Particle Physics in NSF/PHY

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With Input from Program Directors: Jim Shank; Randy Ruchti; Jean Cottam;
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*On detail in MPS/OAD

HEPAP 01 December 2016

FY 2016 Particle Physics Funding in PHY

Base Support:	
Individual Investigator Programs (Theory & Experiment) (Energy, Cosmic, Intensity)	$ 50.66 M
Facilities M&O (ATLAS, CMS, IceCube)	$ 21.48 M
Auxiliary Support (One-time, nonrenewable):	
Mid-Scale (ATLAS, CMS, LHCb Upgrades; Super CDMS)	$ 7.24 M
LHC High Luminosity Upgrade Planning	$ 2.00 M
Other:	
Physics Frontiers Centers	$ 3.00 M
MRI Awards	$ 1.97 M
Computation (CIF21, NSCI)	$ 3.86 M
Total	$ 90.21 M

Some Notable Awards

Software Institute Conceptualization award: Award 1558216 (Elmer, Princeton) / 1558233 (Sokoloff, Cincinnati) / 1558233 (Neubauer, UIUC)

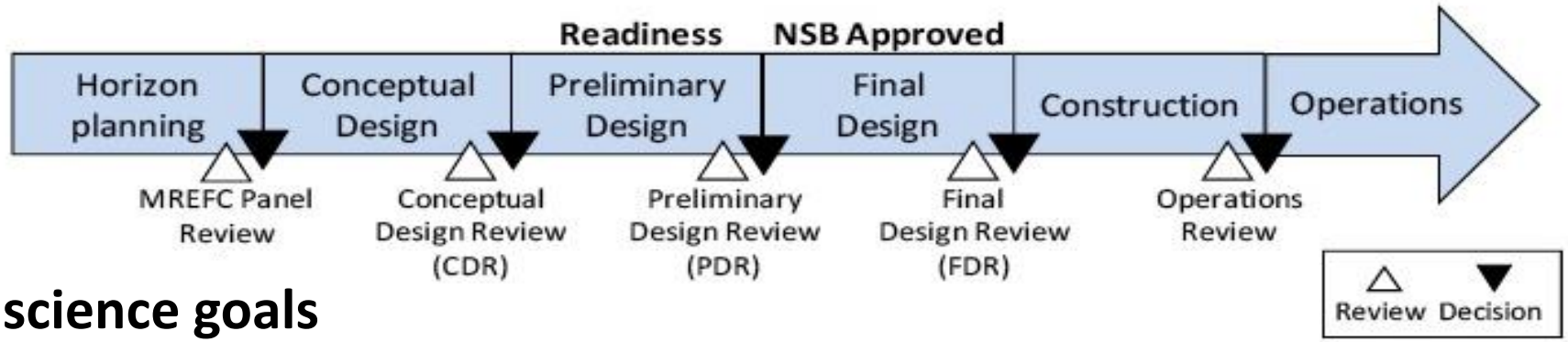
"Conceptualization of an S2I2 Software Institute for High Energy Physics"

sponsors community workshops and conceptual work to take advantage of the significant data and computing requirements of the Large Hadron Collider as a science driver for next generation high-performance software and sustainability developments.

Next workshop: S2I2 HEP/CS Workshop - December 7-9, 2016 at *University of Illinois at Urbana-Champaign.*

"Center for Bright Beams", Award 1549132, a Science and Technology Center at Cornell University, Ritchie Patterson, Director, dedicated to enhancing accelerator capabilities for a broad range of disciplines.

MREFC Process for HL-LHC Upgrades of ATLAS and CMS



- **Review science goals**
- **Conceptual Design Stage (Approval to initiate in November 2015)**
  - Requirements, initial estimates of cost (including operations), risk and schedule
- **Preliminary Design ("Readiness") Stage (Approval to initiate in August 2016)**
  - Definition and design of major elements, detailed estimates of cost, risk and schedule, partnerships, siting
- **Final Design Stage ("Board Approved") Stage**
  - Interconnections and fit-ups of functional elements, refined cost estimates based substantially on vendor quotes, construction team substantially in place

MPS FY 2017 Request by Division

	FY 2016 Estimate	FY 2017 Discretionary		FY 2017 Mandatory	FY 2017 Total	
Astronomical Sciences (AST)	$ 246.73	$ 247.73	0.4%	$ 14.88	$ 262.61	6.4%
Chemistry (CHE)	246.31	247.31	0.4%	14.85	262.16	6.5%
Materials Research (DMR)	310.03	311.03	0.3%	18.68	329.71	6.3%
Mathematical Sciences (DMS)	234.05	235.05	0.4%	14.12	249.17	6.5%
Physics (PHY)	277.03	278.53	0.5%	16.73	295.26	6.6%
Multidisciplinary Activities (OMA)	35.00	35.41	1.2%	2.13	37.54	7.3%
Total MPS	**$ 1349.15**	**$ 1355.06**	**0.4%**	**$ 81.39**	**$ 1436.45**	**6.5%**

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

Five Perspectives on the Frontiers of Physics

Controlling the Quantum World– Electromagnetic radiation in the non-classical limit, Entanglement, Cavity QED, QIS, Optomechanics

Complex Systems and Collective Behavior – Living cells, biological systems, ultracold fermions and bosons, quark-gluon liquid

Neutrinos and Beyond the Higgs – Neutrino mass, new particles, unification of quantum mechanics and gravity, electron and neutron dipole moments

Origin and Structure of the Universe – Star formation and creation of the elements, dark matter and dark energy, modeling of black holes, gravitational waves

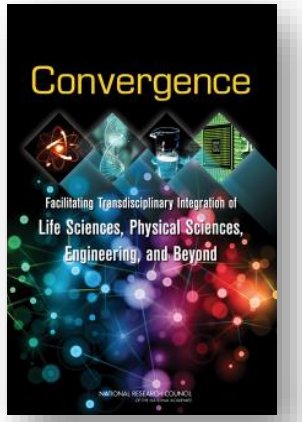
Strongly-Interacting Systems– QCD computations, quark structure of baryons, high-field laser-matter interactions, supernovae, strong gravity

PHY and the Big Ideas

Windows on the Universe

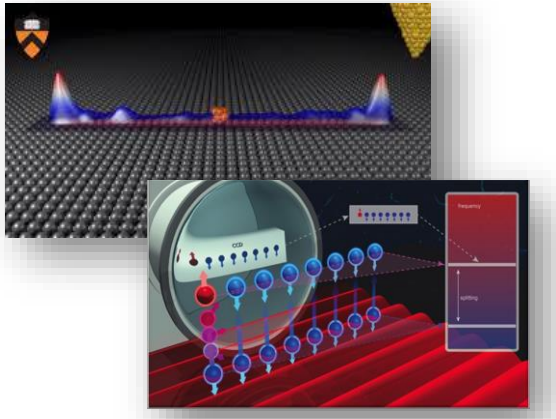
Harnessing Data

Convergence



Mid-scale

Quantum Leap



Rules of Life