



INDIANA ACTSI
Clinical and Translational Sciences Institute

Accelerating Clinical and Translational Research



PHARMAHUB

a PTEC project

COLLABORATION FOR
PHARMACEUTICAL ENGINEERING AND SCIENCE

nanoHUB.org
an NCI project

ONLINE SIMULATION AND MORE
FOR NANOTECHNOLOGY



CUAHD

Communities and Universities Addressing Health Disparities

catalyze **CARE**

transforming healthcare delivery



Collaborative volcano research and risk mitigation

NEEShub

George E. Brown, Jr. Network for Earthquake Engineering Simulation

hpc

Improved Simulation Through Collaboration

Rensselaer Polytechnic Institute • Stony Brook University • University at Buffalo • Brookhaven National Laboratory • NYSERNet

iemHUB
a CIEM project

INTEGRATED
ENVIRONMENTAL
MODELING

*A community center for developing and sharing
knowledge and tools for environmental systems analysis*

trustHUB

CLEERHUB

Collaboratory for Engineering Education Research

VSCSE

VIRTUAL SCHOOL OF COMPUTATIONAL
SCIENCE AND ENGINEERING

MEMTSHUB



cceHUB
cancer care engineering

Science of
Information



NSF Science and Technology Center

thermalHUB

CAT CENTER FOR
ASSISTIVE TECHNOLOGY

CONNECTING ASSISTIVE TECHNOLOGY CONSUMERS,
PROFESSIONALS, INNOVATORS, AND PROVIDERS



MANUFACTURINGHUB

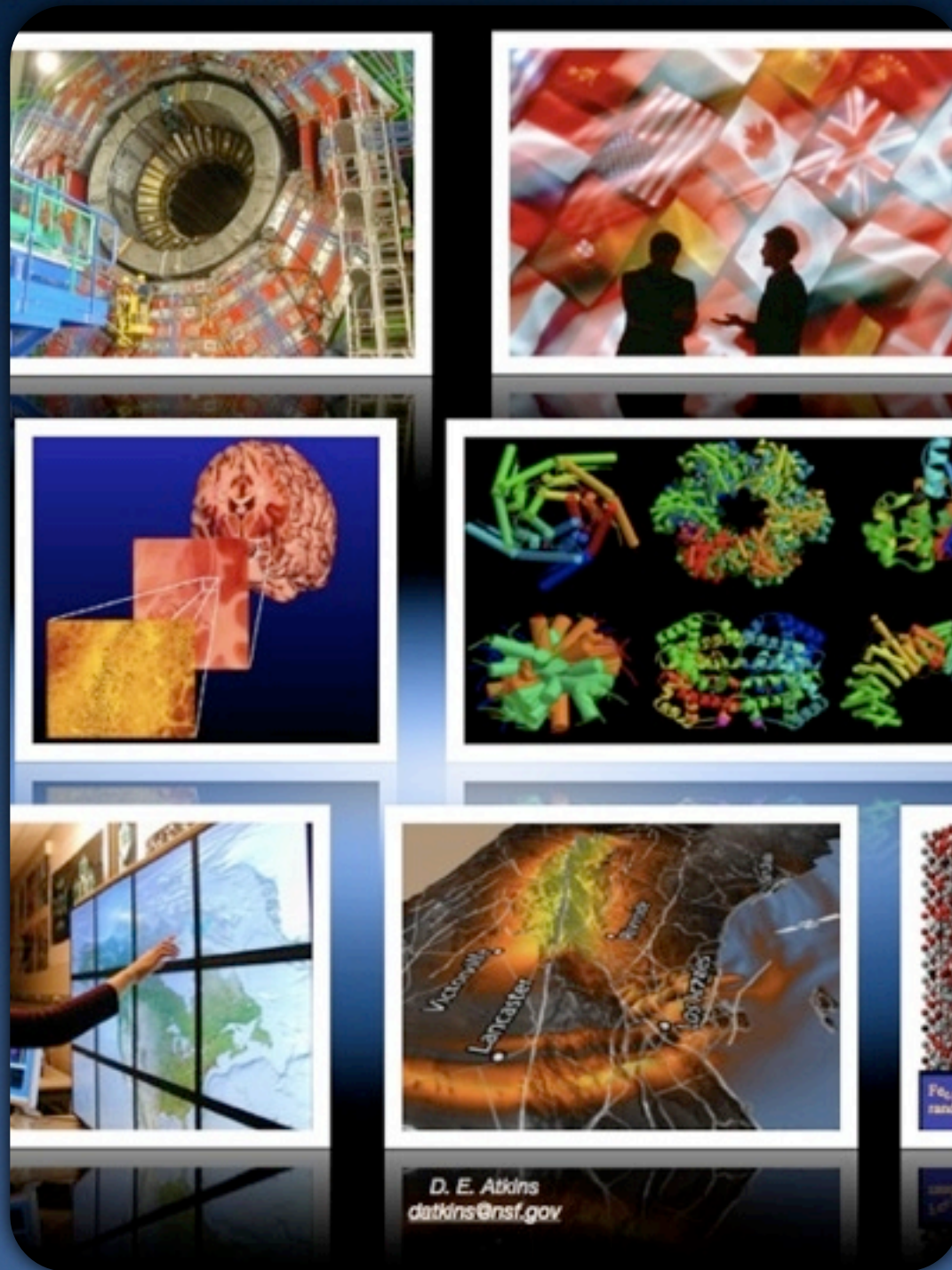
GLOBALHUB Advancing
Global Engineering

The Greatest and Best Use of Cyberinfrastructure: High-Performance Collaboration



Daniel E. Atkins

W.K. Kellogg Professor of Community Informatics,
Professor of EECS,
Associate VP for Research Cyberinfrastructure
University of Michigan
atkins@umich.edu



HUBzero

- In a larger historical context;
- as an object of celebration;
- as a system for future development.



Personal Privilege and Amazement: From Digiclock to Petascale Grid Communities



1964 - Digiklok



1949-62 Iliac I



1956-68 Iliac II



1960-68 Iliac III

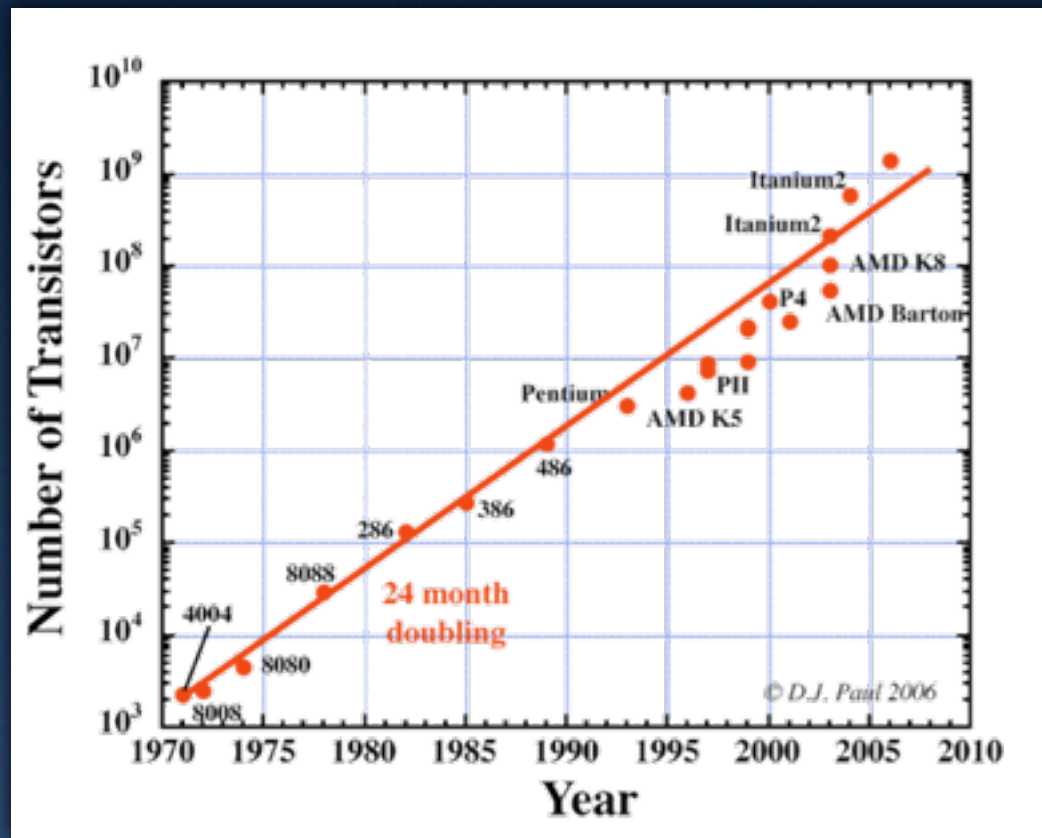


1956-68 Iliac IV

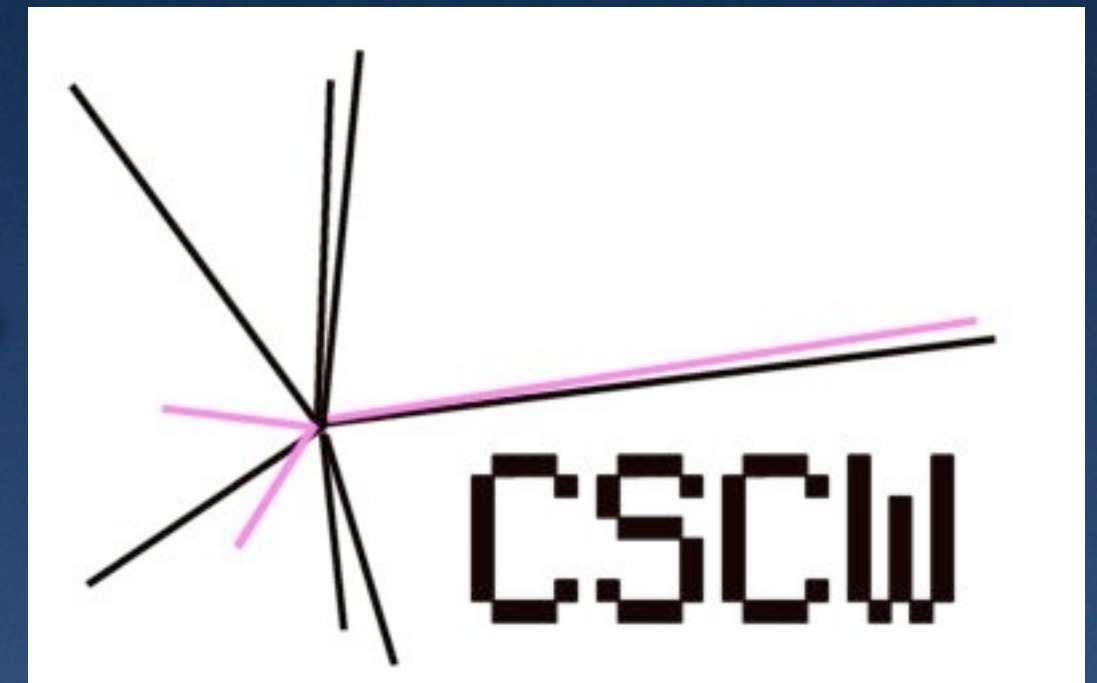
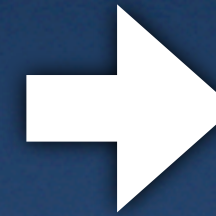


1972-82 - Exp. Machines

The Marriage of Computing and Communication



+

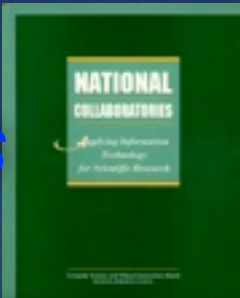


Personal Privilege and Amazement: From Digiclock to Petascale Grid Communities

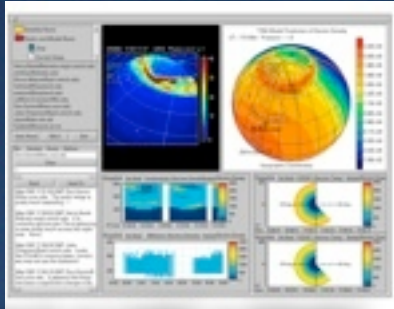


1983- CAEN

EXPRES



1983- Collaboratory Research • UARC • SPARC



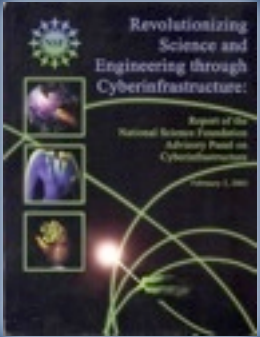
1990- UM Digital Lib Project



1993-School of Information
Information School Movement



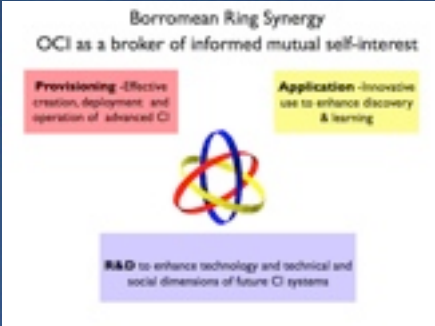
1997- Kellogg ACT



2001-03 CI Adv. Panel



CI Convergence



2006- NSF Office of Cyberinfrastructure

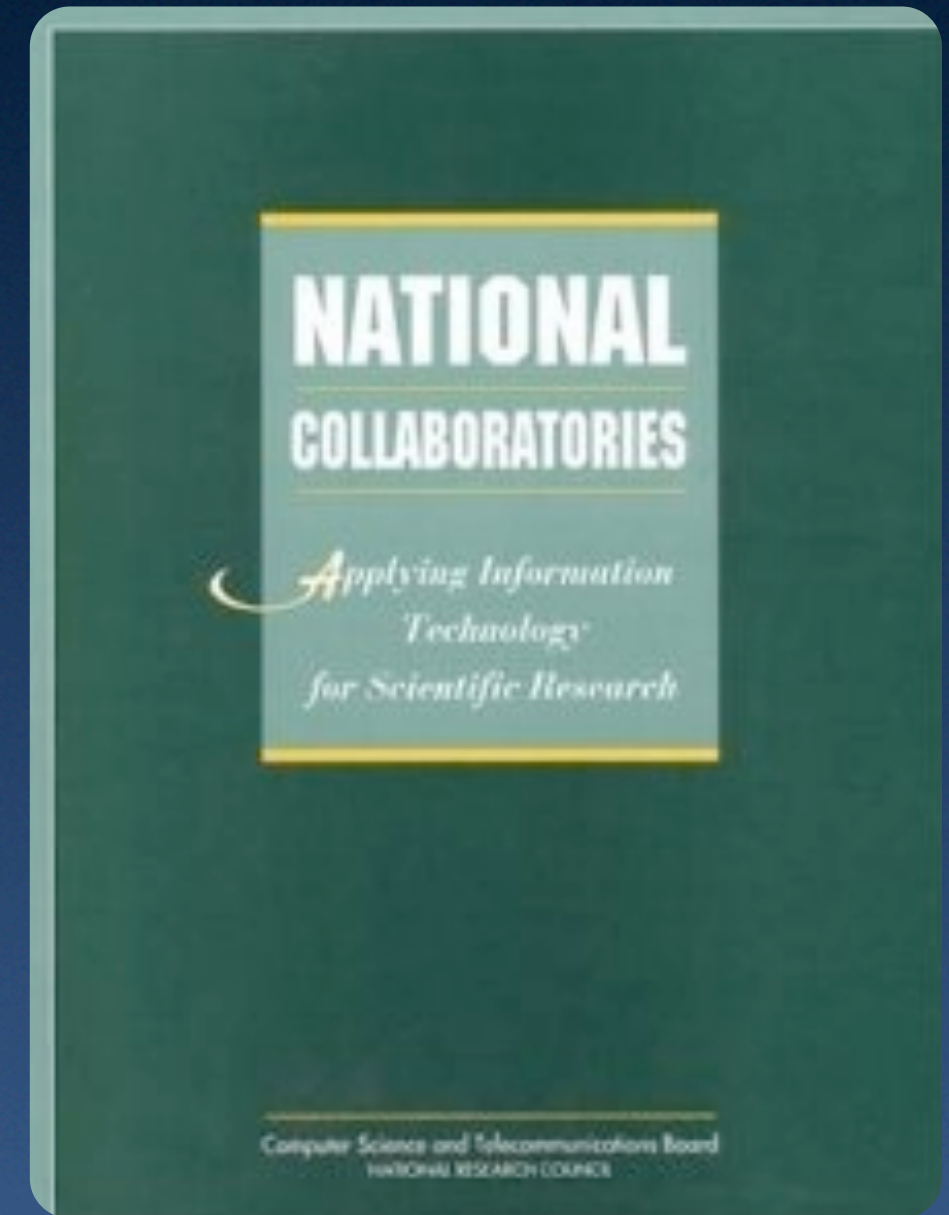


Towards a National Collaboratory



**An Invitational Workshop at the Rockefeller University
March 17-18, 1989**

<http://ai.eecs.umich.edu/people/conway/CSE/CollabTech/CollabTechWorkshop.html>



1993 NRC Report

<http://www.amazon.com/National-Collaboratories-Information-Technology-Scientific/dp/0309048486>

From Executive Summary of National Collaboratories...

The fusion of computers and electronic communications has the potential to dramatically enhance the output and productivity of U.S. researchers. A major step toward realizing that potential can come from combining the interests of the scientific community at large with those of the computer science and engineering community to create integrated, tool-oriented computing and communications systems to support scientific collaboration. Such systems can be called "collaboratories."

The University of Michigan Upper Atmospheric Research Collaboratory (UARC)

http://www.crew.umich.edu/research/research_uarc.html



The Initial Facility at Sondrestrom, Greenland



University of Michigan

Daniel E. Atkins
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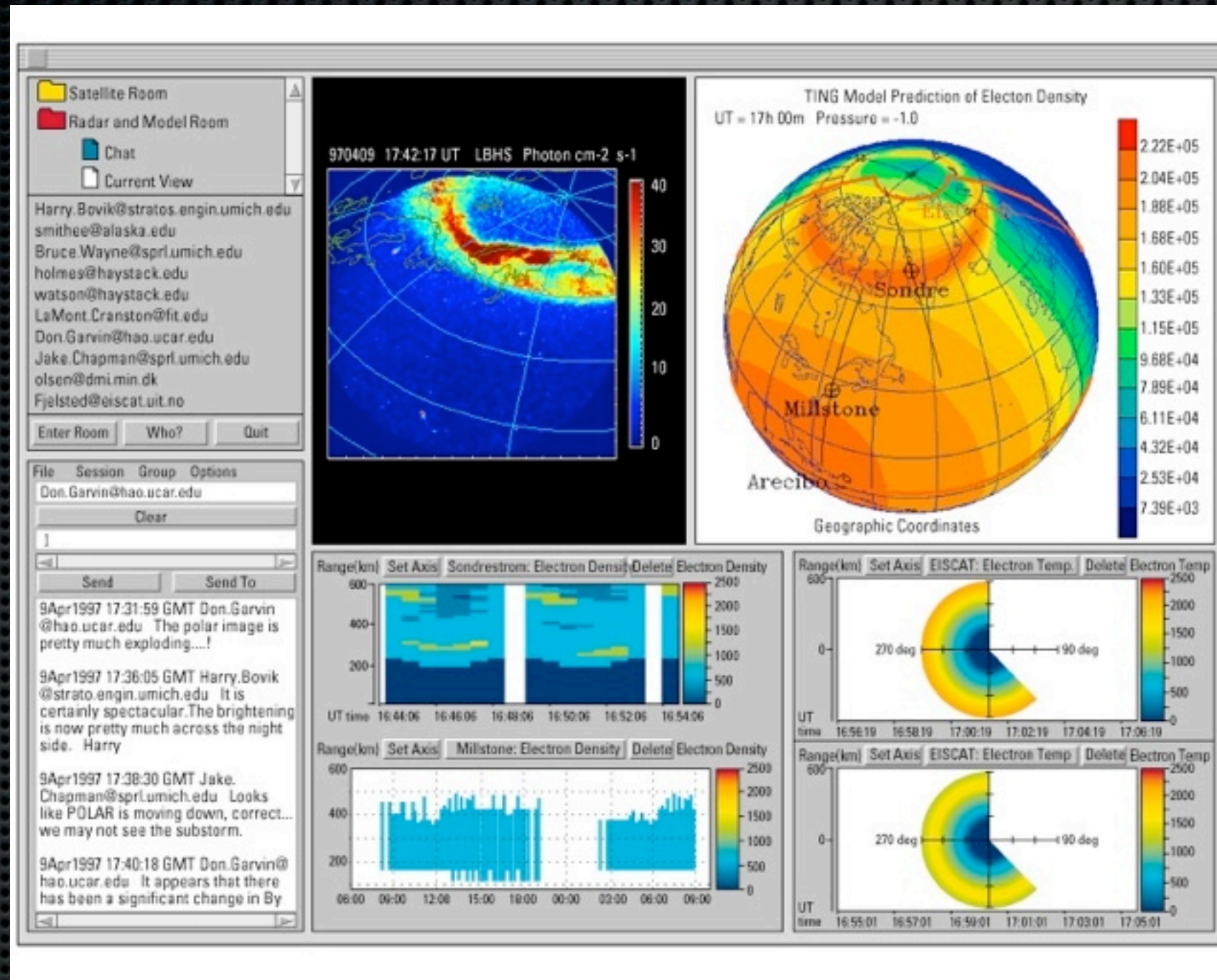


UARC Interface

Real-time instruments *computational models*

*dynamic
work
rooms*

*team
chat*



Session replay *annotation*

Archival data

Journals



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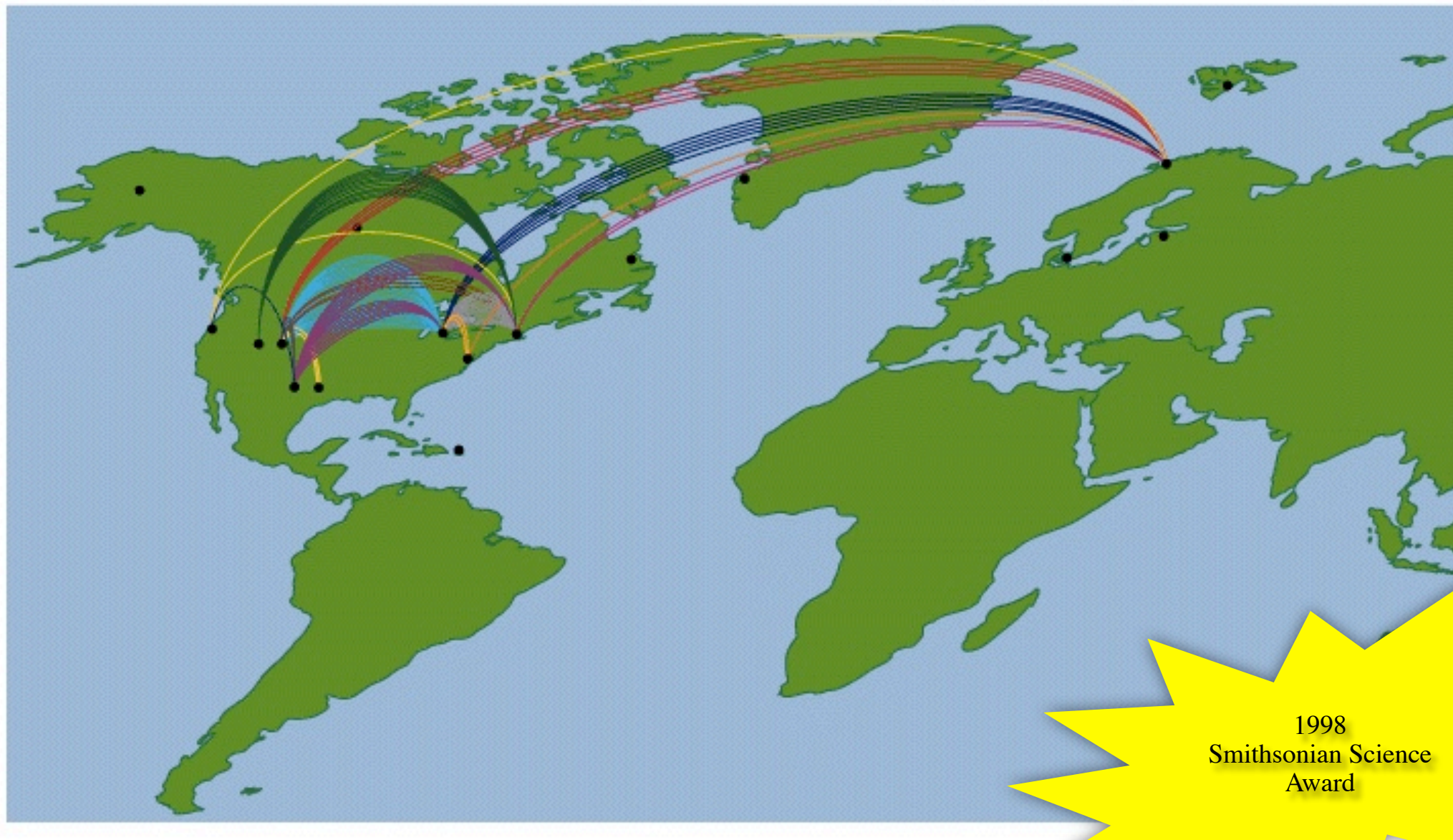


Evolved into a Network of Instruments (one global instrument)



UARC Patterns of Communication

Pattern of Communication, UARC Campaign, April 9, 1997



1998
Smithsonian Science
Award



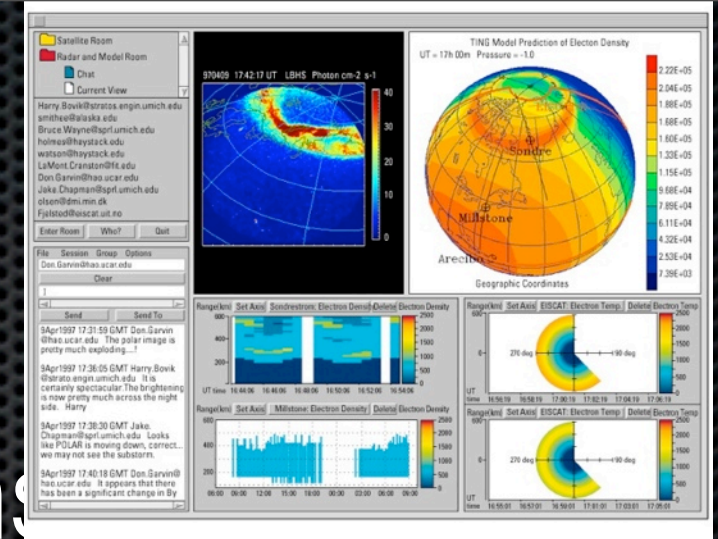
University of Michigan

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Vignettes from UARC/SPARC

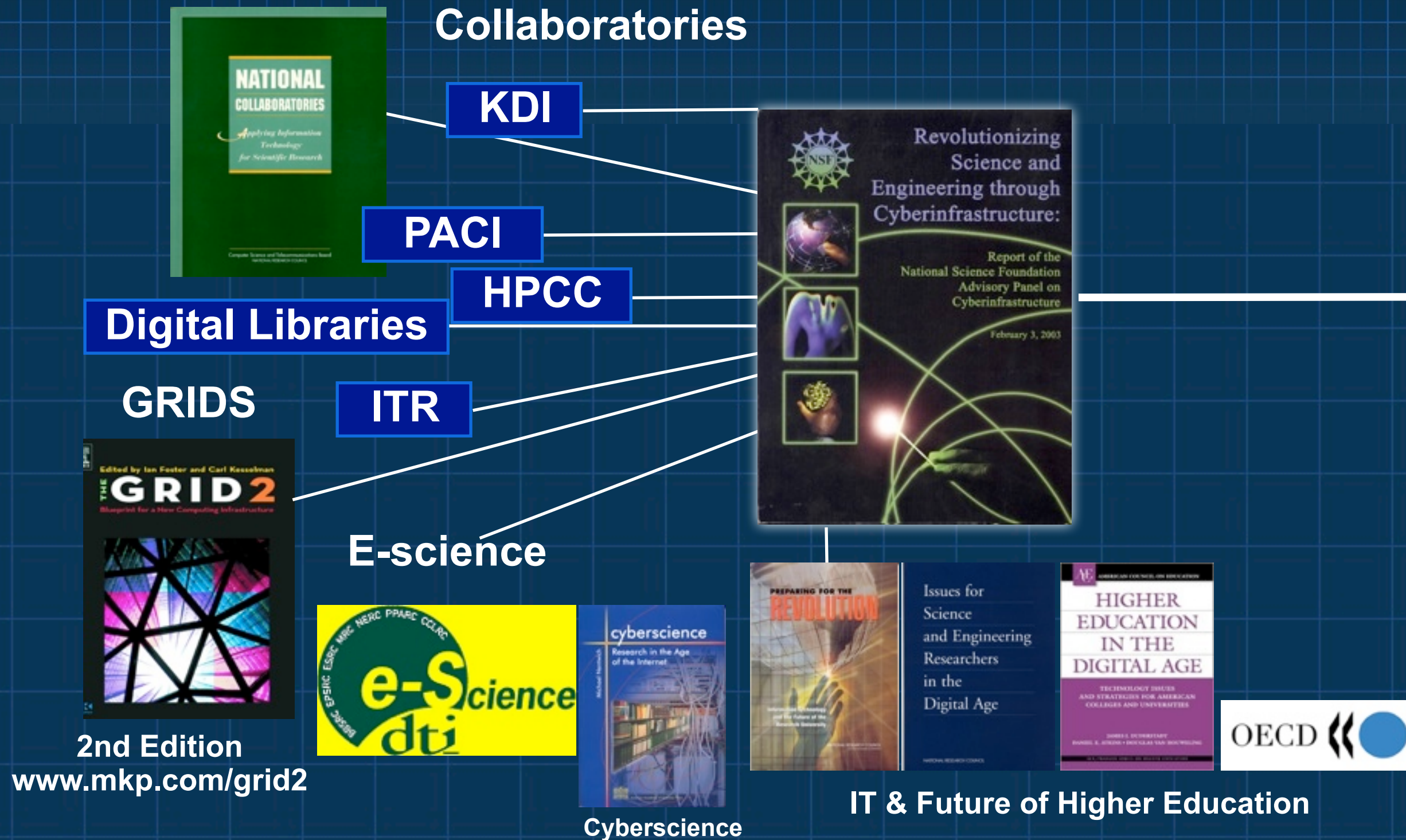
- Shared, tele-instruments & expertise.
- Rapid response, opportunistic campaigns
- Multi-eyes, complementary expertise. Isolated instruments became a global instrument chain.
- Cross-mentoring/training.
- New & earlier opportunities/exposure for grad students.
- Enhanced participation. Legitimate peripheral participation.



- Support for authentic, inquiry-based learning at UG and pre-college level.
- Distributed workshops for post-campaign data analysis.
- Session re-play for delayed participation.
- Data-theory closure.



Cyberinfrastructure Genealogy & Movement



NSF Blue Ribbon Advisory Panel on Cyberinfrastructure

Daniel E. Atkins, Chair

University of Michigan

Kelvin K. Droegemeier

University of Oklahoma

Stuart I. Feldman

IBM

Hector Garcia-Molina

Stanford University

Michael L. Klein

University of Pennsylvania

David G. Messerschmitt

University of California at Berkeley

Paul Messina

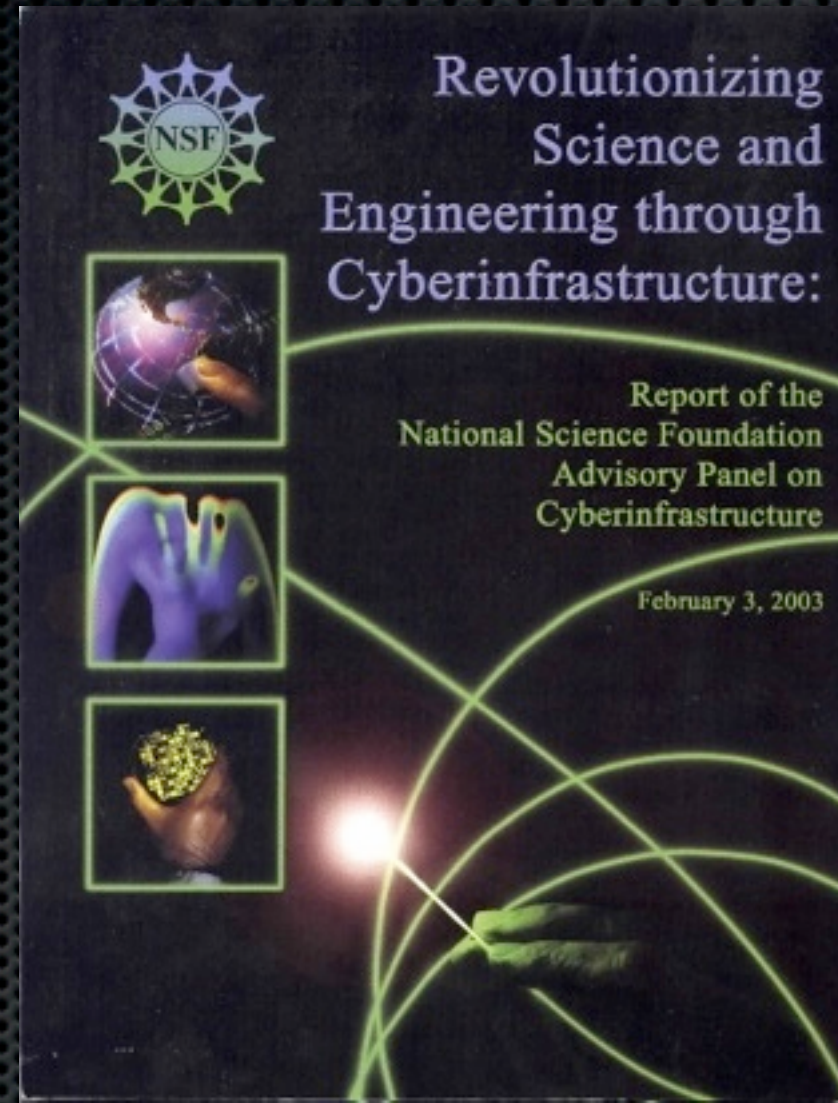
California Institute of Technology

Jeremiah P. Ostriker

Princeton University

Margaret H. Wright

New York University



*“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/oci>



Now 100's of Reports on CI-enabled Research

National Science Foundation
OFFICE OF
Cyberinfrastructure (OCI)

SEARCH
NSF Web Site

OCI Home | OCI Funding | OCI Awards | OCI Discoveries | OCI News | About OCI

Cyberinfrastructure - stimulating advances in 21st century science and engineering

About OCI
View OCI Staff Directory
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General Information About OCI
Career Opportunities
Advisory Committee
Budget Excerpt

Proposals and Awards
Proposal and Award Policies and Procedures Guide
Introduction
Proposal Preparation and Submission
Grant Proposal Guide
Grants.gov Application Guide
Award and Administration
Award and Administration Guide

Award Conditions
Other Types of Proposals
Merit Review
NSF Outreach
Policy Office

Awards
OCI Award Search
Active OCI Awards

Discoveries

High Performance Computing
OCI has released a new HPC Resource Solicitation, PD 11-1155. Proposals are due March 7, 2011. An updated version of the benchmark site will be available by December 27, 2010. For a list of FAQs please see [HPCFAQ](#). For solicitation information please see [High Performance Computing System Acquisition: Enhancing the Petascale Computing Environment for Science and Engineering](#) (NSF 11-511) Posted December 7, 2010.

Strategic Technologies for CI (STCI)
OCI has released a new Strategic Technologies for Cyberinfrastructure (STCI) program description, PD 11-7684. The next window for proposal submissions is January 3, 2011 - January 18, 2011. Please see http://www.nsf.gov/funding/pom_summ.jsp?piims_id=503475&org=OCI&sel_org=OCI&from=fund for additional information and STCI program proposal submission instructions.

New Deputy Director (Acting), OCI
We are pleased to announce that Dr. Susan Winter is the Deputy Director (Acting) for the Office of Cyberinfrastructure (OCI).

Scientific Software Innovation Institutes
Software is an integral part of the computation paradigm for supporting innovation and discovery in science and engineering, and is a primary modality for realizing NSF's Cyberinfrastructure Framework for 21st Century Science and Engineering (CF21) vision. In order to nurture, accelerate and sustain this critical mode of scientific progress, NSF has established the crosscutting Software Infrastructure for Sustained Innovation (SII2) program, a long-term investment with the overarching goal of transforming innovations in research and education into sustained software resources that are an integral part of the cyberinfrastructure. Scientific Software Innovation Institutes (SII2) will be the anchors of the SII2 program and will focus on the establishment of long-term community-wide hubs of sustained software excellence.

Get OCI Updates by Email
Additional OCI Resources
Cyberinfrastructure Vision for 21st Century Discovery
Long-Lived Digital Data Collections: Enabling Research and Education in the 21st Century
Reports and Workshops Relating to Cyberinfrastructure and Its Impacts
A Process-Oriented Approach to Engineering Cyberinfrastructure
OCI Presentations
International Research Network Connections (IRNC)
Cyberenvironment Project Management: Lessons Learned
Publications [See All](#)
Report of Blue-Ribbon Advisory Panel on Cyberinfrastructure
Frequently Asked Questions: Regarding High Performance Computing System Acquisition: Enhancing the Petascale Computing Environment for Science and Engineering (NSF 11-511)

<http://www.nsf.gov/dir/index.jsp?org=OCI>

Research Guides
MLibrary Home | Milyn Search Tools | MGet It | Ask a Librarian

University of Michigan Library | Research & Technology Guides | Cyberinfrastructure and Research Resources

Cyberinfrastructure and Research Resources
Last update: Feb 15th, 2011 | URL: <http://guides.lib.umich.edu/CI> | [Print Guide](#) | [RSS Updates](#) | [Share](#)

Home | Research Articles | Books | Cyberinfrastructure Enabled Discoveries | Build Cyberinfrastructures | Support Data Sharing

Home | Comments (0) | Print Page

Welcome
This research guide is designed to provide links to literature related to cyberinfrastructure and e-Science. Questions? Please contact Ye Li, David Carter or Valerie Waldron.

What is Cyberinfrastructure?
"Cyberinfrastructure consists of computing systems, data storage systems, advanced instruments and data repositories, visualization environments, and people, all linked by high speed networks to make possible scholarly innovation and discoveries not otherwise possible." -- from IUTS Knowledge Base (What is Cyberinfrastructure?, IU)
"Cyberinfrastructure is poised to revolutionize many science and engineering disciplines. Individual researchers will have the power of the world's highest-performance digital resources at their disposal." -- from Cyberinfrastructure (A Special Report, NSF)
Cyberinfrastructure is often discussed together with e-Science, which include any science fields share learned and networked research approaches.
NSF Cyberinfrastructure-TEAM (CI-TEAM) Related URLs
Comments (0)

Online Videos on Cyberinfrastructure
The NSF Cyberinfrastructure Initiative: Vision and Implementation Towards Learning and Discovery...

Quite recently, the National Science Foundation rewarded Daniel Atkins for his unique contributions to high-performance computing and distributed...
inworld.mt.edu
Geoscience in Cyberinfrastructure

[This is] a discussion of cyberinfrastructure in Geoscience and how it empowers global collaboration among scientists, led by SDSC Geoinformatics...
scribbr
HULibzero Cyberinfrastructure for Scientific Collaboration

HULibzero allows you to create dynamic web sites that connect a community in scientific research and educational activities. HULibzero sites combine...
youtube.com
Cyberinfrastructure Software Sustainability &

NSF Publications on Cyberinfrastructure and Data Sharing

Revolutionizing Science and Engineering Through Cyberinfrastructure: Report of Blue-Ribbon Advisory Panel on Cyberinfrastructure, January 2003. Also called Atkins Report.

Cyberinfrastructure (A Special Report from NSF), updated June 2006.

Cyberinfrastructure Vision for 21st Century Discovery, March 2007

Fostering Learning in the Networked World: The Cyberlearning Opportunity and Challenge, June 2008

Cyberinfrastructure at UM
eScience Task Force Report, MLibrary eScience Taskforce, Feb 2010
High-Performance Research Computing and Cyberinfrastructure: An Interim Assessment of the Demand-Side at the University of Michigan, 2009
Inter-University Consortium for Postal and Social Research (ICPSR)
MLibrary Research Data Management and Publishing Support
Open Data Program, School of Information, UM
ORCI Blog - Computational Discovery & Cyberinfrastructure at U-M
ProteomeCommons
A public resource for digital content relating to proteomics. Created by the laboratory of Dr. Philip Andrews at the University of Michigan.
UM Office of Research Cyberinfrastructure (ORCI)
Understanding Infrastructure: Dynamics, Tensions, and Design, 2007
Final report of the workshop, "History and Theory of Infrastructure: Lessons for New Scientific Cyberinfrastructures"
Comments (0)

Publications from Other National Agencies

Long-Lived Digital Data Collections Enabling Research and Education in the 21st Century, National Science Board, September 2005

Grand Challenges: Science, Engineering, and Societal Advances, Requiring Networking and Information Technology Research and Development, National Coordination Office for Networking and Information Technology Research and Development, Third Print, November 2006

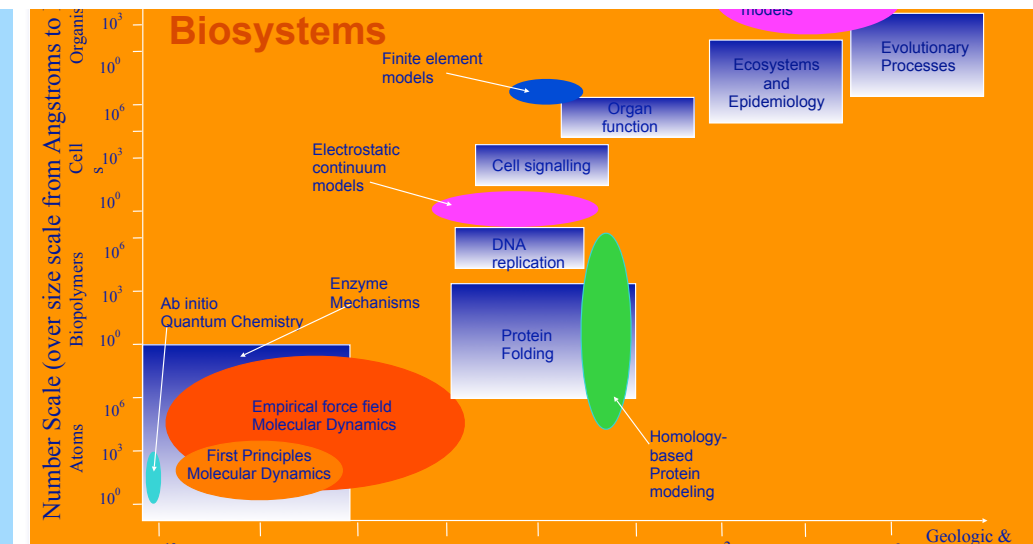
Harnessing the Power of Digital

<http://guides.lib.umich.edu/CI>

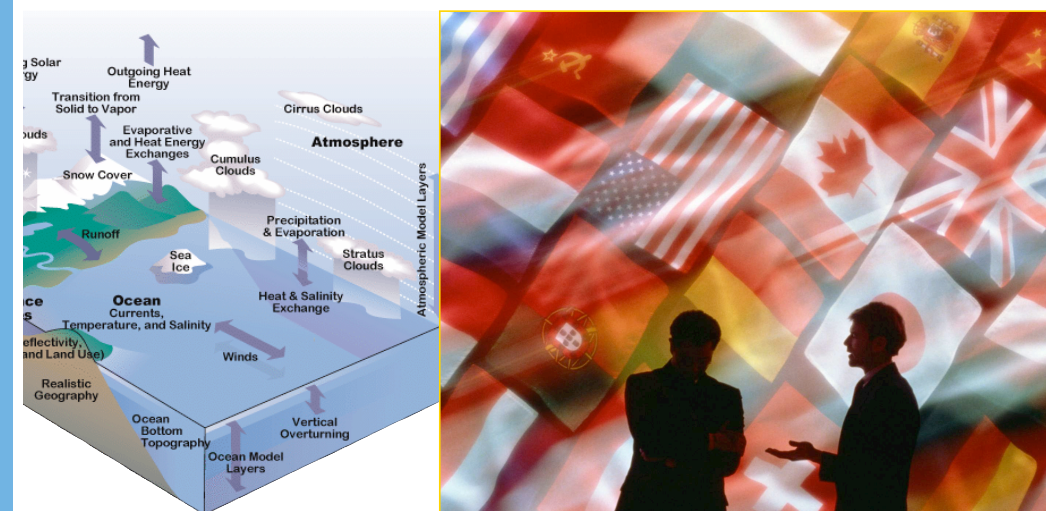
e-science (research enabled by e-infrastructure/ICT) is increasingly essential for meeting 21st century challenges in scientific discovery and learning



The inherent complexity, multi-scale, and multi-science nature of today's frontier science challenges.



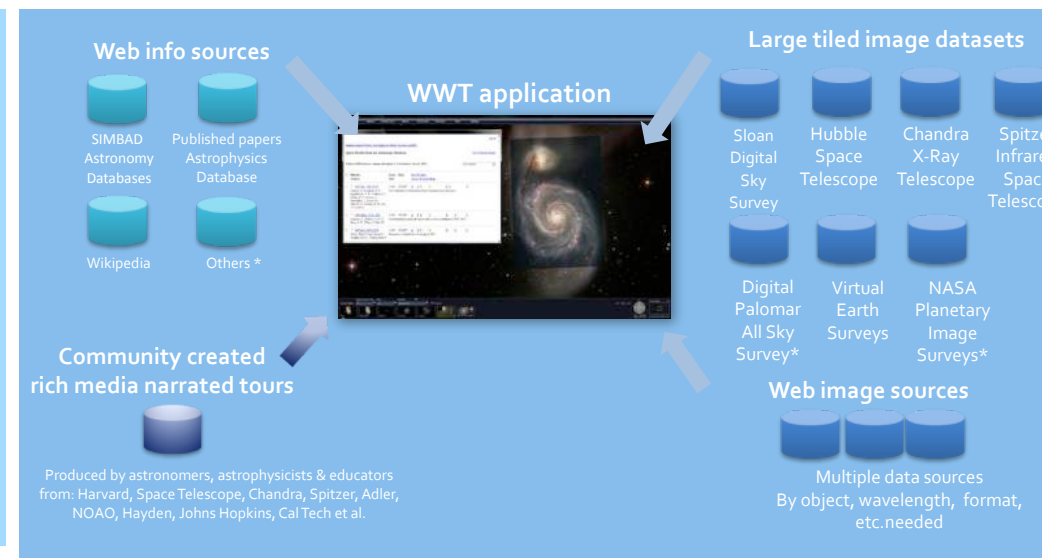
The accompanying requirement for multi-disciplinary, multi-investigator, multi-institutional approach (often international in scope).



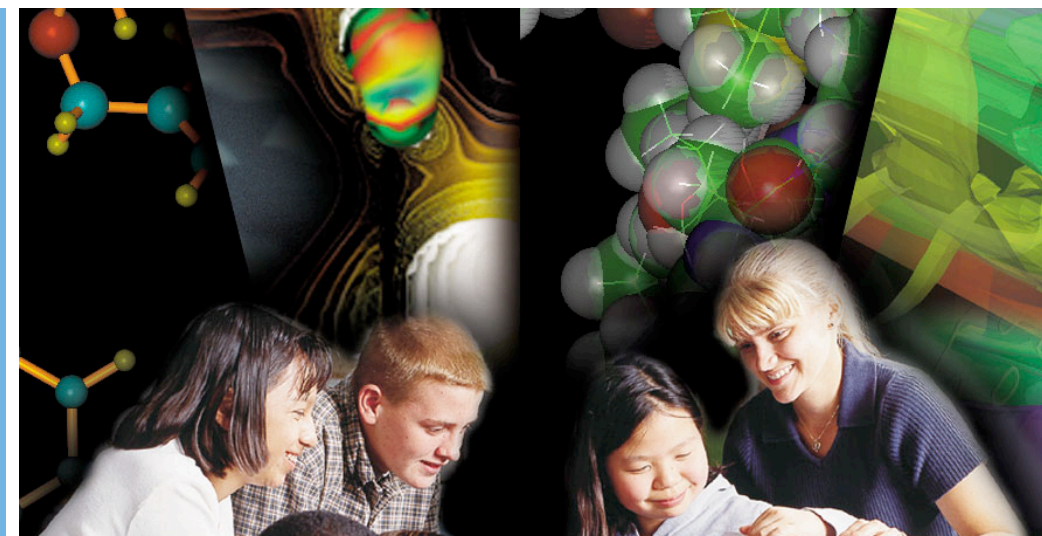
The high data intensity and heterogeneity from simulations, digital instruments, sensor nets, and observatories.



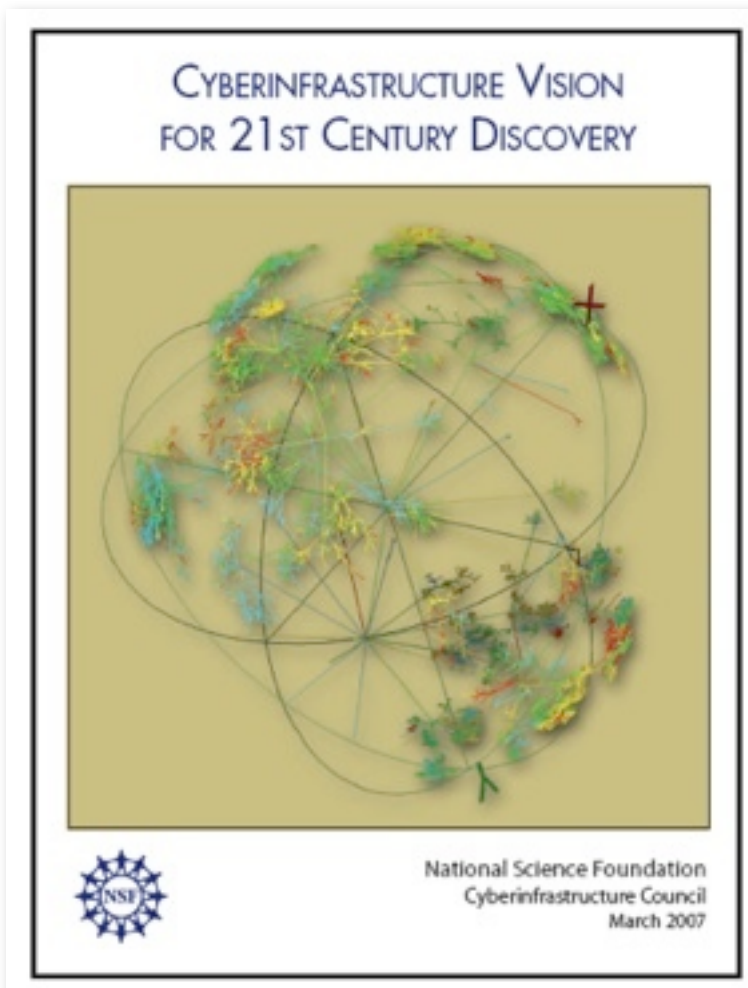
The increased scale and value of data and demand for semantic federation, active curation and long-term preservation of access.



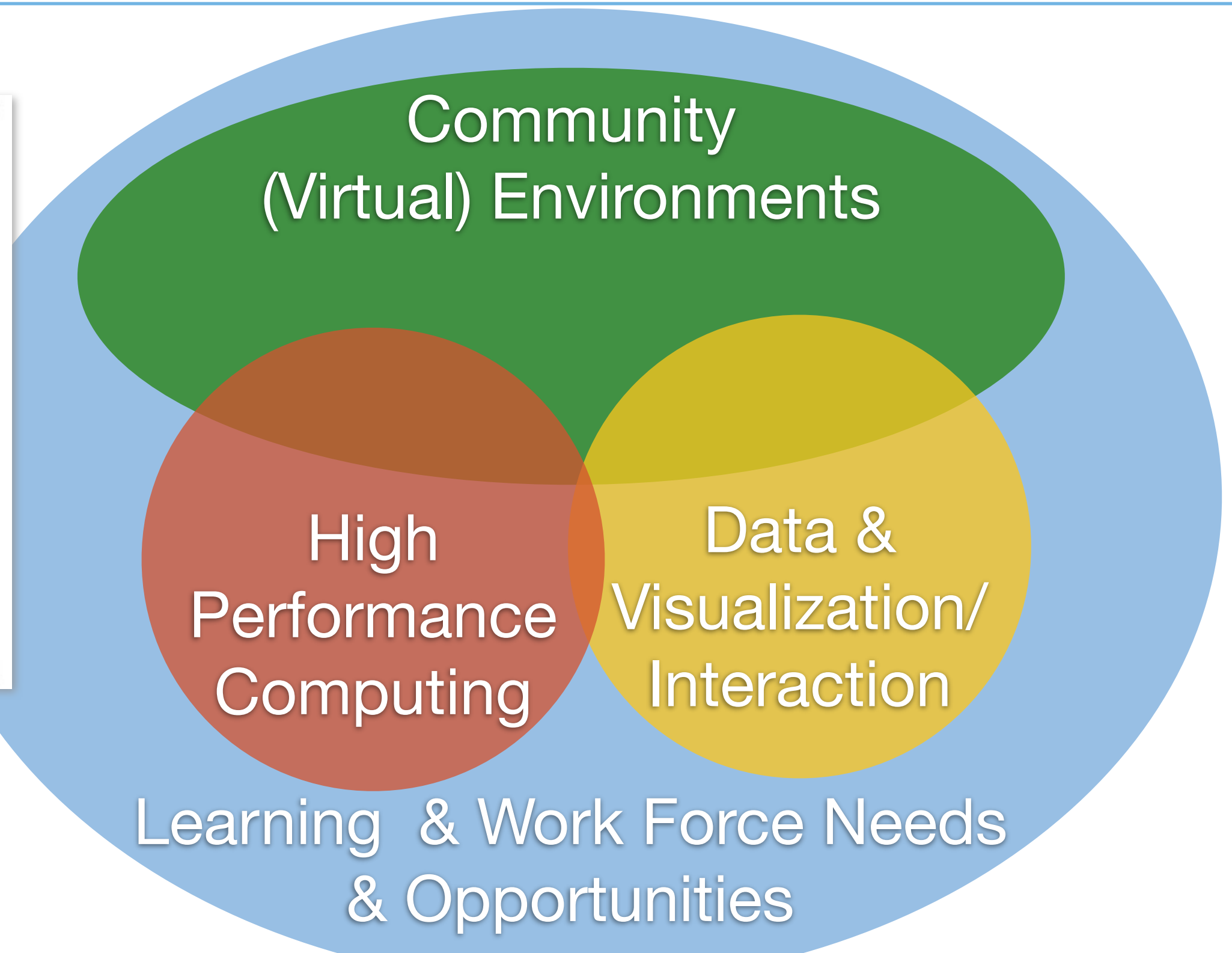
And the need to engage more students in high quality, authentic, passion-building science and engineering education.



e-science



CI-enabled science



Note: Many other reports on discipline-specific visions of and drivers for e-Science are available at www.nsf.gov/oci

NSF CIF-21: What we Need is a Cyberinfrastructure Ecosystem,

not just Components

Expertise

Research and Scholarship
Education
Learning and Workforce Development
Interoperability and operations
Cyberscience

Organizations

Universities, schools
Government labs, agencies
Research and Medical Centers
Libraries, Museums
Virtual Organizations
Communities

Scientific Instruments

Large Facilities, MREFCs, telescopes
Colliders, shake Tables
Sensor Arrays
- Ocean, environment, weather, buildings, climate. etc

**Collaboration in
Discovery
&
Learning**

Data

Databases, Data repositories
Collections and Libraries
Data Access; storage, navigation
management, mining tools,
curation

Computational Resources

Supercomputers
Clouds, Grids, Clusters
Visualization
Compute services
Data Centers

Software

Applications, middleware
Software development and support
Cybersecurity: access, authorization,
authentication

Networking

Campus, national, international networks
Research and experimental networks
End-to-end throughput
Cybersecurity

Maintainable, sustainable, and extensible

CIF-21 FY 12 Focus Areas

- Data-Enabled Science
- Community Research Networks
- New Computational Infrastructure
- Access and Connections to Cyberinfrastructure Facilities

CIF-21 Community Research Networks...

New cyberinfrastructure tools and changes in the research process have enabled community research networks to address complex, multi-disciplinary problems of societal concern such as competitiveness, security, economic development, and well-being. Community research networks enable people and organizations to perform everyday research functions more effectively by building on and integrating diverse resources, knowledge, and abilities. NSF has a long history of investing in community research networks such as the iPlant collaborative, the Southern California Earthquake Center, the SRS Data Enclave, and [the nanoHUB](#). Cyberinfrastructure links these combinations of people, organizations, instrumentation, physical facilities, computers, data, and software, but few scientists know how to select and assemble these components into a functioning community research network. [Focused investments in socio-technical analyses advance understanding of how to develop virtual organizations, and under what conditions they can foster innovation in science, engineering and education. Such investments are necessary to harness the full potential and promise offered by virtual organizations.](#)

Celebrating Hubzero

- In contrast to early collaborative projects such as UARC that were “hard-wired” for particular project, Hubzero is a platform -- a meta collaboratory -- that can be tailored to many different domain specific projects. For example:



- HUBzero is having international impact on science and engineering research and learning.

- HUBzero through a web-based portal reduces the barrier of entry to the use of high-performance computing for modeling, simulation, and prediction. It also draws upon multiple resources, both local and remote including the TeraGrid.
- HUBzero is intentionally designed to support both research and education.
- HUBzero encourages openness in sharing codes, courseware, and data (?).
- HUBzero has done better than most in financial sustainability.

Knowledge Communities CI Model

- The key figure of merit for the application of IT in research, learning and practice should be the extent to which it enhances the effectiveness of knowledge communities engaged in learning, discovery, and practice.
- Developments in CI-enabled science now point the way to creating and nurturing cyberinfrastructure to enable groups to work together in functionally-complete, four-quadrant organizations.
- The overarching goal is “high performance collaboration” not just high performance computing.



Four Quadrant Organizations (virtual organizations) offer additional modes of interaction between People, Information, and Facilities

Time

Same

(synchronous)

Different

(asynchronous)

Geographic Place

Same

Different

ST-SP

P: Physical mtgs
I: Print-on-paper books, journals
F: Physical labs, studios, shops

DT-SP

P: Shared notebook
I: Library reserves
F: Time-shared physical labs, ...

ST-DP

P: AV conference
I: Web search
F: Online instruments

DT-DP

P: Email
I: Knowbots
F: Autonomous observatories

Physical + Virtual,
 Not Physical vs. Virtual

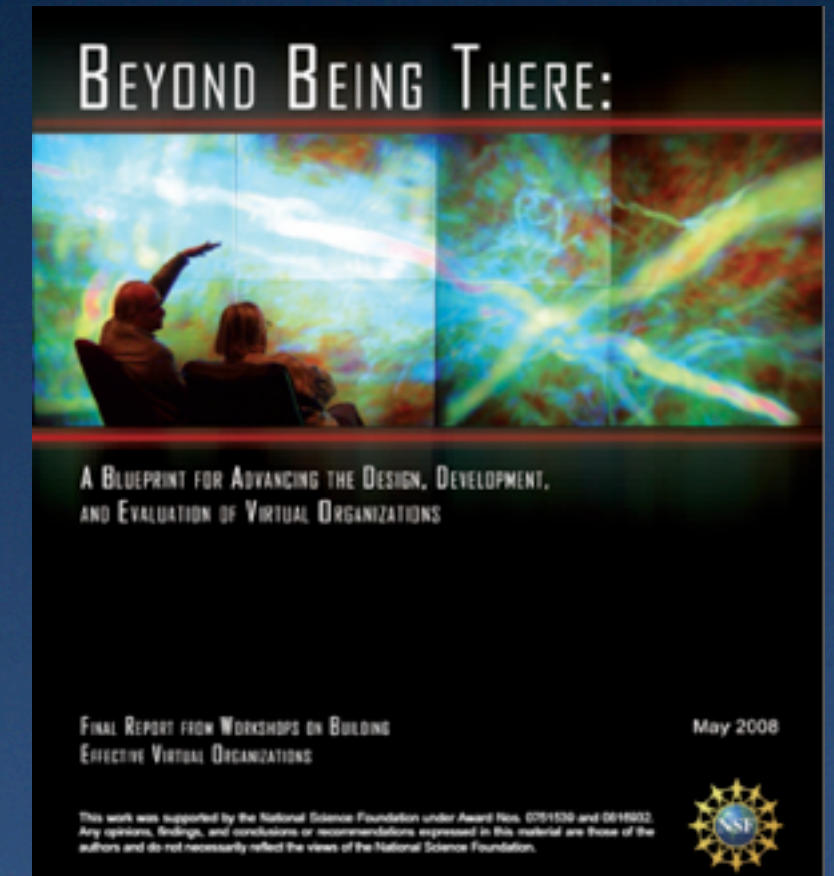
P: People
I: Information
F: Facilities, instruments

Some Attributes of 4-Quadrant Communities

- These all quadrant organizations are not just conversing *about* people and doing work, they are also sharing objects to observe, manipulate, and discuss. They therefore can incorporate **both** explicit and tacit knowledge creation and transfer.
- Conversations themselves (the collaborative sessions) can be captured and used later as an object of conversation and reflection.
- Enables engagement in open learning, exploration, and knowledge creation and to shift more from an authority-based learning model to a discovery-based learning model.
- This model does not make a sharp distinction between learning, teaching, discovery, research, and practice. These are activities all supported in blended ways within the knowledge communities model.

Game Changers

- Game-changing possibilities for “better than being there” organizational forms:
 - decreased time *to* discovery;
 - decreased time *from* discovery;
 - increased intellectual cross-section and transformational results;
 - enhanced stewardship and return on investment for research infrastructure investments;
 - multi-use: discovery, learning, rapid-response,
- A key to economic leadership in a global knowledge-based flat world.



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nanoHUB an NCN project
online simulation and more

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Nanotechnology 101
Introduction to nanotechnology

Nanotechnology 101 is a series of lectures designed to provide an undergraduate level introduction to nanotechnology. Our Nanotechnology 501 series offers lectures directed at the graduate student/ professional level.

NanoSystems Biology
A resource for nanoscience and technology, the development is driven by research themes in:

- Nanoelectronics **NEW**
- NEMS/Nanofluidics
- Nano-Bio Devices

Simulate

- Nanoelectronics
Tools for nanoelectronics
- NEMS/Nanofluidics
Tools for NEMS and Nanofluidics
- Nano-Bio Devices
Tools for nano-bio devices
- More >
Browse all available tools

Research

- Seminars / Workshops
Cutting edge research
- Collaborate
Work with your colleagues
- Web Meetings
Right in your browser
- User Groups
Share with your colleagues

Events
April

Announcements

- 2008 NCN@Purdue Summer Bottom Up – Jul 14th

NanoSystems Biology
Jim Heath Caltech

of Molecular & Medical Pharmacology at UCLA. Heath received a B.Sc. degree in 1984 (Physics) and his Ph.D. in Chemistry (Bio) in 1988 where he was the principal student involved in the Nobel Prize-winning discovery of Gα and the Gβγ subunits. Heath was a Miller Fellow at UC Berkeley from 1988-91, and on the Technical Staff at IBM Watson Lab from 1991-94. In 1994 he joined the faculty at UCLA. He founded the California NanoSystems Institute in 2000 and served as its Director until moving to Caltech. Heath has



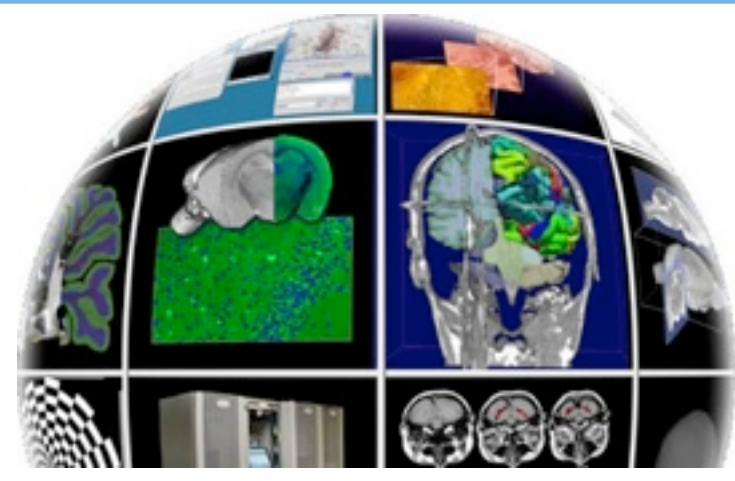
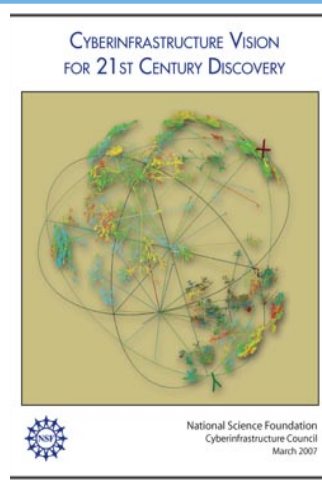
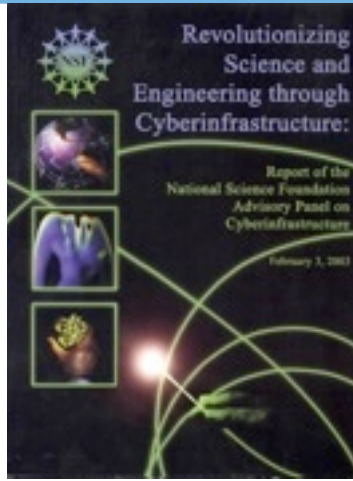
Suggestions & Questions for HUBzero Future

- Conceptualize HUBzero as supporting all-quadrant collaboratories with a goal to become functionally complete.
- Data-intensive scientific discovery is becoming more prominent is what some call a Fourth Paradigm for Science. What does HUBzero need to do to support this?
- View your core competency as that of enabling others to create collaboratories efficiently and effectively and the community you have built as a primary asset, rather than thinking of yourselves more narrowly as the creators and stewards of a particular set of software.

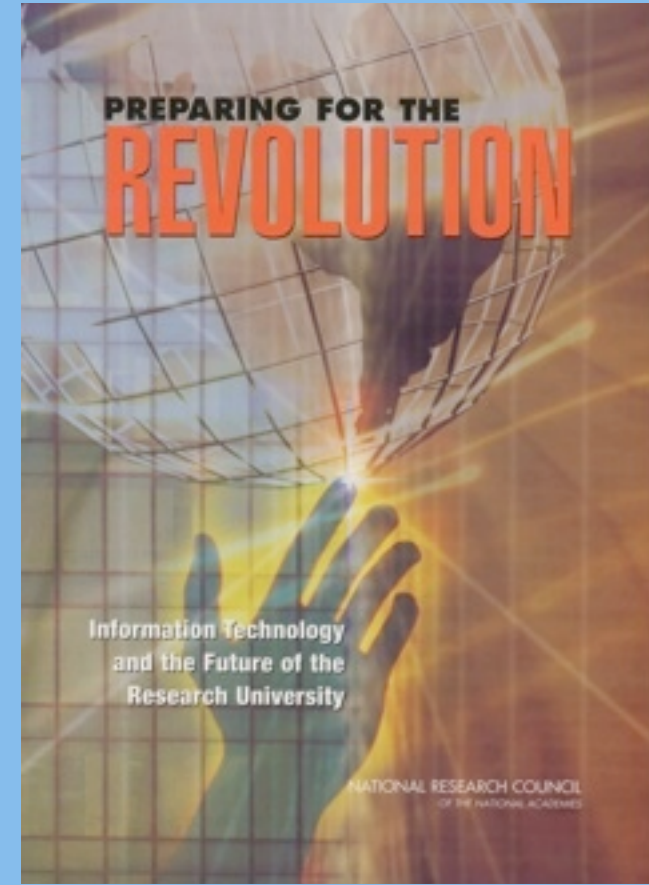
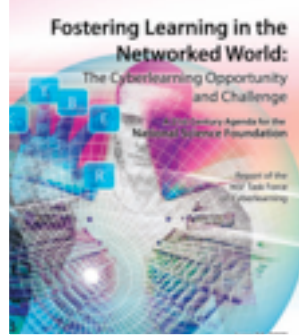
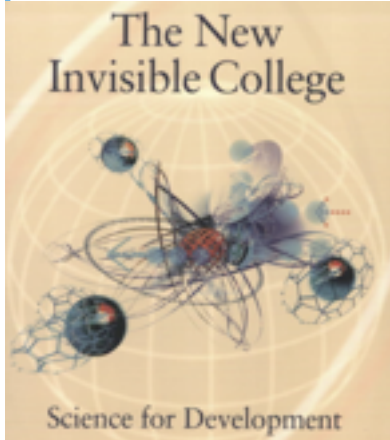
- Many universities are moving to cloud-based collaboration environments now offered by Google and emerging from Microsoft. With this and the previous point in mind, can HUBzero find ways to link with and leverage the Google Apps environment?
- The Sakai Foundation is now embarked on creating an open source platform called Sakai 3 that will be a platform for an Open Academic Environments that are built to provide functions need in the university but not as a monolithic system but rather as one that leverages cloud-based services available from others. Might HUBzero be part of this?

- Be more intentional about the positive impact of HUBzero on STEM education, especially on blended forms of formal and informal learning. Explore, for example, how HUBzero can contribute to visions and directions articulated in the new National Education Technology Policy, the NSF report on Cyberlearning, and the MacArthur Foundation initiatives on Connected Learning.
- Work with the Creative Commons, now with new leadership, to promote appropriate open licensing for codes, data, and scholarly communications.

- What is your plan to provide long-term access to (preservation of) all of the the digital objects in your Hubs? This is important for many reasons, perhaps most profoundly to preserve the reproducibility of research results so fundamental to science.
- What are metrics of impact of HUBzero built environments and can you establish more data gathering and research to explore these metrics? Could you demonstrate quantitative payoff from investments in the Hubs.



The Research University in the Digital Age



Questions & Discussion