

NSF-PHY News

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**NSAC
July 27, 2009**

NSF Budget

	FY 2008 Actual	FY 2009 Omnibus	FY 2009 ARRA	FY 2010 Request	Change over FY 2009	
Research & Related Activities	\$4,853.24	\$5,183.10	\$2,500.00	\$5,733.24	\$550.14	10.6%
Education & Human Resources	766.26	845.26	100.00	857.76	12.50	1.5%
MREFC	166.85	152.01	400.00	117.29	-34.72	-22.8%
Agency Operations & Award Management	282.04	294.00	0.00	318.37	24.37	8.3%
National Science Board	3.82	4.03	0.00	4.34	0.31	7.7%
Office of Inspector General	11.83	12.00	2.00	14.00	2.00	16.7%
Total, National Science Foundation	\$6,084.04	\$6,490.40	\$3,002.00	\$7,045.00	554.60	8.5%

Change over FY
2008: +961M,
+15.8%

R&RA Budget

	FY 2008 Actual	FY 2009 Omnibus	FY 2009 ARRA	FY 2010 Request	Change over FY 2009	
Biological Sciences	\$613.42	\$653.81	\$260.00	\$733.00	\$79.19	12.1%
Computer and Information Sci & Eng	535.26	573.74	235.00	633.00	59.26	10.3%
Engineering (<i>less SBIR/STTR</i>)	531.23	564.94	215.00	632.00	67.06	11.9%
SBIR/STTR	109.07	119.21	50.00	132.52	13.31	11.2%
Geosciences	757.87	807.13	347.00	909.00	101.87	12.6%
Math & Physical Sciences	1,171.13	1,255.96	490.00	1,380.00	124.04	9.9%
Social, Behavior, & Economic Sciences	215.18	229.80	85.00	257.00	27.20	11.8%
Office of Cyberinfrastructure	185.15	199.28	80.00	219.00	19.72	9.9%
Office of International Sci & Eng	47.77	44.03	14.00	49.00	4.97	11.3%
Office of Polar Programs	447.13	470.67	174.00	516.00	45.33	9.6%
Integrative Activities	238.56	263.03	550.00	271.12	8.09	3.1%
U.S. Arctic Research Commission	1.47	1.50	-	1.60	0.10	6.7%
Research & Related Activities	\$4,853.24	\$5,183.10	\$2,500.00	\$5,733.24	\$550.14	10.6%

MPS Budget

	FY 2008 Actual	FY 2009 Current Plan	FY 2009 ARRA	FY 2010 Request	Change over FY 2009 Current Plan	
					Amount	Percent
Astronomical Sciences	\$217.90	\$228.62	\$85.80	\$250.81	\$22.19	9.7%
Chemistry	194.62	211.35	103.00	238.60	27.25	12.9%
Materials Research	262.55	282.13	106.90	308.97	26.84	9.5%
Mathematical Sciences	211.75	226.18	98.00	246.41	20.23	8.9%
Physics	251.64	274.47	96.30	296.08	21.61	7.9%
Office of Multidisciplinary Activities	32.67	33.21	-	39.13	5.92	17.8%
Total, MPS	\$1,171.13	\$1,255.96	\$490.00	\$1,380.00	\$124.04	9.9%

MPS MREFC Projects

	FY 2008 Actual	FY 2009 Omnibus	FY 2009 ARRA	FY 2010 Request
AdvLIGO	\$32.75	\$51.43	-	\$46.30
ALMA	102.07	82.25	-	42.76
ATST	-	7.00	146.00	10.00
IceCube	18.74	11.33	-	0.95

AdvLIGO

Third year of a seven-year project that began in April 2008. Major initial activities include the placing of long lead-time orders and the preparation of the sites for the upgrade.

ALMA

Milestones for FY 2010 are expected to include:

- Acceptance of the first European antennas
- Acceptance of the eighth through fourteenth North American antennas
- Transport of several antennas to the final, high-altitude site in Chile
- Start of commissioning

ATST

It is anticipated that the federal environmental and cultural compliance activities will be completed in FY 2009 and construction will begin in early FY 2010. \$146.0 million of ARRA MREFC funding will initiate construction.

IceCube

Preliminary data acquisition with partial array underway; two seasons remain to completion on time and within budget

DUSEL Update

- **Scientific motivation**
- **Timeline**
- **Solicitation process**
- **Present Conceptual Layout**
- **Mining news (yes, mining)**
- **DOE-NSF DUSEL Physics JOG**
- **Global context**

Deep Underground Science and Engineering Laboratory (DUSEL) – What and Why?

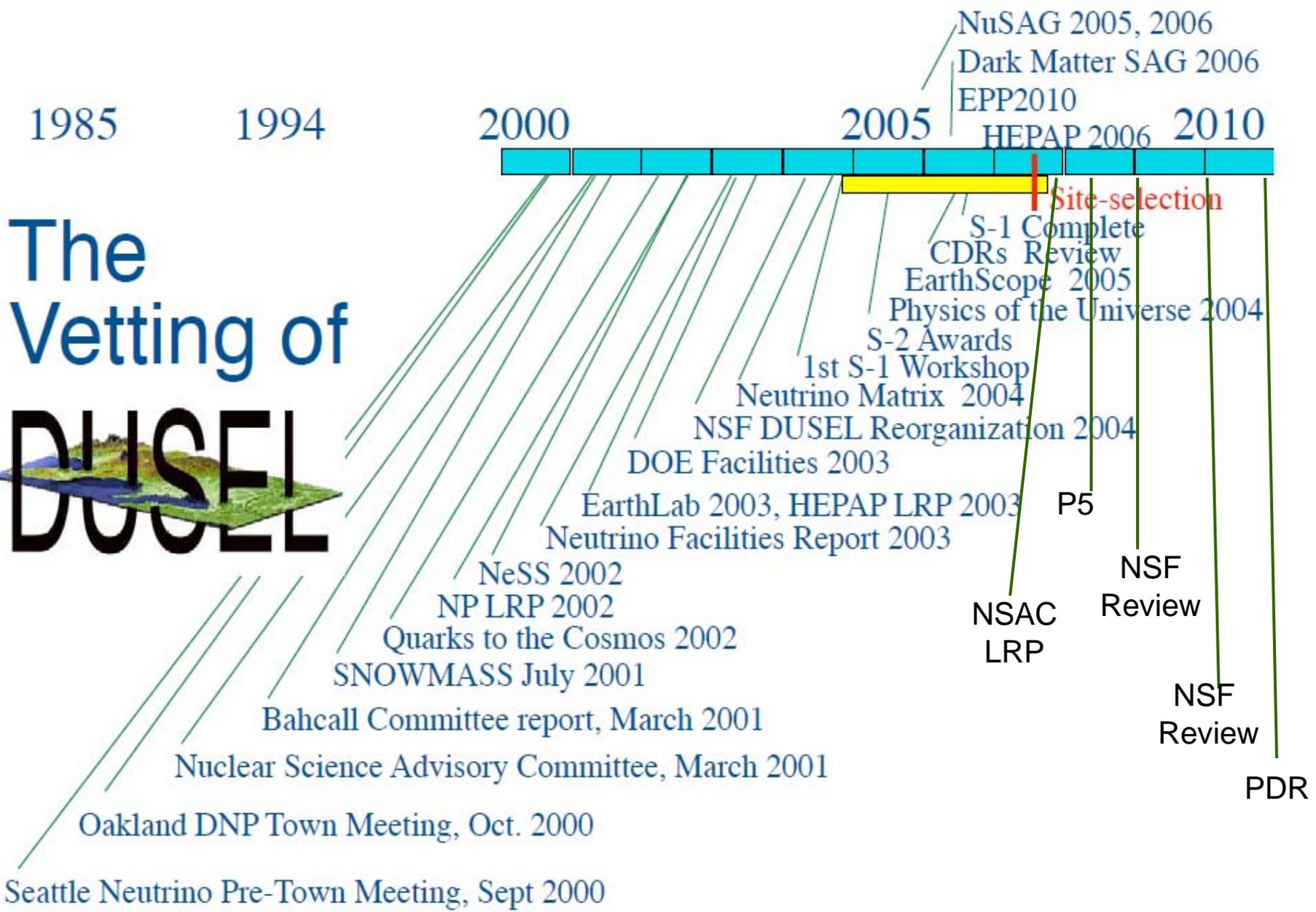
- DUSEL will support a set of potentially transformational physics experiments that require a deep underground location (free of cosmic rays) and the necessary infrastructure.
- The particle, nuclear, and astrophysics communities have selected DUSEL as central to their national programs.
- Although physics is the main cost driver, other communities remain actively engaged.



Fundamental Physics Questions Addressed by DUSEL

- We see only 4 percent of the mass of the universe; of what is the other 96 percent composed?
- Is visible matter stable?
- What are the mass and fundamental properties of the neutrino, and how can these inform our understanding of:
 - The matter/antimatter asymmetry in the universe?
 - The fundamental forces that govern physical laws?
 - Of what the universe is made; how the elements of the universe were created?
 - The origin and pattern of particle masses?
- What is the spectrum of neutrinos from supernovae and the Big Bang, and what can this tell us about the history and evolution of our universe?

The Vetting of DUSEL

DUSEL Solicitation Process

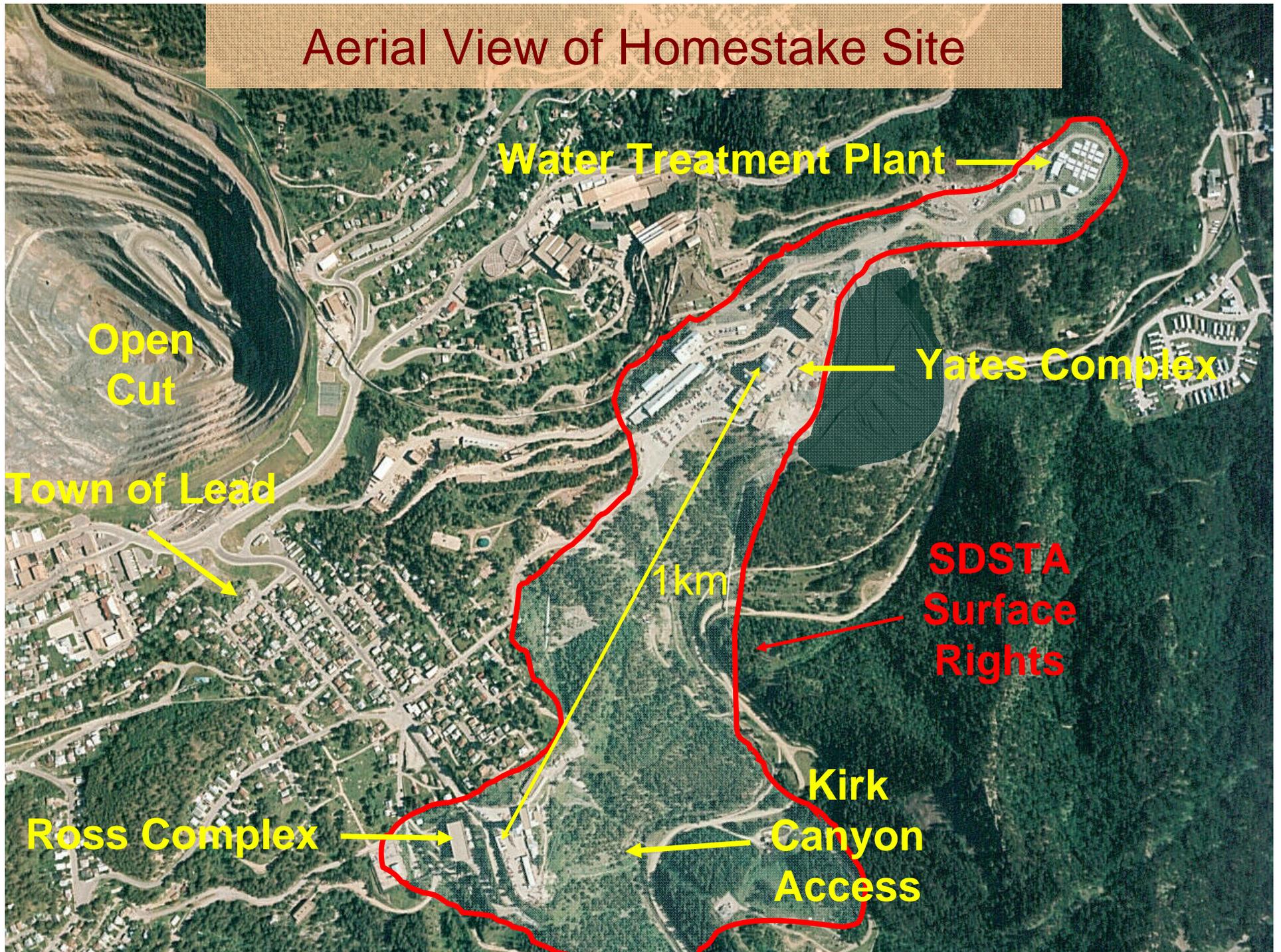
- Initiated at Town Meeting at NSF, March 2004.
- **Solicitation 1 (S1)**: define site-independent science scope and infrastructure needs; unify the community (awarded Jan 2005).
- **Solicitation 2 (S2)**: develop conceptual designs for one or more sites (two awarded, Sep 2005).
- **Solicitation 3 (S3)**: facility design for an MREFC candidate (one awarded – Homestake, U.C. Berkeley).
 - \$15M total over three years, starting in September 2007.
- **Solicitation 4 (S4, in clearance)**: technical designs for candidates for the DUSEL suite of experiments.
 - \$15M total over three years.

S3 & S4 enable initiation of design work for infrastructure, experiments & operations.

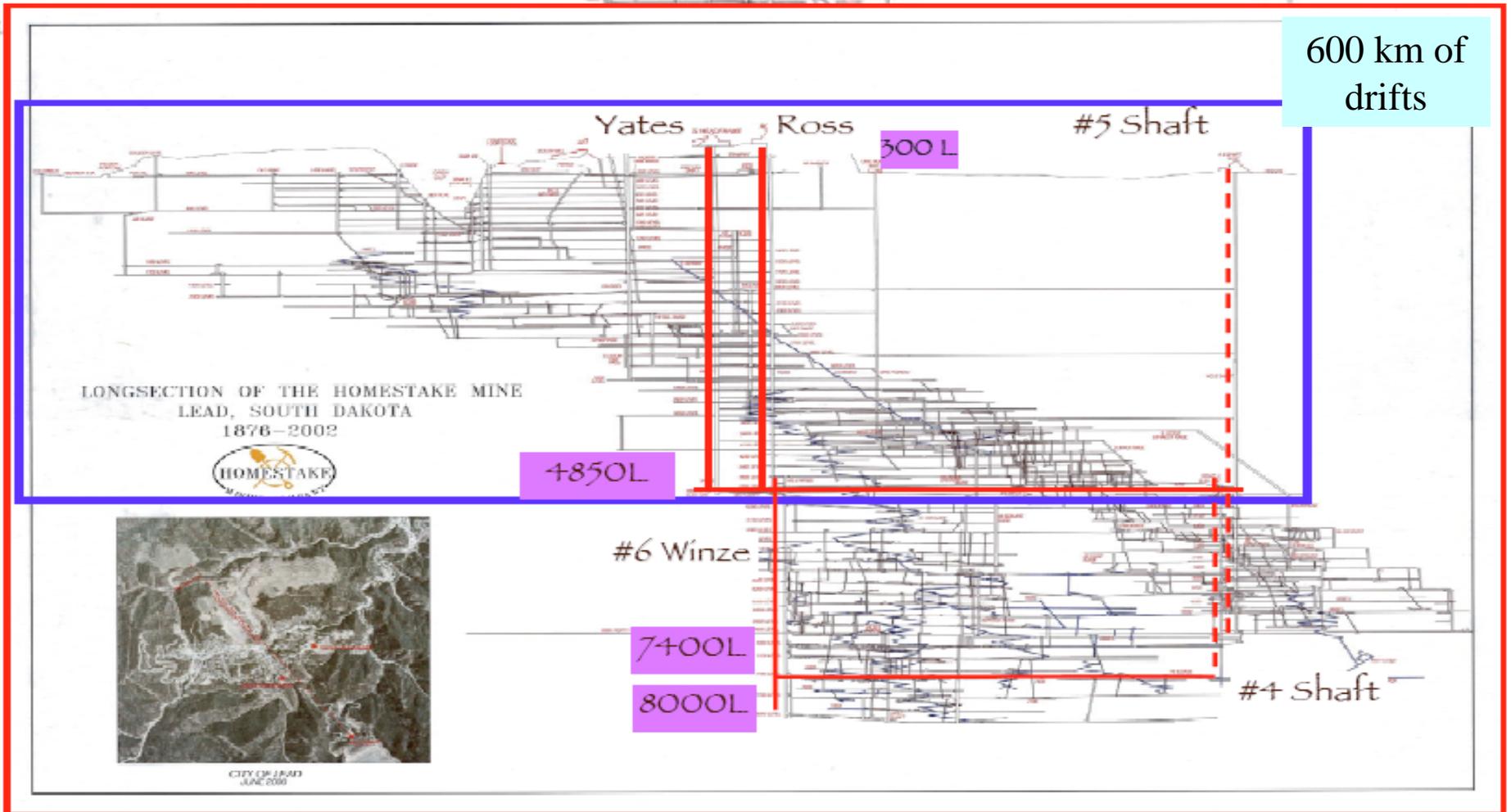
Solicitation 3: DUSEL Site Selection

- Goal was to select single site and team to develop technical design of the facility.
- Four proposals were reviewed by multidisciplinary 22-member expert panel.
- Review included site visits & reverse site visits.
- Panel unanimously voted by secret ballot to recommend the Homestake proposal to the NSF for funding. NSF concurred.
- Cooperative agreement to University of California, Berkeley in Sep 07. Total award \$15M over 3 years to start design work.

Aerial View of Homestake Site

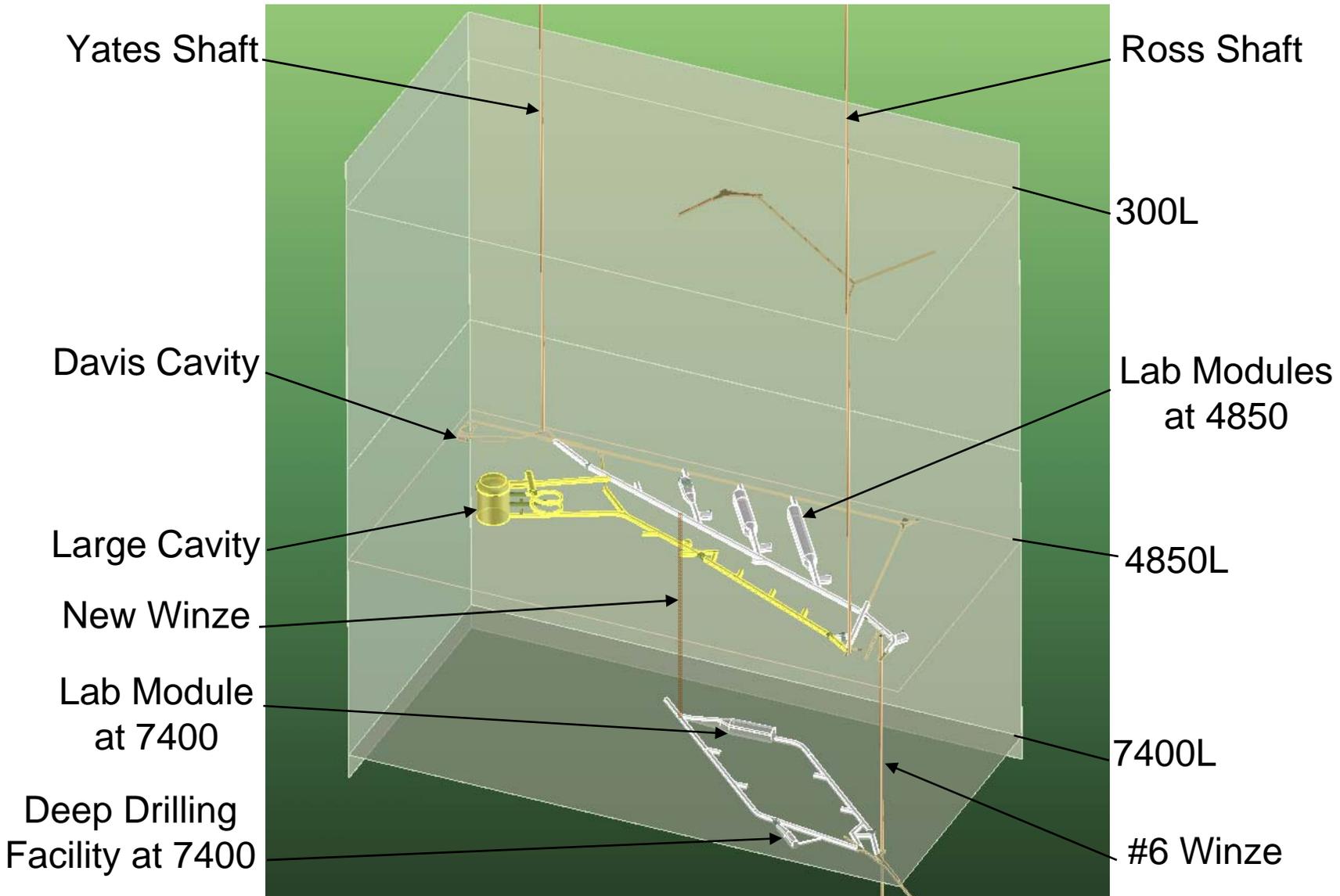


Homestake Mine Workings



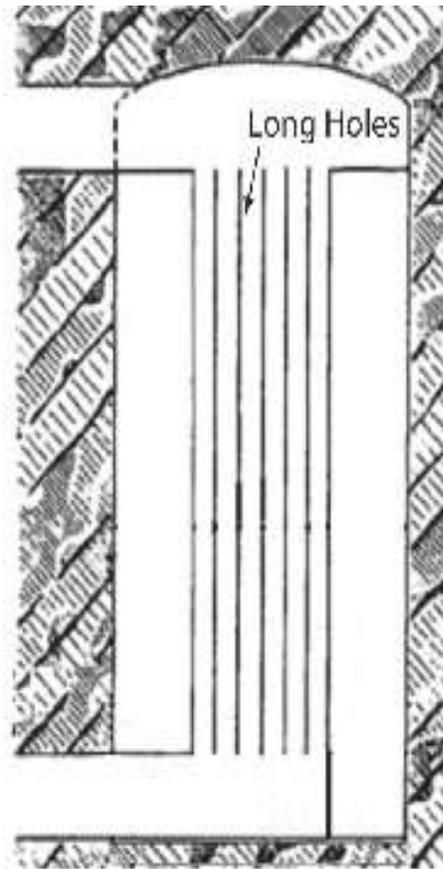
- South Dakota Science and Technology Authority (SDSTA) owns land (footprint and below) outright and in perpetuity.
- Future use dedicated to research and education.

Currently Envisioned DUSEL Laboratory Design

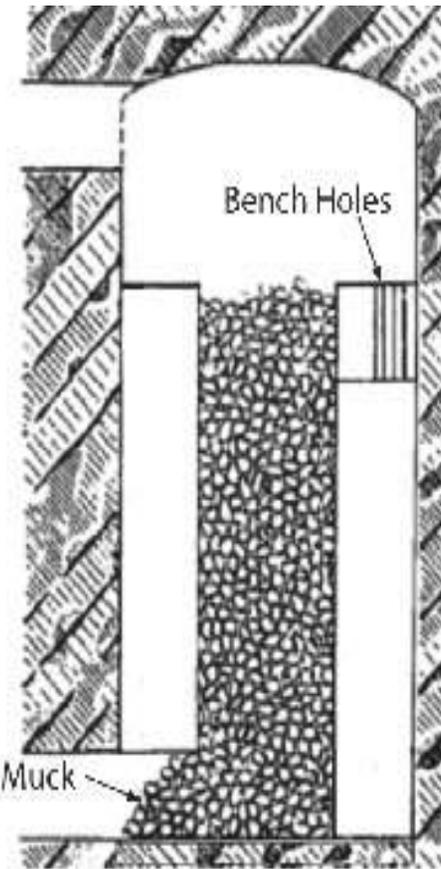




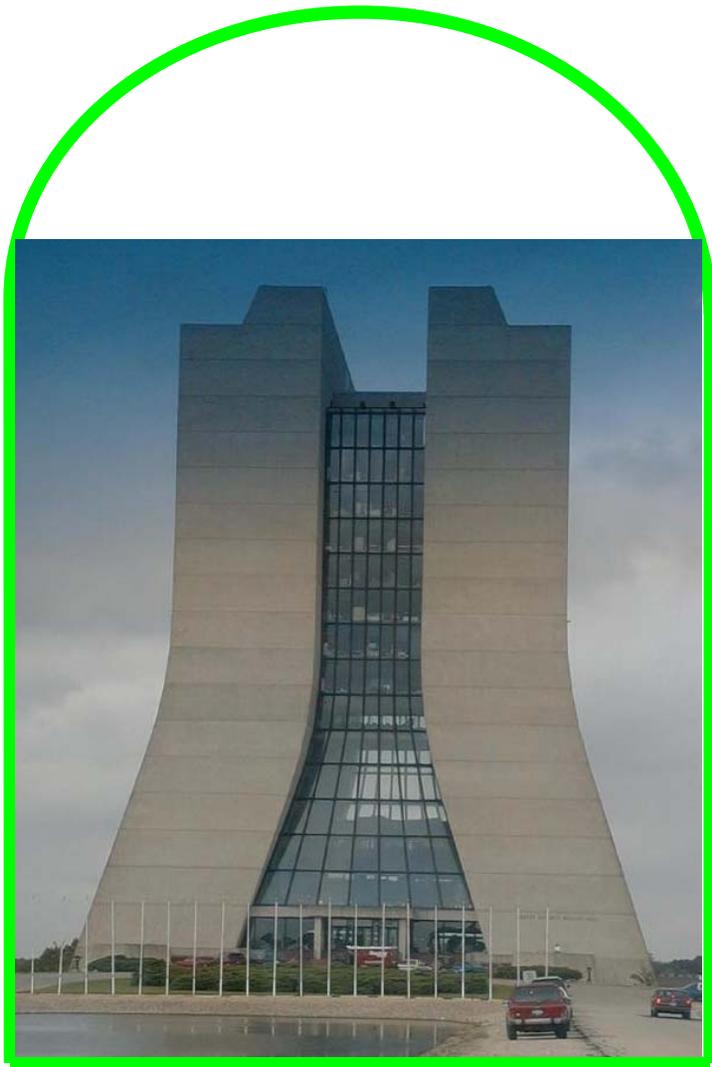
Stage 1



Stage 2

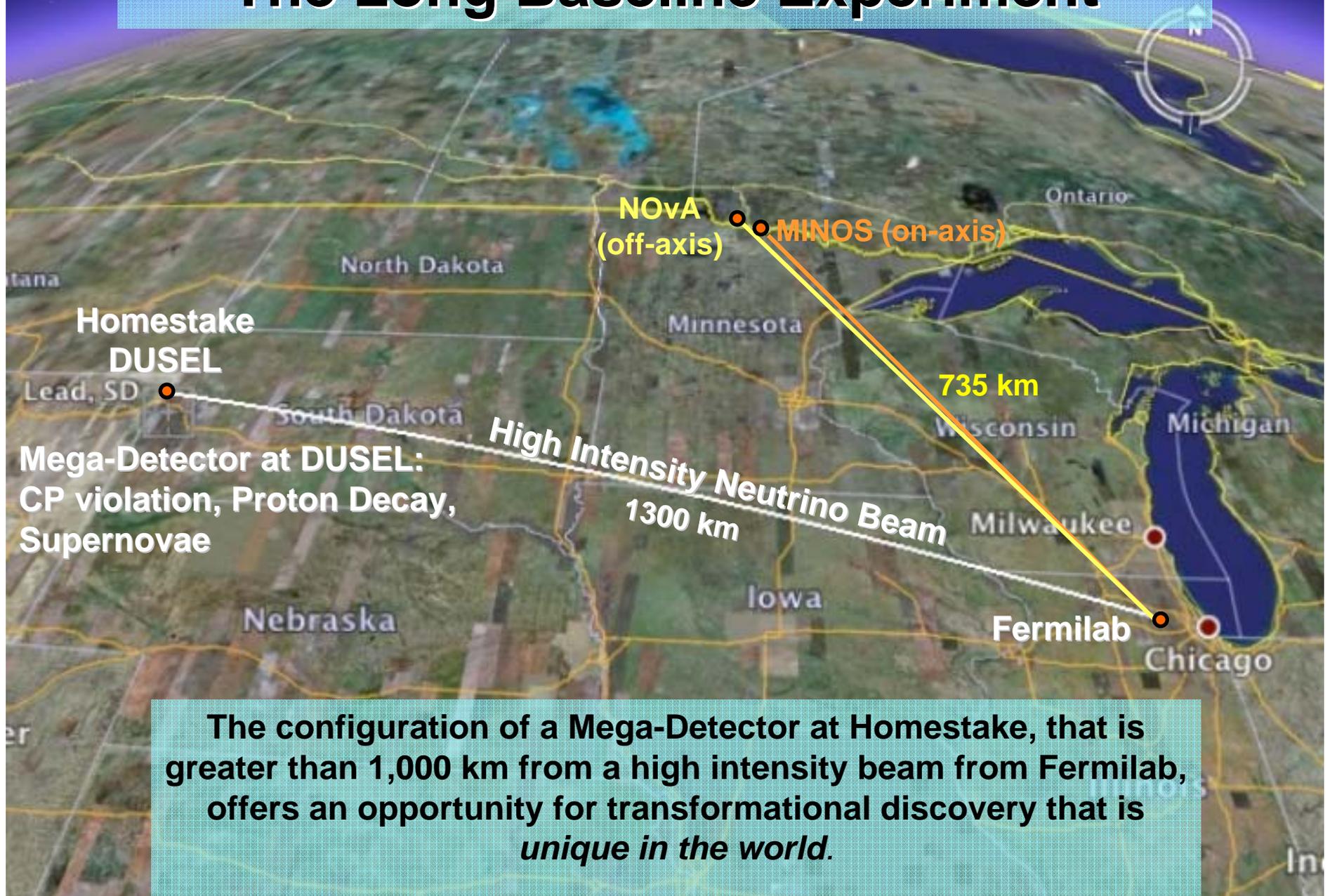


Stage 3





The Long Baseline Experiment



NSF & DOE Collaboration on DUSEL

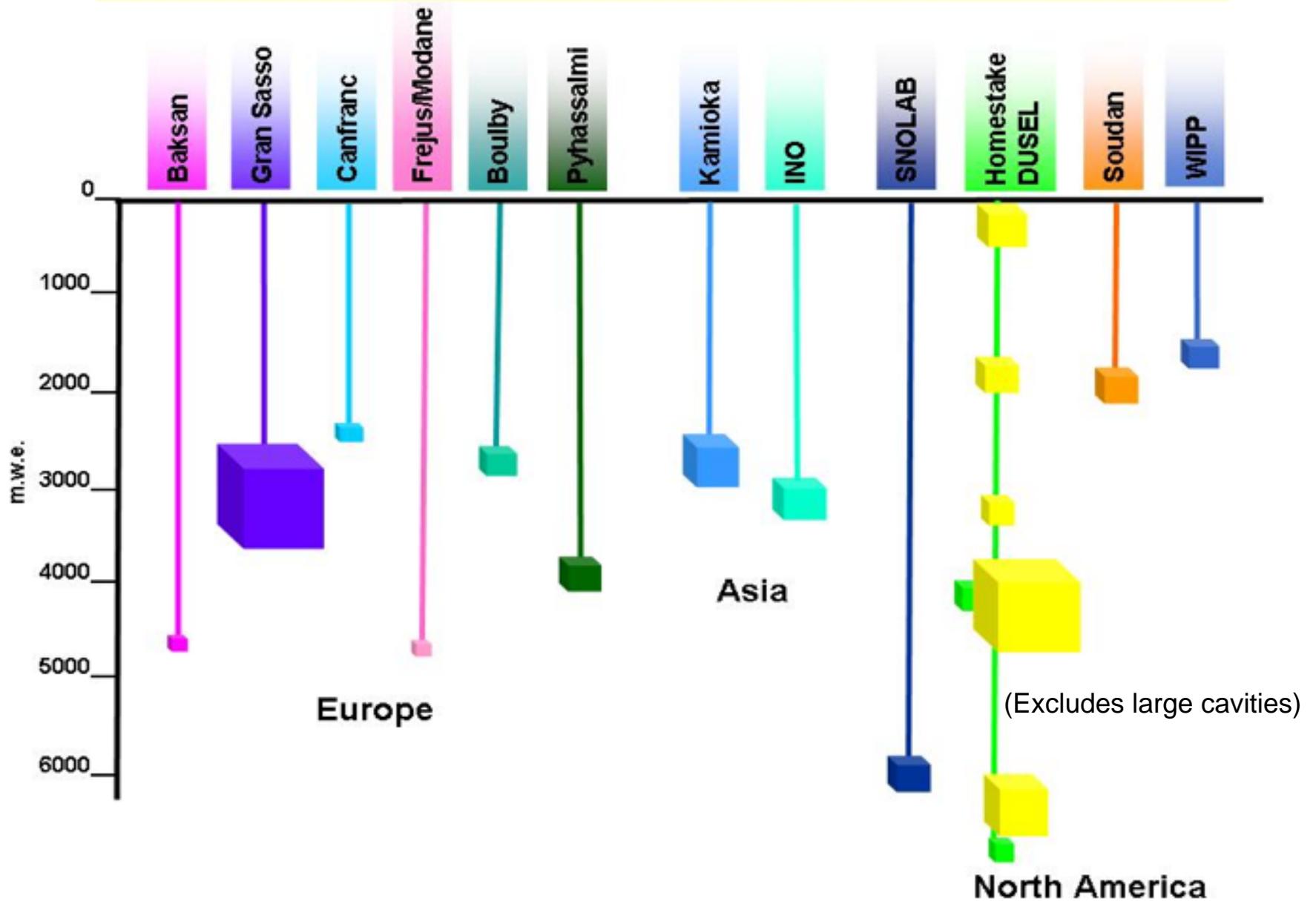
- NSF/DOE agreed to establish DUSEL Physics Joint Oversight Group (JOG) immediately after release of P5 report.
- Representation from NSF/PHY, DOE/OHEP, DOE/ONP.
- Builds on successful NSF & DOE collaboration on Large Hadron Collider (LHC) in high energy physics.
- Will jointly coordinate & oversee DUSEL experimental physics program.
- Meeting quarterly.
- Both agencies closely collaborating in defining and realizing the DUSEL physics program.

OHEP = DOE Office of High Energy Physics
ONP = DOE Office of Nuclear Physics

Status of Sanford Laboratory

- SDSTA holds \$124M for development of Sanford Laboratory.
 - \$70M private benefactor (Sanford), \$44M state SD, \$10M HUD.
- Will fund:
 - Education center.
 - Partial refurbishment of 4850L & 7400L.
 - O&M of Sanford Laboratory activities.
- \$60M released, in use.
- Key staffing continues.
 - Approximately 80 hired to date.
- SDSTA began mine re-entry late July 2007.
 - Dewatering & treatment began 21 April 2008.
- Main campus level at 4850L now dry.
- Local support, State's commitment quite impressive.

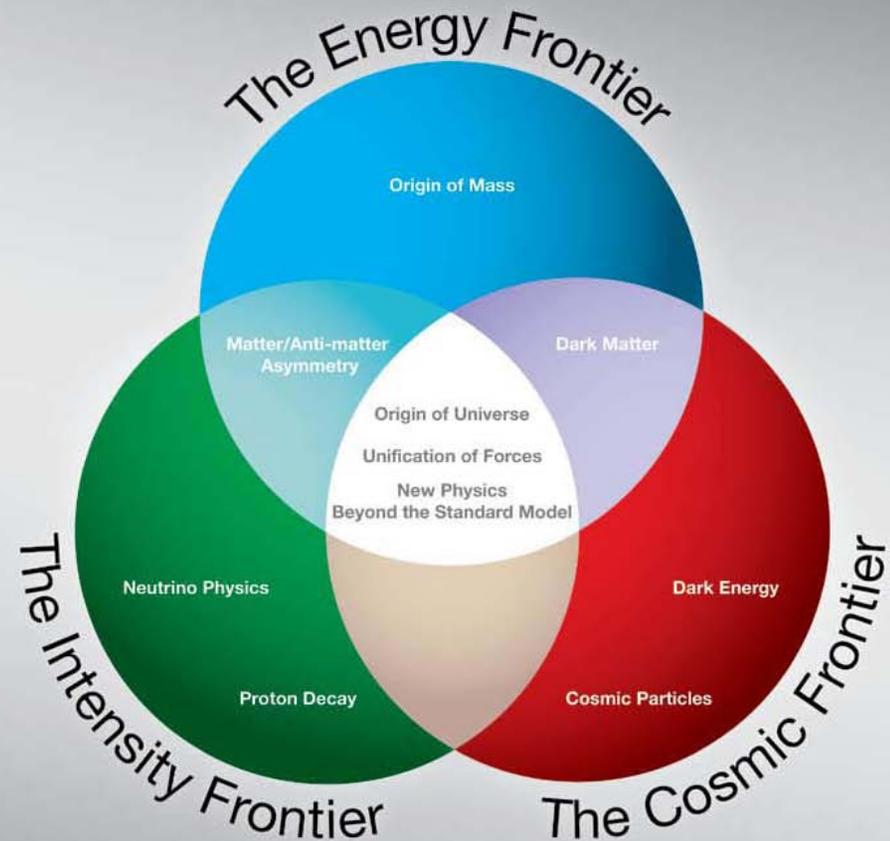
Worldwide Underground Research





Particle Physics Project Prioritization Panel (P5)

- The Particle Physics Project Prioritization Panel (P5) is a sub-panel of the High Energy Physics Advisory Panel (HEPAP).
- Charged in Jan 2008 by NSF and DOE with recommending a 10-year road map for particle physics.



The three frontiers of research in particle physics, as expressed by the P5 Panel, which form an interlocking framework that addresses fundamental questions about the laws of nature and the cosmos.

P5 Recommendations

- Report approved by HEPAP at their May 2008 meeting in Washington.
- From Executive Summary:

“The panel recommends a world-class neutrino program as a core component of the US program, with the long-term vision of a large detector in the proposed DUSEL laboratory and a high-intensity neutrino source at Fermilab.”

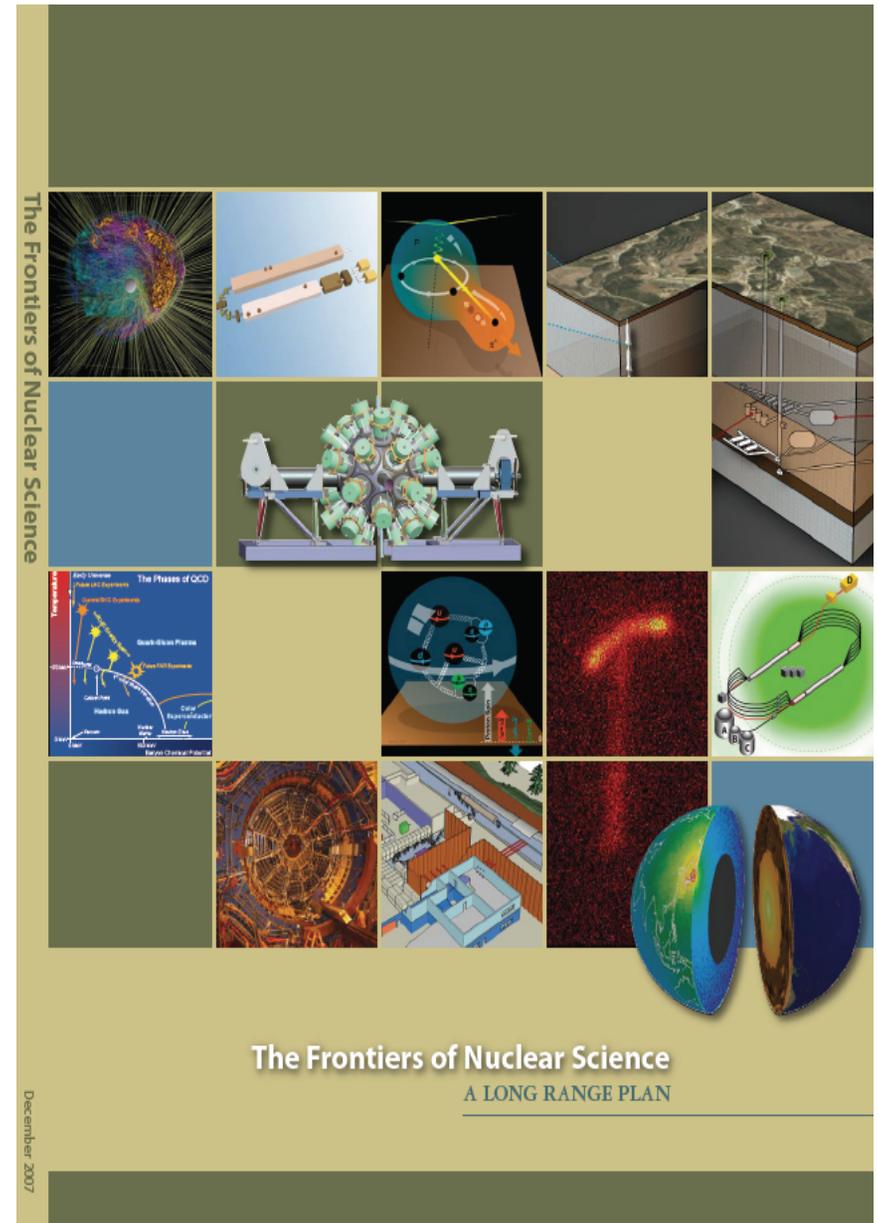
“The panel endorses the importance of a deep underground laboratory to particle physics and urges NSF to make this facility a reality as rapidly as possible. Furthermore the panel recommends that DOE and NSF work together to realize the experimental particle physics program at DUSEL.”

- Fermilab/DUSEL program recommended by P5 constitutes the primary element of the on-shore U.S. particle physics program during the coming decade.

Nuclear Science Advisory Committee (NSAC)

- NSAC charged by DOE and NSF in July 2006 with developing a long range (ten year) plan.
- From Dec 2007 report, Overview and Recommendations:

“We recommend a targeted program of experiments to investigate neutrino properties and fundamental symmetries. These experiments aim to discover the nature of the neutrino, yet-unseen violations of time-reversal symmetry, and other key ingredients of the New Standard Model of fundamental interactions. Construction of a Deep Underground Science and Engineering Laboratory is vital to U.S. leadership in core aspects of this initiative.”





Physics of the Universe

Summary of Recommendations

Ready for Immediate Investment and Direction Known

Dark Energy

- * NASA and DOE will develop a Joint Dark Energy Mission (JDEM). This mission would best serve the scientific community if launched by the middle of the next decade. Studies of approaches to the JDEM mission undertaken now will identify the best methodology.
- * A high-priority independent approach to place constraints on the nature of Dark Energy will be made by studying the weak lensing produced by Dark Matter. This is a scientific goal of the ground-based Large-aperture Synoptic Survey Telescope (LSST). Significant technology investments to enable the LSST are required, and NSF and DOE will begin technology development of detectors, optical testing, and software algorithms leading to possible construction with first operations in 2012. NASA will contribute their expertise as appropriate.
- * Another priority method to constrain Dark Energy will be to use clusters of galaxies observed by ground-based Cosmic Microwave Background (CMB) and space-based X-ray observations. A coordinated NSF and NASA effort using this technique will provide independent verification and increase the precision of the overall measurements.

Dark Matter, Neutrinos, and Proton Decay

- * NSF will be the lead agency for concept development for an underground facility. NSF will develop a roadmap for underground science by the end of 2004.
- * NSF and DOE will work together to identify a core suite of physics experiments. This will include research and development needs for specific experiments, associated technology needs, physical specifications, and preliminary cost estimates.

Gravity

- * NSF, NASA, and DOE will strengthen numerical relativity research in order to more accurately simulate the sources of gravitational waves.
- * The timely upgrade of Laser Interferometer Gravitational wave Observatory (LIGO) and execution of the Laser Interferometer Space Antenna (LISA) mission are necessary to open this powerful new window on the universe and create the new field of gravitational wave astronomy.

Next Steps for Future Investments

Origin of Heavy Elements

- * DOE and NSF will generate a scientific roadmap for the proposed Rare Isotope Accelerator (RIA) in the context of existing and planned nuclear physics facilities worldwide.
- * DOE and NSF will develop a roadmap that lays out the major components of a national nuclear astrophysics program, including major scientific objectives and milestones, required hardware and facility investments, and an optimization of large-scale simulation efforts.

Birth of the Universe Using Cosmic Microwave Background

- * The three agencies will work together to develop by 2005 a roadmap for decisive measurements of both types of CMB polarization. The roadmap will address needed technology development and ground-based, balloon-based, and space-based CMB polarization measurements.

High Density and Temperature Physics

- * In order to develop a balanced, comprehensive program, NSF will work with DOE, NIST, and NASA to develop a science driven roadmap that lays out the major components of a national High Energy Density Physics (HEDP) program, including major scientific objectives and milestones and recommended facility modifications and upgrades.
- * NNSA will add a high energy high-intensity laser capability to at least one of its major compression facilities in order to observe and characterize the dynamic behavior of high-energy-density matter.
- * DOE and NSF will develop a scientific roadmap for the luminosity upgrade of the The Relativistic Heavy Ion Collider (RHIC) in order to maximize the scientific impact of RHIC on High Energy Density (HED) physics.



A 21ST CENTURY FRONTIER FOR DISCOVERY THE PHYSICS OF THE UNIVERSE

A STRATEGIC PLAN FOR FEDERAL RESEARCH AT THE INTERSECTION OF PHYSICS AND ASTRONOMY



DUSEL Life Cycle Planning: August Action Item

- **PHY has constructed a DUSEL R&RA life cycle plan.**
- **Activities include design, R&D, O&M, and research by DUSEL physics groups.**
- **Source of funds agreed to by OD, MPS, & PHY in March 2009.**
- **This action will be governed by a Cooperative Agreement that will lead to a Preliminary Design Review targeted for December 2010.**