# Imaging applications of 165Er and its surrogate 155Tb (Otto-165)

**User project identifier:** 1648739900_NHBST
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**PRISMAP facility in charge:** CERN-MEDICIS

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## 1. Authors

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## 2. Context of the project (800 characters max. including spaces)

To develop new probe for MRI, a radioactive lanthanide, $^{165}$Er, for bimodality imaging (SPECT/MRI) was produced with our cyclotron. For the first time in France, $^{165}$Er, was complexed with a new probe (sensitive to concentration of Zn) and used as a cocktail with its Gd(III) complex to quantify Zn(II) ions in vitro based on MRI images. However, the shut-down of our cyclotron at the end 2022 will stop these projects. Therefore, we looked for alternatives to continue our high impact projects.

Project Otto-165 aims at exploring alternatives of production of $^{165}$Er by proton/deuton irradiation, which will be used for quantification methods in bimodal imaging SPECT/MRI projects:

(1) Production of $^{165}$Tm by spallation
(2) Separation $^{165}$Tm/$^{165}$Er
(3) Creation of a generator $^{165}$Tm/$^{165}$Er

## 3. Results and discussion (1000 characters max. including spaces)

Due to difficulties to obtain licence in France (2 years), first delivery was done at Roskilde (Denmark).

The 100MBq of $^{165}$Tm was delivered at Orleans.

The separation of 165Tm/165Er by an extraction resin LN2 (20 – 50 µm) give access to a high purity $^{165}$Er in less than two hours after dissolution of target.

At point no $^{165}$Er free was eluted from a generator 165Tm/165Er. High level of impregnation of DOTA on CV support, presence of carboxyl groups in CV support and chemistry of complexation of DOTA according to conditions of middle explain this negative result.

## 4. Conclusions (800 characters max. including spaces)

The concept of generator 165Tm/165Er is not available (one delivery was planned for the 14 th October). No free 165Er to elute but:
Production of 165Tm is available at CERN
Recover 165Er from 165Tm is possible by classical separation using extraction resin as LN2 (20 – 50 µm) with high quality.
No experiments with 155Tb were done because 165Er at point not available for comparison.

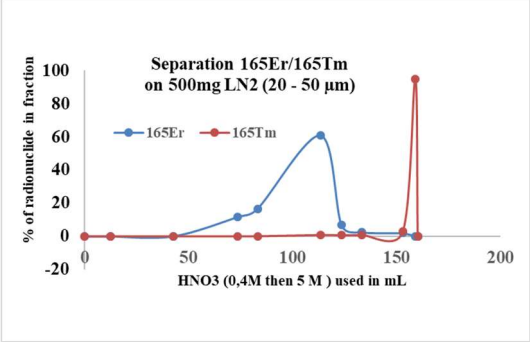

Figure 1. Separation 165Er/165Tm on 500 mg LN2 ( 20 – 50 µm)

## 5. Involvement of the PRISMAP services (600 characters max. including spaces)

Without PRISMAP, the possibilities to continue our activities around 165Er will be limited. This project supports our idea of generator 165Tm/165Er and probably, helps us to obtain foundings for this topic : CNRS call project Gen-165Tm (2024 – 2025). By this way, some studies about used carbon porous materials have been initiated to understand the retention of 165Tm on support and how to solve it. More generally, this project initiates a reflexion about development of exotic radionuclides using the network PRISMAP.

## 6. Feedback to PRISMAP (600 characters max. including spaces)

The contact with PRISMAP for the 165TM delivery were great and efficient. I appreciate the exchanges and understanding of staff about our difficulties (authorization, delay of delivery). For 165Tm, the mayor difficulty is the logistic between delivery and use the source. We receive the source on Friday and it's difficult to benefit of it correctly. On Monday, the activity was divided by more than 4 reducing the possibilities to use it. For the last delivery, we will receive on Tuesday that is better for us.

## 7. Publications and other dissemination activities (conferences etc.)

We intend to publish an article about the generator 165Tm/165Er considering data from spallation irradiation (Project PIRSMAP) and alpha irradiation (CNRS project : Gen-165Tm).
We present partial results about this project (separation 165Tm/165Er) on the 7$^{th}$ SCIENTIFIC DAYS OF THE CNRS NETWORK "MOLECULAR IMAGING AGENTS" (GDR AIM) (France Nantes 30.06.25 – 02.07.25) : production of 165Er. We has been submitted an abstract (accepted) to *JEMP 2025 – Orléans –4-6 November 2025 :* Use of functionalized mesoporous carbons in production of $^{165}$Er. Finally, we intend to present some results on the 16th Workshop of the European Network of Research Cyclotron (22 – 24 October 2025 Coimbra).

## Appendix 1. Dissemination guidelines for user projects as agreed in the signed User Agreement

### Dissemination rules

Only user groups that are allowed to disseminate the results which they have generated under the project may benefit from the access, unless they are working for SMEs.

For each user group project, a publishable project summary and a publishable summary of the results will be published on the European Union Horizon 2020 PRISMAP project website www.prismap.eu. The publication of results in journals or at conferences is strongly encouraged.

To ensure the long-term sustainability of the PRISMAP initiative, proper recognition of the contributing facilities, their services and the involved persons is necessary. All participating PRISMAP facilities shall be acknowledged in the publication. Acknowledgement and co-authorship of PRISMAP staff members who participated in the experiment shall be considered according to the research field best practices and verified with the PRISMAP Technical Manager before any publication.

The user group shall contact the PRISMAP Technical Manager 30 days prior to submission of publications or other communications of results that were obtained by making use of services provided by PRISMAP (radionuclides delivered or medical services provided). The Technical Manager will communicate to the user group the list of PRISMAP facilities and persons that have contributed to each specific project and the way this contribution must be acknowledged in the publication/communication or where co-authorship is required to reflect specific scientific contributions.

Users must comply with Horizon 2020 dissemination rules (i.e. acknowledge that their work was financially supported by the European Union's Horizon 2020 Research and Innovation Programme by including the following acknowledgement: "This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008571 (PRISMAP)"), and grant open access to resulting publications and related data.

Dissemination shall take place only once legitimate interests regarding intellectual property have been safeguarded. A maximum publication delay of 90 days may be granted for this purpose.

### Acknowledgements

The list of name(s) to be mentioned in the acknowledgment section is sent to the technical manager by the main contact of the involved facilities.

A general sentence will be added by the corresponding author of the article (user side):

"The authors would like to thank the members of the PRISMAP consortium and of the PRISMAP user selection panel, coordination and management team for their advice and support."

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