



Comparison of experimental and simulated neutron cold spectra for para- and ortho-hydrogen

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The High Brilliance Neutron Source (HBS) [1] project aims to develop a High-Current Accelerator-driven Neutron Source (HiCANS) for neutron scattering, analytics, and imaging. It will feature several cold neutron sources, including a liquid para-hydrogen moderator. At the Forschungszentrum Jülich, time-of-flight measurements were performed with the prototype of such a cryogenic moderator for different ratios between para- and ortho-hydrogen. In order to optimize the design of future instruments that will use this cold neutron source, an accurate description of the source characteristics is necessary, which requires simulations of the neutron transport to the detector for a comparison of simulated and experimental data.

This work focuses on the comparison of various simulated spectra against experimental ones for different para- and ortho-hydrogen ratios. Several Monte Carlo codes, including MCNP, PHITS, McStas, VITESS, and KDSOURCE, and nuclear data from the ENDF/B-VII.1, JENDL-4.0 and JENDL-5.0 libraries were utilized. The simulations started with the comparison of the proton-neutron yield spectra, continued with coupling the event files before and after the modeling of the neutron guide, and ended with the neutron time distribution at the detector. A good agreement between simulations and experiments was obtained, with a relative error below 20%.

The results provide insights into the strengths and limitations of each Monte Carlo code and nuclear data library combination. Not only the observed discrepancies are discussed, but also the potential sources of uncertainty are identified. Also, the conclusions will help to improve the accuracy and reliability of neutron cold moderator designs, especially for projects that will deploy a para-hydrogen cold source such as the HBS.

[1] T. Brückel et al, 2022. Technical Design Report High Brilliance Neutron Source. Forschungszentrum Jülich. <https://doi.org/10.34734/FZJ-2023-03722>

Hauptautor: SCHMIDT, Norberto (Jülich Centre for Neutron Science - Forschungszentrum Jülich GmbH)

Co-Autoren: Dr. SCHWAB, Alexander (Jülich Centre For Neutron Science (JCNS-2), Forschungszentrum Jülich, Germany); LI, Jingjing (Jülich Centre for Neutron Science JCNS); RÜCKER, Ulrich (Jülich Centre for Neutron Science JCNS); VOIGT, Jörg (Forschungszentrum Jülich GmbH); Dr. LIEUTENANT, Klaus (Jülich Centre For Neutron Science (JCNS-2), Forschungszentrum Jülich, Germany); Dr. MÁRQUEZ DAMIÁN, José Ignacio (European Spallation Source ERIC, Lund, Sweden); Prof. GRANADA, Rolando (Neutron Physics Department, Comisión Nacional de Energía Atómica (CNEA), Argentina); DAWIDOWSKI, Javier (Neutron Physics Department, Comisión Nacional de Energía Atómica (CNEA), Argentina); MAUERHOFER, Eric (Jülich Centre for Neutron Science JCNS); GUTBERLET, Thomas (Jülich Centre for Neutron Science JCNS); ZAKALEK, Paul (Jülich Centre for Neutron Science (JCNS-HBS), Forschungszentrum Jülich GmbH, 52425 Jülich, Germany)

Vortragende(r): SCHMIDT, Norberto (Jülich Centre for Neutron Science - Forschungszentrum Jülich GmbH)

Sitzung Einordnung: Mounting Posters, Beer and light Dinner

Track Klassifizierung: Sources & Upgrades