Vivian Tran
UROP Faculty Supervisor: Prof. Ben Forget, Prof. Kord Smith
Graduate Student Supervisor: Jon Walsh
Term: Fall 2014
September 14, 2014

# Impact of Neutron Resonance Elastic Scattering on Nuclear Reactor Reactivity Calculations

## Project Overview

OpenMC is an open-source Monte Carlo neutron transport code which is under active development here at MIT by the Computational Reactor Physics Group within the Department of Nuclear Science and Engineering. This platform is capable of building models and running simulations of nuclear reactor cores and other nuclear systems.

This project will focus on investigating the reactivity impact of different models and parameters for treating the resonance elastic scattering of neutrons from different nuclides. When modeling neutron-nucleus interactions, assumptions are made by Monte Carlo codes which can sometime affect results significantly. One common assumption is that the 0K elastic scattering cross section of the nuclide with which the neutron is interacting stays constant in energy. For nuclides with resonances, this is a poor assumption, since their cross-sections can vary significantly within small energy ranges. Currently, the ways of correcting this assumption are computationally costly. Therefore, it is ideal to only apply the corrections when necessary. This project looks at determining when the corrections are needed.

## Personal Role & Responsibilities

For this project, I will be studying and analyzing simulations and output data from OpenMC to determine when corrections for cross section energy dependence are necessary. I will be installing the open-source code on my personal computer, and will be able to work at home or in the lab. In addition, I will be having weekly meetings with my graduate student advisor, Jon Walsh every Wednesday to discuss the progress of my work and determine possible goals for the next week. I plan to commit about 10 hours a week to this UROP project. The work schedule is flexible, as I can work on the project from my laptop. I will also be producing a report for the results of the project.

## Goals and Personal Statement

The goal of this project is to improve the efficiency of the current model for treating resonance elastic scattering of neutrons in nuclear core reactors while capturing all important reactivity effects. This is an exciting and active area of research in the nuclear reactor physics community, as OpenMC is under active development and is being used across various universities, laboratories and other organizations in the world. This project will give me a unique opportunity to advance recent work that is of practical interest to core designers and analysts. I

also hope to present the results of this project in either a report or presentation at a professional conference. Furthermore, I think the computational skills I will gain and develop from this project will prove useful to me in the future, whether I go into industry or research.