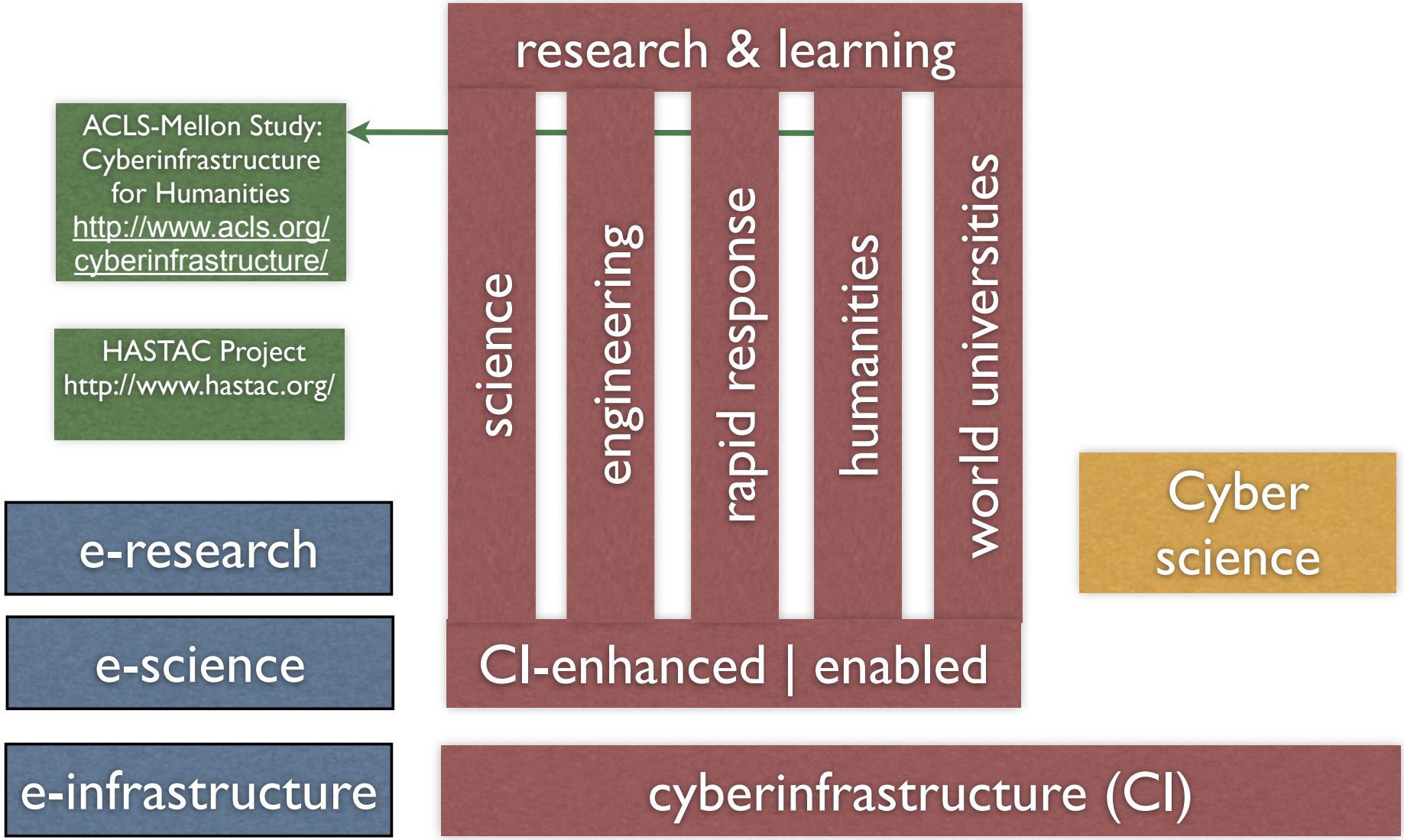
Work in Progress: Status Report on the Office of Cyberinfrastructure

Daniel E. Atkins
Director,
National Science Foundation
Office of Cyberinfrastructure
datkins@nsf.gov

Nomenclature



Dualities

cyberinfrastructure ⟷ enables ⟷ research & development

CI is both an object and means for R&D

collaboration ⟷ enables ⟷ CI environments

Multi-stakeholder collaboration required to create, provision, and apply CI; CI supports collaborations across time and distance (geographic, disciplinary, institutional)

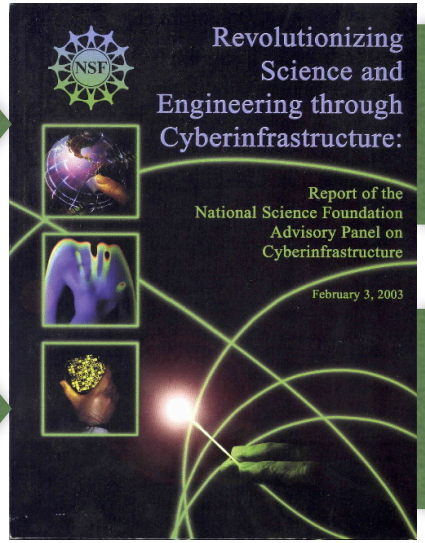
learning | education ⟷ enables ⟷ CI environments

Learning and workforce development initiatives required to create and use CI; CI enables/enhances learning/education

Vision and Activities Based on Broad and Diverse Community Engagement

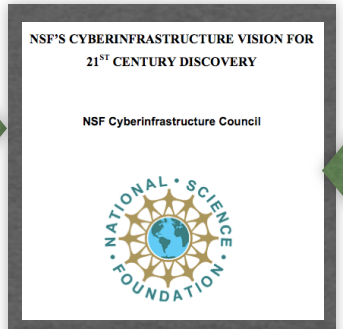
Advances in components of CI-systems for S&E R&E

Complex, multi-scale, multidisciplinary S&E research challenges



30+ disciplinary workshops on CI vision & impact

NSF internal working groups



CI Council, Directorate/Office CI Activities, OCI, ACCI

NSB & Community Input

Vision Framework

- High Performance Computing
- Data, Data Analysis & Visualization
- Virtual Organizations
- Learning & Workforce Development

- *All directorates and offices support cyberinfrastructure.*
- *Science-driven partnerships between creation, provisioning and use of CI*
- *Supports integrated research and education and broadened access and participation.*

Some Science Drivers

- Inherent **complexity and multi-scale** nature of todays frontier science challenges.
- Requirement for **multi**-disciplinary, **multi**-investigator, **multi**-institutional approach (often international).
- High **data intensity** from simulations, digital instruments, sensor nets, observatories.
- Increased value of data and demand for data **curation & preservation** of access.
- Exploiting infrastructure **sharing** to achieve better stewardship of research funding.
- Strategic need for **engaging more students** in high quality, authentic science and engineering education.

NSF CI FY07 Budget Request Total of $600M in CI Funding with $182M in OCI

Cyberinfrastructure Funding

(Dollars in Millions)

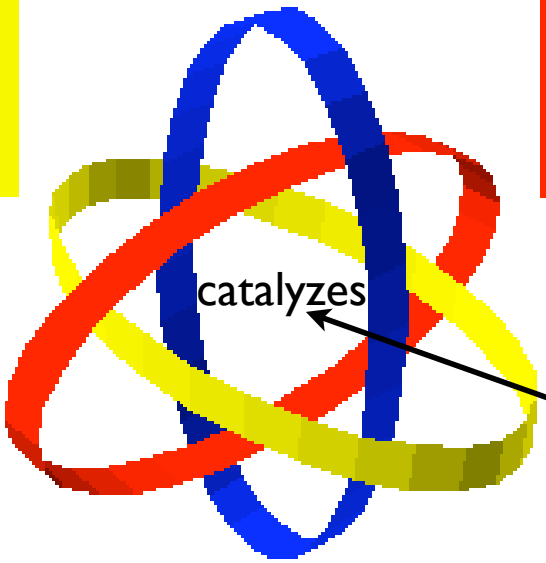
	FY 2005 Actuals	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Biological Sciences	$77.00	$84.00	$90.50	$6.50	7.7%
Computer and Information Science and Engineering	45.32	63.00	68.00	5.00	7.9%
Engineering	52.00	52.00	54.00	2.00	3.8%
Geosciences	71.35	71.35	75.00	3.65	5.1%
Mathematical and Physical Sciences	56.52	59.30	63.56	4.26	7.2%
Social, Behavioral and Economic Sciences	20.39	20.54	20.54	-	-
Office of Cyberinfrastructure	123.28	127.12	182.42	55.30	43.5%
Office of International Science and Engineering	0.22	1.00	1.05	0.05	5.0%
Office of Polar Programs	25.38	26.24	26.24	-	-
Subtotal, Research and Related Activities	471.47	504.55	581.31	76.76	15.2%
Education and Human Resources	20.27	15.02	15.52	0.50	3.3%
Total, Cyberinfrastructure Funding	$491.74	$519.57	$596.83	$77.26	14.9%

Totals may not add due to rounding.

Achieving the NSF CI (e-science) Vision requires synergy between 3 types of activities

Transformative Application - to enhance discovery & learning

Provisioning - Creation, deployment and operation of advanced CI



provides shared and connecting CI

Office of Cyberinfrastructure

Borromean Ring: The three rings taken together are inseparable, but remove any one ring and the other two fall apart. See www.liv.ac.uk/~spmr02/rings/

R&D to enhance technical and *social* effectiveness of future CI environments

Draft

Mission of OCI

The mission of the OCI is to enhance significantly the ability of the NSF community to create, provision, and use the comprehensive cyberinfrastructure *essential to 21st century advances in science and engineering*. This goal is implicit in many areas of the new NSF Strategic Plan and is being pursued within the context of the evolving *Cyberinfrastructure Vision for 21st Century Discovery*.

OCI will serve the Foundation and the NSF community in its mission through three types of synergistic activity:

1. **provisioning of cyberinfrastructure together with mechanisms for flexible, secure, coordinated sharing among collections of individuals, institutions, and resources;**
2. **partnerships with others in science/engineering-driven, transformative use of CI in research and education; and**
3. **partnerships with others in the transfer of the fruits of relevant R&D into the next generation of CI.**

OCI is a cross-cutting enterprise that builds mutually beneficial partnerships will all parts of the NSF, with other Federal agencies, and with the large and growing CI/e-science initiatives in other countries. OCI is also the lead in supporting the Advisory Committee for CI (ACCI) for the Foundation.

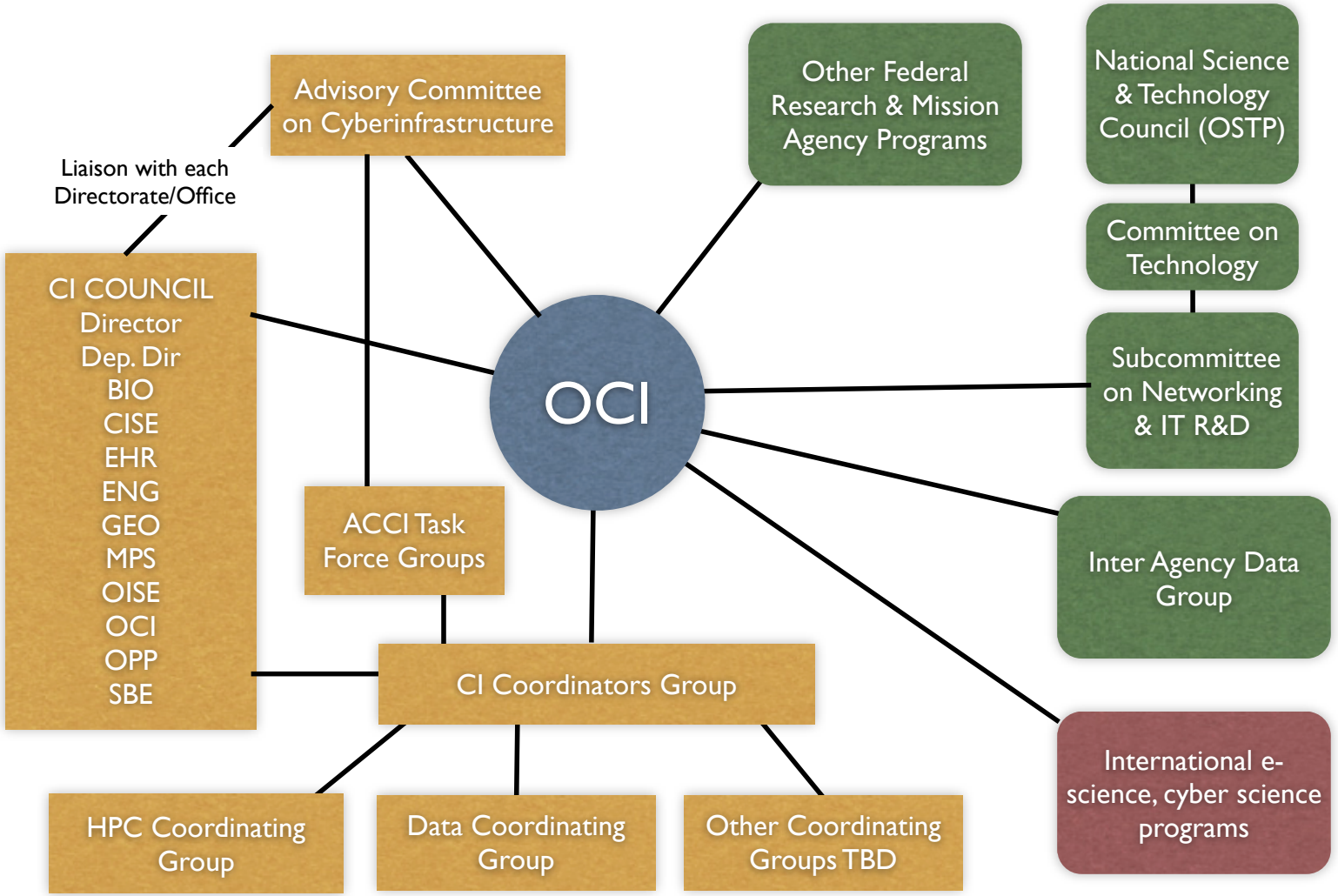
Borromean Ring: Symbol of peer-to-peer synergy. The three rings taken together are inseparable, but remove any one ring and the other two fall apart. See www.liv.ac.uk/~spmr02/rings/

New NSF Strategic Plan

Includes many imperatives for innovation in provisioning and transformative application of cyberinfrastructure to discovery and learning.

Available at http://www.nsf.gov/pubs/2006/nsf0648/nsf0648.jsp

Emerging CI Coordination Structure

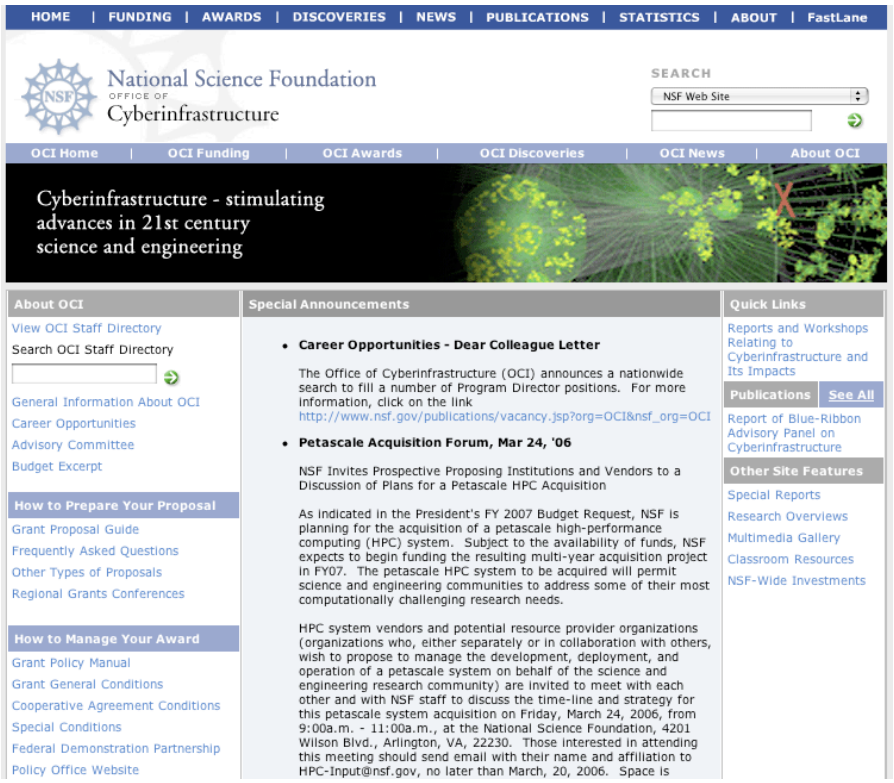


Additional linkage within NSF through joint appointments and every OCI Program Officer having a liaison role with another Directorate or Office

Proposed ACCI Task Force Groups

- Digital Data
- Integration of the NSF CI Portfolio & Alignment with S&E Needs
- CI and Competitiveness
- CI-enhanced Learning, Discovery, and Broadened Participation

www.nsf.gov/oci/



NSF'S CYBERINFRASTRUCTURE VISION FOR 21ST CENTURY DISCOVERY

NSF Cyberinfrastructure Council

Several Active Solicitations Posted

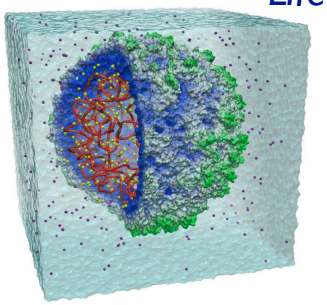
Seeking more program officers.

www.nsf.gov/od/oci/ci-v7.pdf

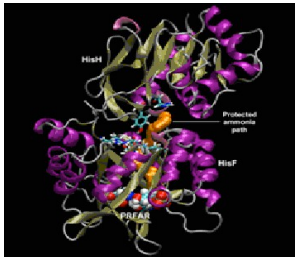
High Performance Computing

increasingly important tool for understanding

Life



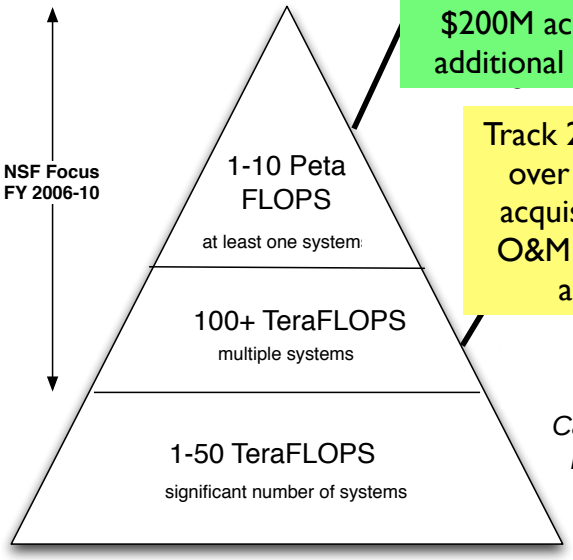
Satellite tobacco mosaic virus, P. Freddolino et al.



Aldehyde dehydrogenase, T. Wymore and S. Brown

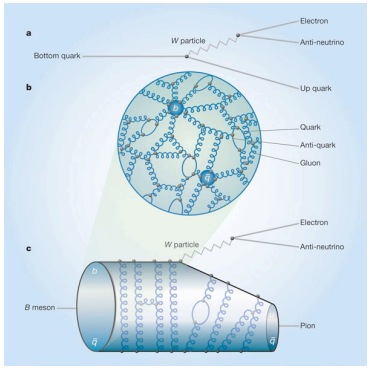
Track 1: One solicitation funded over 4 years: $200M acquisition + additional O&M cost.

Track 2: Four solicitations over 4 years: $30M/yr acquisition + additional O&M cost. First track 1 approved 8-07



Campus Level

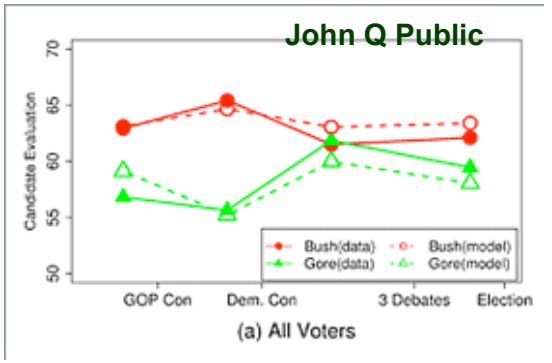
Matter



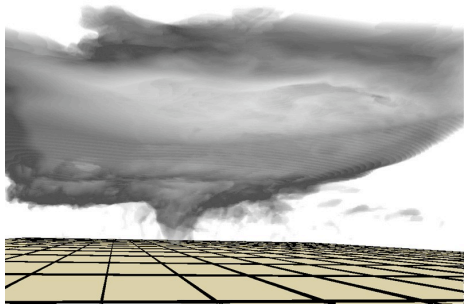
I. Shipsey

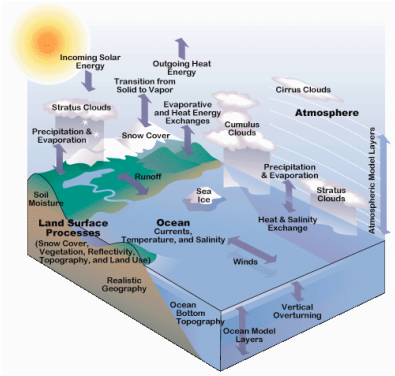
The Environment

Society

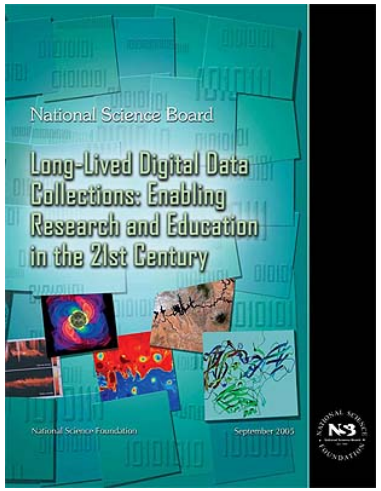


S.-Y. Kim, M. Lodge, C. Taber.

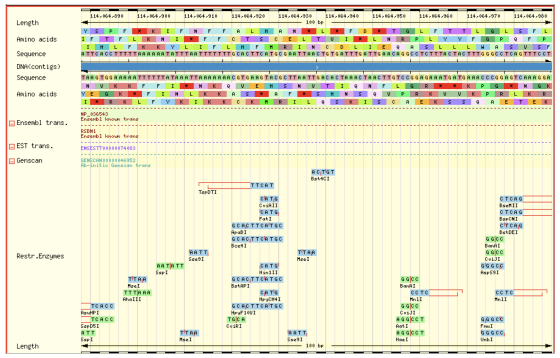


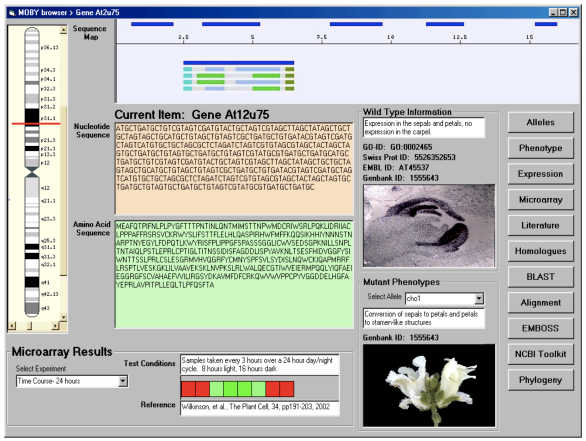


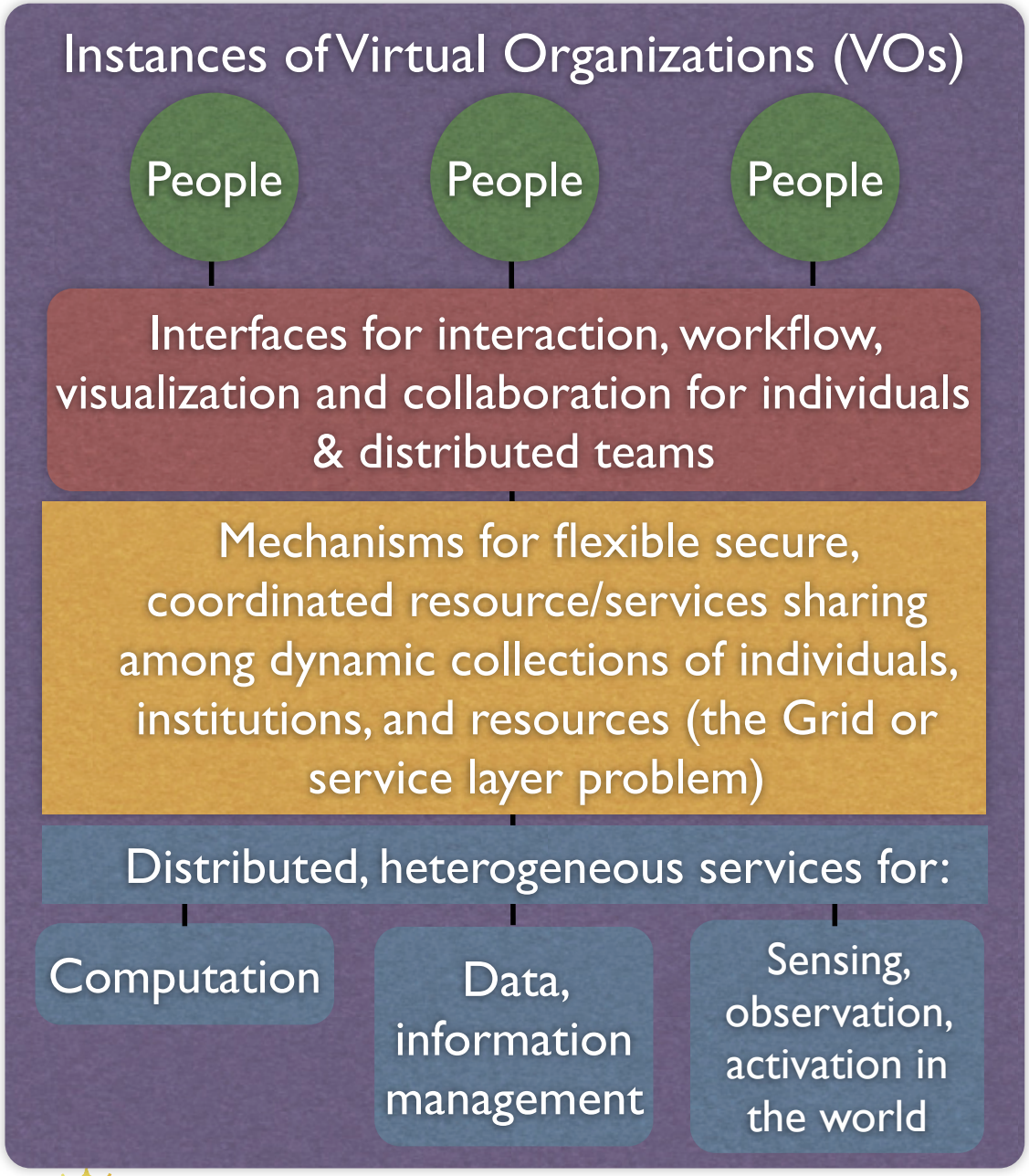
Data, Data Analysis & Visualization



- Challenges: **increased scale, heterogeneity, and re-use value** of digital scientific information and data. Inadequate digital preservation strategy of long-lived data.
- Taking initial steps to **catalyze the development** of a federated, global system of science and engineering data collections that is open, extensible, evolvable, (and appropriately curated and long-lived.)
- Complemented by a **new generation of tools** and services to facilitate data mining, integration, analysis, visualization essential to transforming data into knowledge.
- NSF Leadership for OSTP/Interagency Working Group on Digital Data







Alternate Names for Instances of VOs:

- Co-laboratory
- Collaboratory
- Grid (community)
- Network
- Portal
- Gateway
- Hub
- Virtual Research Environment (VRE)
- Cyberinfrastructure Collaborative
- Other?

Virtual Organizations

Virtual Organizations: Goals

- To catalyze the development, implementation and evolution of a functionally-complete national cyberinfrastructure that integrates both physical and cyberinfrastructure assets and services.
- To promote and support the establishment of world-class VOs that are secure, efficient, reliable, accessible, usable, pervasive, persistent and interoperable, and that are able to exploit the full range of research and education tools available at any given time
- To support the development of common cyberinfrastructure resources, services, and tools that enable the effective, efficient creation and operation of end-to-end cyberinfrastructure systems for and across all science and engineering fields, nationally and internationally.

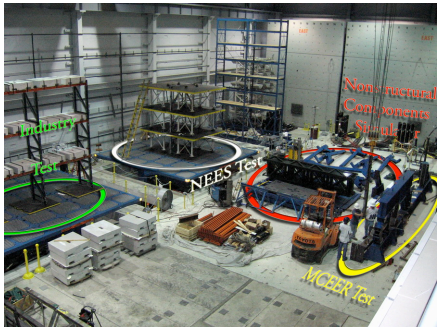
Virtual Organizations

NVO

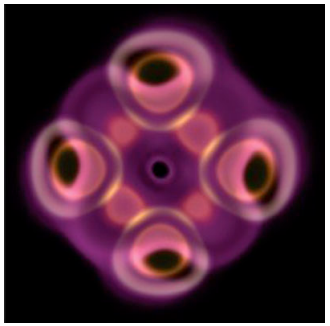
LEAD

iVDgL

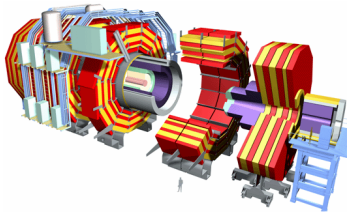
- Distributed virtual organizations are **based upon CI** that provides flexible, secure, coordinated resource sharing among dynamic collections of individuals, institutions, and resources.
- **Resources and services** include HPC, data/information management, sensor-nets/observatories, linked through global networking and middleware, and accessed by people through web portals and workflow environments.
- Increasing numbers of **virtual organizations are required** by S&E research and education communities. Referred to by many names, e.g. *collaboratory, co-laboratory, grid, gateway, portal,. hub, ….*
- **Challenges** being address include tools for more rapid building and ease of use, interoperability/middleware, high performance, end-to-end networking, and dynamic reconfiguration, social issues, assessment of impact, and economic and technical sustainability.



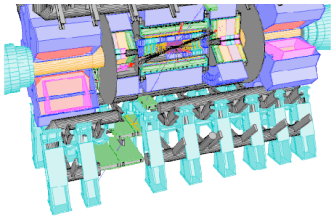
NEES



NanoHub



CMS

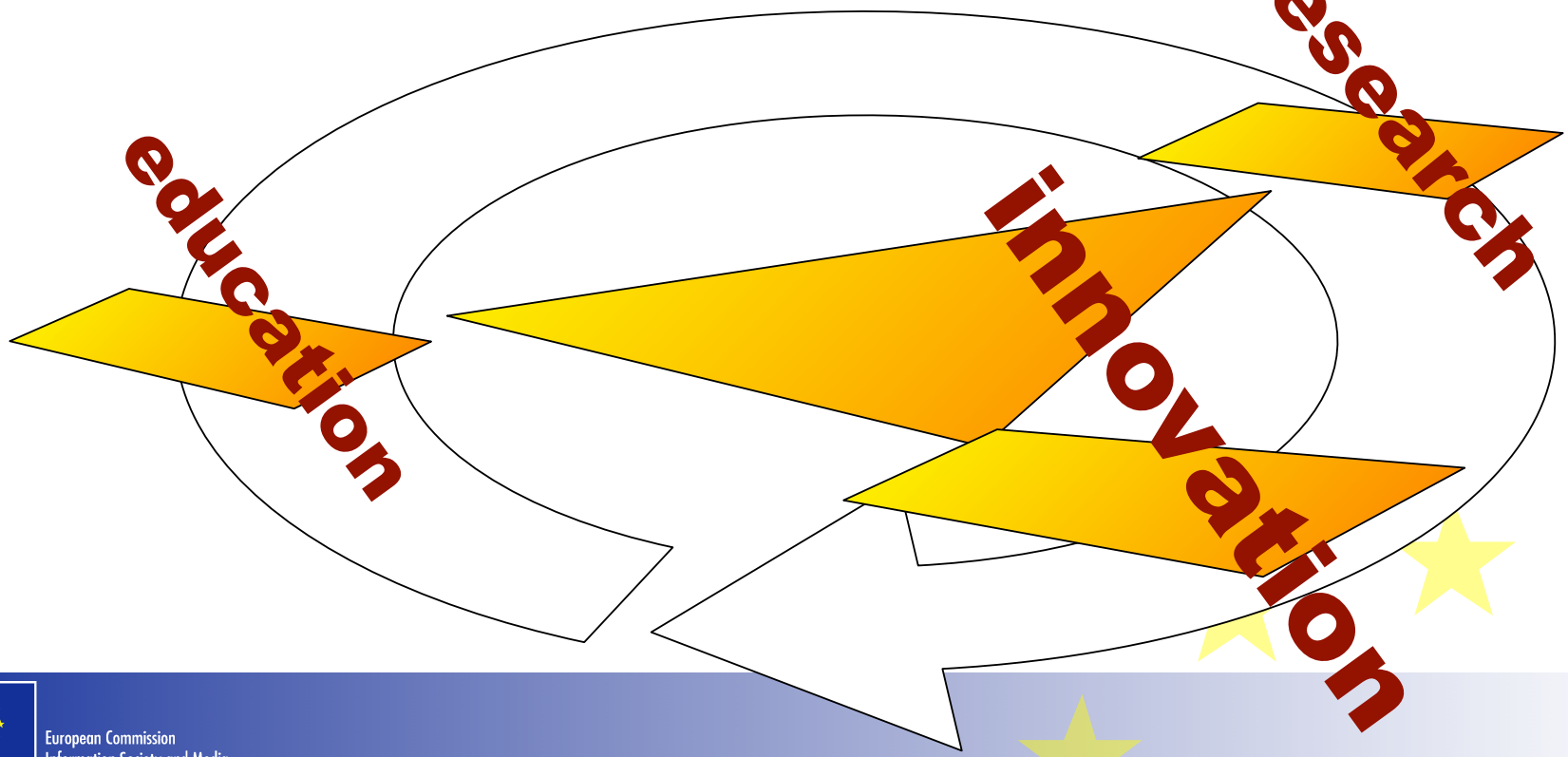


ATLAS

FP7 - Putting the knowledge triangle at work

To be a genuinely competitive knowledge economy, Europe must be better

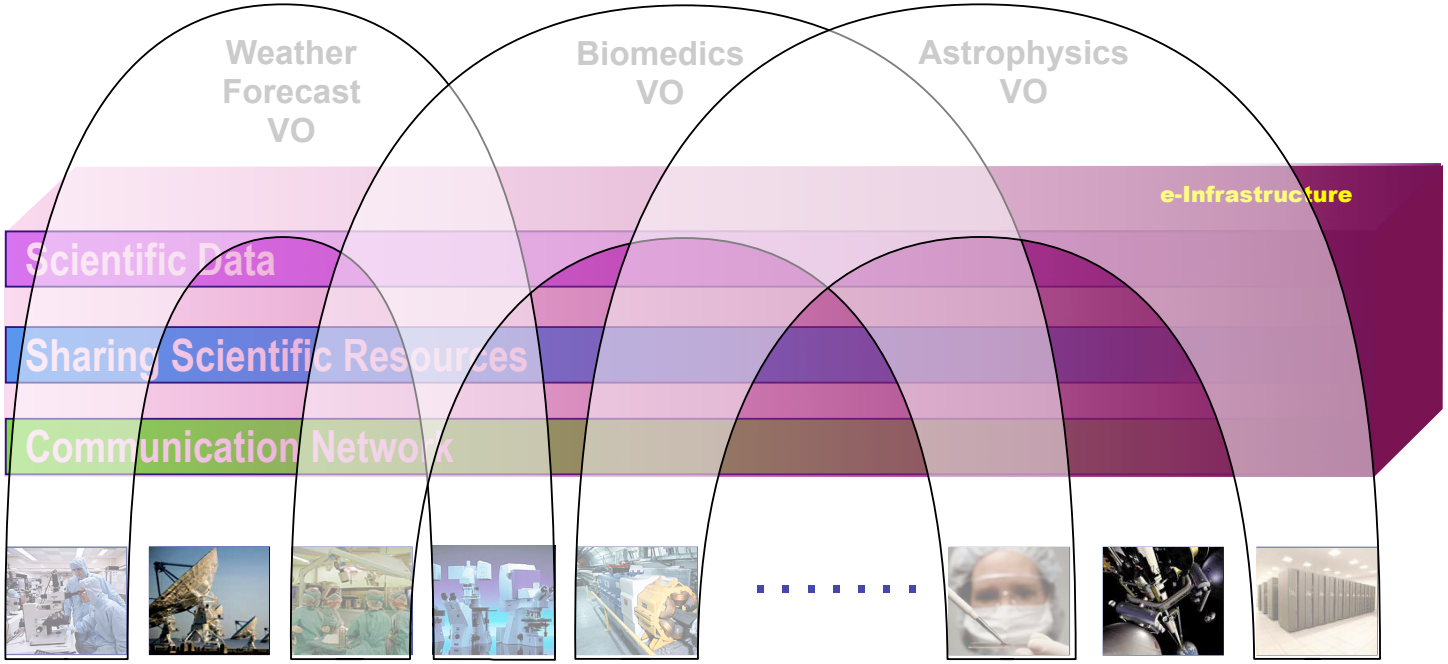
- **in producing knowledge through research**
- **in diffusing it through education**
- **in applying it through innovation**



e-Infrastructures in FP7 - strategy - Virtual Organizations (VO)

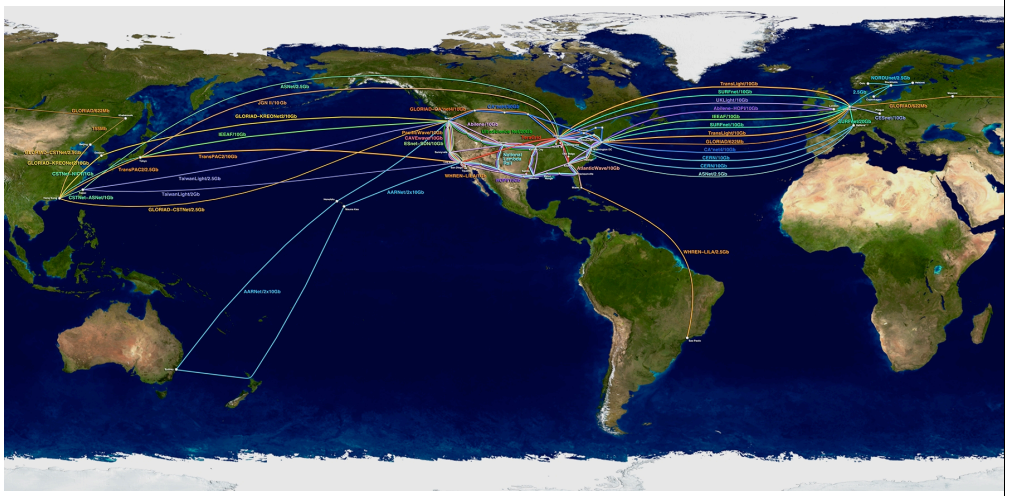
Bringing the best brains together

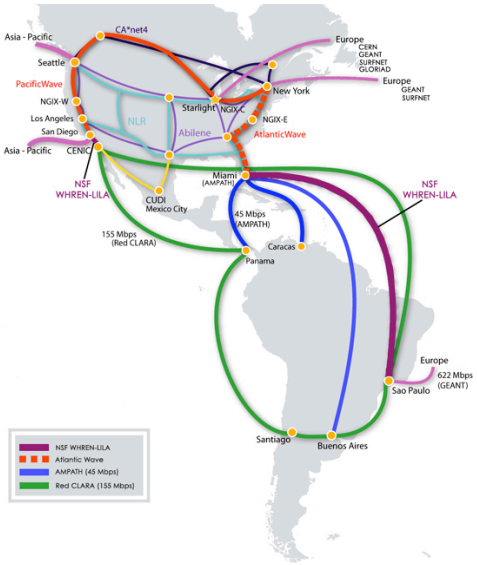
Sharing the best scientific resources

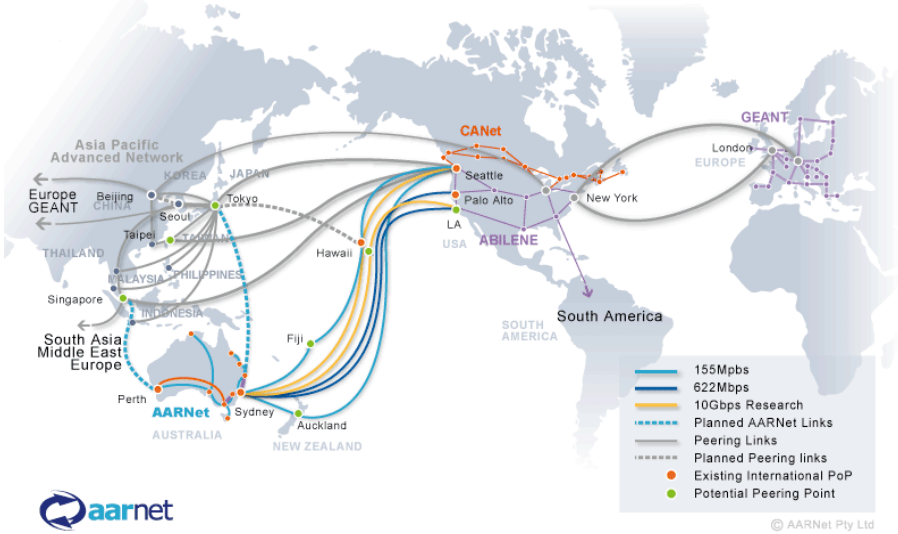


Producing the best science

VO-substrate: International R&E Networking







Office of Cyberinfrastructure

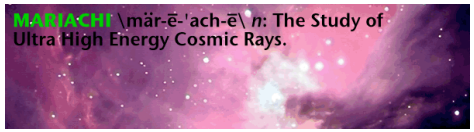
D. E. Atkins

Learning & Workforce Development

- Learning **supported by** CI. (cyber-enabled learning).
- Workforce development **to create and use** CI for S&E research and education.
- **Broadened participation**: Exploit the new opportunities that cyberinfrastructure brings for … people who, because of physical capabilities, location, or history, have been excluded from the frontiers of scientific and engineering research and education.
- Explore CI support for **integrated research and education**.

BIOINFORMATICS CI INSTITUTE

EPIC



MARIACHI

CyberBridges

OCI Program Officer Presentations

- *HPC Program* - Steve Meacham
- *CI TEAM* - Miriam Heller
- *Implementing the Strategic Vision for Digital Data* - Chris Greer
- *Middleware/ Software* - Kevin Thompson
- *Towards Virtual Organization Initiatives* - Abhi Deshmukh

Other OCI Personnel

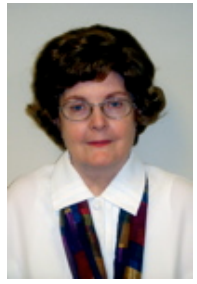
- Terry Langendoen. Program Officer

- Diana Rhoten, Consultant

- Abani Patra, Consultant

- Judy Hayden, Budget & Operations

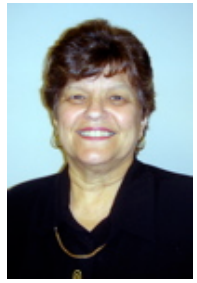
José Muñoz, Deputy Director



- Irene Lombardo, Staff Associate

- Priscilla Bezdek, Prog. & Tech. Specialist

- Deborah White-Wilkins, Sec. to Dir.



- Mary Daley, Sec. to Dep. Dir.
- Courtney Zajdel, STEP Student

Questions & Discussion

ACCI Task Force Groups

The Halloween Project

- **Portfolio**
- Jim Bottum, Chair
- Mark Ellisman
- J. Tinsely Oden
- Priscilla Nelson
- Anne Trefethen
- Jeron Tromp

- **Digital Data**
- Henry Brady, Chair
- Sara Graves
- Robert Robbins
- James Kinter
- Terry Gaasterland
- Gordon Shepard

- **CI and Competitiveness**
- James Duderstadt, Chair
- Stuart Feldman
- Brian Bershad
- Neerja Raman
- Ann Gates
- Brian Behlendorf

- **CI-Learning, Discovery, and Broadened Participation**
- Steve Castillo, Chair
- Diana Oblinger
- Adebisi Oladipupo
- David Oxtoby
- N. Radhakrishnan
- John Gage
- Wesley Harris (liaison)