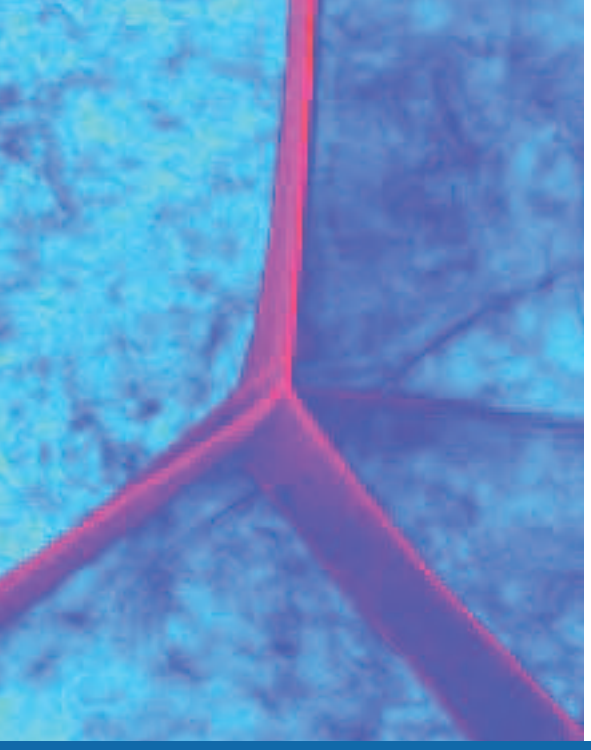

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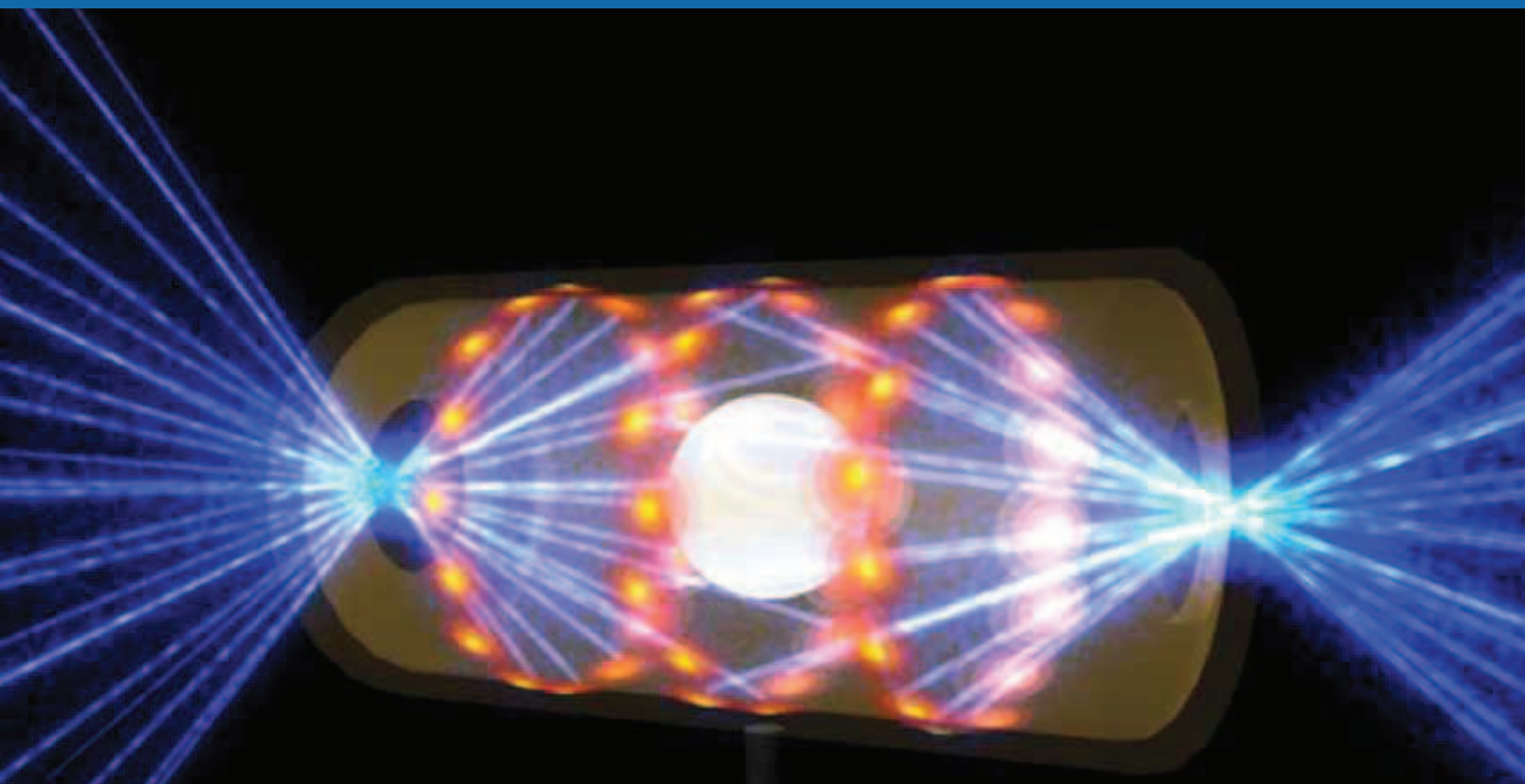
extending the frontiers of science



2010 Science Highlights

November 2010

Energy Technologies

Scalable, Explicit Geometry, Whole-Core Nuclear Reactor Simulations

Multi-physics simulations aid design and safety in nuclear reactors

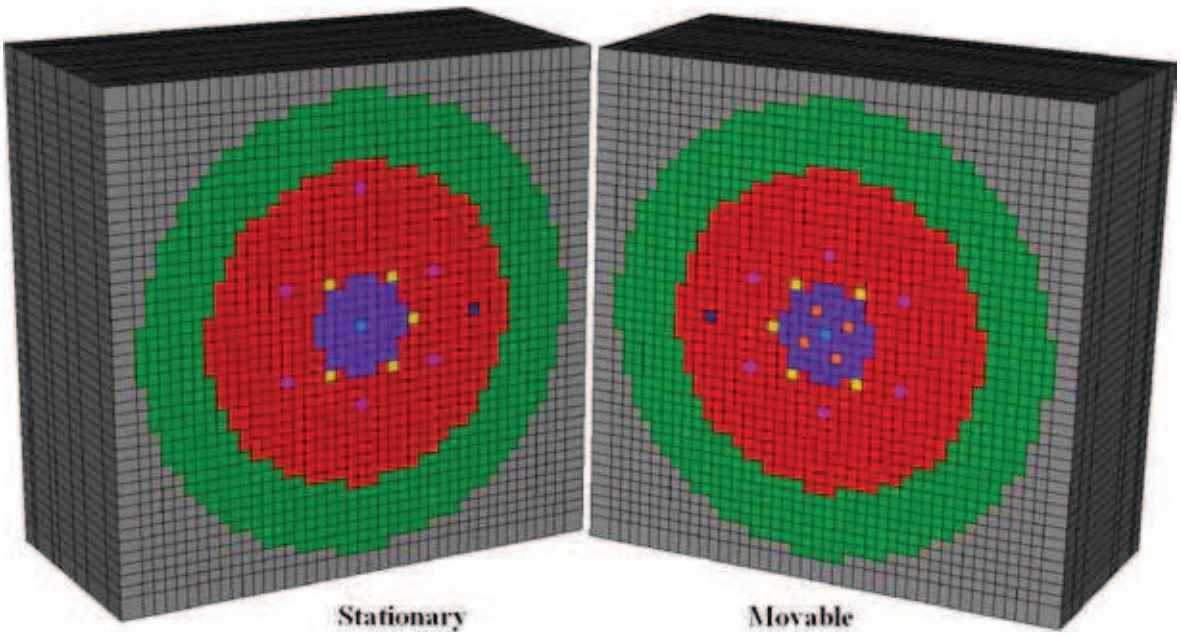
With its focus on solving nuclear energy issues, the Department of Energy is developing a multi-physics simulation framework at Argonne National Laboratory specifically for the analysis and design of nuclear reactors. Researchers will use this framework to simulate multi-physics problems requiring coupled neutronics, thermo-fluids and structural analyses. In such a framework UNIC can provide the power distribution on the deformed geometry, thereby allowing researchers to predict the change in power distribution derived from thermal expansion and improve the design and safe operation of nuclear reactors.

Full-scale simulation to validate high-performing UNIC neutronics code

UNIC has accurately predicted global parameters and has demonstrated excellent parallel computation performance for several benchmarking problems, including problems containing up to 0.9 trillion degrees of freedom and better than 75 percent weak scaling on the full capacity on the world's fastest and largest open science supercomputers. This work earned a finalist designation for the Gordon Bell Award at Supercomputing 2009. UNIC has also shown its capability to produce very detailed solutions, which first must be validated against experiments before it is fully coupled with thermo-fluid and structural analysis codes. For this validation, researchers will analyze the detailed reaction rate distributions measured in a full-scale critical experiment carried out in ZPR-6—the Zero Power Reactor facility at Argonne National Laboratory.

ALCC Allocation:

38 Million Hours



ZPR6/7 Loading 104 consists of a Pu filled core with a High Pu240 central core region. Loadings 104 through 132 focused on modifying the base case to study the impact of various material changes (sodium void, control rod worth, etc.). In loading 104, the fuel was removed from the center drawer to simulate a control rod position (control rod is not inserted) and foil measurements were carried out to investigate the altered energy dependence with respect to the other loadings.

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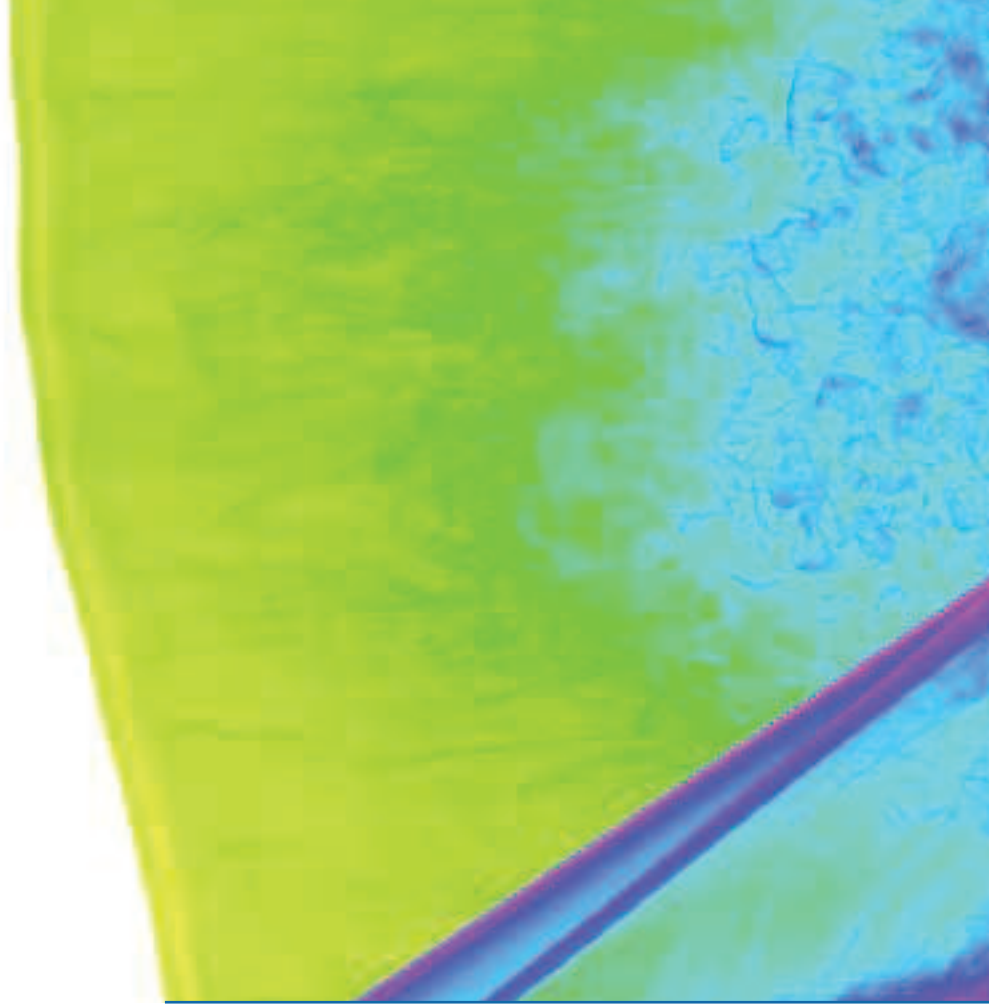

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