

Underground Research at the National Science Foundation

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Deep Underground Research Association Meeting
Fermilab
Batavia, IL
January 19-20, 2012

**“Science is a wonderful thing if one does not
have to earn one’s living at it.”**

**- Albert Einstein, letter to an admirer
March 1951 (age 72)**

Outline

- **Background, current status**
- **Highlights from the past year**
- **Comments on overall funding climate**
- **Funding redirection and mid-scale program**
- **Closing remarks**
- **Questions**

Recent Personnel Changes

- Significant turnover in NSF PHY at the end of CY 2011.
- Current EPP/PNA Program Directors (**new**):
 - **EPP**
 - Marv Goldberg (also PNA)
 - **Saul Gonzalez**
 - **Randy Ruchti**
 - **PNA**
 - **Jean Cottam**
 - Brad Keister (also NP)
 - Kyungseon Joo (also NP)
 - Jon Kotcher (also EPP)
 - Jim Whitmore (also EPP)
- Many thanks to Moishe Pripstein & Jim Reidy (retired).

Recent History, Background

- **In December 2010, the Committee on Programs and Plans (CPP) of the National Science Board (NSB) voted to discontinue further DUSEL design funding.**
- **NSF DUSEL facility design activities were zeroed out in the FY12 budget.**
- **The Department of Energy subsequently established a review process intended to inform their decision on if and how they intend to move forward with the Sanford Laboratory (SL) program.**
 - **Marx/Reichanadter Panel, spring 2011.**

Follow-Up Agency Actions

- **After the NSB decision, NSF agreed to provide \$4M to continue dewatering and maintenance of security at SL to cover the remainder of FY11 (June – Sep, 2011).**
- **Funds have been provided in the FY12 DOE HEP and NP budgets to maintain conditions in SL.**
- **Early science program (LUX, MJD) is moving forward.**
 - **Co-funded by the NSF and DOE programs.**
- **NSF is assisting in the transition of the facility to DOE in FY12, which should be complete next month (February).**
- **NSF is supporting UC Berkeley project team in any and all ways possible, short of providing additional funds.**
- **NSF/DOE JOG (DOE HEP & NP, NSF PHY) continues to meet regularly.**

Past Year's Events, Highlights

- **July 2011 NRC report on the DUSEL Assessment**
 - **Extremely strong endorsement of the scientific opportunities accessible underground (PHY, BGE), and the pursuit of an on-shore U.S. leadership role in underground science.**
 - **Benefits of co-location of experiments, multi-disciplinary synergies.**
- **July 2011 PDR Review, Sanford Laboratory**
 - **Panel found that PDR provided a sound basis for establishing project baseline (maturity analogous to CD-2). Noted the unique skills and strength of the UC Berkeley project team.**
- **Aug 2011 PDR/S4 Physics Review, NSF**
 - **Very strong support of the physics program put forward in the PDR. Panel noted the value and quality of the S4 design work, and its importance in laying further groundwork for the ongoing experimental program.**
- **SD aggressively continued its build-out of the Sanford Laboratory lab/infrastructure, enabling the accommodation of the early science program.**

DUSEL Solicitation Process

- Initiated at Town Meeting at NSF, March 2004.
- **Solicitation 1 (S1):**
 - Define site-independent, multi-disciplinary science scope and infrastructure needs; unify the community (awarded Jan 2005).
- **Solicitation 2 (S2):**
 - Develop conceptual designs (8 received, 2 awarded, Sep 2005).
- **Solicitation 3 (S3): (facility)**
 - Site selection to initiate facility design for 1 potential MREFC candidate (4 received, 1 awarded – Homestake, U.C. Berkeley [UCB]).
 - Total facility design: \$53M from FY 2007 through FY 2011.
- **Solicitation 4 (S4): (experiments)**
 - Initiate technical designs for candidates for the DUSEL suite of experiments (all disciplines).
 - 25 proposals received January 9, 2009; reviewed spring 2009.
 - \$21M total physics awards (+\$3M BGE) over three years, beginning in FY09.

Developing the DUSEL Experimental Program: S4

- **Solicitation 4 (S4):** called for proposals to develop designs and pursue targeted R&D for potential DUSEL experiments. Jan 2009.
- **25 proposals received; 300 senior researchers; 91 institutions.**

- **Nine proposals funded in physics:**

- Dark matter (4)
- Neutrino-less double-beta decay (2)
- Large water Cerenkov detector (multipurpose)
- Underground accelerator
- Assaying sub-facility

- **Total physics awards: \$21M over 3 years.**

- **Seven proposals funded in BIO, GEO & ENG sciences:**

- Fracture processes
- Coupled processes
- Subsurface imaging and sensing
- Fiber optic strain monitoring
- CO₂ sequestration
- Eco-hydrology & deep drilling
- Underground monitoring

- **Total BGE awards: \$3M.**

NSF DUSEL-Related Funding

DUSEL Awards	NSF Funding (\$M)
Facility Design (to UCB)	
S3	15
S3 Supplement	3
PDR	29
PDR Supplement	6
Subtotal Facility Design	53
Physics Experimental Design	
S4 (nine awardees, complete)	21 (over 3 yrs)
DUSEL R&D	
Individual awards (~ complete)	12 (over 3 yrs)
Dewatering in FY11	4
TOTAL	90

Excludes ~ \$3M in BIO, GEO and ENG (BGE) awards from S4 and individual programs, and funding for early science experiments (LUX/MJD).

Facility Design

Experiment Design

Dewatering

Excludes funding for DUSEL-related development from the State of South Dakota (\$124M) and DOE (~ \$50M).

Comment on the Current Climate

- **The pressure on agency budgets is unlikely to abate in the near future.**
- **Broadly speaking, research budgets and priorities appear to be undergoing a phase transition, rather than an isolated, more localized perturbation.**
- **In particular, facility-driven research – and, more specifically, new large-project starts – will continue to be subjected to a very high level of scrutiny, probably for the foreseeable future.**
- **NSF PHY continues to try to optimize its means of supporting the best possible research, in light of these and other considerations.**

Moving Forward (1)

- **As stated by the NRC and other advisory panels, underground physics offers the opportunity for discoveries of seminal importance in the coming years.**
- **In light of this, and also in response to the recent shift in agency responsibilities, NSF PHY is planning to redirect its future-generation, facility-driven investments in underground research to the nearer-term development and realization of individual underground experiments and experimental techniques.**
- **Such an approach is responsive to the stated NSF and NSB goals and directives, as well as the strong NRC and community endorsement of underground physics.**

Moving Forward (2)

- **This redirection encompasses experimental physics topics that require an underground environment, such as:**
 - **Underground nuclear astrophysics, direct detection of dark matter, neutrinoless double-beta decay, neutrino oscillations, proton decay, supernovae neutrinos...**
- **The funds will support site-independent development of experiments and/or techniques, including:**
 - **R&D, engineering and design, detector construction and deployment, operations and maintenance, or other activities on the critical path to significant scientific advancement.**

Moving Forward (3)

- **By definition, these initiatives will be smaller in scale, and therefore more tractable, than the development of a facility and its infrastructure, and the associated future-generation experimental program.**
- **A Dear Colleague Letter targeting a redirection in FY12 is currently in process at NSF. It has not been finalized.**

Mid-Scale Program

- **Projects > \$140M (10% of the \$1.4B MPS budget) are funded through the Major Research Equipment and Facilities Construction (MREFC) budget line.**
- **Major Research Instrumentation (MRI) program supports acquisition or development of instrumentation at universities. Range = \$0.1M - \$4M.**
- **Mid-scale instrumentation program is currently under development in NSF PHY that would fill the gap between few M\$ (PNA, MRI) and \$140M (MREFC).**
- **Would support one-time capitalization projects (i.e., construction, not research groups).**
- **Competed Division-wide (AMO, Biophysics, EPP,...). Is independent of aforementioned redirection of underground science funding.**
- **Dear Colleague Letter is in preparation.**

Closing Remarks

- **Particle, nuclear and astrophysics are poised to probe a series of rich, fundamental questions, a number of which can be accessed only underground.**
- **NSF PHY is adapting to a leaner, more focused future during this period of transition in U.S. underground research, and while the more global scientific and budgetary priorities are being assessed.**
- **Resources in the next few years will be stretched – a strongly collaborative, consensus-driven community approach will be a major determinative factor in the quality of the scientific future that can be established.**
- **NSF PHY looks forward to working with the community in defining this new path forward during this exciting and challenging time.**

Questions