Contribution ID: **630** Type: **Invited Speaker / Conférencier invité**

Accelerator-Based Medical Isotope Production at TRIUMF

Tuesday 16 June 2015 13:45 (30 minutes)

TRIUMF operates a suite of [H-] cyclotrons (13, 2 x 30, 42 and 500 MeV) which, in addition to supplying our basic science program, are used to produce a variety of medical isotopes. Within the next few years TRIUMF will also begin isotope production in our new Advanced Rare IsotopE Laboratory (ARIEL) –a 50 MeV, 10 mA continuous-wave electron linac. The breadth and power of our infrastructure has positioned TRIUMF to be a major producer for some medical isotopes, while enabling access to others that are less common.

Since 2010, a TRIUMF-led collaboration has sought to produce Tc-99m directly on small cyclotrons via the Mo-100(p,2n) reaction. Recent successes have shown >30 Ci (1110 GBq) of Tc-99m produced in a single 6 hr irradiation on a 450 μA TR30 cyclotron (at 24 MeV) at TRIUMF. Solutions for 16 and 19 MeV cyclotrons have also been developed. Our goal is to enable all Canadian cyclotron centres to produce Tc-99m in lieu of the imminent cessation of isotope production at the Chalk River reactor.

TRIUMF is also pursuing novel methods for producing radiometals that are of interest to the medical community. We have demonstrated the utility of liquid targets for producing research quantities of Zr-89, Ga-68, Y-86 and Sc-44; made by irradiating salt solutions of the appropriate starting material. To date, mCi (MBq) quantities have been isolated and purified, opening the door for the development of novel radiopharmaceuticals.

Finally, a brief discussion will ensue on efforts to apply Isotope Separation On-Line (ISOL) infrastructure within the ISAC facility at TRIUMF to produce research quantities of radiotherapeutic isotopes. Progress on the isolation of alpha emitters At-211 and Ac-225 will be presented. TRIUMF seeks to enable clinical trials with these and many other potentially useful radiotherapeutic isotopes available through our existing science program.

Overall, TRIUMF's Nuclear Medicine program seeks to address current and anticipated challenges in the production of important clinical isotopes. With over 1000 small (<30 MeV) cyclotrons in 70 countries, the time is ripe to establish accelerators as a viable, decentralized source of medical radionuclides.

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Session Classification: T2-6 Nuclear Physics in Medicine (DNP-DMBP-DIAP) / Physique nucléaire en médecine (DPN-DPMB-DPIA)

Track Classification: Nuclear Physics / Physique nucléaire (DNP-DPN)