LBNL User Facilities

Janos Kirz
Advanced Light Source
July 21, 2009

The setting

jc/AL Saerial/11-96

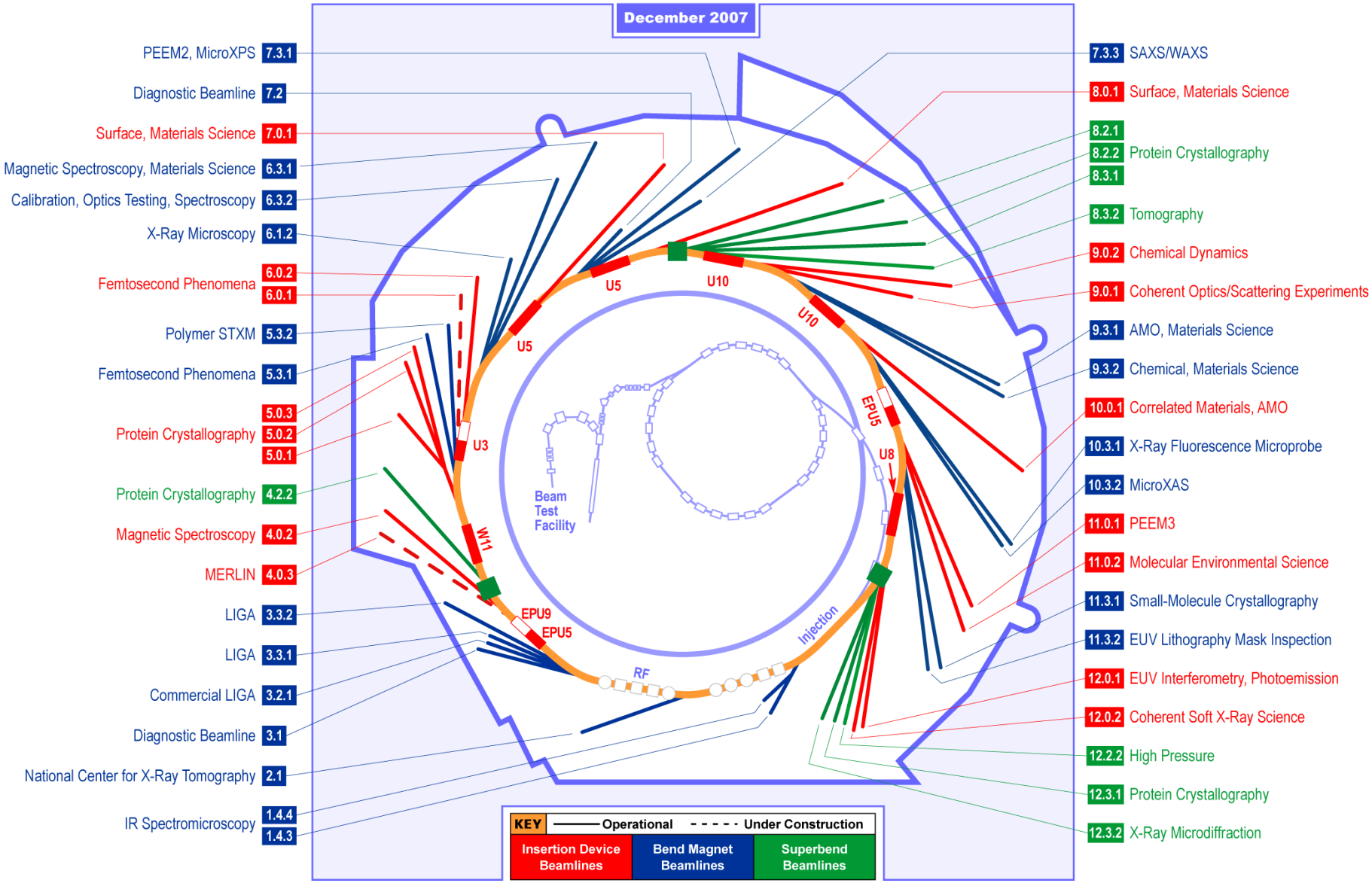
User facilities

- Advanced Light Source
- Joint Genome Institute
- Molecular Foundry
- National Center for Electron Microscopy
- National Energy Research Scientific Computing Center

Advanced Light Source

- Third generation Synchrotron Radiation Source
- 1.9 GeV, 500mA
- Premier source for soft X-rays (0.1 – 1 KeV)
- Great source for IR, VUV, hard X-rays
- 2000 users/year
- 36 beamlines
- Emphasis on user service
- New: Top-off operation started Feb 2009
- New: Guest house opening Sep 2009
- New: User Services Building opening Sep 2010

Beamlines at the ALS 2007



Strengths

- Energy research
  - Catalysis, surfaces & interfaces, clusters, nanomaterials
  - Combustion, batteries
- Condensed matter physics & Materials Research
  - Correlated electron systems: HTc; CMR;oxides
  - Magnetic systems, vortex dynamics
- Environmental and geoscience
- Polymer science, soft matter research
- Macromolecular crystallography
- Ultrafast phenomena
- EUV lithography
- Biology
- Development of novel optics and instrumentation

DOE Joint Genome Institute

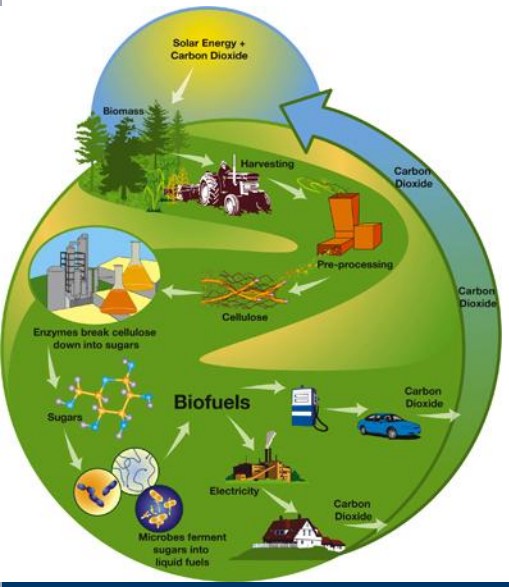
U.S. DEPARTMENT OF ENERGY | Office of Science

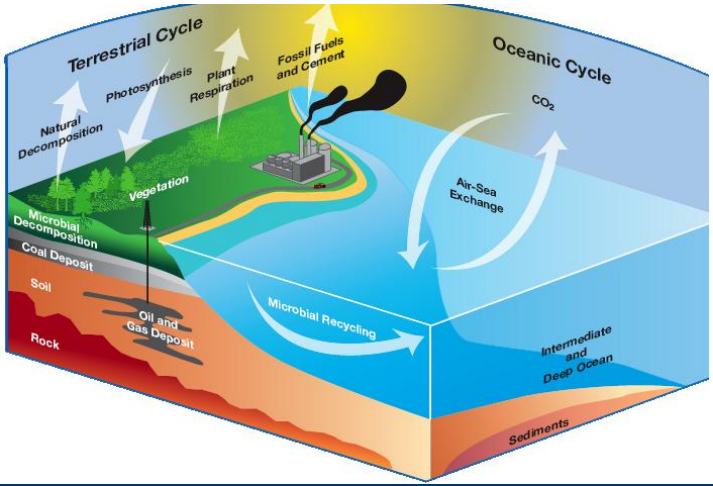
- Walnut Creek, Calif. facility opened in 1999
- ~305 employees
- $52.4M annual budget

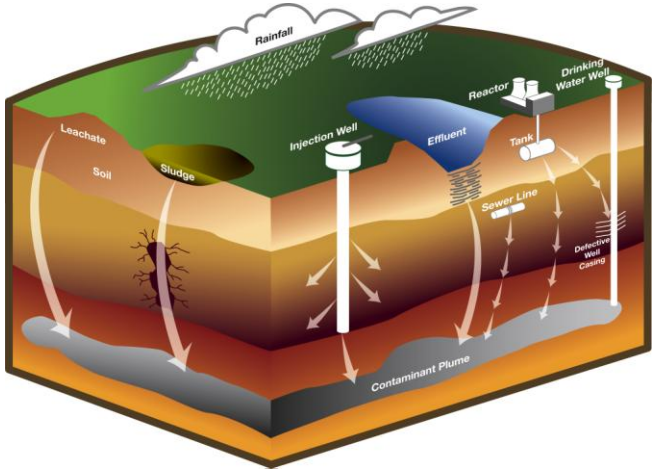
A partnership w/LBNL-LLNL-ORNL-PNNL & the HudsonAlpha Institute

A genomics user facility in support of the DOE missions:

bioenergy, carbon cycling, & biogeochemistry







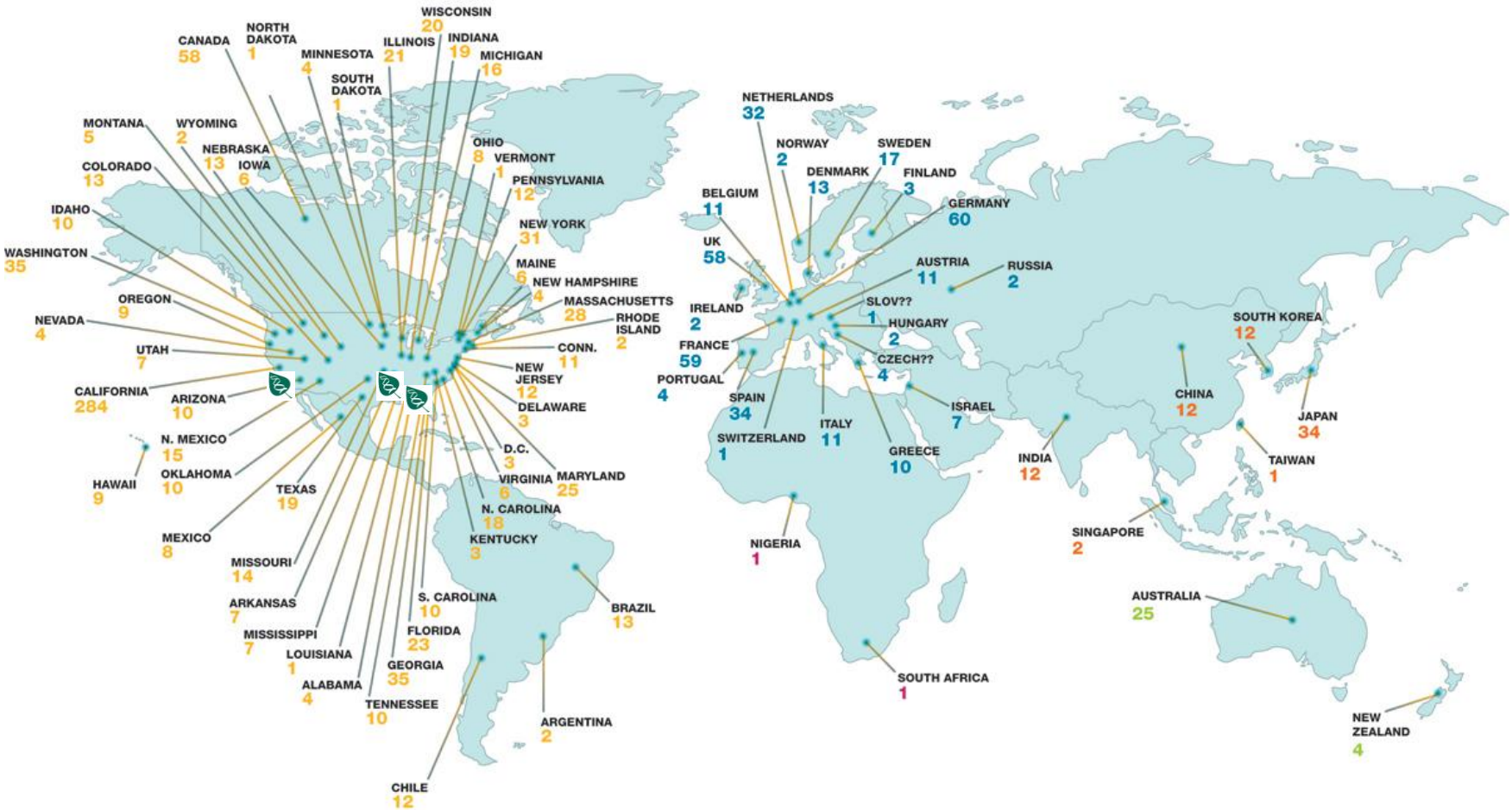
JGI Worldwide User Community

1351

JGI Users Worldwide in 2008

AMERICAS	EUROPE	AFRICA	ASIA	AUSTRALASIA
856	336	2	64	29

DOE Bioenergy Research Centers = DOE JGI's largest customers



Genome Sequencing Worldwide Completed/Committed Organisms

According to GOLD, Genomes Online Database, on a per project basis

DOE JGI	1045
J Craig Venter Inst	719
Broad Institute	458
Sanger Centre	304
Washington Univers.	355
Genoscope	131
Integrated Genomics	58
Institut Pasteur	41
Rest of World	1741
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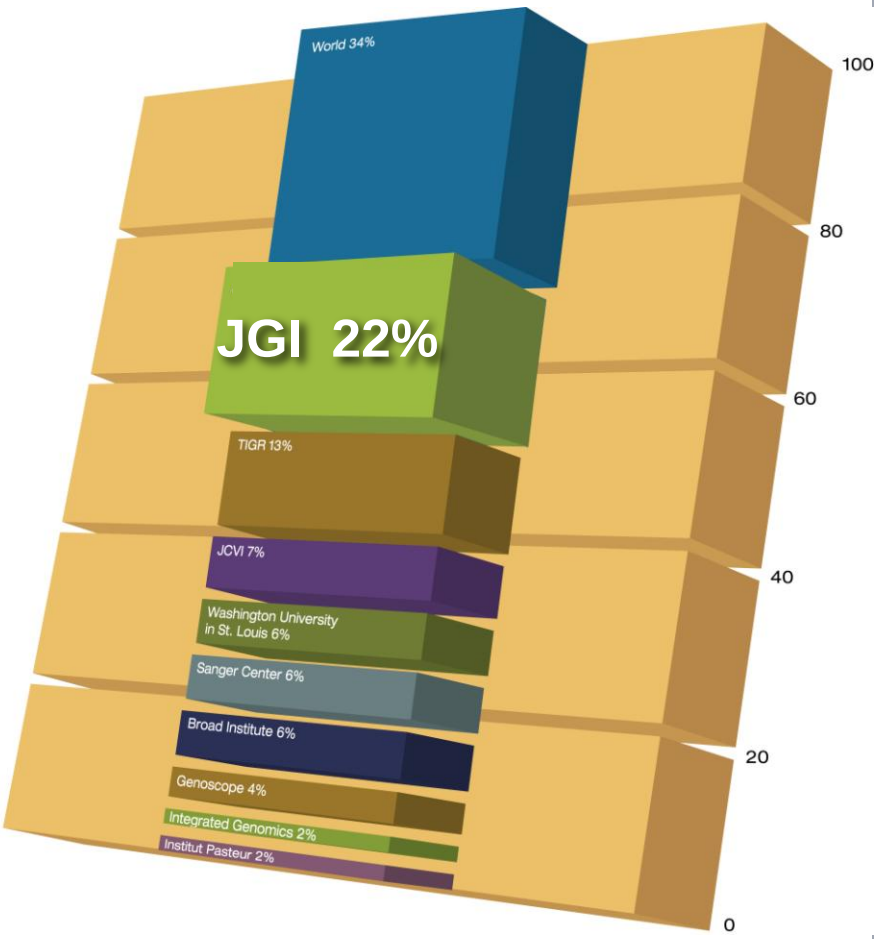
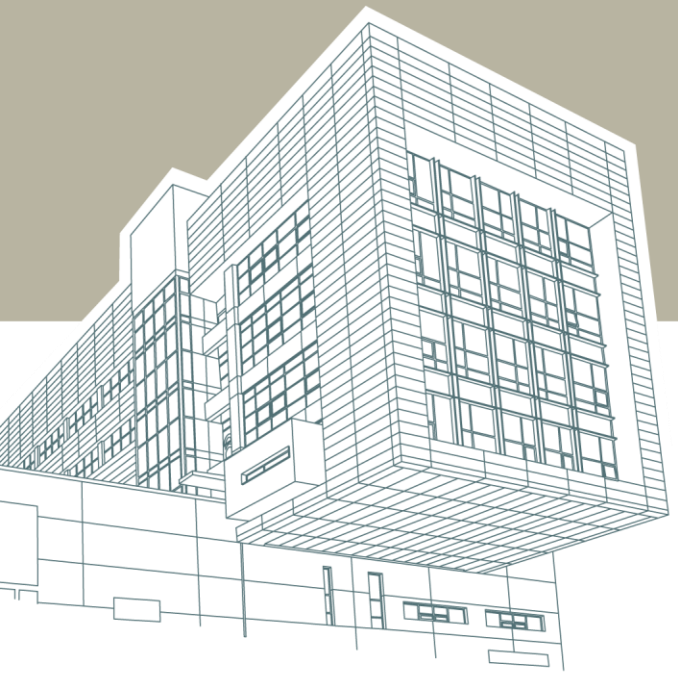
TOTAL	4852





Lawrence Berkeley National Laboratory

The Molecular Foundry

A Department of Energy nanoscience user facility

- Provides expert scientific personnel, instrumentation and techniques to advance synthesis, characterization and theory of “hard” and “soft” nanomaterials
- Promotes interdisciplinary collaboration among scientists studying nanoscale phenomena
- More than 500 users from 32 states and 17 countries to date

http://foundry.lbl.gov/

Molecular Foundry Facilities

Imaging and Manipulation of Nanostructures

Characterization and manipulation of nanostructures

Nanofabrication

Advanced lithographic and thin-film processing techniques

Inorganic Nanostructures

Science of semiconductor, carbon and hybrid nanostructures

Organic and Macromolecular Synthesis

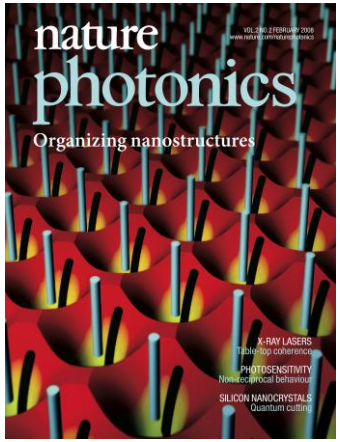
Studies of organic molecules, macromolecules, polymers and their assemblies

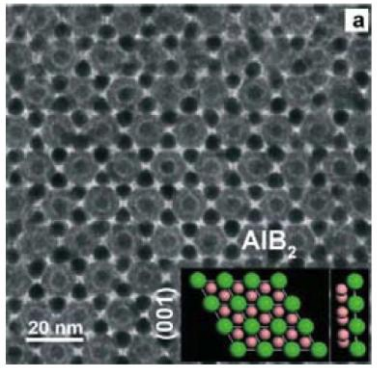
Biological Nanostructures

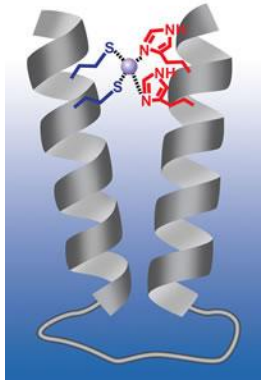
New biomaterials, probes for bioimaging, synthetic biology techniques

Theory of Nanostructured Materials

Theoretical understanding of new principles, behavior and experiments







National Center for Electron Microscopy

Electron Scattering User Facility for Materials Science

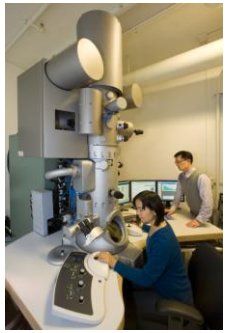
Staff

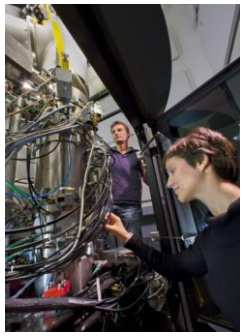
- 7 Scientific
- 6 Technical
- 1 Administrative

NCEM was established in 1983

Present Unique Instrumentation:

- One-Angstrom Microscope
- Monochromated TEM/STEM
- SPLEEM
- E-filtered monochromated TEM/STEM
- Cs-corrected VG STEM
- In-situ Microscope
- TEAM 0.5
- TEAM I

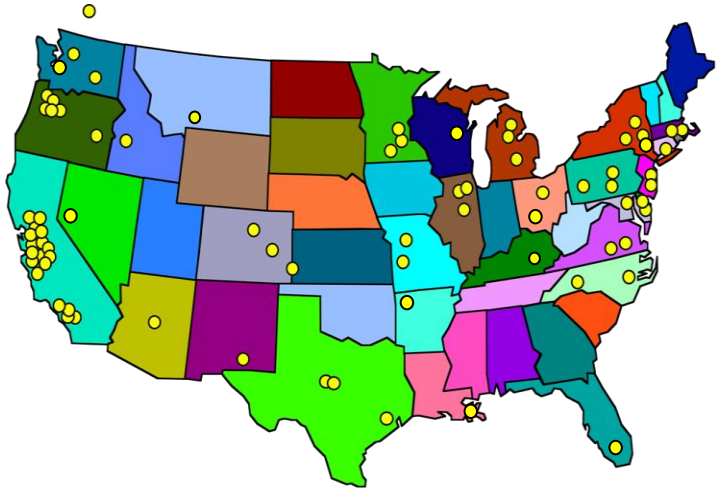


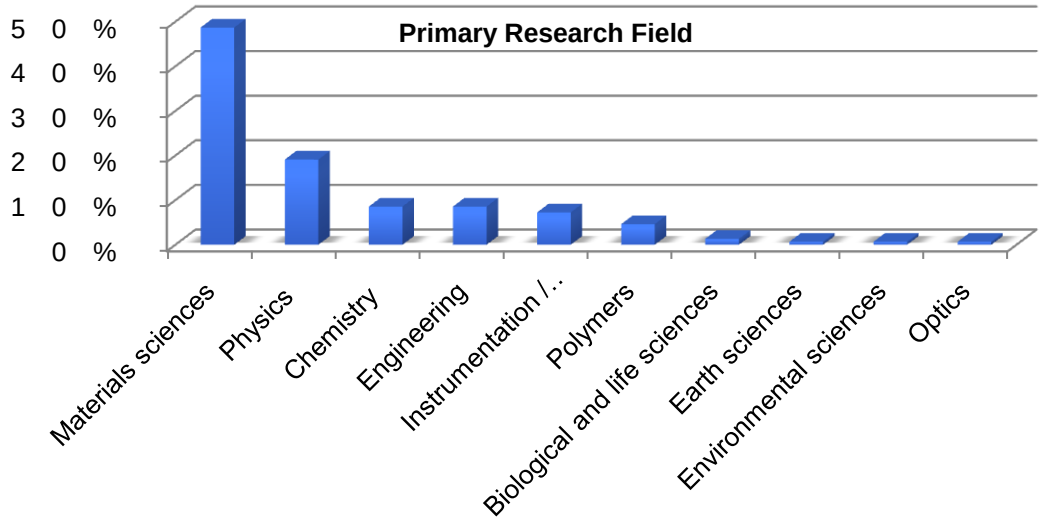


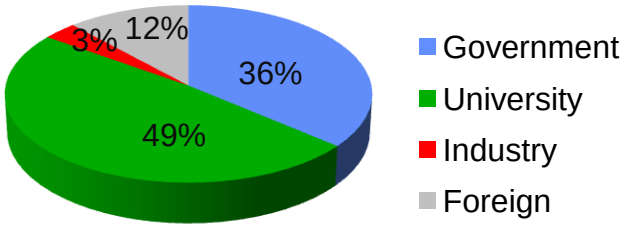
Specializing in quantitative characterization of materials microstructures at high spatial resolution.

NCEM Demographics

- NCEM serves many research programs nationwide and abroad.
  - ~ 200 users/year
- Free access controlled by external Proposal Review Committee





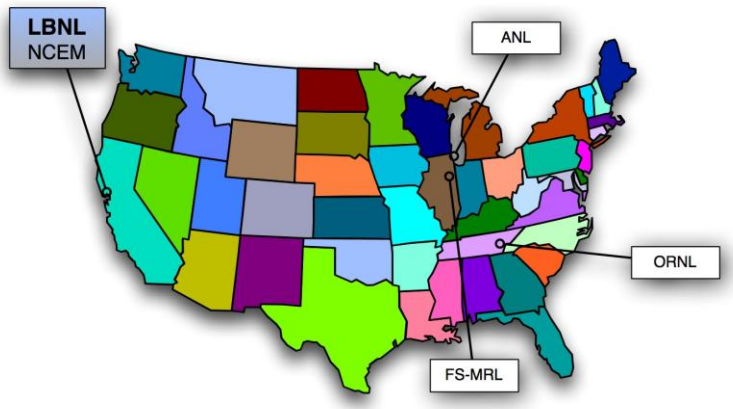


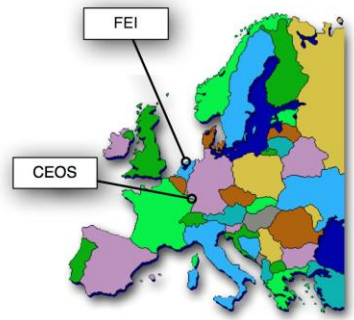
TEAM Project

Transmission Electron Aberration-corrected Microscope

A collaborative project to develop the next-generation electron microscope.

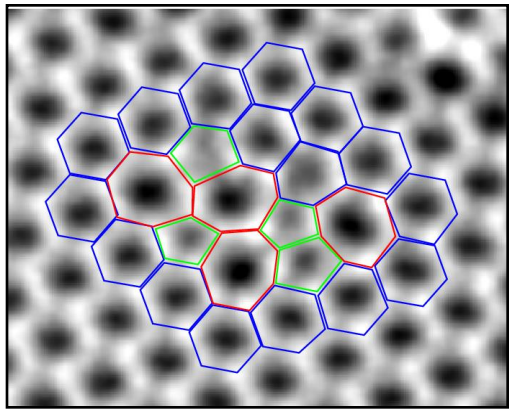
Final TEAM I instrument to begin user operations at NCEM in October 2009



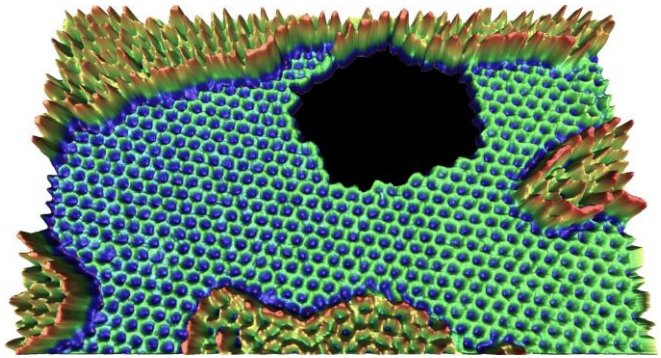


Example: Direct imaging of single atoms and defects in graphene

Unprecedented scientific opportunities for observing the atomic-scale order, electronic structure and dynamics of individual nanostructures …



J. Meyer, et al., Nano Letters, 2008,

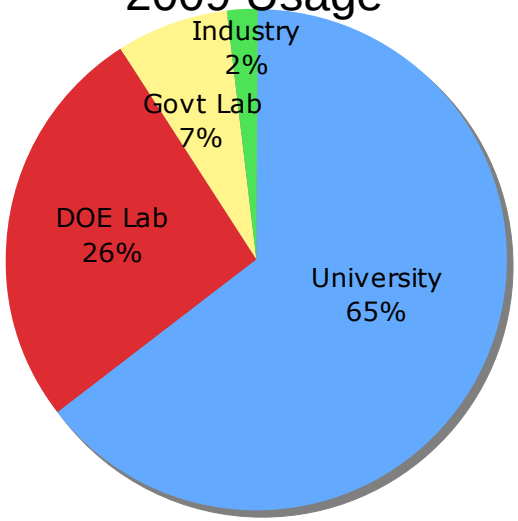


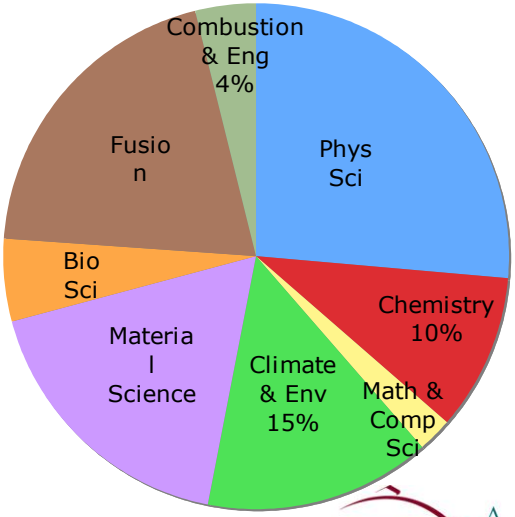
C.O. Girit, et al., Science, 2009

Science Supercomputer Production Facility

- **NERSC serves unclassified science**
  - DOE Office of Science "open science" facility
  - Approximately 3000 researchers, 400 projects
- **Focus on "high-end" resources**
  - 38,128 core Cray System: #7 on TOP500 list
  - 440 terabyte global filesystem
  - 59 petabyte tape archive
  - 20 gigabit/second Internet 2/ESnet link
- **Full-service facility**
  - User Services Group staffed with science PhDs
  - Code optimization & debugging
  - Visualization
  - Training
- **Startup accounts**
  - http://www.nersc.gov

2009 Usage





NERSC 2009 Configuration

Large-Scale Computing System

Franklin (NERSC-5): Cray XT4

- 9,532 compute nodes; 38,128 cores
- ~25 Tflops/s sustained application performance
- 356 Tflops/s peak performance
- 8 GB of memory per quad-core node

Clusters

Bassi (NCSb)

- IBM Power5 (888 cores)

Jacquard (NCSa)

- LNXI Opteron (712 cores)

PDSF (HEP/NP)

- Linux cluster (~1K cores)

NERSC Global Filesystem (NGF)

Uses IBM's GPFS

440 TB; 5.5 GB/s

HPSS Archival Storage

- 59 PB capacity
- 11 Tape libraries
- 140 TB disk cache

Analytics / Visualization

- Davinci (SGI Altix)

User access

- Peer reviewed proposals
- Access free of charge (except proprietary)
- Web sites:

  http://www.lbl.gov/
- To contact me:
  - http://www.als.lbl.gov/als/ourorg/kirzbio.html
  - jkirz@lbl.gov