Department of Engineering Physics
UNIVERSITY OF WISCONSIN–MADISON

INSTITUTE FOR NUCLEAR ENERGY SYSTEMS

Presents:

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Multiphysics Simulations for Space Nuclear Propulsion Systems

Abstract: NASA's Nuclear Thermal Propulsion (NTP) Project is focused on determining the feasibility and affordability of an NTP engine for exploration of Mars and beyond. NTP has the potential to greatly increase efficiency, thus reducing propellant requirements, relative to current systems. This project has the the goal of assessing the affordability and viability of NTP in which a nuclear reactor superheats hydrogen gas. The superheated hydrogen expands through a diverging/converging nozzle to produce in-space propulsion. The feasibility of this game changing technology was clearly established in the 1960's during the Rover/NERVA (Nuclear Engine for Rocket Vehicle Application) Program. However, many questions concerning the development and affordability of nuclear thermal rockets remain unanswered. With support from INL, NASA has begun using MOOSE-based reactor physics, thermal fluids and structural mechanics solvers to be able to simulate the complex and tightly coupled multiphysics occurring with an NTP engine to begin to assess design options and performance impacts in design of a prototype experimental engine. This talk will provide some of the background in NTP design and the status of the current work at INL.

Biography**:** Mark DeHart is a Directorate Fellow in the Nuclear Science & Technology Directorate at Idaho National Laboratory (INL) where he has worked since March 2010. He holds BS, MS and PhD degrees nuclear engineering from Texas A&M University. Dr. DeHart is the group leader for Advanced Reactor Physics Modeling and Simulation, supporting projects with the DOE Nuclear Energy Advanced Modeling and Simulation (NEAMS) program, US National Aeronautics and Space Administration (NASA) and the US Nuclear Regulatory Commission (NRC). He is also engaged in ongoing reactor physics methods updates for the current ATR fuel cycle, and in experimental measurements being performed to improve characterization of the current and redesigned core performance for both ATR and the ATR Critical Facility. Previously Dr. DeHart was employed at ORNL, working in both methods and analysis related to criticality safety, burnup credit, data validation, and reactor physics. He is the primary author of the NEWT lattice physics code and the TRITON depletion sequence within the SCALE code system, and led development of modern lattice physics methods at ORNL. He is a Fellow of the American Nuclear Society (ANS) and a member and past Chair of the local section of ANS. He is a past Chair of the ANS Reactor Physics Division and is the chair of the ANS 19.5 Standard Working Group. He has more than 150 publications in journals, conference proceedings, and national laboratory reports related to computational methods and applications in reactor physics and multiphysics, radiation transport, criticality safety, and depletion methods for spent nuclear fuel.

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