

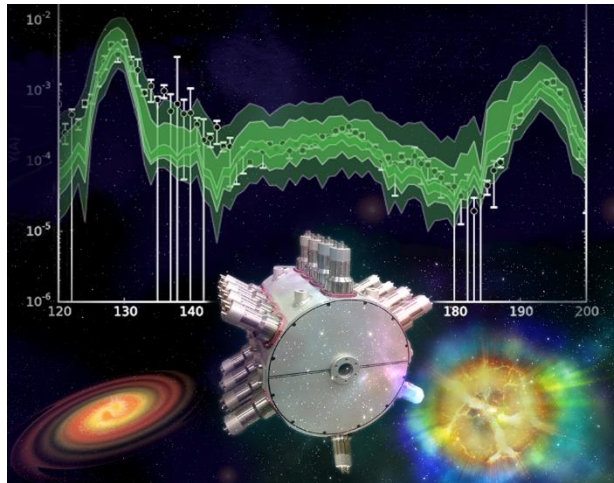


NSF Physics Division Overview

Denise Caldwell

Division Director
Division of Physics

With Input from Program Directors: Allena Opper, Kenneth Hicks,
Bogdan Mihaila



S.N. Liddick, A. Spyrou et al.,
Phys. Rev. Lett 116, 242502 (2016)

NSAC 27 June 2016



Era of Gravitational Wave Astrophysics

Direct Detection of Gravitational Waves

Binary Black Hole – Black Hole mergers

Event GW150914

Original black holes:

29 and 36 solar masses (M_{\odot}).

Final black hole:

62 M_{\odot} with dimensionless spin 0.67

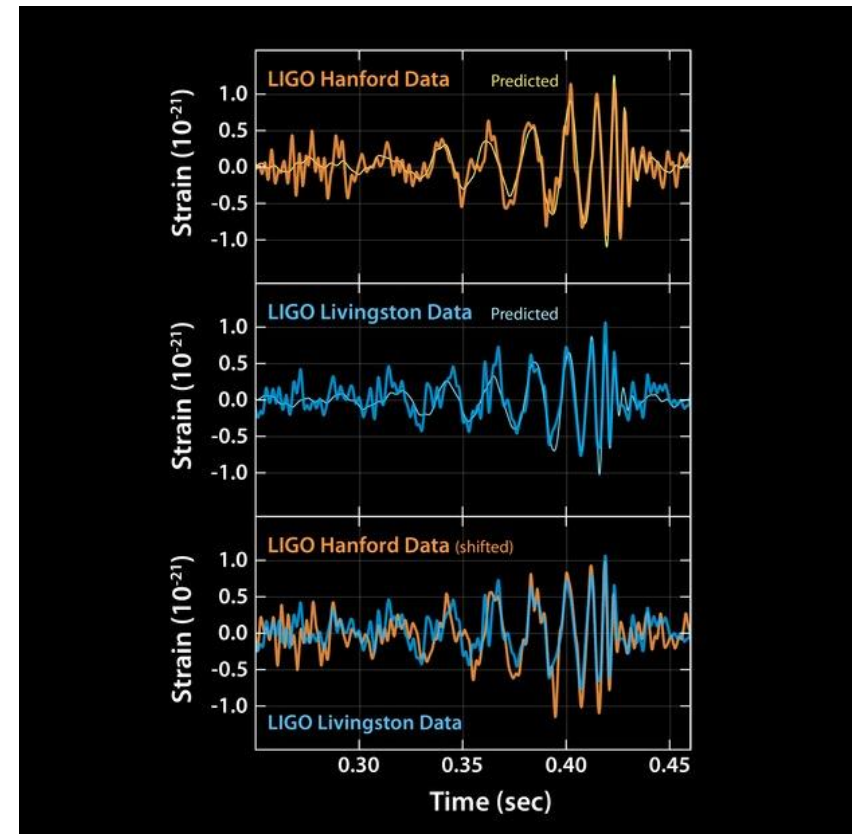
Event GW151226

Original black holes:

14 and 7.5 solar masses (M_{\odot}).

Final black hole:

20.8 M_{\odot} with one component spin >0.2





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FY 2017 Request by Appropriation

	FY 2016 Estimate	FY 2017 Discretionary		FY 2017 Mandatory	FY 2017 Total	
Research & Related Activities	\$ 6034	\$ 6079	0.8%	\$ 346	\$ 6425	6.5%
Education & Human Resources	880	899	2.1%	54	953	8.3%
Major Res Equip & Facilities Const.	200	193	-3.6%		193	-3.6%
Agency Operations & Award Mgmt.	330	373	13%		373	13%
National Science Board	4	4			4	
Office of the Inspector General	15	15			15	
Total NSF	\$ 7463	\$ 7564	1.3%	\$ 400	\$ 7964	6.7%

Totals may not add because of rounding (\$ in millions)



FY 2017 Investment Request in Priority Areas

FY 2017 Funding for Ongoing NSF-Wide Investments (Dollars in Millions)			
	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request
Cyber-Enabled Materials, Manufacturing and Smart Systems (CEMMSS)	\$269.83	\$256.30	\$257.12
Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)	157.04	132.42	100.07
NSF Innovation Corps (I-Corps™)	26.19	30.00	30.00
Research at the Interface of Biological, Mathematical, and Physical Sciences (BioMaPS)	35.47	31.31	29.81
Science, Engineering, and Education for Sustainability (SEES)	183.01	74.73	52.48
Secure and Trustworthy Cyberspace (SaTC)	124.71	129.75	149.75

FY 2017 Priority Request Total = \$619.23 M

Approximately 10% of Total R&RA Funding of \$6425M

FY 2017 Physics Division Discretionary Request \$278.53 M



THE CORE – THE HEART OF WHAT WE DO

Major Sub-Areas of Physics (Experiment and Theory)

Gravitational Physics

Atomic, Molecular, and Optical Physics (Includes QIS)

Nuclear Physics

Particle Physics (EPP and PA)

Physics of Living Systems

Plasma Physics (NSF/DOE Partnership in Basic Plasma Science
and Engineering)

Accelerator Science

(Note that Condensed Matter Physics is NOT included)



Cross-Cutting Programs

Computational Physics – Computational Development for all Sub-Areas

Integrative Activities in Physics - PHY Component of REU Site Program; Activities in Physics Education and Outreach (PhysTech, QuarkNet, I2U2, LIGO Science Center); Broadening Participation Co-Funding Activities

Physics Frontiers Centers - Currently fund ten centers (KITP, KICP, JILA, CUA, CTBP, JINA-CEE, JQI, CPLC, IQIM, Nanograv); Broad and often Highly Multidisciplinary (with co-funding from AST, CHE, DMR, MCB, CCF, PLR)

Major Facilities – NSCL, LIGO, IceCube (with Polar Programs), ATLAS and CMS Detectors at LHC (with DOE)



Physics Division Portfolio

The portfolio of awards made through the Physics Division has as primary goal “to promote the progress of science”, as expressed in the NSF act. Awards in the portfolio support the research needed to address a scientific question that is at the frontier of knowledge as it is currently known, while at the same time extending and redefining that frontier. Inherent in the implementation of this portfolio, which includes significant support for students and junior scientists, is the preparation of the next generation of the advanced high tech workforce and the development of innovative new technologies that arise in the quest to answer some of the hardest questions that Nature can pose.



Questions Cut Across Disciplinary Programs

Controlling the Quantum World: Optical Physics;
Quantum Information Science

Complex Systems and Collective Behavior: Physics of Living Systems; Atomic
and Molecular Dynamics; Nuclear Physics; Plasma Physics

Neutrinos and Beyond the Higgs: Particle Astrophysics; Gravitational Physics;
Nuclear Physics; Precision Measurements; Elementary Particle Physics

Origin and Structure of the Universe: Gravitational Physics; Cosmology;
Nuclear Physics; Particle Astrophysics; Plasma Physics

Strongly-Interacting Systems: Nuclear Physics; Gravitational Physics;
Plasma Physics



Nuclear Physics @ NSF

- **Nucleon and Hadron QCD** – properties and behavior of nucleons and nuclear matter under extreme conditions, confinement, hadron spectra, nuclear equation of state
- **Nuclear Reactions and Structure** – structure of many-body nuclei and reactions of relevance to structure
- **Nuclear Astrophysics** – origin of the elements, properties of dense matter in a compact object, nuclear reactions that drive stars and stellar explosions
- **Nuclear Precision Measurements and Fundamental Symmetries** – tests of QCD and chiral perturbation theory, tests of the Standard Model in a strongly interacting environment
- **Nuclear Theory** – structure and reactions of nuclei and of hadrons in few-nucleon and nuclear environments, the quark/gluon substructure expressed by QCD



Nuclear Physics @ NSF (cont'd)

Experimental Nuclear Physics Program	\$18.5 M
Hadrons and Light Nuclei	
Nuclear Structure and Reactions	
Nuclear Precision Measurements	
Nuclear Astrophysics	
Theoretical Nuclear Physics Program	\$ 4.2 M
NSCL Operations	\$23.0 M
Physics Frontiers Centers Program – JINA –CEE	\$ 2.3 M
Mid-Scale Neutron eDM	\$ 1.4 M
Total FY 2015 Dollars	\$49.4 M

18 % of FY 2015 Physics Division R&RA Funds



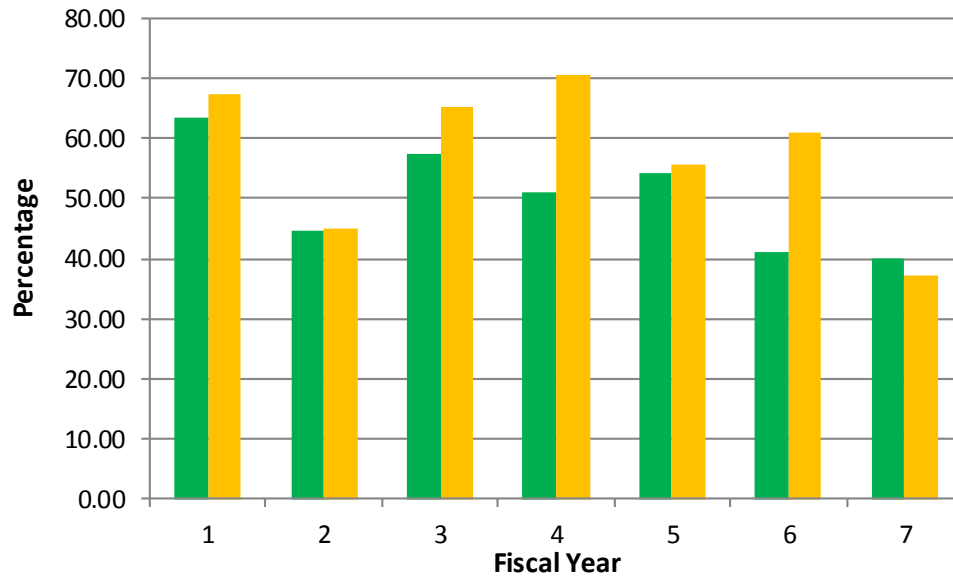
Funding Trends – Experimental Program

ENP Trends

New awards only

■ (AwarDED \$)/(Requested \$) yr 1

■ (AwarDED Props)/(Submitted Props)

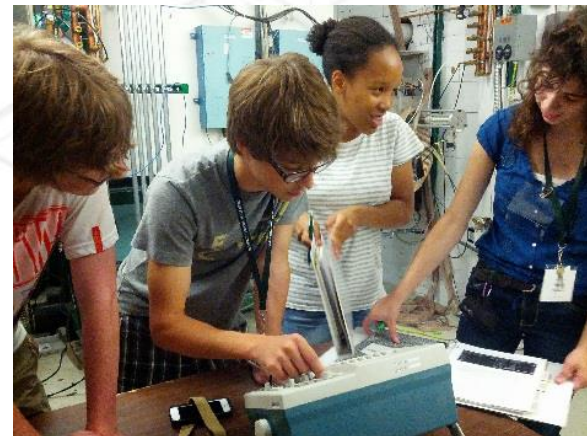
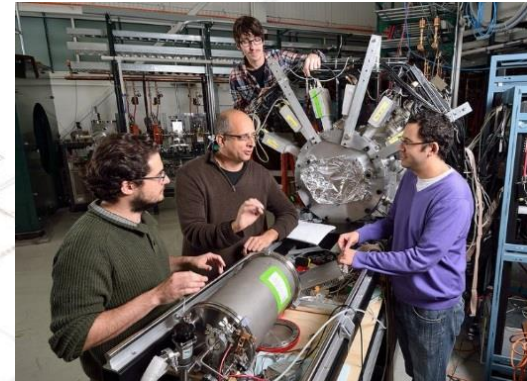
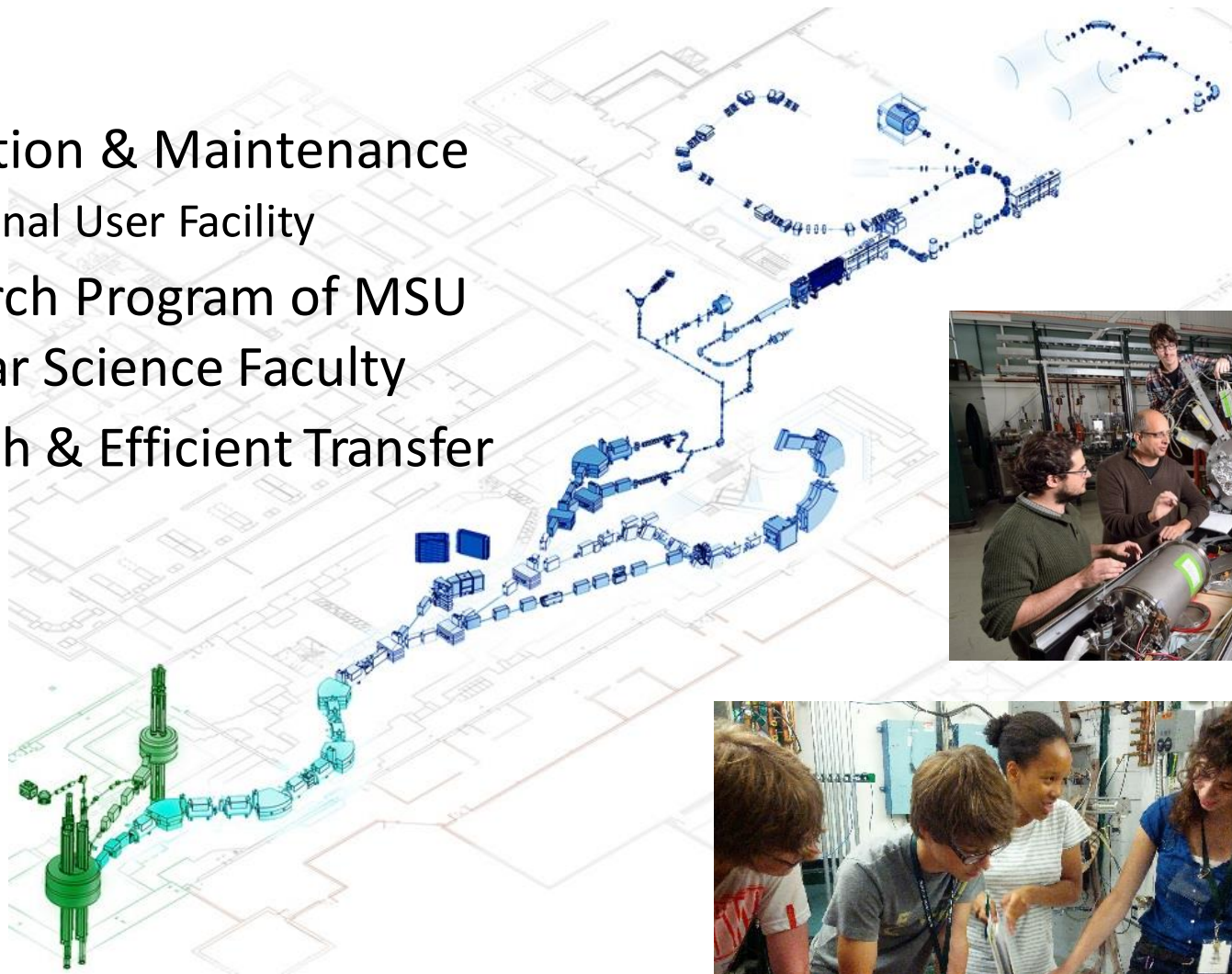


- ▶ Success rate = (awarded)/(submitted) < 40%
 - Increased competition
- ▶ Strategic investment to maximize impact



NSCL: Five-year Renewal

- ▶ Operation & Maintenance
 - National User Facility
- ▶ Research Program of MSU Nuclear Science Faculty
- ▶ Smooth & Efficient Transfer
 - MOU

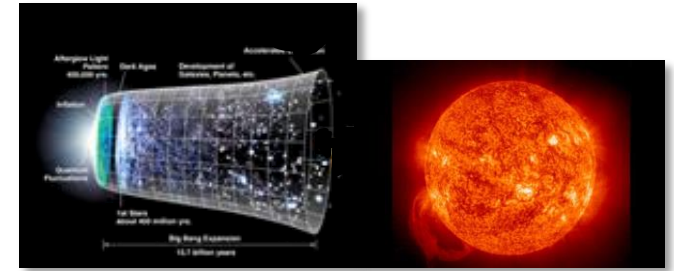




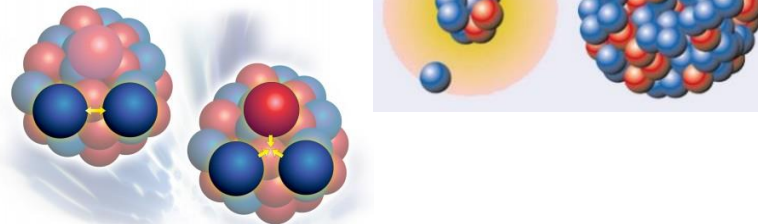
Scientific Goals of NSCL Program

– the nuclear landscape and the big questions

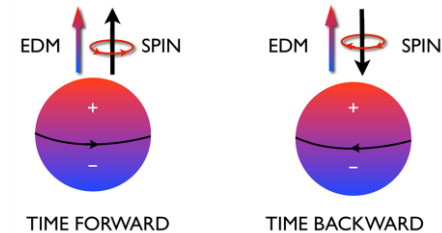
- ▶ Where does visible matter come from?



- ▶ How are atomic nuclei organized?



- ▶ Are the fundamental interactions underlying the structure of matter understood?



Needs radioactive isotopes!



What to Look Out For in FY 2017

Updated: NSF 16-566 – Division-Wide Solicitation for Program Proposals
Includes additional details for submitting proposals requiring
large-scale investments, including mid-scale

Physics Frontiers Centers Competition – NSF 16-561
Pre-Proposals due August 1, 2016

Contact: Jean Cottam-Allen or Kathleen McCloud

Opportunities offered by the National Strategic Computing Initiative (NSCI)

Contact: Bogdan Mihaila



Other NSF Programs of Interest

(Options for addressing specific needs and opportunities)

Major Research Instrumentation Program (MRI)

Software Infrastructure for Sustained Innovation –
SSE and SSI - NSF 16-532

(managed through Division of Advanced CyberInfrastructure)

NSF 16-023 - Dear Colleague Letter: Integrated NSF Support
Promoting Interdisciplinary Research and Education (INSPIRE)