

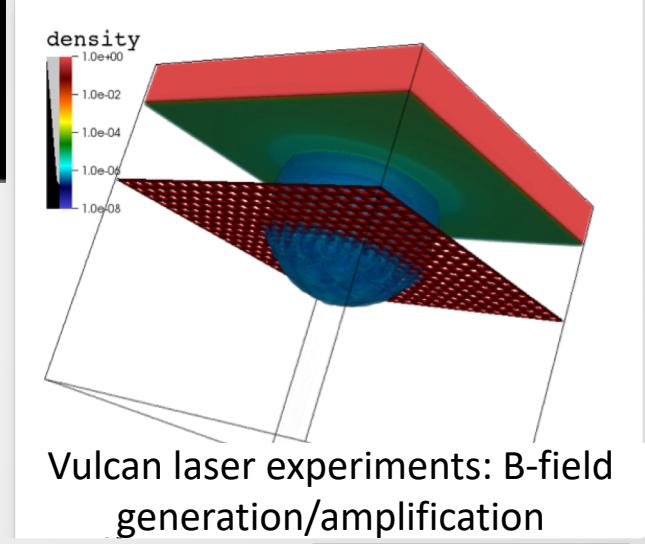
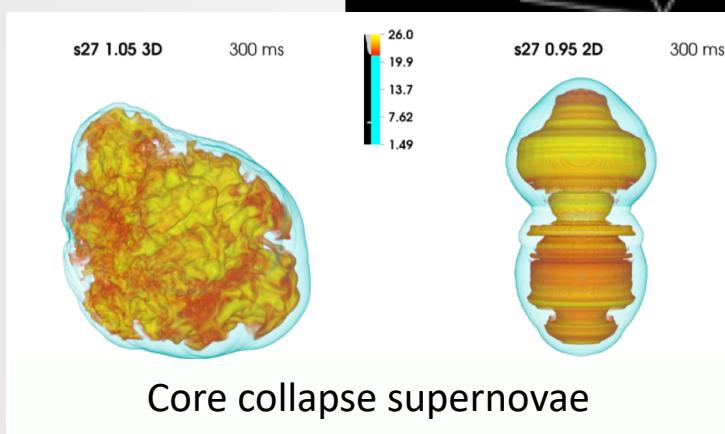
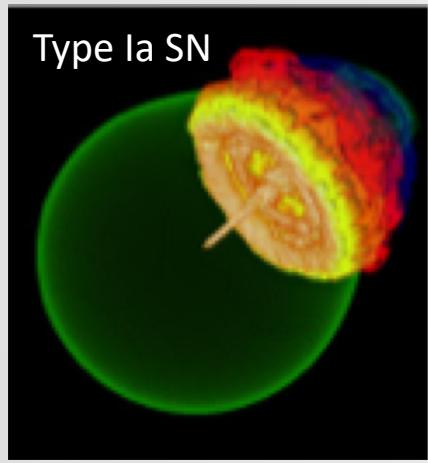
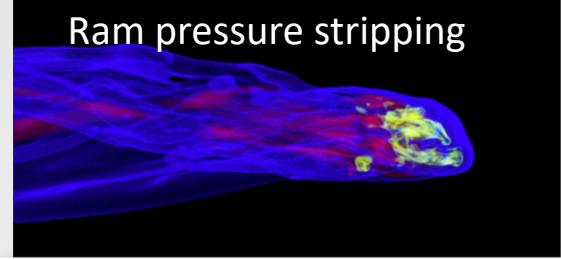
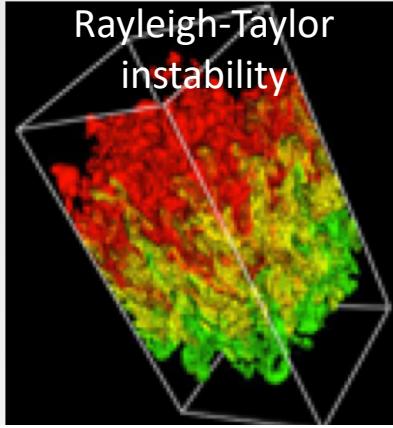
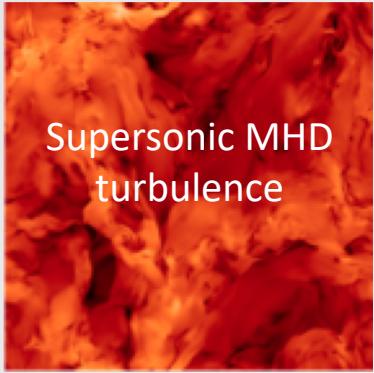
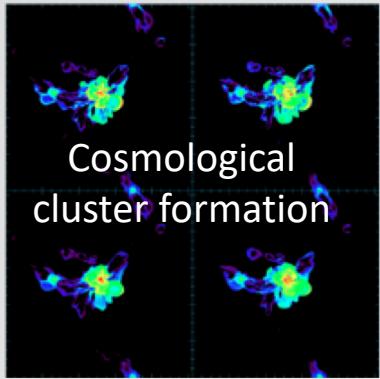
SUSTAINABILITY OF MULTIPHYSICS HIGH PERFORMANCE COMPUTING COMMUNITY SOFTWARE



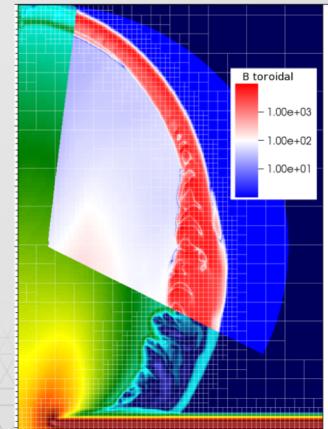
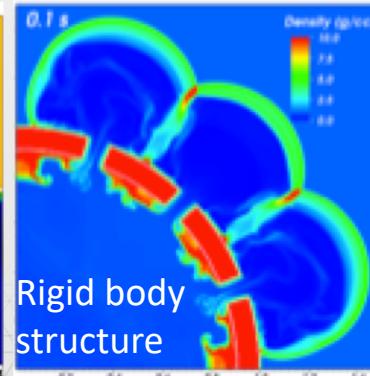
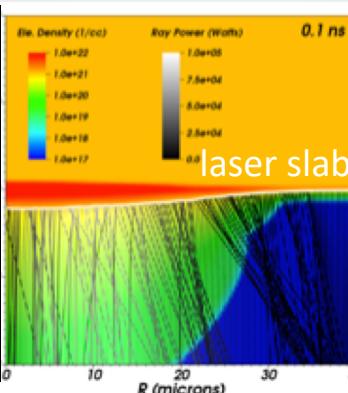
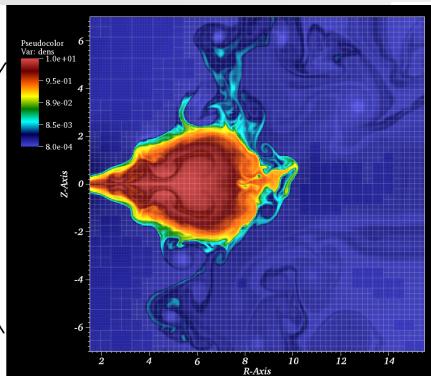
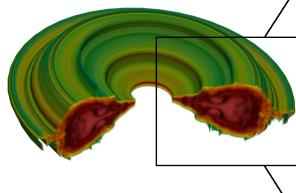
ANSHU DUBEY

sustaining research software
panel
SC 18
November 14, 2018

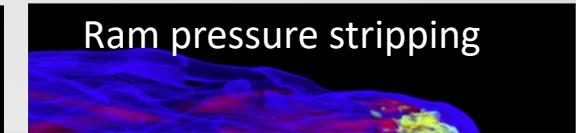
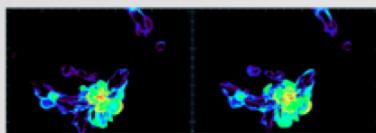
FLASH: Serves 6+ Science Communities



Accretion torus

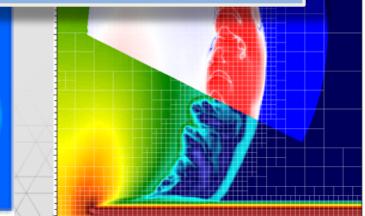
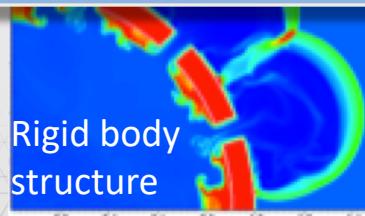
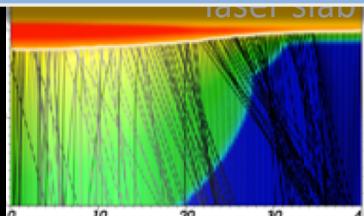
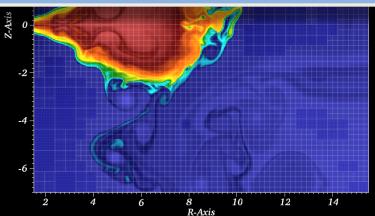
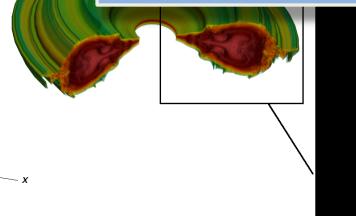


FLASH capabilities span a broad range



FLASH is a multi-physics finite-volume Eulerian code and framework whose capabilities include:

- Adaptive mesh refinement (AMR) on a block-structured mesh
- Multiple state-of-the-art hydrodynamic solvers
- State-of-the-art magnetohydrodynamics
- Implicit solvers for diffusion using the HYPRE library (currently being used to model thermal conduction, radiation diffusion, and viscosity)
- Many physics modules relevant to astrophysics and cosmology, including gravity and nuclear burning
- Generic, highly scalable parallel particles framework (currently used for PIC simulations, laser ray tracing, dark matter, tracer particles)



LOOKING TOWARD FUTURE

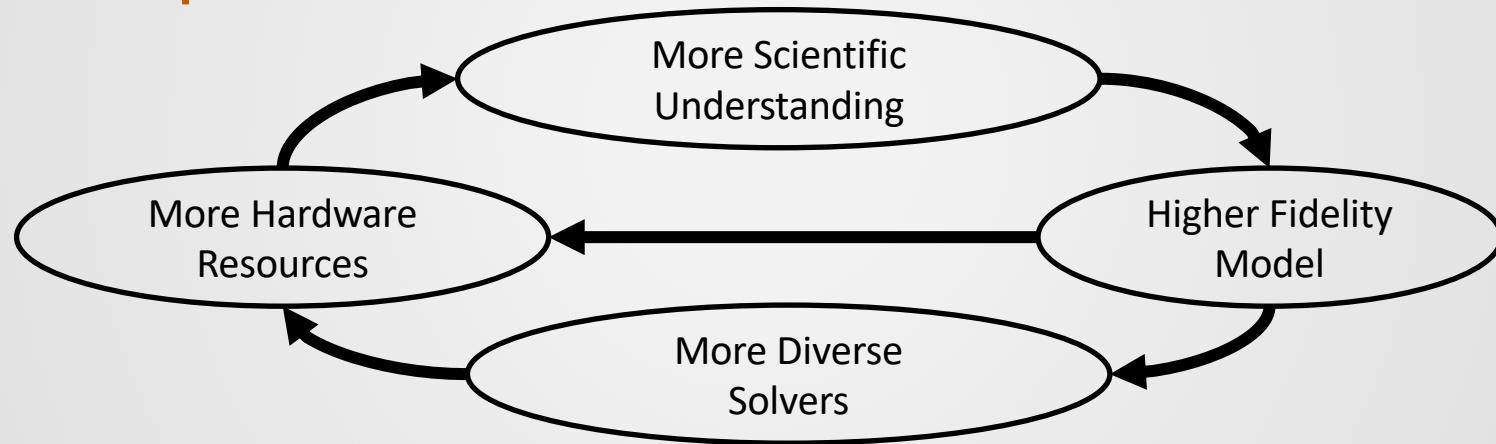
Code aiming for higher fidelity modeling

More complex code, simulations and analysis

Numerous models, more moving parts that need to interoperate

Variety of expertise needed

It is more difficult to work on the same software in different roles without a process



Onset of higher platform heterogeneity

Requirements are unfolding, not known apriori - **particularly challenging for sustainability**

The only safeguard is investing in flexible design and robust software engineering process



DESIGN CONSTRAINTS

- Several Axes of Complexity
 - Architecture, infrastructure, data layout, interoperability
 - Many moving parts
- Requirements
 - Maintainable code with reliable results
 - Retain code portability and performance
 - Measurable and predictable performance
- The challenges in meeting the requirements; tension between
 - Modularity and performance
 - Readable/maintainable code and portability
 - Easy adaptability to new and heterogeneous architectures and complex multi-physics capabilities - **Extensibility**



OTHER CHALLENGES

Technical

- All parts can be under research
- Knowledge growth => change in requirements
- Real world is messy, so is the software

Sociological

- Competing priorities and incentives
- Limited resources
- Perception of overhead without benefit
- Interdisciplinary interactions

