

NEAMS Multiphysics Applications Overview

Presented by Mauricio Tano (INL), *Work Package Manager for Molten Salt Reactor Applications*

on behalf of

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April 22, 2026

ART MSR Campaign Review, Albuquerque, NM



U.S. DEPARTMENT
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Office of
Nuclear Energy

Multiphysics Applications Technical Area Overview

Reactor Applications

- Engage with stakeholders
- Apply tools to reactor technologies
- Identify code gaps
- Perform V&V
- Publish mature models on NRIC Virtual Test Bed



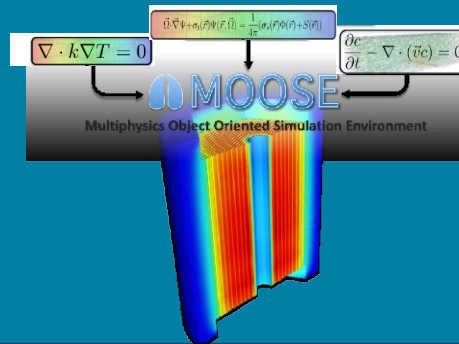
MOOSE



BLUECRAB

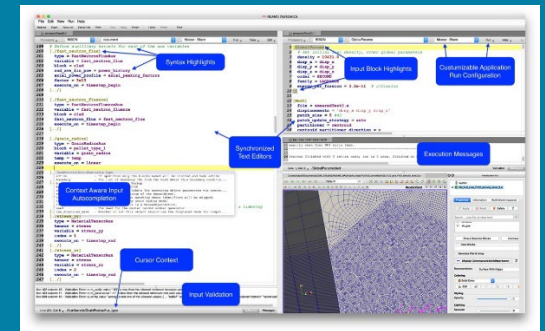
Multiphysics Framework Development

- Enhance MOOSE to provide a robust & efficient infrastructure for code developers and multiphysics users



Deployment & User Workflows

- Deploy software containers on INL HPC for easy access
- Enhance the NEAMS Workbench GUI for enabling user workflows



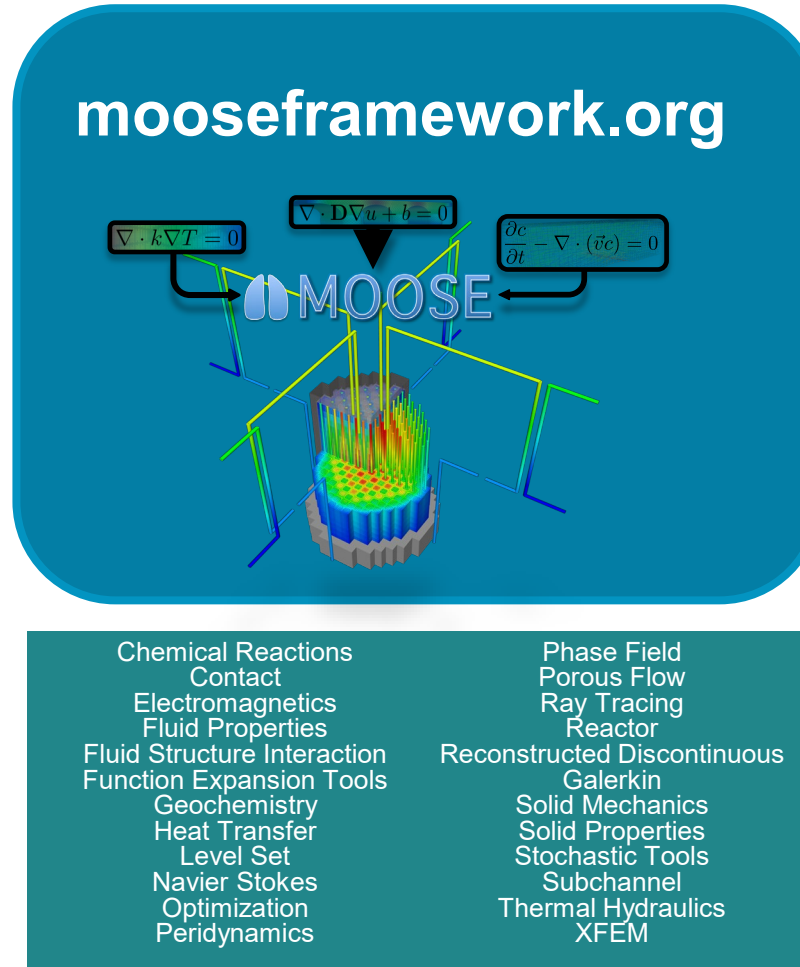
MOOSE Ecosystem

What is MOOSE?

- Open-source
- Massively Parallel
- NQA-1 Compliant
- Flexible multiphysics coupling options

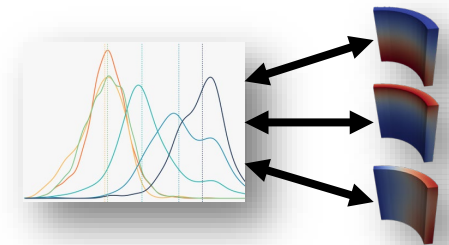
Recent efforts:

- Physics/Component system (simpler input files)
- LSP integration for live syntax completion/validation
- Kokkos/MFEM integration for GPU accelerators

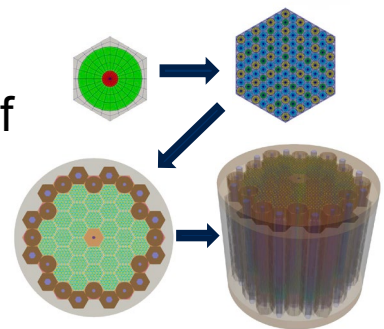


MOOSE also contains modules...

MOOSE Stochastic Tools Module enables parameter sampling, UQ and sensitivity analysis



MOOSE Reactor Module enables rapid construction of reactor geometry finite element meshes



MSR Applications Highlights

FY25 Milestones (Complete)	FY26 Milestones (In progress)
Multiphysics Applications: Fast Spectrum Molten Chloride Salt Reactor (LOTUS) Thermal Spectrum Molten Fluoride Salt Reactor (MSRE) Thermal Spectrum Molten Salt Breeder Reactor (TS-MSBR)	
Steady state core simulation capability including reactor physics, thermal hydraulics, and evolving <u>chemistry</u> MSRE: - Stochastic perturbations for depletion calculations to capture experimental data removal rates - Reactor physics coupled with depletion including cross section generation - Xe transport calculation with bubble flow Code validation: Xe poisoning data LOTUS: - Demonstration of corrosion and noble-metal plating - Demonstration of 3D coupled neutronics and flow field in pool-type reactor	Develop an evaluation MSR model (TS-MSBR) using NEAMS tools Preliminary demonstration of operational transient capability for both thermal (TS-MSBR) & fast (LOTUS) MSRs w/ validation against MSRE data where possible Develop preliminary multiphysics UQ framework based on MOOSE stochastic tools to support MSR operations
NRIC Virtual Test Bed Contributions: https://mooseframework.inl.gov/virtual_test_bed/	
Subset of Recent Available Models: - LOTUS molten chloride fast reactor steady state (Griffin-Pronghorn) (link) - Wear analysis of graphite components in MSRs (Grizzly) (link) - Molten salt infiltration into graphite (MOOSE) (link)	Upcoming: - MSRE Xenon poisoning (Griffin-Pronghorn) - MSRE steady state multiphysics with chemistry (Griffin-Pronghorn-SAM-Saline) - LOTUS-MSR loop (NekRS)

Contact Information

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