ALCF at Argonne

- Opened in 2006
- Operated by the Department of Energy's Office of Science
- Located at Argonne National Laboratory (30 miles southwest of Chicago)

Overview

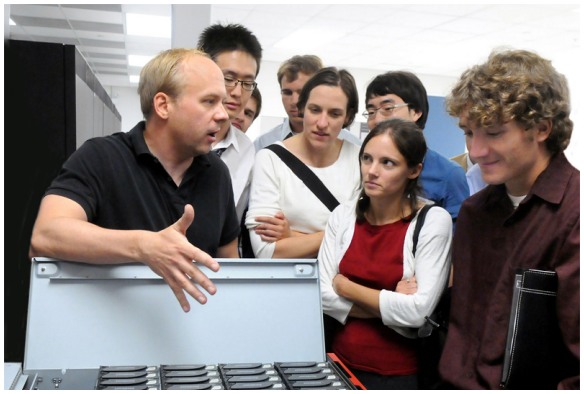
The mission of the Argonne Leadership Computing Facility is to accelerate major scientific discoveries and engineering breakthroughs for humanity by designing and providing world-leading computing facilities in partnership with the computational science community.

Breakthrough research at the ALCF aims to:

- Reduce our national dependence on foreign oil and promote green energy alternatives
- Aid in curing life-threatening blood disorders
- Improve the safety of nuclear reactors
- Assess the impacts of regional climate change
- Cut aerodynamic carbon emissions and noise
- Speed protein mapping efforts

Transformational Science

The ALCF provides a computing environment that enables researchers from around the world to conduct breakthrough science.



Astounding Computation

The Argonne Leadership Computing Facility is currently home to one of the planet's fastest supercomputers. In 2012, Argonne will house Mira, a computer capable of running programs at 10 quadrillion calculations per second—that means it will compute in one second what it would take every man, woman and child in the U.S. to do if they performed a calculation every second for a year!

www.alcf.anl.gov | info@alcf.anl.gov | (877) 737-8615

Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC

Current IBM Blue Gene System, Intrepid

- 163,840 processors
- 80 terabytes of memory
- 557 teraflops
- Energy-efficient system uses one-third the electricity of machines built with conventional parts
- Ranked 13th fastest computer in the world today
- #1 on Graph500

IBM Blue Gene Supercomputer recipient of the 2008 National Medal of Technology and Innovation

The groundbreaking Blue Gene

- General-purpose architecture excels in virtually all areas of computational science
- Presents an essentially standard Linux/PowerPC programming environment
- Significant impact on HPC – Blue Gene systems are consistently found in the top ten list
- Delivers excellent performance per watt
- High reliability and availability

IBM Blue Gene/Q, Mira – Arriving 2012

- System arriving in 2012: IBM Blue Gene/Q, Mira
  - 768,000 processors
  - 768 terabytes of memory
  - 10 petaflops

Design Parameters	Blue Gene/P	Blue Gene/Q	Change
Cores per Node	4	16	4
Clock Speed (GHz)	0.85	1.6	1.9
Flops per Clock per Core	4	8	2
Nodes per Rack	1,024	1,024	--
RAM per Core (GB)	0.5	1	2
Flops per Node (GF)	13.6	204.8	15
Concurrency per Rack	4,096	65,536	16
Network Interconnect	3D torus	5D torus	Smaller diameter
Cooling	Air	Water	~30% savings per watt

THE GREEN 500™

Blue Gene/Q
Prototype 2 ranked #1
June 2011

Programs for Obtaining System Allocations

60%	30%	10%	
Innovative and Novel Computational Impact on Theory and Experiment (INCITE)	**ASCR Leadership Computing Challenge Program (ALCC)**	**Early Science Program (ESP)**	**Discretionary Projects**
ALCF resources are available to researchers as part of the U.S. Department of Energy's INCITE program. Established in 2003, the program encompasses high-end computing resources at Argonne and other national laboratories. The INCITE program specifically seeks out computationally intensive, large-scale research projects with the potential to significantly advance key areas in science and engineering. The program encourages proposals from universities, other research institutions, and industry. It continues to expand, with current research applications in areas such as chemistry, combustion, astrophysics, genetics, materials science and turbulence.	Open to scientists from the research community in academia and industry, the ALCC program allocates resources to projects with an emphasis on areas directly related to the Department of Energy's energy mission, national emergencies, or for broadening the community of researchers capable of using leadership computing resources. Projects are awarded an ALCC allocation based on a peer review for scientific merit and computational readiness.	Allocations through the Early Science Program (ESP) provide researchers with preproduction hours (between system installation and full production) on the ALCF's next-generation, 10 petaflops IBM Blue Gene system. This early science period provides projects with a significant head start for adapting to the new machine and access to substantial computational time. During this shakedown period, users assist in identifying the root causes of any system instabilities, and work with ALCF staff to help develop solutions. More than four billion core hours are allocated through ESP.	Discretionary allocations are "start up" awards made to potential future INCITE projects. Projects must demonstrate a need for leadership-class resources. Awards may be made year round to industry, academia, laboratories and others, and are usually between three and six months in duration. The size of the award varies based on the application and its readiness/ability to scale; awards are generally from the low tens of thousands to the low millions of hours.

For more information: http://www.alcf.anl.gov/research

The U.S. Department of Energy's INCITE Program

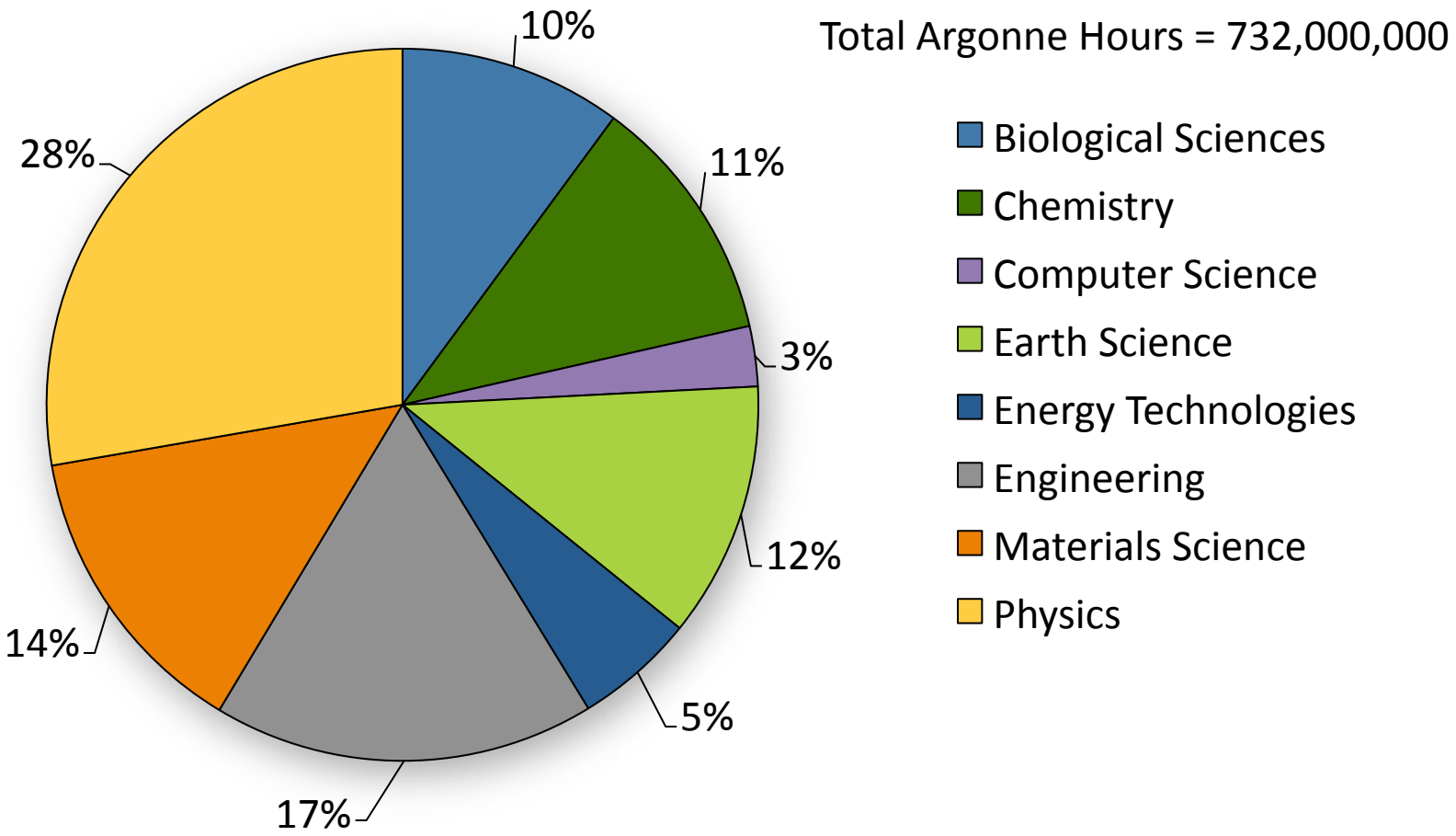
INCITE seeks out large, computationally intensive research projects and awards more than a billion processing hours to enable high-impact scientific advances.

- Open to researchers in academia, industry, and other organizations
- Proposed projects undergo scientific and computational readiness reviews
- More than a billion total hours are awarded to a small number of projects
- Sixty percent of the ALCF's processing hours go to INCITE projects
- Call for proposals issued once per year

Innovative and
Novel
Computational
Impact on
Theory and
Experiment

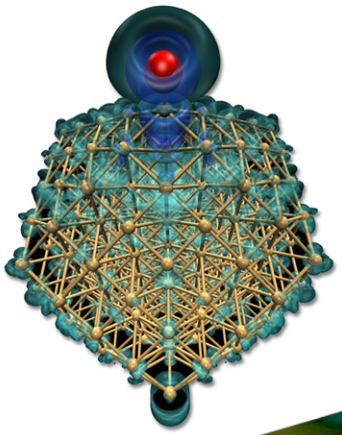
U.S. DEPARTMENT OF ENERGY
INCITE
LEADERSHIP COMPUTING

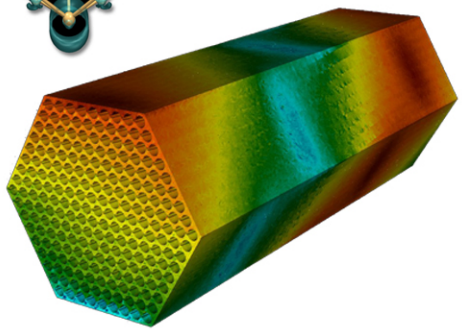
2011 INCITE Allocations by Discipline

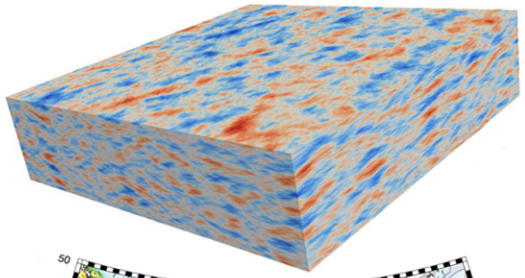


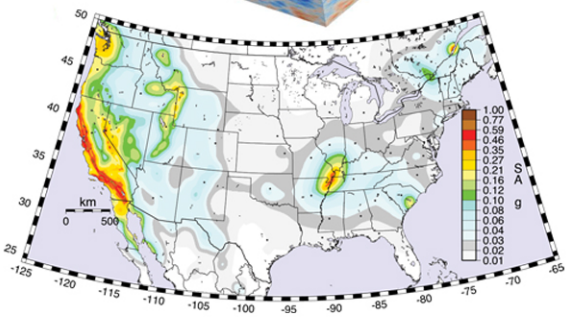
World-Changing Science Underway at the ALCF

- Research that will lead to improved, emissions-reducing catalytic systems for industry (Greeley)
- Enhancing pubic safety through more accurate earthquake forecasting (Jordan)
- Designing more efficient nuclear reactors that are less susceptible to dangerous, costly failures (Fischer)
- Accelerating research that may improve diagnosis and treatment for patients with blood-flow complications (Karniadakis)
- Protein studies that will apply to a broad range of problems, such as a finding a cure for Alzheimer's disease, creating inhibitors of pandemic influenza, or engineering a step in the production of biofuels (Baker)
- Furthering research to bring green energy sources, like hydrogen fuel, safely into our everyday lives, reducing our dependence on foreign fuels (Khoklov)



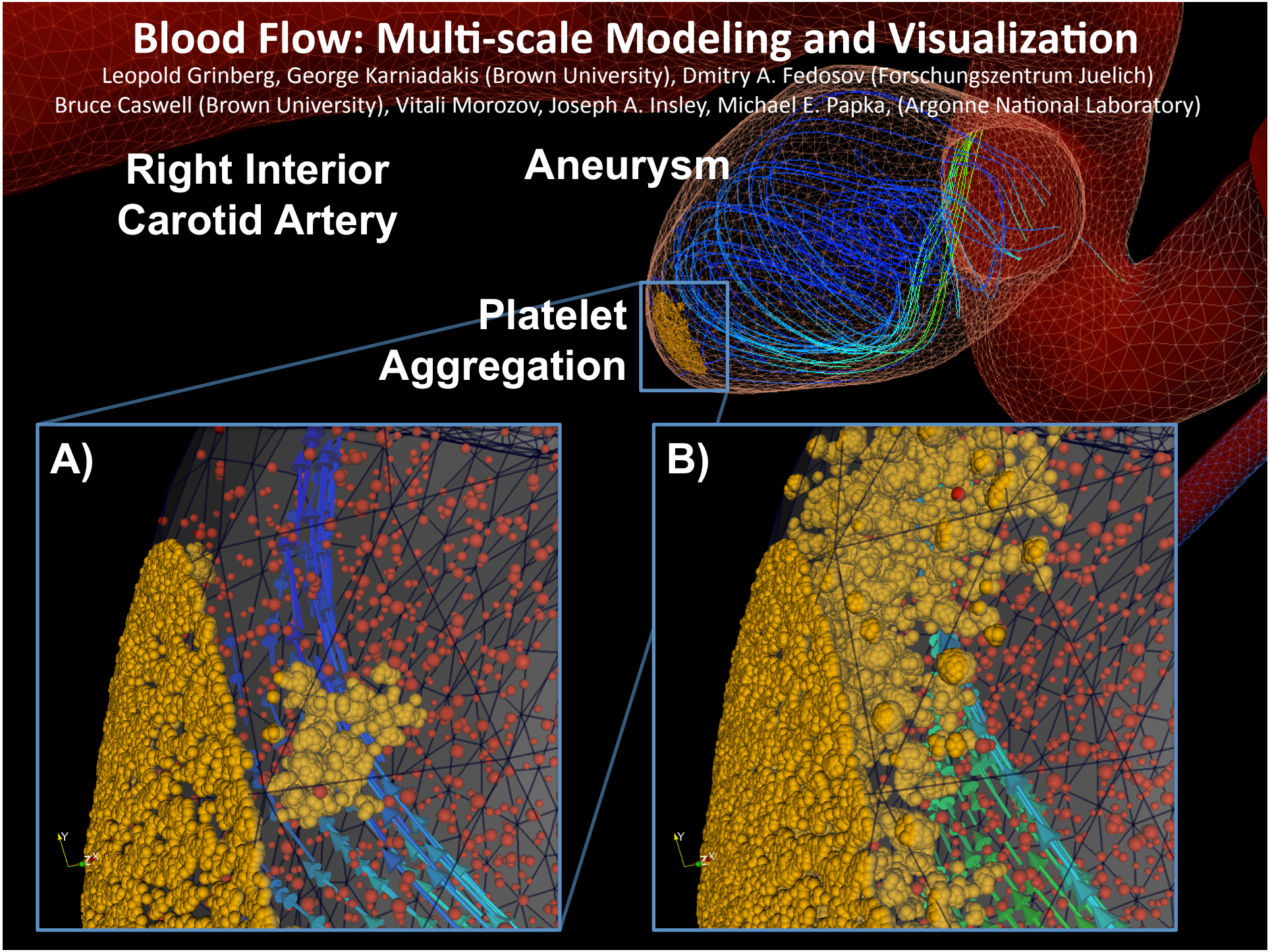




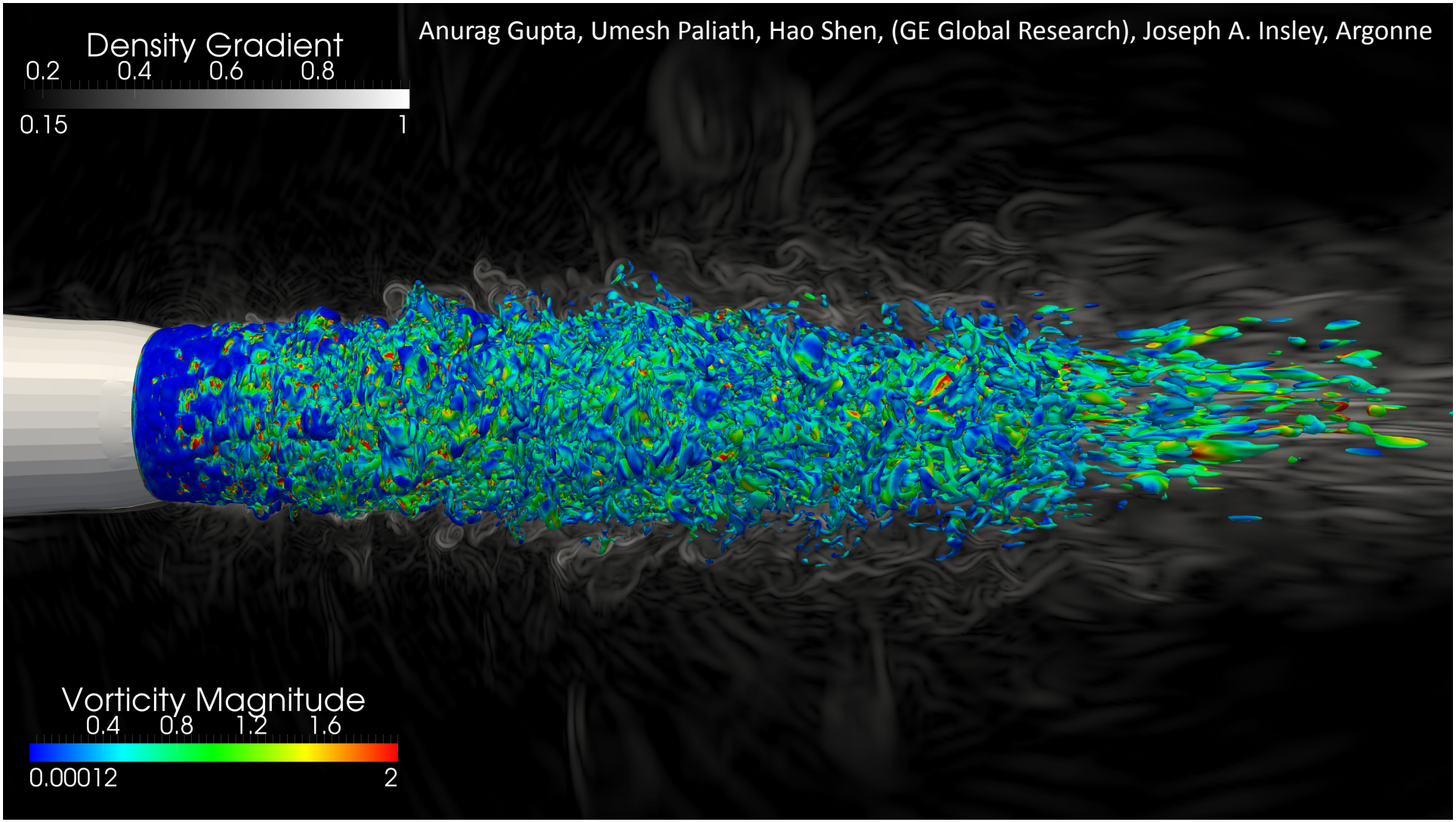


Blood Flow: Multi-scale Modeling and Visualization

Leopold Grinberg, George Karniadakis (Brown University), Dmitry A. Fedosov (Forschungszentrum Juelich)
Bruce Caswell (Brown University), Vitali Morozov, Joseph A. Insley, Michael E. Papka, (Argonne National Laboratory)



Turbulent Mixing Noise from Jet Exhaust Nozzles



Turbulent structures in free shear layer flow from dual flow conic nozzle