U.S. DEPARTMENT OF ENERGY | Office of Science

Comments from the Office of Science

NSAC

24 April 2014

Patricia M. Dehmer
Acting Director, Office of Science
U.S. Department of Energy

Professor Marc Kastner – Nominee for SC-1

Professor Marc Kastner is the dean of MIT's School of Science and the Donner Professor of Physics. He has been on the MIT faculty since 1973 and has led MIT's Department of Physics and its Center for Materials Science and Engineering.

MIT's School of Science, which Kastner has led since 2007, includes the departments of Biology; Brain and Cognitive Sciences; Chemistry; Earth, Atmospheric and Planetary Sciences; Mathematics; and Physics. The school is home to approximately 300 faculty, 1,200 graduate students, and 1,000 undergraduate majors.

Kastner's early research focused on the electronic and optical properties of amorphous semiconductors. In 1990, his research group fabricated the first semiconductor single-electron transistor; his group continues to use these devices as tools to study the quantum mechanical behavior of electrons confined to nanometer dimensions.

Kastner is a member of the NAS and American Academy of Arts and Sciences, and a fellow of the AAAS and the APS. He received a B.S. in chemistry, an M.S. in physics, and a Ph.D. in physics from the University of Chicago.

Professor Marc Kastner

Professor Lynn Orr – Nominee for S-4

Professor Franklin "Lynn" Orr has served as director of the Precourt Institute for Energy at Stanford University since 2009. The $100 million Precourt Institute, founded by primary donors Jay Precourt and the husband-and-wife team of Thomas Steyer and Kat Taylor, draws talent from across the campus and around the world to develop sustainable energy solutions and search for ways to reduce atmospheric levels of carbon. The Precourt Institute and the TomKat Center for Sustainable Energy foster Stanford-wide, interdisciplinary research combining science and technology research with research on energy economics, policy, finance and the behavior of energy consumers. Prior to leading the Precourt Institute, Orr served as the founding director of the Global Climate and Energy Project at Stanford from 2002 to 2008.

Since 1985, Orr has been an associate professor and professor in Stanford's Department of Energy Resources Engineering (formerly the Department of Petroleum Engineering). He was dean of the School of Earth Sciences at Stanford from 1994 to 2002 and chairman of the Department of Petroleum Engineering from 1991 to 1994. Orr held several other research positions from 1970 to 1985 in New Mexico, Texas and Washington, D.C. He received his BS degree from Stanford University and PhD from the University of Minnesota.

Professor Lynn Orr

Office of Science FY 2015 Budget Request to Congress

(Dollars in thousands)

	FY 2013 Current (prior to SBIR/STTR)	FY 2013 Current Approp.	FY 2014 Enacted Approp.	FY 2015 President's Request	FY15 President's Request vs. FY14 Enacted Approp.	
Advanced Scientific Computing Research	417,778	405,000	478,093	541,000	+62,907	+13.2%
Basic Energy Sciences	1,596,166	1,551,256	1,711,929	1,806,500	+94,571	+5.5%
Biological and Environmental Research	578,294	560,657	609,696	628,000	+18,304	+3.0%
Fusion Energy Sciences	385,137	377,776	504,677	416,000	-88,677	-17.6%
High Energy Physics	748,314	727,523	796,521	744,000	-52,521	-6.6%
Nuclear Physics	519,859	507,248	569,138	593,573	+24,435	+4.3%
Workforce Development for Teachers and Scientists	17,486	17,486	26,500	19,500	-7,000	-26.4%
Science Laboratories Infrastructure	105,673	105,673	97,818	79,189	-18,629	-19.0%
Safeguards and Security	77,506	77,506	87,000	94,000	+7,000	+8.0%
Program Direction	174,862	174,862	185,000	189,393	+4,393	+2.4%
Subtotal, Office of Science	**4,621,075**	**4,504,987**	**5,066,372**	**5,111,155**	+44,783	+0.9%
Small Business Innovation Research/Technology Transfer	...	176,208	...	...	...	...
Use of Prior Year Balances	...	...	...	...	...	...
Total, Office of Science	**4,621,075**	**4,681,195**	**5,066,372**	**5,111,155**	+44,783	+0.9%

Highlights of the FY 2015 SC Budget – Research

Research: New investments in research underpinning next-generation computing and in the development of computational models for disciplinary computing.

ASCR **Increased research investments in exascale and data-intensive science** in Applied Mathematics, Computer Science, and R&E Prototypes, including work in the representation, analysis, visualization, and management of extreme-scale data from simulations and experiments; also in processors, memory, and data flow leading to the development of exascale systems.

BES **Computational materials sciences** will combine theory, modeling, and computer science to develop new community codes for the design of functional materials—that is, materials that "function" by responding to external stimuli such as pressure, temperature, electric/magnetic fields, or chemical changes in their environment. Teams will address topics such as catalysis, superconductivity, and materials in high fields. Validation and verification of materials codes will involve experiments using SC facilities to probe materials at fast time scales (e.g., LCLS) and with near-atomic resolution (synchrotron x-ray sources, neutron scattering sources, electron-beam microscopy sources) under a variety of conditions.

Highlights of the FY 2015 SC Budget – Facility Ops

Facility operations: Most of the scientific user facilities operate at or near optimal levels—including the Leadership Computing Facilities and the light sources that together host more than half of all users at the facilities**.**

ASCR

- **NERSC and the Leadership Computing Facilities at ANL and ORNL** operate optimally. NERSC moves to the Computational Research and Theory Building at LBNL. Funds for the LCFs support the preparation of planned 75-200 petaflop upgrades in the FY 2017-2018 timeframe.

BES

- **4 Light Sources, 2 Neutron Scattering Sources,** and **5 Nanoscale Science Research Centers** operate optimally. **NSLS-II** transitions to operations and **NSLS-I** ceases operation. With **SNS** operating at full power and nearly fully instrumented, operations at the **Lujan Neutron Scattering Center** cease.

FES

- **NSTX** operates for an 18-week run following the 3-year-long upgrade.
- **DIII-D** operates for a 15-week run.
- **Alcator C-Mod** operates for a 5-week run.

HEP

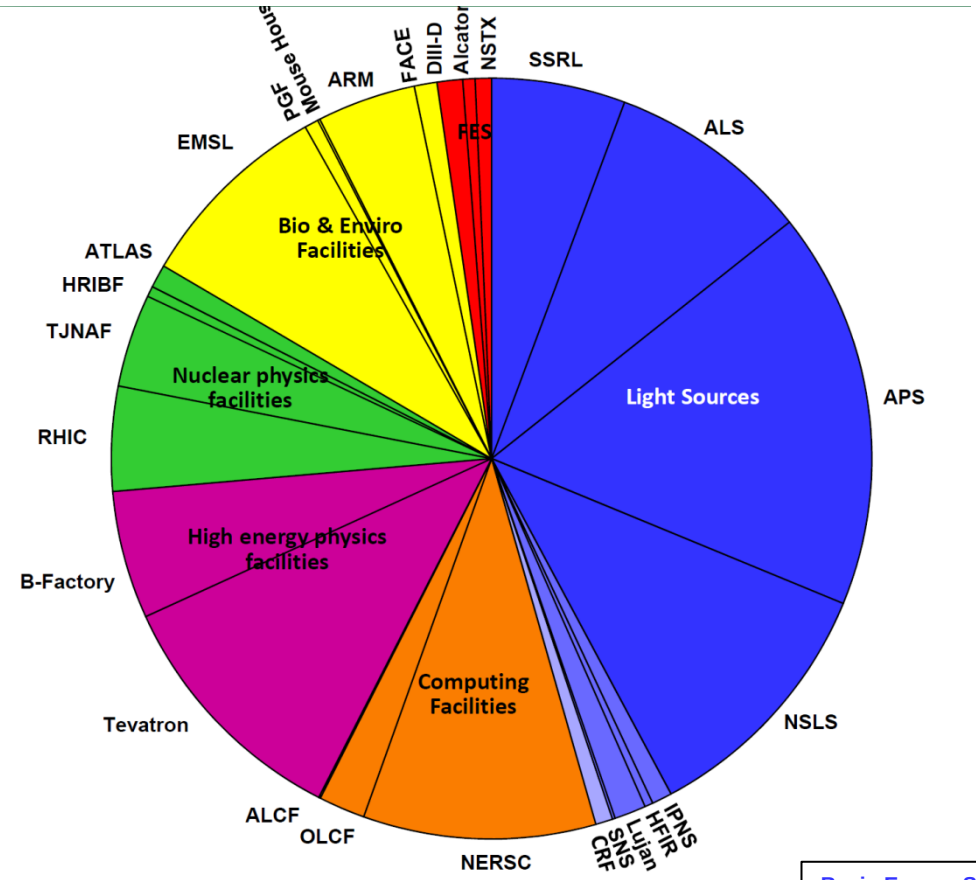
- The **Fermilab Accelerator Complex** operates to support experiments such as **NOvA, Minerva, MicroBoone, MINOS**

NP

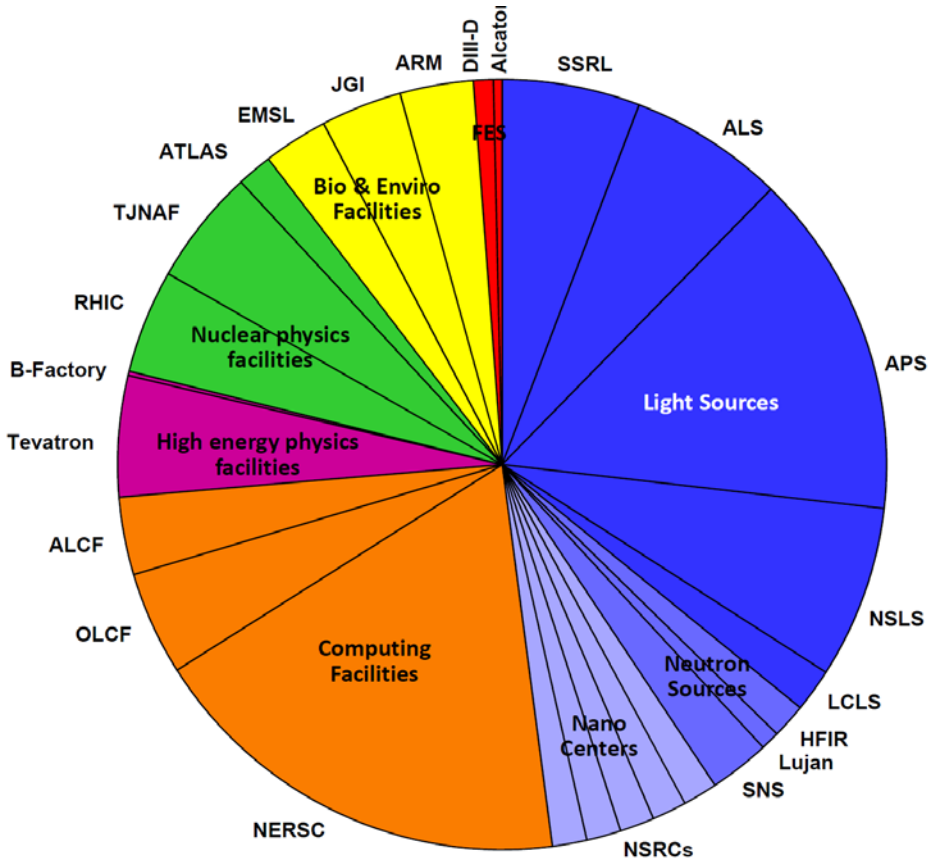
- **RHIC** operates for 22 weeks, the same as FY 2014.
- **ATLAS** operates at 95% of optimal.

Distribution of Users at the ~30 SC Facilities

2007
~20,000 users



2013
~28,000 users



Basic Energy Sciences
Advanced Scientific Research Computing
High Energy Physics
Nuclear Physics
Biological & Environmental Research
Fusion Energy Sciences

Highlights of the FY 2015 SC Budget – Construction

Construction: Several large projects are nearing successful completion, on time and within budget; new projects are initiated to address science and infrastructure needs.

BES

- **NSLS-II** is transitioning from early operations to full operations; construction funding ended in FY 2014. The planned CD-4 date is June 2015.
- **LCLS-II** is in its second year of construction.

FES

- **ITER** funding supports continuation of in-kind hardware, cash contributions to the IO, and the USIPO.

HEP

- **NOvA** is in its first full year of early operations; the planned CD-4 date is November 2014.
- **Muon to Electron Conversion Experiment** continues construction. The planned CD-2 date is 4Q FY 2014.
- **Long Baseline Neutrino Experiment** continues R&D.

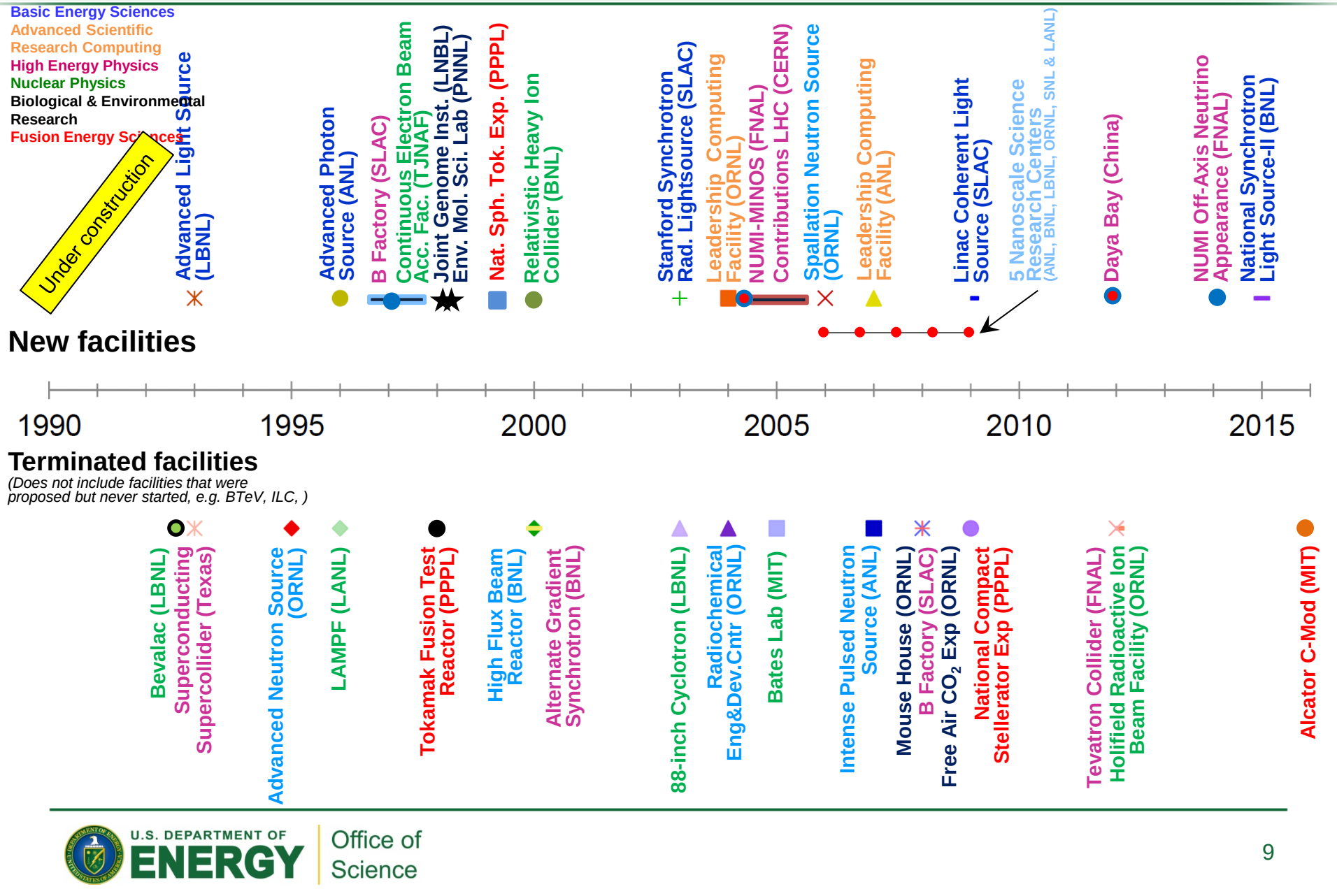
NP

- **12 GeV CEBAF Upgrade** is nearing completion. Activities at TJNAF focus on beam development and commissioning of the new machine.
- **Facility for Rare Isotope Beams** is in early civil and technical construction.

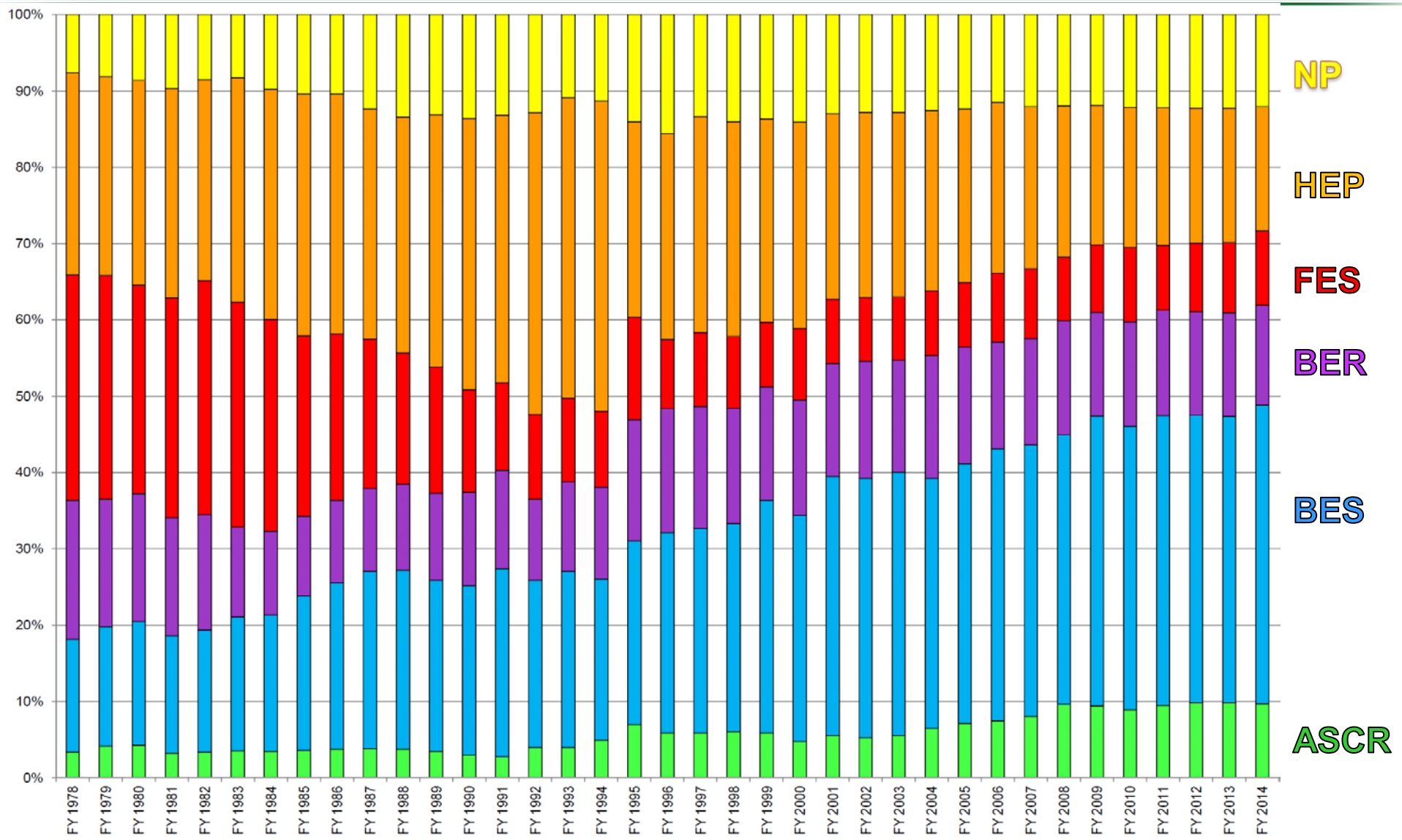
SLI

- **Science and User Support Building at SLAC** completes construction.
- **Infrastructure Improvements at PPPL; Materials Design Laboratory at ANL; Photon Sciences Laboratory Building at SLAC; Integrative Genomics Building at LBNL** all are initiated, with the PPPL project fully funded.

A Summary of Terminated and New Major Facilities 1990-2015



Major SC Program Funding (% of total) FY 1978-2014



Facilities for the Future of Science: A 20-year Outlook (November 2003)

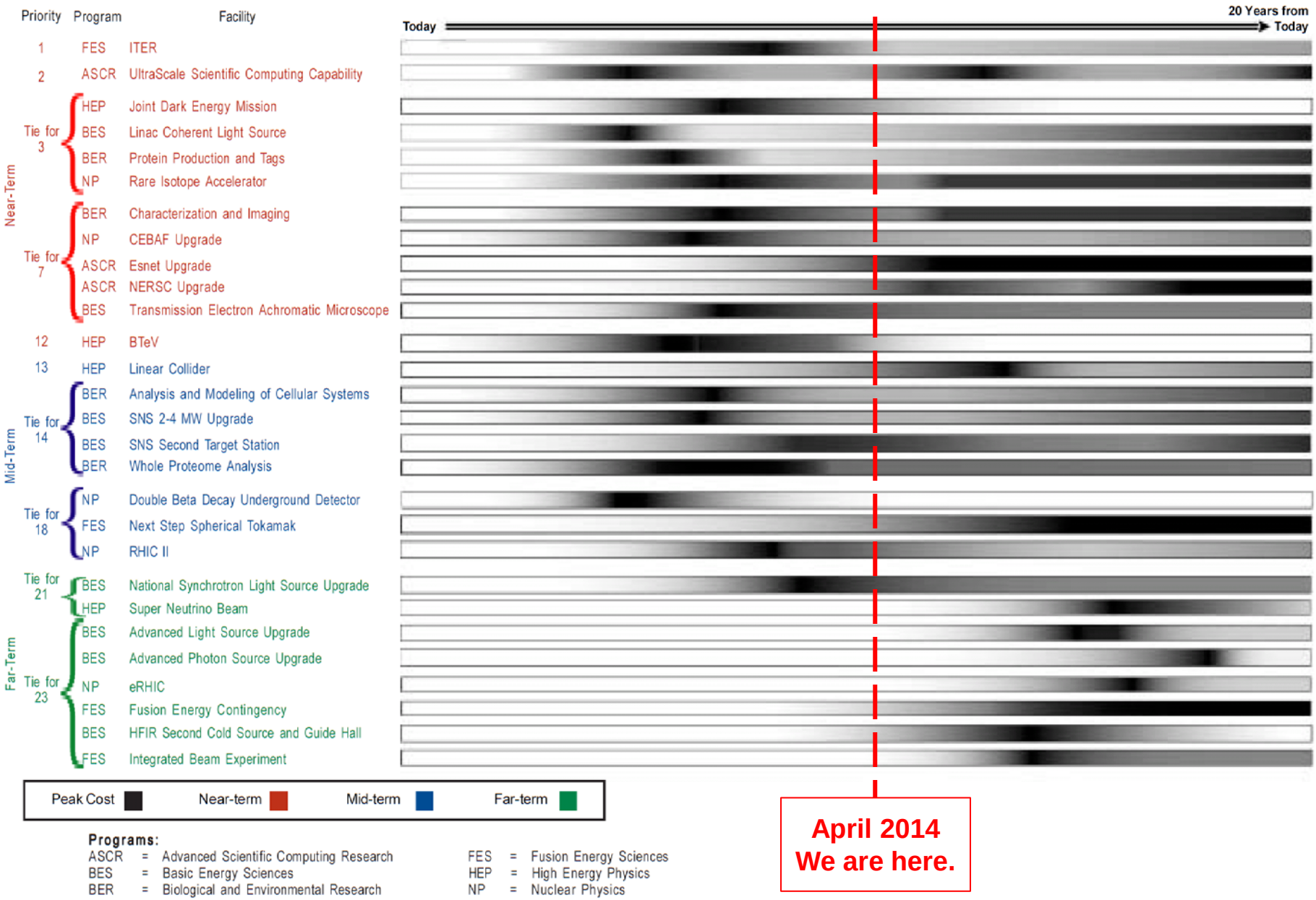
Facilities for the Future of Science (2003)

Paraphrasing FFS, “Today, the Department of Energy is building the Spallation Neutron Source, the last large-scale SC user facility under construction. And that raises the question that *Facilities for the Future of Science: A Twenty-Year Outlook* addresses*:* What facilities are needed next for scientific discovery?”

Funding envelopes were constructed from the “Biggert Bill” authorization levels for SC for FY 2004 through FY 2008 (replaced later by H.R. 6 and S. 14) and then a four percent increase in authorization level each following year until 2023.

H.R. 34, the "Energy and Science Research Investment Act of 2003,” aka the Biggert Bill, authorized an increase in funding for SC of ~60% from FY 2004 through FY 2007. The bill called for an increase of ~8% for FY 2004 followed by increases of 11%, 15%, and 15% in the following three years. The FY 2007 authorization level would have been $5.31 B.

U.S. Department of Energy — Office of Science — 20-Year Facility Outlook — Peak of Cost Profile

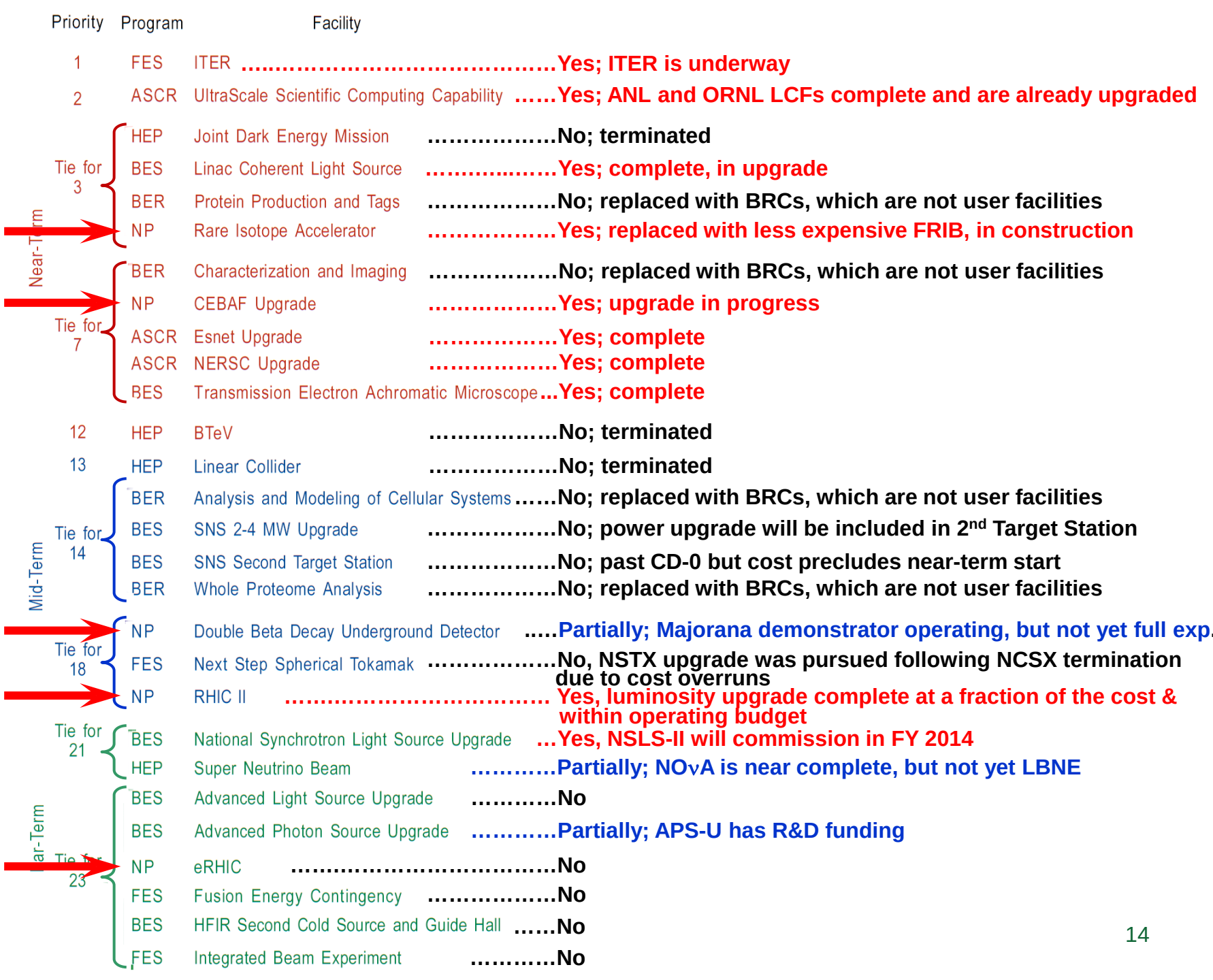


Programs:

ASCR = Advanced Scientific Computing Research
BES = Basic Energy Sciences
BER = Biological and Environmental Research
FES = Fusion Energy Sciences
HEP = High Energy Physics
NP = Nuclear Physics

Facilities for the Future of Science: A Twenty-Year Outlook 13

Published November 2003


Priority Program Facility
1 FES ITER .....Yes; ITER is underway
2 ASCR UltraScale Scientific Computing Capability .....Yes; ANL and ORNL LCFs complete and are already upgraded
Near-Term
Tie for 3
HEP Joint Dark Energy Mission .....No; terminated
BES Linac Coherent Light Source .....Yes; complete, in upgrade
BER Protein Production and Tags .....No; replaced with BRCs, which are not user facilities
NP Rare Isotope Accelerator .....Yes; replaced with less expensive FRIB, in construction
Tie for 7
BER Characterization and Imaging .....No; replaced with BRCs, which are not user facilities
NP CEBAF Upgrade .....Yes; upgrade in progress
ASCR Esnet Upgrade .....Yes; complete
ASCR NERSC Upgrade .....Yes; complete
BES Transmission Electron Achromatic Microscope ...Yes; complete
12 HEP BTeV .....No; terminated
13 HEP Linear Collider .....No; terminated
Mid-Term
Tie for 14
BER Analysis and Modeling of Cellular Systems .....No; replaced with BRCs, which are not user facilities
BES SNS 2-4 MW Upgrade .....No; power upgrade will be included in 2nd Target Station
BES SNS Second Target Station .....No; past CD-0 but cost precludes near-term start
BER Whole Proteome Analysis .....No; replaced with BRCs, which are not user facilities
Tie for 18
NP Double Beta Decay Underground Detector .....Partially; Majorana demonstrator operating, but not yet full exp
FES Next Step Spherical Tokamak .....No, NSTX upgrade was pursued following NCSX termination due to cost overruns
NP RHIC II ..... Yes, luminosity upgrade complete at a fraction of the cost & within operating budget
Tie for 21
BES National Synchrotron Light Source Upgrade ...Yes, NSLS-II will commission in FY 2014
HEP Super Neutrino Beam .....Partially; NOνA is near complete, but not yet LBNE
Far-Term
BES Advanced Light Source Upgrade .....No
BES Advanced Photon Source Upgrade .....Partially; APS-U has R&D funding
Tie for 23
NP eRHIC .....No
FES Fusion Energy Contingency .....No
BES HFIR Second Cold Source and Guide Hall .....No
FES Integrated Beam Experiment .....No

Workforce Development Charge to FACs

DOE Programs Terminated in the FY 2014 President's Budget Request

- Computational Sciences Graduate Fellowship (SC-ASCR)
- Summer School in Nuclear Chemistry and Radiochemistry (SC-BES&NP)
- Global Change Education Program (SC-BER) (phased out)
- QuarkNet (SC-HEP)
- National Undergraduate Fellowship Program in Plasma Physics and Fusion Energy Sciences (SC-FES) (phased out as a stand-alone program; merged with SULI)
- Plasma/Fusion Science Educator Programs (SC-FES)

- Graduate Automotive Technology Education (EERE)
- Wind for Schools (EERE)
- Nuclear Scholarships/Integrated University Partnerships (NE)

Some Administration Perspectives on Workforce Development Activities in DOE

- DOE has mission-specific workforce needs in STEM fields.
- DOE laboratories are a unique resource for training in STEM R&D.
- STEM workforce development activities in SC should include:
  - an evidence-based statement of the workforce need;
  - a statement of program goals;
  - a diverse applicant pool and unbiased selection; and
  - tracking of outcomes and evaluation of success.
- SC should consider consolidating electronic applications, data collection, and tracking activity in a single place, e.g., WDTS, to achieve efficiency.

Charge to All Six Federal Advisory Committees

Charge: Assessment of workforce development needs in Office of Science research disciplines

The Office of Science research programs have a long history of training graduate students and postdocs in disciplines important to our mission needs as part of sponsored research activities at universities and DOE national laboratories. In addition, the Office of Workforce Development for Teachers and Scientists supports undergraduate internships, graduate thesis research, and visiting faculty programs at the DOE national laboratories.

We are asking the assistance of each of the Office of Science Federal Advisory Committees to help us identify disciplines in which significantly greater emphasis in workforce training at the graduate student or postdoc levels is necessary to address gaps in current and future Office of Science mission needs. As part of your expert assessment, please consider:

- Disciplines not well represented in academic curricula;
- Disciplines in high demand, nationally and/or internationally, resulting in difficulties in recruitment and retention at U.S. universities and at the DOE national laboratories;
- Disciplines identified in the previous two bullets for which the DOE national laboratories may play a role in providing needed workforce development; and
- Specific recommendations for programs at the graduate student or postdoc levels that can address discipline-specific workforce development needs.

Please submit to me, no later than June 30, 2014, a letter report describing your findings and recommendations. These results will be used to help guide future activities and investments.