Contribution ID: **55** Type: **Submitted oral (In person)**

Terbium-149 production and separation: IS688 and beyond

Wednesday 3 December 2025 15:20 (12 minutes)

Terbium-149 has been regarded as an attractive candidate for Targeted Alpha Therapy (TAT) since the 1990's [1], due to its favourable physical decay properties (T1/2 = 4.1 h, Eα = 3.97 MeV, 17%; Eβ+mean = 720 keV, 7%) [2]. Preclinical studies have demonstrated its therapeutic potential [3-6], as well as its potential for therapy monitoring via positron emission tomography (PET) [4]. The absence of its daughter nuclides emitting relevant quantities of α-particles, make it particularly promising for therapy despite its current limited availability.

Terbium-149 was produced at ISOLDE/CERN via spallation induced in a tantalum target using high-energy (1.4 GeV) protons, followed by release and ionization of the spallation products, which were mass-separated online. The mass 149 isobars were collected in zinc-coated Au/Pt/Ta foils and, subsequently, transported to PSI for processing. The desired Tb nuclide was chemically separated from its isobaric impurities, as well as the collection material, using cation exchange and extraction chromatography, employing an optimized process [7]. The quality of the radionuclide produced was assessed analytically and by means of radiolabelling experiments. To date, up to 1.9 GBq terbium-149 were collected and transported to PSI. Upon arrival, the foil was placed into a dedicated hot cell and processed. The four-hour radiochemical separation process yielded up to 400 MBq final product. The product radiochemical purity, measured by γ-spectrometry, was determined to be 99.8%. Quality control was performed using DOTATATE, which was successfully labeled at molar activities up to 50 MBq/nmol with >99% radiochemical purity [7]. The chemical purity was further proven by ICP-MS measurements, which showed Pb, Cu, Fe and Zn contaminants at ppb levels.

Based on the successful collaboration between PSI and ISOLDE, the TATTOOS project (Targeted Alpha Tumour Therapy and Other Oncological Solutions) as part of the Swiss Large Facilities project IMPACT [8] was submitted and, subsequently, approved by the Swiss parliament in December 2024. TATTOOS intends to address the means of producing 149/152/155Tb in large quantities towards potential clinical application.

The authors thank CERN and PSI radiation safety and logistics teams for their contribution to this project, as well as Hanne Heylen for run coordination.

[1] Allen. Australasian Radiology 1999, 43:480.
[2] Singh & Chen. Nuclear Data Sheets 2022, 185:2
[3] Beyer et al. Radiochim Acta 2002, 90:247.
[4] Muller et al. EJNMMI Radiopharm Chem 2016, 1:5.
[5] Umbricht et al. SciRep 2019, 9:17800.
[6] Mapanao et al. EJNMMI 2025, 52:1383.
[7] Favaretto et al. SciRep 2024,14:3284
[8] IMPACT Project: https://www.psi.ch/en/impact

Author: VAN DER MEULEN, Nicholas Philip (Paul Scherrer Institute (CH))

Co-authors: Dr GRUNDLER, Pascal (PSI); Dr MOISEEVA, Anzhelika (PSI); Prof. KOESTER, Ulli (ILL); JOHNSTON, Karl; Dr WARREN, Stuart (PSI); Dr MOSTAMAND, Maryam (PSI); Prof. EICHLER, Robert (PSI); Prof. MUELLER, Cristina (PSI)

Presenter: VAN DER MEULEN, Nicholas Philip (Paul Scherrer Institute (CH))

Session Classification: Session 3