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P.O. Box 245, H-1519 Budapest, Hungary
Phone: +36 1 464 8240
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TTY and RNP calculations for the production of ^{155}Tb using the precursor technique ^{nat}Dy(d,x)^{155}Dy(ε,β$^+$)^{155}Tb

Michele Colucci[1,2], Flavia Groppi[1,2], Ferid Haddad[3,4], Etienne Nigron[4], Simone Manenti[1,2]*

[1]Department of Physics, University of Milan, via Celoria 16, I-20133 Milan, Italy
[2]LASA, University of Milan and INFN-Milano, via F.lli Cervi 201, I-20090 Segrate, MI, Italy
[3]Laboratoire Subatech, IN2P3-CNRS, IMT Atlantique, Nantes Université, 4 rue Alfred Kastler, 44307 Nantes, France
[4]GIP Arronax, 1 rue Aronnax, 44817 Saint-Herblain, France
[*]E-mail: michele.colucci@unimi.it

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Four of the terbium radioisotopes have great potential as theranostic radionuclides [1]. This work mainly focuses on ^{155}Tb (I_{ec}=100%, $T_{1/2}$=5.32 d). It emits gamma rays with energies suitable for SPECT studies and the absence of β^+/ β^- emissions reduces the radiotoxicity of this radionuclide. The effectiveness of ^{155}Tb for the diagnostic in nuclear medicine has been preclinically proved [1].

It has been demonstrated that ^{155}Tb can be produced using the precursor technique ^{155}Dy(ec,β$^+$)^{155}Tb [2]. ^{155}Dy, in turn, can be produced exploiting the nuclear reaction induced by deuterons on natural dysprosium targets. The cross-section of this reaction has been experimentally measured [3,4]. Here, the Thick-Target Yield (TTY) as a function of the irradiation conditions and of the thickness of the dysprosium target has been determined. EMPIRE-3.2.3 simulation tool has been used to decuple the cumulated cross-sections of ^{1xx}Dy and ^{1xx}Ho when the experimental values are not present. The double step radiochemical separation process that permits to extract ^{155}Tb in no-carrier added condition has been theoretically optimised and maximum RadioNuclidic Purity (RNP) obtainable has been determined. A simplified scheme is reported in Figure 1. The possibility to exploit the optimised production and the subsequent separation process to obtain high purity ^{155}Tb for clinical applications has been discussed.

Figures

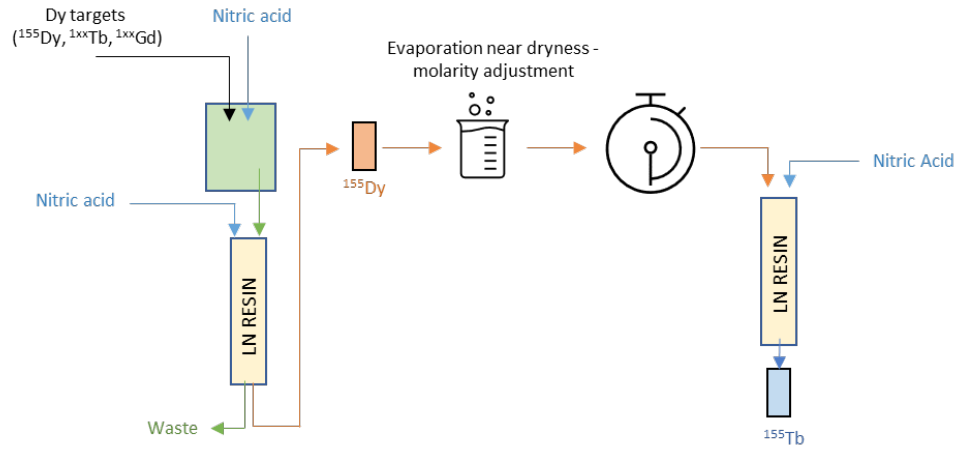

Figure 1. Simplified scheme of a double step radiochemical separation to realise a theoretical precursor for the production of ^{155}Tb starting from ^{nat}Dy targets irradiated with deuterons.

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