Vulcan and the HPC Innovation Center

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Blue Gene Consortium
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www.hpcinnovationcenter.com

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Lawrence Livermore National Security, LLC

HIGH PERFORMANCE COMPUTING
INNOVATION CENTER

Vulcan available to industry since June 2013

24 rack IBM BG/Q (¼ size of Sequoia)

LC Unclassified HPC Enclave provides access to external users

- including foreign nationals
- Joins "Cab" and "Sierra" Linux clusters for combined access to nearly 6PF of computing for industrial and academic projects

Vulcan statistics:

5 PF/s target
0.4 PB memory,
393K cores, 1.57M threads
3.6 PB disk, 200GB/s

Leading Supercomputing Center Seeks Partners for High-Impact Collaborations

The High Performance Computing Innovation Center (HPCIC) is an outreach initiative to industry and academia by Lawrence Livermore National Laboratory under the auspices of the U.S. Department of Energy.

In support of LLNL's national security mission to:

- boost American competitiveness
- accelerate science and technology advancements
- develop a future HPC-skilled workforce

Situated on the Livermore Valley Open Campus, In Livermore, California

The HPC Innovation Center seeks to . . .

1) ***Engage with companies*** to deliver transformational HPC-based solutions

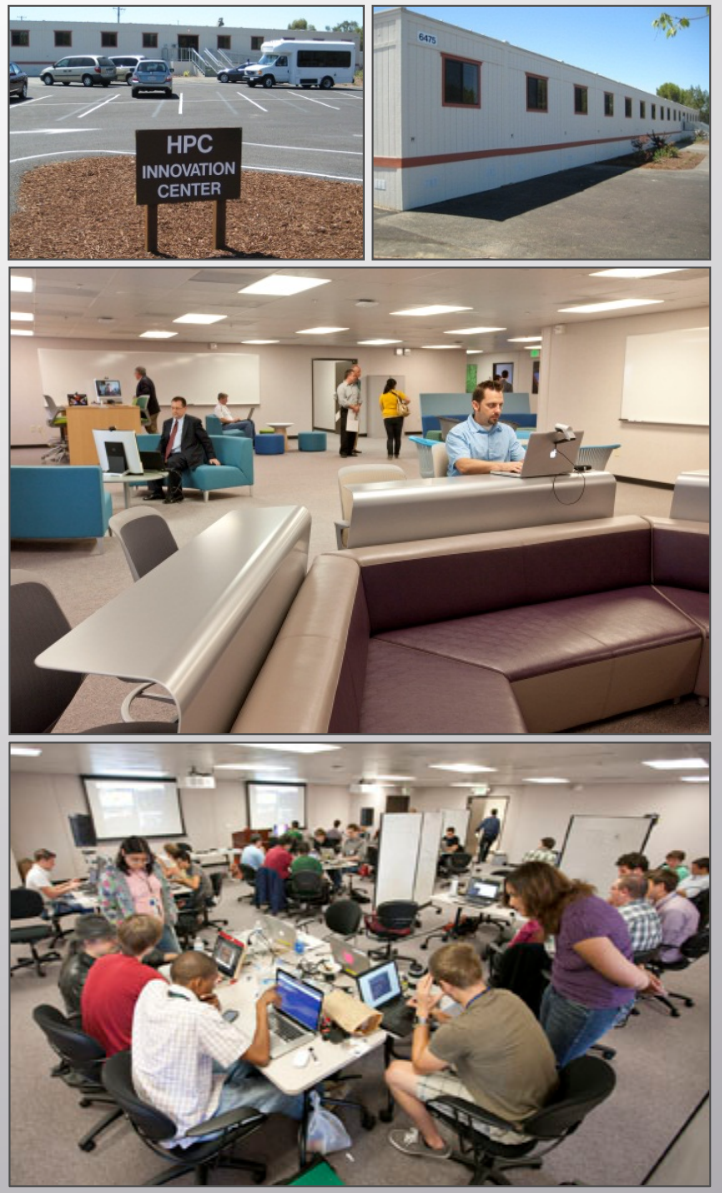
   … that combine HPC expertise with supercomputing technologies

2) ***Engage with HPC ecosystem partners*** (equipment suppliers, ISVs, other HPC centers, academia, expert users, etc.)

   … to collaboratively deliver sustainable advanced computing innovations that broadly benefit the economy

3) ***Engage with academia and students*** to advance computational sciences

   … and develop future HPC-skilled professionals



HPCIC offers client companies depth to develop, prove and deploy transformational HPC solutions

Rapid assembly of experts

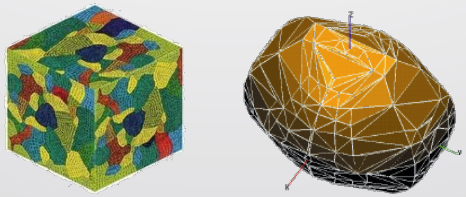
Industrial Sponsor +

+

HPC Ecosystem Partners

Multi-discipline project teams

Cost-effective access to resources



Multi-scale Codes

Visualization

Big Data Analytics

Code Development Frameworks

Uncertainty Quantification

High-impact solutions that deliver

Industrial Competitiveness

Job Creation

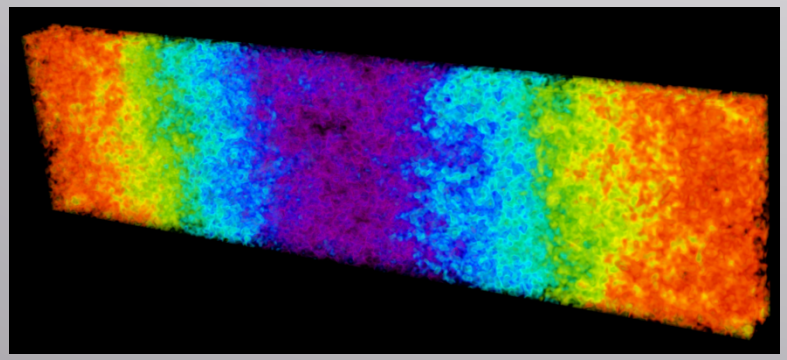
Workforce Development

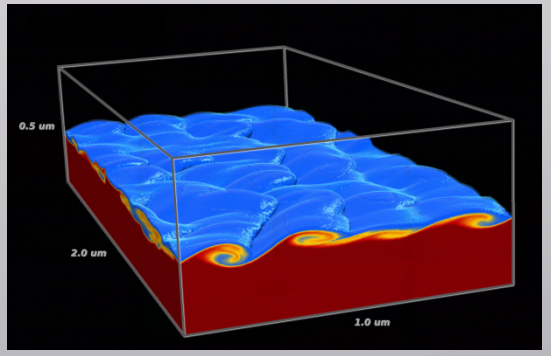
Decades of investments in supercomputing expertise accessible to industry

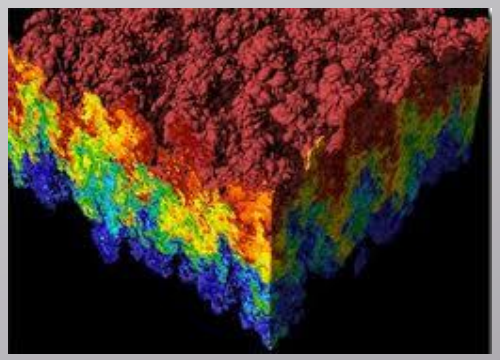
Lawrence Livermore National Laboratory: A National Science and Technology Resource

Award-winning multi-disciplinary computational science and engineering deep expertise in vital domains:

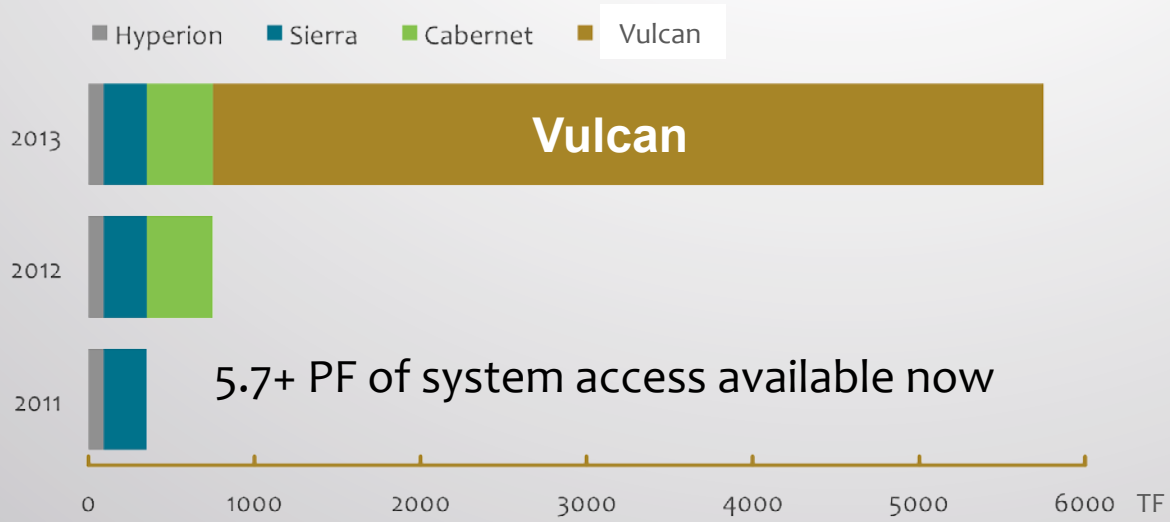
- Mathematics, physics, chemistry, biology, material science
- Energy management, alternative energy technologies, life sciences, earth sciences, transportation, green technologies
- Cyber security, networking, program management
- Massively parallel computing, data analytics, visualization





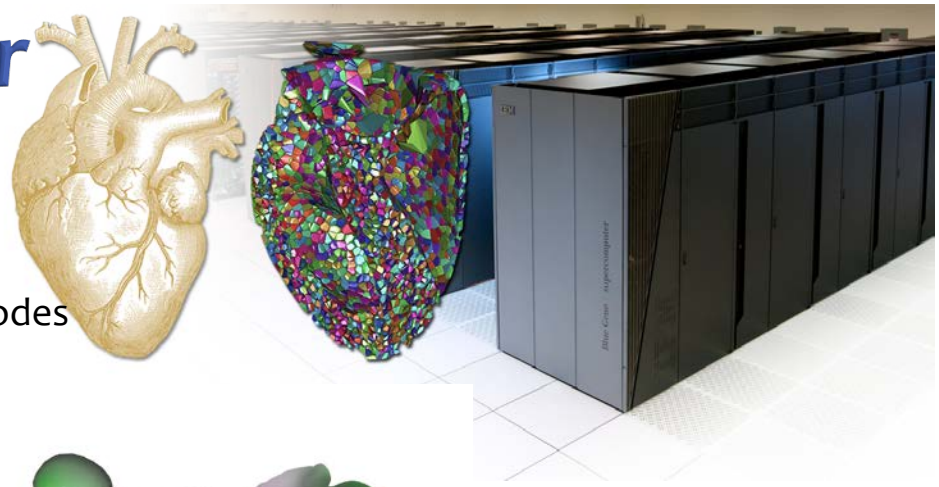


System access with Livermore Computing data center support

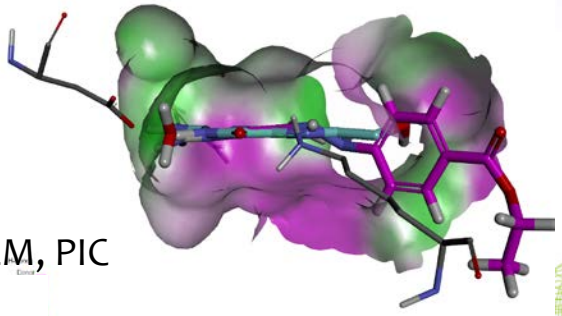


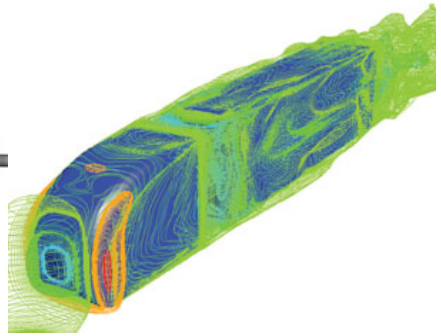
- Hotline, user support, training and consulting
- Development tools availability and expertise
- Deep OS and file system knowledge
- 24x7 operations and call center
- Balanced HPC environment:
  - Computation and storage
  - Networking and visualization
  - Support for >2800 users, 750+ remote
- Massive archival storage

HPC Innovation Center Focus Markets

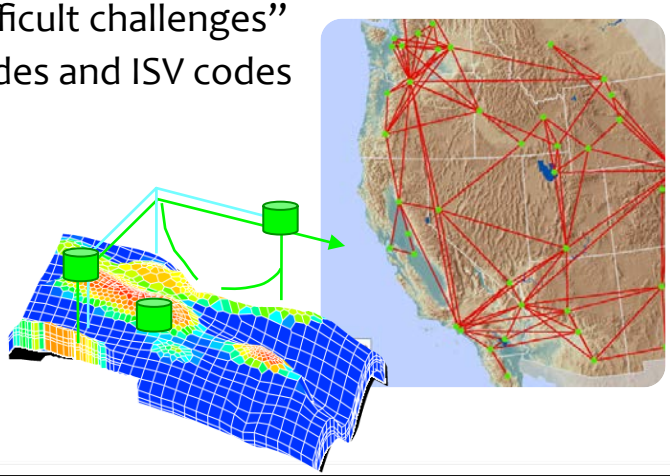


- Life Sciences
  - ***Cardioid*** electrophysiology and mechanical codes
    - Cardiotoxicity screening of prescription drugs
    - Cardiovascular pathology and ECG response
    - Medical devices and clinical medicine
  - Molecular dynamics and drug design
  - Big Data applications: -omics + clinical

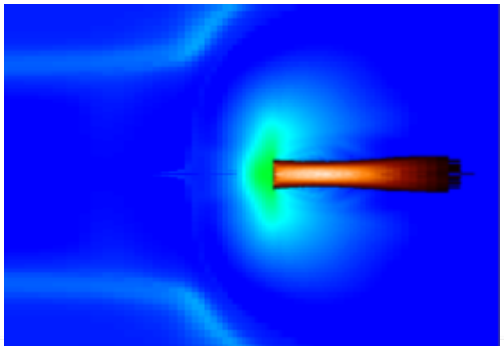




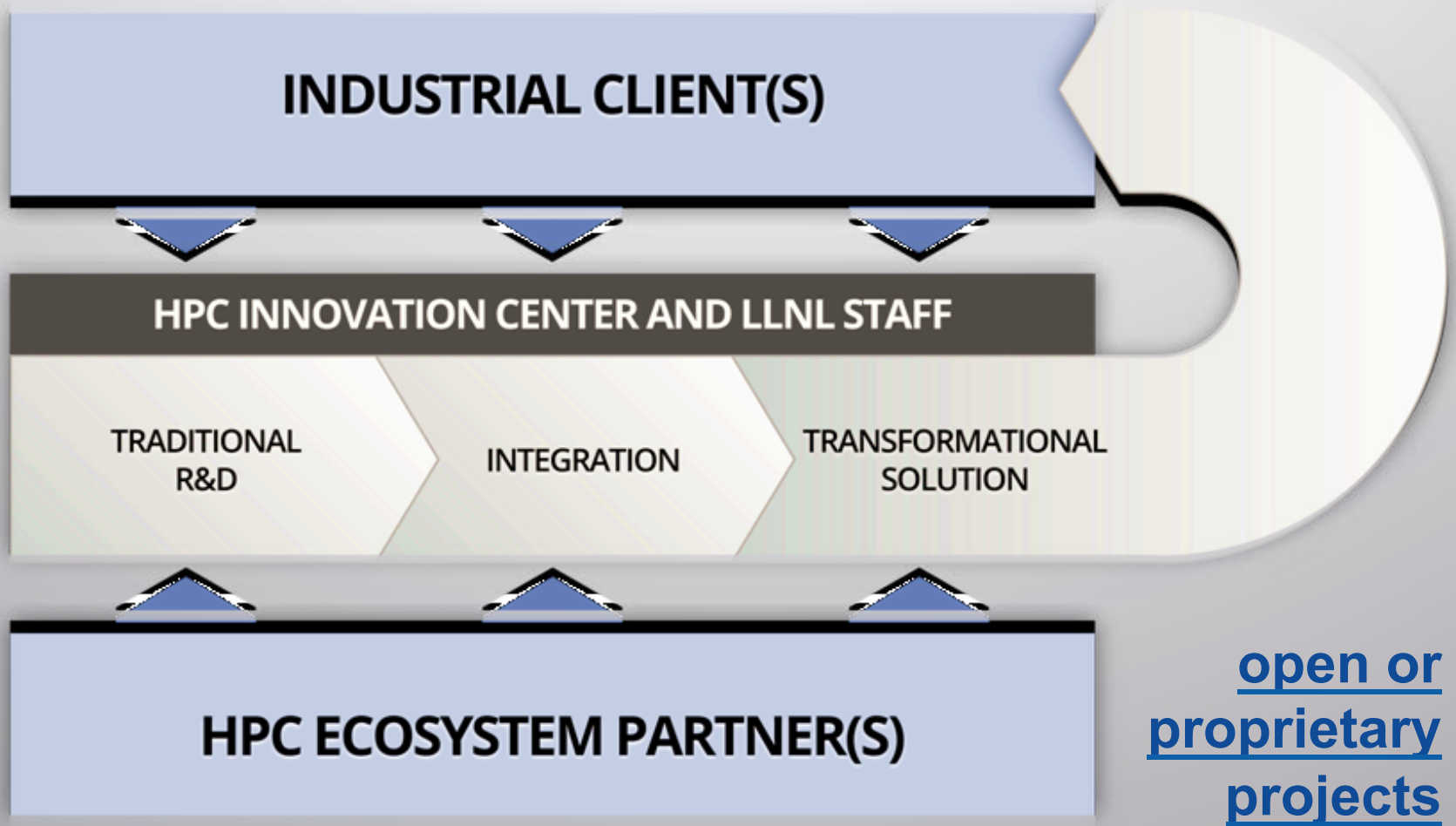
- Computational Engineering
  - Higher scaling for traditional FEA, CFD, EM, PIC
  - Multi-physics and multi-scale
  - Semiconductor ITRS "difficult challenges"
  - LLNL codes, research codes and ISV codes



- Energy
  - SMART Grid
  - Alternative energy
  - Infrastructure security



HPCIC's scalable engagement model goes beyond pure research to deliver integrated solutions . . . on-demand



open or proprietary projects

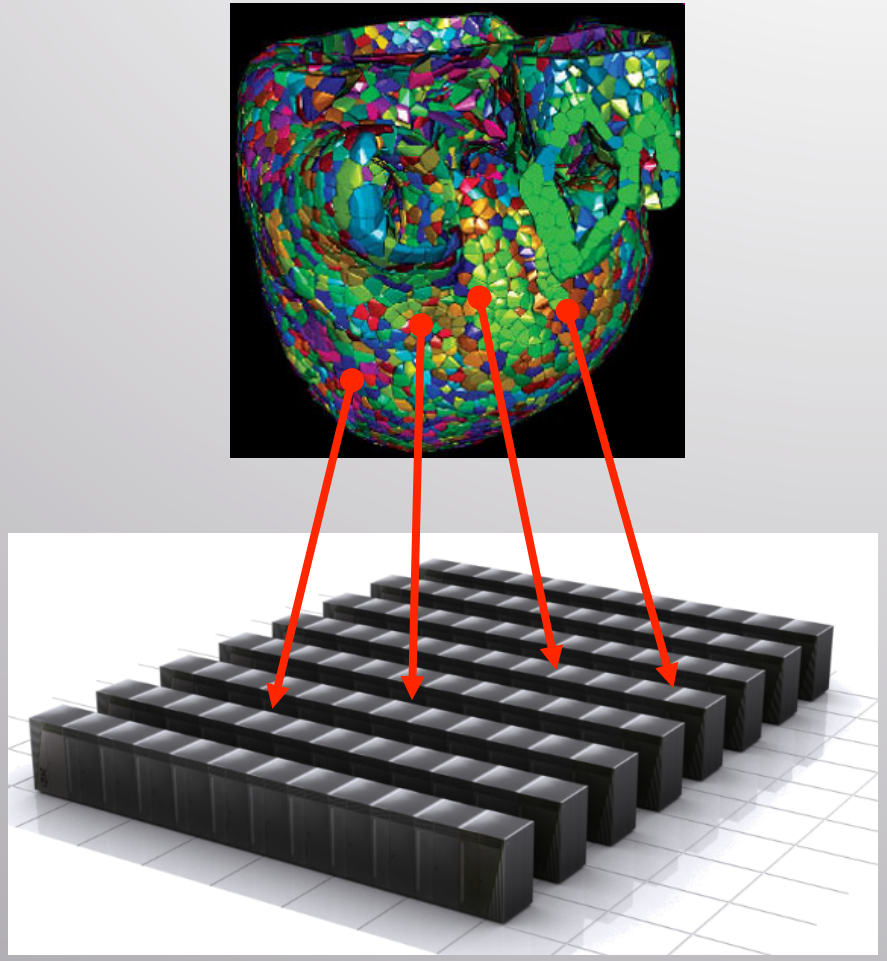
Deep Computing Solutions:
a collaboration between IBM and LLNL

- Operates within LLNL's HPC Innovation Center as an HPC ecosystem partner option for industrial engagements
  - Joint staffing of industrial partner projects by experts from both IBM and LLNL
  - Extends HPCIC's range of industrial solutions to include integration, installation and management of enterprise-critical systems
  - Built on 20 year track record of collaborative innovation
  - Seven #1 ranked supercomputers, five Gordon Bell awards
- Shared commitment by IBM and LLNL to explore collaboration with other ecosystem partners to broaden adoption of advanced computing technologies by American industries

The Cardioid Model on Sequoia

A joint capability development between LLNL and IBM Research

Anatomical model of human heart



96 racks of Blue Gene/Q in Sequoia

- Complete heart is 370-700 million cells in a complex geometry
- Sub-domains of ~200-500 cells must be mapped to each of 1.5 M cores
- Cell model must be computed on every cell for each time step including reaction and diffusion
- Sub-domains must exchange boundary data on each time step
- Code is written from scratch to take advantage of BG/Q hardware
- Extensive algorithmic improvements
- *1200x faster than previous record*
- 2012 Finalist in Gordon Bell Prize

HIGH PERFORMANCE COMPUTING
INNOVATION CENTER

Hartree Centre
Science & Technology Facilities Council

Partnership between LLNL and STFC - Daresbury, UK

MOU signed August 29, 2013 connecting two similar organizations

- Both Hartree Centre and HPC Innovation Center focus on boosting innovation and economic competitiveness through HPC engagements with industry and academia
- Both centers utilize Blue Gene/Q supercomputers and Linux clusters

Both parties see partnership as an opportunity to enable

- Sharing of expertise, best practices, tools, software, solutions, successes
- Rapid solution development on Blue Gene/Q, especially for data analytics
  - BG/Q is #1 architecture on Graph 500 list
- Unique capabilities for large, multi-disciplinary projects, especially for multi-national organizations

What can we do for you?

For more information on the HPC Innovation Center and to explore engagement options, please visit **www.hpcinnovationcenter.com** and contact:

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