

Proton-induced nuclear reactions on natV and ⁴⁹Ti for the theranostic ⁴⁷Sc production: preliminary cross-section results

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In recent years, as underlined by the IAEA CRP (Coordinated Research Project) on ⁶⁷Cu, ⁴⁷Sc, and ¹⁸⁶Re (1), the scientific interest focused on ⁴⁷Sc due to its theranostic characteristics making it exploitable both for therapeutic and diagnostic purposes. In fact, in its radioactive decay to the stable ⁴⁷Ti, ⁴⁷Sc ($t_{1/2}=3.3492$ d) emits γ -rays of the proper energy ($E=159.381$ keV, $I=68.3\%$) to be used with SPECT (Single Photon Emission Computed Tomography) cameras, together with low-energy β^- -particles ($E_{mean}=162.0$ keV, $I=100\%$) suitable for the treatment of small-medium sized tumors.

At INFN-LNL, in the framework of LARAMED (LABoratory of RADionuclides for MEDicine) (2), the possible production routes of ⁴⁷Sc using proton beams are investigated in two different projects: PASTA (Production with Accelerator of Sc-47 for Theranostic Applications) and REMIX (Research on Emerging Medical radIonuclides from the X-sections). In PASTA, funded by INFN for the years 2017/2018, the production using natV and enriched ⁴⁸Ti targets is studied (3,4). On the other hand, within the REMIX project, funded by INFN for the years 2021/2023, the employment of enriched ⁴⁹Ti and ⁵⁰Ti is analyzed. Those targets are irradiated in collaboration with the ARRONAX facility (5) where a 70 MeV proton beam is provided by a cyclotron similar to not yet operative one installed at LNL. However, the enriched targets are realized at Legnaro laboratories (6).

In this work, the ⁴⁷Sc cross-section values obtained from the proton bombardment of natV targets are presented and compared to the preliminary results achieved when using, instead, enriched ⁴⁹Ti targets. Together with ⁴⁷Sc, also the cross-sections of the co-produced contaminants are taken into account since they can contribute to the dose delivered to a patient. In particular, ⁴⁶Sc ($t_{1/2}=83.79$ d) represents the main contaminant since it is not possible to wait for its decay and it cannot be separated chemically. The results are also compared to the literature data, when available.

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