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# Comparison of (p,n) and (n,gamma) reactions for ADS decommissioning

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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 [1]. 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 technology looks promising and will give an essential impulse to developing high-power cyclotrons.

The IAEA advocates for the definition of a decommissioning plan for any particle accelerator facilities. Such plans mandate in particular a radionuclides inventory. The Monte Carlo software are an essential components of achieving such estimation, with a critical choice of nuclear database.

JANIS is a database regrouping the main models (such as ENDF, TENDL or JEFF). This work focuses on the (p,n) and (n,gamma) reaction on the ADS range of energy i.e., 1 - 1000 MeV and give a systematic analysis of them. This discussion will be joined by the extraction of cross-sections and particle yield of the four main Monte Carlo software which are Fluka, PHITS, Geant4 and MCNP6.

This discussion will be applied to the study of the radioactivity induced in various materials (Sc, Tb, Ta, W, Au), of known composition, irradiated by protons of 13.5 and 16.5 MeV energies in the cyclotron facility CYRCé, focusing on the lower energy range of ADS. Through MC, we have estimated the neutron fields and their associated induced activities [2]. We confronted the simulation calculations results with experimental activation measurements performed by high-resolution gamma-ray spectrometry (HpGe, LABSOCS).

### References

- [1] A. Nourredine, N. Arbor, J. Riffaud and al., Assessment of Activation in Food Products Irradiated with High Energy X Rays. IAEA-TECDOC-2008, 978-92-0-137022-Vienna (2022) pp. 193-214
- [2] J. Collin, J.M Horodyski, N. Arbor, M. Barbagallo, L. Tagliapietra, F. Carminati, G. Galli Carminati, A. Nourredine, Validation of Monte Carlo simulations by experimental measurements of proton- and photon-induced activation in cyclotrons and LINAC, 8th International Conference on Advancements in Nuclear Instrumentation Measurement Methods and their Applications, Lucca, 12-16 June 2023

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