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FLUKA and MCNP simulation benchmark for neutron yield measurement in HBS project

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The High Brilliance Neutron Source (HBS) project was initiated at the Jülich Centre for Neutron Science of the Forschungszentrum Jülich (JCNS). This project aims to develop an accelerator-driven pulsed neutron source operating at low energy (below the spallation threshold) with high current ion beams (~100 mA) and optimized to deliver high brilliance neutron beams to a variety of neutron instruments.

In the framework of the HBS-project the neutron production in beryllium, vanadium and tantalum targets irradiated with protons of various energies (22, 27, 33 and 42 MeV) delivered by JULIC (Jülich Light Ion Cyclotron) was investigated. The neutron yield was determined via gamma-ray spectrometry measuring the count rate of 2.23 MeV prompt gamma-line of hydrogen induced by thermal neutron capture in the polyethylene moderator surrounding the target. For calibration, measurement with an AmBe source of well-known neutron emission was carried out. Corrections for neutrons escaping the moderator as well as for the spatial extension of the 2.23 MeV -gamma source inside the moderator were numerically performed using the Monte Carlo codes FLUKA and MCNP6.

In this work, the results of the simulations obtained with FLUKA and MCNP6 including the neutron yields of the targets and, the neutron and gamma correction factors to assess to the experimental neutron yields are presented and discussed. Finally, the simulated neutron yields are compared with the experimental neutron yields.

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