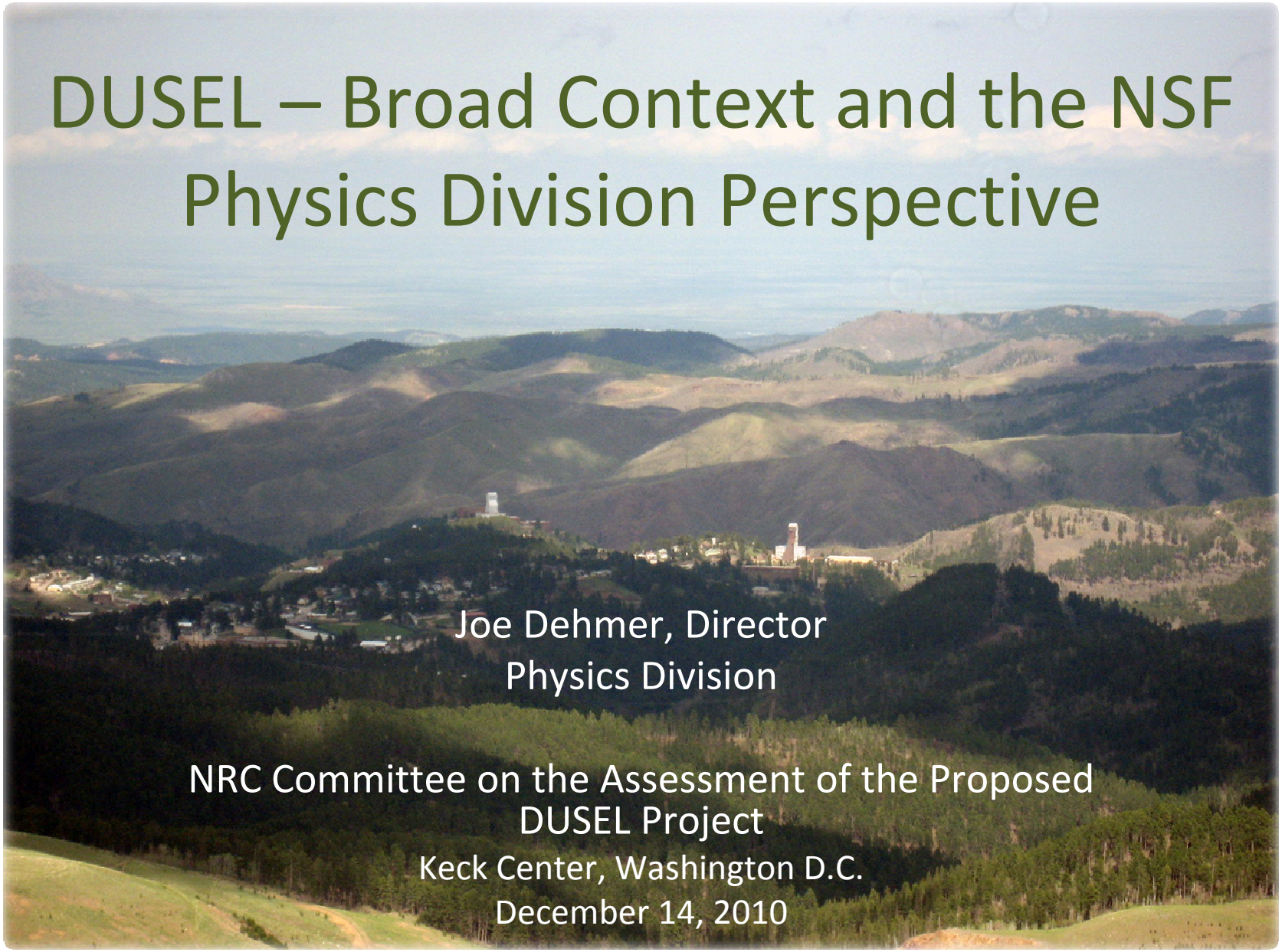
DUSEL – Broad Context and the NSF Physics Division Perspective



Joe Dehmer, Director
Physics Division

NRC Committee on the Assessment of the Proposed DUSEL Project

Keck Center, Washington D.C.

December 14, 2010

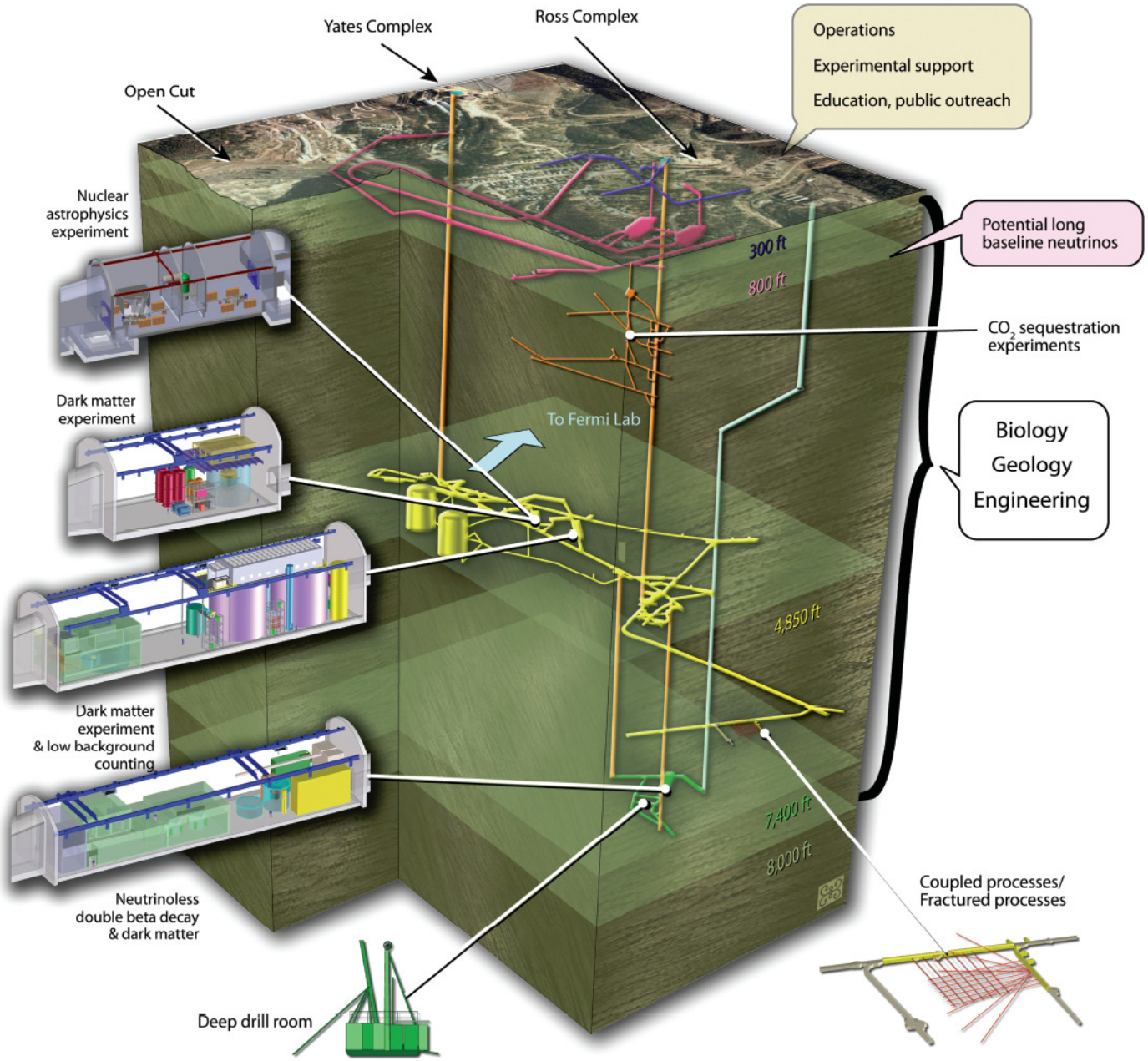
Topics

- Intellectual Scope
- Community Planning and Involvement
- NSF Actions
- NSF-DOE Partnership
- Lifecycle Funding Plan
- International context
- Final Comment

Deep Underground Science and Engineering Laboratory (DUSEL)

- **DUSEL is envisioned as a dedicated international underground research & education facility that would enable frontier research in multiple disciplines.**
- **The U.S. particle, nuclear, and astrophysics communities have selected DUSEL as central to their national programs.**
- **The engineering, geology and biology communities have participated in all aspects of DUSEL planning.**
- **Development focused on the former Homestake Gold Mine (Lead, SD), the deepest mine in North America.**

Intellectual Scope of DUSEL



DUSEL's Central Role in the Field of Particle Physics

–*High Energy Physics Advisory Panel* (2008) long range plan: "The physics *program* of the Deep Underground Science and Engineering Laboratory *is of central importance to particle physics*. *Experiments at DUSEL would address many issues, including neutrino physics, proton decay, dark matter, and neutrinoless double beta decay*.

–"The panel endorses the importance of a deep underground laboratory to particle physics and urges NSF to make this facility a reality as rapidly as possible. Furthermore the *panel recommends that DOE and NSF work together* to realize the experimental particle physics program at DUSEL."

–The DUSEL program in particle physics is viewed by that community as *vital to the on-shore US particle physics program* for the foreseeable future.

A Decade of Community Planning

- Bahcall Report
- Nuclear Science Advisory Committee (NSAC) Long-Range Plan
- International Workshop on Neutrinos and Subterranean Science
- High Energy Physics Advisory Committee (HEPAP) Long-Range Plan
- *EarthLab*
- Connecting Quarks to the Cosmos
- Neutrinos and Beyond
- DOE 20-yr. Facility Plan
- The Neutrino Matrix (Four APS Divisions)
- Physics of the Universe – A Strategic Plan for Federal Research at the Intersection of Physics and Astronomy
- Quantum Universe – The Revolution in 21st Century Particle Physics
- *Deep Science*
- Revealing the Hidden Nature of Space and Time (*EPP2010*)
- The Frontiers of Nuclear Science: A Long Range Plan
- Particle Physics Project Prioritization Panel (P5): A Strategic Plan for the Next Ten Years

2000 → 2010

NEXT: NSF/DOE Sponsored NRC Study; Broad, Independent Review of DUSEL (Spring 2011)

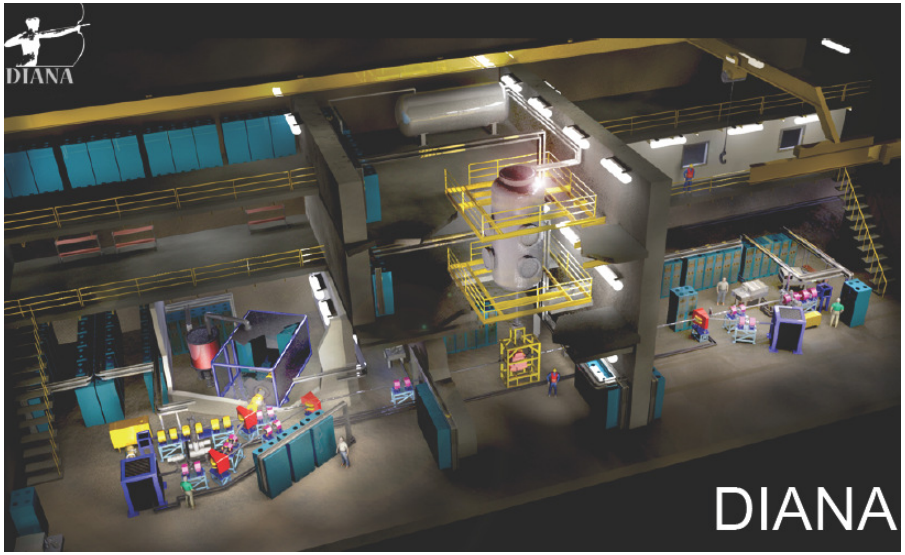
DUSEL Solicitation Process

- **Initiated at Town Meeting at NSF, March 2004.**
- **Solicitation 1 (S1):**
  - **Define site-independent science scope and infrastructure needs; unify the community (awarded Jan 2005).**
- **Solicitation 2 (S2):**
  - **Develop conceptual designs (8 received, 2 awarded, September 2005).**
- **Solicitation 3 (S3):**
  - **Site selection to initiate facility design for 1 potential MREFC candidate (4 received, 1 awarded – Homestake, U.C. Berkeley).**
  - **$15M total over three years, starting in September 2007.**
- **Solicitation 4 (S4):**
  - **Initiate technical designs for candidates for the DUSEL suite of experiments.**
  - **$15M total over three years, beginning in FY09.**
  - **25 proposals received January 9, 2009.**

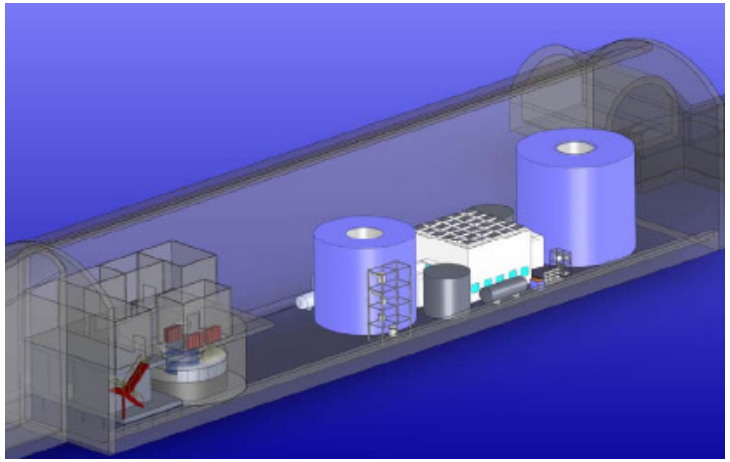
S4: Broad Research Program Being Planned

- **25 proposals received; 300 senior researchers named; 91 institutions.**

- **Nine proposals funded in physics.**
  - **Dark matter (4)**
  - **Neutrino-less double-beta decay (2) (one concept in lower right figure)**
  - **Large water Cerenkov detector (multipurpose)**
  - **Nuclear astrophysics (Diana, see below)**
  - **Assaying sub-facility**
- **Total physics awards: $21M over 3 years.**

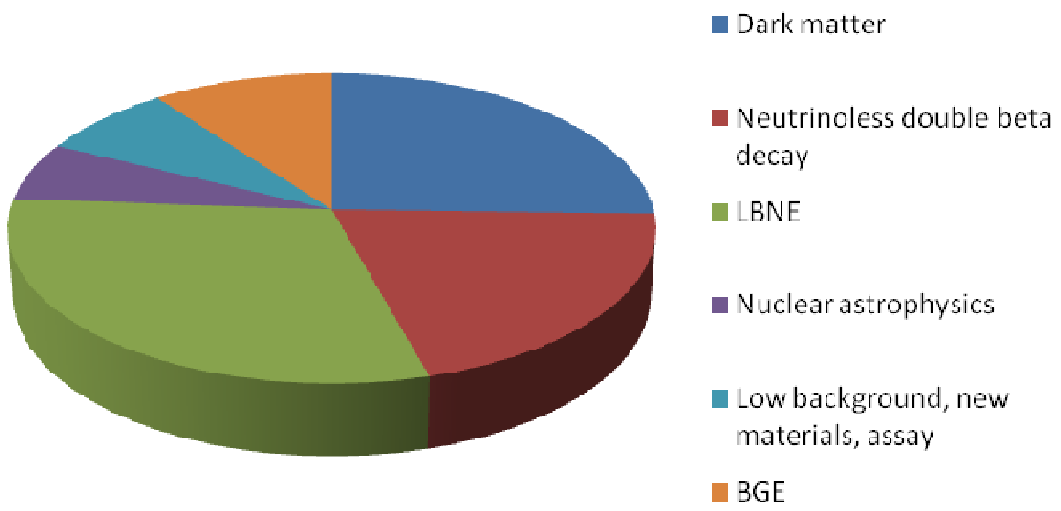


- **Seven proposals funded in GEO, GEO/BIO & ENG sciences:**
  - **Fracture processes**
  - **Coupled processes**
  - **Subsurface imaging and sensing**
  - **Fiber optic strain monitoring**
  - **CO_2 sequestration**
  - **Eco-hydrology & deep drilling**
  - **Large Cavity workshops**
- **Total awards: $3M.**



Current Community Involvement

- Nearly **1000** individual researchers
- Over **230** institutions supporting DUSEL collaborations (~ 50 foreign institutions)



Distribution of Individual Researchers Across Major Experimental Programs

DOE Partnership

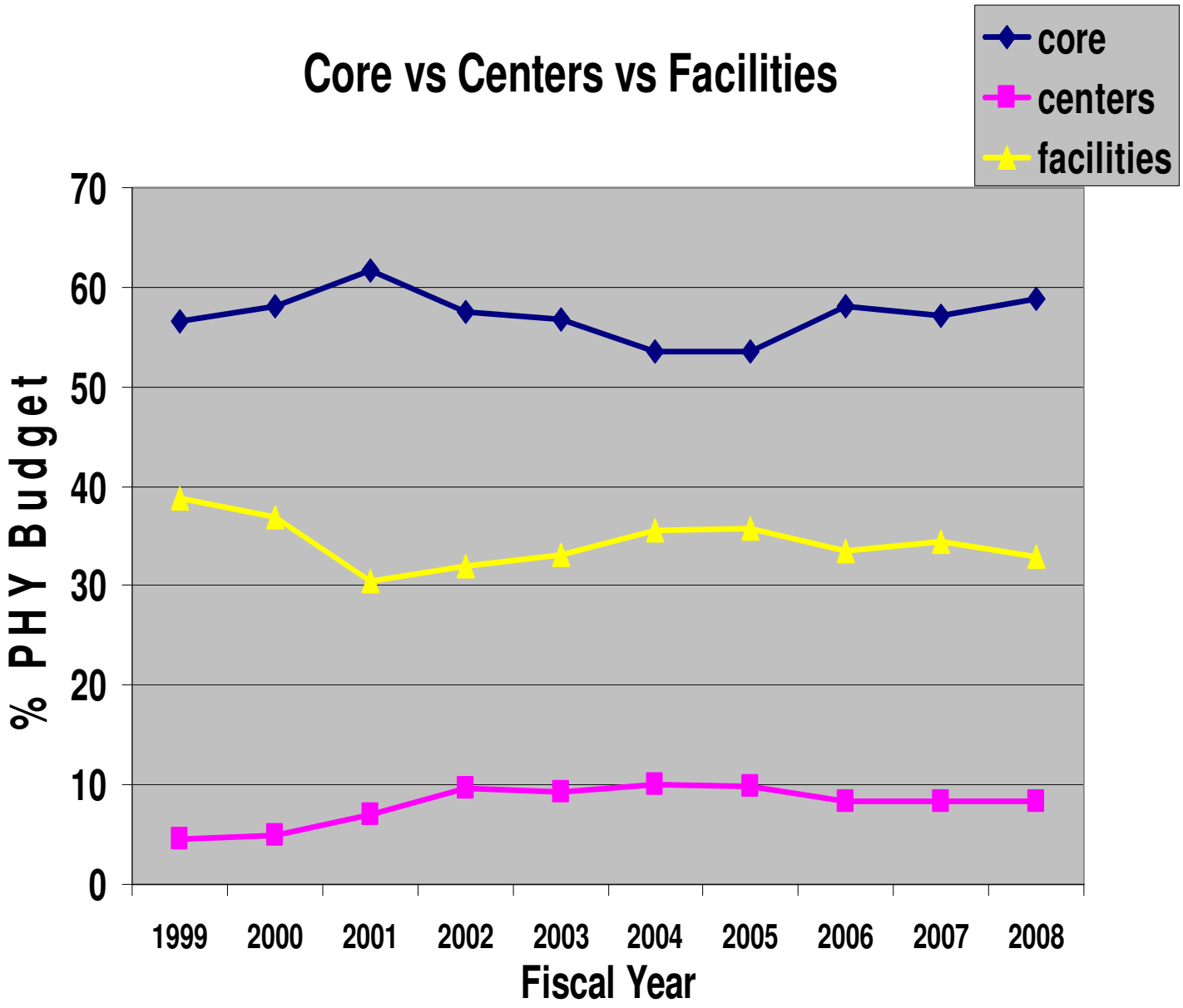
- NSF/DOE DUSEL Joint Oversight Group (JOG) meets monthly
- Stewardship Model defines scope as well as roles and responsibilities for cost, risk, and management for NSF and DOE
- Joint Briefings to OSTP, OMB, and Congress

DUSEL Stewardship Model

Program Element	Steward	Contributing Partners
DUSEL facility and infrastructure	NSF	OHEP (LBNE)
Direct dark matter detection	NSF	DOE OHEP
Long baseline neutrino studies	DOE OHEP	NSF
Proton decay	DOE OHEP	NSF
Neutrino-less double-beta decay	DOE ONP	NSF
Smaller physics experiments	NSF	ONP, OHEP (TBD)
Bio/Geo/Eng	NSF	TBD

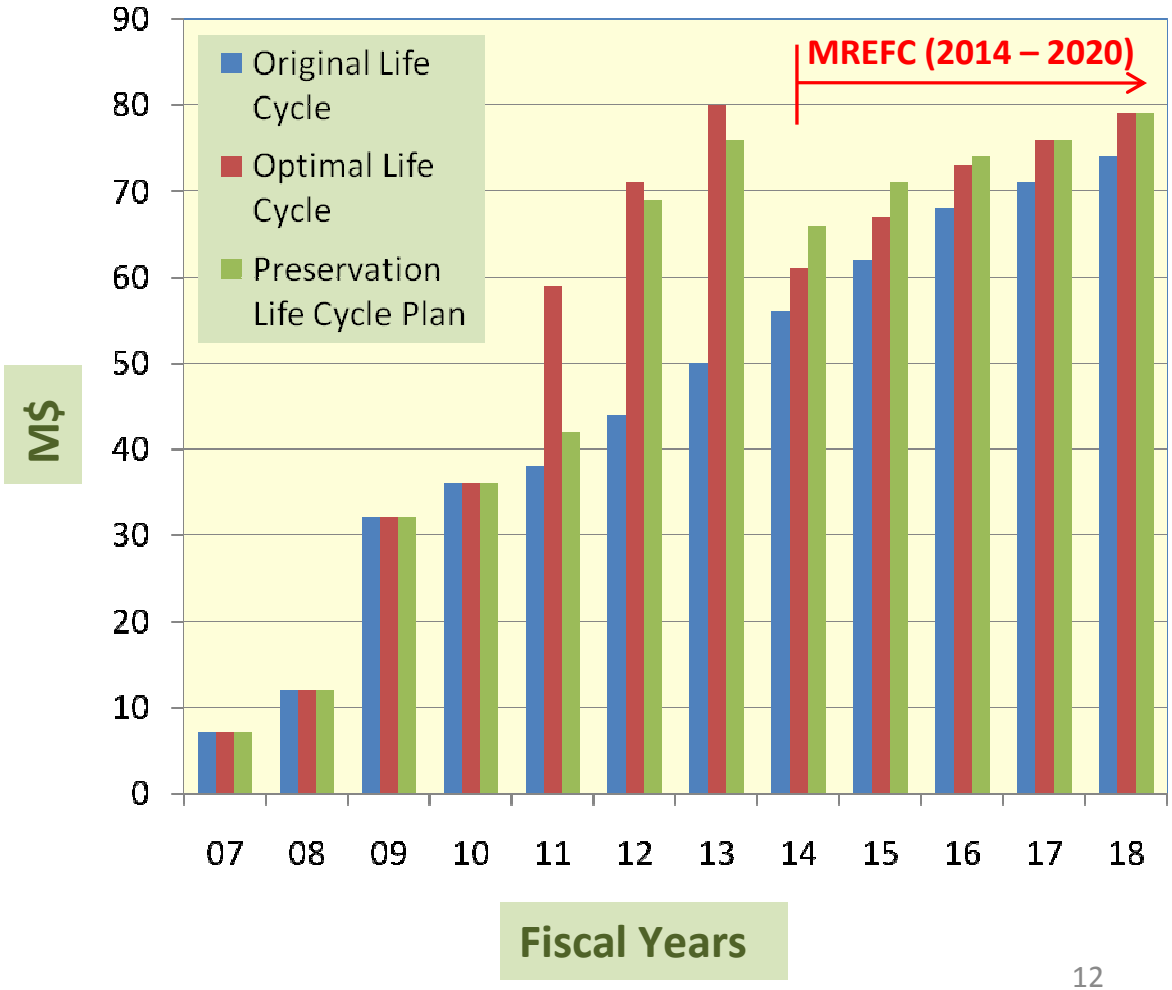
OHEP – Office of High Energy Physics
ONP – Office of Nuclear Physics

Budget sectors over time

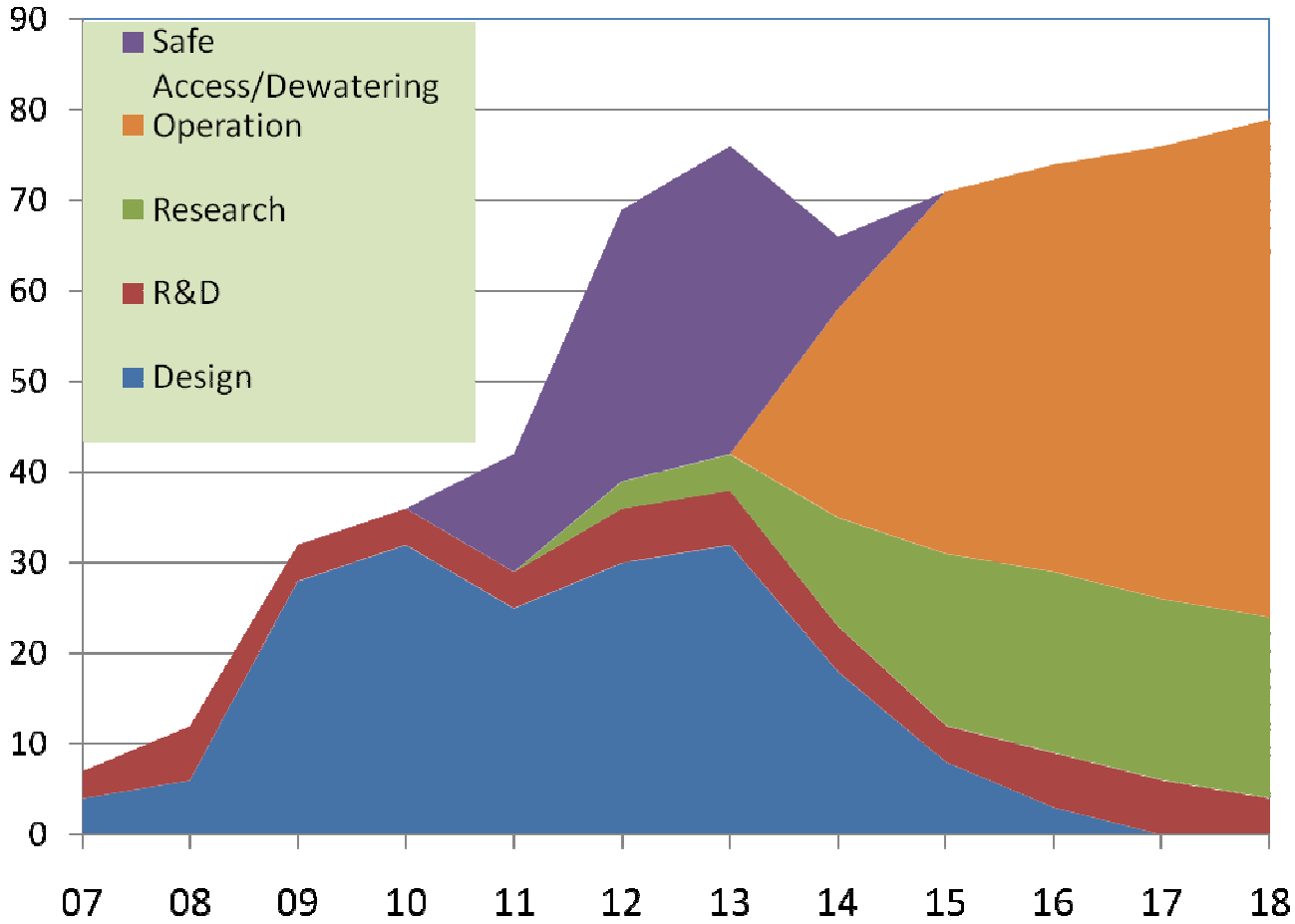


DUSEL R&RA Lifecycle Funding Plan

- *Original plan* agreed to by PHY, MPS and OD in 2009; majority of funds for design in early phases and transitions to operations in the later phases
- *Optimal plan* includes activities recommended by NSF review panels for safe access and preservation of infrastructure
- *Preservation plan* represents efforts to keep project viable and minimize budget impact in FY 2011



DUSEL Lifecycle R&RA Funds by Major Activity



DUSEL Awards To Date

DUSEL Awards FY07 – FY10	NSF Funding *(Rounded to nearest $M)*
Facility Design ***(awards to UCB)***	
S3	**15**
S3 Supplement	**3**
PDR ***award***	**29**
PDR Supplement	**5**
Subtotal Facility Design	**52**
Experimental Design	
S4 ***(Three year awards)***	**21**
DUSEL R&D	
Individual awards	**12**
Totals	**85**

South Dakota Contributions

- SDSTA has contributions of $127M for development of Sanford Laboratory
  - $70M private benefactor (Sanford)
  - $47M state SD (including $5M in 2010)
  - $10M HUD
- State and private funds support:
  - Planned education center
  - Partial refurbishment of 4850L & 7400L
  - Partial refurbishment of surface buildings
  - O&M of Sanford Laboratory activities
  - Early science program
- SDSTA began mine re-entry late July 2007
  - Dewatering & treatment began April 2008
  - Current water level at 5050

Sanford Laboratory Science Research Groups and Efforts

Physics
- **LUX-350** – Dark Matter
- **Majorana Demonstrator** – 0νββ
- **CUBED** – Crystal growth
- Bkgd Characterization – μ,n,γ, Rn
- Vertical Facility – Magnetic field

Biology
- Microbiology – Bang, Anderson
- Lignocellulose – Bleakley
- Manifold Sampling – Onstott, Pfiffner
- Microbiology – Sani

Geology
- CO_2 Sequestration – Environment
- DUGL – Seismic characterization
- Fiber Sensors – Ext, Temp
- Hydrology – SDSMT/Sanford/DUSEL
- PODS – Geology (pet,ore dep, structure)
- Tiltmeter – Water, Budker arrays
- Transparent Earth – Seismic

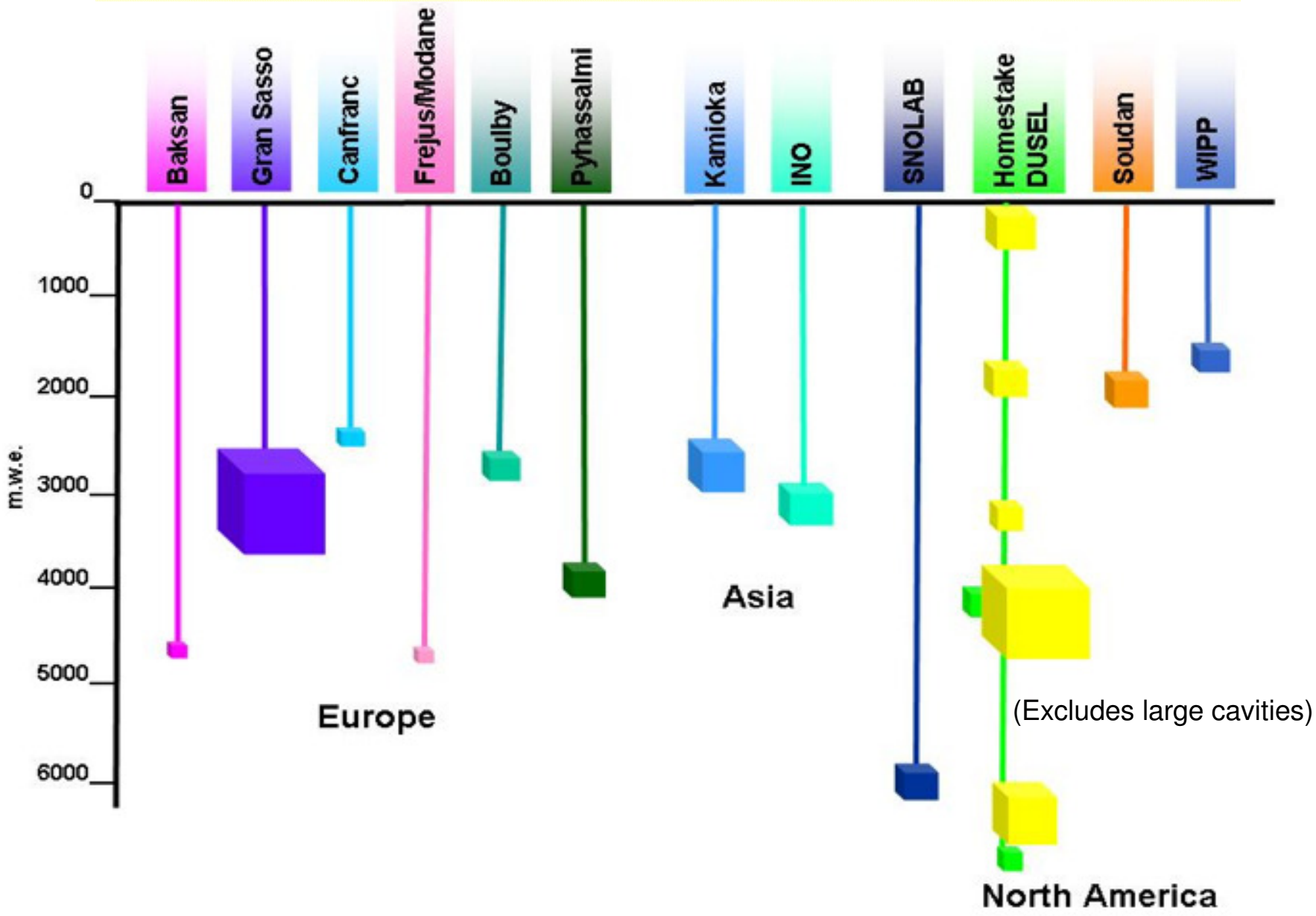
Engineering
- Signal Prop – Anagnostou

Others (Site Selection Only)
- Cummingtonite – Geology (Berman)
- THMCB – Geology (DUSEL S4)
- Vertical Array – Geology (Dahlgren)
- Submersible – Engineering (McGough)

Total Active = ~19 groups
(plus others)

Significant input to DUSEL EH&S, Operations, Design, Engineering, Construction, Outfitting, ...

Worldwide Underground Research



Final Comments

- Does the potential value of the research enabled by DUSEL warrant the investment from the national perspective in the current global context?
- Does the multidisciplinary scope add significantly to the potential payoff?
- What is the best framework for the interagency partnership?