ABSTRACT

Benchmarking of Monte Carlo Codes and Sensitivity Analysis of Physics models in MCNPX for High Energy Projectile-Target Interaction. **JERRAD DEASON**[1] (Student) **ERIC WRIGHT**[1] (Student) **SUKESH AGHARA**[1] (Faculty) **IGOR REMEC**[2] (Mentor) and **JEFFREY O. JOHNSON**[2] (Mentor) [1] Prairie View A&M University, Prairie View, TX 770446 [2] Oak Ridge National Laboratory, Oak Ridge, TN 37831

Neutral and charged particle transport phenomena is described with the Boltzmann transport equation. The numerical solution of the Boltzmann transport equation is applicable to various fields of nuclear engineering and physics. One such numerical technique, the Monte Carlo method, provides stochastic solutions to the particle transport calculations utilizing detailed three-dimensional geometry. With improved computational speeds, Monte Carlo codes are being applied for many radiation transport application such as reactor physics, radiation shield analysis and medical physics. Recent implementation of heavy ion transport capabilities has advanced the applicability of these codes to space and high energy physics problems. MCNPX (Monte Carlo N-Particle eXtended) and PHITS (Particle and Heavy-Ion Transport System) are two such multi-purpose particle and heavy ion transport codes that implement the Monte Carlo method and are ideally suited for characterization of high energy charged particle interactions and heavy ion transport design studies. However, the application of these codes currently has limitations as they are relatively new and unverified, particularly in the energy regimes where charged particle interaction data is sparse or absent. In these regions codes rely on physic model calculations to compute interaction probabilities. The work performed here was to validate and benchmark these two transport codes against the quantitative data collected from a peer-reviewed journal article. The article reports secondary neutron spectra measurements at discrete angles from a target to the scintillator detectors. The report presents the comparison of measured values with the computational results for two targets (water and lead) at nine different angles (0, 6, 15, 30, 45, 60, 90, 120 and 150) with a specific energy distribution at each angle. Additionally, for the lead target, calculations were performed at two different incident alpha energies (710-MeV and 640-MeV) and compared to the measured data. The resulting data extracted from the codes, are graphed on a log-log plot to illustrate the difference between the measured and computational neutron spectra at the various angles. The simulated geometries for the water target were then subjected to several alterations in the computational structures and physic mode implementations, such as, removing the columbic barrier parameter, and changing the physics models from the program defaults (Bertini and ISABEL) to the CEM2K model. These additional calculations were performed to compare the sensitivity of the physics models on the neutron production spectra.

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