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# Report from NSF Particle Physics

47<sup>th</sup> Annual Fermilab Users Meeting  
June 11, 2014

**Saul Gonzalez, Randy Ruchti, Jim Shank**

Elementary Particle Physics

**Jean Cottam, Jim Whitmore**

Particle Astrophysics

**Marc Sher**

Particle Theory, Astrophysics/Cosmology Theory

Program Directors, Physics Division, NSF



## Program Activities: FY14-FY15

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- PHY Organizational Overview
- Base Programs – EPP, PA, THY, AS
  - Review of Budgetary History FY08-FY13 and estimates for FY14
  - New in FY14 – Accelerator Science
  - Direct Detection of Dark Matter (DDDM)
  - Calendar ahead for FY15
- NSF and the P5 Report
- NSF Funding Opportunities
  - Major Research Instrumentation (MRI) Program
  - Mid-Scale Research
  - Major Research Equipment and Facilities Construction (MREFC)
  - Physics Frontier Centers (PFC)
- Broader Impacts
- Particle Physics Program Staffing
- Closing Comment



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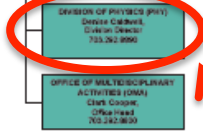
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 4201 Wilson Boulevard  
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Jean Cottam-Allen, Jim Whitmore

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Cross-cutting

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Jean Cottam-Allen

Education and Interdisciplinary Research  
Kathy McCloud

Physics at the Information Frontier  
Bogdan Mihalia, Ann Orel, Jim Shank

Physics Instrumentation

Core Particle Physics

Particle Physics Related

# Particle Physics – Recent Budgetary History



	FY 2008	FY 2009	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
(in M\$)	Actuals	Actuals	ARRA	Actuals	Actuals	Actuals	Actuals	Estimate
EPP Research	20.5	18.8	14	25.8	25	24.7	21.8	18.6
LHC Ops	18	18		18	18	18	18	17.4
LHC Upgrades (Midscale)								5.9
CESR	13.7	8.5	1.3					
APPI	4	2.2		3	4.1	11.9	4.5	
Accel Research								In Prog
PA Research	15.8	15.9	15.3	17.9	9.7	11.5	12	11.9
IceCube Ops	1.5	2.2		2.2	3.5	3.5	3.5	3.5
DUSEL Planning	2	22		28.9	10.2			
Underground R&D	5	4	5.6	4.6	6	11	3.9	0.4
Underground Physics					8.4	6.3	6.8	6.8
THY (EPP/Astro/Cosmo)	11.7	12	6.8	13.2	14.1	13.6	12.1	12.1
Physics Frontier Centers	6.3	5.9		5.9	6	6	6	6
<b>Total Particle Physics</b>	<b>98.5</b>	<b>109.5</b>	<b>43</b>	<b>119.5</b>	<b>105</b>	<b>106.5</b>	<b>88.5</b>	<b>82.6</b>
<b>Total Physics Division</b>	<b>285</b>	<b>275.5</b>	<b>102.1</b>	<b>307.8</b>	<b>280.3</b>	<b>277.4</b>	<b>247.4</b>	<b>260</b>
<b>% of Physics Division</b>	<b>34.6%</b>	<b>39.7%</b>	<b>42.1%</b>	<b>38.8%</b>	<b>37.5%</b>	<b>38.4%</b>	<b>35.8%</b>	<b>31.8%</b>
Allied Funding	7.2	4.9	0.5	12.7	12.3	24.7	20.8	In Prog
<b>Effective Total</b>	<b>105.7</b>	<b>114.4</b>	<b>43.5</b>	<b>132.2</b>	<b>117.3</b>	<b>131.2</b>	<b>109.3</b>	<b>In Prog</b>



## New in FY 2014: Accelerator Science

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The acceleration and control of charged particle beams are essential tools for discovery science within the Physics Division: from high to low energy beams, high intensity sources for secondary or tertiary beams (e.g., neutrinos), nuclear physics, nuclear astrophysics.

- We are starting an accelerator science program with the goal of enabling fundamental discoveries and train students and postdocs across disciplinary boundaries
  - Program Description *PD 13-7243: “Accelerator Science”*
  - [http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=504937](http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504937)
  - Program Contact: Saul Gonzalez
- Broader impacts are significant: industrial applications, medical applications, homeland security, light sources
- Program will focus on transformational developments that are likely to come from curiosity-driven research with strong interdisciplinary link.
- Program will evolve with the community as new challenges are identified

Merit review process currently underway. A total of 60 proposals have been received requesting ~ \$70M in funding.

# Direct Detection of Dark Matter Solicitation

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The current generation of direct dark matter experiments should all achieve their projected sensitivities and complete operations within the next few years. The more sensitive, "second generation" direct detection experiments, will then be required to either search with increased sensitivity or to measure in detail the detected dark matter.

- These next generation experiments will be selected through a solicitation with funding beginning in FY 2014.
  - *Solicitation NSF 13-597: “Support for Construction of Direct Detection Dark Matter Experiments in Particle Astrophysics”*
  - *Program Contacts: Jean Cottam and Jim Whitmore*
- NSF and DOE are closely coordinating the review, selection and funding of the awards and subsequent support for the experiments. The resulting program will be a joint NSF/DOE portfolio of investments in the next generation of Dark Matter experiments.
- We expect to announce selections shortly.

# Particle Physics & Related Programs – FY15

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- Dates (deadlines) for proposal submissions:
  - CAREER – July 23, 2014
  - EPP and PA – October 29, 2014
  - Accelerator Science (AS) – November 28, 2014
  - THY – December 4, 2014
  - MRI – January 22, 2015
- Merit Review process:
  - Ad hoc/email reviews
  - Panel reviews
  - May include site reviews or reverse site reviews
- Decision process on funding actions:
  - For CAREER, typically by December.
  - For Base Programs, once merit review processes are completed and when budgets are known, typically April-May.
  - MRI decisions typically in June.





## NSF and the P5 Report

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- NSF sincerely appreciates the work of P5 and the Particle Physics Community over the last two years.
- The P5 Process and Report are very important to the NSF, especially for articulating clear Science Drivers and for identifying the experimental and theoretical opportunities.
- The P5 Report recommendations represent critical input to ongoing strategy for NSF investments, aligned with the agency's mission, both for the short and longer term.



## Potential sources of funding...

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- MRI – Major Research Instrumentation
  - Physics Division Competition – up to \$1M
  - MPS Directorate Competition – up to \$4M
  - Requires 30% match from participating institutions
- Midscale Funding
  - Funding level variable
  - Resources from Division(s) and Directorate(s)
- MREFC – Major Research Equipment and Facilities Construction
  - Funding request exceeds 10% of Directorate Budget
  - Competition is NSF-wide



## Major Research Instrumentation (MRI)

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- The Major Research Instrumentation Program (MRI) serves to increase access to shared scientific and engineering instruments for research and research training in our Nation's institutions of higher education, and not-for-profit museums, science centers and scientific/engineering research organizations.
- This program especially seeks to improve the quality and expand the scope of research and research training in science and engineering, by supporting proposals for shared instrumentation that fosters the integration of research and education in research-intensive learning environments. Two types.
  - Track (1) acquisition of a research instrument.
  - Track (2) development of a research instrument.
- Solicitation 13-517
- Program Contact: Kathleen McCloud or EPP/PA program directors



## MRI Program – Impact in Particle Physics

- MRI Support has been significant to the various programs from FY08 – FY13, totaling \$26.3M
  - EPP related: \$14.5M
  - PA related: \$9.4M
  - Accelerator Science: \$2.4M
- MRI funding decision process for FY14 is still underway



## Mid-Scale Instrumentation

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One of the most critical needs of research projects funded through the Physics Division is that of having cutting-edge instrumentation that enables investigators to remain competitive in a rapidly-changing scientific environment.

- The Physics Division has established a Mid-Scale Instrumentation Fund.
  - Dear Colleague Letter *NSF 13-118*: “Announcement of Instrumentation Fund to Provide Mid-Scale Instrumentation for FY2014 Awards in Physics Division”
  - [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf13118](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf13118)
- This is not a separate program to which investigators can apply directly. PI’s should request funding for specialized equipment as part of a regular proposal to a disciplinary program in the Division. The Program Officer can then request funds be provided through the Mid-Scale Instrumentation Fund.
- Prior year examples: formerly called the APPI Program
  - Has provided significant instrumentation and development for PA experiments. Examples HAWC, XENON1T, SCDMS...
  - \$25.9M over the period FY08 - FY13.

# MREFC: Major Research Equipment and Facilities Construction

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To be eligible for consideration for MREFC funding, each candidate project should represent an outstanding opportunity to enable research and innovation, as well as education and broader societal impacts.

Each project should offer the possibility of transformative knowledge and the potential to shift existing paradigms in scientific understanding, engineering processes and/or infrastructure technology.

Moreover, each should serve an urgent contemporary research and education need that will persist for years beyond the often lengthy process of planning and development.

## Current MREFC Projects:

- Advanced LIGO, AdvLIGO (MPS)
- Daniel K Inouye Solar Telescope, ATST (MPS)
- Large Synoptic Survey Telescope, LSST (MPS)
- National Ecological Observatory Network, NEON (BIO)
- Ocean Observatories Initiative, OOI (GEO)

# Physics Frontier Centers (PFC) Competition on a 3-year cycle

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The PFC program supports university-based centers and institutes where the collective efforts of a larger group of individuals can enable transformational advances in the most promising research areas.

- The program is designed to foster major breakthroughs at the intellectual frontiers of physics by providing needed resources such as combinations of talents, skills, disciplines, and/or specialized infrastructure, not usually available to individual investigators or small groups, in an environment in which the collective efforts of the large group can be shown to be seminal to promoting significant progress in the science and the education of students.
- PFCs can be in any subfield of physics within the purview of the Division of Physics, including elementary particle physics, particle astrophysics, theory and accelerator science.
- The Physics Division issues a new solicitation every three years. Next in FY17.
- **Solicitation NSF 13-559: “Physics Frontier Centers (PFC)”**
  - [http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=5305&org=PHY&from=home](http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5305&org=PHY&from=home)
  - Program Contact: Jean Cottam
  - Current FY14 Merit Review is complete and funding actions are being taken.



## Broader Impacts...

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- NSF Merit Criterion #2 is important.
- Now in theaters...
  - Documentary on the quest for the Higgs Boson entitled “Particle Fever” by David Kaplan and Mark Levinson, shown in Washington DC on March 12. Reviewed in the New York Times, March 4, 2014.
- Coming soon... and in preparation for planetarium presentation...
  - Show on Dark Matter entitled “Dark Secrets of the Big Bang” lead by Reinhard Schwienhorst, Kaushik De and Michael Barnett.
- QuarkNet... Now in its 16<sup>th</sup> year and still going strong...
  - Strong support from Fermilab (Marge Bardeen, Liz Quigg and colleagues) and the university-wide particle physics community (Mitch Wayne, Dan Karmgard, Anna Goussiou and colleagues).
- And much more...
  - [usparticlephysics.org](http://usparticlephysics.org)



# Particle Physics Program Staffing

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- Incoming: New Program Director in EPP – Jim Shank from Boston University has joined NSF as an IPA effective January 2014.
- Outgoing: Current Program Directors: M. Sher (THY) and R. Ruchti (EPP) tours of duty end at the end of FY14.
- Position Openings:
  - In THY – Particle & Astrophysics/Cosmology Theory
    - <http://go.usa.gov/KBPT>
    - Job Announcement Number: PHY-2014-0006
    - Application deadline is now passed and we are interviewing candidates
  - In EPP – Elementary Particle Physics (Experiment)
    - Position is available (IPA)
    - <http://www.nsf.gov/pubs/2013/phy13002/phy13002.jsp?org=PHY>
    - DCL PHY 13-002



## Closing Comments

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- NSF is very appreciative of the Particle Physics Community's considerable efforts in the Snowmass 2013 Process which have led to important reports on the scientific opportunities in the field.
- NSF, with our DOE colleagues, has sincerely appreciated the work P5 and its report and recommendations. We are now actively evaluating the NSF options.
- While the funding climate is challenging, NSF is committed to advancing Particle Physics research across its many intellectual frontiers, with emphasis on university-based research efforts.