Overview of the NSF Directorate for Mathematical and Physical Sciences (MPS)

Collaborative Scientific Research Opportunities Relative to the Gulf Oil Spill

November 1-2, 2010

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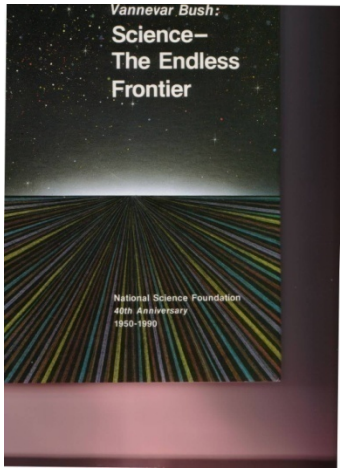
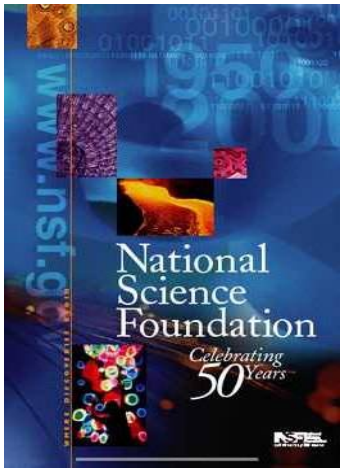
Program Director
Mathematical and Physical Sciences
Division of Chemistry

NSF in a Nutshell

- **Mission: Promote Science, Advance national health, prosperity, welfare, defense.**
- **Independent agency**
- **Supports basic research and education**
- **Uses grant mechanism in two forms**
  - **Unsolicited, curiosity driven**
  - **Solicited, more focused**
- **Peer reviews: *intellectual merit* & *broader impact***
- **Supports large facilities**
- **Discipline-based structure**
- **Supports all fields of Science/Engineering**
- **Cross-disciplinary mechanisms**

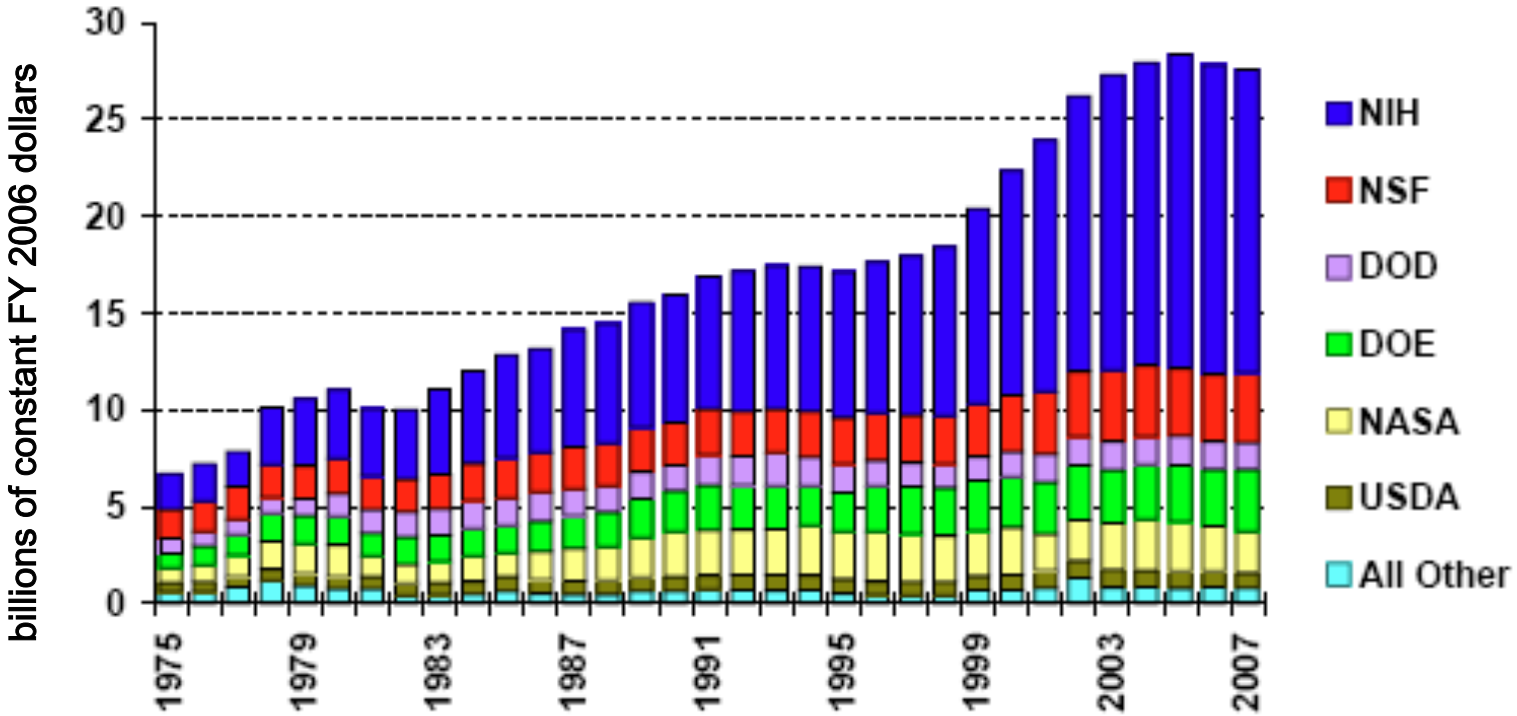




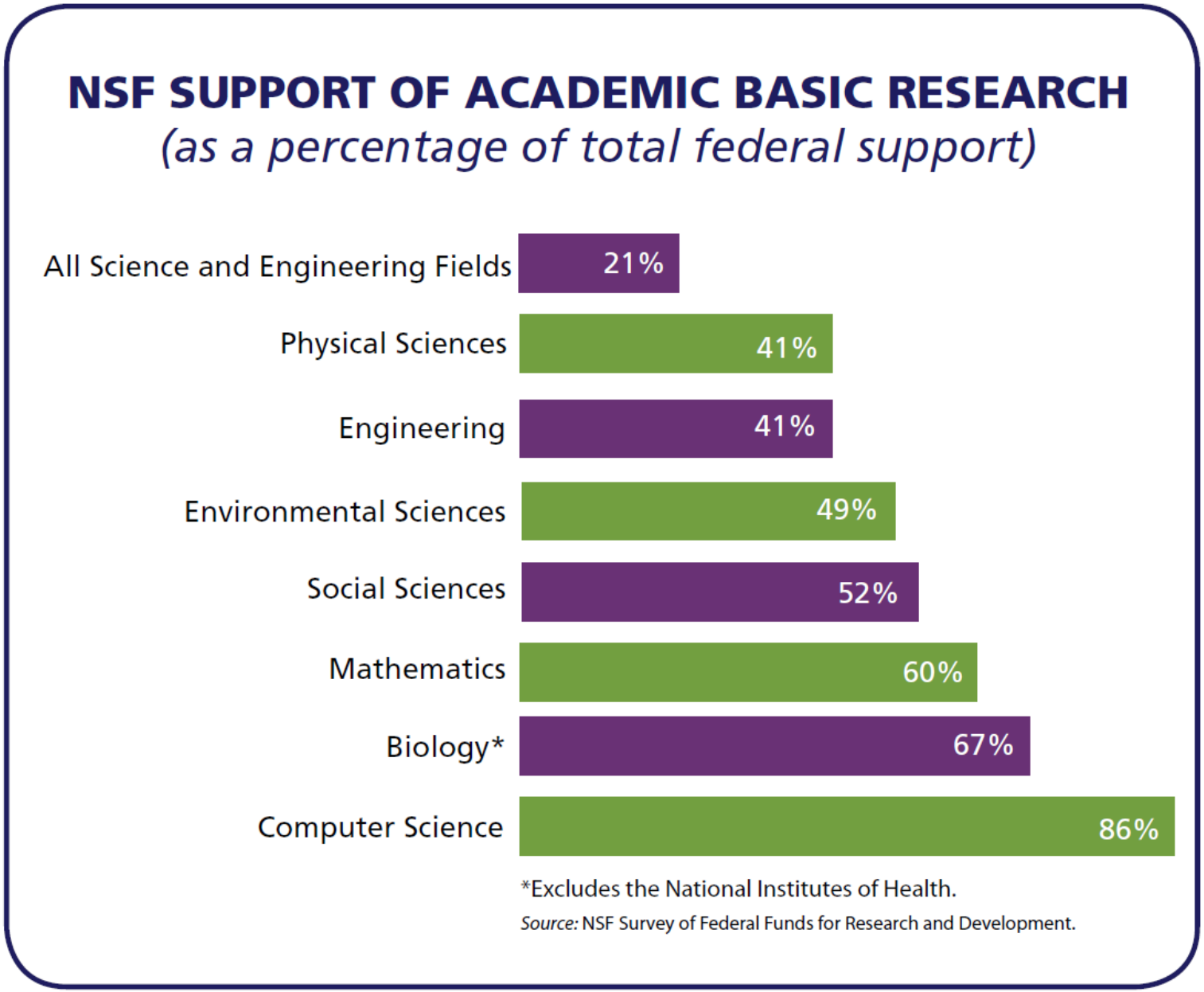
NSF Vision and Goals

- **Vision**
  - **Advancing discovery, innovation and education beyond the frontiers of current knowledge, and empowering future generations in science and engineering.**
- **Goals**
  - **Discovery**
  - **Learning**
  - **Research Infrastructure**
  - **Stewardship**

Trends in Basic Research by Agency FY 1975-2007

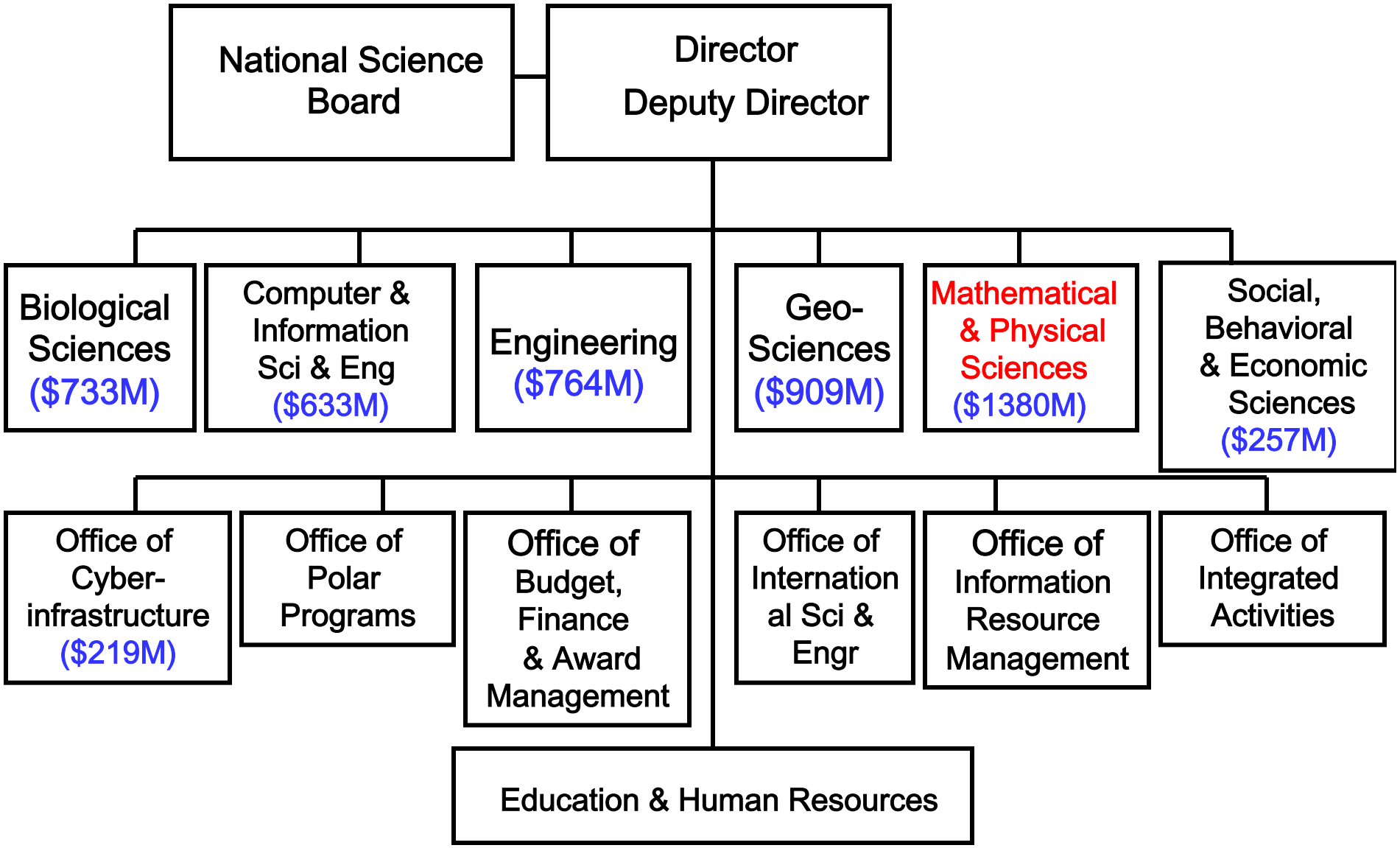


Source: AAAS analyses of R&D in *AAAS Reports I-XXXI.* FY 2007 figures are President's request. Basic research only. March '06 © 2006 AAAS.



FY 2008 Performance Highlights, NSF 09-26

National Science Foundation



Budgets presented are FY 2010 Request

About the Directorate of Mathematical and Physical Sciences

- Most extensive & diverse scientific portfolio in NSF
- Fundamental discovery to innovative technologies
- Largest budget in NSF: $1.38B (FY 2010 Request)
- Develops & supports major facilities
- Diverse approaches: small PI grants, major facilities, centers/institutes

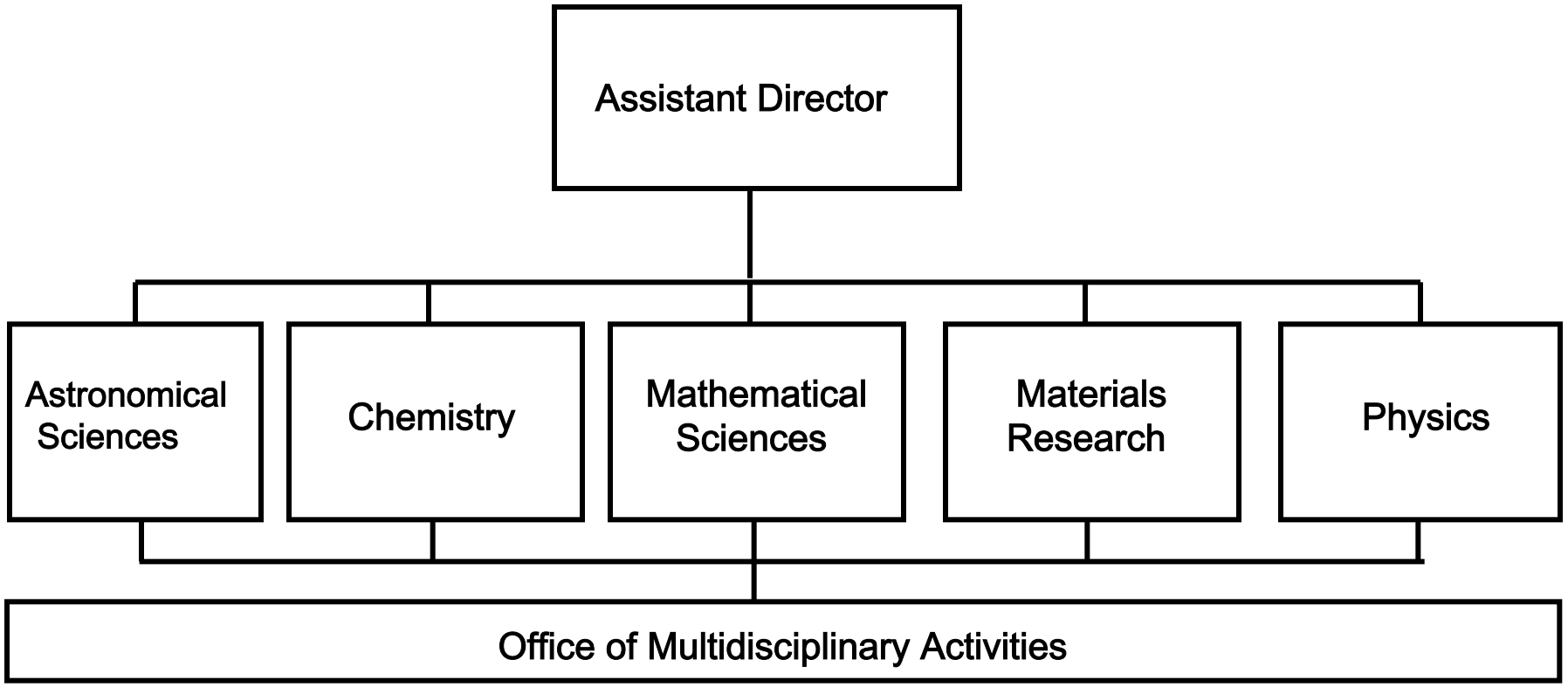
Mission Statement

To make discoveries about the Universe and the laws that govern it;

To create new knowledge, materials, and instruments which promote progress across science and engineering;

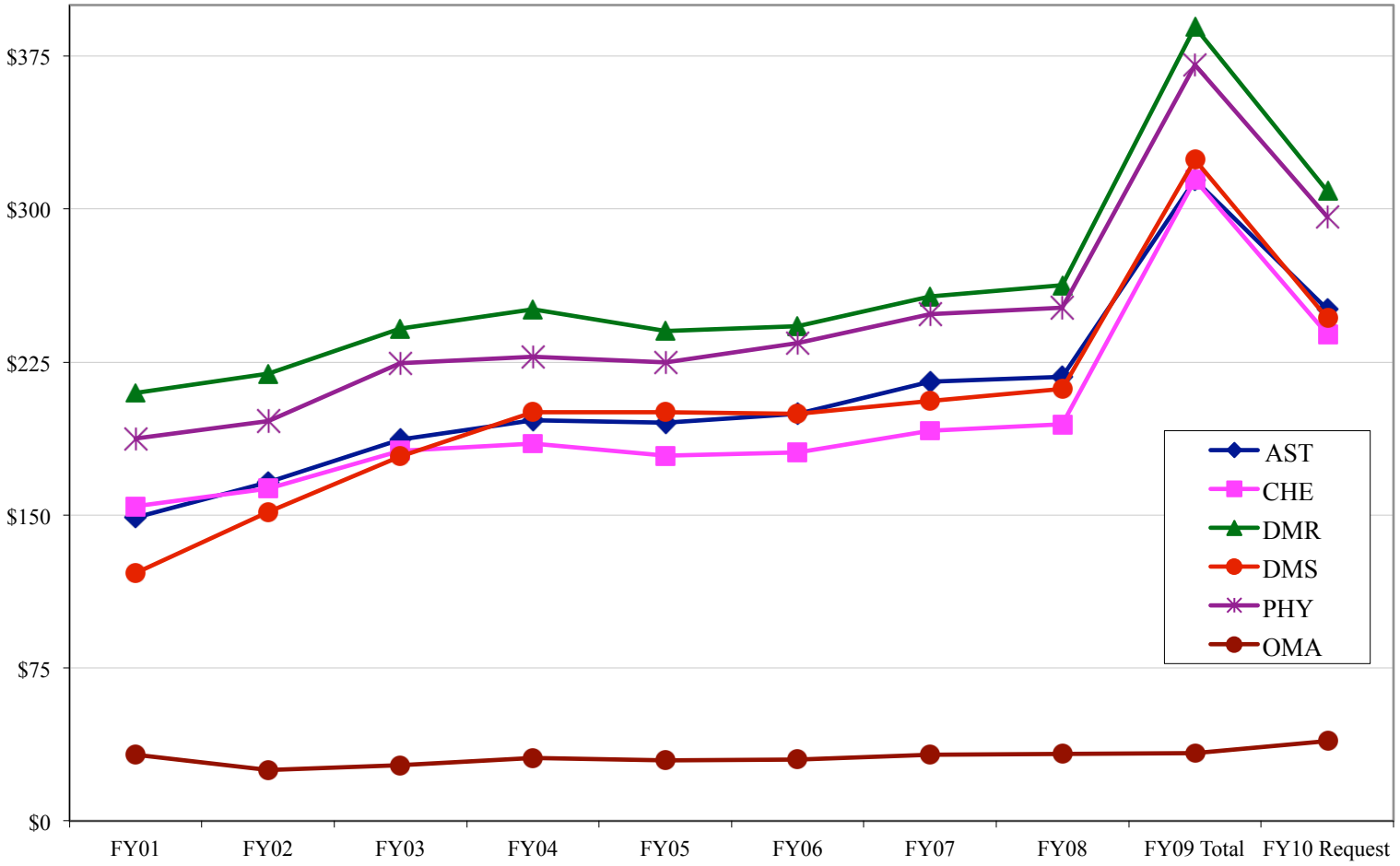
To prepare the next generation of scientists through research, and to share the excitement of exploring the unknown with the nation.

Mathematical & Physical Sciences



MPS Division Funding

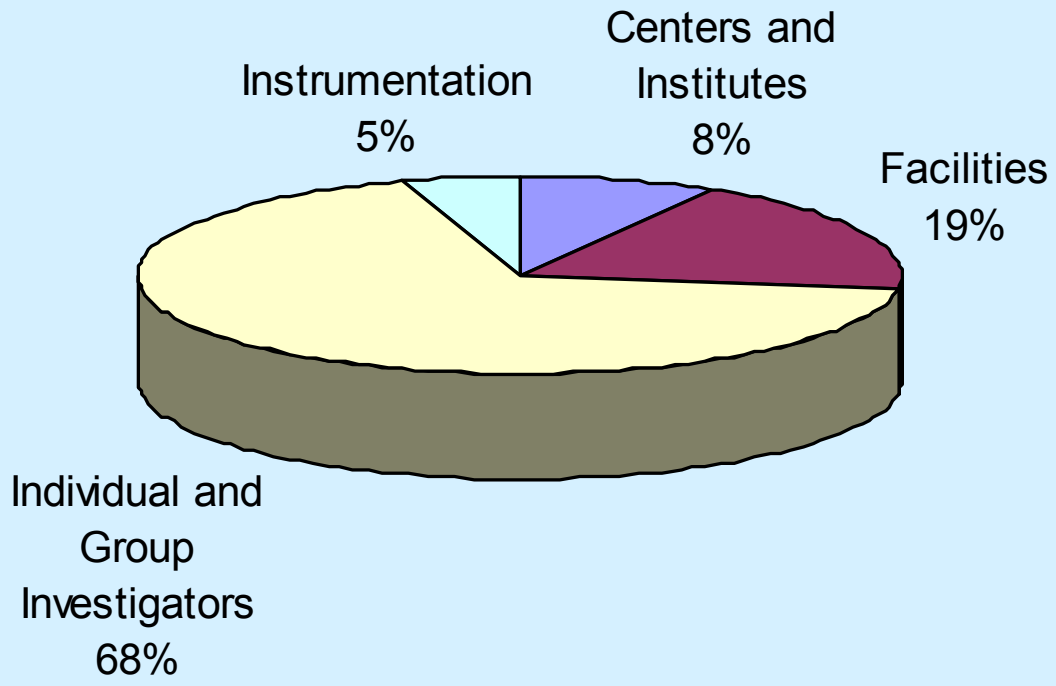
(dollars in millions)



FY2010 MPS Budget Request

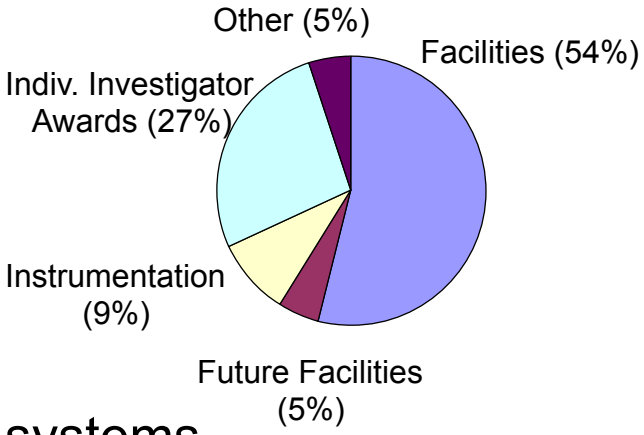
Mathematical and Physical Sciences Funding (Dollars in Millions)						
		FY 2009	FY 2009		Change Over	
	FY 2008	Current	ARRA	FY 2010	FY 2009 Plan	
	Actual	Plan	Estimate	Request	Amount	Percent
Major Components:						
Research and Education Grants	773.16	845.24	403.45	934.55	89.31	10.6%
Instrumentation	52.25	47.71	25.95	69.68	21.97	46.0%
Centers Programs	97.37	114.95	-	114.27	-0.68	-0.6%
Facilities Operation & Maintenance	248.35	248.24	60.60	261.50	13.26	5.3%
Total, MPS	**$1,171.13**	**$1,255.96**	**$490.00**	**$1,380.00**	**$124.04**	**9.9%**

MPS Funding Modality in the FY2010 Budget Request



The MPS Divisions

Astronomical Sciences (AST)



- From the Big Bang to DNA
  - » Origin and evolution of the Universe
  - » Origin and evolution of galaxies
  - » Origin and evolution of planetary and stellar systems
- National astronomy portfolio
  - » Three agencies - NSF, NASA, and DoE – and internat'l partnerships
  - » Strong tradition of private funding
  - » NSF assigned federal stewardship of ground-based astronomy
  - » **Includes open-access facilities and mission-free unrestricted grants**

AST has a strong program in Education and Special Programs (including a major investment in post-docs)

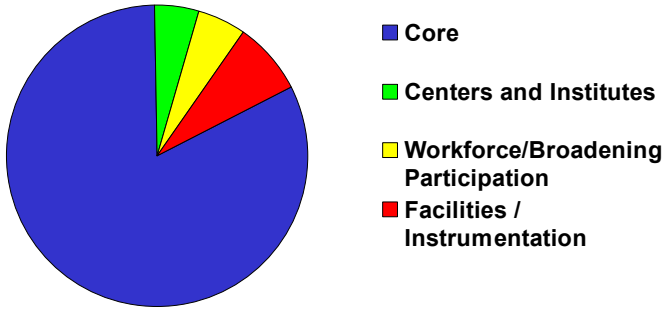
Chemistry (CHE)

- Chemical Synthesis
- Chemical Structure, Dynamics, and Mechanisms
- Theory, Models, and Computational Methods
- Chemical Measurement and Imaging

Integrative Chemistry Activities

- Centers
- Education and Broadening Participation
- Facilities and Instrumentation

- Environmental Chemical Sciences
- Chemistry of Life Processes
- Chemical Catalysis
- Macromolecular, Supramolecular, and Nanochemistry



- Major CAREER and REU support
- Centers program growing
- Collaborations with NIH and DOE
- Critical areas of research for FY 2010: Energy, Element and Molecule Recycling, Designed Emergent Behavior, Imaging the Ultrasmall

Materials Research (DMR)

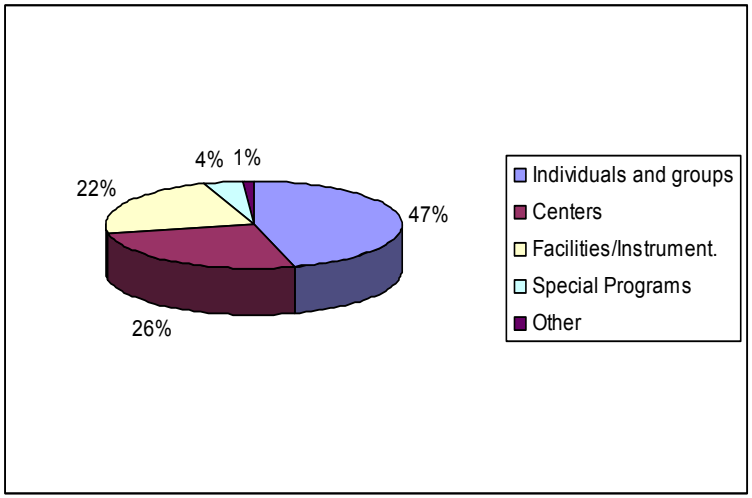
DMR Programs:

- Metals, Ceramics, Electronic Materials
- Condensed Matter Physics, Condensed Matter and Materials Theory
- Solid-Sate Chemistry, Polymers, Biomaterials
- Materials Research Science and Engineering Centers
- National Facilities and Instrumentation
- Office of Special Programs

DMR supports a wide breadth of science – fundamental research to the development of technological applications.

Key Research Areas for FY 2010:

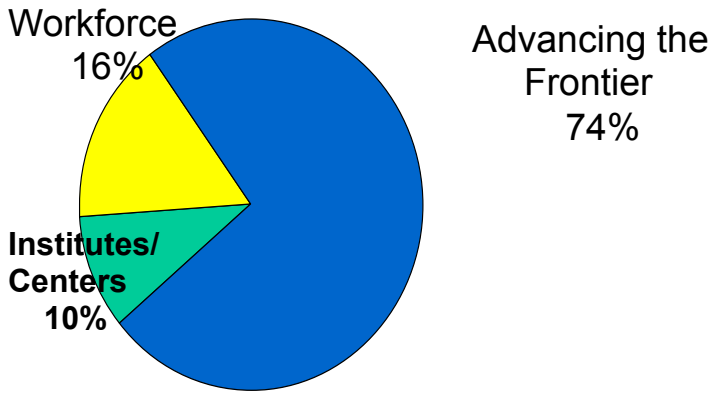
- Environmental, energy, and economic sustainability
- Matter by design
- The quantum realm
- Physical-chemical-biological interfaces



Mathematical Sciences (DMS)

Analysis	Algebra Num. Th. Combinat	Geometry Topology	Applied Math	Comp Math	Probabil. Statistics	Workforce	Institutes

- "Core business": single investigator and group proposals through targeted solicitations
  Covers the entire mathematical spectrum
- Institutes: 5 NSF-initiated, support for 3 others
  - Visitors to long term programs, workshops
- Workforce: responding to a major challenge.
  - EMSW21 training grants
  - Postdoctoral fellowships
  - Research for Undergraduates



In addition to the fundamental research in mathematical sciences, DMS plays an enabling role of all other sciences; DMS has been successful in partnering with other NSF Divisions and Directorates and with other government agencies.

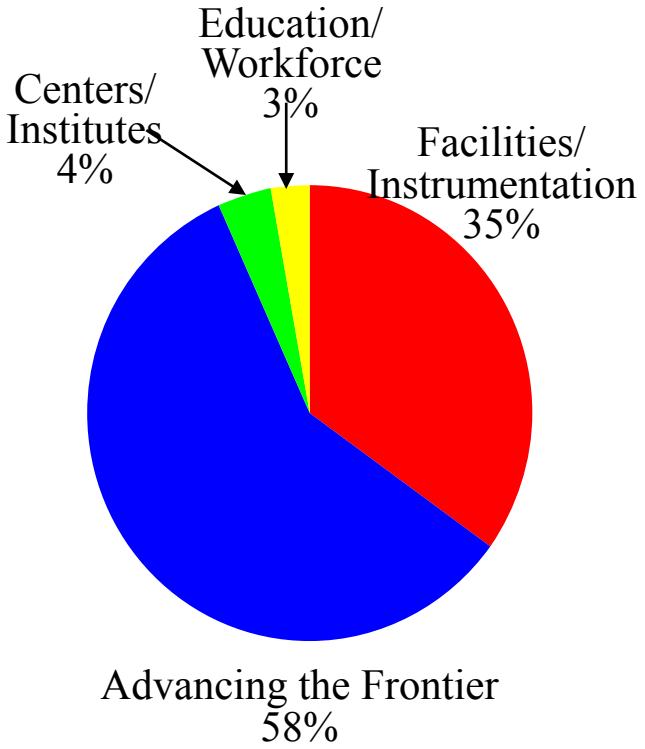
Physics (PHY)

Facilities:

LHC, LIGO, IceCube, NSCL, CESR, DUSEL (?)

Programs:

Atomic, Molecular, Optical, and Plasma Physics
Biological Physics
Elementary Particle Physics
Gravitational Physics
Nuclear Physics
Particle and Nuclear Astrophysics
Physics at the Information Frontier
Physics Frontiers Centers
Theoretical Physics
Education and Interdisciplinary Programs



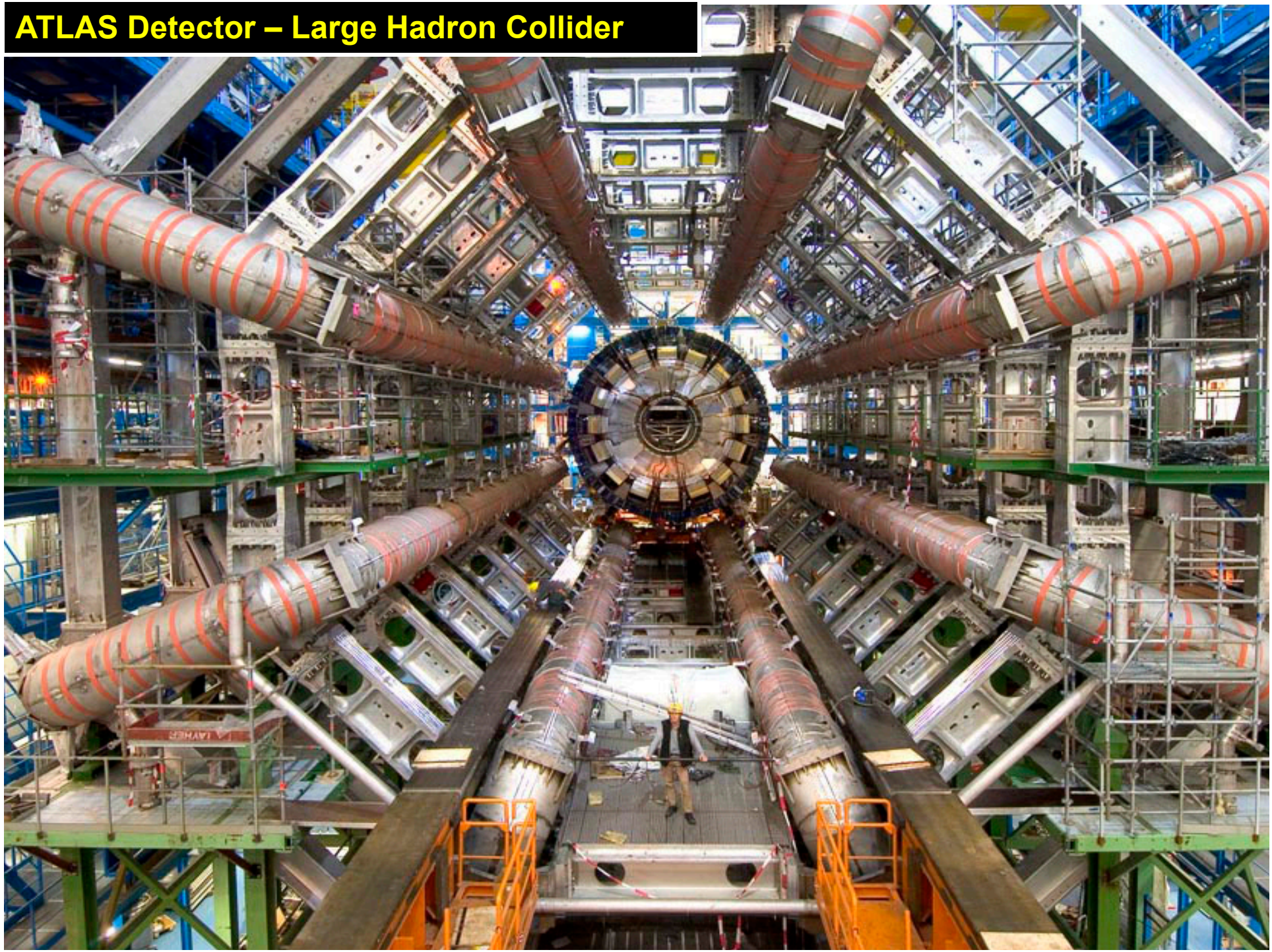
PHY collaborates closely with DOE and international partners to support science at large facilities. NSF's physics portfolio is more diverse than physics portfolios at any other federal agency.

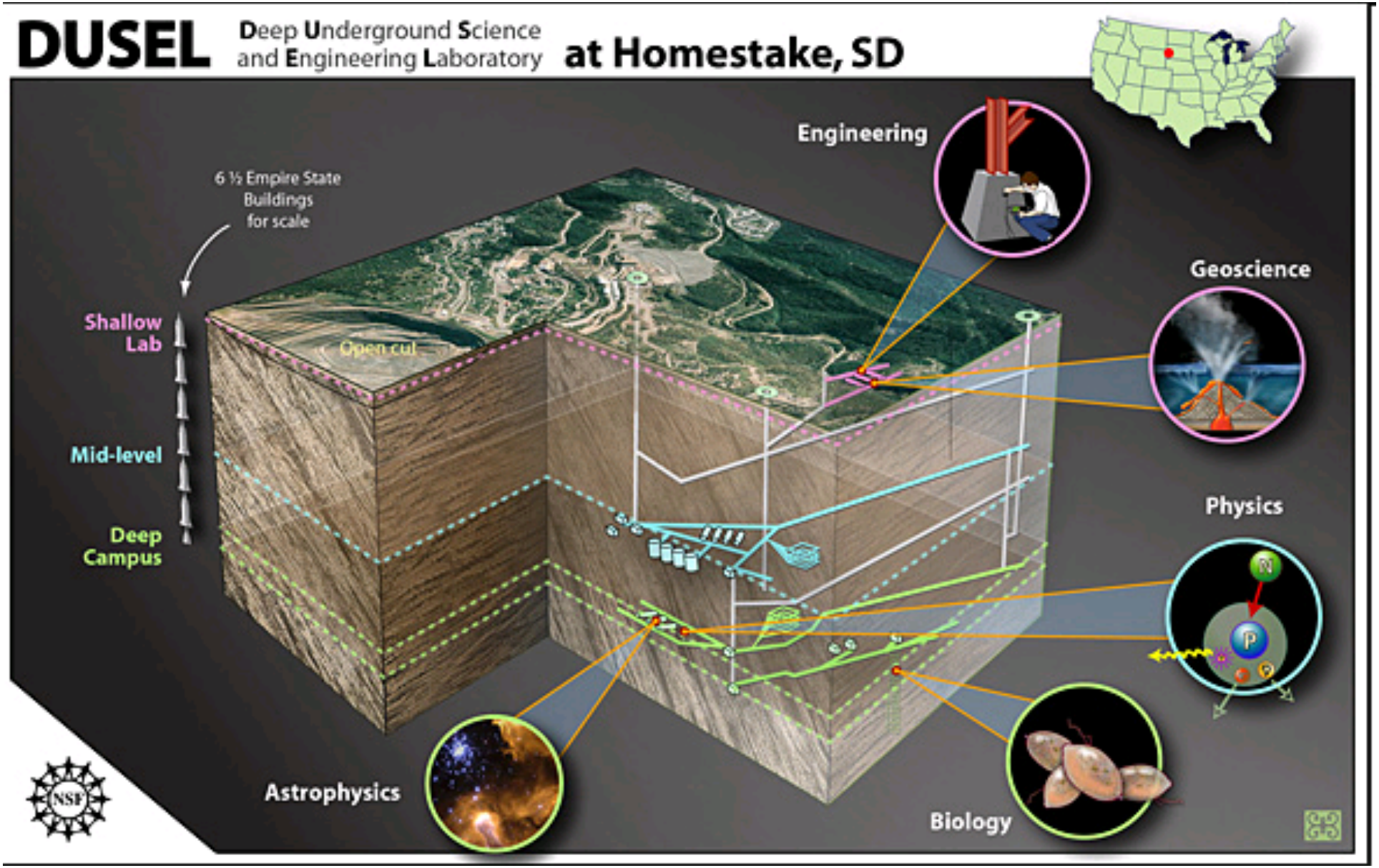
Office of Multidisciplinary Activities (OMA)

- Catalyzes cross-cutting research in areas of strategic emphasis in MPS, as well as areas that may emerge as strategic
- Facilitates partnerships with other agencies, industries, state and local governments, and international organizations
- Supports innovative experiments in education and broadening participation

OMA neither receives nor reviews proposals; rather, OMA co-invests with MPS Divisions

ATLAS Detector – Large Hadron Collider



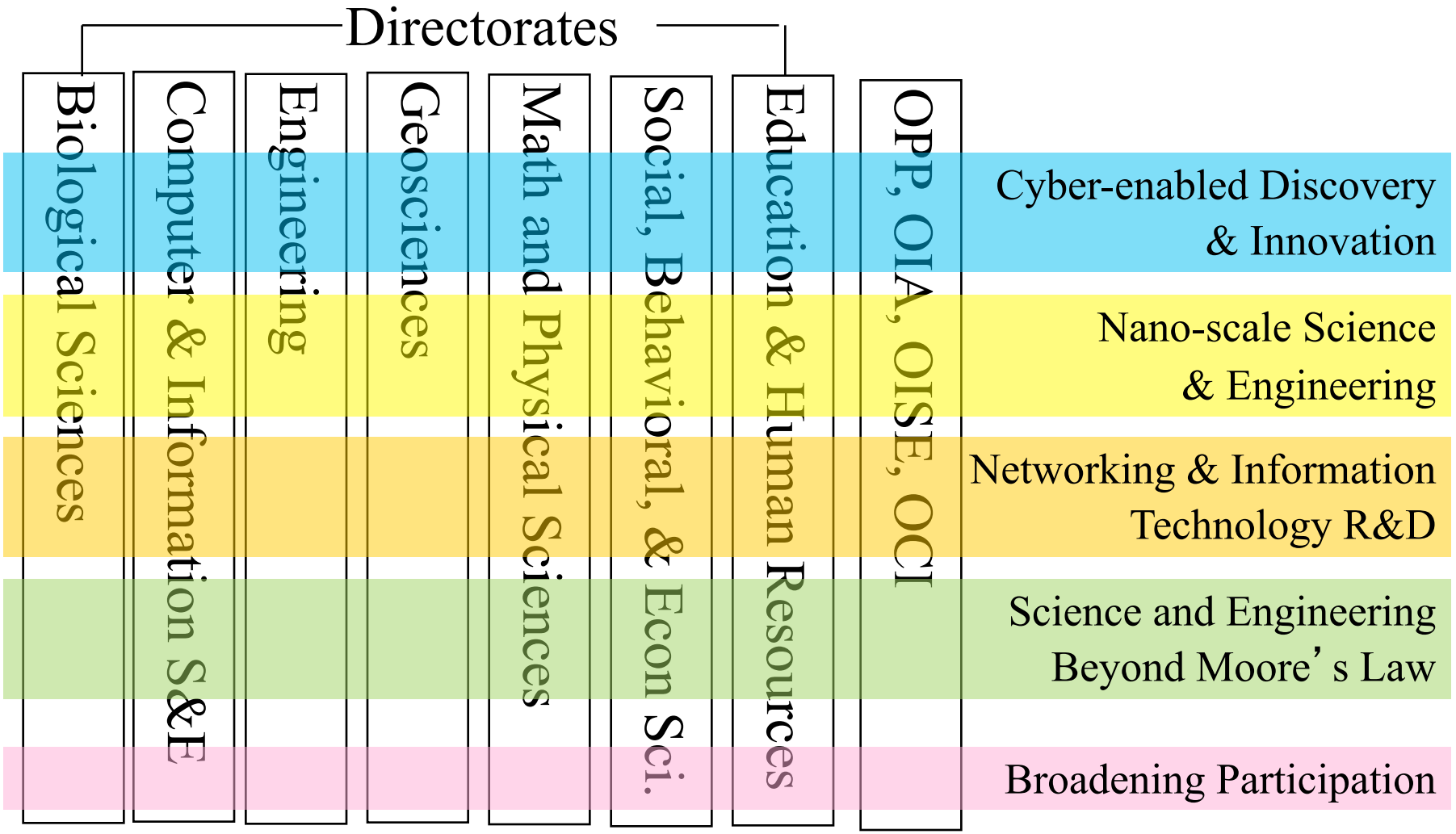

DUSEL
Deep Underground Science and Engineering Laboratory
at Homestake, SD
Engineering
6 ½ Empire State Buildings for scale
Shallow Lab
Mid-level
Deep Campus
Open cut
Geoscience
Physics
Astrophysics
Biology
NSF

Scientific Opportunities

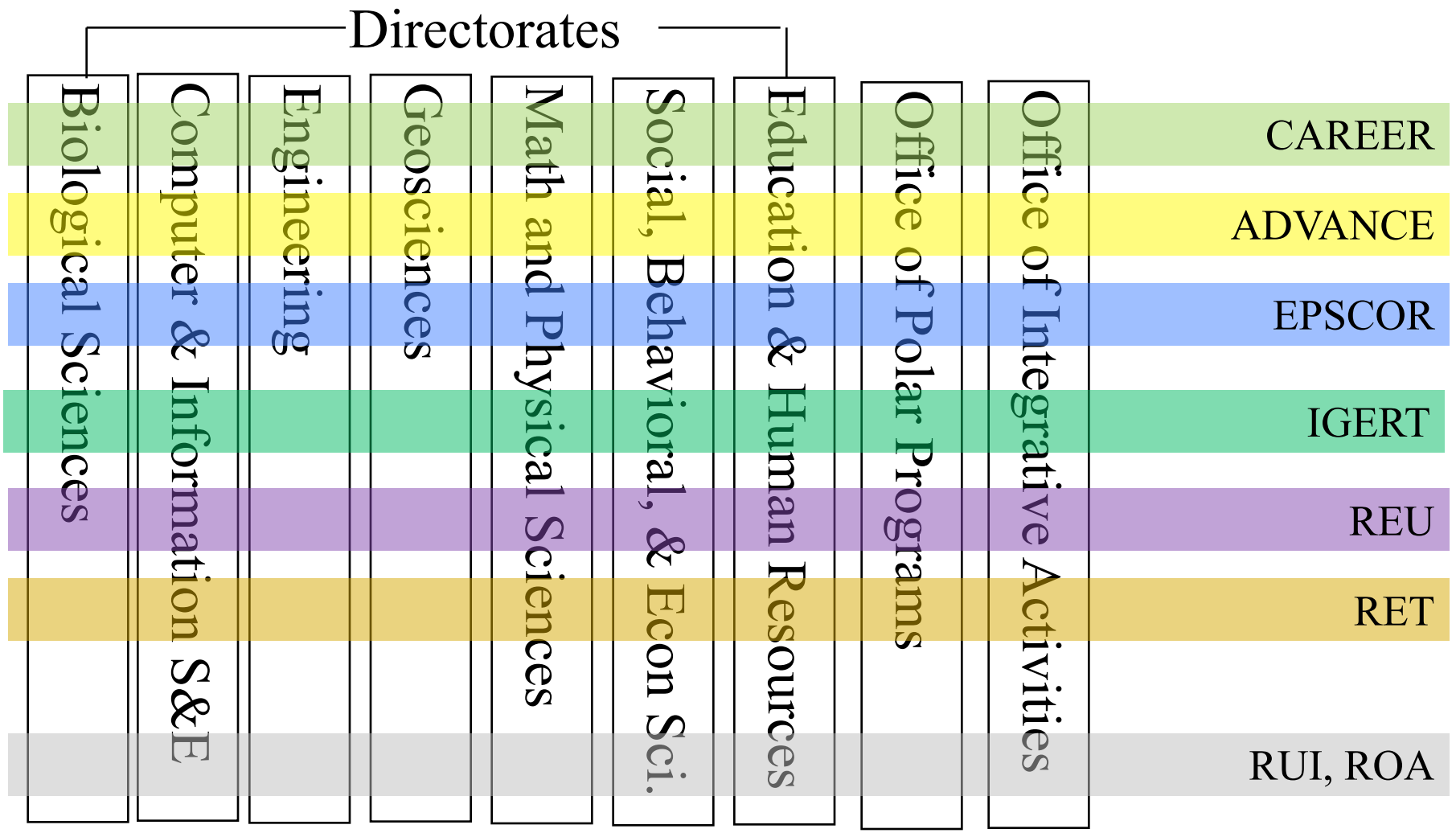
MPS Scientific Priorities for FY 2010

- Science beyond "Moore's Law" and Quantum Information Sciences
- Sustainability (energy, environment, climate)
- Interface between physical & life sciences
- Cyber-enabled Discovery and Innovation
- Physics of the universe
- Education and Workforce (CAREER, post-doc programs, REUs…)

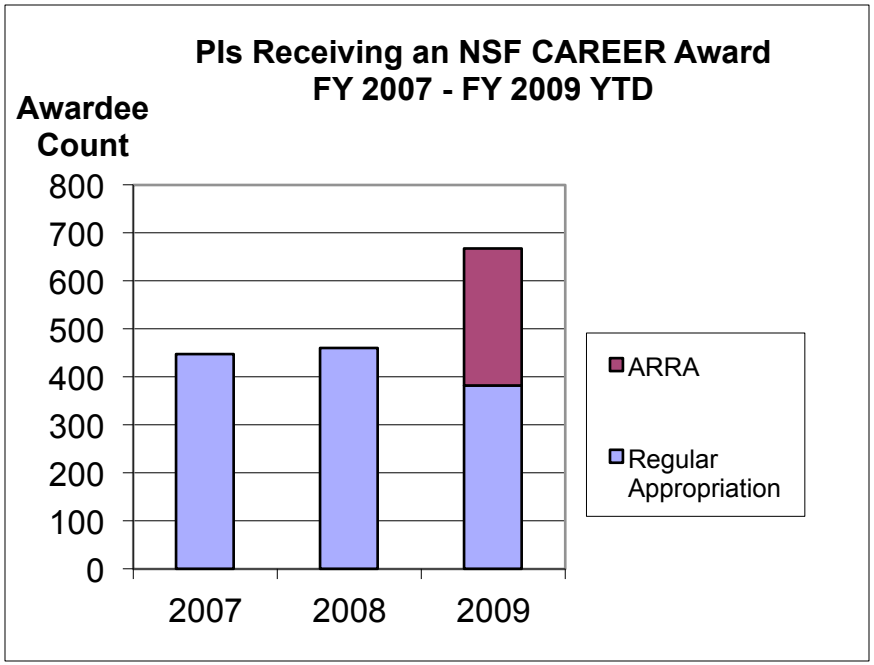
NSF-Wide Scientific Investments



NSF-Wide Programs



CAREER Program



- NSF's most prestigious awards for new junior faculty.
- Awardees are selected based on their plan to develop a highly integrative and effective research and education career within the context of the mission of their institution.
- Increased participation of those traditionally under-represented in science and engineering is encouraged.

How do I apply?
What are the processes?
How will I be reviewed?

How to make an NSF Proposal Competitive

- Match and justify the budget to the scope of the proposed work – ask for what you need!
- Be familiar with projects that have succeeded – search award abstracts at
  - http://www.nsf.gov/awardsearch
- Special programs/consideration exist for Primarily Undergraduate Institutions, e.g., RUI and ROA; for colleges and universities in EPSCoR states

NSF Proposal Process

1. Principal Investigator submits proposal (solicited or unsolicited)
2. NSF conducts a compliance check/review
3. NSF evaluates proposals using merit review:
   a) By mail (ad hoc) and/or panel
   b) Confidential
   c) Anonymous
4. Program Officers weigh reviews and portfolio balance issues; recommend proposals for funding or decline
5. Management reviews those recommendations; makes decisions
6. PIs are notified

Merit Review Criteria: Intellectual Merit

- How important is the proposed activity to **advancing knowledge** and understanding within its own field or across different fields?
- How **well qualified** is the proposer (individual or team) to conduct the project?
- To what extent does the proposed activity suggest and explore creative, original, or **potentially transformative** concepts?
- How **well conceived and organized** is the proposed activity?
- Is there sufficient access to **resources**?

Merit Review Criteria: Broader Impacts

- How well does the activity advance discovery and understanding while **promoting teaching, training, and learning**?
- How well does the proposed activity broaden the participation of **underrepresented groups**?
- To what extent will it enhance the **infrastructure** for research and education, such as facilities, instrumentation, networks, and partnerships?
- Will the **results be disseminated** broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to **society**?

Reasons For Funding A Competitive Proposal

- **Scientific Impact**
- **PI Career Point**
- **Program Portfolio Balance**
- **Diversity Issues**
- **Educational Impact**
- **Impact on Institution/State**
- **Special Programmatic Considerations (CAREER/RUI/ EPSCoR, for example)**

Secrets for Success !

- New and original ideas
- Sound, succinct, detailed focused plan
- Preliminary data and/or feasibility calculations
- Relevant experience
- Clarity concerning future direction
- Well-articulated broader impacts

Get Involved

- Volunteer to be a reviewer and panelist
- Participate in NSF-funded events, workshops, etc.
- Send your best ideas to NSF: consistent with program focus and goals
- Get to know your Program Directors
- Keep us informed of your accomplishments
- Work within your institutions to support collaborative, interdisciplinary research
- Call our attention to things that need improvement
- Suggest transition strategies from basic research to prototyping and production
- Plan to serve as a program officer (“rotator”) or division director

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