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SI 507: Information Policy Analysis and Design

Wk 8: Infrastructure and Innovation Policy

U.S. Science and Technology Policy

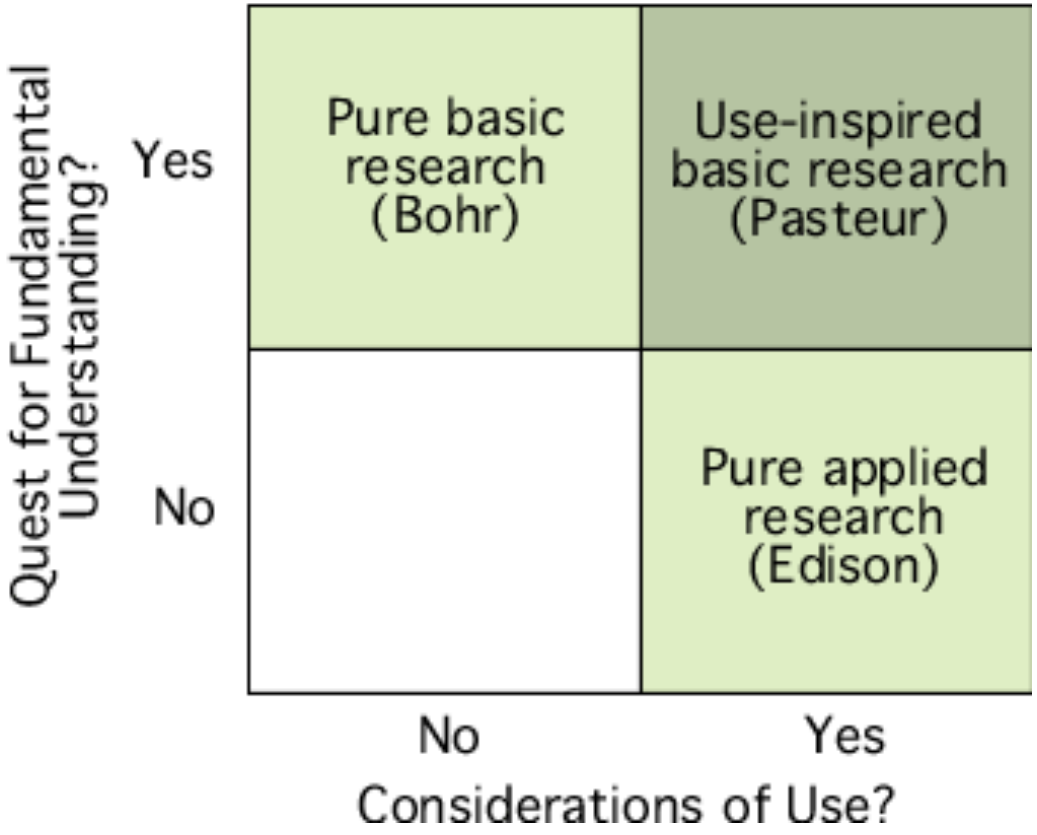
- 19th-C development of the (German) research university – science seated in universities, polytechnics, and foundations (*less so* government and industry)
- 19th-C agricultural extension
- World War II: Office of Scientific Research and Development, Manhattan Project, etc.

U.S. Science and Technology Policy (cont'd)

- Vannevar Bush, *The Endless Frontier* – "America's social contract with science." The terms:
  - Basic / applied distinction – government would fund basic knowledge, and reap downstream rewards.
  - Governance: the social autonomy of science (incl. peer review and Congressional insulation)
  - Establishing the NSF, 'civilianizing' the wartime OSRD.
  - Military / industrial / academic complex
  - The 'linear model' and the Cold War university

A new social contract with science? (pt 1)

- **Pasteur's Quadrant** (Donald Stokes): questioning the basic / applied split

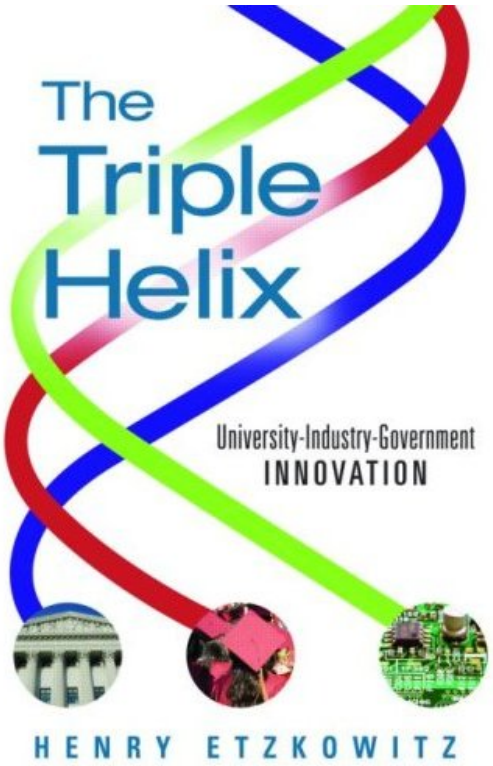


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Donald Stokes

A new social contract with science? (pt 2)

- **'triple helix' model** – state/university/industry (Etzkowitz and Leydesdorff)



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A new social contract with science? (pt 3)

- **'Mode-2' science** – context-driven, problem-focused, interdisciplinary, contingent, socially responsive (vs. Mode-1: investigator-driven, disciplinary, relatively autonomous) (Gibbons, Scott, Nowotny, et. al.)

A new social contract with science? (pt 4)

- **National Innovation Systems –** "*the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies"(Freeman 1987)* © FAIR USE
- **key actors**: national science funders; industry; universities (research and educational functions); K-12 education; etc.;
- **affiliated policies**: science policy; competition policy; education policy; intellectual property; trade policy; etc. – harmonization or coordination under broader vision of 'innovation policy'

Pt II: Cyberinfrastructure and science policy…

Illiac I (1949-1962)

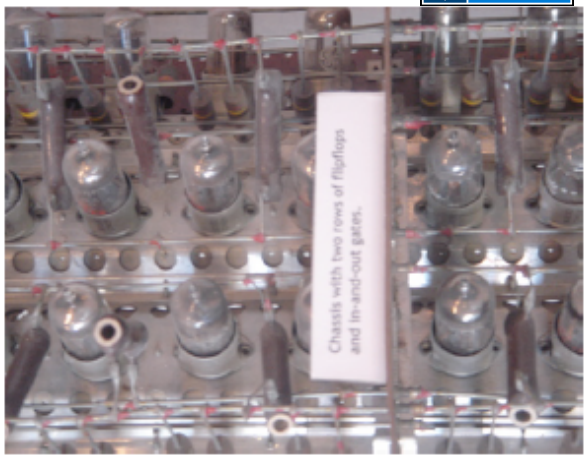


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Source:
Dan Atkins

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Vacuum tube circuits

Illiac I was the first computer built and owned entirely by a university. It went on line on September 22, 1952. With the computing power of a modern-day handheld calculator, Illiac had 2,800 vacuum tubes and weighed 10,000 pounds. It was more than 10 ft long, 2 ft high, and 8 ft high, with a 5k main memory and 64k Drum memory.

Supercomputing and science policy

'Lax Report,' 1982 (National Science Foundation, Department of Defense)

1) Lack of access to supercomputers hurts research efforts in the U.S. science and defense communities – the 1970s 'supercomputer famine';
2) U.S. industrial and academic leadership in advanced computing declines through the 1970s (vis-à-vis Europe and Japan)

The Advanced Scientific Computing Program (1985)

National Science Foundation Office of Advanced Scientific Computing –

1. NSFnet (forerunner to the Internet);
2. The Supercomputer Centers Program (Illinois, San Diego, Pittsburgh, Cornell, Princeton)
3. Buying and selling computing resources ('cycle broker')

3 challenges / drivers of U.S. supercomputing policy in the 90s.

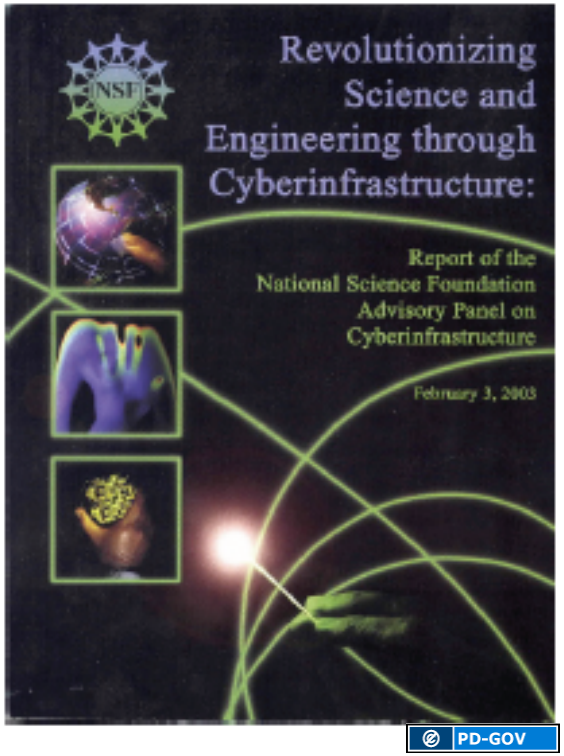
- **Changing computer *architectures* –**
  commodity, cluster, and grid computing

- **International *competition* –**
  'computenik': the Japanese Earth Simulator; later UK and European E-Science Program

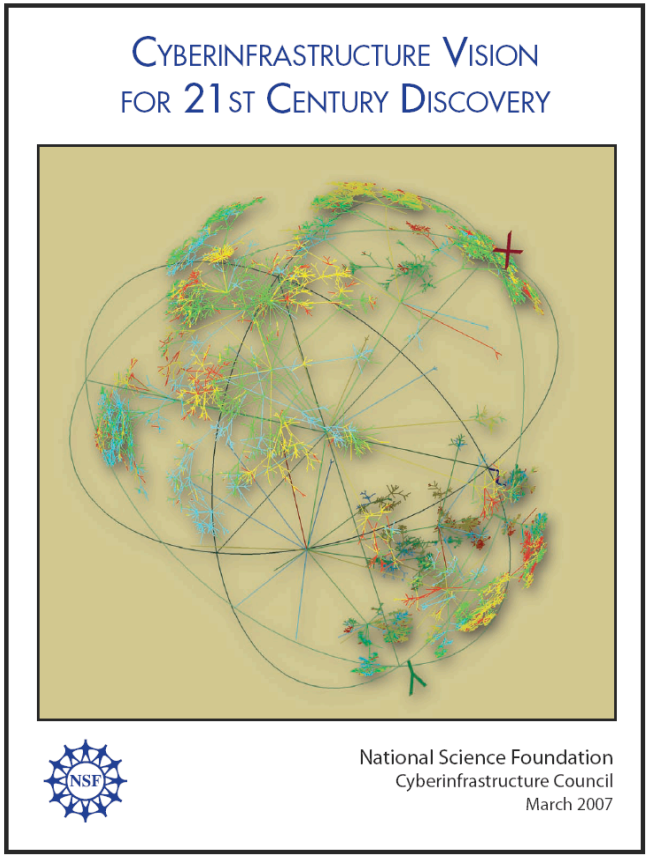
- **Changing needs of science –**
  scale, scope, and complexity (e.g. climate science)

NSF Blue Ribbon Advisory Panel on Cyberinfrastructure

"a new age has dawned in scientific and engineering research, pushed by continuing progress in computing, information, and communication technology, and pulled by the expanding complexity, scope, and scale of today's challenges. The capacity of this technology has crossed thresholds that now make possible a comprehensive "cyberinfrastructure" on which to build new types of scientific and engineering knowledge environments and organizations and to pursue research in new ways and with increased efficacy."



http://www.nsf.gov/od/oci/reports/toc.jsp



PD-GOV

"At the heart of the cyberinfrastructure vision is the development of a *cultural community* that supports *peer-to-peer collaboration* and *new modes of education* based upon broad and open access to *leadership computing*; *data and information resources*; online *instruments and observatories*; and *visualization and collaboration services*. Cyberinfrastructure enables *distributed knowledge communities* that collaborate and communicate across disciplines, distances, and cultures. These research and education communities extend beyond traditional brick-and-mortar facilities, becoming *virtual organizations* that transcend geographic and institutional boundaries. This vision is new, exciting, and bold."

- Arden Bement, NSF Director PD-GOV

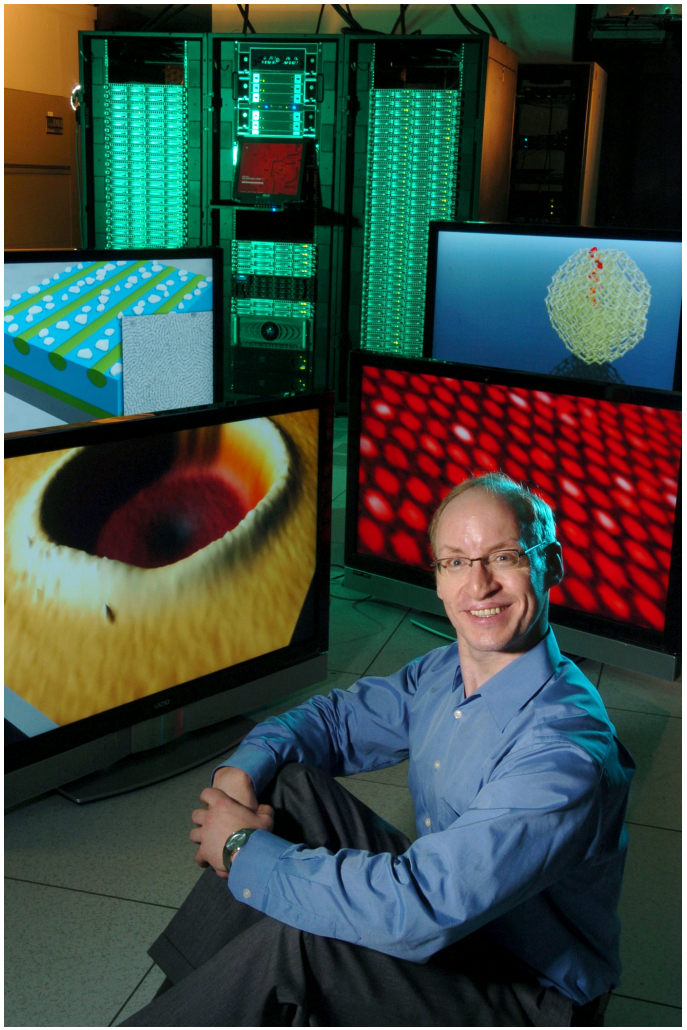
CI Vision: High Performance Computing

"Provide communities addressing the most computationally challenging problems with access to a world-class **high performance computing** (HPC) environment through NSF acquisition and exchange-of-service agreements with other entities…"

"Broaden access to **state-of-the-art computing resources**, focusing especially on institutions with less capability and communities where computational science is an emerging activity."

"Support the development and maintenance of robust **systems software, programming tools, and applications** needed to close the growing gap between peak performance and sustained performance on actual research codes…"

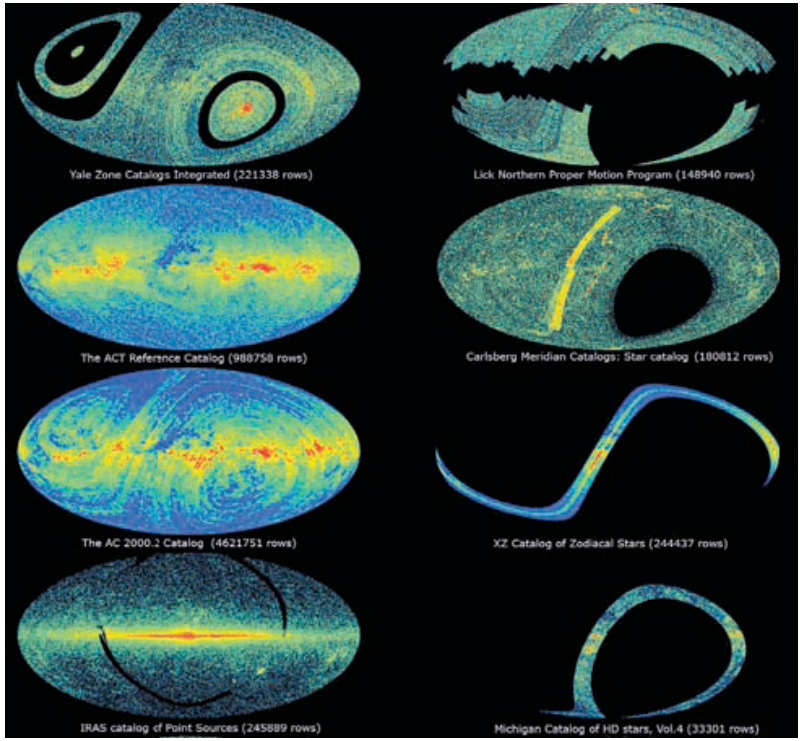
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Argonne National Laboratory, Nanoscale High-Performance Computing Facility (Flickr)

CI Vision: Data, Data Analysis, and Visualization



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"Support state-of-the-art innovation in **data management and distribution systems**, including digital libraries and educational environments that are expected to contribute to many of the scientific breakthroughs of the 21st century."

"In the future, U.S. international leadership in science and engineering will increasingly depend upon our ability to leverage this reservoir of scientific data captured in digital form, and to transform these data into information and knowledge aided by **sophisticated data mining, integration, analysis and visualization tools**."

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CI Vision: Virtual Organizations

"a group of individuals whose members and resources may be dispersed geographically and/or temporally, yet who function as a coherent unit through the use of end-to-end CI systems… providing shared access to centralized or distributed resources or services, often in real-time."

"creating and sustaining effective virtual organizations, especially those spanning many traditional organizations, is a complex technical and social challenge. It requires an **open technological framework** consisting of, for example, applications, tools, middleware, remote access to experimental facilities, instruments, and sensors… Overall effectiveness also depends upon the **appropriate social, governance, legal, economic and incentive structures**."

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CI Vision: Learning and Workforce Development



BY-SA Jim Champion (Flickr)

"Cyberinfrastructure moves us beyond the old-school model of teachers/students and classrooms/labs. **Ubiquitous learning environments** now will encompass classrooms, laboratories, libraries, galleries, museums, zoos, workplaces, homes and many other locations. Under this transformation, established components of education… become highly leveraged elements of a more **open learning world** where people learn as a routine part of life, throughout their lives."

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Cyberinfrastructure:

Interoperable Scientific Data:

> "We envision an environment in which raw data and recent results are easily shared, *not just within a research group or institution but also between scientific disciplines and locations.* […] This will only take place if all share standards and underlying technical infrastructures."



Tailored Domain Applications:

> "Cyberinfrastructure should be produced and managed in a way that enables research communities/projects to *tailor efficient and effective application-specific [...]knowledge environments* for research and education."

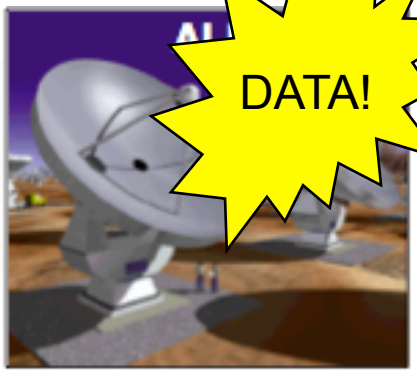


Atkins, Daniel E. (Chair) (2003) 'Revolutionizing Science and Engineering Through Cyberinfrastructure: Report of the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure', in: National Science Foundation.

Some examples of CI projects:







GriPhyN



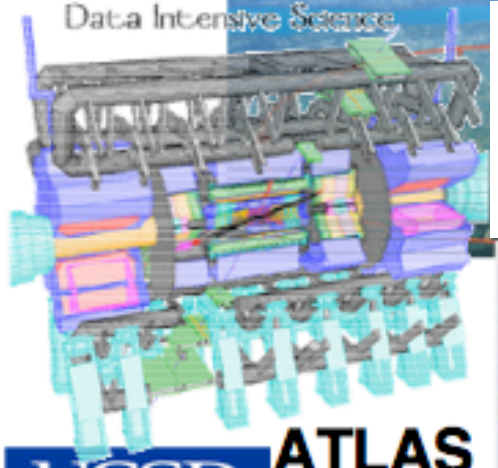






NEON
National Ecological Observatory Network

Data Intensive Science







GEON



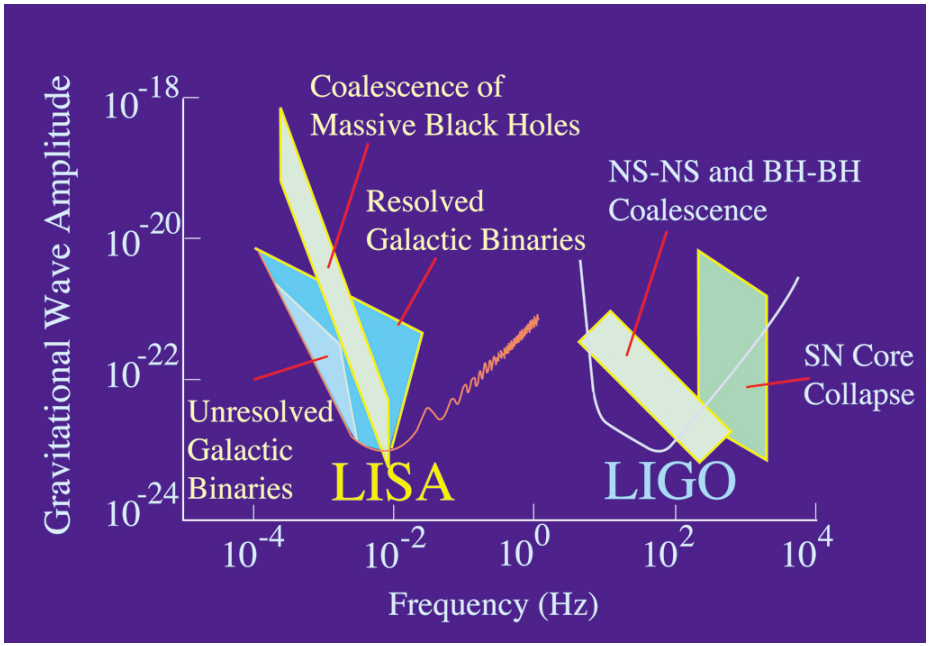
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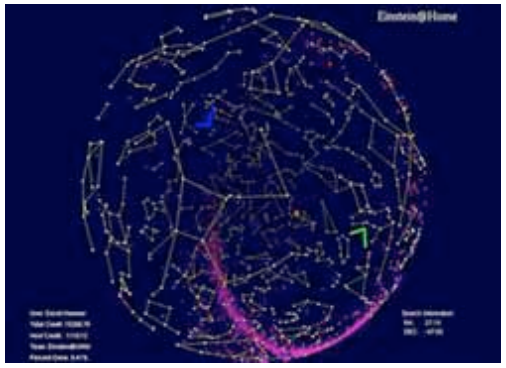
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Laser Interferometer Gravitational-Wave Observatory (LIGO)

"The Laser Interferometer Gravitational-Wave Observatory (LIGO) is a facility dedicated to the detection of cosmic gravitational waves and the harnessing of these waves for scientific research. It consists of two widely separated installations within the United States — one in Hanford Washington and the other in Livingston, Louisiana — operated in unison as a single observatory." FAIR USE



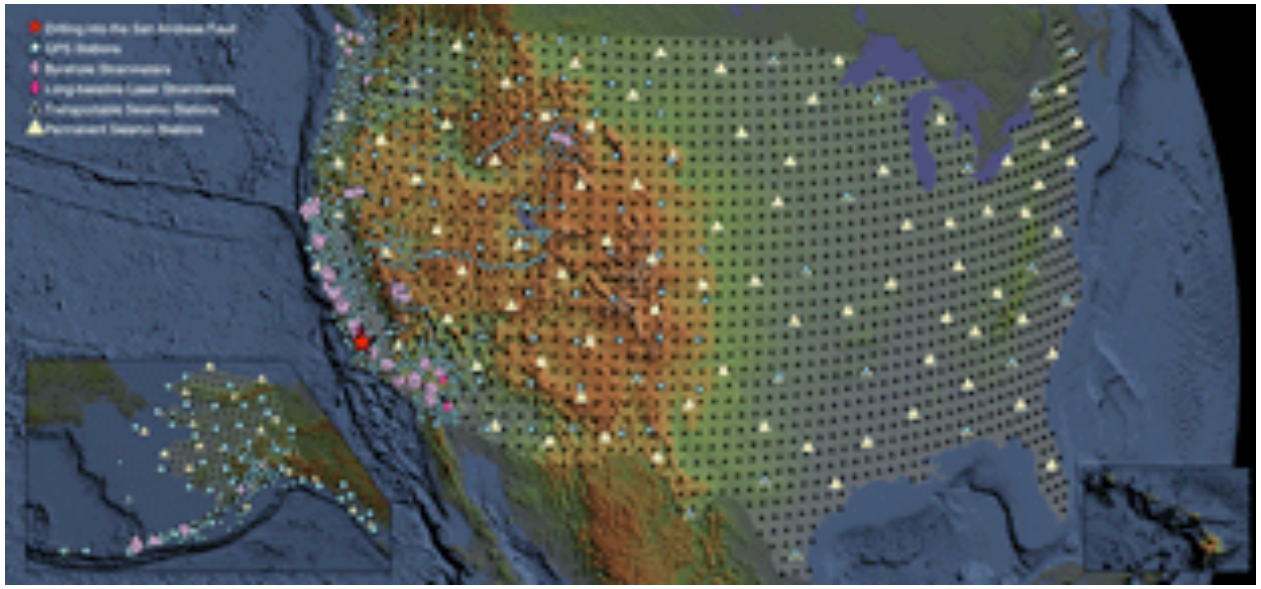
PD-GOV NASA (Wikimedia Commons)



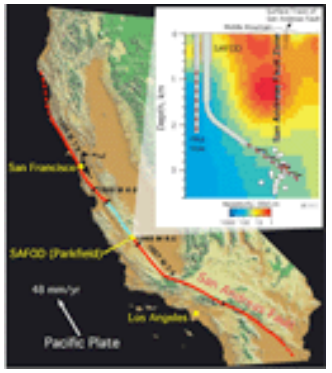
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Einstein@Home uses computer time donated by computer owners all over the world to process data from gravitational wave detectors. Participants in Einstein@Home download software to their computers, which process gravitational wave data when not being used for other computer applications, like word processors or games. Einstein@Home doesn't affect the performance of computers and greatly speeds up this exciting research.

EarthScope – "EarthScope is a bold undertaking to apply modern observational, analytical and telecommunications technologies to investigate the structure and evolution of the North American continent and the physical processes controlling earthquakes and volcanic eruptions. EarthScope will provide a foundation for fundamental and applied research throughout the United States that will contribute to the mitigation of risks from geological hazards, the development of natural resources, and the public's understanding of the dynamic Earth." FAIR USE



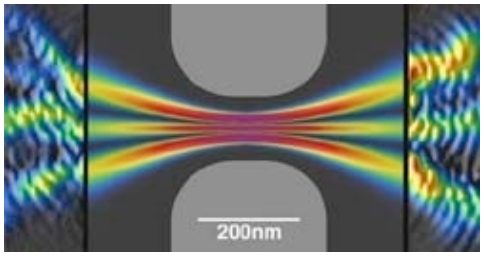
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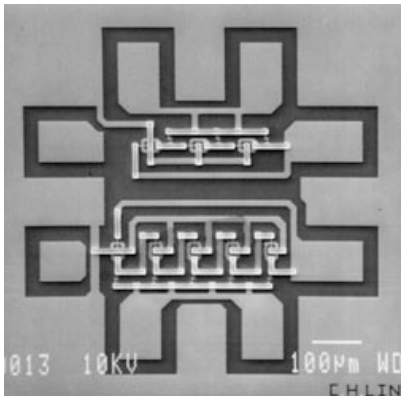
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National Nanotechnology Infrastructure Network

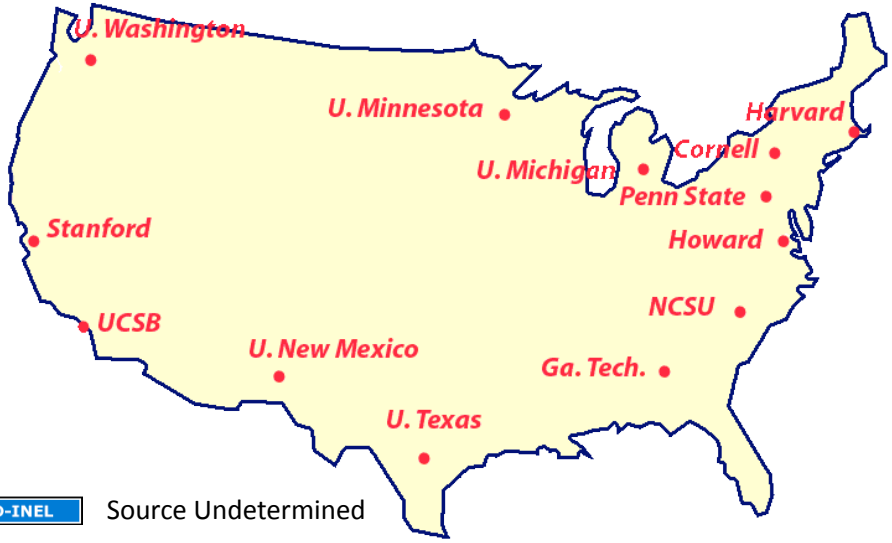
"The mission of **National Nanotechnology Infrastructure Network** (NNIN) is to enable rapid advancements in science, engineering and technology at the nano-scale by efficient access to nanotechnology infrastructure. We provide shared open, geographically diverse laboratories, each with specific areas of technical excellence, and provide fabrication, synthesis, characterization, and integration resources to build structures, devices, and systems from atomic to complex large scales."



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