**Canadian Radiotheranostics Leaders' Summit 2025**
**Abstract Submission**

**Title:** Cyclotron Production of Tb-155

**Authors and institutional affiliation:**
*Scott McNeil, Life Sciences Division TRIUMF, Department of Chemistry University of British Columbia. Hua Yang, Life Sciences Division TRIUMF, Department of Chemistry University of British Columbia, Department of Chemistry Simon Fraser University.*

**Email of submitting/first author:**
smcneil@triumf.ca **(Scott McNeil)**

**Training program first author is enrolled in:**
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**Abstract:**

**Purpose:** $^{155}$Tb is a promising radionuclide capable of SPECT imaging, and may serve well as a elementally matched theranostic pair for $^{161}$Tb. The purpose for this study is to produce Tb-155 from a TR13 cyclotron reliably and routinely via the $^{155}$Gd(p,n)$^{155}$Tb reaction using a low energy cyclotron and a solid $Gd_2O_3$ target.

**Methods:** Considering the fragile nature of the $Gd_2O_3$ target material, a sealed target system was deployed. An aluminum foil and indium seal will be used to ensure the $Gd_2O_3$ pellet remains affixed to the target backing during the irradiation. The outer foil serves not only to contain the fragile contents, but also to degrade the incident proton beam from 13 MeV down to 10.8 MeV (foil thickness optimized using Stopping Range in Matter simulations). Degrading the incident proton energy is necessary to avoid the $^{155}$Gd (p, 2n)$^{154}$Tb. Theoretical thermal calculations were conducted and reveal little risk of target failure/melting with the proposed maximum beam current of 20 µA. As a precaution short irradiations were

conducted at low beam currents to verify the target's stability.

**Results:** 5 successful irradiations of natural $Gd_2O_3$ targets have been conducted (at the time of this submission) from beam currents of 2-20 µA . With the maximum production rate for $^{155}$Tb achieved being 0.9387 5 MBq·µA$^{-1}$·h$^{-1}$. Analysis via high purity germanium gamma spectroscopy revealed co- production of other Tb isotopes, mainly $^{156}$Tb, $^{154}$Tb, and $^{152}$Tb.

**Conclusion:** With successful irradiations completed and the target's design verified, work onchemical separation can begin. Once a robust purification procedure is established enriched [$^{155}$Gd]$Gd_2O_3$ material can be used in the targets. Simulations reveal that the production rate of $^{155}$Tb from enriched target material is expected to be ~3.5 MBq·µA$^{-1}$·h$^{-1}$ (100 MBq in 1.5 hours), which can adequately supply chelation and preclinical studies with the radionuclide.