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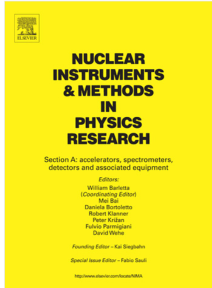


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# Comparison of the thermal neutron scattering treatment in MCNP6 and GEANT4 codes

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**Abstract.** To ensure the reliability of simulation tools, verification and comparison should be made regularly. This paper describes the work performed in order to compare the neutron transport treatment in MCNP6.1 and GEANT4-10.3 in the thermal energy range. This work focuses on the thermal neutron scattering processes for several potential materials which would be involved in the neutron source designs of Compact Accelerator-based Neutrons Sources (CANS), such as beryllium metal, beryllium oxide, polyethylene, graphite, para-hydrogen, light water, heavy water, aluminium and iron. Both thermal scattering law and free gas model, coming from the evaluated data library ENDF/B-VII, were considered. It was observed that the GEANT4.10.03-patch2 version was not able to account properly the coherent elastic process occurring in crystal lattice. This bug is treated in this work and it should be included in the next release of the code. Cross section sampling and integral tests have been performed for both simulation codes showing a fair agreement between the two codes for most of the materials except for iron and aluminium.

**Keywords:** Benchmarking, Monte Carlo simulation, thermal scattering law, MCNP6, GEANT4, CANS.

## 1. Introduction.

Monte-Carlo simulation tools have been used for decades to design and develop thermal neutron facilities, typically neutron reactors. These tools provide an efficient and economical way to predict neutron flux and shielding as well as optimization studies. In the framework of Compact Accelerator-driven Neutron Source (CANS) developments such as the SONATE project in France [1], accurate and validated simulation codes are needed to design the Target-Moderator-Reflector (TMR) system and to estimate reliably the neutron production, expressed in terms of neutron fluence, time resolution and energy spectrum. Two of the most widely used codes are MCNP [2] and GEANT4 [3]. To ensure the reliability of these two codes, many verifications and validations can be found in the literature [5][6]. Besides the comparisons with measurement data, these two codes are frequently the objects of benchmarks [8][10][12]. Good agreements between these codes, which basically use similar models or evaluated data libraries, are often found, but rarely show the same results in realistic measurement simulations [10]. This fact was illustrated in the work performed by Mendoza *et al*. [8], in which differences in the neutron energy distributions have been found between GEANT4 and MCNPX for a small set of isotopes in the ENDF/B-VII.0 library. Nevertheless, an ambiguity remains about the origin of this difference that could come from the statistical treatment of the unresolved resonance region or the neutron thermal library. Recently, Monk *et al.* [10] showed a good agreement between MCNP6-1.0 and GEANT4-10.1 on the neutron energy spectrum for distances close to the source, yet larger deviations when greater distances and more complex geometries are considered.