

Verification & validation of the collision tracking feature in OpenMC for light output simulations in organic scintillators

Oskari Pakari^{1,2,*}, Michel Saliba¹, David Breitenmoser³, Sara Pozzi³

¹EPFL, Laboratory of Reactor Physics and System Behavior, 1015 Lausanne, Switzerland;

²PSI Center for Nuclear Engineering and Sciences, 5232 Villigen, Switzerland;

³Department of Nuclear Engineering and Radiological Sciences, University of Michigan, Ann Arbor, Michigan, 48105, USA

ABSTRACT

Accurate modeling of organic scintillators requires access to event-by-event particle interaction histories to properly account for non-linear light yield and quenching effects. While MCNPX-PoliMi with MPPost processing has historically served as frequently used tool for detector response simulations, the open-source Monte Carlo code OpenMC has recently implemented a collision-tracking feature capable of similar particle-history outputs. In this work, we validate the efficacy of OpenMC for predicting the response of organic scintillation materials. We performed a comparative study using a trans-stilbene crystal exposed to a ^{252}Cf source. Collision histories were generated in OpenMC and post-processed using the MPPost code to apply energy-dependent light yield functions. The resulting simulated light-output spectra were benchmarked against both MCNPX-PoliMi simulations and experimental pulse-height distributions. The OpenMC results demonstrate agreement with the established MCNPX-PoliMi methodology and reproduce the experimental measurement within uncertainty limits. These results confirm that OpenMC's collision tracking capability provides a robust, open-source alternative for the precise modeling of organic scintillator response functions and spectral analysis.