

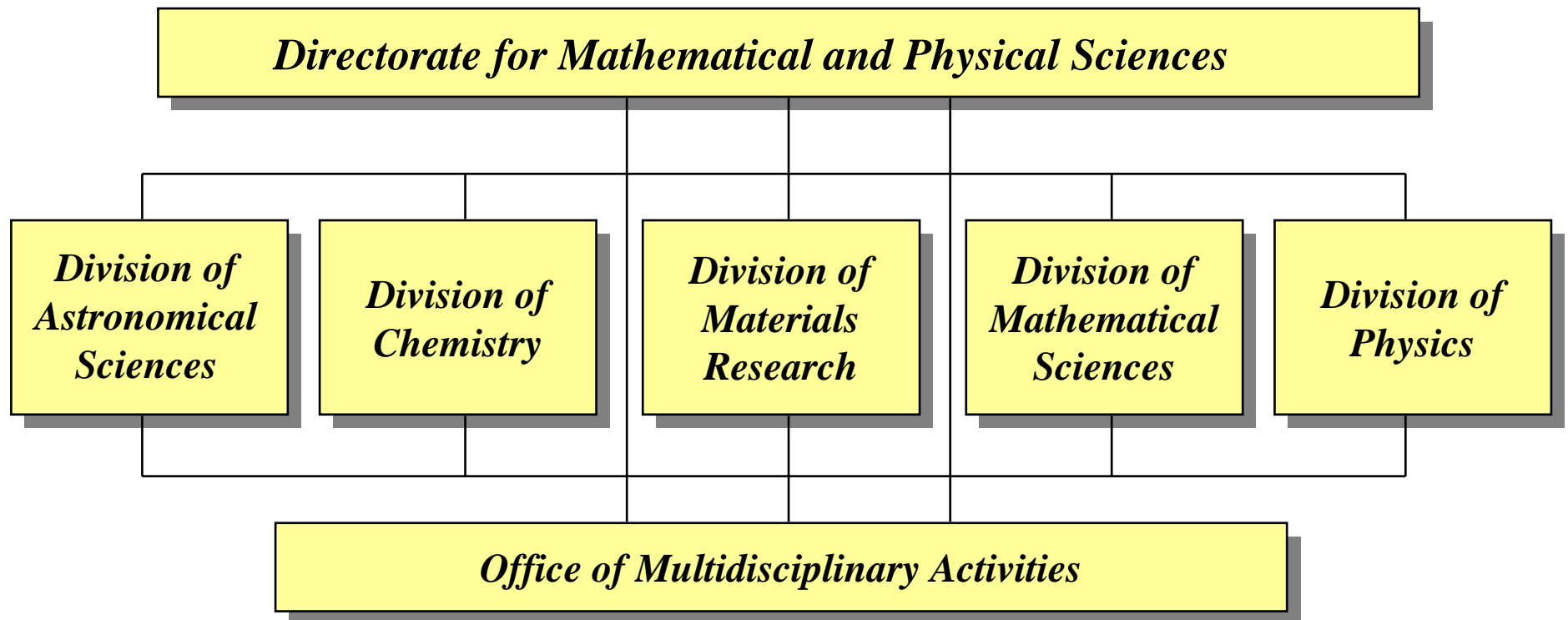
NSF PHY Budget

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Division of Physics

HEPAP

March 3, 2006

Directorate for Mathematical and Physical Sciences



Advancing the Frontier

Elementary Particle Physics (EPP), fundamental research across

- (1) the **energy** frontier – the attempt to discover new fundamental particles and laws of physics by studying collisions at the highest energies achievable with current and future accelerators;
- (2) the **neutrino** frontier – exploration of the properties of the neutrino, a particle now known to carry mass and believed to be fundamental to understanding the developing universe; and
- (3) the **cosmic** frontier – the study of dark matter and dark energy.

Physics of the Universe (POU), a set of activities carried out in partnership with DOE and NASA for exploring

- the mysteries of dark matter and dark energy;
- the earliest phases in development of the universe;
- the fundamental nature of time, matter and space; and
- the role of gravitation.

Advancing the Frontier

Fundamental mathematical and statistical science, strengthening the core of the Mathematical Sciences Priority Area and enable effective partnering across NSF as well as with NIH and DARPA.

Physical sciences at the nanoscale, the foundation for innovative nanoscale technologies in partnership with other NSF organizations and the government-wide National Nanotechnology Initiative.

Cyberinfrastructure and the cyberscience it enables, connecting with NSF's high priority activities in this area and the government-wide Networking and Information Technology R&D activities.

Molecular basis of life processes, study of complex biological systems in areas such as self-assembly of disordered collections of molecules into the elements of living systems; protein folding; membranes; and emergence of physiological processes such as breathing and thinking out of complex, coupled arrays of individual reactions.

Sustainability, areas that link the physical sciences with environmental sustainability, including green chemistry, water chemistry and energy.

MPS FY07 Budget

Highlights

+\$65M (6%) Over FY06 Current Plan to \$1.15B

- Increased support for the grants programs (great discovery machine) across the Divisions (AST: 13%; PHY: 6.4%; CHE: 5.5%; DMR: 5%; and DMS: 3%)
- New investment in Elementary-particle Physics frontier activities (\$5M in FY06 to \$15M in FY07 and beyond)
- Increased support for Nanoscale Science (\$14.9M) and Cyber activities (\$4.3M), NB: \$50M in OCI toward a petascale capability
- Increased support for Physics of the Universe activities (\$8.5M) in AST, PHY
- Increased support for Molecular Basis of Life Activities (\$9.4M in CHE, DMR, PHY)
- Increased support for facility operations: LHC (\$4.6M), Gemini (\$1.7M), LIGO (\$1.3M), CESR (\$0.15M) and early operations for ALMA (\$2M)
- Increased support for public/private partnership in optical/IR (\$1.1M for AODP, \$2M for TSIP)
- Increased support for Materials mid-scale instrumentation (\$1M) and Astronomy ATI (\$3.7M)
- Design and development funding for GSMT (\$5M), continued funding for Energy Recovery Linac (ERL), DUSEL and LSST
- Increased support for Participation and Education/Workforce Activities (\$8.5M)

MPS Facilities

(Dollars in Millions)

Facilities	FY 2005 Actual	FY 2006	FY 2007 Request	Change over	
		Current Plan		FY 2006 Amount	FY 2006 Percent
Cornell Electron Storage Ring (CESR)	16.62	14.56	14.71	0.15	1.0%
GEMINI Observatory	15.48	18.26	20.00	1.74	9.5%
Large Hadron Collider (LHC)	10.51	13.36	18.00	4.64	34.7%
Laser Interferometer Gravitational Wave Observatory (LIGO)	32.00	31.68	33.00	1.32	4.2%
MSU Cyclotron	17.50	17.32	17.60	0.28	1.6%
Nanofabrication (NNUN/NNIN)	2.80	2.77	2.80	0.03	1.1%
National High Magnetic Field Laboratory (NHMFL)	25.50	25.74	26.50	0.76	3.0%
Rare Symmetry Violating Processes (RSVP)	2.65	0.99	-	-0.99	-100.0%
National Astronomy and Ionosphere Center (NAIC)	10.52	10.46	10.46	-	-
National Center for Atmospheric Research (NCAR)	1.04	1.12	1.12	-	-
National Optical Astronomy Observatories (NOAO)	37.94	36.91	40.05	3.14	8.5%
National Radio Astronomy Observatory (NRAO)	47.03	50.74	50.74	-	-
Other MPS Facilities	13.49	12.31	12.47	0.16	1.3%
Total, MPS	\$233.08	\$236.22	\$247.45	\$11.23	4.8%

Division of Physics

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graph TD; A[Division of Physics] --> B[AMOP Physics]; A --> C[Theoretical Physics]; A --> D[Gravitational Physics]; B --> B1[Elementary Particle Physics]; B --> B2[Part. & Nucl. Astrophysics]; B --> B3[Physics Front. Centers]; C --> C1[Nuclear Physics]; C --> C2[Biological Physics]; C --> C3[Physics @ Inform. Front.]; D --> D1[Education & Interdisc. Res.]; D --> D2[Accelerator Phy. & Phy. Instrum.];
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**AMOP
Physics**

**Elementary
Particle Physics**

**Part. & Nucl.
Astrophysics**

**Physics Front.
Centers**

**Theoretical
Physics**

**Nuclear
Physics**

**Biological
Physics**

**Physics @
Inform. Front.**

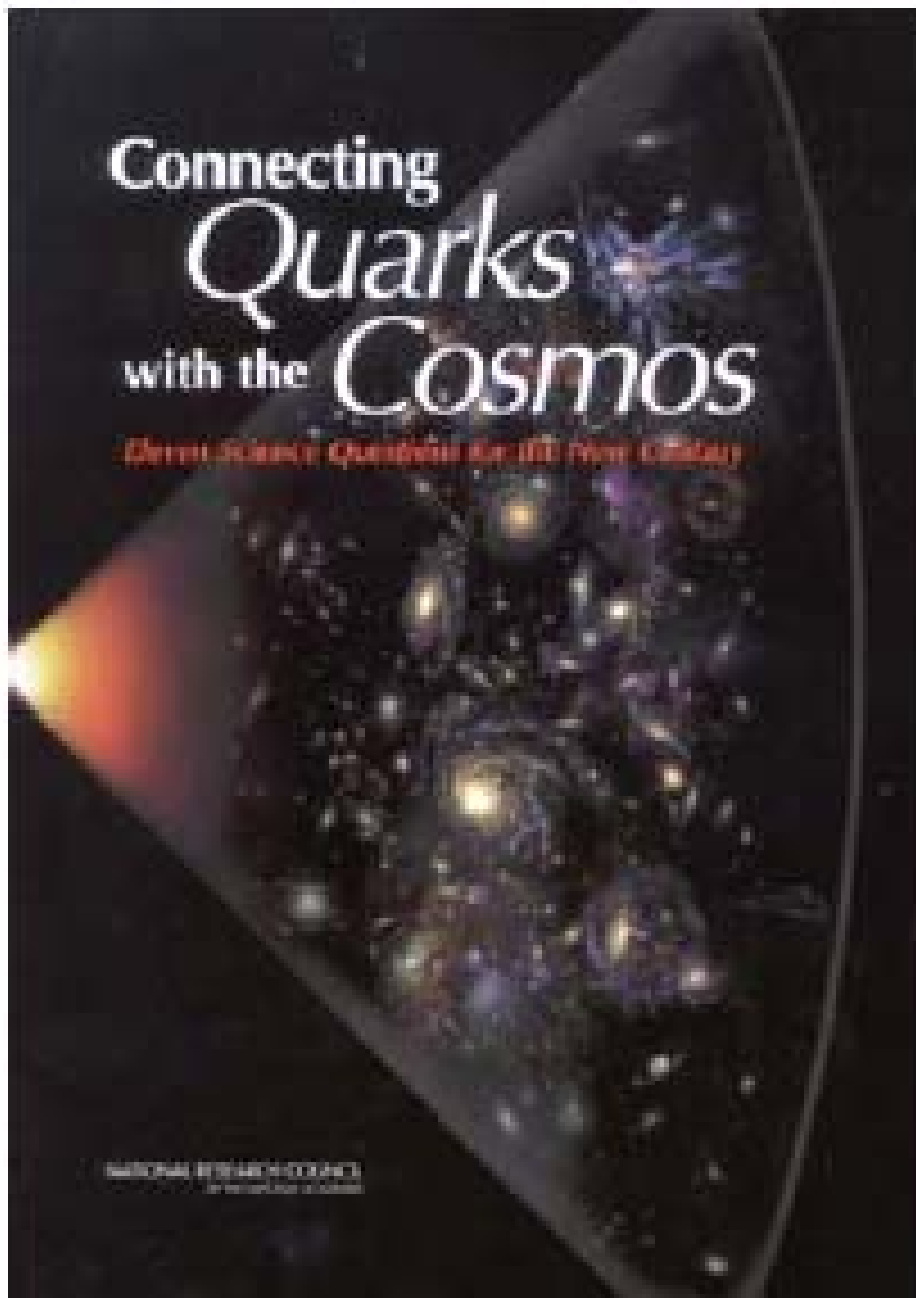
**Gravitational
Physics**

**Education &
Interdisc. Res.**

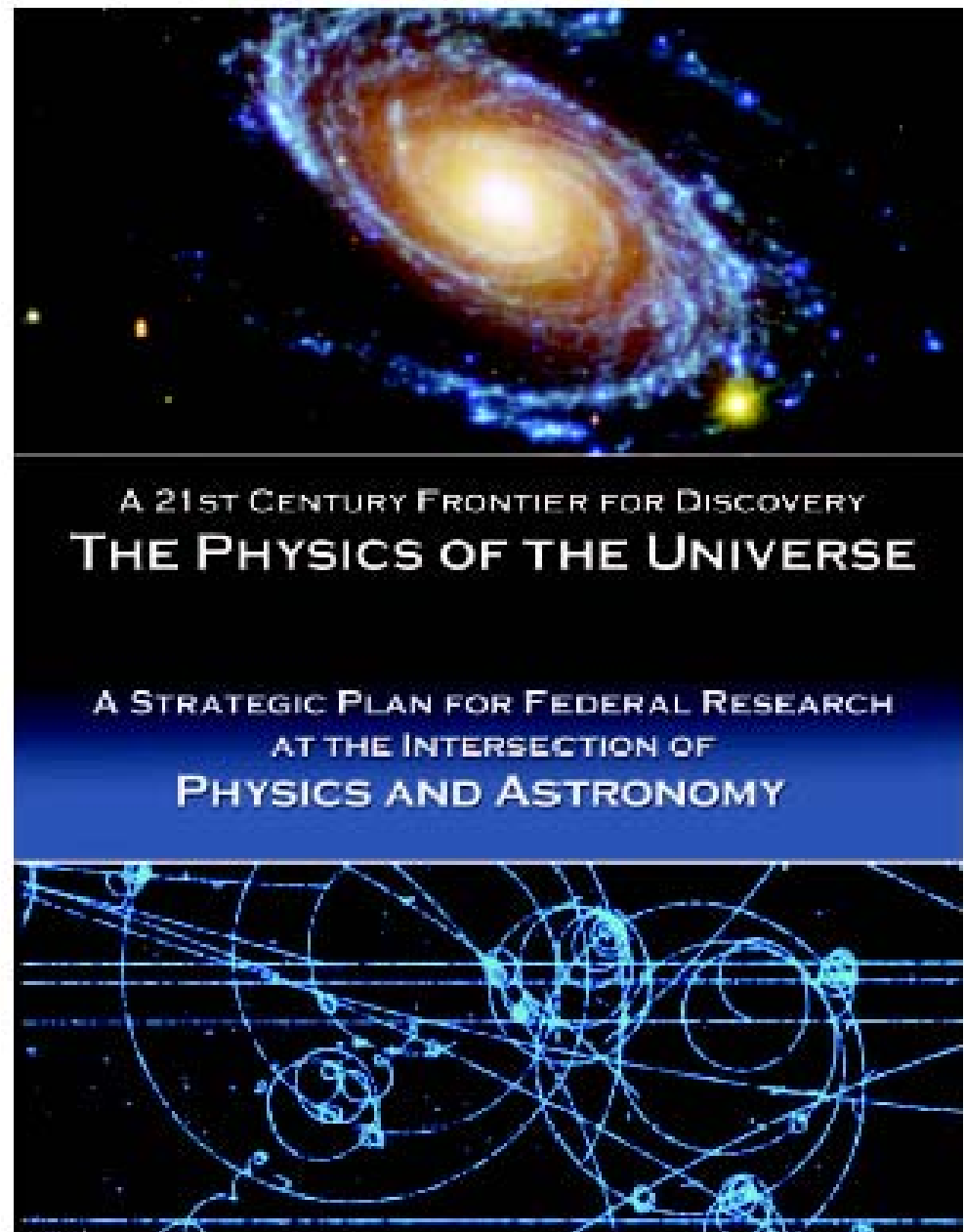
**Accelerator Phy.
& Phy. Instrum.**

PRIORITIES for FY 2006+

- **Strong, flexible core programs (GDM, >50% of PHY budget)**
- **Physics of the Universe (10%/yr)**
- **Increase diversity (10%/yr)**
- **Strengthen theory (5%/yr)**
- **Stewardship of facilities**
- **Cultivate new opportunities, e.g., Biological Physics, Physics at the Information Frontier, DUSEL...**



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http://www.ostp.gov/nstc/html/NSTC_Home.html

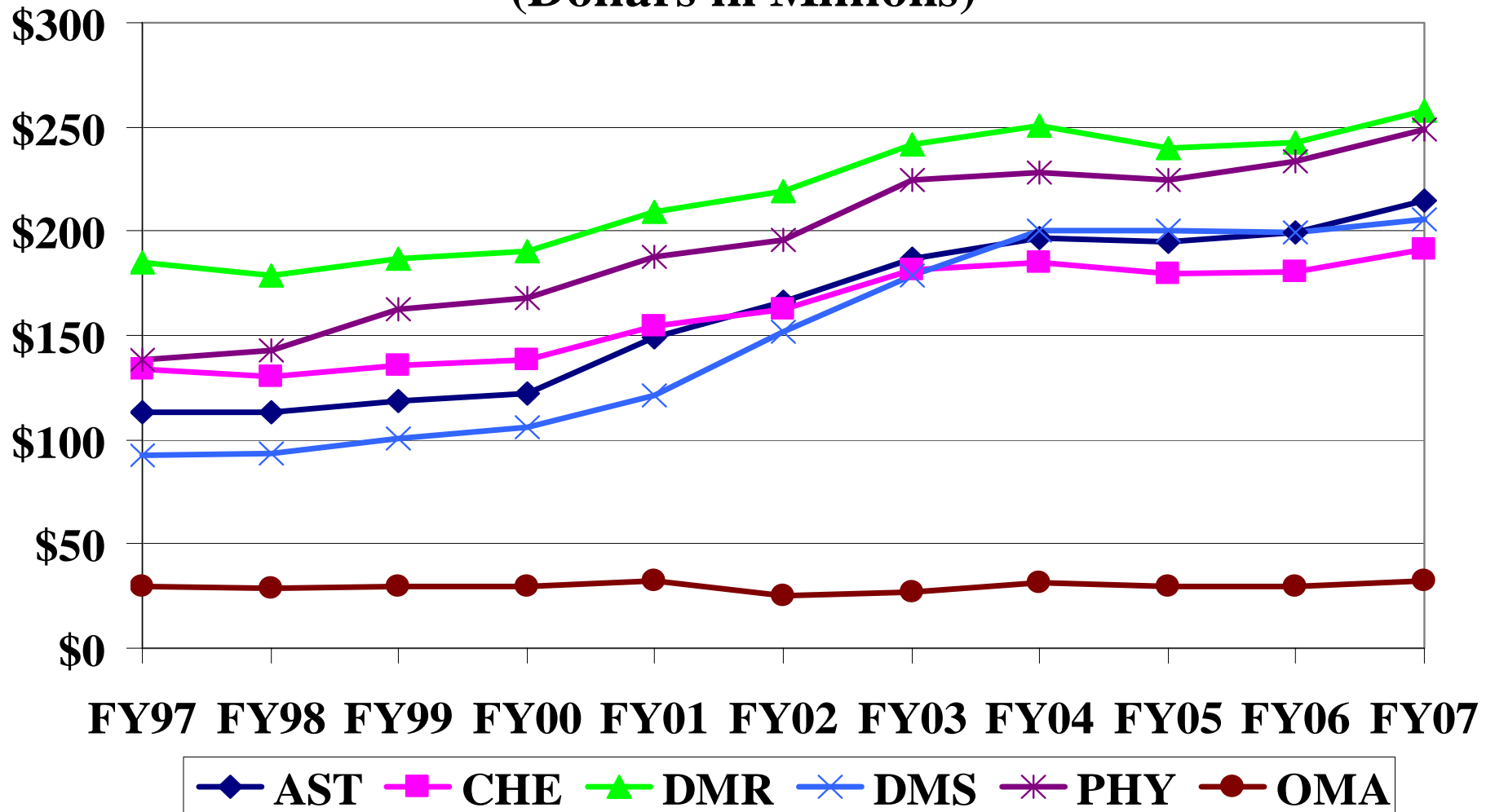
Budget Request for FY 2007

(Dollars in Millions)

	FY 2004 Actuals	FY 2005 Actuals	Change from 04 to 05	FY 2006 Current Plan	Change from 05 to 06	FY 2007 Request	Change from 06 to 07
AST	196.63	195.11	-0.8%	199.65	2.3%	215.11	7.7%
CHE	185.12	179.26	-3.2%	180.78	0.8%	191.10	5.7%
DMR	250.65	240.09	-4.2%	242.91	1.2%	257.45	6.0%
DMS	200.35	200.24	-0.1%	199.30	-0.5%	205.74	3.2%
PHY	227.77	224.86	-1.3%	233.13	3.7%	248.50	6.6%
OMA	31.07	29.80	-4.1%	29.68	-0.4%	32.40	9.2%
Total, MPS	1,091.59	1,069.36	-2.0%	1085.45	1.5%	1150.30	6.0%
R&RA	4293.34	4234.82	-1.4%	4,331.48	2.3%	4,665.95	7.7%
NSF	5652.01	5480.78	-3.0%	5,581.17	1.8%	6,020.21	7.9%

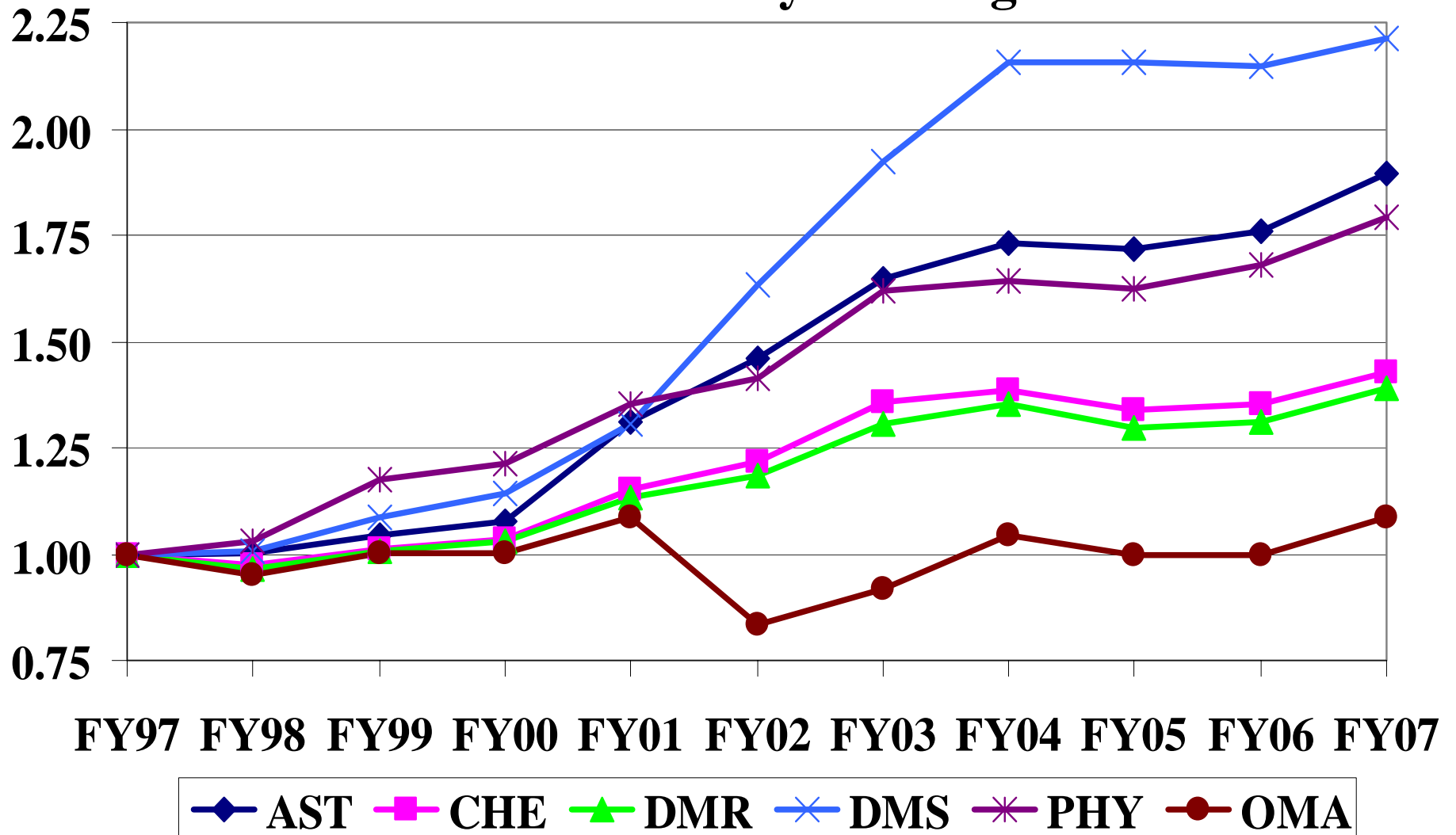
Ten-Year Funding History

**MPS Subactivity Funding
(Dollars in Millions)**

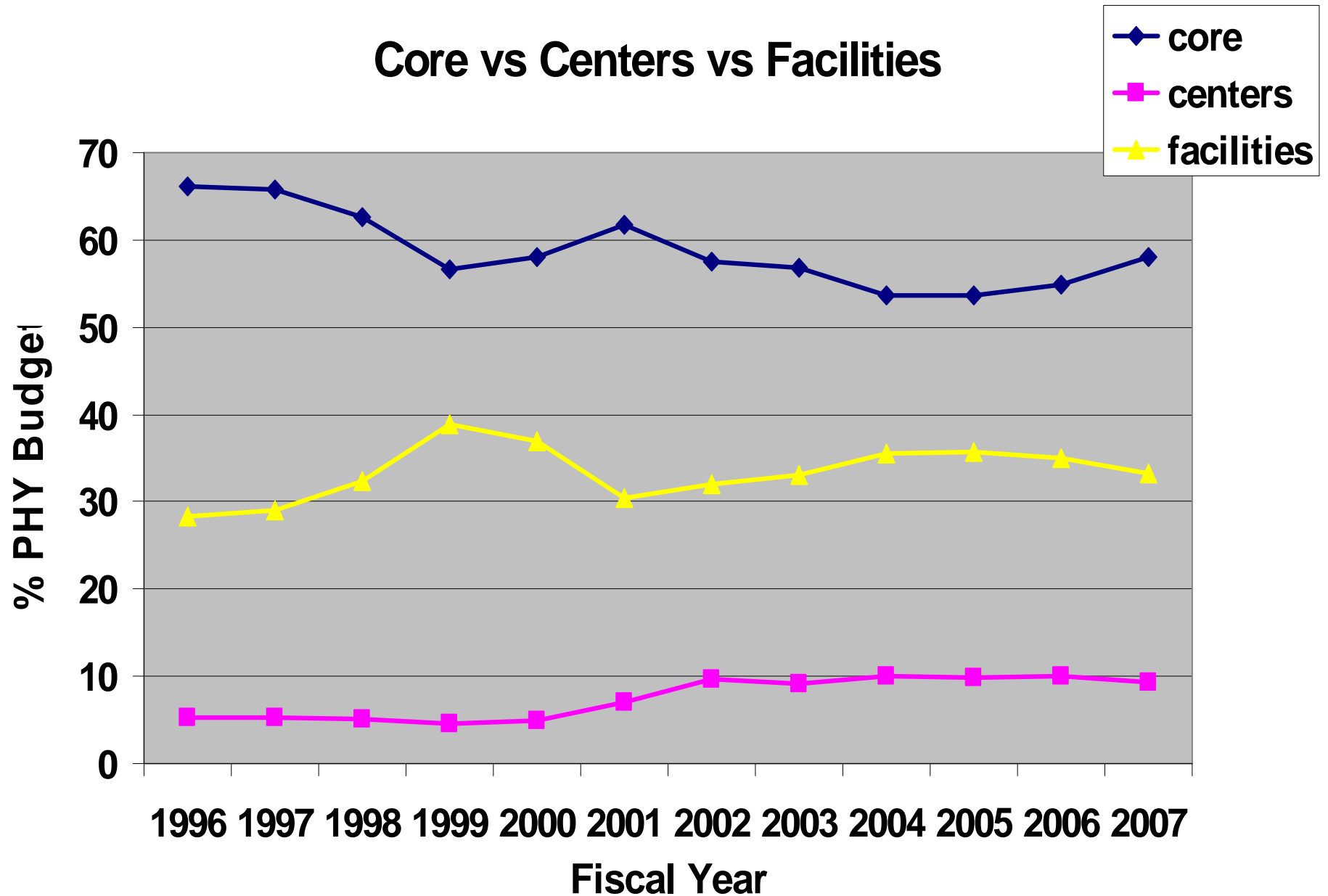


Ten-Year Funding History

MPS Subactivity Funding



Budget sectors over time

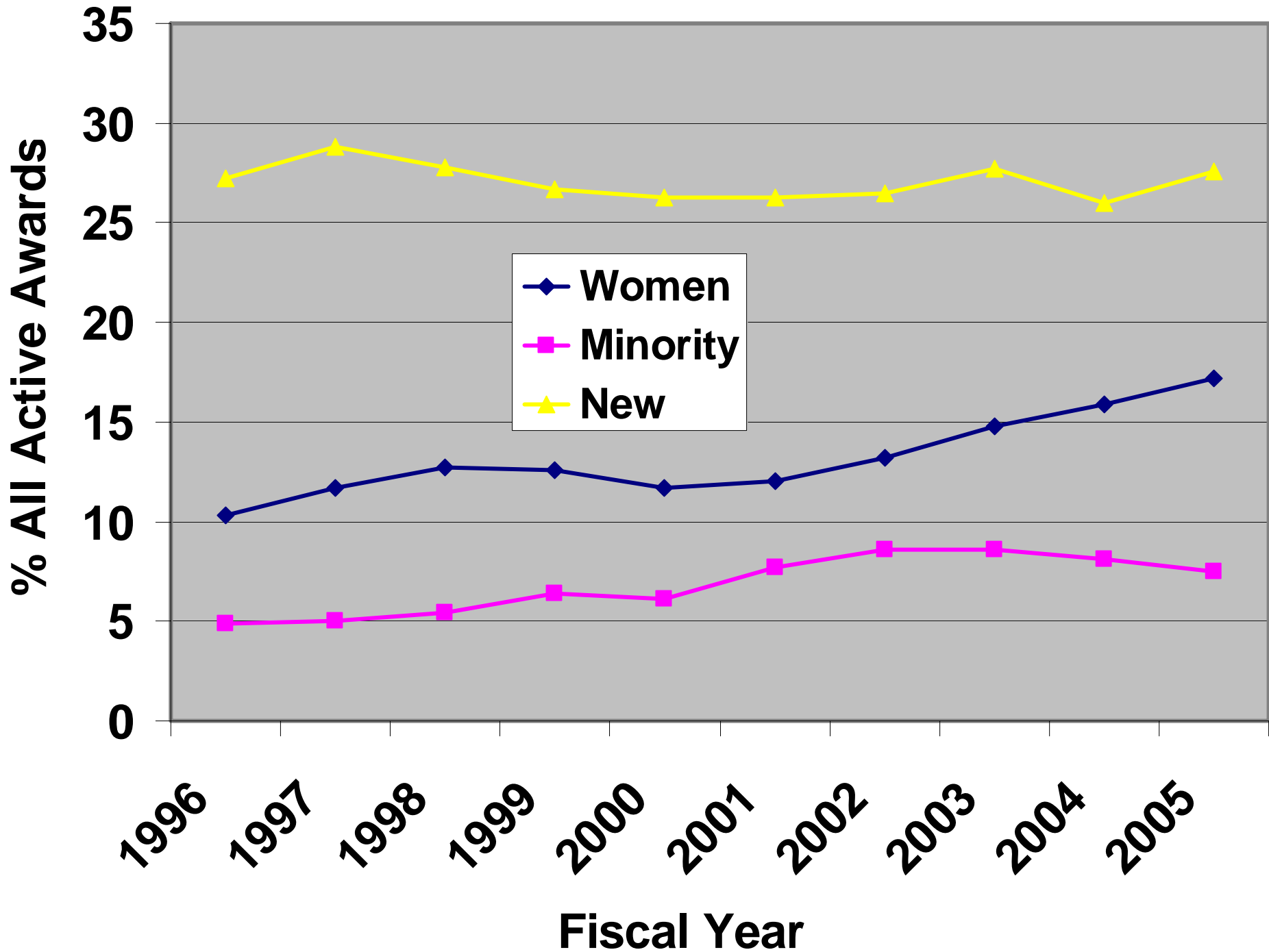


Personnel on Awards (FY 05)

- **Senior Personnel** 969
- **Active awards** 664
- **Postdocs** 536
- **Other Professionals** 370
- **Graduate Students** 997
- **Undergraduate Students** 419*

***Plus about 500 at REU Sites**

% of All Active Awards



DUSEL

- **DUSEL = Deep Underground Science and Engineering Lab**
- **Interdisciplinary Scope: particle physics, nuclear physics, astrophysics, geosciences, engineering, biosciences, industry, defense**
- **Physics would benefit from lowest cosmic ray flux possible anywhere**
- **Proton decay, neutrinoless double beta decay, dark matter detection, long-baseline neutrino experiments, solar and supersovae neutrinos, low-energy nuclear cross sections for nucleosynthesis research, etc.**

Community Planning Activities

Bahcall report (2001): NSF-DOE sponsored ad hoc committee of scientists strongly recommended that Homestake Mine

NSAC Long-Range Plan (2002): Strongly supported development of an underground laboratory to enable some aspects of nuclear research, e.g., double beta decay.

NESS 2002: An NSF sponsored conference on Underground Science showcases the wide variety of science that would be enabled with an underground laboratory.

Connecting Quarks to the Cosmos (2003): Known as Turner Report, NRC panel recommended development of an underground laboratory to enable a number of fundamental science experiments.

HEPAP Long-Range Plan (2003): Supported development of an underground laboratory to enable some aspects of high energy research, e.g., long baseline neutrino detector and proton decay

Neutrinos and Beyond (2003): Known as Barish Report, OSTP charged NRC panel emphasized neutrino physics, much of which requires an underground laboratory; placed in international context.

EarthLab 2003: An NSF sponsored report of the GeoSciences and GeoEngineering opportunities that would be enabled by an underground laboratory.

Physics of the Universe—A Strategic Plan for Federal Research at the Intersection of Physics and Astronomy (NSTC) 2004: Strongly supported development of an underground laboratory for science and engineering

Quantum Universe—The Revolution in 21st Century Particle Physics, 2004: NSF-DOE HEPAP Sub Panel report identifies key science drivers and indicates need for DUSEL to address key questions

A lot more activity in 2005: NuSAG (HEPAP, NSAC, AAAS sub panel), Dark Matter sub panel...

Process, from March 2004

- Prehistory from ~ 1960s (Ray Davis Nobel Prize)
- Town Meeting at NSF, March 2004
- Solicitation (S1) to define site-independent science scope, infrastructure needs, and unify the community
- Solicitation (S2) to develop conceptual designs for specific sites
- Solicitation (S3) to do full technical design
- Could lead to MREFC candidate for FY 09