NUMERICAL ANALYSIS OF BENCHMARK DATA using MCNPX

Developments in the radiation transport codes for high energy radiation transport have triggered the applicability of these codes to new areas of research within the high energy physics and the NASA communities. These codes are now being utilized to analyze secondary particle production from Galactic Cosmic Ray (GCR) and Solar Particle Event (SPE) interactions in space environments. Similarly, they are also applicable to the analyses associated with target selection and design for advanced high energy particle accelerators and associated shielding. MCNPX (Monte Carlo N-Particle eXtended), an extended version of the industry standard Monte Carlo N-Particle transport code (MCNP), is being evaluated for such applications. MCNPX provides a complete 3D simulation of the problem geometry. It also provides the ability to utilize nuclear cross section libraries, when available, and physics models for particle types and energies where tabular nuclear data are not available. The results from MCNPX calculations, performed to benchmark neutron production from high energy source (alpha) – target interactions, were compared to measured values reported in a peer-reviewed journal article. This work was performed to better understand the limitations of the MCNPX physics models and to validate the code's applicability to heavy ion accelerator target design. The analysis was performed for a focused 710 MeV alpha ion beam on four different target materials: Water, Carbon, Lead and Stainless Steel (SS). The computational results are compared with the measured data at nine different angles; seven forward angles (0, 6, 15, 30, 45, 60, and 90) and two back angles (120 and 150) with a specific energy distribution at each angle. The source-target-detector geometry was modeled explicitly with all the details that were documented in the journal article. The calculations were performed to attain 10% uncertainty or better. In most cases sixty million source particles were simulated in a parallel mode (Parallel Virtual Machine, PVM) on a 24 node Linux Cluster, "cpile," within the Nuclear Science and Technology Division (NSTD) of Oak Ridge National Laboratory (ORNL). This work supports the benchmark efforts of the Radiation Shielding Group of NSTD for applying MCNPX to target station design for particle accelerators such as the Rare Isotope Accelerator (RIA) and Spallation Neutron Source (SNS).

Student's Names:	**Eric Wright, Jerrad Deason**
School Students Attend:	Prairie View A&M University
Faculty's Name:	**Sukesh Aghara**
Name of Mentors:	**Igor Remec , Jeffrey O. Johnson**
Division:	Nuclear Science and Technology
Program:	DOE Faculty and Student Teams