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Advancing the MCNP Unstructured Mesh Calculations at ORNL's Second Target Station

Tuesday, 28 May 2024 12:40 (20 minutes)

The Second Target Station (STS) at Oak Ridge National Laboratory (ORNL) Spallation Neutron Source is designed to become the highest peak-brightness source of cold neutrons in the world. A preliminary design of the STS consists of a rotating tungsten spallation target driven by a short-pulsed 1.3-GeV, 700-kW proton beam and two coupled parahydrogen neutron moderators at 20 K surrounded with a water premoderator and a beryllium reflector. To advance the STS design in a timely manner and complete a large volume of supporting neutronics calculations, we employ the most efficient computational tools that are currently available. Key among these tools is the Unstructured Mesh (UM) geometry capability of the radiation transport code MCNP6.2 [1] and the latest Attila4MC [2] mesh generator and variance reduction modules. The UM geometry capability allows us to convert the computer aided design (CAD) models into high-fidelity models for neutronics calculations, evaluate the performance of the moderators, calculate the dose rates throughout the facility, and deliver heating profiles in the beam intersecting devices with high spatial resolution for the subsequent structural stress, thermodynamic, and other engineering analyses.

This talk focuses on several practical applications of the UM geometry capability within the scope of the STS. We discuss the use of Attila4MC's Part-by-Part Mesher and Cottonwood, a new variance reduction solver designed to be used with discontinuous (complex) meshes. These highly efficient tools were used to carry out radiation shielding calculations, including streaming through the gaps, for a few cases involving prompt neutron and shutdown gamma radiation. Problems encountered and their resolution will be presented.

[1] C. WERNER (ed.), et al. "MCNP User's Manual, Code Version 6.2," LA-UR-17-29981, Los Alamos National Laboratory (2017).

[2] Attila4MC 10.2 Overview of Core Functions, Silver Fir Software, Inc., Gig Harbor, WA, USA, SFSW-UR-2020-OCF102 (2020).

Scientific Topic 1

Source terms, new accelerator facilities and related topics

Scientific Topic 2

Code status, development and model converters

Scientific Topic 3

Scientific Topic 4

Scientific Topic 5

Scientific Topic 6

Scientific Topic 7

Scientific Topic 8

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Session Classification: Session 2 - Code status, development and model converters

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