssim 1$  mm<sup>3</sup>) source of short-lived radioactive atoms

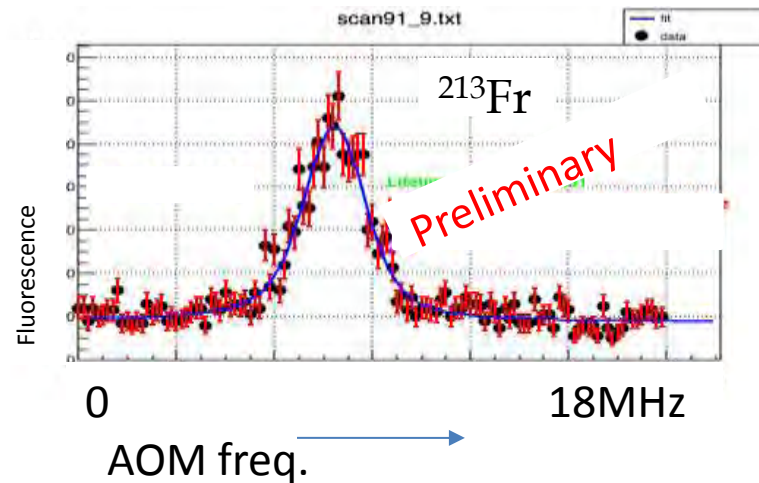
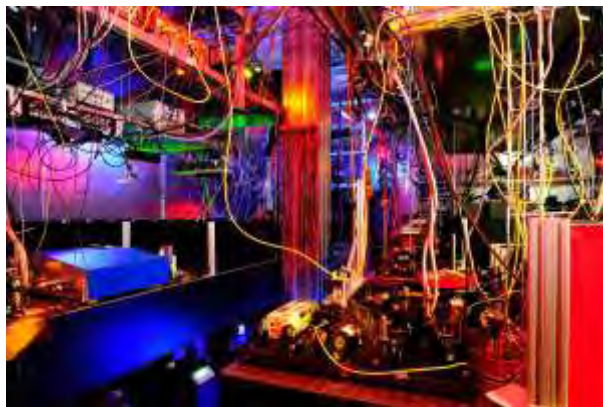
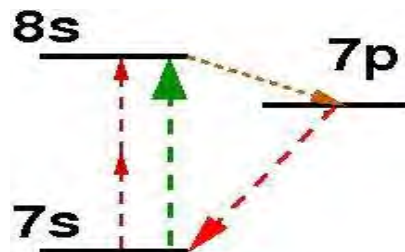


Atom trap: electro-weak study to probe S/V/T interactions using  $\beta$ - $\nu$  correlations.

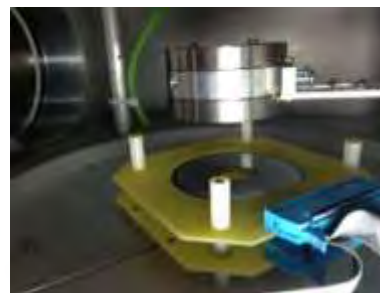
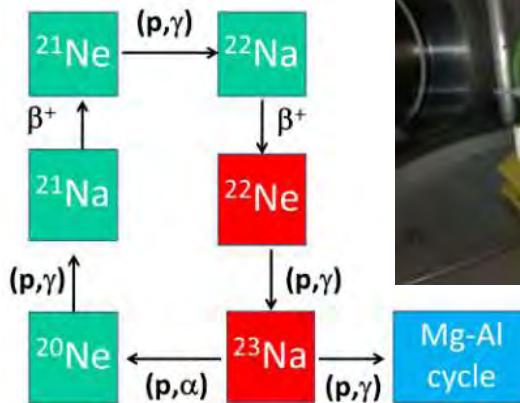
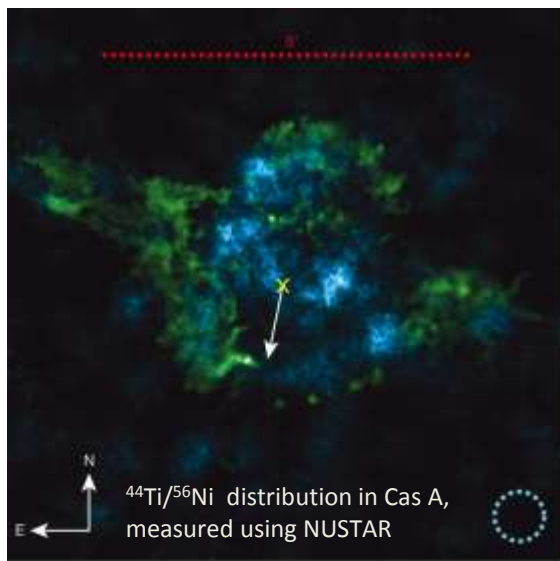
- TAMU PhD 2016 B. Fenker
- best  $A_\beta$  accuracy measurement in a nucleus or neutron
- complementary sensitivity to LHC for 4-fermion contact interaction.
- publication in preparation

Atom trap experiment for tests of parity non-conservation and searches for an anapole moment in Fr isotopes.

- Observed for the first time the 7s-8s transition (the parity-violating transition) using two-photon spectroscopy
- Demonstrated DC Stark shift of the 7s-8s transition
- Major milestone!
- Neutralizer worked well
- Science trap operational



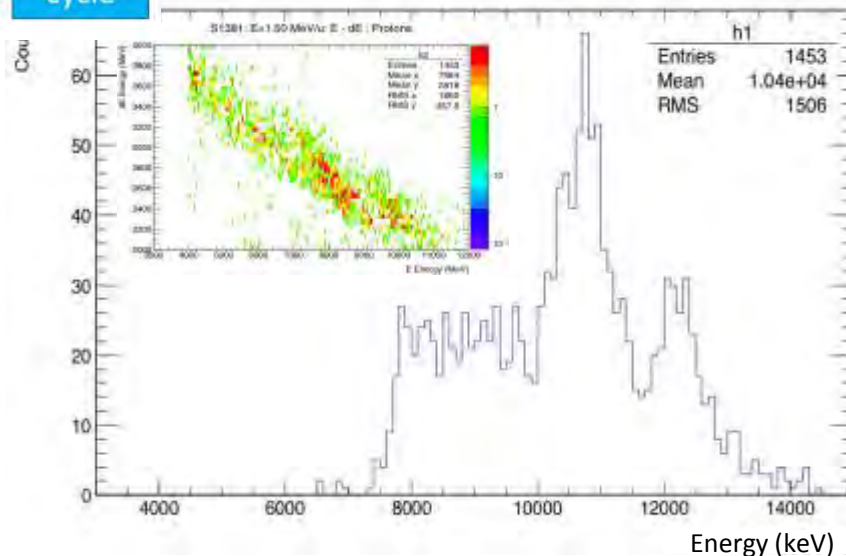




UNIVERSITY of York



S1381: E=1.50 MeV/u: Total Energy : Protons



- $^{44}\text{Ti}$  production in core-collapse SNe
- Affected by  $^{21}\text{Na}(\alpha, p)^{24}\text{Mg}$  reaction in alpha-rich freeze-out
- Measure with TUDA facility and  $^{21}\text{Na}$  beam
- Data taken July 2016 → under analysis






- Beam line to EMMA completed, tested
- EMMA electrostatic deflectors conditioned to potential difference of 200 kV with currents of 10-25  $\mu$ A
- 3 slit systems installed, 2 aligned
- Vacuum control system operational in 2 of 4 sections
- Position-sensitive focal plane detector vacuum box installed and aligned

## International EMMA workshop Science Program July 2016



EMMA installation on track, ready for commissioning in 2016. First RIB experiments in 2017.



Milestone	Date
DAQ system complete	May 23 <sup>rd</sup> 
EMMA beam line installed	May 31 <sup>st</sup> 
Focal plane chambers ready to install	June 6 <sup>th</sup> 
Target chamber ready to install	June 20 <sup>th</sup> 
ED2 HV tests complete	July 21 <sup>st</sup> 
ED1 HV tests complete	September 15 <sup>th</sup> 
EMMA installed	September 15 <sup>th</sup> 
Alpha source commissioning complete	November 8 <sup>th</sup> 
Stable beam commissioning complete	December 22 <sup>nd</sup>

# Center for molecular and material science

*CMMS - S. Kreitzman*

*Deputy - G. Morris*

[S. Kreitzman](#)

G. Morris (P&S)

R. Abasalti (tech)

D. Arseneau (P&S)

B. Hitti (P&S)

M. McLay (tech)

[I. McKenzie](#)

D. Vyas (tech)

[S. Percival \(SFU\)](#)

Support quantum material science experiments (molecular and material science) at  $\mu$ SR and  $\beta$ NMR or  $\beta$ NQR facilities at TRIUMF.

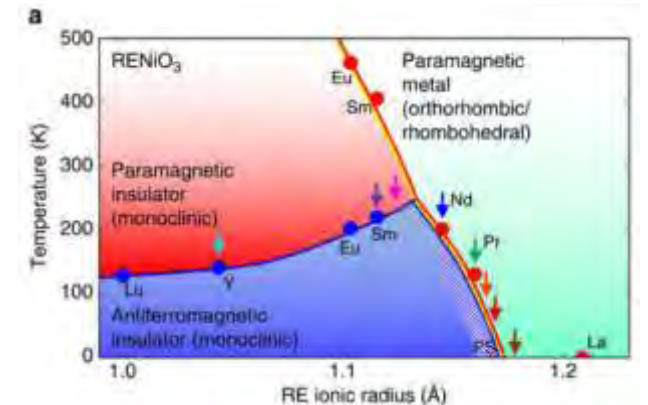
Develop and operate customized and user-friendly spectrometers for the community.



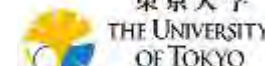
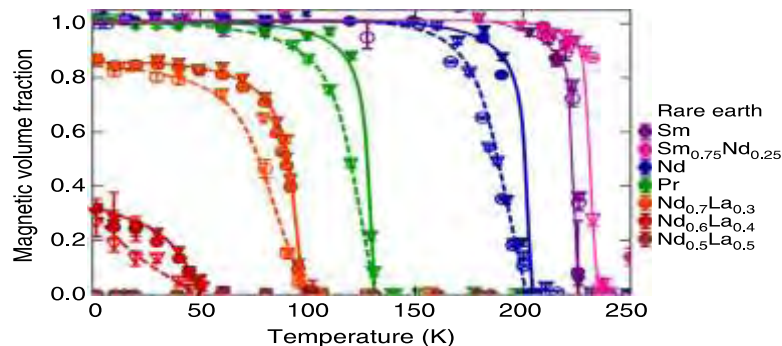
# Volume-wise Destruction of the Antiferromagnetic Mott Insulating State Through Quantum Tuning

B. Frandsen et al.

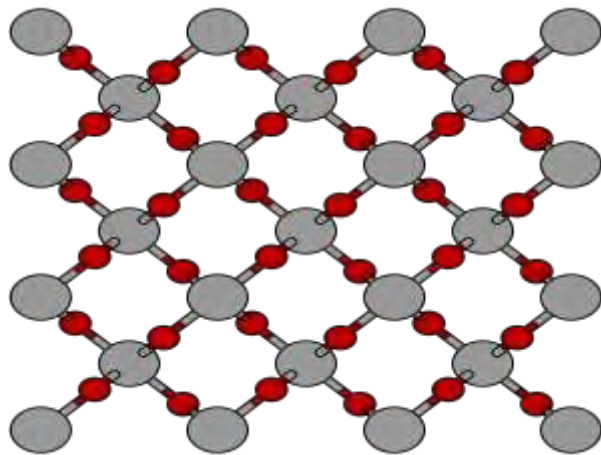
*Nature Communications*, **2016**, 7, 12519



$\text{RENiO}_3$  (RE = rare-earth element): Mott insulator systems that can be tuned by chemical substitution and exhibit a quantum phase transition (QPT) between an antiferromagnetic Mott insulating state and a paramagnetic metallic state.  $\mu$ Sr measurements demonstrated the QPT is first order.

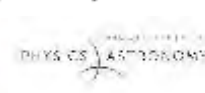
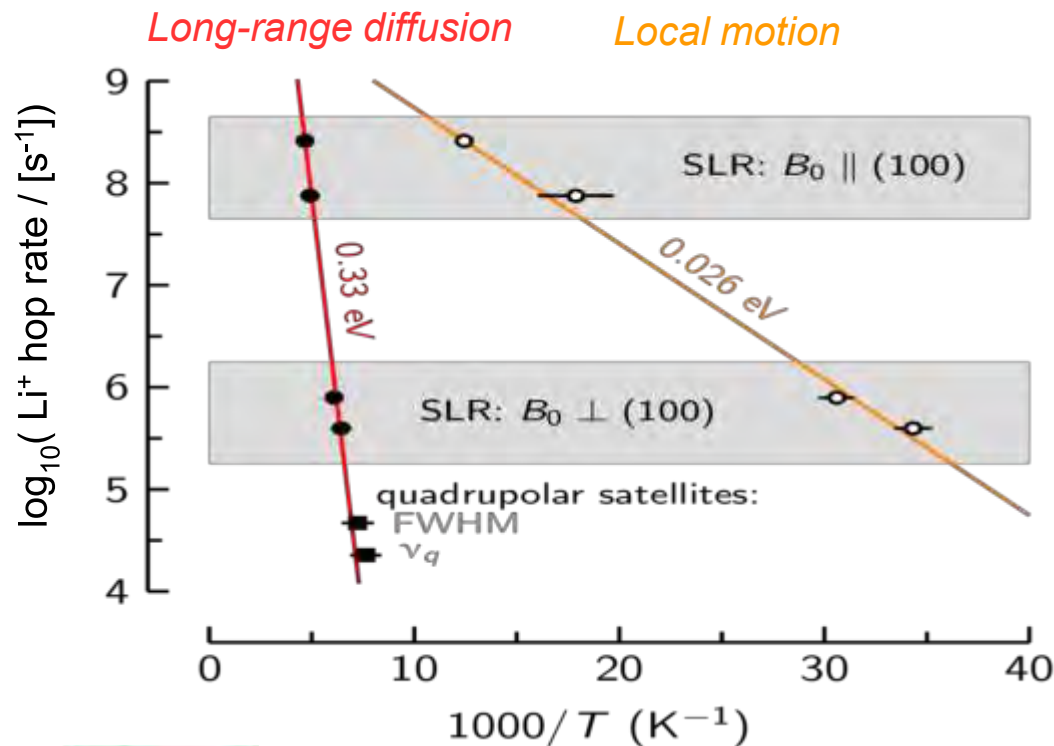


Li<sup>+</sup> dynamics in rutile TiO<sub>2</sub>:  
solving a long-standing mystery



Rutile TiO<sub>2</sub>: a candidate electrode for  
solid-state lithium-ion batteries. Detailed studies  
on ionic motion and diffusion behavior.

Publication: R. McFadden (UBC chem) PRL in prep



# Theoretical physics department

***Theory - P. Navratil***  
***Deputy NN***

P. Navratil

S. Bacca

J. Ng

J. Holt

D. Morrissey

S. Stroberg (PDF)

M. Vorabbi (PDF)

A. Wijangco (PDF)

N. Nevo (PDF)

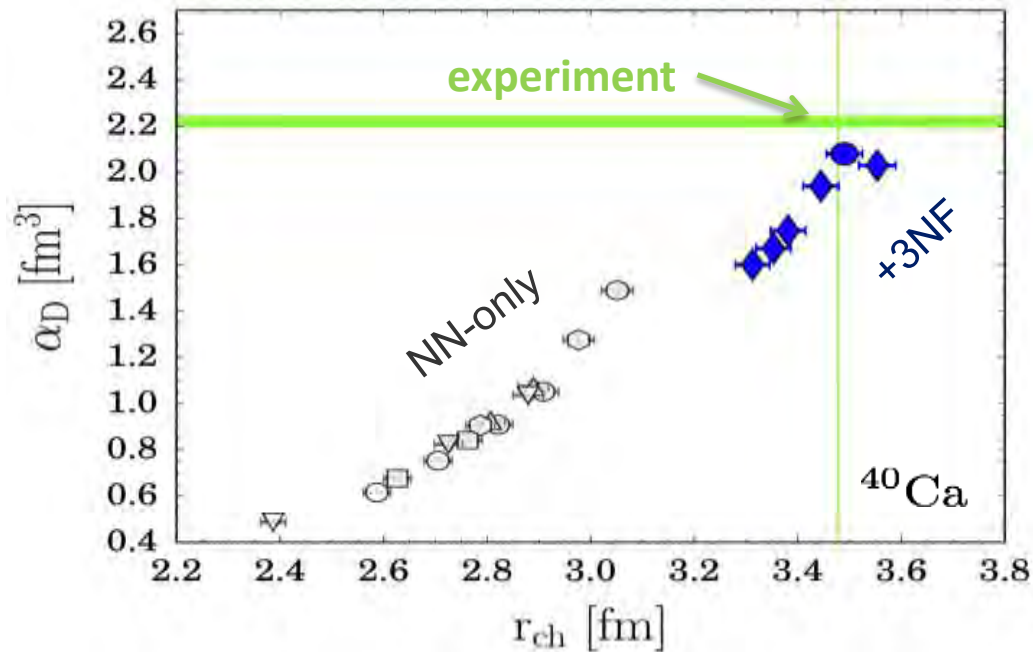
A. Calci (PDF)

Carry out theoretical research in nuclear and particle physics, to guide and support experiments, or to do exploratory studies.

New hire in Particle Theory:

- Search underway, over 100 applications recieved

## Coupled-cluster theory computations



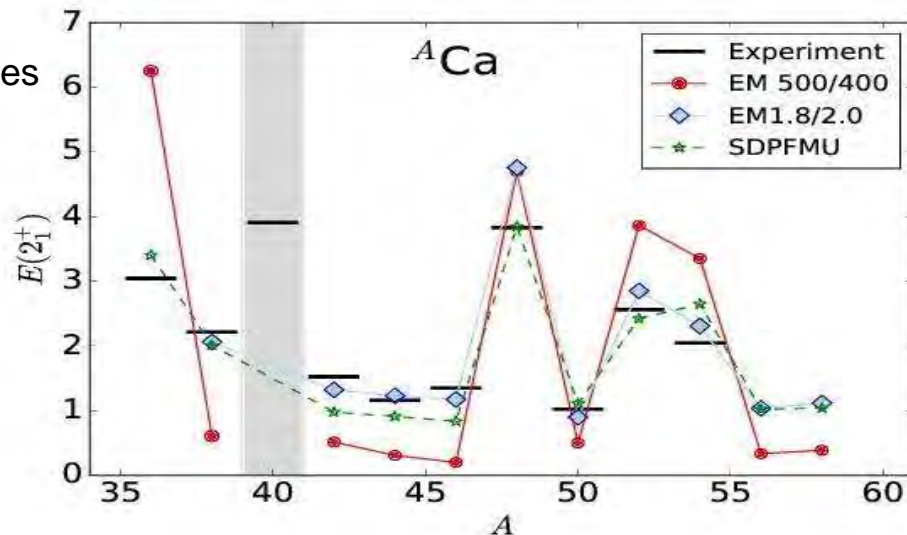
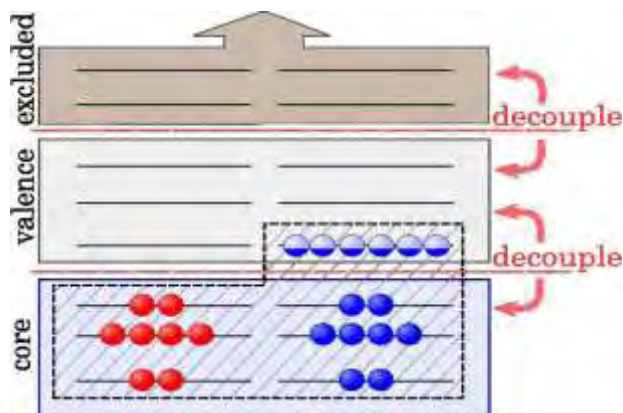
M. Miorelli et al., PRC 94, 034317 (2016)



- Follow-up study of recent Nature Physics
- Strong correlation between electric dipole polarizability and charge radius
- Two-body forces substantially underestimate both quantities
- We explore different three nucleon forces
- Three nucleon forces play a crucial role and are needed to improve agreement with experiment

## Valence-space In-Medium SRG

- Follow-up study of recent Nature Physics
- Same cost as coupled-cluster (CCSD)
- Access to all nuclei up to  $A \sim 100$
- Access to absolute energies and excited states
- Consistent treatment of moments and transitions



R. Stroberg, J. Holt et al., arXiv: 1607.03229

# Particle physics department

**Particle Physics - M. Fujiwara**

**Deputy - O. Stelzer- Chilton**

G. Azuelos (UofM)

M. Vetterli (SFU)

D. Gingrich (UofA)

P. Savard (UofT)

I. Trigger

O. Stelzer-Chilton

G. Oakham (Carleton)

M. Fujiwara

**A. Carpa (PDF)**

S. Yen

R. Tacik (UofR)

M. Hartz (KAVLI-IPMU) D. Karlen (Uvic)

R. Gornea (Carleton) A. Konaka

T. Numao

G. Marshall

R. Picker

R. Mammei A (UofW)

**ATLAS Tier 1 - R. Tafirout**

R. Tafirout

A. De Silva (P&S)

D. Deatrich (P&S)

A. Wong (P&S)

R. Devbhandri (tech)

V. Kondratenko (P&S)

D. Qing (P&S)

S. Liu (P&S)

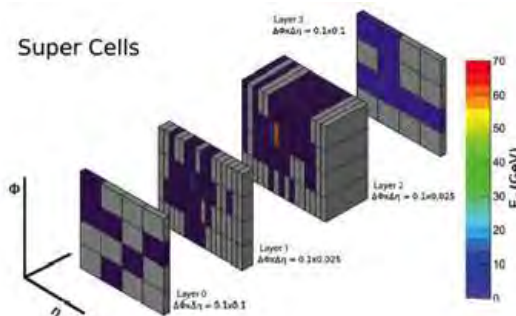
Y. Shin (P&S)

Carry out and support particle physics experiments with the TRIUMF community.

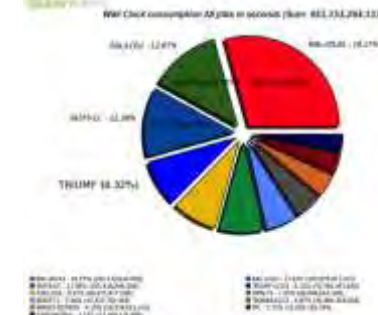
- ATLAS
- ALPHA
- Neutrino-program (T2K, EXO, HALO)
- PINU
- g-2
- UCN



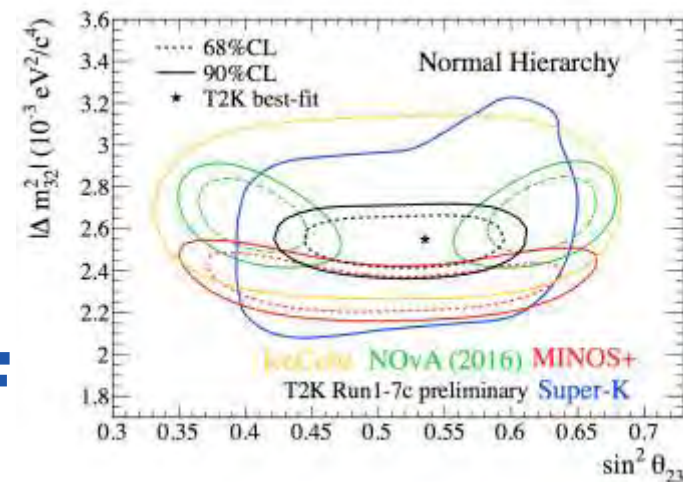
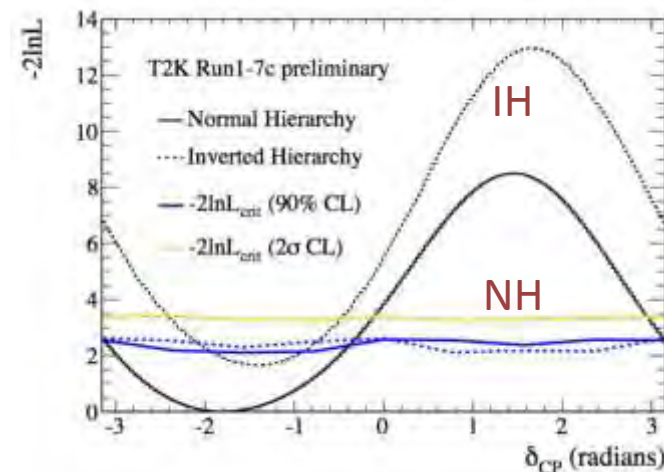
- **LHC & ATLAS Run 2 at 13 TeV well underway**
- **Local Analysis Effort**
  - Searches for Beyond the Standard Model
  - Higgs Boson Characterization
- **ATLAS Upgrades**
- **Phase 1 2019-2020**
  - NSW, LAr Electronics
- **Phase 2 2024-2026**
  - ITK, LAr Electronics



- **Tier-1 performing well**

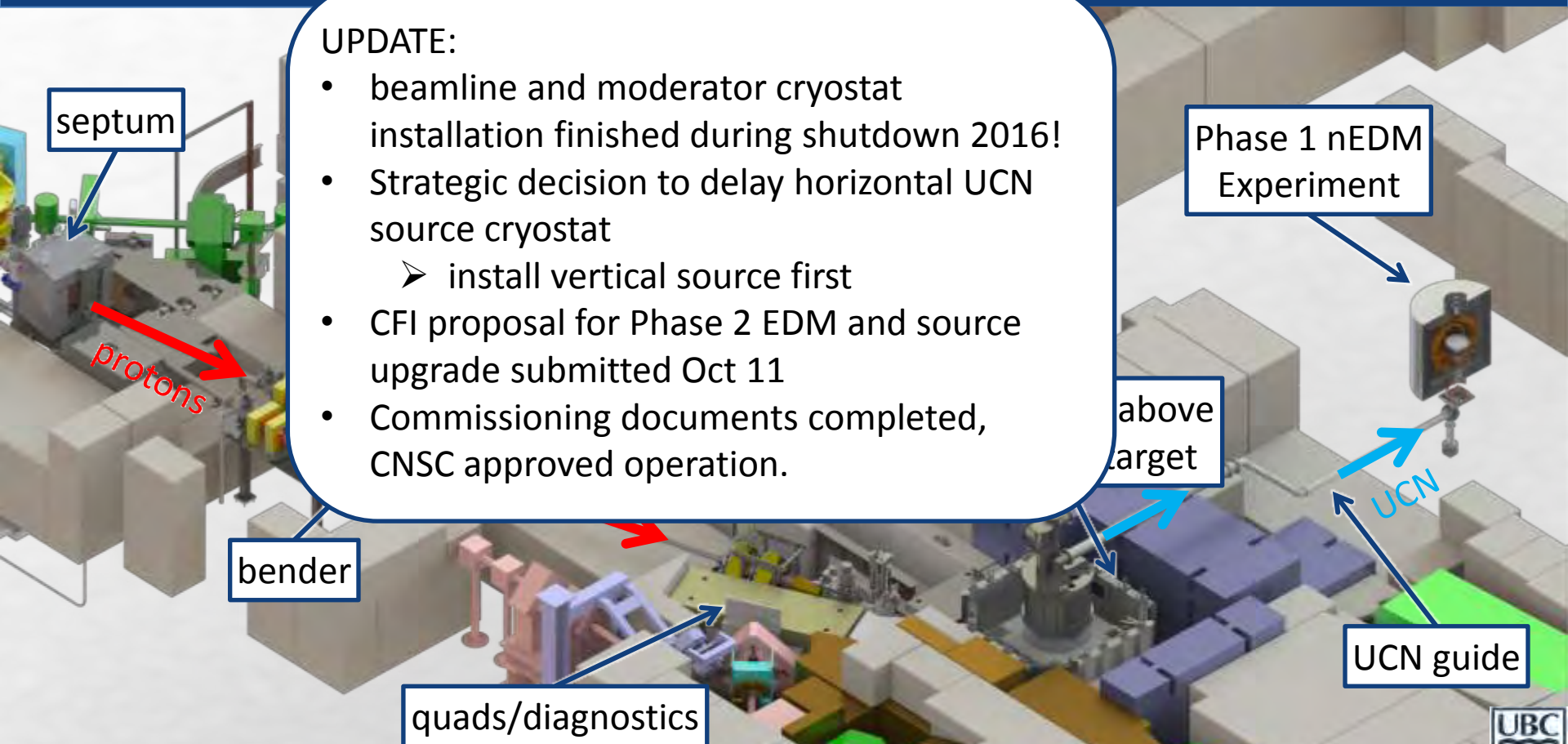


- T2K result @Neutrino2016
  - CP conserving  $\delta_{cp}$  dis-favored @ 90%CL
    - $\delta_{cp} \sim -\pi/2$  and normal hierarchy (NH) favored
  - T2K favours maximal  $\theta_{23}$  (atmospheric) mixing
    - Tension with the latest NOvA result ( $2.5\sigma$ )
- Data taking resumed in October 2016
  - Doubling the neutrino mode statistics by the next spring
- Progress on the future of T2K
  - T2K-II received Stage-1 @ J-PARC PAC
    - $3\sigma$  CP violation sensitivity at  $\delta_{cp} \sim -\pi/2$  by 2025
  - NuPRISM received Stage-1 @ J-PARC PAC
    - Intermediate water Cherenkov for T2K-II and HyperK
    - CFI grant request for photo-sensor construction



## UPDATE:

- beamline and moderator cryostat installation finished during shutdown 2016!
- Strategic decision to delay horizontal UCN source cryostat
  - install vertical source first
- CFI proposal for Phase 2 EDM and source upgrade submitted Oct 11
- Commissioning documents completed, CNSC approved operation.



# Science technology department

**Science Technology - F. Retiere**

**Deputy - R. Henderson**

## **Engineering/Construction**

R. Henderson (P&S)

W. Faszer (P&S)

C. Lim (P&S)

S. Chan (tech)

J. Zielinski (tech)

P. Lu (P&S)

R. Maharaj (tech)

I Nikinov (P&S)

P. Vincent (tech)

## **Instrumentation Physics**

N. Hessey

B. Franke

L. Doria (P&S)

P. Gumplinger (P&S)

## **Detector Electronics**

L. Kurchaninov (P&S)

M. Constable (P&S)

## **DAQ**

P. Amaudruz (P&S)

S. Daviel (tech)

T. Lindner (tech)

D. Vavilov (tech)

**L. Martin (PDF)**

K. Olchanski (tech)

C. Pearson (P&S)

## **Electronics Development**

D. Bishop (P&S)

Y. Linn (P&S)

B. Shaw (P&S)

Support detector and experiment development and fabrication for the TRIUMF community in Canada.



- Canadian Survey of Users at CAP Congress



- Presentations at CINP and IPP town-hall meetings
- New group: instrumentation physics
- Supported 5 CFI grant applications
  - Service: simulations and engineering
  - UCN EDM experiment
  - Mechanical design and electronics for future Water Cerenkov experiment
  - Electronics for MØLLER
  - Electronics for ATLAS LAr calorimeter
  - Photo-detector development for future Liquid Xenon and Argon experiments

- Setting up infrastructure for ATLAS-ITk (new hire N. Hessey)
  - New clean room in MHESA 1<sup>st</sup> floor
  - Coordinate Measuring Machine (CMM)
  - Silicon strip module assembly



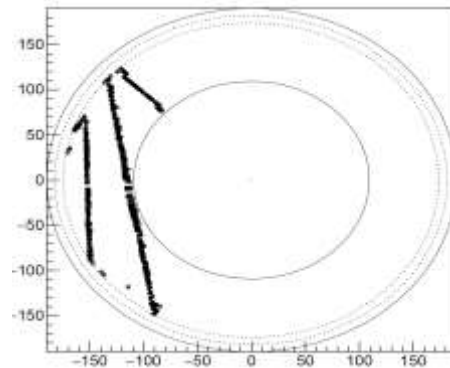
ALPHA-g prototype operational  
project plan: on track

prototype TPC constructed

– 1/7th of the full system



- mechanical design
- fabrication
- gas system
- analog electronics
- digital electronics
- data acquisition





- APS DNP (Division of Nuclear Physics) Fall Meeting held in Vancouver

- TRIUMF host of the 2016 DNP Fall Meeting
- first meeting in Canada since 1997

- excellent participation: 668 registered
- and 168 undergrad students (record)

- TRIUMF organized:

- 3 mini workshops:

- *Recent Atomic Physics for Nuclear Physics and Vice Versa*
- *New Frontiers in Low-Energy Nuclear Theory*
- *New Science Opportunities at RIB Facilities*

- 4 (7) mini-symposia

- *Opportunities in Underground Nuclear Physics (I and II)*
- *Physics of Ultra-Cold Neutron Sources (I and II)*
- *Instrumentation for Physics Beyond the SM*
- *Application of Nuclear Physics (I and II)*

- Invited session:

- *Rare Isotopes in Pure and Applied Nuclear Physics*

- Public Talk: V. Smil (Innovation and Moore's Law):

- *20 science ambassadors selected from undergrad poster session*



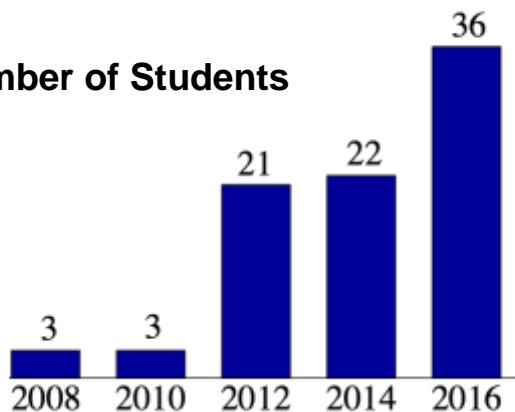
**Nuclear Physics Course**  
currently offered through UBC, PHYS 505

(S. Yen & S. Bacca)

on-line tools allow to teach across the country:



**Number of Students**



TRIUMF is involved in many academic programs:

- teaching uni. undergrad and grad classes
- undergraduate program at TRIUMF
- training of post docs
- Summer schools
- Accelerator program

TRAC: TRIUMF's Academic Committee:

Chair: S. Bacca

Mandate:

- coordinate and advocate academic activities, liaison with universities
- all TRIUMF divisions involved

- Science Week at TRIUMF (July 18-23 2016)
  - TRIUMF User Group AGM
    - Presentation of re-launched Beam Strategy Development Committee (next slide)
  - International ARIEL Science Workshop – Instrumentation for ARIEL
    - Start of ARIEL user consultation process, in particular for Science Phases (next slide)
- Division All-Hands meeting
  - Division BAE Strategy Workshop (Dec 20/21)
  - Division Retreat Feb 2017
    - Hiring plan, succession plan, upcoming TRIUMF 5YP
    - Division structures
  - Health and Wellness Committee introduced
  - Rolled out Divisional and Departmental Safety Officers



---

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

Thank you!  
Merci!

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

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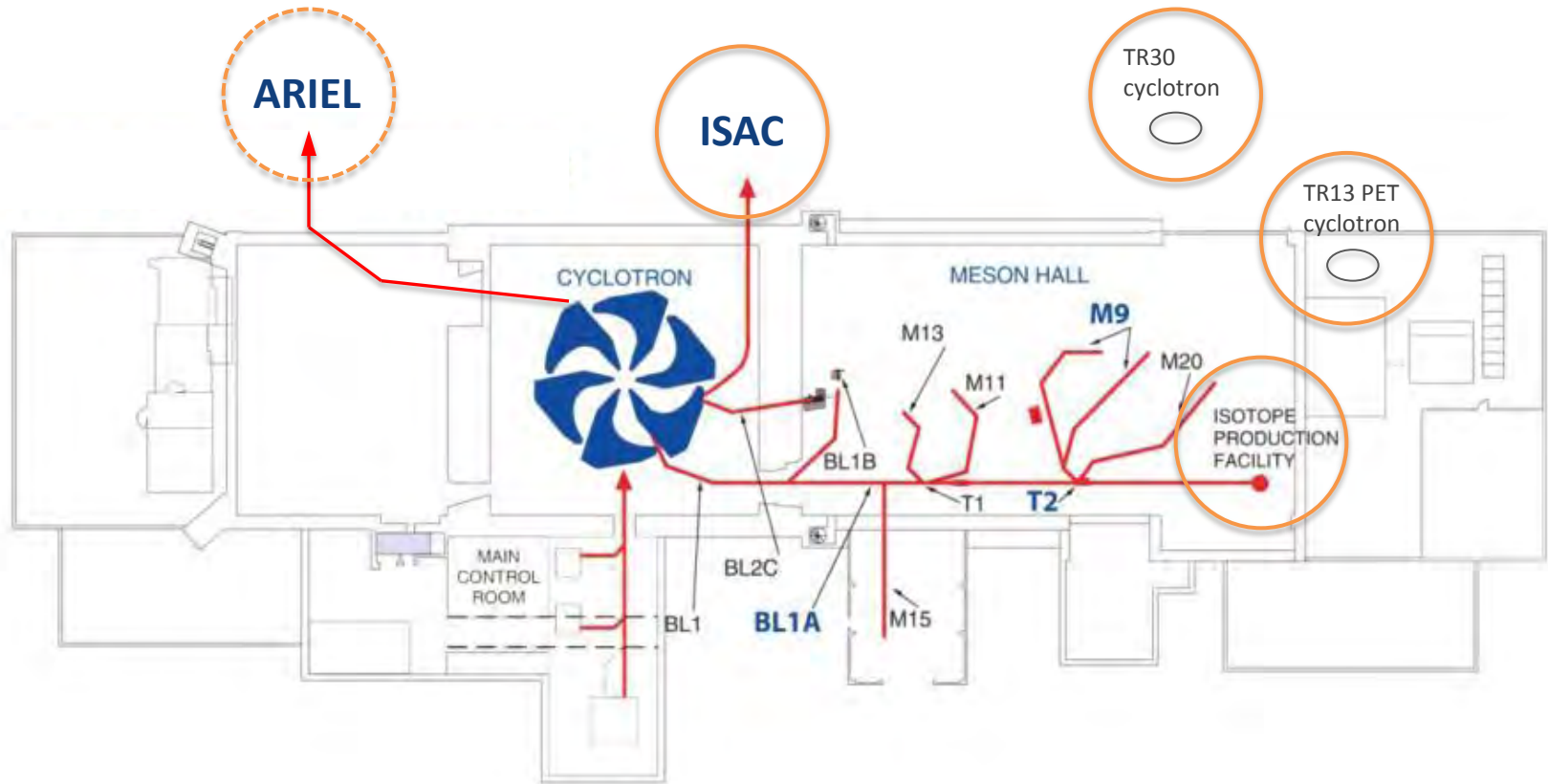




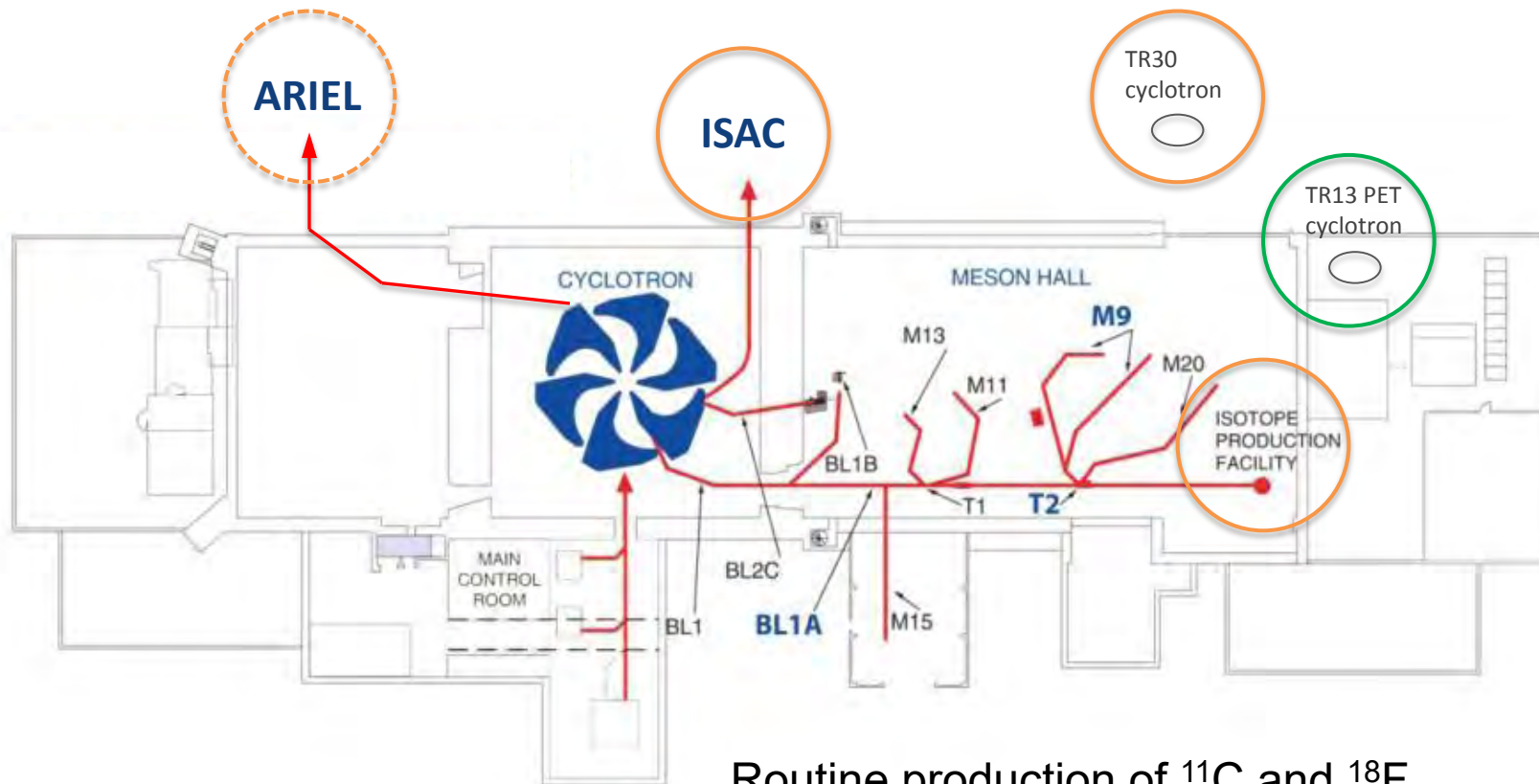
Canada's National Laboratory for  
Particle and Nuclear Physics

# Medical isotope production at TRIUMF - from imaging to treatment

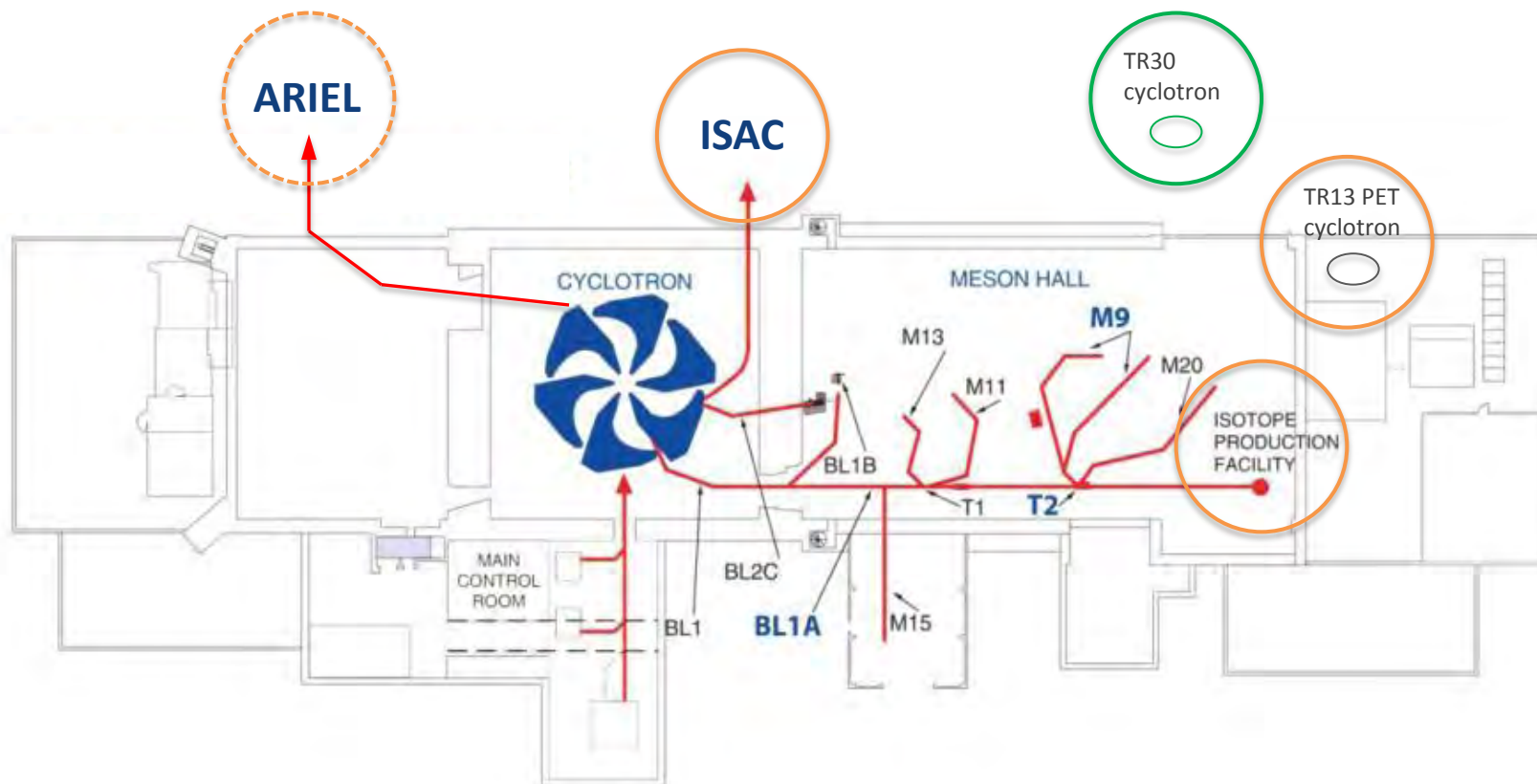
Cornelia Hoehr  
Research Scientist, Life Sciences



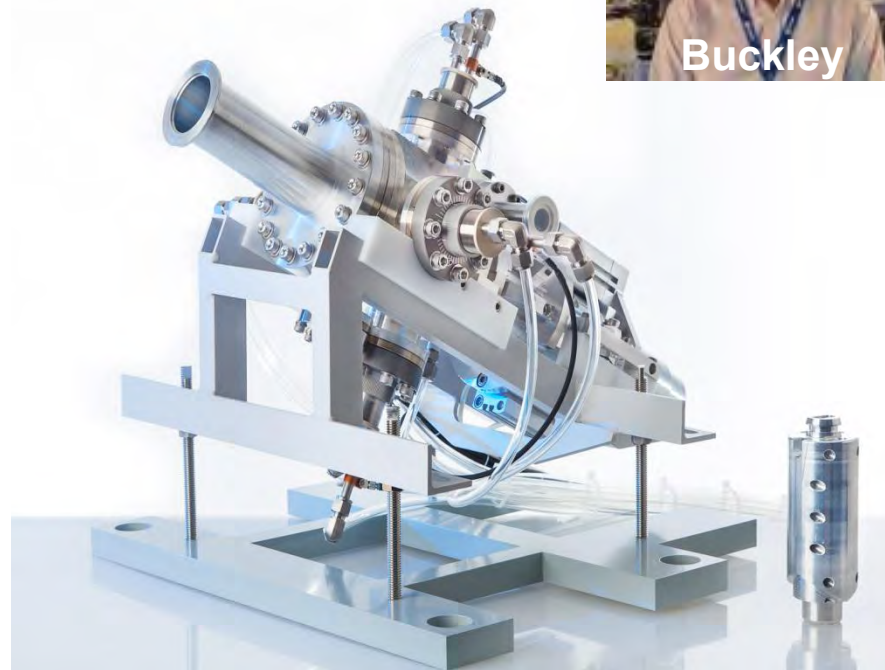




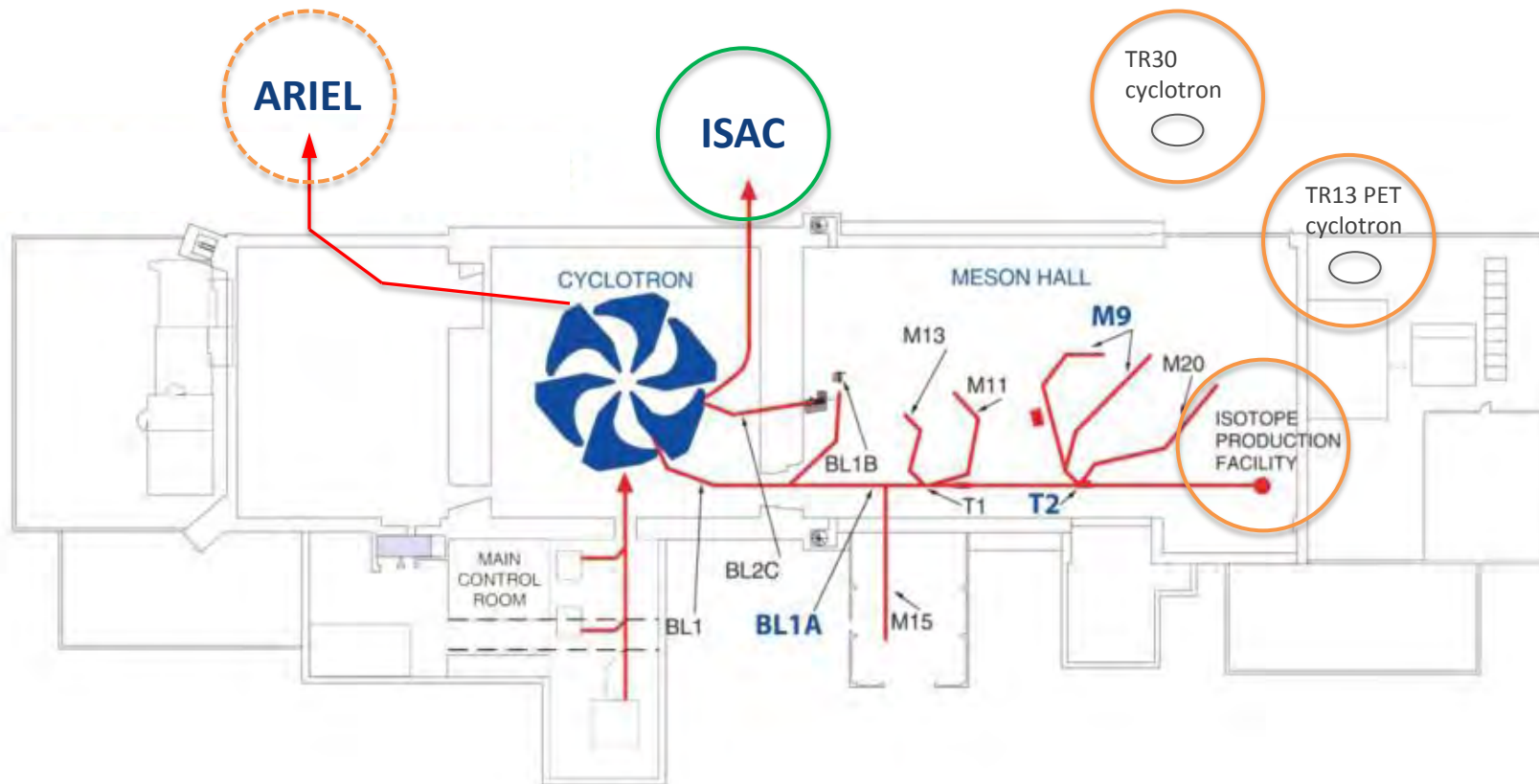
Routine production of  $^{11}\text{C}$  and  $^{18}\text{F}$   
 New: radiometals Sc-44, Ga-68, Y-86, Zr-89

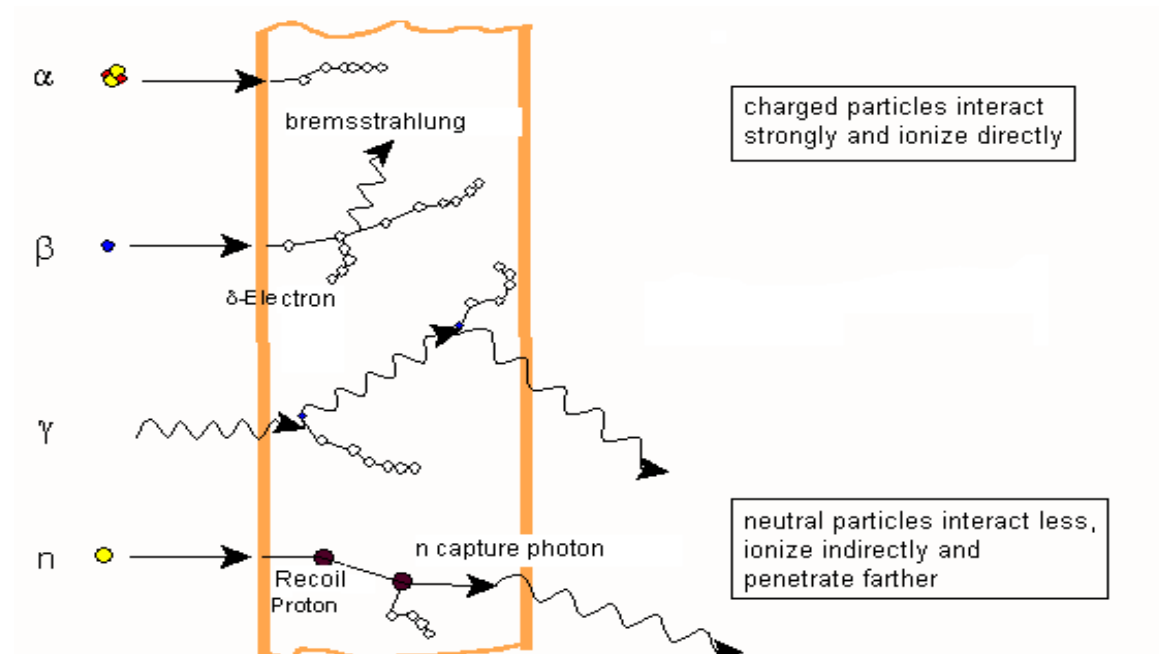


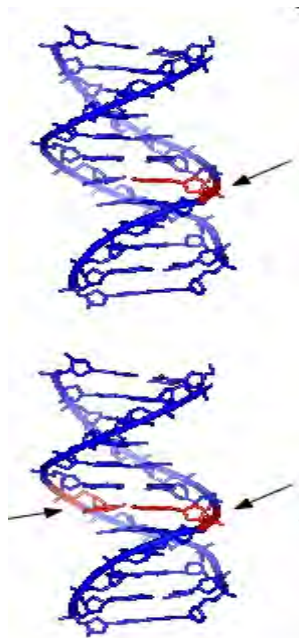
- Project Status
  - 4.7 Ci (GE), 15 Ci (TR19), 32 Ci (TR30)
  - Clinical Trials Underway
    - Bone/thyroid (36/60 patients scanned)
- Commercialization
  - Sole license issued to ARTMS Products Inc.
  - Pursuing venture funding - ~\$1.6M in stated interest to date



ARTMS  $^{99m}\text{Tc}$  Production System

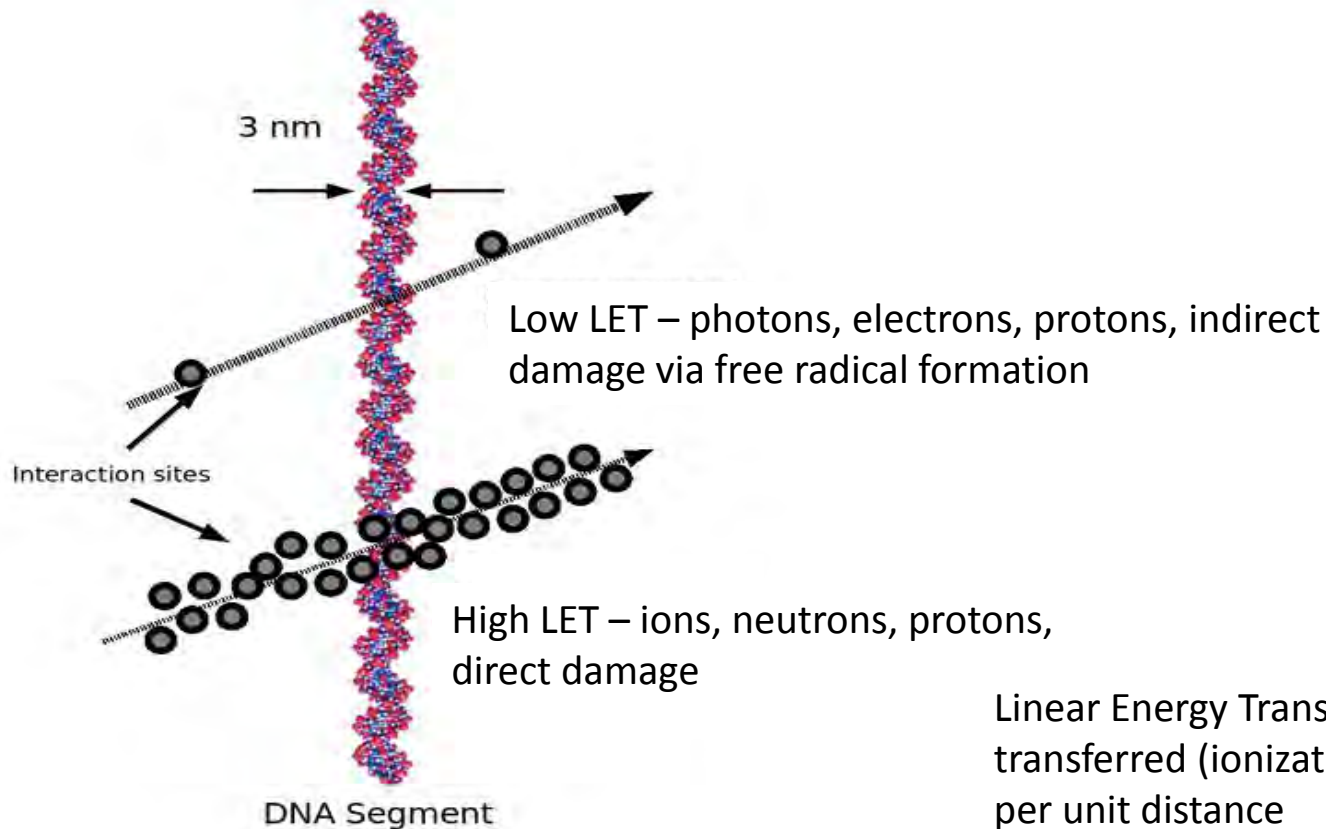




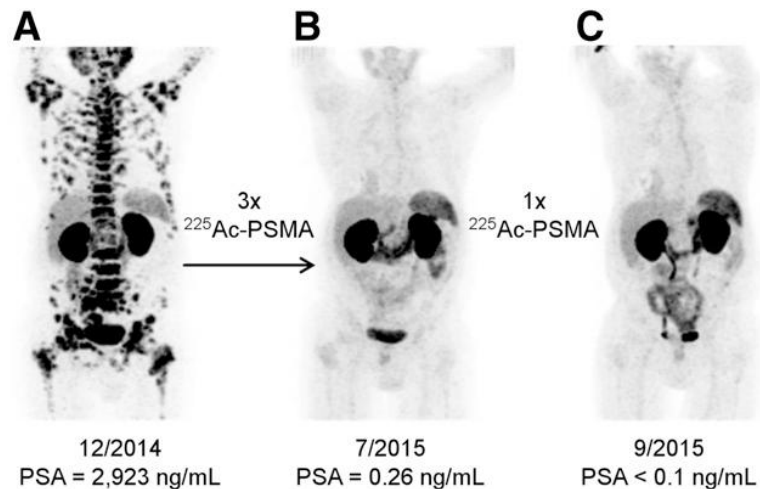


- DNA (Deoxyribonucleic acid): genetic instructions for development and functioning
- Cell needs information from DNA for survival
- Single helix break easy to repair
- Double helix break more difficult to repair
- Cell can not survive
- Radiotherapy: as many double helix breaks in cancer cells as possible with as few double breaks as possible in healthy cells



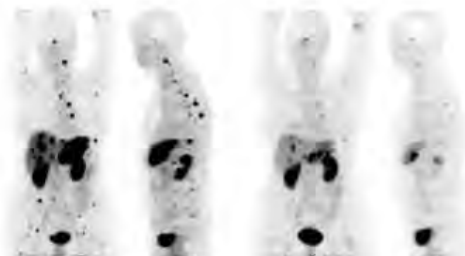


Linear Energy Transfer (LET): Energy transferred (ionization, secondary electrons) per unit distance

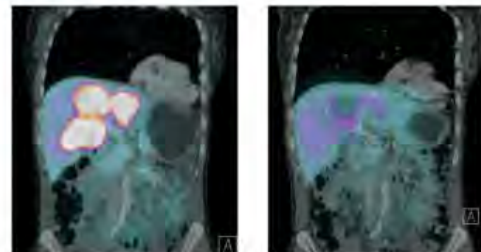


*Kratochwil et al., J. Nuc. Med. July 2016.*

## Remarkable responses to Bi-213-DOTATOC observed in tumors resistant to previous therapy with Y-90/Lu-177-DOTATOC



Case I: Shrinkage of liver lesions and bone metastases after i.a. therapy with 11 GBq Bi-213-DOTATOC



Case II: Response of multiple liver lesions after i.a. therapy with 14 GBq Bi-213-DOTATOC

*SNM 2012 Image of the Year (A. Morgenstern, JRC, Germany)*

**Targeted alpha therapy (TAT) showed very high potential!**

Slide: Valery Radchenko

## Isotope production using TRIUMF's 500 MeV infrastructure

### 1) ISAC – ISOL (Research, Feasibility)

Low activity (kBq to MBq), high purity

### 2) 500 MeV – IPF (BL1A)

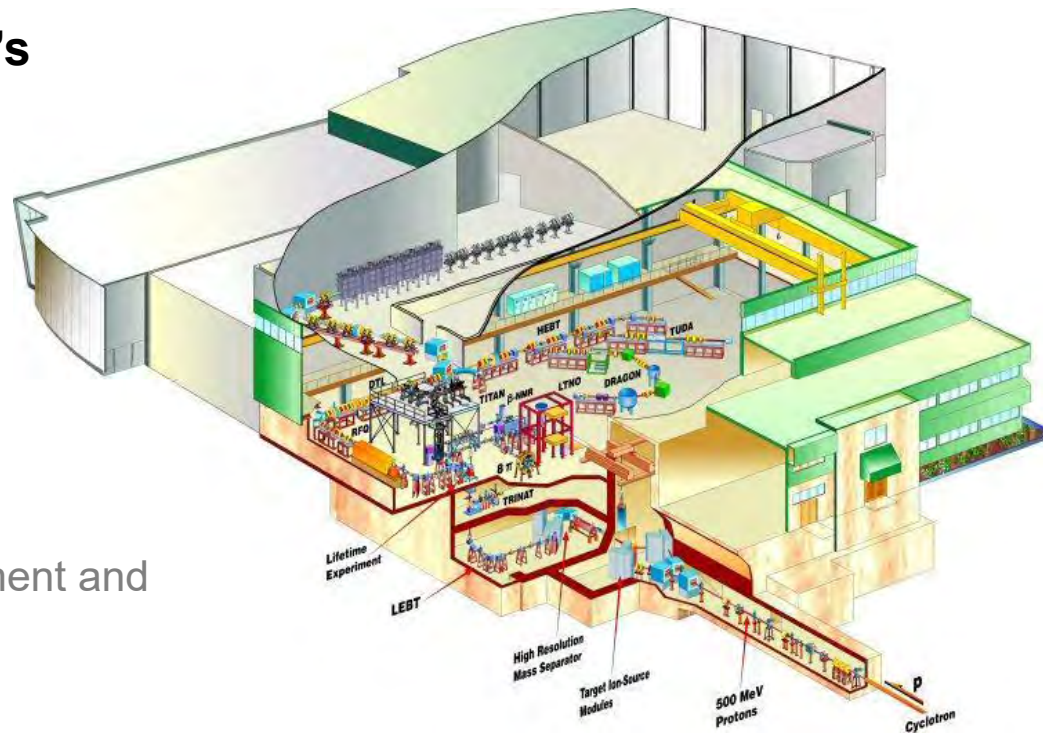
Intermediate activity (MBq), spallation

- Routine, independent production

### 3) ARIEL/H<sup>+</sup>

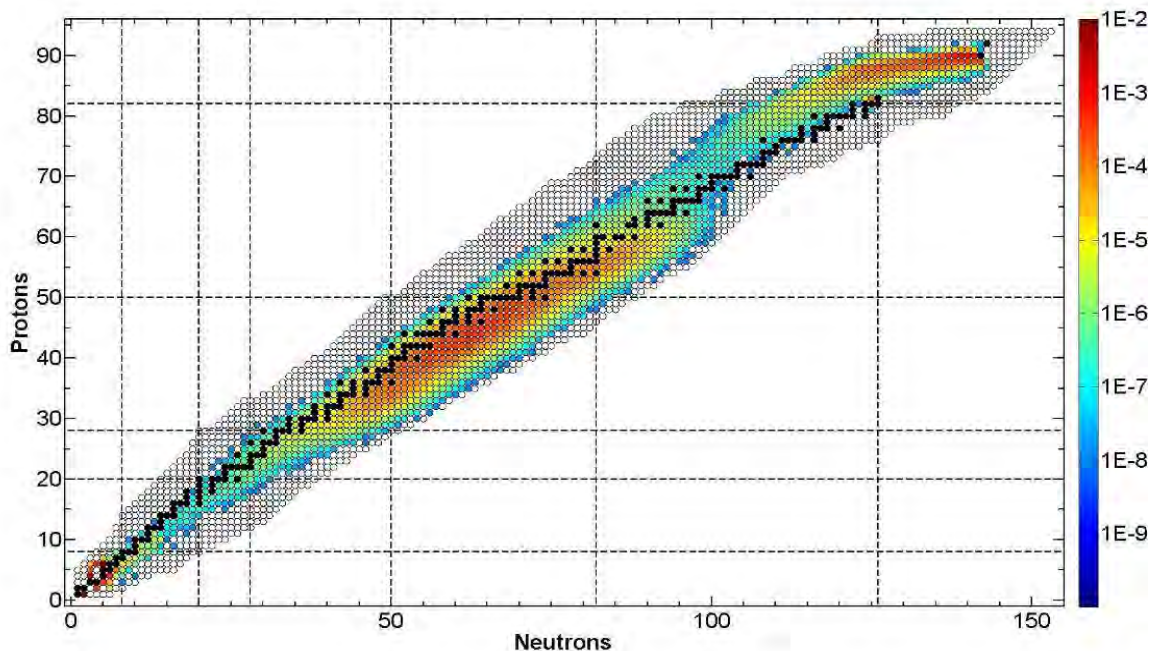
High activity (GBq), spallation

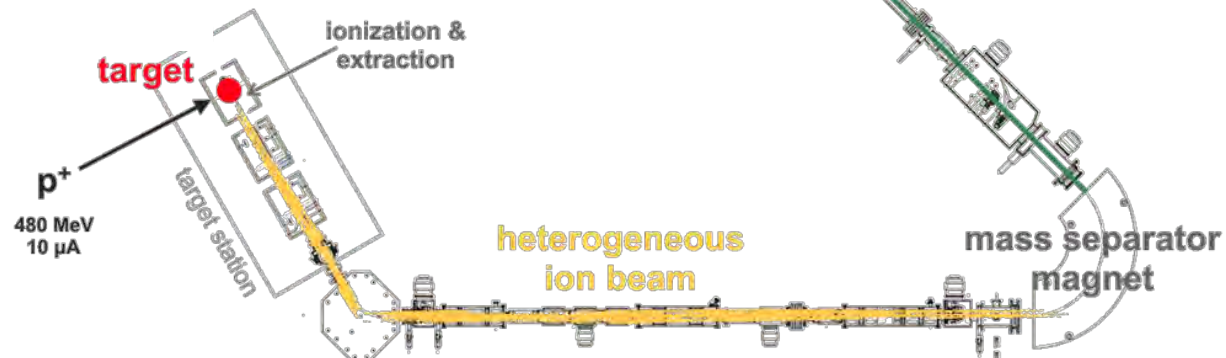
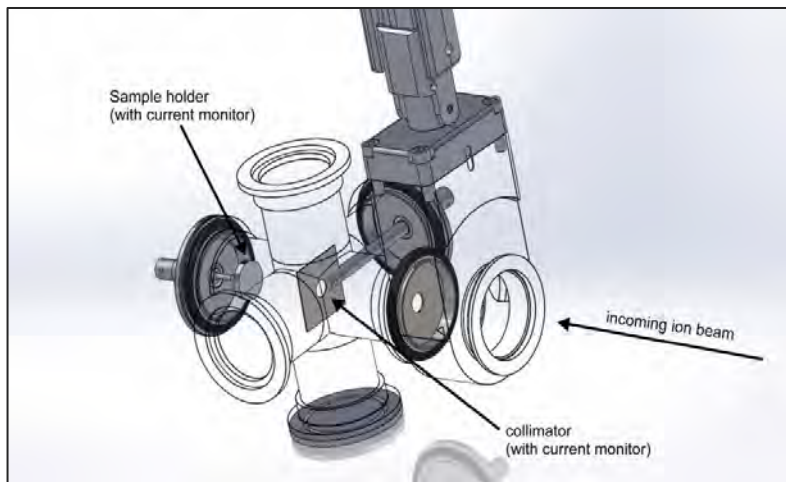
- Enable radiopharmaceutical development and clinical trials

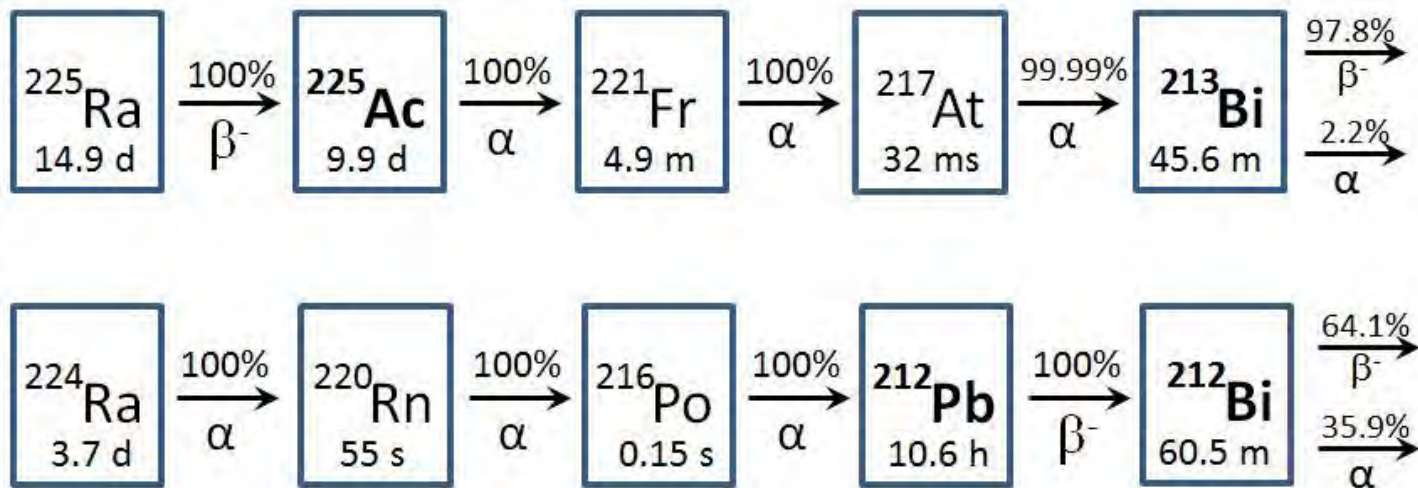


Experiments underway

- Hundreds of co-produced isotopes including;
- $^{225}\text{Ra}$ ,  $^{225}\text{Ac}$ ,  $^{224}\text{Ra}$ ,  $^{223}\text{Ra}$ ,  $^{213}\text{Bi}$ ,  $^{212}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{209/211}\text{At}$

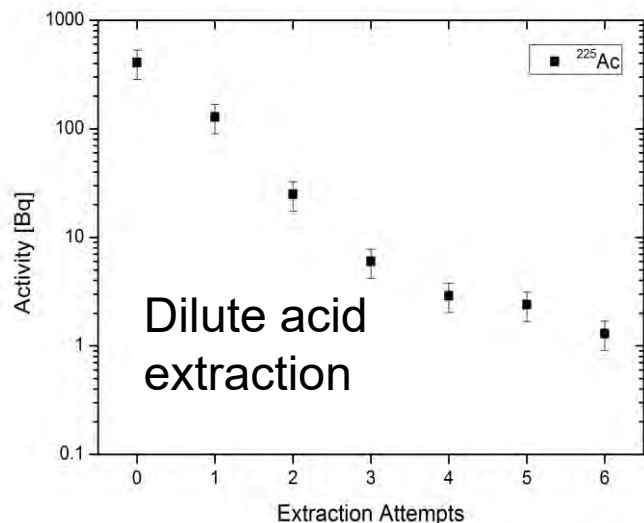








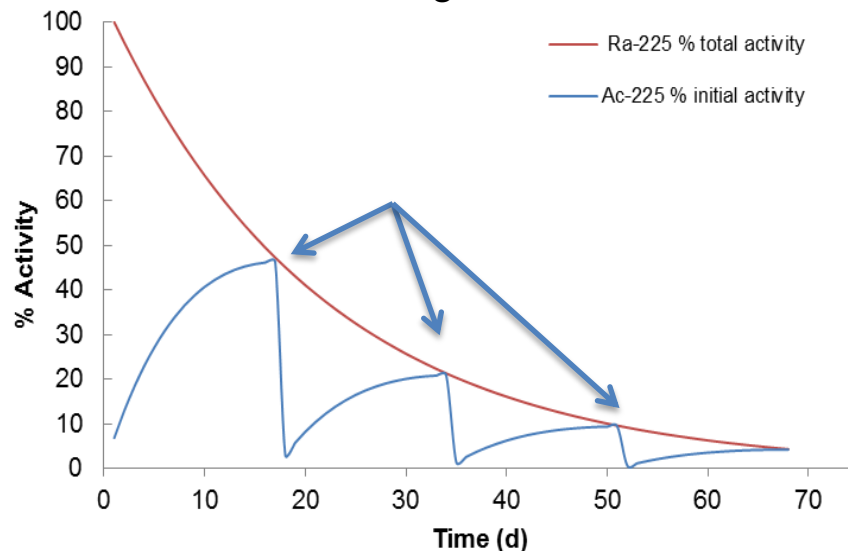
## Implantation and Isolation $^{225}\text{Ra}/^{225}\text{Ac}$



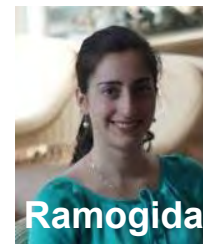
> 99% of all implanted  $^{225}\text{Ra}/^{225}\text{Ac}$  activity\* recovered

\*quantified using HPGe gamma spectroscopy

## $^{225}\text{Ra}/^{225}\text{Ac}$ generator



Clean sample of  $^{225}\text{Ra}$  and  $^{225}\text{Ac}$   
 <1 mCi  $^{225}\text{Ac}$  per implantation  
 4 runs so far

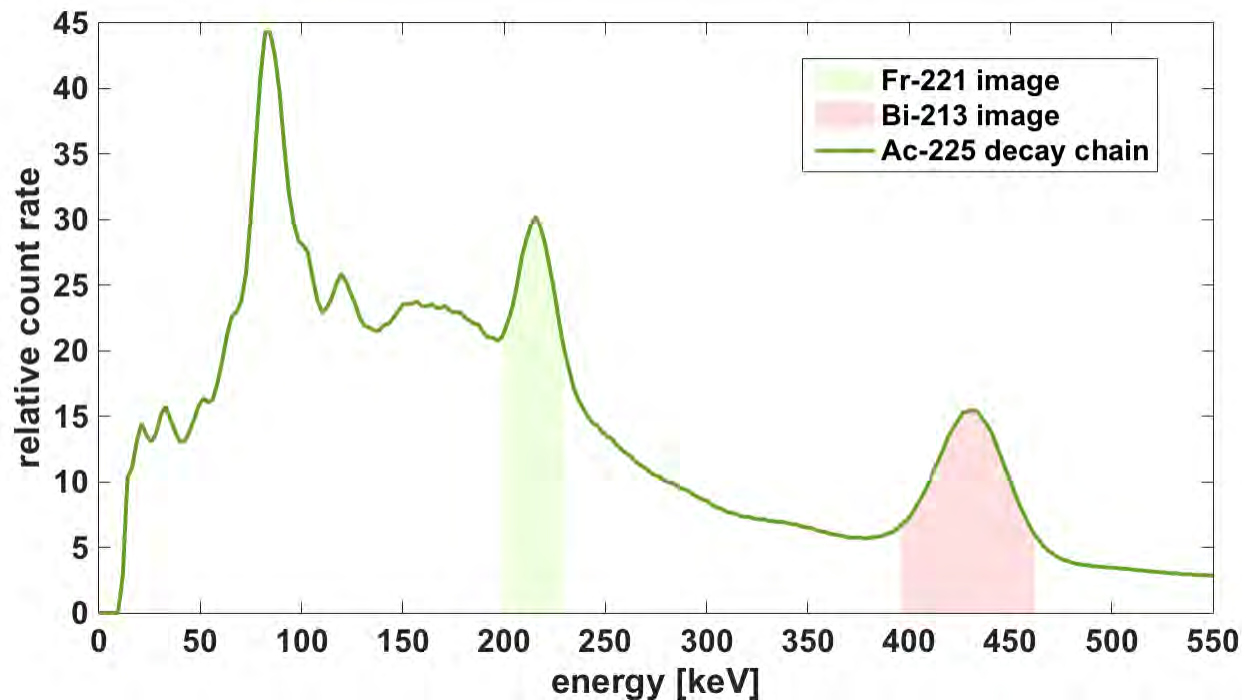


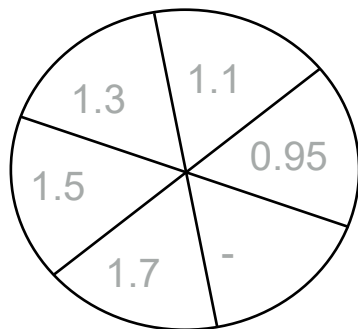
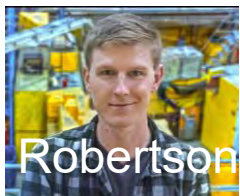
NSERC  
CRSNG



CIHR IRSC  
Canadian Institutes of Health Research  
Instituts de recherche en santé du Canada

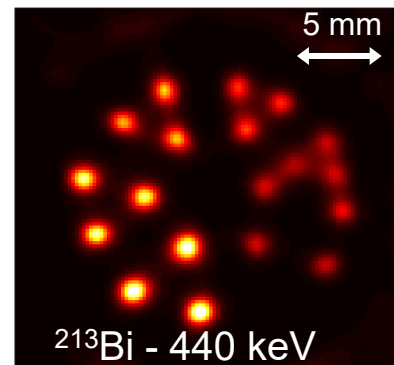
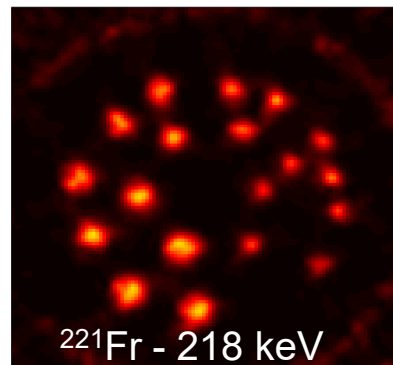
$^{225}\text{Ac}$  Decay Chain Energy Spectrum



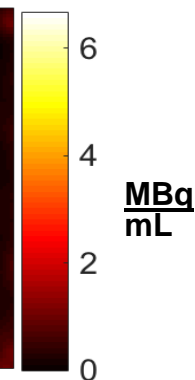
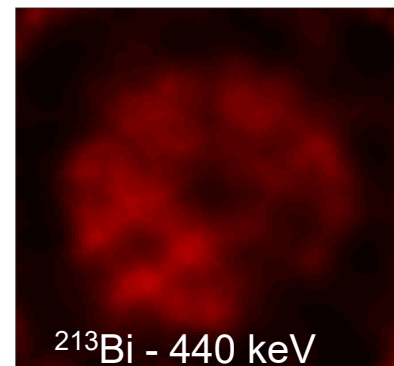
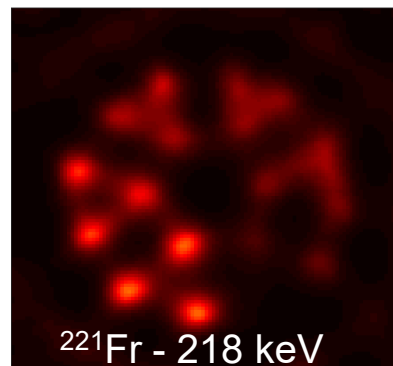


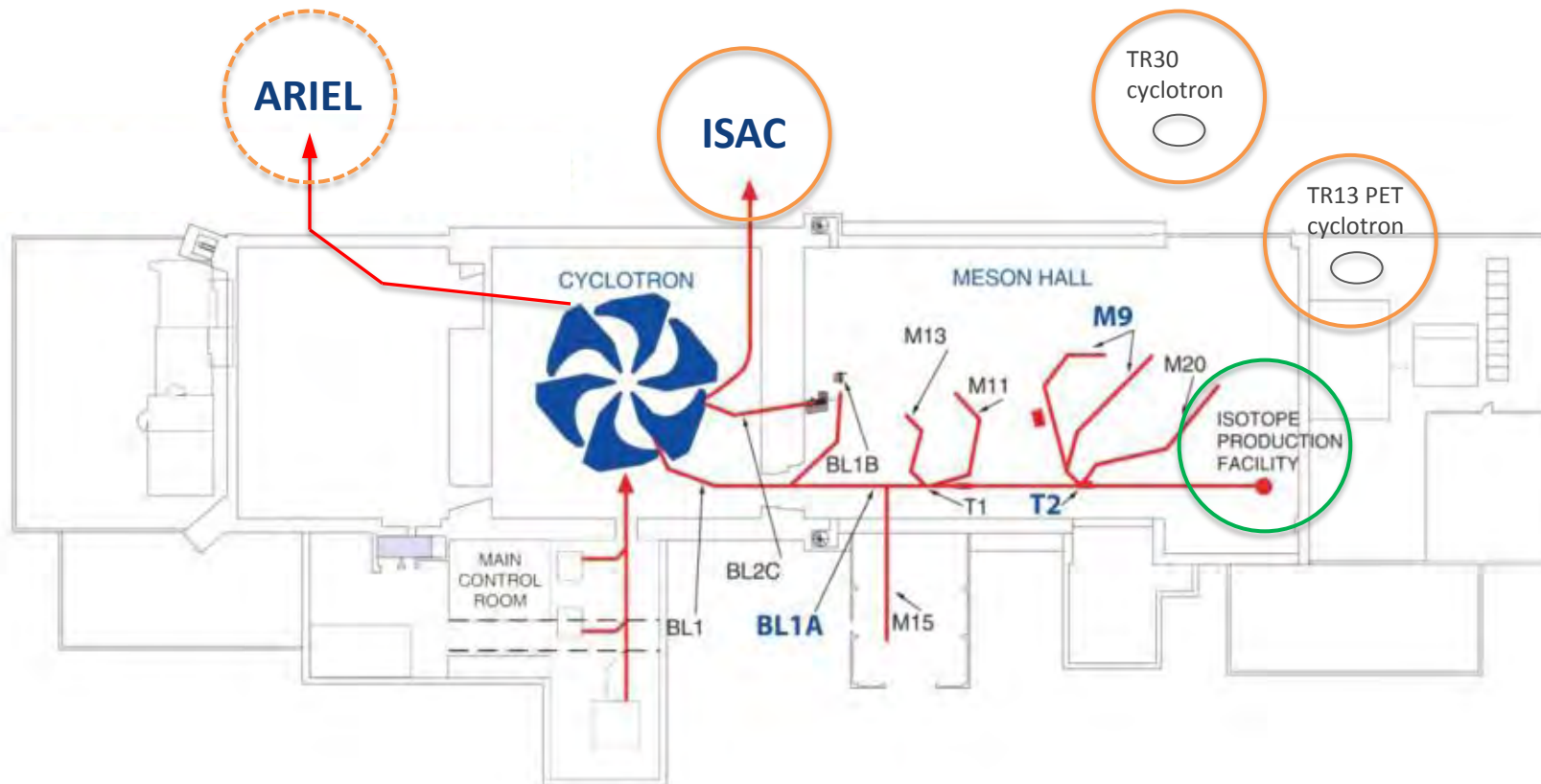
rod diameters  
[mm]

High Energy  
Collimator



High Sensitivity  
Collimator





## Isotope production using TRIUMF's 500 MeV infrastructure

### 1) ISAC - ISOL

Low activity (kBq to MBq), high purity

- Feasibility chemistry, radiolabeling

### 2) 500 MeV – IPF (BL1A)

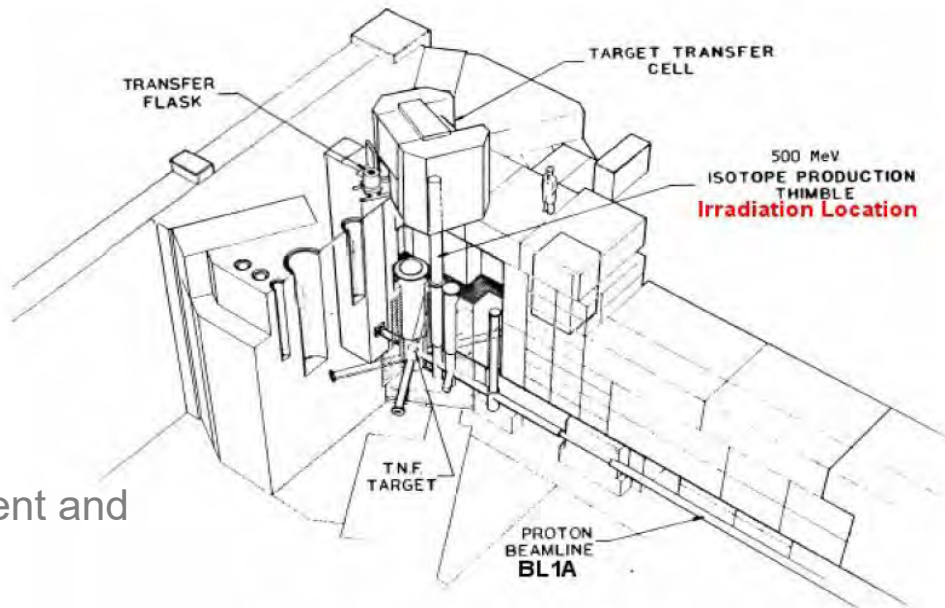
Intermediate activity (MBq), spallation

- Routine, independent production

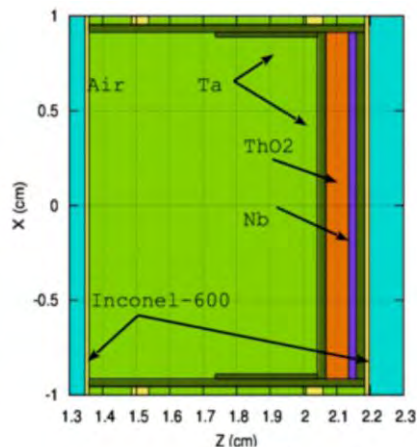
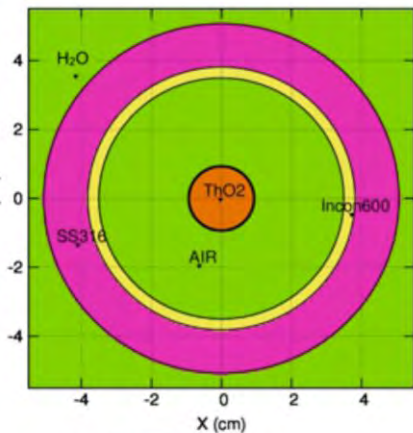
### 3) ARIEL/H<sup>+</sup>

High activity (GBq), spallation

- Enable radiopharmaceutical development and clinical trials



500 MeV Isotope Production Facility



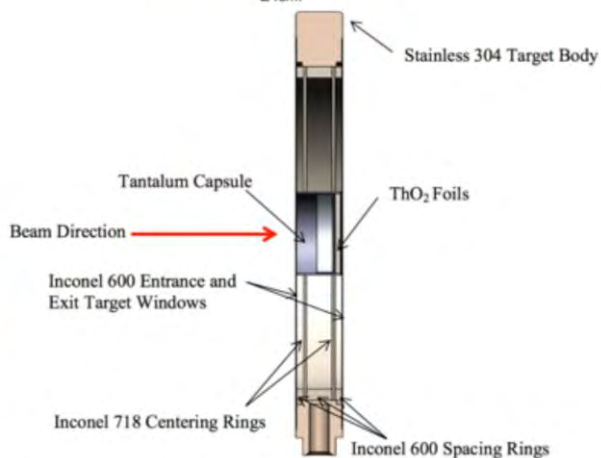
0.4 g/cm<sup>2</sup> ThO<sub>2</sub> target

## FLUKA Parameters

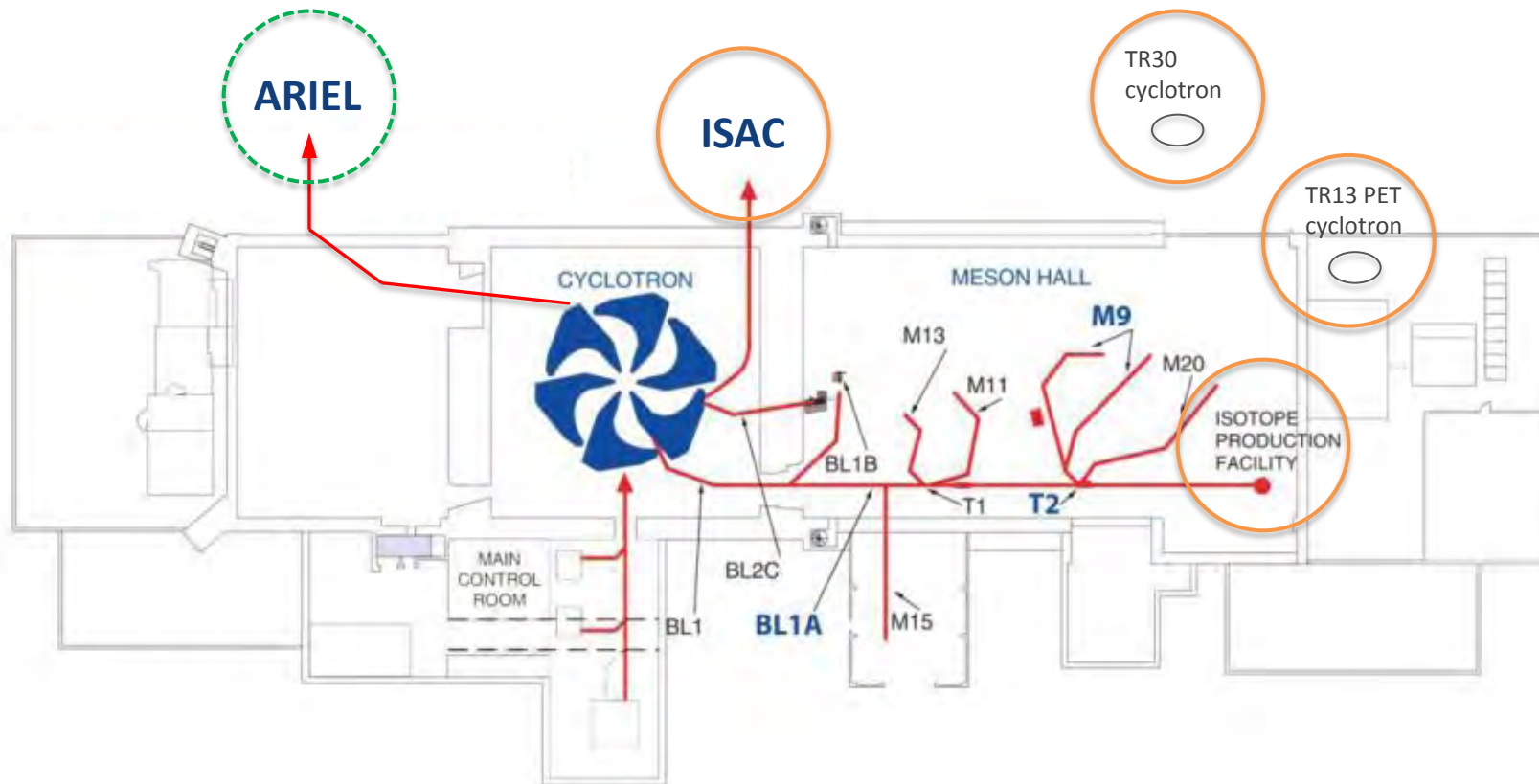
beam time	12.5 h
current	90 $\mu$ A
FWHM x	1.35 cm
FWHM y	1.38 cm



Isometric







## Isotope production using TRIUMF's 500 MeV infrastructure

### 1) ISAC - ISOL

Low activity (kBq to MBq), high purity

- Actinide targets
- Feasibility chemistry, radiolabeling

### 2) 500 MeV – IPF (BL1A)

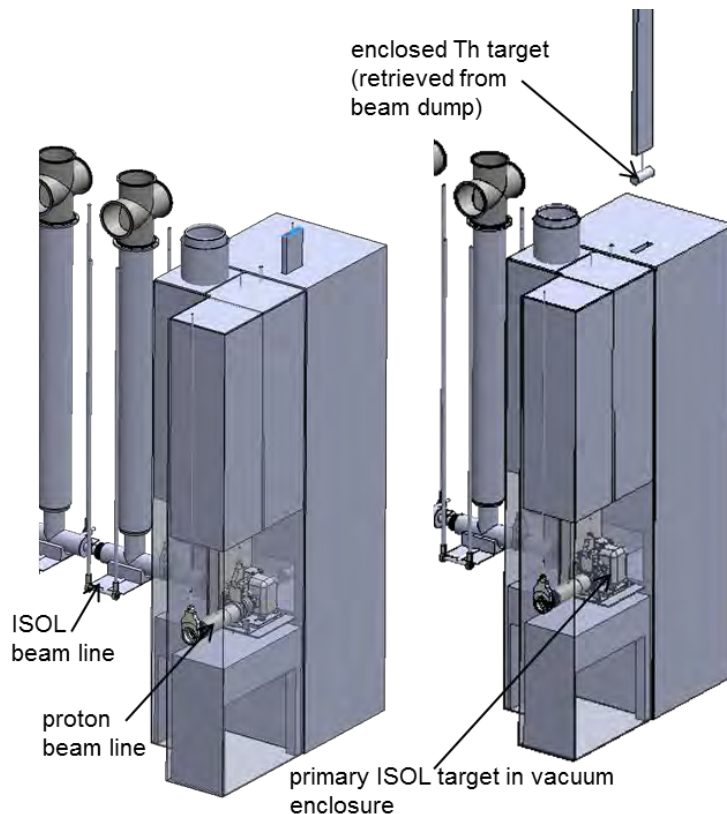
Intermediate activity (MBq), spallation

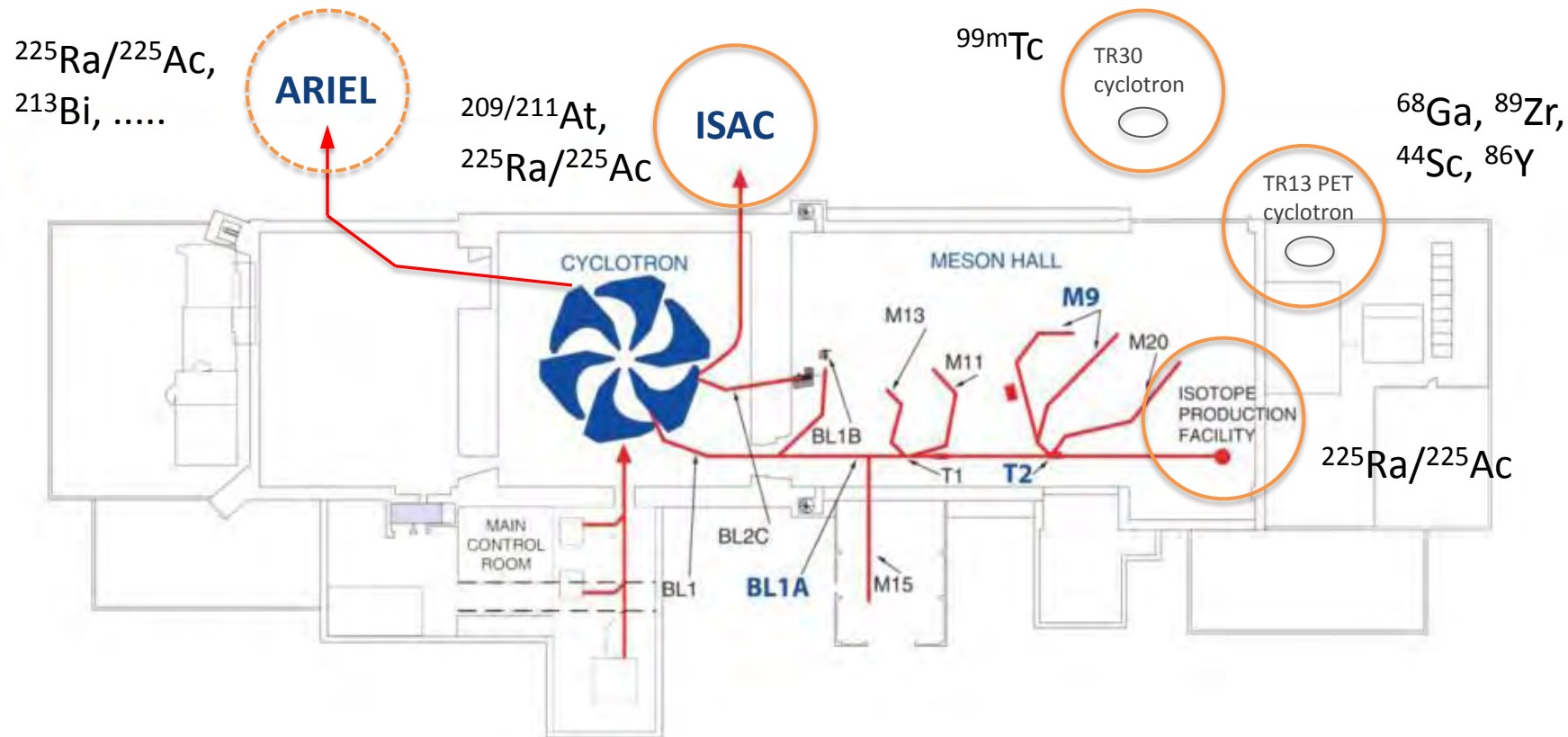
- Routine, independent production

### 3) ARIEL/H<sup>+</sup>

High activity (GBq), spallation

- **Enable radiopharmaceutical development and clinical trials**





## Alpha Research Team

Jason Crawford, Keith Ladouceur, Andrew Robertson, John D'Auria, Caterina Ramogida, Peter Kunz, Paul Schaffer, Tom Ruth, Vesna Sossi, Francois Benard, Chris Orivg, Scott Wilbur

## ARIEL Parasitic Target Station

Reiner Kruecken, Pierre Bricault, Alex Gottberg, Cornelia Hoehr

## Applied Technology Group

Jozef Orzechowski, Yetvart Hosepyan, Louis Moskven

## RIB Target Group

Anders Mjos

## Radiation Protection Group

Joe Mildemberger

## Environmental Health and Safety

Anne Trudel, Mina Nozar





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Laboratoire national canadien  
pour la recherche en physique  
nucléaire et en physique des  
particules

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Montréal | Northern British Columbia | Queen's |  
Regina | Saint Mary's | Simon Fraser | Toronto |  
Victoria | Western | Winnipeg | York

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and accelerator-based science



# AAPS – November 2016 Update for TARA

Don Furseth  
Interim President and CEO

November 17, 2016



## CECR

To Dec 31, 2015

## Transition

Now

## New AAPS

Q1 2017

**CECR obligations  
(completed)**

**Mandate from TRIUMF, not NCE. Funded from  
commercial revenue, royalties, industry projects, etc.**

AAPS Board Resigns:  
last day Dec 31, 2015

Interim AAPS Board (Jan 1 to  
June 30) completed CECR  
reporting; Interim President  
& CEO (March 1 to  
**December**)

New AAPS Board  
(**November**)  
Full-time CEO  
(**December**)

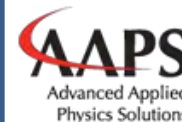
Final CECR report provided to  
NCE (July 31, 2016.)  
CECR Exit date:  
**November 30, 2016.**

Management Services  
Agreement (**finalize by Mar  
31**). Strengthen commercial  
framework. Prepare for full-  
time AAPS CEO.

TRIUMF's not-for-profit  
commercialization arm  
(ongoing, sustainable)

Create a climate of  
**Innovation &  
Entrepreneurship**

- Manage **TRIUMF's IP**
- Disclosures → license/assign
  - NDAs, disclosures



## Increase TRIUMF Commercial **Revenue**

Generate & Manage  
**New  
Opportunities**

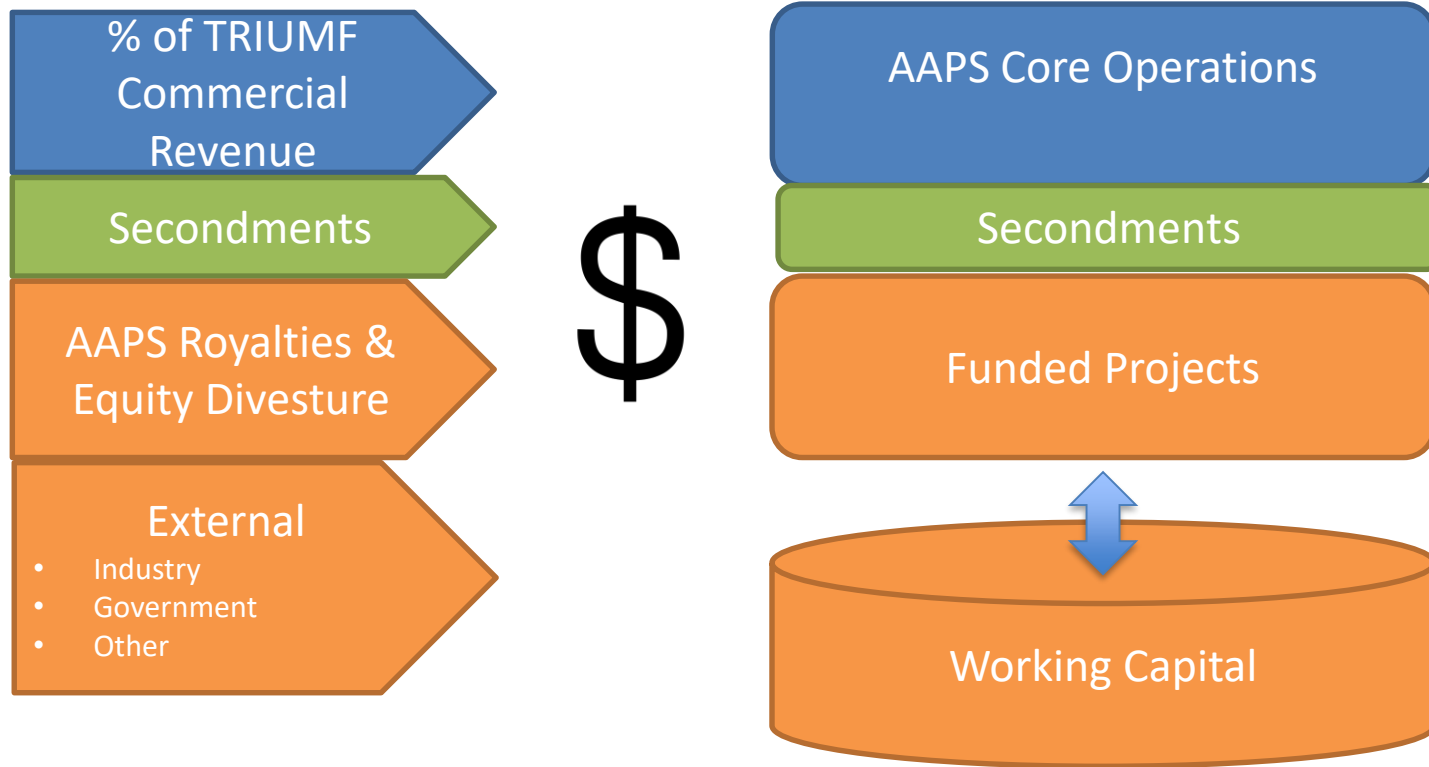
Pathways:

- **Products & Services**
- **Licensing**
- **Start-ups / JVs**

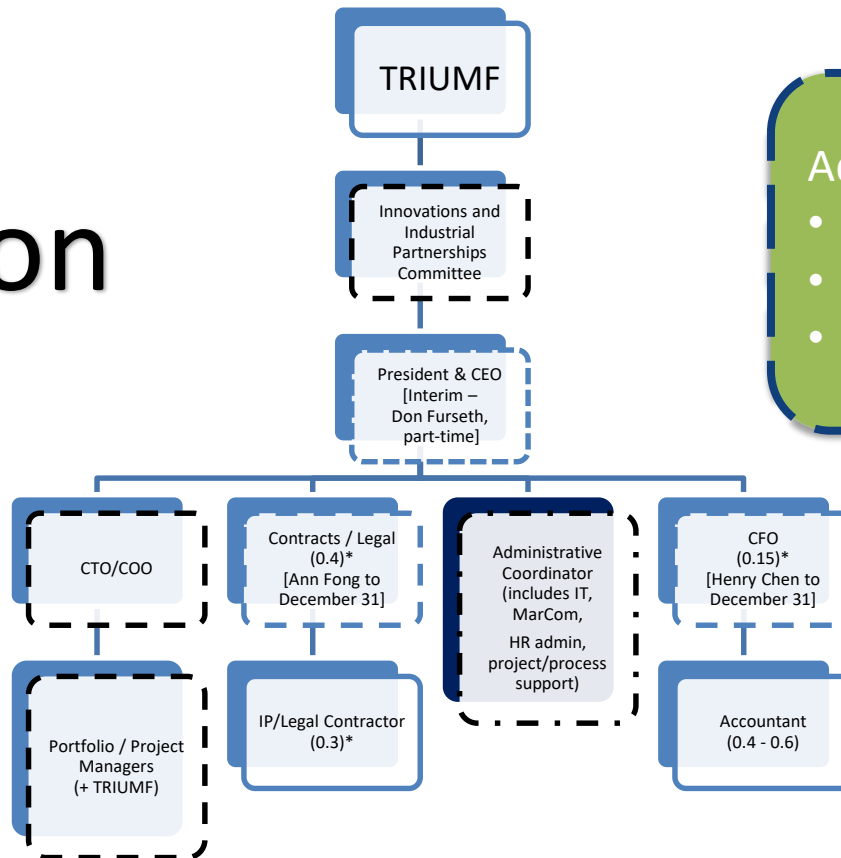
Manage **Industry**

Relationships & Agreements

- PIF/NIF - industry
- Nordion, D-Pace, ACSI
- Industry alliances



# AAPS Transition Team



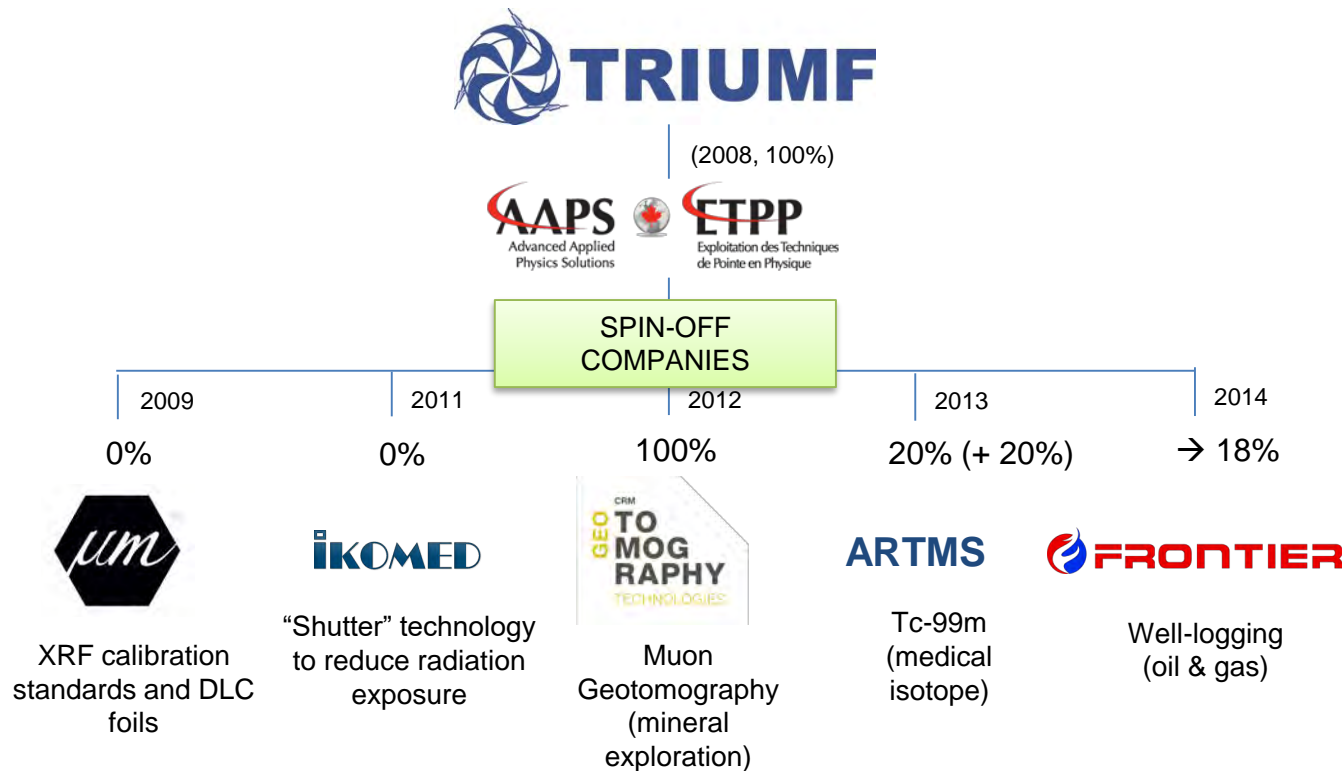
\*Shared TRIUMF resource

## Advisors:

- Subject Matter Experts
- Industry
- Innovation ecosystem

Consultants  
(therapeutic isotopes):  
Kevin McDuffie  
Tom Ruth

Seconded AAPS  
Employees  
(e.g., Life Sciences: 1,  
Frontier Sonde: 1)





In 2009, AAPS acquired the assets of Micromatter Inc., a U.S. niche manufacturer of X-Ray fluorescence (XRF) calibration standards. The assets were complementary to the diamond-like carbon thin film coating expertise of AAPS scientists.

In 2014, the assets and business of the division were sold to the senior engineer responsible for the commercial development of this technology.

Update:

- Winner of a Surrey Business Innovation Award
- Now manufacturing XRF windows

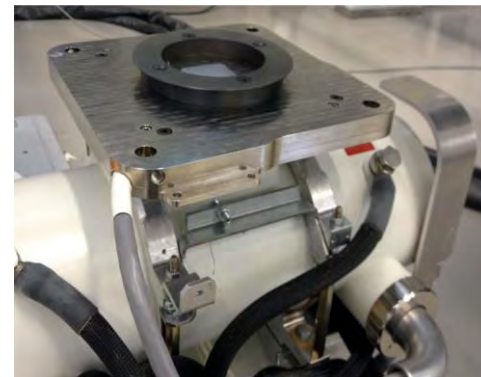
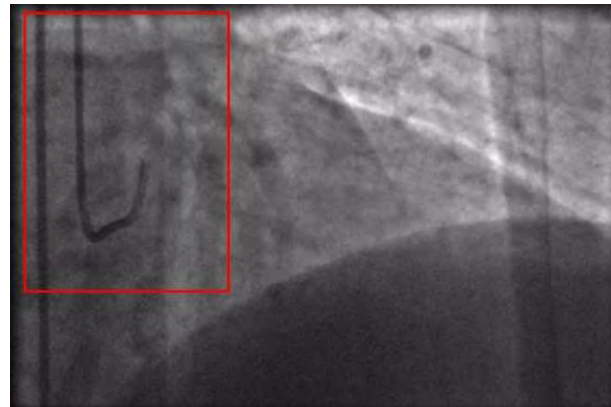






IKOMED developed a patented system to reduce X-ray radiation exposure to both patients and medical staff during minimally-invasive surgery.

(Verbal update only –  
Commercially Sensitive)

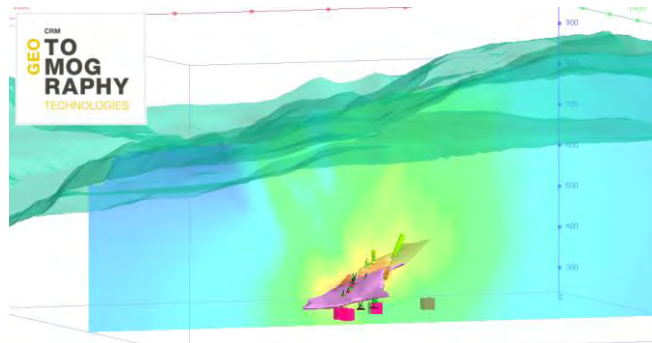




CRM GeoTomography Technologies uses cosmic ray muons to help mining companies reduce exploration costs by providing geologists with 3D insights of dense ore bodies.

Thanks to WD/AAPS/NRC-IRAP and the development team, the technology has advanced from proof of concept to commercial capability.

(Verbal update only –  
Commercially Sensitive)





System can provide measurements on porosity, water saturation, gas detection, location and monitoring of gas/oil and water/oil contacts, and uses innovative algorithms and localization tools for specific oil field formations.

Aids oil and gas companies to locate residual oil reservoirs and enhance oil recovery.

#### Update:

- Successful Canadian Field Trials
- Additional investment pending patent filing (November)



## ARTMS

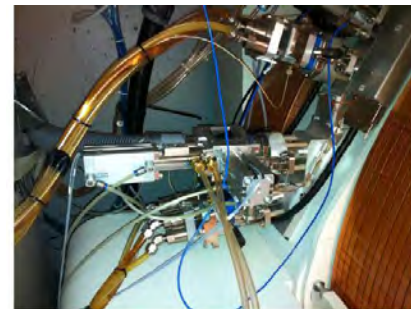
AAPS founded ARTMS, Inc. to commercialize cyclotron based Tc-99m production.

### Update:

- Owned by ITAP Consortium & AAPS
- Governance: Board in place.
- Clinical trials well underway
- Investment pending: from Accel-Rx and European firm.
- Other discussions (e.g., China)



TR19 target assembly



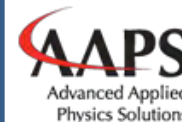
PETtrace target assembly

## Other news:

- Nordion – Last NRU Mo-99 shipment October 31
- SRF – PAVAC bankrupt. Other options for SRF licencing to be explored.
- D-Pace/Buckley:
  - Ion Source Test Facility completed (NZ)
  - UniBEaM (Universal Beam Monitor) launched
  - Involved in CANREB High Resolution Spectr.

Create a climate of  
**Innovation &  
Entrepreneurship**

- Manage **TRIUMF's IP**
- Disclosures → license/assign
  - NDAs, disclosures



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Montréal | Northern British Columbia | Queen's |  
Regina | Saint Mary's | Simon Fraser | Toronto |  
Victoria | Western | Winnipeg | York

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