

CESAR: Overview of Deep Dive

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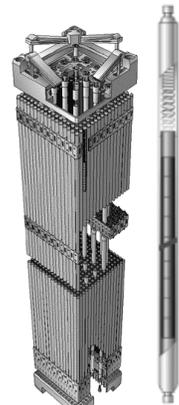
CESAR Challenge: Predict Pellet-by-Pellet Power Densities and Nuclide Inventories for the Full Life of Reactor Fuel (~5 years)



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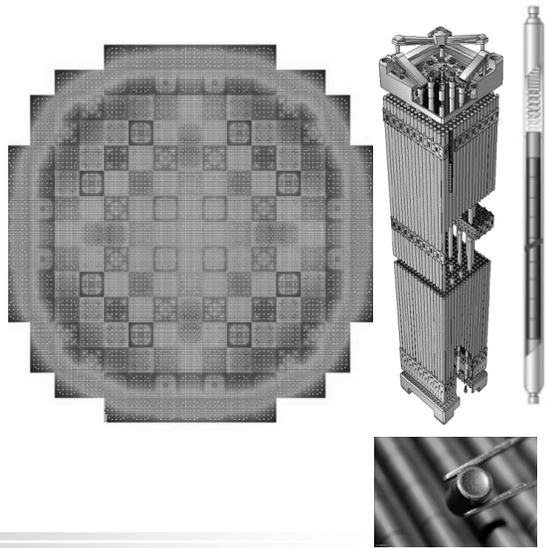


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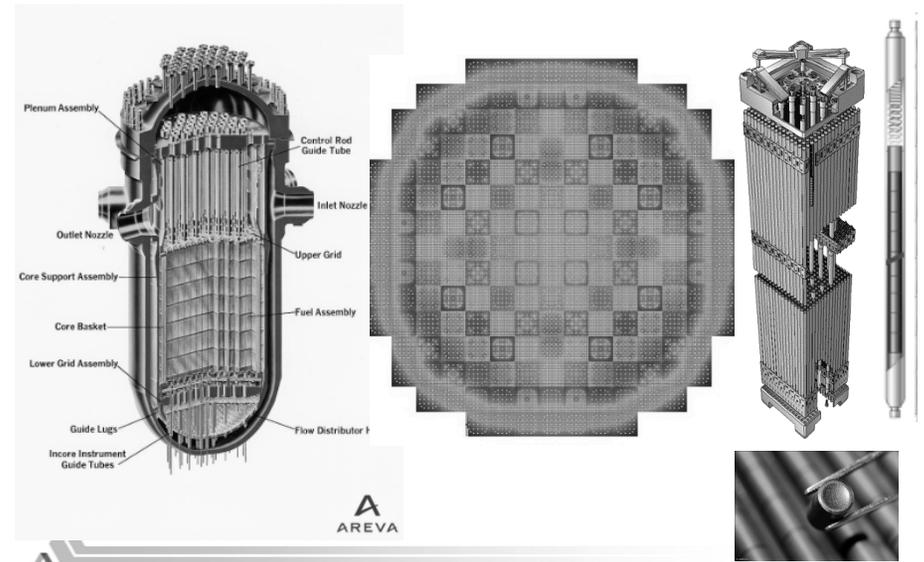
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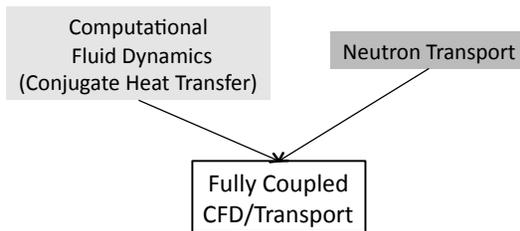


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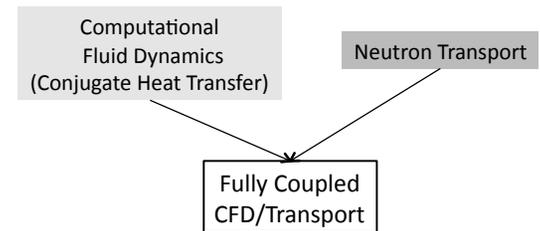
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CESAR physics

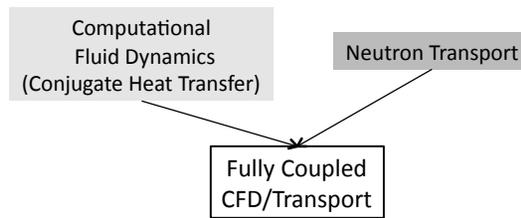


CESAR physics



- CESAR focuses on **nuclear reactor** flows and physics (neutron transport) calculations
 - Accurate simulations have always been an integral part of design, licensing, and optimization of nuclear reactors
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- However, many of the co-design issues are of more general relevance to
 - **Incompressible CFD**
 - **Neutral particle transport**

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Three codes are focus of CESAR research

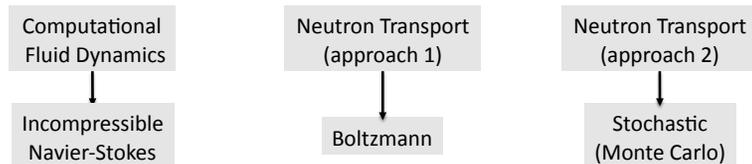
Computational
Fluid Dynamics

Neutron Transport
(approach 1)

Neutron Transport
(approach 2)

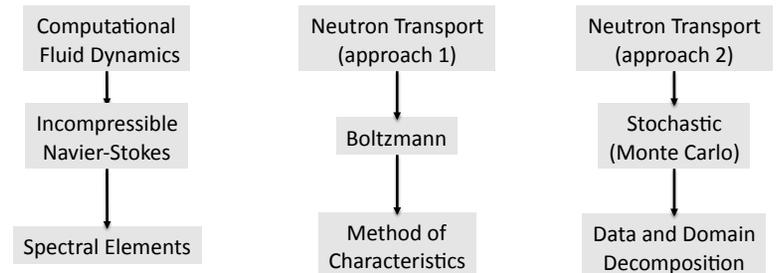
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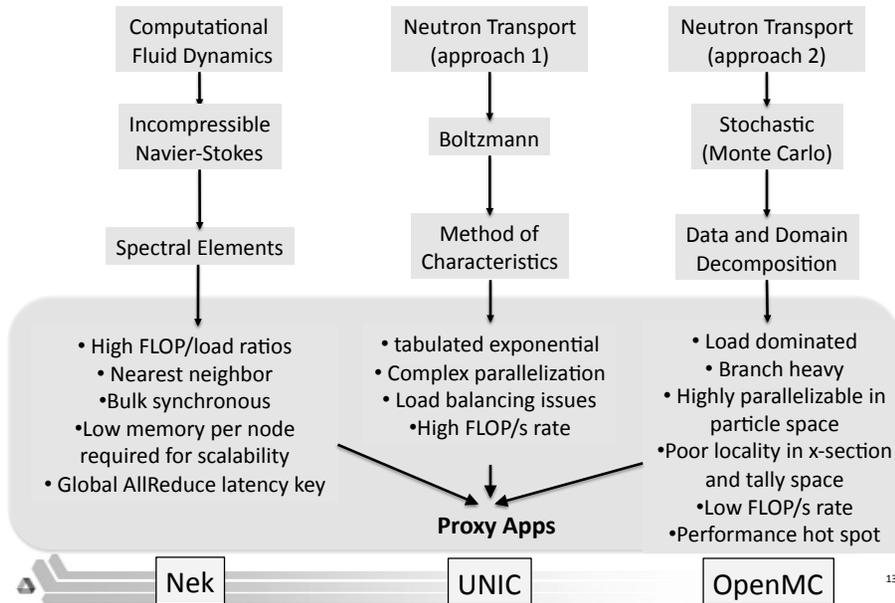
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Categories of Proxy-apps

- **Kernels**
 - A standalone faithful representation of a performance critical component whose behavior does not qualitatively change when interoperating with other components
 - **Micro-apps**
 - Components that cannot have a meaningful standalone representation in a minimal combination with other components
 - **Mini-apps**
 - Reduced instantiation of application configurations that exercise the interoperability
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Organization of Proxy Apps

- Each class of proxy-apps has its own webpage
 - Download
 - Quick start guides (README files)
 - Instructions to build and run
 - Parameters that affect the run
 - Verification data
 - Example configuration
 - Links for
 - Publications related to the whole application
 - Technical reports of findings and acquired wisdom
 - Discussion forum

<http://cesar.mcs.anl.gov/content/software>

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Possible Limitations

- **Proxy-apps** inherently have the implementation bias built into them
 - Data structures
 - Control flow
 - Communication pattern
 - Some way to represent the basic computation without the bias would provide more insight
 - Ample verification studies needed
 - Provision for embedding algorithmic innovations for exascale in the proxy-apps
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Four CESAR deep dive talks

- Monte Carlo neutronics(Siegel)
- Incompressible CFD (Elia Merzari)
- Deterministic Transport (Micheal Smith)
- Neutronics/CFD coupling (Tim Tautges)

