Development of an Epithermal and Fast Neutrons Target-Moderator-Reflector Unit for the HBS

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Abstract

The High Brilliance Neutron Source (HBS) project aims to develop a High-Current Accelerator-driven Neutron Source (HiCANS) for neutron scattering, analytics, and imaging. Fast neutrons with an average energy of 0.5 MeV will be generated by the interaction of 70 MeV, 100 mA proton beam with a tantalum target. Three target-moderator-reflector (TMR) stations will operate at different frequencies to deliver individually tailored beam characteristics for each instrument. For the low (24 Hz, 667 us) and medium (96 Hz, 167 us) frequency stations, the neutrons will be slowed down into the thermal and cold energy regimes, respectively, by corresponding moderator systems. In addition, a high-frequency mode can be adopted for a short pulse (~4-8 us) in one of the medium-frequency stations using an appropriate chopper system.

For this last case, it is desired to have an optimal epithermal and fast neutron flux, in order to carry out different experiments such as prompt gamma analysis based on inelastic neutron scattering (PGAINS), and resonance neutron imaging (RNI). These instruments will be well-suited for preservation of cultural heritage, characterization of archaeological objects, materials science, and study of large and dense objects such as batteries or aeronautical components.

Some of the most essential neutronic parameters for this kind of experiments are the integral epithermal neutron flux, the ratio over integral fast neutron flux, and the energy versus time neutron distribution. For the optimization of these different parameters, simulations with the PHITS Monte Carlo code were performed.

The objective of this work is the presentation of the conceptual design of an epithermal and fast neutron TMR unit for the HBS project, considering the choice of the coolant, moderator, and reflector materials.

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