СОФИЙСКИ УНИВЕРСИТЕТ
„СВ. КЛИМЕНТ ОХРИДСКИ“

ФИЗИЧЕСКИ ФАКУЛТЕТ

SOFIA UNIVERSITY
ST. KLIMENT OHRIDSKI

FACULTY OF PHYSICS

# FACULTY SEMINAR

## Venue: day Tuesday, date 30.05 2023, 13:30h
## Lecture Hall B29a & Zoom

Zoom: https://us02web.zoom.us/j/87139708557?pwd=dktqRVBWL09BUjVQWlZsMFlZcDdtdz09

Meeting ID: 871 3970 8557 ; Passcode: 942946

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## Advanced Multi-Physics Multi-Scale Modeling and Simulation Frameworks for Nuclear Reactors

The modeling and simulation (M&S) of nuclear reactors is continuously improving beyond the traditional multi-physics coupling tools. Novel multi-physics tools have recently been developed such as in the U.S. and around the world. There is thus a need for High to Low (Hi2Lo) model fidelity information approaches that will expand the usage of novel tools to a larger spectrum of applications and at the same time improve the predictive capabilities of traditional multi-physics tools at a reasonable computational cost. Such need is identified in the industry for easy-to-use, low-cost, fuel-product independent, safety analysis capabilities to facilitate and optimize core reload processes with the ability to consider mixed/transition cores, introduction of ATF assemblies, etc. In response to those needs, recent developments at the North Carolina State University are focused on extending these capabilities into a mature commercial product. Part of these efforts are the introduction of an algorithm to generalize the use of high-fidelity simulations to inform lower-order models for the design, analysis, and licensing of PWRs.

The seminar will present consistent Hi2Lo approaches between the different modeling fidelities and for three physics domains within a reactor core: reactor physics, thermal-hydraulics and fuel performance. These different Hi2Lo approaches are integrated into multi-physics frameworks. Uncertainty quantification capabilities are included in the multi-physics frameworks that propagates consistently the uncertainties through the Hi2Lo approaches and allow the computations of sensitivities between multi-physics outputs of interest and the High Fidelity (HiFi) inputs. This seminar will describe streamlining the application of Hi2Lo procedures to inform the improved use of lower-order models within fast-running design tools. Integrated Uncertainty Quantification Framework (IUQF) is included to identify and propagate input uncertainties across Hi2Lo procedures and to navigate between the different physics domains. The goal is to streamline the core design activities and provide a fuel-technology independent platform to deal with a more flexible operation, consider new loading scenarios (mixed cores) for current and new emerging reactors.