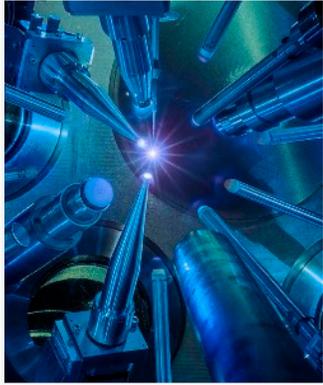# CIRC Symposium Series 2025-2026

Simulations of Shocks in Wetted Foams Irradiated by Intense Lasers Using the FLASH Code and Wetted Foam Target Stability

Andrey Solodov, PhD | Laboratory for Laser Energetics

Plastic foams saturated with liquid deuterium/tritium (DT) (wetted foams) have been proposed for use in many inertial confinement fusion and energy (ICF, IFE) target designs primarily for obviating layering challenges but also for advantages in stability and absorption. We present 2D and 3D simulations of laser interaction with planar wetted foam targets using the FLASH code, a highly versatile, parallel, adaptive mesh refinement, finite-volume Eulerian radiation-magnetohydrodynamics code with extended physics capabilities. These simulations address the impact of foam microstructure on the propagation of the laser-generated shock, post-shock plasma turbulence, homogenization, and subsequent acceleration. Systematic studies are being conducted as functions of foam density, pore size, and simulation dimensionality. Simulations demonstrate expansion of the plastic material into the surrounding DT ahead of the shock by the radiative preheat from the plasma corona, shock speed similar to that in a fully-homogenized plasma, and difference in the turbulence regimes in two and three dimensions. We are particularly examining the impact of the foam structure on seeding of hydrodynamic instabilities in the ICF and IFE contexts. This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0004144.

BlueHive-Enabled Optimization of Bullseye Cavities for Single Photon Sources

Martin Sanchez | The Institute of Optics

Bullseye cavities are promising devices for single photon sources due to their high Purcell enhancement and excellent emission profile. Recently, it was shown that nonuniform periods can substantially improve bullseye cavity performance; however, navigating the design space of a 10-ring bullseye cavity can require optimizing up to 24 geometric variables, motivating the development of efficient solvers and the use of the University of Rochester's BlueHive cluster. We present a custom finite-difference frequency-domain (FDFD) eigenfrequency solver, written in Julia, operating in cylindrical coordinates. By exploiting the axisymmetry of the bullseye cavity, we collapse the simulation domain into 2D enabling eigensolves that take approximately 30 seconds. To efficiently explore the design space, the solver is parallelized across BlueHive's compute nodes using SLURM job arrays. From a single eigensolve, the solver extracts the resonant wavelength, quality factor, Purcell enhancement (F_p), and collection efficiency (η), as well as modal volume and confinement factor. Preliminary optimization results show aperiodic designs achieving a 38% improvement in $F_p \cdot \eta$ over a uniform period reference (24.5 vs. 17.7), with Purcell factor increasing from 18.8 to 27.8, while maintaining collection efficiency above 85%. Together, these results demonstrate that aperiodic designs enable considerably higher Purcell enhancement than periodic designs, and that fast eigensolves enable global optimization that is impractical with commercial tools, which typically require minutes to hours per evaluation. Future work will experimentally validate optimized aperiodic designs, and extend the approach to adjoint-based local refinement of designs. segmentation performance.

Friday, March 20, 2026
11:30 am - 1 pm
Wegmans Hall 1400

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