

Nov 7th, 3:00 PM - 4:00 PM

Use of High Fidelity Fission Models in Criticality Calculations

Daniel H. Timmons

University of New Mexico - Main Campus, dtimmons@unm.edu

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Use of High Fidelity Fission Models in Criticality Calculations Daniel Timmons, Dr. Christopher Perfetti

The use of Monte Carlo, random number sampling, for neutron transport has been used for about half a century. There are many benchmarks that have been used to validate neutronics codes, mostly for critical systems. Critical systems are systems where the neutron population from one generation to the next is the same. Subcriticality is when there are less neutrons in the next generation and supercriticality is when there are more neutrons in the next generation than there were in the previous. To calculate criticality, a set number of neutrons are started in a system. Those neutrons interact and the number that were created for the next cycle are compared to that of the previous cycle. This is done for a certain amount of cycles after the source has converged, which is necessary due to the stochastic nature.

Another method of tracking neutrons is called a fixed source problem. In this case the neutrons are only tracked from start to finish and can be useful in dosimetry cases. This method relies on all the particles ultimately being captured, by larger nuclei, or leaking out of the system. For a critical or supercritical systems this may be impossible, due to the divergence of the neutron population. Therefore, it was proposed to use the previously mentioned method for neutron transport. This allows for the use of high fidelity fission event models. This would allow for more accurate fission event modeling and thus results for these fission events.