Application of Monte Carlo simulation codes to plan an activation experiment in Scandium-45 targets

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Data characterizing excitation functions of nuclear reactions are necessary for different applications, with the process of radionuclide production being assumed as a relevant example. This is the only way to define and optimize technical parameters involved in such a process. However, nuclear activation experimental studies are sometimes difficult to implement, and care should be taken before its execution, in order to obtain all relevant data, while correctly planning the experiences. In this context, Monte Carlo simulation tools are widely applied to overtake such difficulties.

This work describes a case-study aiming to characterize nuclear reactions excitation functions induced by a proton beam and its interaction with a Scandium target – a specific situation that is not yet completely characterized and that might be of relevance, since it could be useful to produce medically relevant radionuclides (eg. Titanium-45).

Proton induced nuclear reactions in Scandium were studied (with emphasis for low energy/current beams, bellow 18 MeV) in the way to plan an activation experiment based on the stacked foil technique to study radionuclide production. Monte Carlo TALYS code was used to obtain cross-sections and SRIM/TRIM code with SSSM sub-routine was applied to study stopping power and range of the ion beam in the target, important to define the number and dimensions of foils applied.

Results seem to demonstrate the possibility to obtain clinically useful radionuclides based on Scandium-45 irradiation with low energy beams, as well as the design of an optimized methodology for the experimental apparatus to be used. Other results will be presented with emphasis on the description of technical variables and quantification of its impact on results, including nuclear reactions fundamental statistics, beam geometry and currents applied, as well as considerations for the specific case in study, aiming to demonstrate the value of these

methodologies when approaching the development of candidate radionuclides underpinning new biomarkers.

Simulated excitation functions are very important to give an overview of nuclear reactions before the experimental exploration phase, and real beam simulation using SSSM sub-routine appears to provide more precise beam energy degradation and projected range study than using SRIM/TRIM code alone.

Foi decidido que não será apresentada a versão integral deste documento.

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