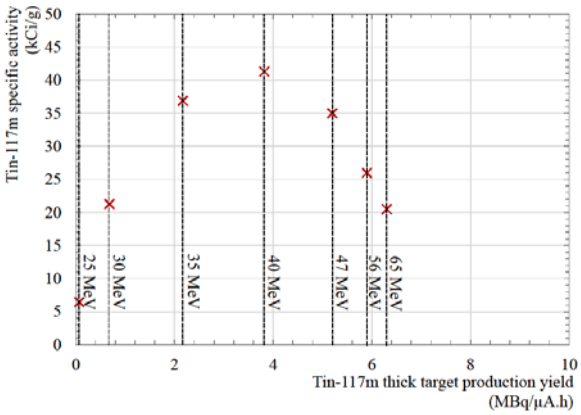

Conclusions: New experimental data have been obtained at the ARRONAX cyclotron that permits to expand the knowledge of the tin-117m TTY up to 65 MeV. The results of the TALYS 1.6 code, which reproduce correctly the tin-117m production cross section, have been used to determine the tin-117m SA taking into account the stables and long live tin isotopes produced during the irradiation. The highest tin-117m SA could be obtained using 40 MeV alpha beams which gives a TTY of 3.9 MBq/(µA.h). It is possible to get higher production yields but with a lower SA of the final product.

Keywords: tin-117m, ARRONAX cyclotron, specific activity

References:
[1] Clear Vascular Inc. Clinical stage company, http ://www.clearvascular.com/,
[2] Haddad F., Ferrer L., Guertin A., Carlier T., Michel N., Barbet J., and Chatal J.F. Arronax a high-energy and high-intensity cyclotron for nuclear medicine. Eur. J. Nucl. Med. Mol. Imaging, 35 :1377–1387, 2008
[3] Duchemin C. PhD thesis, Université de Nantes (2015).
[4] Koning A.J. and Rochman D. Modern nuclear data evaluation with the TALYS code system. Nucl. Data Sheets, 113, 2012.

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Tb-155 production with gadolinium target: proton, deuteron or alpha beam?

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Purpose: Terbium is an element of growing interest for medical applications, considered as the "Swiss-knife of nuclear medicine" [1]. Indeed, four terbium radioisotopes can be used in nuclear medicine. Tb-149 is considered for alpha targeted therapy, Tb-161 for beta- targeted therapy, Tb-152 for Positron Emission Tomography (PET) and Tb-155 for Single Photon Emission Computed Tomography (SPECT). However, terbium-155 can also be used as a radionuclide that emits Auger electrons for therapy. The interest on this radioisotope is increased by the conversion electrons emitted and the possibility to follow the treatment by SPECT imaging in a theranostic approach. The Tb-155 production has been investigated using the deuteron beam delivered by the ARRONAX cyclotron [2] and natural gadolinium target, motivated by the lack of data for this reaction at the beginning of our experiments.
Materials/methods: Tb-155 production study has been considered at the ARRONAX cyclotron (France) taking advantage of the deuteron beam ranging from 15 to 35 MeV. Production cross section measurements of Tb-155 as well as radioactive contaminants have been made using the stacked-foils technique. The stacks were made of thin natural gadolinium as targets, aluminum foils as degraders and thin natural titanium as monitor foils. After irradiation, the activity of each radionuclides produced in the foils has been determined by γ spectrometry [3]. From the cross section values obtained during these experiments, the Tb-155 Thick Target production Yield (TTY) has been calculated and compared with the other Tb-155 production routes using data available in the literature. When no experimental data were available, the TALYS code [4] version 1.6 helped to estimate the TTY.
Results: In 2014, cross section values have been published for the Gd-nat(d,x)Tb-155 reaction [5]. Our set of data is in good agreement therewith. Tb-155 production cross section values for the Gd-nat(p,x) and Gd-nat(α,x) are also available in the literature. The Tb-155 TTY have been compared for each routes. Close values are obtained for the proton and the deuteron route. The Gd-nat(α,x) reaction gives the lowest TTY, whatever the incident beam energy. However, the use of a natural gadolinium target leads to the production of several contaminants and especially of Tb-156g which has the same half-life as Tb-155. Results based on calculations for two reactions using Gd-154 and Gd-155 enriched targets with, respectively, deuterons and protons as projectiles, are also discussed [3,6]. The Tb-159(p,5n)Dy-155(ε)Tb-155 reaction, with results published in 2014 [7], is also discussed as a promising production route using high energy protons.
Conclusions: New experimental data have been obtained at the ARRONAX cyclotron for the Gd-nat(d,x) reaction with a special emphasis on the Tb-155 production. The results have been compared with different production routes, using natural and enriched gadolinium target. Based on the calculations published in 2012 [6], the Gd-155(p,n) reaction seems to be the most promising for the production of Tb-155 with gadolinium as target element. However, the Tb-159(p,5n)Dy155(ε)Tb155 seems an interesting alternative.

Keywords: terbium-155, production routes, Thick Target production Yield

References:
[1] Müller C., et al. (2012). The journal of nuclear medicine, 53.
[2] Haddad F., et al. (2008). Eur. J. Nucl. Med. Mol. Imaging, 35:1377–1387.
[3] Duchemin C. PhD thesis, Université de Nantes (2015).
[4] Koning A.J. and Rochman D. Modern nuclear data evaluation with the TALYS code system. Nucl. Data Sheets, 113, 2012.
[5] Tárkányi F., et al. (2014). Applied Radiation and Isotopes, 83.
[6] Vermeulen C., et al. (2012). Nuclear Instruments and Methods in Physics
Research Section B: Beam Interactions with Materials and Atoms, 275.
[7] Steyn, et al. (2014). Nuclear Instruments and Methods in Physics Research Section B, 319.

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RapidArc commissioning and dosimetric verification using EPID portal dosimetry system

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Purpose: In this study, we report the rapid arc commissioning and dosimetric verification measurements performed with the electronic portal imaging device (EPID) having portal dosimetry software.
Material and Methods: The dosimetric tests were performed on RapidArc capable Varian Unique linac, which is equipped with millennium 120 Dynamic Multi Leaf Collimators (DMLCs) and having 6 MV X-ray beam. The Varian RapidArc QA files, Eclipse treatment planning system (TPS) and EPID portal dosimetry system were used in this study. The RapidArc QA files incorporate following tests. 1) DMLC dosimetry. 2) Picket Fence (PF) test vs. gantry angle. 3) PF test during