

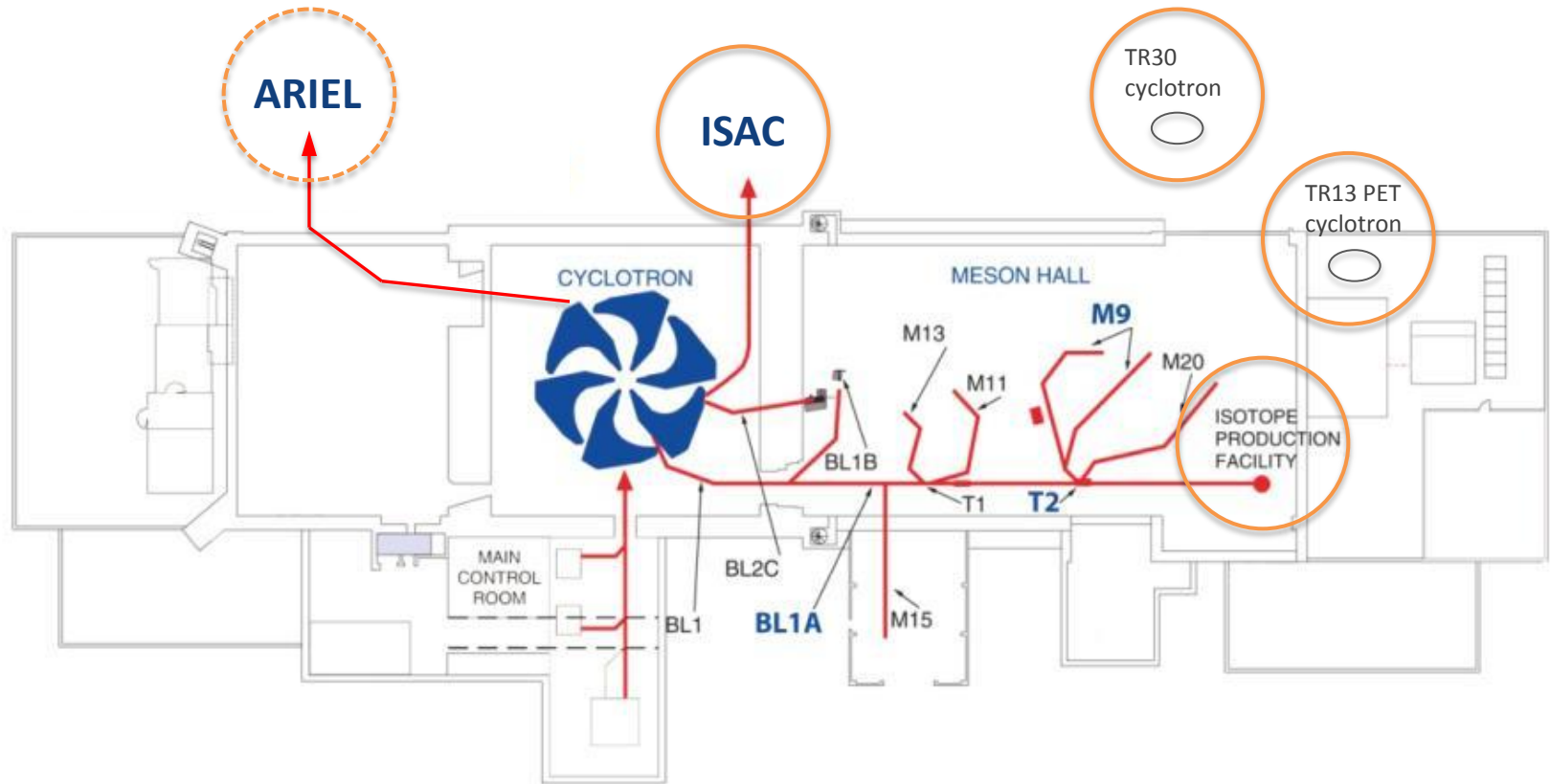


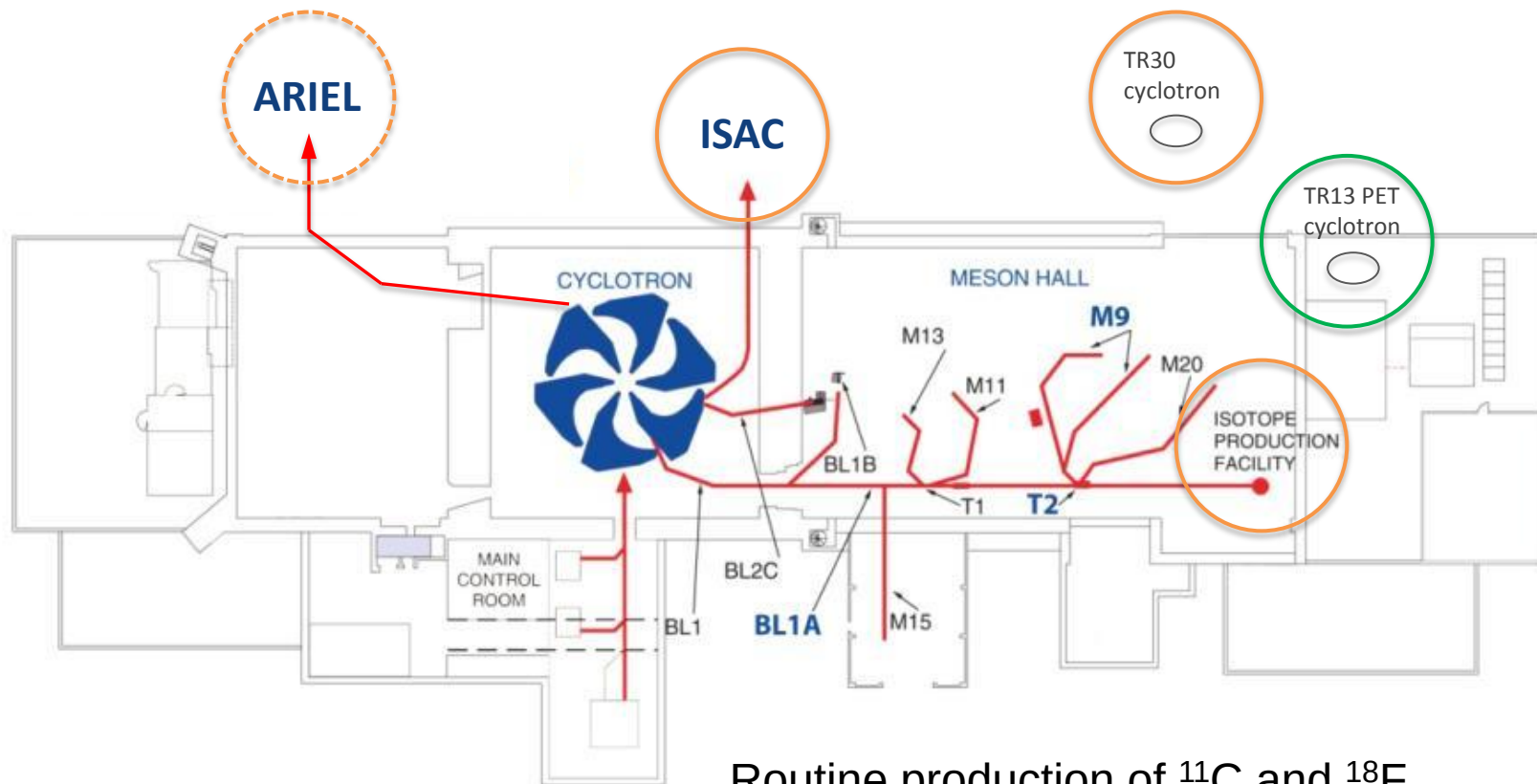
Canada's National Laboratory for
Particle and Nuclear Physics

Medical isotope production at TRIUMF - from imaging to treatment

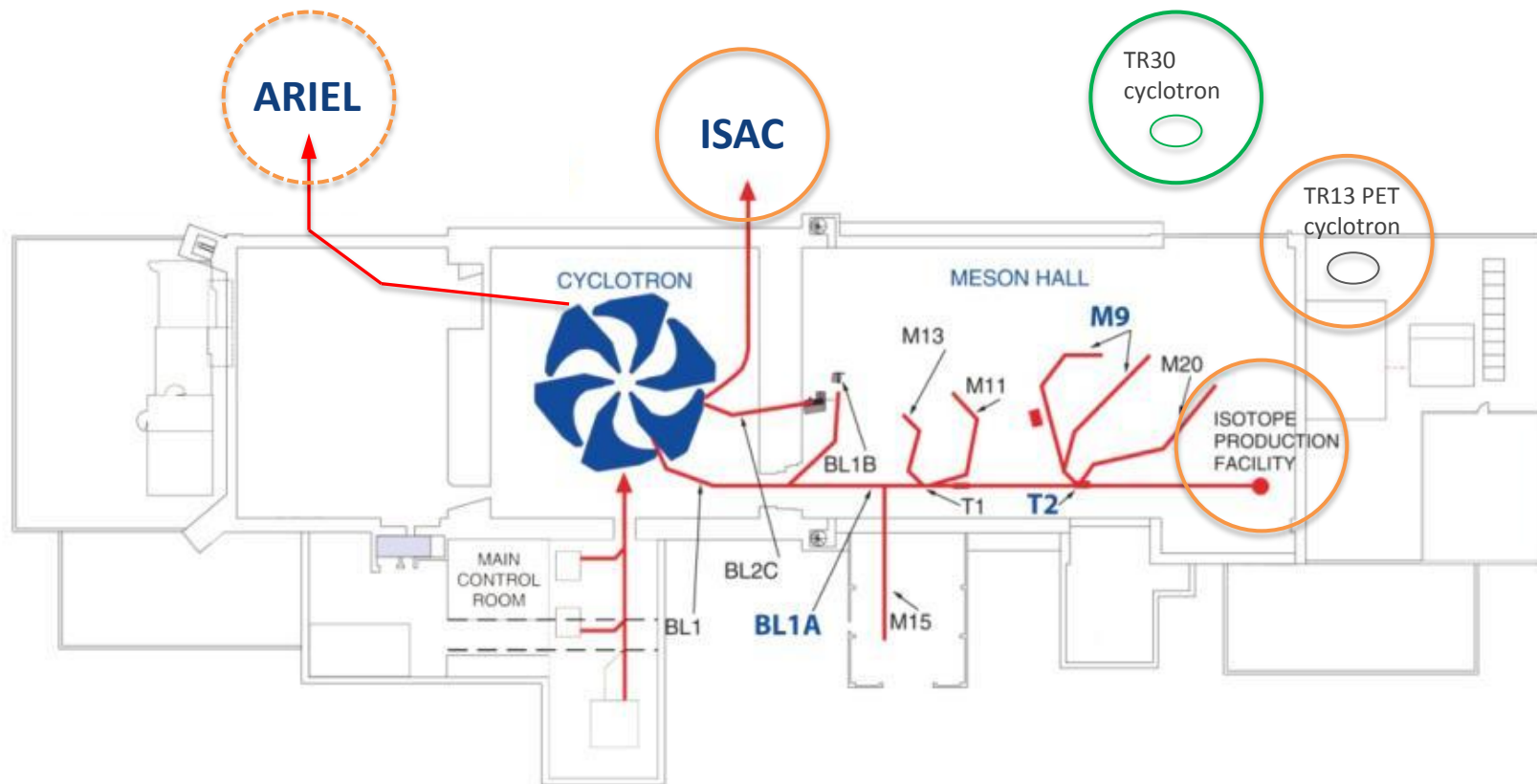
Cornelia Hoehr
Research Scientist, Life Sciences



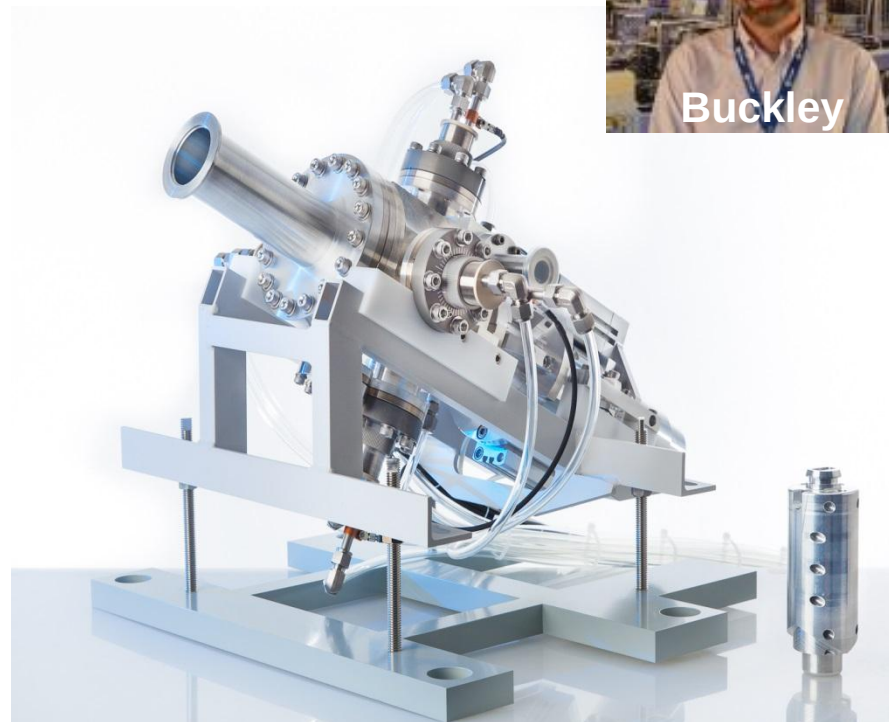
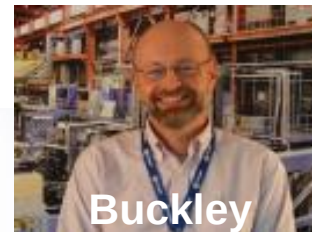




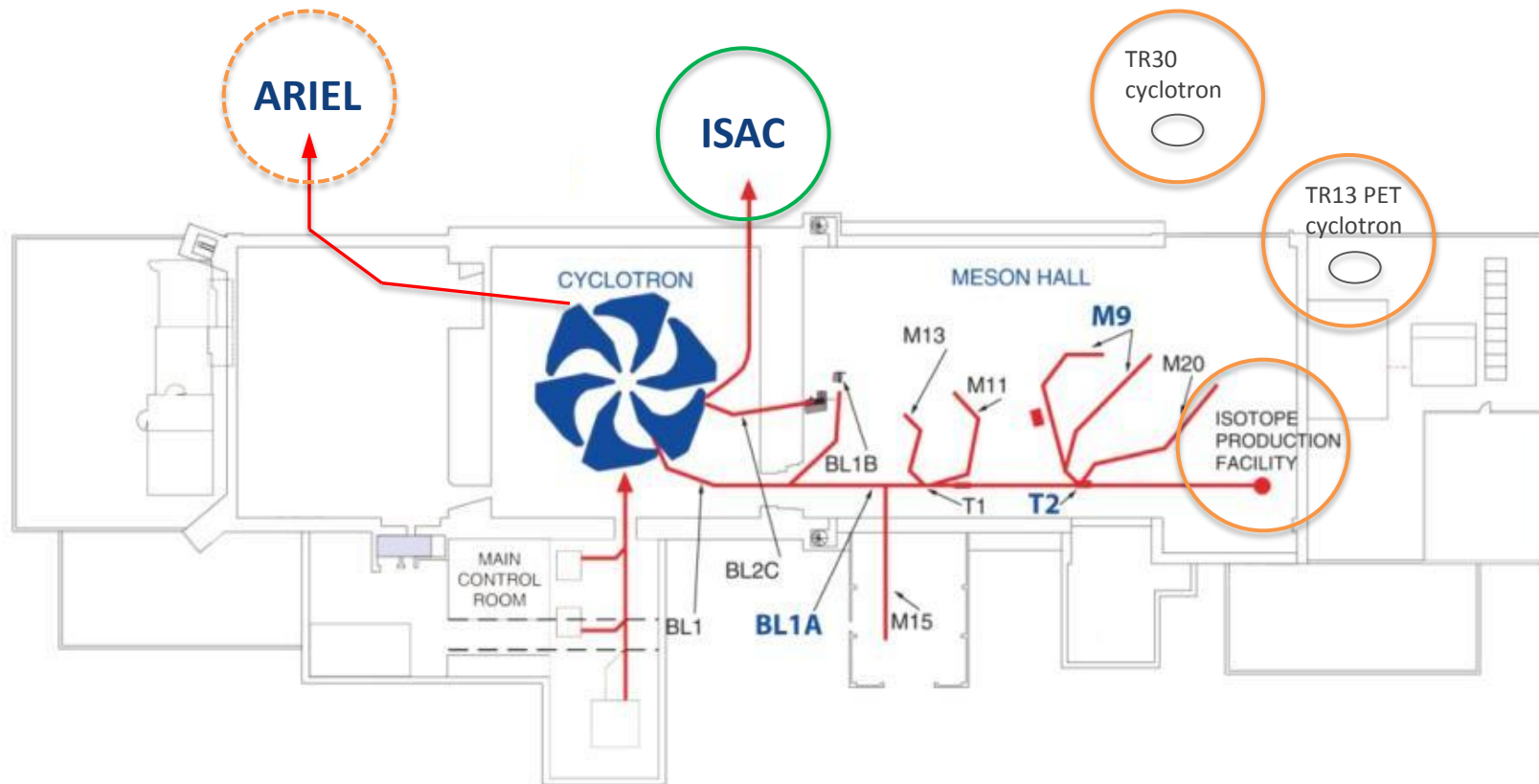
Routine production of ^{11}C and ^{18}F
 New: radiometals Sc-44 , Ga-68 , Y-86 , Zr-89

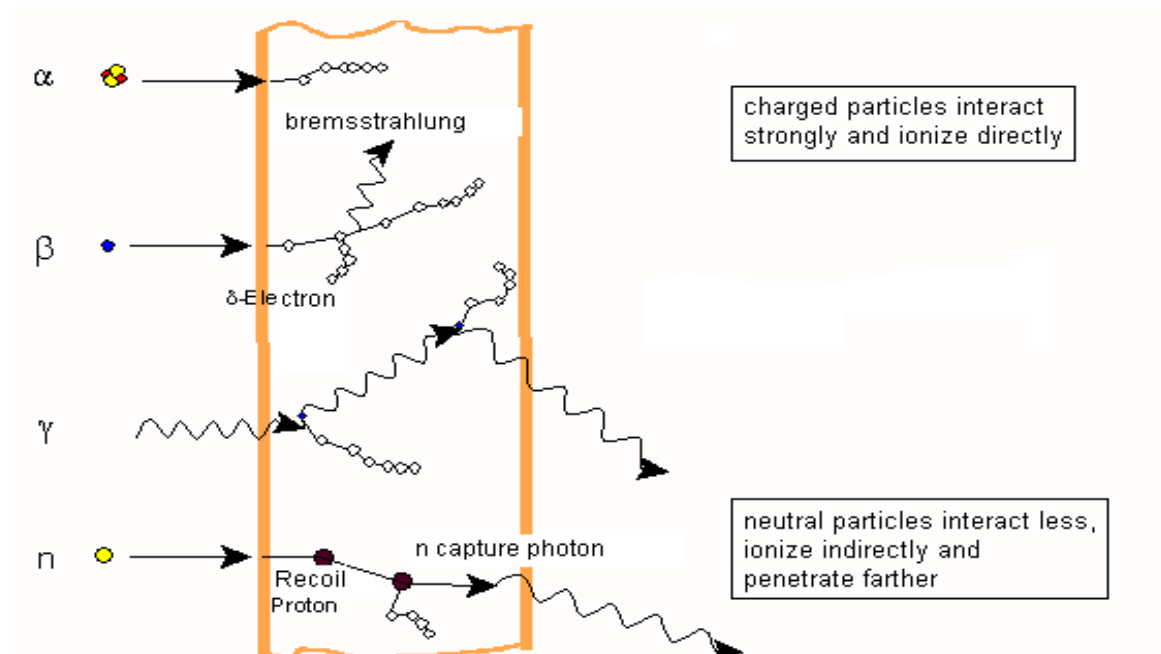


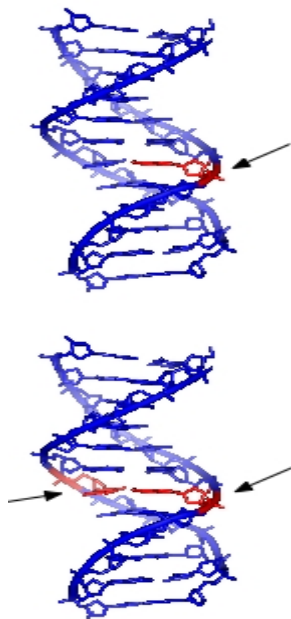
- Project Status
 - 4.7 Ci (GE), 15 Ci (TR19), 32 Ci (TR30)
 - Clinical Trials Underway
 - Bone/thyroid (36/60 patients scanned)
- Commercialization
 - Sole license issued to ARTMS Products Inc.
 - Pursuing venture funding - ~\$1.6M in stated interest to date



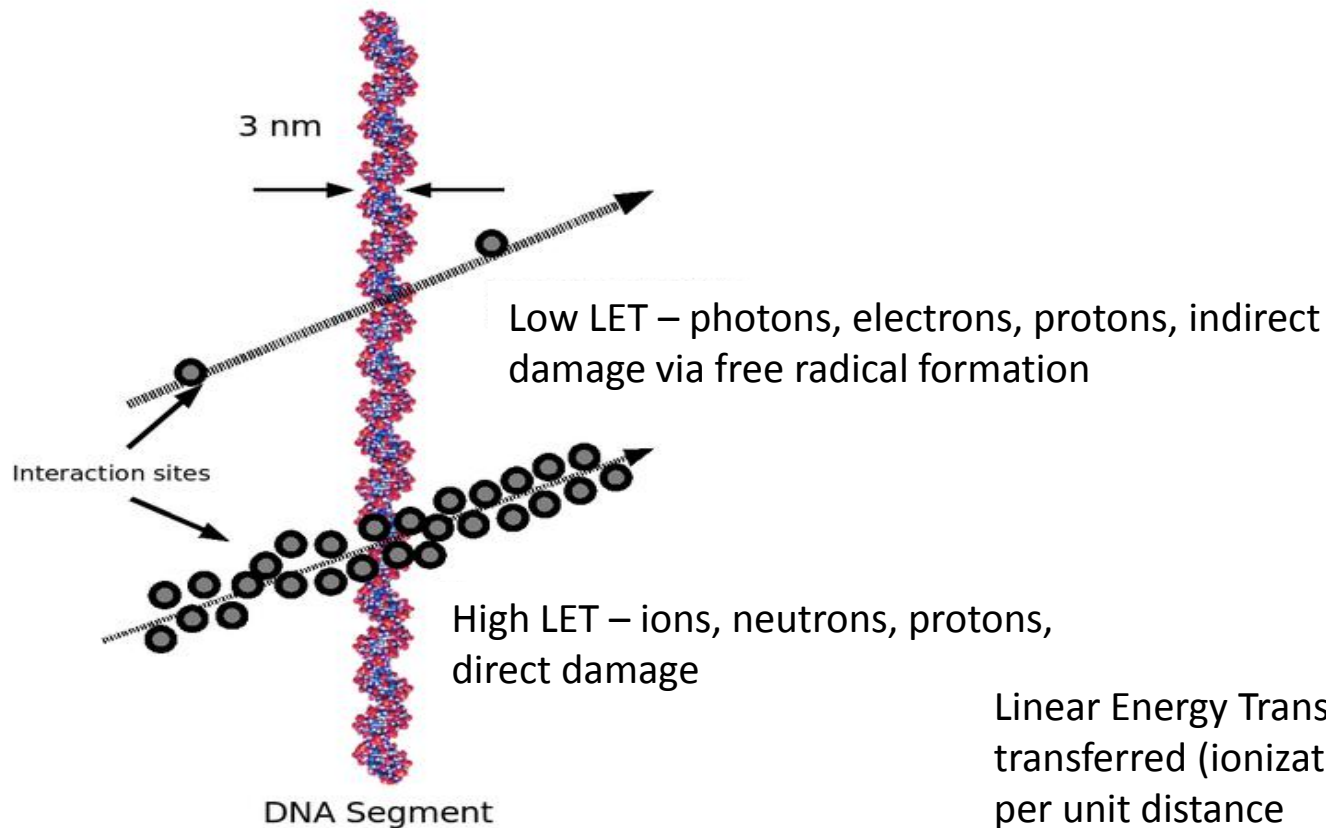
ARTMS ^{99m}Tc Production System



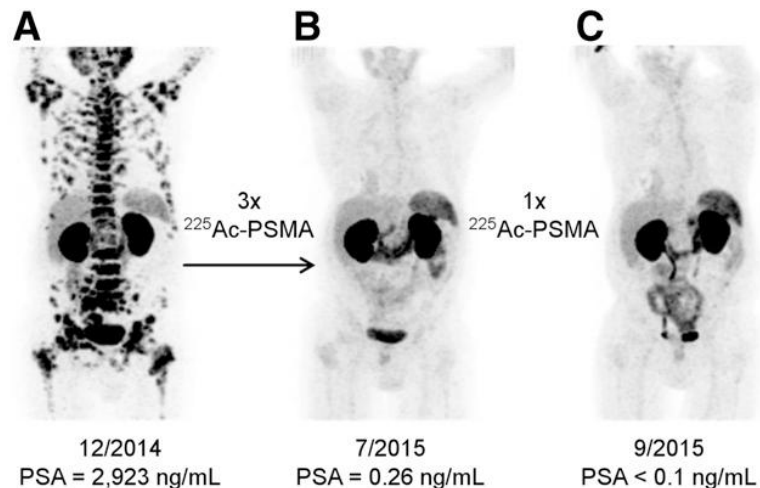




- DNA (Deoxyribonucleic acid): genetic instructions for development and functioning
- Cell needs information from DNA for survival
- Single helix break easy to repair
- Double helix break more difficult to repair
- Cell can not survive
- Radiotherapy: as many double helix breaks in cancer cells as possible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

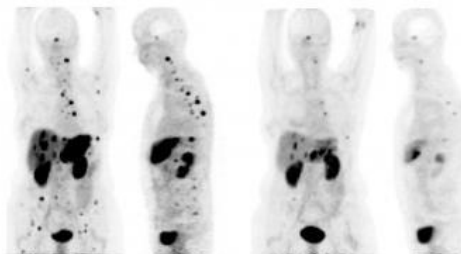


Linear Energy Transfer (LET): Energy transferred (ionization, secondary electrons) per unit distance

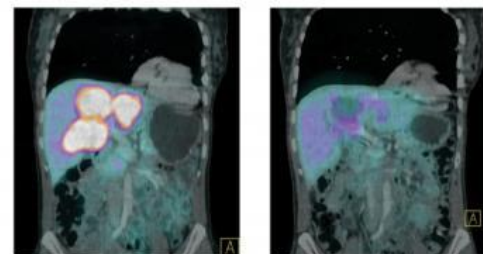


Kratochwil et al., J. Nuc. Med. July 2016.

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

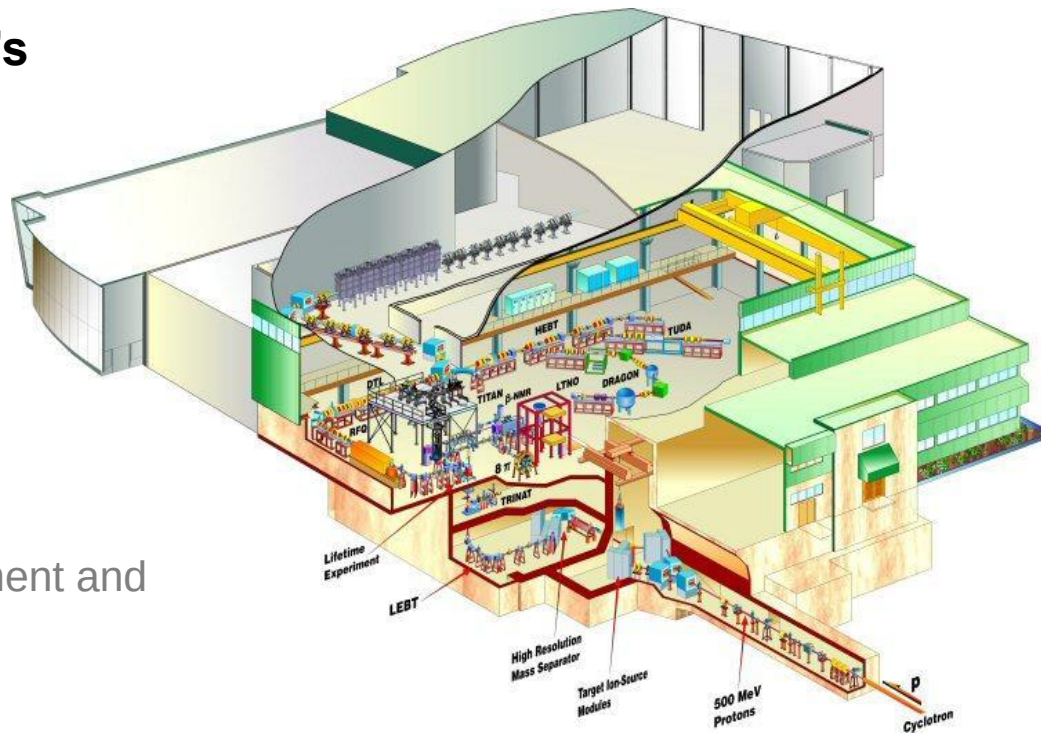
1) ISAC – ISOL (Research, Feasibility)
Low activity (kBq to MBq), high purity

2) 500 MeV – IPF (BL1A)
 Intermediate activity (MBq), spallation

- Routine, independent production

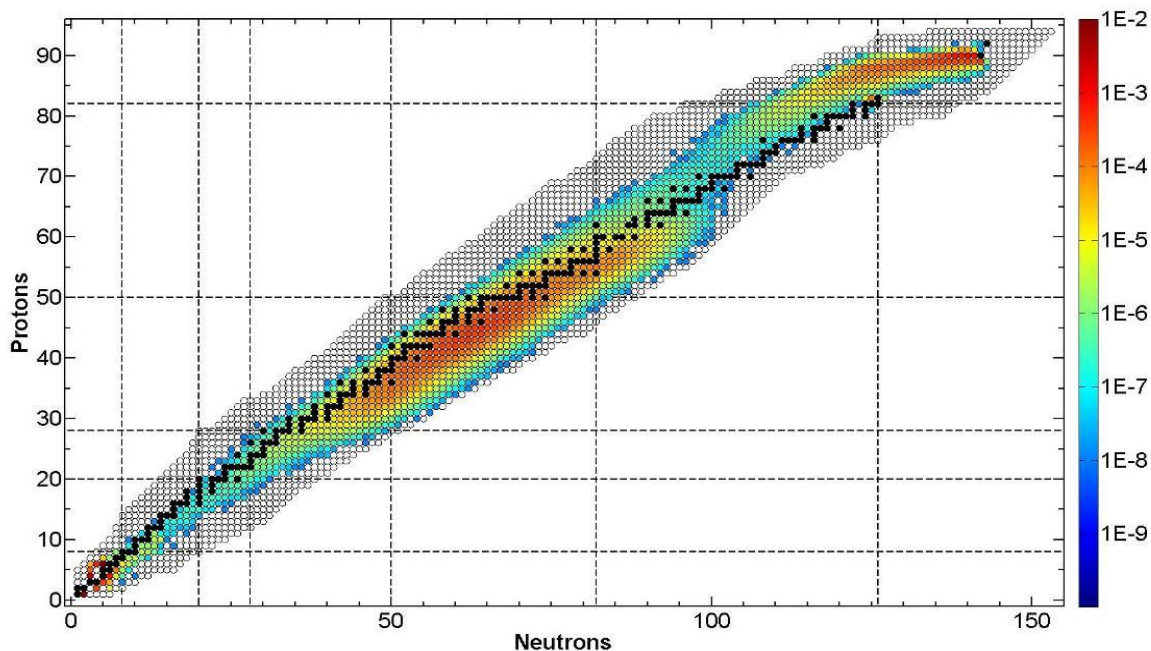
3) ARIEL/H⁺
 High activity (GBq), spallation

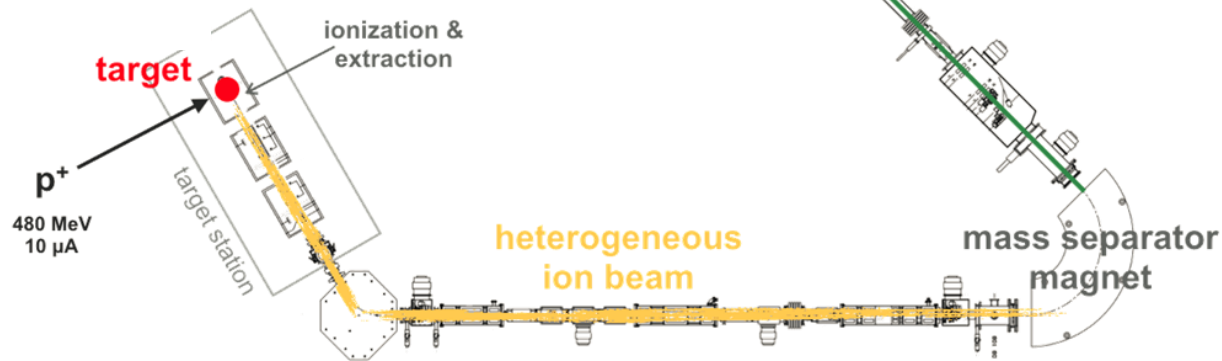
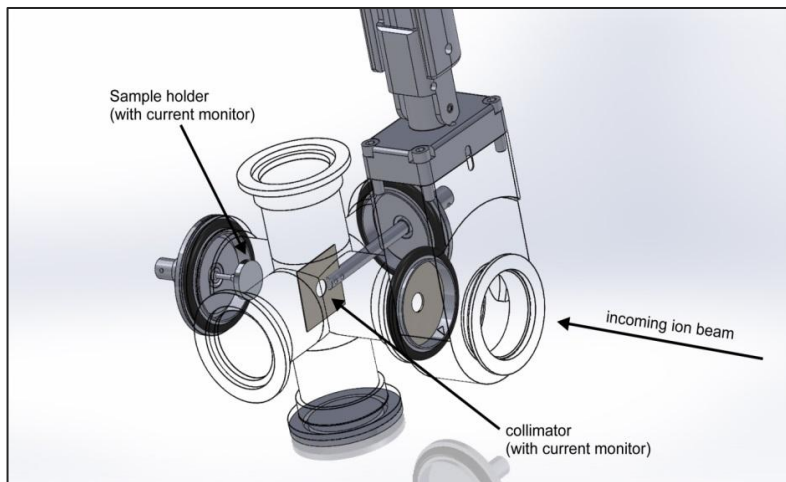
- Enable radiopharmaceutical development and clinical trials

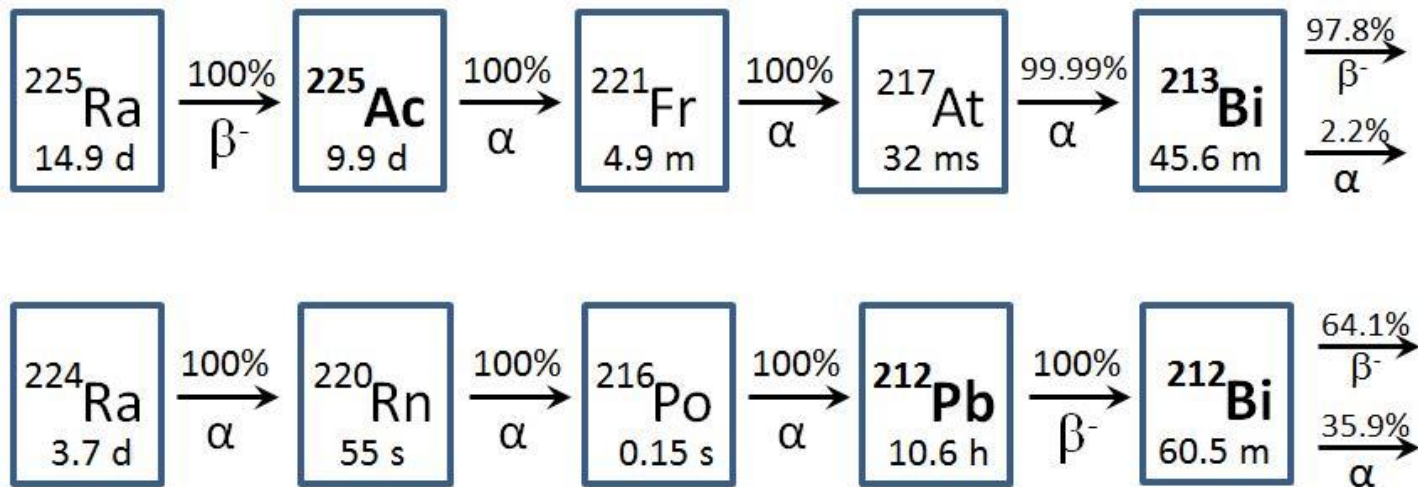


Experiments underway

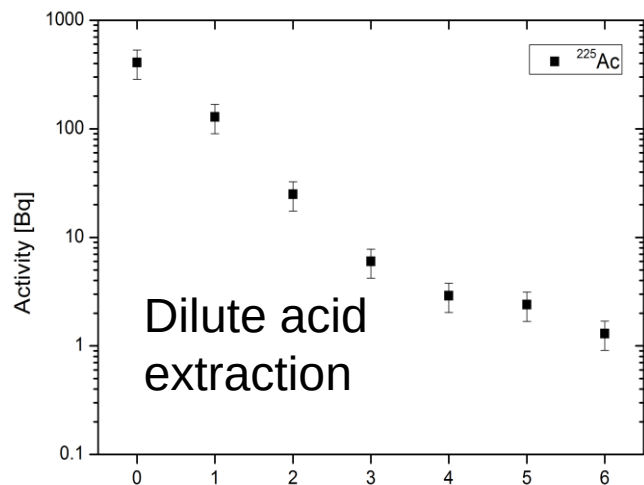
- Hundreds of co-produced isotopes including;
- ^{225}Ra , ^{225}Ac , ^{224}Ra , ^{223}Ra , ^{213}Bi , ^{212}Pb , ^{212}Bi , $^{209/211}\text{At}$







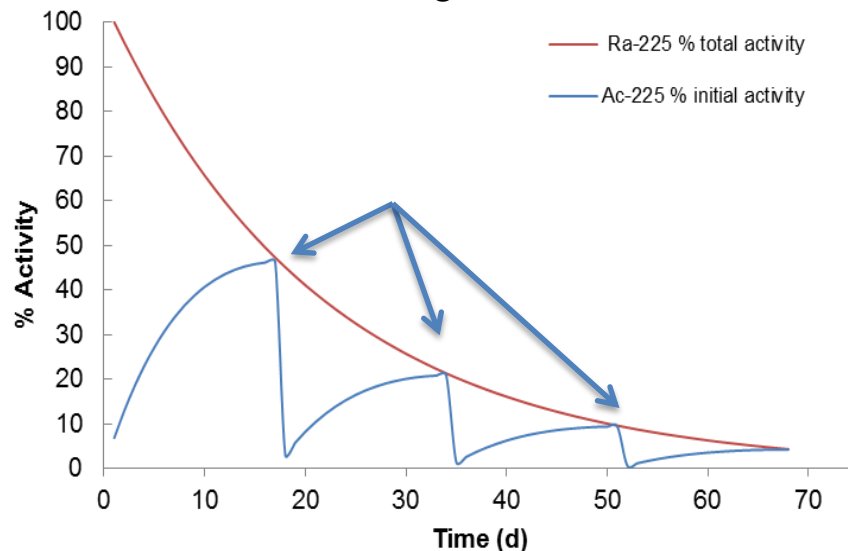
Implantation and Isolation $^{225}\text{Ra}/^{225}\text{Ac}$



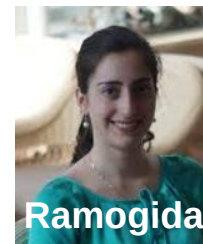
> 99% of all implanted $^{225}\text{Ra}/^{225}\text{Ac}$ activity* recovered

*quantified using HPGe gamma spectroscopy

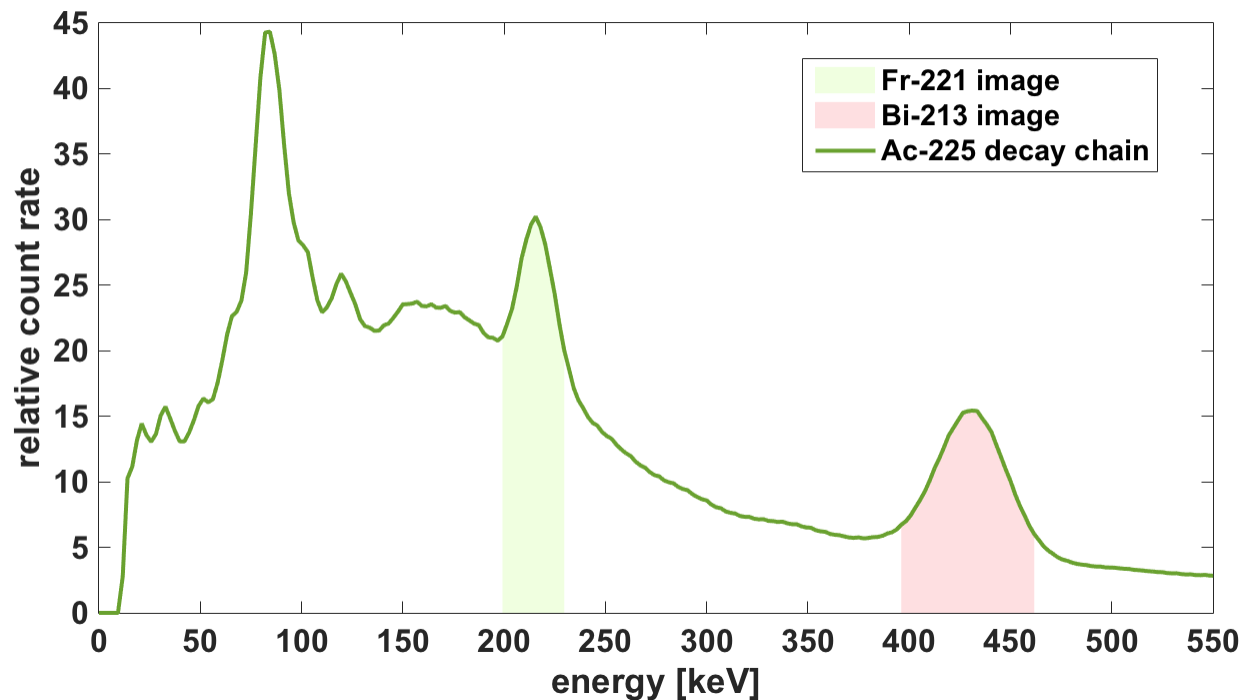
$^{225}\text{Ra}/^{225}\text{Ac}$ generator

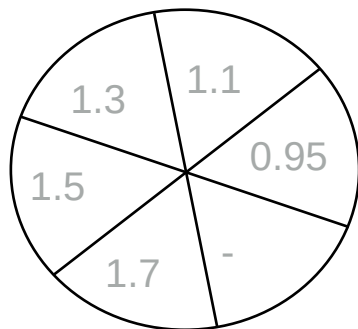
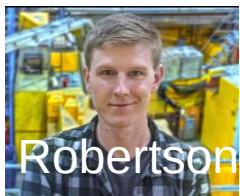


Clean sample of ^{225}Ra and ^{225}Ac
 <1 mCi ^{225}Ac per implantation
 4 runs so far



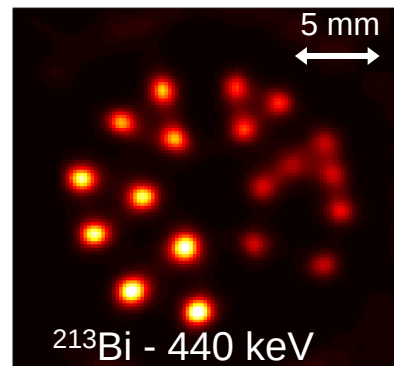
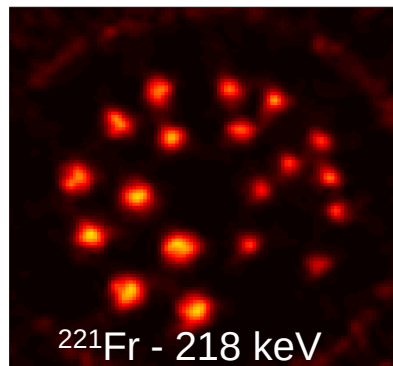
^{225}Ac Decay Chain Energy Spectrum



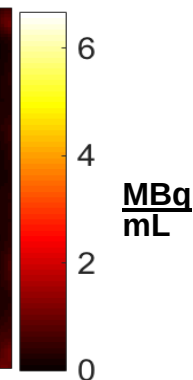
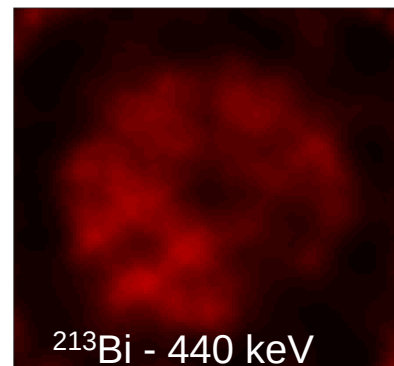
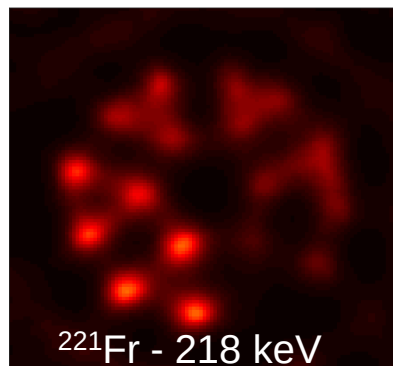


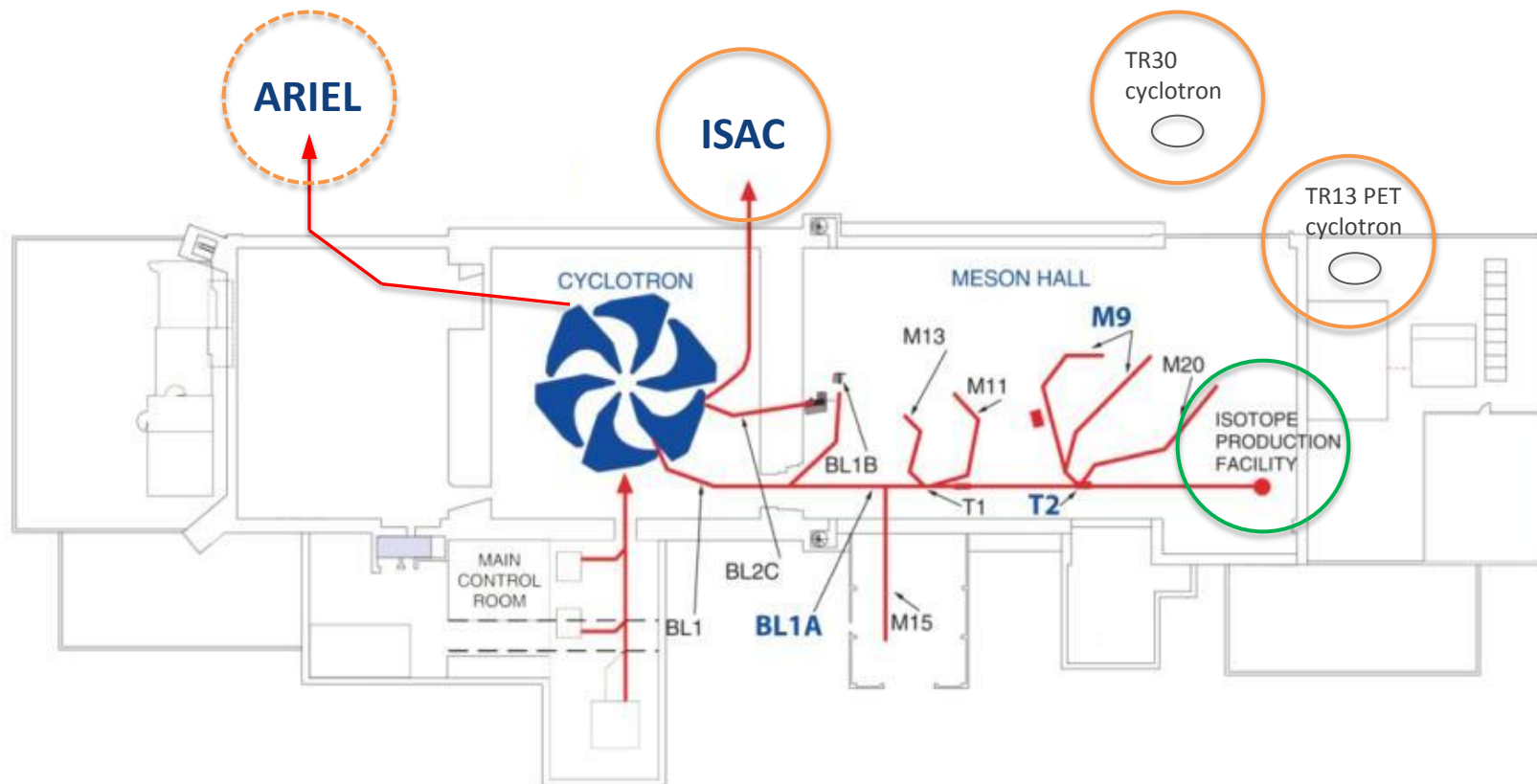
rod diameters
[mm]

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)

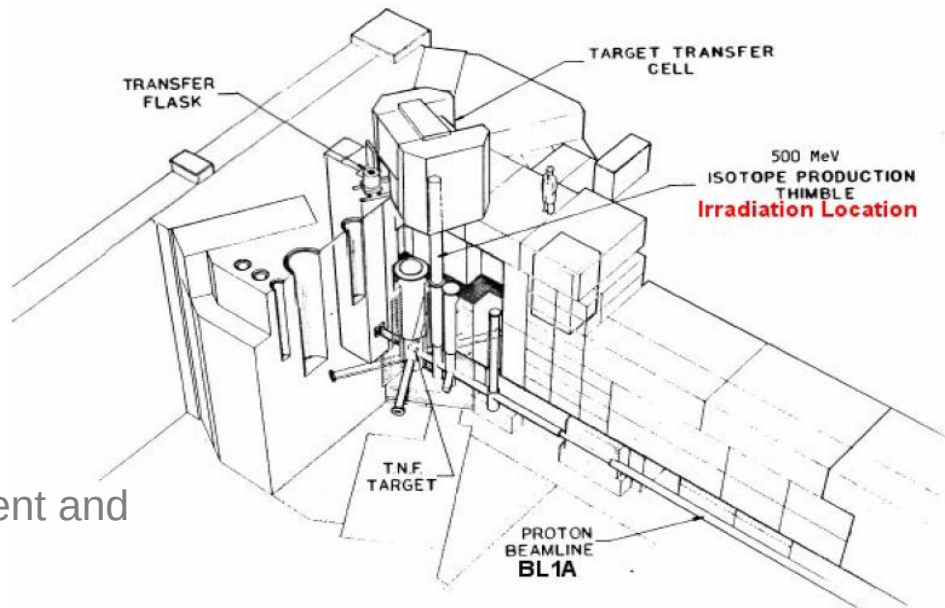
Intermediate activity (MBq), spallation

- Routine, independent production

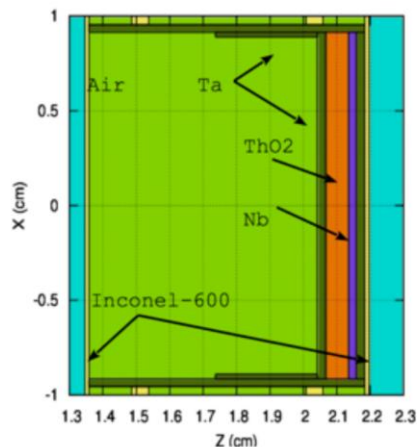
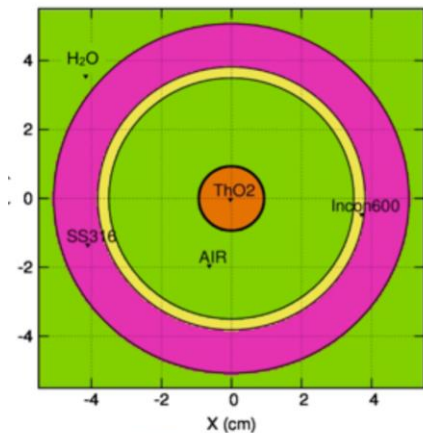
3) ARIEL/H⁺

High activity (GBq), spallation

- Enable radiopharmaceutical development and clinical trials



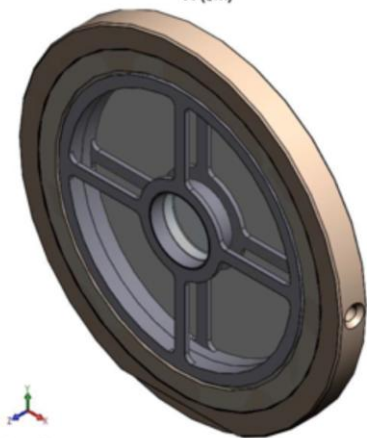
500 MeV Isotope Production Facility



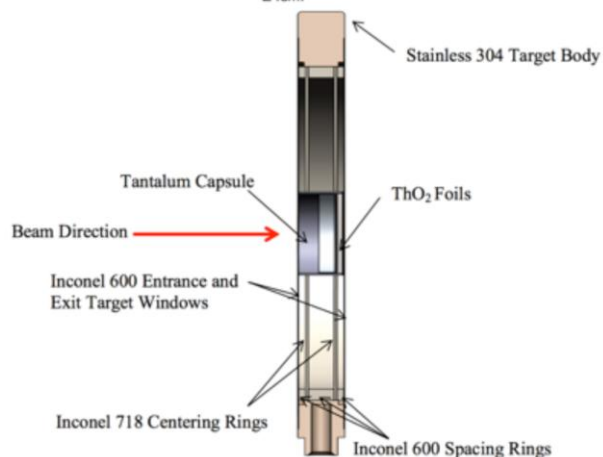
0.4 g/cm² ThO₂ target

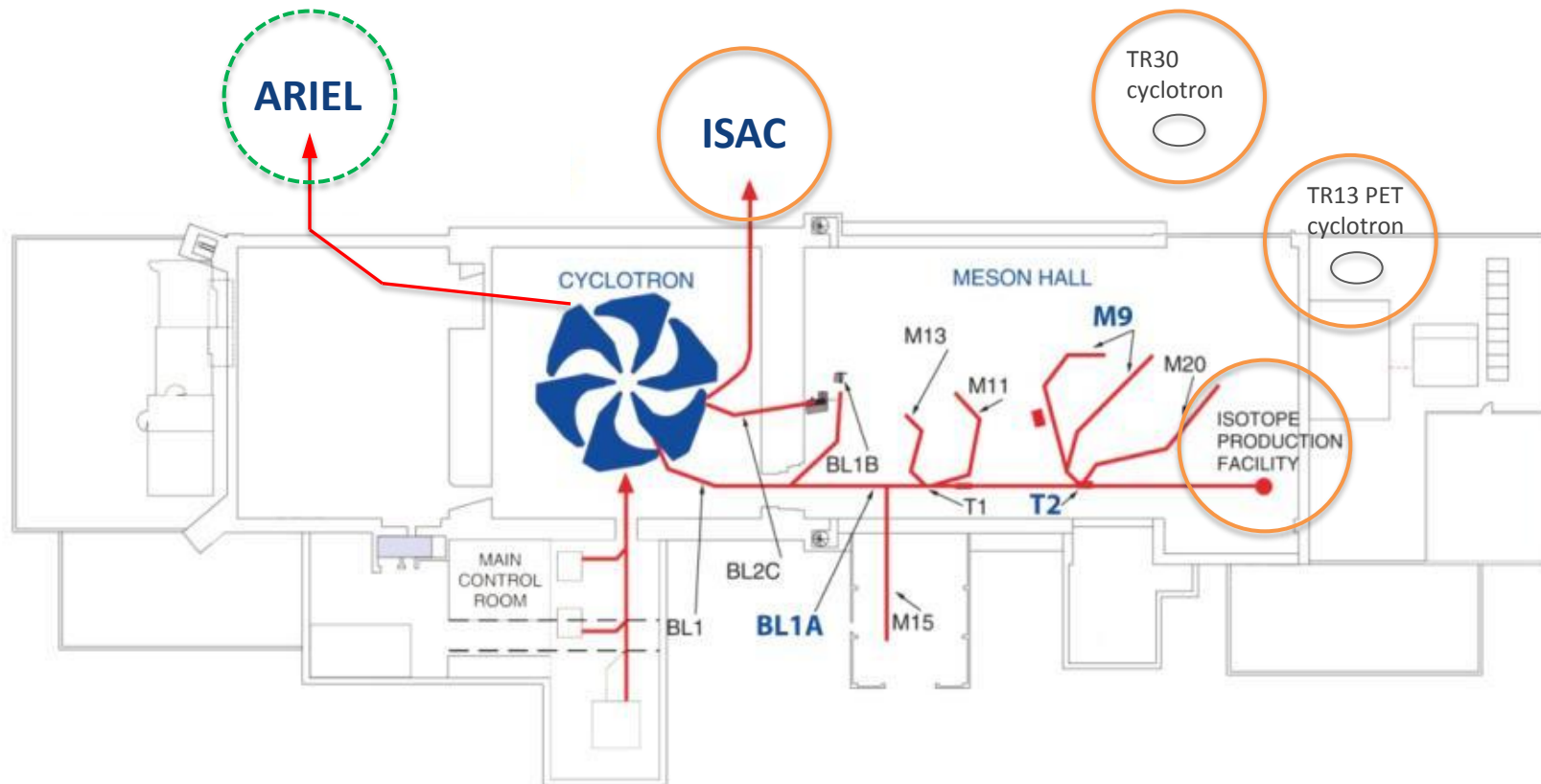
FLUKA Parameters

beam time	12.5 h
current	90 μ 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)

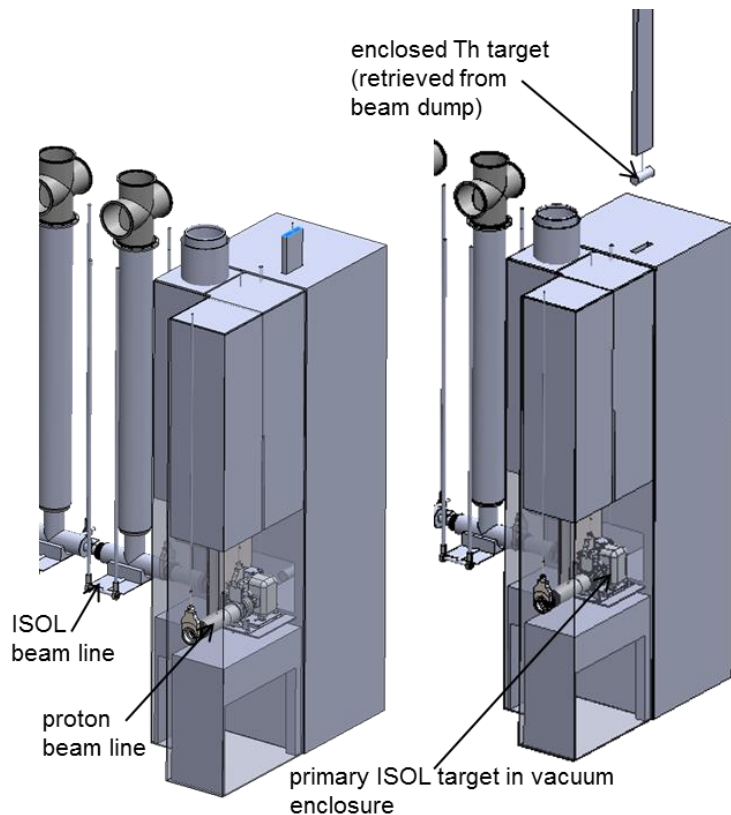
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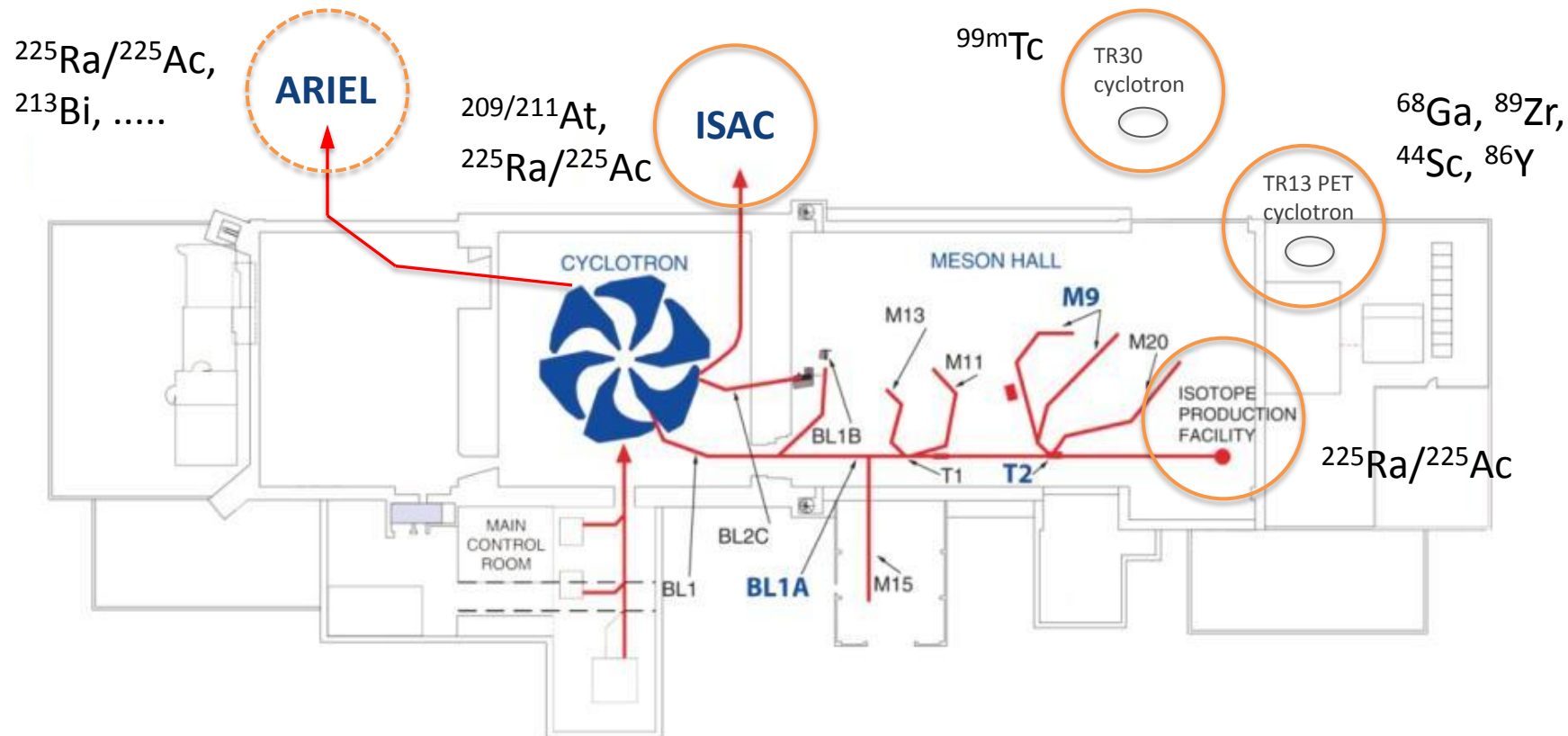
- Routine, independent production

3) ARIEL/H⁺

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 Mildenberger

Environmental Health and Safety

Anne Trudel, Mina Nozar





Canada's national laboratory for
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nucléaire et en physique des
particules

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Victoria | Western | Winnipeg | York

Thank you! Merci!

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