

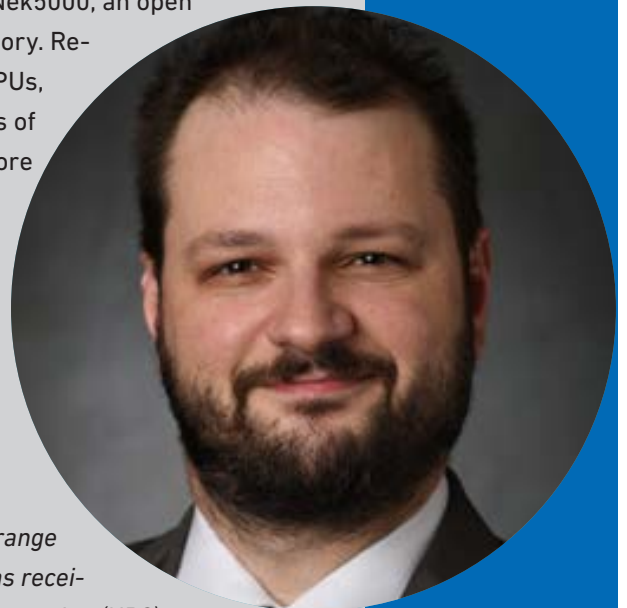
Colloquium Thermo- and Fluid Dynamics

Exascale Simulations of Advanced Reactor Flows

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GPU-based supercomputing is enabling a significant advancement in Computational Fluid Dynamics (CFD) capabilities for nuclear reactors. In fact, exascale GPU-based super-computers such as ORNL's Frontier are allowing for the first time to perform full core CFD calculations at high-fidelity. Key to this has been the development of NekRS, a novel GPU-oriented variant of Nek5000, an open source spectral element code in development at Argonne National Laboratory. Recent performance measurements showed that NekRS, when running on GPUs, outperforms the CPUs by 40x. In this talk finally, we review a few examples of this new and groundbreaking capabilities, including a simulation of a full core pebble bed reactor and a multi-physics light water reactor simulation. In fact, on Frontier, NekRS has recently achieved an unprecedented milestone in breaching over one billion spectral elements and 350 billion degrees of freedom in a coupled calculation with the Monte Carlo code Shift. We focus, however, on how these calculations are being used to improve the fidelity of more traditional approaches such as porous media models.

Elia Merzari is a professor at the Ken and Mary Alice Lindquist Department of Nuclear Engineering at Pennsylvania State University. His expertise covers modeling and simulation of advanced reactors including safety analysis for a range of reactor types. Since 2019 he is a member of the faculty at Penn State. He has received several awards related to these efforts on the area of high performance computing (HPC) including the American Nuclear Society (ANS) Landis Young Member Engineering Achievement Award, the American Society of Mechanical Engineers (ASME) George Westinghouse Silver Medal and the ANS Bal-Raj Sehgal Memorial Award. He is a fellow of ASME and ANS.



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