A GRADUATE STUDENT PERSPECTIVE ON FUTURE RESEARCH OPPORTUNITIES IN REACTOR PHYSICS

R. Matthew Miller
School of Nuclear Engineering
Purdue University
rmmiller@ecn.purdue.edu

ABSTRACT

The current state of the art in reactor physics represents a long period of successful methods and code development. Today, the fuel pin powers in a light water reactor can be predicted within a few per cent of measured data. This is a significant engineering achievement and reactor physicists can take pride in their accomplishments.

The new generation of reactor physicists often hear that the field has matured and that there are very few new areas to be explored. Obviously this can be discouraging for someone currently in a PhD reactor physics program at a US University. However, there do remain several important new issues in reactor physics, particularly in light of recent DOE interest in advanced reactor core designs and new fuel types. Several of the proposed new designs (e.g. seed blanket thorium fuel lattices, MOX fueled cores) are very heterogeneous and present challenges for the current generation of reactor physics methods. Research opportunities will include new methods that eliminate or at least mitigate homogenization, collapsing, and transport errors in modern nodal methods used to analyze heterogeneous core designs.

The recent US interest in best estimate reactor analysis has also created several research opportunities in computational reactor physics. Future safety analysis will be performed with coupled systems thermal-hydraulics and neutronics codes. The recent OECD PWR Main Steam Line Break benchmark problem has demonstrated the potential for recovering safety margin through best estimate analysis. However, the computational feasibility of coupled code analysis as part of reload licensing will depend on reducing the computational burden for coupled field calculations. New research in this area will include both advanced numerical methods as well as high performance computing.

The field of reactor physics has matured and courses in reactor physics are currently a key part of the graduate curriculum in most nuclear engineering departments. While many of the fundamental issues related to reactor physics appear to have been adequately addressed, new core designs and new fuel types present new challenges and provide fertile ground for current and future PhD research in reactor physics.