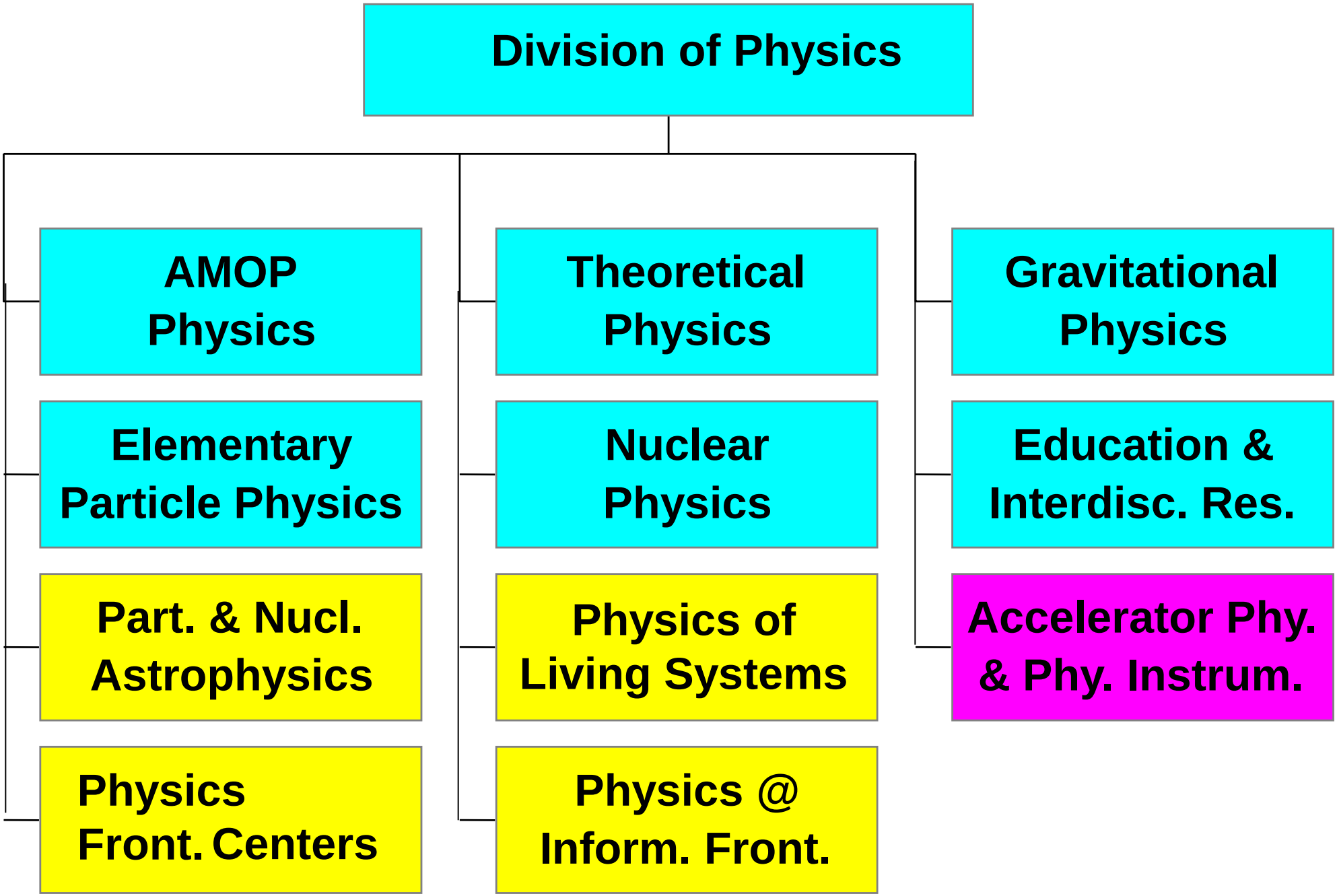
# Report from the NSF Division of Physics

**Joe Dehmer**
**Division of Physics**

**HEPAP**
**March 12, 2012**

# People

- Welcome to the new HEPAP members, with special welcome to Andy Lankford
- Thanks to Moishe Pripstein and Jim Reidy for their distinguished service
- Welcome to new members of PHY:
  - Randy Ruchti, Program Director, EPP
  - Jean Cottam Allen, Program Director, PA
  - Saul Gonzalez, Program Director, LHC and EPP


Division of Physics
AMOP Physics
Theoretical Physics
Gravitational Physics
Elementary Particle Physics
Nuclear Physics
Education & Interdisc. Res.
Part. & Nucl. Astrophysics
Physics of Living Systems
Accelerator Phy. & Phy. Instrum.
Physics Front. Centers
Physics @ Inform. Front.

# PHYSICS* FRONTIERS, *circa* 2012

- Cold Atoms, Bose-Einstein Condensates
- Dark Matter, Dark Energy, Cosmology
- Gravitational Waves (GW), GW Astronomy
- New Fundamental Particles and Laws > TeV
- $\nu$ physics and astrophysics
- String Theory, Branes, Duality, Quantum Gravity
- Quark-Gluon Plasma, Supernova Dynamics
- Ultra-Fast, Ultra-Intense Laser Fields
- Cyberscience, Quantum Information Science
- Biophysics of Single Molecules, Cells, Networks
- Complexity, Emergent Behavior

* CMP in Division of Materials Research

# INVESTMENT GOALS

- Major scientific advances that alter the course of physics and other fields
- Seeds of advances in nation's health (Varmus), wealth (Solow), and defense (Hart-Rudman), also Gathering Storm, ACI, ACA…
- International leadership/cooperation across the intellectual frontiers of science
- Recruitment of exceptional talent into science (education, outreach, and early inspiration)
- Significantly increase diversity in science
- Production of highly trained professionals for the nation's workforce

# Innovation: PHY Role

- Innovation involves the answers to two questions: "What is possible," and "What is needed."
- A non-linear process, involving advancing the intellectual frontiers, making connections between what is possible and what is needed, and inventing a new deployable capability.
- Best viewed as an innovation "ecosystem," with multiple keystone species, e.g., universities, industry, government, scientists, concepts, techniques.
- PHY role (strategy) has three components:
  - Advance intellectual frontiers – expanding boundaries of "what is possible"
  - Develop the intellectual capital to activate the ecosystem
  - Seize opportunities to apply new knowledge to practical needs
- This ecosystem perspective matters because planning horizons shorten when funding is short, and this tends to emphasize incremental steps, not disruptively transformational events, which are usually not at all related to perceived needs, e.g., GPS system, which depends on fundamental developments made decades apart over a century for other reasons.

# Facilities

- **LIGO/AdvLIGO (construction to end in FY2015)**
- **LHC (began operating at 7 Tev in FY 2010)**
- **IceCube (began operating in FY2011)**
- **NSCL (to be succeeded by FRIB)**
- ~~**DUSEL**~~ **(MREFC project cancelled in FY2011)**
- ~~**CESR/CLEO**~~ **(Phased out in FY2009)**
- **Midscale: ACT, SPT, Auger, CDMS, XENON, LUX, WARP, ZEPLIN, CoGeNT, COUPP, DArkside, DRIFT, MiniLens, Borexino, Double Chooz, Daya Bay, CUORE, Majorana, QUIET, ~~HiRES~~, TA, ~~Milagro~~, HAWC, ~~Stacey~~, Veritas, MiniBoone, MicroBoone, Numi/MINOS, RHIC end-cap calorimeter, university based NP accelerators, several MRI projects, etc.**

## Summary Table

## FY 2013 Request to Congress

## (Dollars in Millions)

| NSF by Account | FY 2011 Actual | FY 2012 Estimate | FY 2013 Request | FY 2013 Request over: FY 2011 Actual Amount | FY 2011 Actual Percent | FY 2012 Estimate Amount | FY 2012 Estimate Percent |
|---|---|---|---|---|---|---|---|
| BIO | $712.27 | $712.38 | $733.86 | $21.59 | 3.0% | $21.48 | 3.0% |
| CISE | 636.06 | 653.59 | 709.72 | 73.66 | 11.6% | 56.13 | 8.6% |
| ENG | 763.33 | 826.17 | 876.33 | 113.00 | 14.8% | 50.16 | 6.1% |
| *ENG Programs* | *636.86* | *673.41* | *711.13* | *74.27* | *11.7%* | *37.72* | *5.6%* |
| *SBIR/STTR* | *126.47* | *152.76* | *165.20* | *38.73* | *30.6%* | *12.44* | *8.1%* |
| GEO | 885.32 | 885.27 | 906.44 | 21.12 | 2.4% | 21.17 | 2.4% |
| MPS | 1,312.42 | 1,308.94 | 1,345.18 | 32.76 | 2.5% | 36.24 | 2.8% |
| SBE | 247.33 | 254.25 | 259.55 | 12.22 | 4.9% | 5.30 | 2.1% |
| OCI[1] | 300.75 | 211.64 | 218.27 | -82.48 | -27.4% | 6.63 | 3.1% |
| OISE | 49.03 | 49.85 | 51.28 | 2.25 | 4.6% | 1.43 | 2.9% |
| OPP[2] | 440.70 | 435.87 | 449.74 | 9.04 | 2.1% | 13.87 | 3.2% |
| IA | 259.60 | 349.59 | 431.52 | 171.92 | 66.2% | 81.93 | 23.4% |
| U.S. Arctic Research Commission | 1.58 | 1.45 | 1.39 | -0.19 | -11.8% | -0.06 | -4.1% |
| Research & Related Activities | $5,608.38 | $5,689.00 | $5,983.28 | $374.90 | 6.7% | $294.28 | 5.2% |
| Education & Human Resources | $861.04 | $829.00 | $875.61 | $14.57 | 1.7% | $46.61 | 5.6% |
| Major Research Equipment & Facilities Construction | $125.37 | $197.06 | $196.17 | $70.80 | 56.5% | -$0.89 | -0.4% |
| Agency Operations & Award Management | $299.29 | $299.40 | $299.40 | $0.11 | 0.0% | - | - |
| National Science Board | $4.47 | $4.44 | $4.44 | -$0.03 | -0.7% | - | - |
| Office of Inspector General | $13.92 | $14.20 | $14.20 | $0.28 | 2.0% | - | - |
| OIG FY 2011 ARRA Obligations | $0.08 | - | - | - | - | - | - |
| Total, NSF | $6,912.55 | $7,033.10 | $7,373.10 | $460.55 | 6.7% | $340.00 | 4.8% |

Totals may not add due to rounding.

[1] FY 2011 Actual for OCI includes $90.50 million in funds that were obligated in FY 2010, deobligated in FY 2011, and then obligated in FY 2011 to other projects in the OCI portfolio.

## R&RA Funding

## (Dollars in Millions)

| | FY 2011 Actual | FY 2012 Estimate | FY 2013 Request | Change over FY 2012 Estimate Amount | Change over FY 2012 Estimate Percent |
|---|---|---|---|---|---|
| Biological Sciences | $712.27 | $712.38 | $733.86 | $21.48 | 3.0% |
| Computer & Information Science & Engineering | 636.06 | 653.59 | 709.72 | 56.13 | 8.6% |
| Engineering | 763.33 | 826.17 | 876.33 | 50.16 | 6.1% |
| Geosciences | 885.32 | 885.27 | 906.44 | 21.17 | 2.4% |
| Mathematical & Physical Sciences | 1,312.42 | 1,308.94 | 1,345.18 | 36.24 | 2.8% |
| Social, Behavioral & Economic Sciences | 247.33 | 254.25 | 259.55 | 5.30 | 2.1% |
| Office of Cyberinfrastructure | 300.75 | 211.64 | 218.27 | 6.63 | 3.1% |
| Office of International Science & Engineering | 49.03 | 49.85 | 51.28 | 1.43 | 2.9% |
| Office of Polar Programs[1] | 440.70 | 435.87 | 449.74 | 13.87 | 3.2% |
| Integrative Activities | 259.60 | 349.59 | 431.52 | 81.93 | 23.4% |
| U.S. Arctic Research Commission | 1.58 | 1.45 | 1.39 | -0.06 | -4.1% |
| Total, R&RA | $5,608.38 | $5,689.00 | $5,983.28 | $294.28 | 5.2% |

Totals may not add due to rounding.

[1] Funding for FY 2011 Actual excludes a one-time appropriation transfer of $54.0 million, less the 0.2% rescission, to the U.S. Coast Guard per P.L. 112-110.

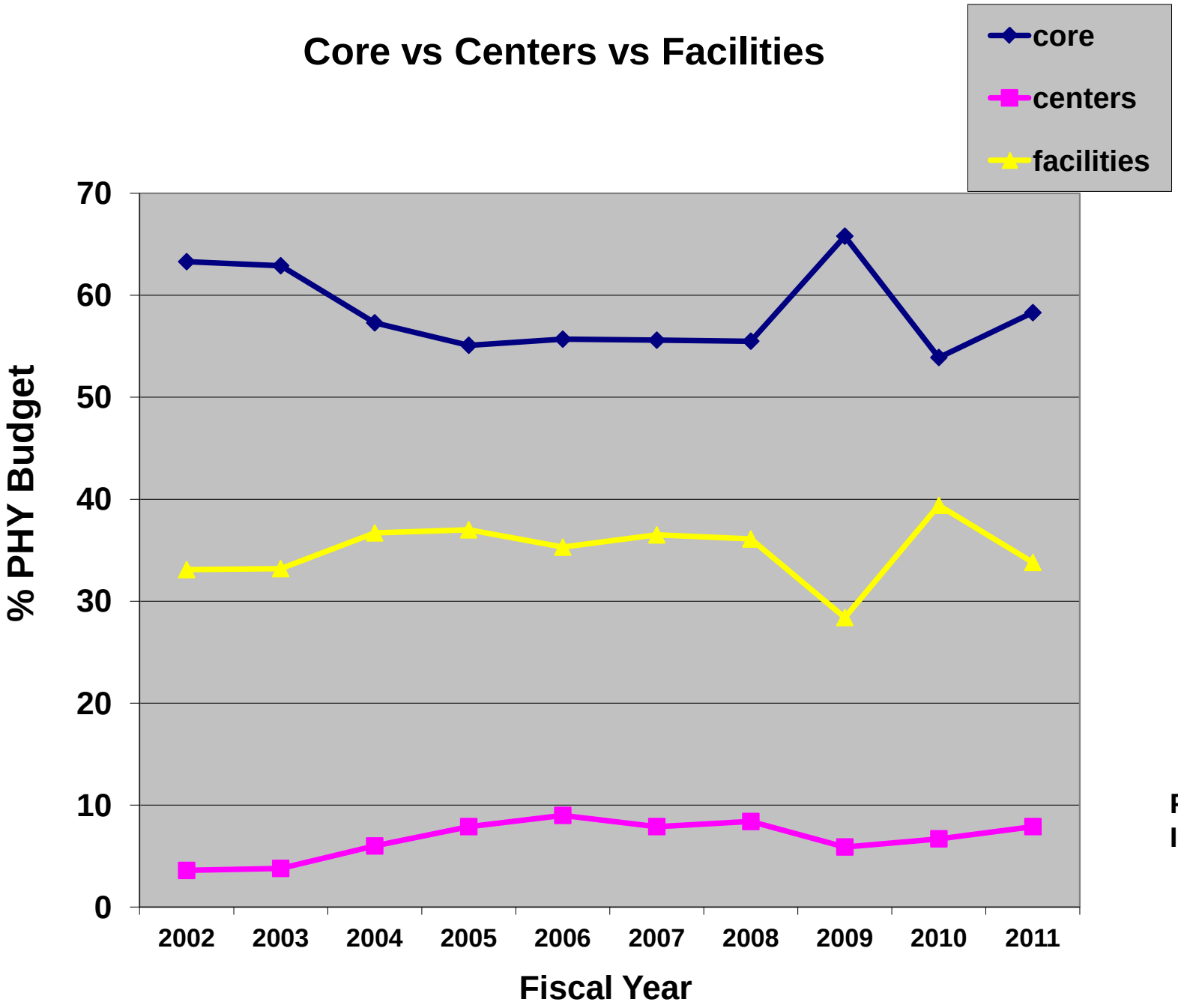
## MPS Funding

## (Dollars in Millions)

| | FY 2011 Actual | FY 2012 Estimate | FY 2013 Request | Change Over FY 2012 Estimate Amount | Change Over FY 2012 Estimate Percent |
|---|---|---|---|---|---|
| Division of Astronomical Sciences (AST) | $236.78 | $234.55 | $244.55 | $10.00 | 4.3% |
| Division of Chemistry (CHE) | 233.55 | 234.06 | 243.85 | 9.79 | 4.2% |
| Division of Materials Research (DMR) | 294.91 | 294.55 | 302.63 | 8.08 | 2.7% |
| Division of Mathematical Sciences (DMS) | 239.79 | 237.77 | 245.00 | 7.23 | 3.0% |
| Division of Physics (PHY) | 280.34 | 277.37 | 280.08 | 2.71 | 1.0% |
| Office of Multidisciplinary Activities (OMA) | 27.06 | 30.64 | 29.07 | -1.57 | -5.1% |
| Total, MPS | $1,312.42 | $1,308.94 | $1,345.18 | $36.24 | 2.8% |

Totals may not add due to rounding.

# Budget sectors over time

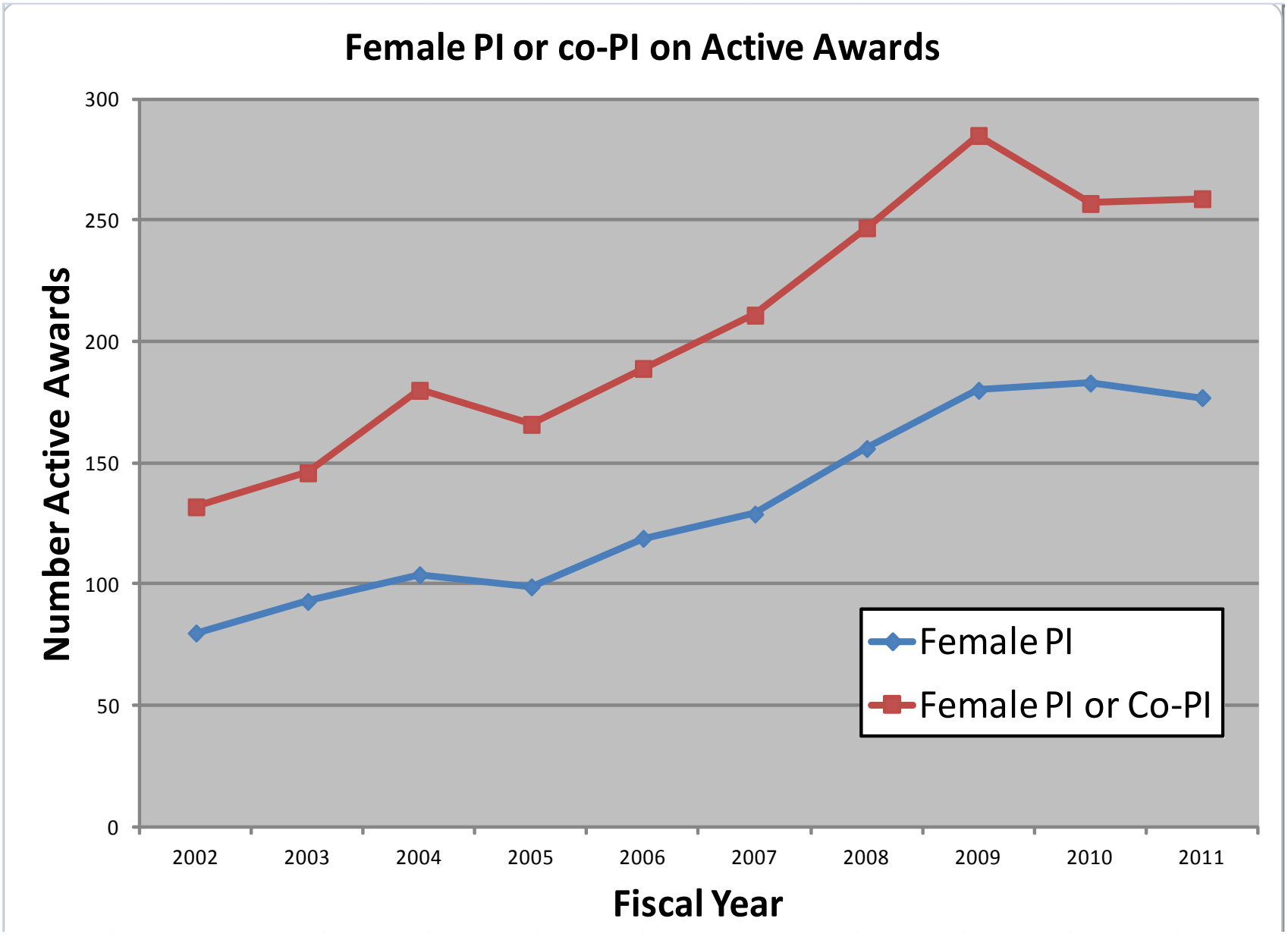


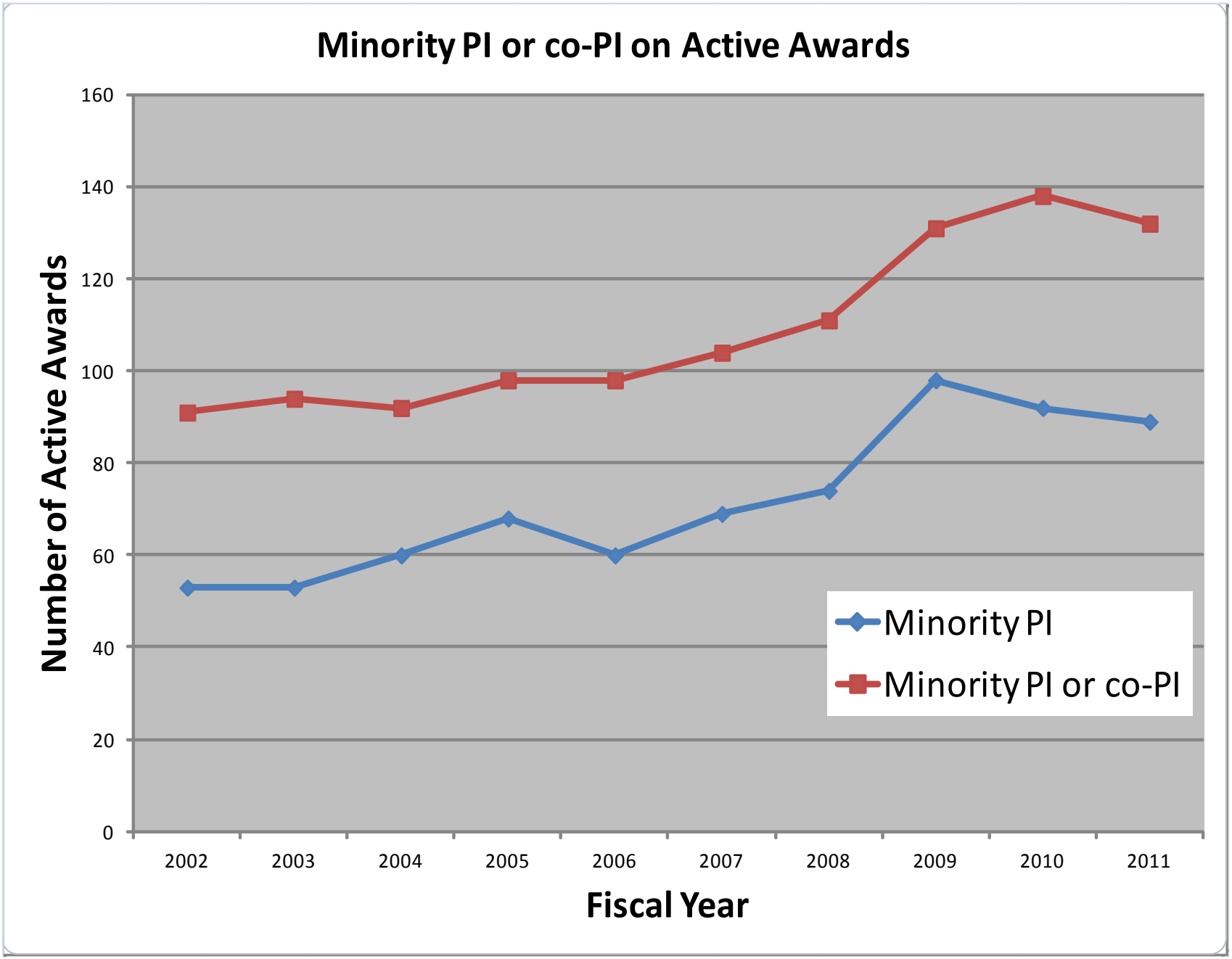

FY 2009
Includes
ARRA

# Personnel on Awards (FY 11)

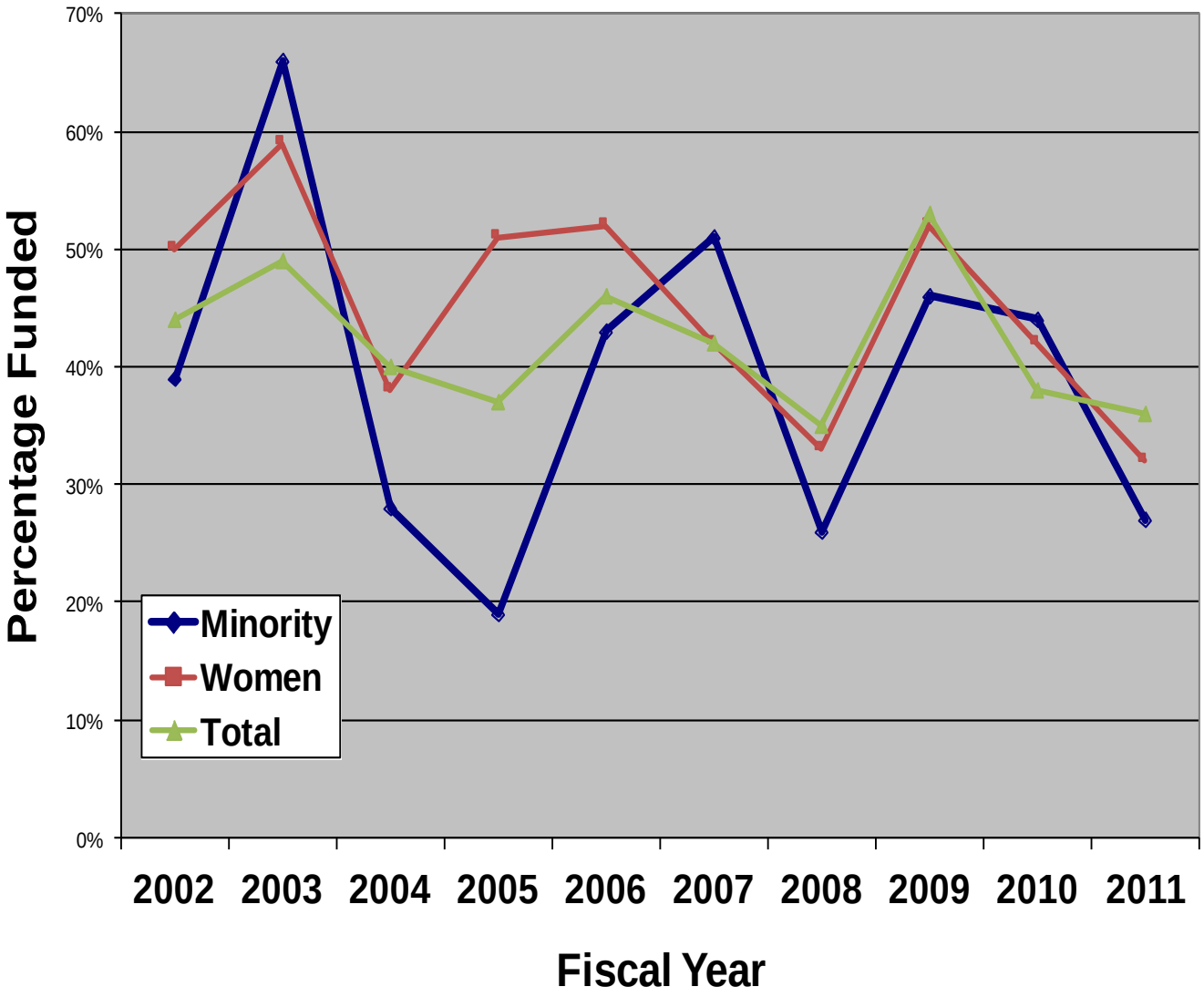
- **Senior Personnel** **1,422**
- **Active awards** **1,302**
- **Postdocs** **534**
- **Other Professionals** **1,198**
- **Graduate Students** **1,208**
- **Undergraduate Students** **672***

***Plus about 444 at REU Sites**


Female PI or co-PI on Active Awards
Number Active Awards
300
250
200
150
100
50
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Fiscal Year
Female PI
Female PI or Co-PI


Minority PI or co-PI on Active Awards
Number of Active Awards
160
140
120
100
80
60
40
20
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Fiscal Year
Minority PI
Minority PI or co-PI

# Women and Minority Funding Rates



# PHY Budget Actions/Plans

- LHC, IceCube, NSCL flat, LIGO up $100K
- All programs cut 5% initially, with 2% restored when budget finalized
- Investments in BioMaPS, CIF21, SAVI
- Redirect S4 funding to underground science (Jon Kotcher will address later today)
- Midscale physics instrumentation is a priority for future budget cycles, and some funds are being applied to seed the activity
- Also discussing accelerator physics research at universities for possible investment
- The last two bullets express the APPI concept, and the last three bullets should benefit work at the three frontiers of particle physics

# Comments

- Three frontiers concept was a breakthrough by P5
- Better, more robust and interesting  picture of field
- Recent results and opportunities in each
- Accept budget reality for next few years, at least
- Important planning effort by DPF and others, leading to Snowmass 2013 – give this priority
- Think on two levels:  what's doable this decade, and the grander vision
- Make a plan/vision for the next decade that "makes sense" to those outside the field in that it's executable, delivers significant results at a regular pace, maintains vigorous US community, meshes with the global picture, and flows into the future in a plausible way