Investigation of the mutual influence of multiple extraction channels for accelerator-based neutron sources

Doruntin Shabani[1], Ulrich Rücker [2], Jingjing Li[2], Paul Zakalek[2], Norberto Schmidt[2],

Christoph Langer[1], Thomas Gutberlet[2], Thomas Brückel[2]

[1] University of Applied Sciences, Fachhochschule Aachen, 52428 Jülich, Germany
[2] Jülich Center for Neutron Science (JCNS-HBS), Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

Abstract

Compact accelerator-based neutron sources (CANS) are an emerging technology that enables scientists to analyze the dynamics and structure of matter. One of these projects is the High Brilliance neutron Source (HBS) project, which aims to tailor the neutron beams to meet requirements for different instruments [1]. A key component in the optimization process is the development of the target-moderator-reflector (TMR) system, where the moderator plays an important role in accumulation, moderating, and emitting neutrons towards several instruments through extraction channels. This study investigates the mutual influences of several extraction channels on the neutron flux and the beam divergence compared to a one extraction channel system.

To understand the production, moderation and propagation of neutrons Monte Carlo particle-tracking codes, such as MCNP and PHITS can be used. Simulations using the PHITS program have first been performed for a single extraction channel system to observe moderator design effects on the beam divergence and the peak neutron flux emitted towards the instrument. Lastly, several arrangements of multiple extraction channels have been simulated to investigate the influence of additional extraction channels on the flux and the beam divergence.

The results achieved in this study show that the influence of multiple extraction channels on the thermal neutron flux is minimal depending on the amount of moderator material that is used and on the arrangement of the channels. The insights gained from this work contribute to the continuous development of the HBS project and provide helpful information for the optimization of such a neutron source and design of neutron extraction channels in forthcoming neutron source facilities.

References

[1] T. Brückel, T. Gutberlet (Eds.), Conceptual Design Report – Jülich High Brilliance Neutron Source (HBS), (2020)

PLEASE INDICATE YOUR TOPIC No.: 12

All topics are exclusively CANS-related.

1. Accelerators and beam optics
2. Target development and moderator neutronics
3. Neutron detection and neutron optics
4. Neutron scattering and material characterization
5. Neutron imaging and analytics
6. Nuclear data measurements and evaluation
7. Nuclear astrophysics and other neutron applications
8. Innovative instrumentation
9. Medical applications
10. Computer simulations and instrument performance
11. Neutron irradiation
12. CANS projects and facility developments
13. Potentials for industrial applications