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#4-230 Characterization of the neutron field of a proton accelerator using Monte Carlo simulation and gamma spectrometry-SSNTD measurements

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Nuclear activation is the process of production of radionuclides by irradiation. This phenomenon concerns all operating or soon-to-be dismantled particle accelerators used in various fields, from medical applications with the production of radioisotopes or radiotherapy cancer treatments to industrial applications with the sterilization of materials and food preservation. For more than three decades, the possibility of using cyclotrons for nuclear power generation and nuclear waste disposal has also been discussed, based on the Accelerator-Driven System technology.
This work focuses on the lower energy range of such cyclotrons, in particular with the study of the radioactivity induced in various materials (Sc, Tb, Ta, W, Au) of known composition, irradiated by protons of 13.5, 16.5 MeV and 18 MeV energies in the cyclotron facilities CYRCé and Cycéron. We have performed Monte Carlo simulations based on GEANT4, FLUKA, and PHITS to estimate the neutron fields and their associated induced activities, associated with FISPACT-II, DCHAIN-PHITS and TMX_Bateman.
A comparative study with nuclear data and MC codes highlighting discrepancies for certain nuclear reactions has been analyzed with relevance. We confronted the simulation calculations results with experimental activation measurements performed by high-resolution gamma-ray spectrometry (HpGe, LABSOCS). For this comparison, a new decay database was produced and used based on latest results from NUBASE20 and ENSDF.
These results are strongly correlated to the neutron fields. These fields were characterized experimentally through their thermal and fast neutron components using Solid-State Nuclear Track Detectors (CR-39, Chiyoda Technol) to validate the MC simulations.

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