Particle Astrophysics at the National Science Foundation

Community Summer Study 2013
August 1, 2013

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(Based on Saul Gonzalez's talk on Monday)

What do the Particle Astrophysics programs cover?

- **Particle Astrophysics spans the fields of high-energy astrophysics, cosmology and elementary particle physics. The studies we fund include:**
  - **the search for dark matter particles,**
  - **the search for understanding dark energy, and cosmology;**
  - **the study of the messengers comprising the High Energy Universe;**
  - **the studies of neutrinos and their elusive properties;**
  - **Theory covers all of the above.**

NSF Particle Astrophysics Program

PHY funds projects in both the Cosmic Frontier and the Intensity Frontier fields

Cosmic Frontier:
Dark Matter, Dark Energy, Cosmology, High Energy Particles (CR, γ-rays, ν, Grav. Waves)

Intensity Frontier:
Neutrino mass, Neutrinoless Double Beta Decay, non-accelerator (and solar/geo) neutrinos

PLR (formerly OPP) Cosmic Frontier:
IceCube, SPTpol, BiCEP, … BICEP2, SPUD/SPICE

AST Division PA Activities

- Dark Energy
  - BOSS
    - Partnership NSF/AST with DOE
    - One component of Sloan Digital Sky Survey III
    - Underway, transition to SDSS IV in mid-2014
  - DES
    - Partnership NSF/AST with DOE for the camera
    - Operational late 2012 on NSF telescope in Chile; survey starts August 31
  - LSST
    - Partnership NSF/AST with DOE for the camera
    - In the FY2014 NSF budget request for construction (MREFC)
    - Current schedule – operational ~2022
- Other
  - US CTA
    - No significant funding for CTA project for foreseeable future
- CMB expts: ACTPol, POLARBEAR, etc.

PHY Dark Matter searches

WIMP – Spin-Independent

Super CDMS	Ge Target	Soudan	Commissioning/Ops
XENON100/1T	2 phase Xe Target	LNGS	Operations/Constr
LUX-350	2 phase Xe Target	SURF	Commissioning/Ops
MiniCLEAN	Liquid Ar & Ne Target	SNOLab	Construction
DArkSide-50	2 phase Depleted Ar	LNGS	Commissioning/Ops

WIMP – Spin-Dependent

COUPP-60	Bubble Chamber	(SNOLab)	Commissioning
PICASSO	Superheated C_4F_{10}	SNOLab	Operations
CoGeNT	Single Ge crystal PPCS	Soudan	Operations
DRIFT-II	Directional Gaseous TPC	Boulby	Operations
DMTPCino	Directional CF_4 TPC	WIPP	Construction

Axion Searches

ADMX-HF	Microwave cavity	Yale	Construction

PHY Cosmic Ray and Gamma-Ray Expts

Cosmic Rays

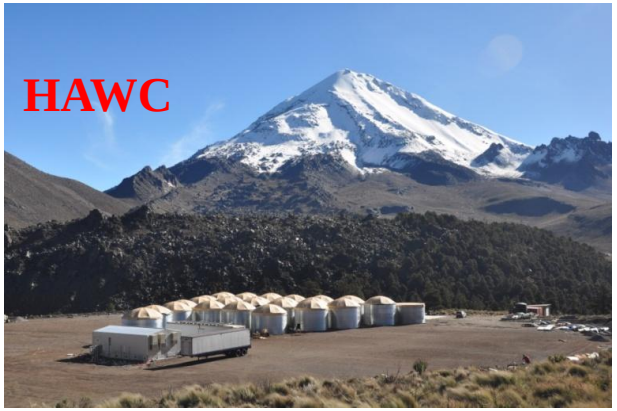
Pierre Auger	Water tank/fluorescence	Argentina	Operations
Telescope Array	Scintillator/fluorescence	Utah	Operations/R&D

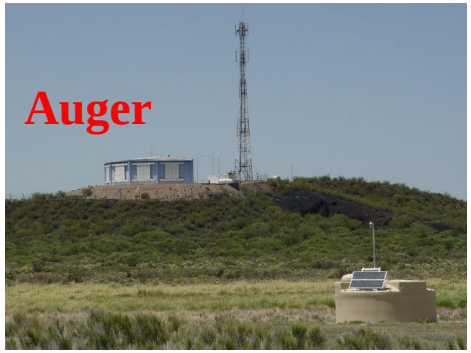
Gamma-Rays

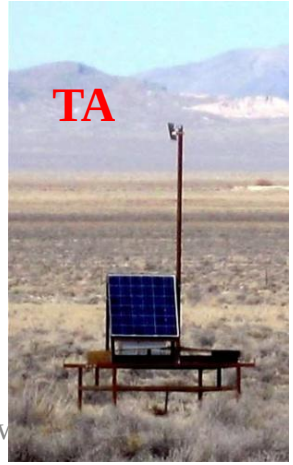
VERITAS	4 telescopes	Arizona	Operations
HAWC	250-300 water tanks	Mexico	Constr/Operations
CTA	R&D only	N & S Hemisphere	Planning

Neutrinos

IceCube			Operations







IceCube

PHY: Astrophysics and Cosmology Theory

- The Astrophysics and Cosmology Theory program supports proposals that primarily are involved with theoretical particle astrophysics and big-bang cosmology as well as more speculative string theory inspired cosmologies.
- The cosmology and astrophysics research supported by the program is usually associated with people with training in particle theory and encompasses dark matter, dark energy, high energy cosmic rays as well as exotic cosmologies arising from Brane-world and String Theory scenarios.
- Theorists are working to understand CDM in the context of Particle Physics and Cosmology
- **Target Date: December 5, 2013 (First Thursday in December**)

PHY Neutrino Experiments

Neutrino-less Double Beta Decay

EXO	Xe	Soudan	Operations
CUORE	Te	LNGS	Construction
MAJORANA (MJD)	Ge	SURF	Construction
Super-NEMO	Se	LNGS	Planning

Non-accelerator Neutrinos

Double Chooz	Reactor expt	France	Operations
Daya Bay	Reactor expt	China	Operations
BOREXINO	Solar/geo neutrinos	LNGS	Operations

Neutrino Mass

Project-8			Construction

Accelerator neutrino physics is supported by EPP Program in PHY

Budgets

NSF and MPS Budgets

FY2012 and FY2013

National Science Foundation
Funding Summary Table

(Dollars in Millions)

NSF by Account	FY 2012 Actual	Δ	FY 2013 Enacted	Δ	FY 2014 Request
BIO	$712.28	-4.7%	$678.93	12.0%	$760.58
CISE	937.16	-8.4%	858.53	10.7%	950.25
ENG	824.55	-1.3%	813.54	12.0%	911.10
GEO	1,321.37	-4.2%	1,265.84	10.1%	1,393.86
MPS	**1,308.70**	**-4.5%**	**1,249.50**	**10.9%**	**1,386.12**
SBE	254.19	-4.6%	242.51	12.3%	272.35
IIA	398.60	8.7%	433.47	23.8%	536.62
US ARCTIC RESEARCH COMMISSION	1.45	-4.1%	1.39	0.4%	1.40
Research & Related Activities	$5,758.30	-3.7%	$5,543.71	12.1%	$6,212.27
Education & Human Resources	$830.54	0.3%	$833.31	5.6%	$880.29
Major Research Equipment & Facilities Construction	$198.08	-1.0%	$196.17	7.1%	$210.12
Agency Operations & Award Management	$299.30	-1.9%	$293.60	3.6%	$304.29
National Science Board	$4.37	-5.7%	$4.12	8.5%	$4.47
Office of Inspector General	$14.82	-11.0%	$13.19	8.6%	$14.32
Total, NSF	$7,105.41	-3.1%	$6,884.10	10.8%	$7,625.76

MPS

Totals may not add due to rounding.
In FY 2013, a realignment of offices previously under the Office of the Director was implemented: the Office of Cyberinfrastructure (OCI) is now the Advanced Cyberinfrastructure (ACI) division in the Directorate for Computer and Information Science and Engineering (CISE); the Office of Polar Programs (OPP) is now the Division of Polar Programs (PLR) in the Directorate for Geosciences (GEO); and the Office of International Science and Engineering (OISE) has been merged with Integrative Activities (IA) to form International and Integrative Activities (IIA).

MPS PHY Budget

- Instructed to protect ongoing commitments, including facilities

Physics Division

Mathematical and Physical Sciences (MPS) Funding

(Dollars in Millions)

	FY 2012 Actual	Δ	FY 2013 Enacted	Δ	FY 2014 Request
Division of Astronomical Sciences (AST)	$234.72	-0.9%	$232.52	4.8%	$243.64
Division of Chemistry (CHE)	234.03	-2.2%	228.97	10.8%	253.65
Division of Materials Research (DMR)	294.40	-1.2%	290.74	8.2%	314.63
Division of Mathematical Sciences (DMS)	237.72	-7.8%	219.19	11.6%	244.54
Division of Physics (PHY)	**277.44**	**-9.6%**	**250.72**	**15.3%**	**289.02**
Office of Multidisciplinary Activities (OMA)	30.37	-9.9%	27.36	48.5%	40.64
Total, MPS	$1,308.70	-4.5%	$1,249.50	10.9%	$1,386.12

Totals may not add due to rounding.

- FY 2013 Reduction of -9.6% ($26.7M) has serious impacts
- Biggest impact is on research grants: approximately -12%
- Typically, 2/3 of a program's funding is in commitments (3-year awards)

Features of PA Program in PHY

Supported Personnel	Theory	EPP	PA	TOTAL
Awards	104	60	134	298
Senior investigators	186	181	63	430
Postdocs	50	104	64	218
Graduate Students	50	176	127	353

Total 254

(For PA, probably ~50 less in Fy2013)

- People chase the best science, wherever it might be (US, Europe, Japan, China, Canada, Antarctic…)
- While majority of work is typically carried out at the home institution, many facilities are outside the U.S.

- Approximate numbers for FY 2012
- Distributed over many types of universities, including research, undergraduate, minority-serving, etc.

US-based physicists working on US/non-US facilities	Domestic	Abroad
Theory	100%	0%
Elem. Particle Physics	45%	55%
Particle Astrophysics	52%	48%
TOTAL	59%	41%

FY2014 Budgets

- **Total National Science Foundation:**
- The FY 2013 budget (not including the mandatory 5 percent sequestration reduction) is $7,239.8 million ($6,884.1 M, actual)
- The FY 2014 request is $7,625.8 million, an increase of $386.0 million or +5.3 %
- The Senate Approp. Comm. recommendation is $7,425.9 million, an increase of $186.1 million or +2.6 %
- The House Approp. Comm. recommendation is $6,995.1 million, a decrease of $244.7 million or -3.4 %

Science and Technology Priorities for the FY 2015 Budget

- http://www.whitehouse.gov/sites/default/files/omb/memoranda/2013/m-13-16.pdf

- Advanced Manufacturing
- Clean energy
- Global climate change
- R&D for informed policy-making and management
- Information Technology
- R&D for National-Security Missions
- Innovation in Biology and Neuroscience
- Science, technology. Engineering, and mathematics (STEM) education
- Innovation and commercialization

Mid-Scale Innovations Program in Astronomical Sciences (MSIP)

- AST Mid-scale solicitation:
- Preliminary Proposals due September 16, 2013
- Full Proposals due Febuary 21, 2014

- Funding from$4M to $40M
- AST website for details: http://www.nsf.gov/div/index.jsp?div=AST

Other News:

- AST has announced the competition for management of NOAO, including Kitt Peak and the Mayall (possible host telescope for the DESI project),

AST: LSST-related proposals:

- The LSST Project will create a science-ready database. Proposals to any NSF program that claim to be essential to carrying out the Project are not acceptable as that bypasses the cost assessment and subsequent cost cap for Project funding.
- It is not part of the Project to do the science, so proposals can request support to work on how best to carry out research with the database, but it is critical not to suggest that your results are necessary for the Project to create a usable database.
- Note this also means NSF proposals should not request funding for activities related to science working groups or for institutional dues to join LSST, etc., as this would also bypass the cap on NSF support for the Project.

- If in doubt, or perhaps even if you're not, please ask a current and cognizant NSF Program Officer ***before submitting.***

New requirements for NSF proposals/awards

  - (Now require a Data Management section and PD mentoring)
- For any **proposal submitted** after March 18, 2013 there will be "automated compliance checking of required sections of proposals." (See Grant Proposal Guide):
- Sections will have boxes requiring some text
- **Reporting has also changed (March 18, 2013)**
- Now through **Research.gov** instead of Fastlane
- Include Postdoc mentoring if a pd was funded by the award
- **Submission dates for Proposals to PHY:**
- **October 30** – Target date for FY14 EPP and PA Base Program proposals
- **October 31 (?)** – Probable target date for FY14 Dark Matter Solicitation (coordinated with DOE-OHEP) (LOIs before that)
- **December 5** -- Target date for FY14 Theory Proposals
- **MRI** – Jan deadline (internal University competition is earlier)

Comments from Saul's Talk:

- U.S. budgetary climate for fundamental research is very challenging
  - And a lot of competition for research funding
- For the most part, we are not aligned with the National Priorities (climate, energy, etc.)
  - But priorities change – we must be ready
- Articulate the Return on Investment (ROI)
  - What is the added value in terms of science if we build "X"? (even for upgrades!)
  - What is the added value in terms of broader impacts to society?
- We need: Effective Communication