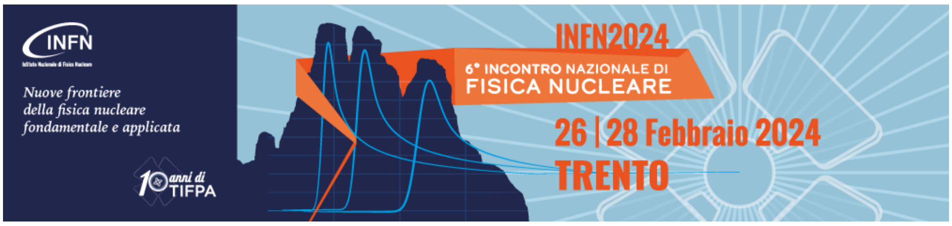

Contribution ID: **96** Type: **flash talk**

Theoretical simulations for innovative nuclear medicine applications: cyclotron production of the theranostic radionuclides ^{47}Sc and ^{155}Tb

Wednesday, February 28, 2024 12:40 PM (5 minutes)

The novel approach of the precision nuclear medicine is tailoring the treatments on the patient instead of adapting the patient to standard therapies. The uniqueness of the patients'response to treatments is now the focus of the latest research. To achieve this goal the use of radiopharmaceuticals suitable for theranostic applications is a valid strategy. Theranostics conjugates diagnosis and therapy exploting the chemically identical composition of the drug used for both imaging and therapy.
Scandium-47 and Terbium-155 are both very promising and innovative radionuclides for precision nuclear medicine and the scientific community currently debates about feasible production routes in compliance with the clinical standards. In view of pre-clinical and clinical applications it is fundamental to produce the radionuclides of interest with high quality. The theoretical analysis is the first and crucial step to identify the optimal production parameters and irradiation conditions, limiting the co-production of those contaminants that could affect the purity of the final product. Nuclear-reaction theory for equilibrium and pre-equilibrium processes is well established and can be employed to simulate the cross sections production of both ^{47}Sc and ^{155}Tb and their main contaminants [1].
Currently, the ^{47}Sc production methods are not adequate to meet the medical standards required for a safe clinical practice. We have investigated the cyclotron routes ^{49}Ti(p,2pn), ^{49}Ti(d,α), and ^{50}Ti(p,α). The theoretical results of the cross sections have been compared with the the new preliminary REMIX data and few old datasets of the literature. To better reproduce the cross sections an optimization through genetic algorithms, inspired by Darwin's theory of natural selection, has been performed. The tuning of the models free parameters of the nuclear level densities allows to improve the theoretical cross sections and to be more precise in the prediction of the activities and radionuclidic purity derived form the cross sections evaluation. The results indicate the d-^{49}Ti channel a promising reaction, possibly also for a ^{47}Sc production by low-energy (hospital) cyclotrons. Similar outcomes are obtained for the reaction with protons on enriched ^{50}Ti targets, while the route p-^{49}Ti results unfeasible for clinics [2].
Regarding ^{155}Tb its interest is on the rise, however its availability in the market with sufficient purity to be adequate for actual applications is still an open issue. Focusing the attention on the level of enrichment of the enriched ^{155}Gd targets we found out that the major contribution to the contamination depends on the amount of ^{156}Gd impurity in the target. Thus, the target purity is the crucial issue and we identified the minimum enrichment necessary for the use of ^{155}Tb as safe imaging agent [3].

[1] A. Koning, S. Hilaire, S. Goriely, Eur. Phys. J. A59 131 (2023)

[2] F. Barbaro, L. Canton, Y. Lashko, L. Zangrando, arXiv: 2310.02825 [physics.med-ph] (2023)

[3] F. Barbaro, L. Canton, N. Uzunov, L. De Nardo, L. Melendez-Alafort, arXiv: 2309.06250 [physics.med-ph] (2023)

Primary authors: BARBARO, Francesca (Department of Physics and Astronomy, University of Padova; Istituto Nazionale di Fisica Nucleare Padova); CANTON, Luciano (Istituto Nazionale di Fisica Nucleare); LASHKO, Iuliia (Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine; Istituto Nazionale di Fisica Nucleare Padova); ZANGRANDO, Lisa (Istituto Nazionale di Fisica Nucleare Padova)

Presenter: BARBARO, Francesca (Department of Physics and Astronomy, University of Padova; Istituto Nazionale di Fisica Nucleare Padova)

Session Classification: Applications of Nuclear Physics III