Committee to Evaluate DOE-SC Options for Underground Science

Briefing to NSAC

July 1, 2011

Mark Reichanadter

Committee Co-chair

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Charge to the Committee

- Help define cost-effective options for planned underground experiments, and strategies for implementing a world-class program of underground science, consistent with SC's mission in High Energy and Nuclear Physics.
  - Experiments – long baseline neutrino experiment (LBNE), 3rd generation dark matter (3G DM), 1-ton scale neutrinoless double-beta decay (DBD)
  - Assess cost and schedule estimates for deploying these experiments
  - Review will provide the “baseline” needed for budget planning and discussion of strategies going forward.

The Charge - Scenarios to Consider

At Homestake Mine

1. A long baseline neutrino experiment (LBNE) using water Cherenkov detectors (WCD) located on the 4850ft level near the existing Sanford Laboratory's Davis Campus.
2. A LBNE using LAr detectors located at a shallow campus (800ft level), including the resource need to carry out a program of R&D necessary to prove the scalability of LAr technology to 17 kilotons.
3. A 3rd generation dark matter (3G DM) experiment located on the 4850ft level.
4. A ton-scale neutrinoless double-beta decay (DBD) experiment located on the 4850ft level.
5. A 3G DM experiment located on the 7400ft level.
6. A ton-scale neutrinoless DBD experiment located on the 7400ft level.

At SNOLAB

7. A 3G DM experiment located at the Sudbury Neutrino Observatory (SNOLAB) at 6800ft.
8. A ton-scale neutrinoless DBD experiment located at the SNOLAB at 6800ft.

Added by committee - Scenario 9 with a LBNE using a WCD at 4850ft and LAr detector at 800ft. (designated 1+1)

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This Review Did Not –

(As presented by Tim Hallman at SLAC meeting)

- Evaluate the compelling nature of the science or set science priorities
- Review the DUSEL project
- Consider strategies for the further future of DUSEL
- Pick winners and losers
- Consider the full range of possible sites, alternate technologies, etc.

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Review Committee Membership

- **Co-chairs** – Jay Marx (Caltech), Mark Reichanadter (SLAC)
- **Physics Issues** – Mel Shochet* (U. Chicago), Stuart Henderson (FNAL)
- **Dark Matter** – Marty Breidenbach* (SLAC), Susan Seestrom (LANL)
- **Double-Beta Decay** – James Symons* (LBNL), Howard Gordon (BNL)
- **LBNE** – Janet Conrad* (MIT), Stan Wojcicki (Stanford), Frank Sciulli (Columbia)
- **Conventional/Underground Facilities** – Dixon Bogert* (FNAL), Frank Kornegay (ORNL), Chris Laughton (Consultant), William Miller (Soudan), Toby Wrightman (Consultant)
- **Cost/Schedule** – Suzanne Herron* (ORNL), Ron Lutha (DOE), Steve Meador (DOE)

*-- subgroup leader

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Review Committee Process

- Committee considered input from
  - The Long Baseline Neutrino Experiment (LBNE)
    - Fermilab and LBNE Collaboration
  - Representatives of dark matter and neutrinoless double-beta decay experiments
  - The NSF supported DUSEL Project Team
  - The Sanford Laboratory
  - The Sudbury Neutrino Observatory
- Over 3 days heard presentations from representatives of these activities and from the larger scientific community
  - Speakers were well prepared and engaged in candid, effective discussions with the committee
- Members of committee visited both Homestake mine and SNOLAB.
- In addition, numerous meetings of subcommittees were held to evaluate input material

Response to Specific Charge Scenarios

- The committee provides an assessment for each of the specific charge scenarios.
- This assessment attempts to capture, at a high level, the readiness, technical risks as well as design, construction and operations costs and schedule for each of the scenarios.
- Not a Lehman-type cost/schedule review. Committee costs are simple top-down evaluations based on estimates provided us by proponents.
  - Estimates are in current-year dollars and conditions.
    - We note that inflation can be a very significant cost risk over time scale of these experiments; e.g. 3.5% escalation over ten years, increases the actual year TPC by ~40%.
  - We used a standard rule for adjusting contingency based on design maturity – pre-conceptual 50%, conceptual 40%

Charge Scenario #1
LBNE using WC Detector at 4850ft at Homestake

- This option was considered viable and the most cost effective option for LBNE physics, given uncertainties in LAr (scenario 2)
  - TPC range 1.2B – 1.5B (FY11$), including 50% contingency and infrastructure costs
    - Shafts need full upgrade to support safe/effective construction and operations (high-end cost est.)
    - Assumes 700kW beam, not Project X.
- Design Status: WCD Pre-conceptual (approaching CD-1)
  - WC Detector technology is mature.
  - Detailed design on caverns and detector can begin immediately.
  - Could simplify near detector design
- Primary areas of risk
  - General underground construction; e.g. underground cavern span (65m)
  - Fermilab site boundary limitation complicates beamline design.

Charge Scenario #2--LBNE using LAr Detector at 800ft at Homestake; including R&D program to prove scalability of LAr technology

- LAr technology needs multi-year R&D to prove viability. Earliest date for decision ~2015
  - TPC range 1.0B – 1.4B (FY11$), including 50% contingency, infrastructure costs, and costs for LAr R&D already underway
  - Note- at this time considered less “cost effective” than scenario #1 due to additional escalation during 4-5-years to complete R&D; risk of LAr being very costly
- Design Status: Pre-conceptual
- Fermilab scope of work (neutrino source, near detector) is comparable for WCD or LAr
- Primary areas of risk
  - LAr technology may not be workable or cost prohibitive.
  - Unknown conditions – 800ft level not well characterized
  - LAr cryogenic safety concerns in an underground cavern.

Note: DM and/or DBD experiments not viable at the 800ft level

Charge Scenario #3
A 3rd Gen DM Experiment at 4850ft at Homestake

- A 3G DM experiment is a viable, cost-effective option if LBNE detector at 4850ft and LBNE supports infrastructure costs. It is not considered cost-effective as a stand-alone experiment.
  - TPC ~0.3B (FY11$), including 40-50% contingency; with LBNE sharing infrastructure costs
- Design Status: Roughly conceptual
- Primary areas of risk
  - Whether additional background at 4850ft compared to 7400ft can be mitigated with additional shielding
  - Risks from being underground

Note: US community consensus is that two complementary DM experiments are needed

Charge Scenario #4-- A Ton-scale Neutrinoless DBD Experiment at 4850ft at Homestake

- A DBD experiment is a viable, cost-effective option if LBNE detector at 4850ft and LBNE supports infrastructure costs. It is not considered cost-effective as a stand-alone experiment.
  - TPC ~0.4B (FY11$), including 40-50% contingency; with LBNE sharing infrastructure costs
- Design Status: Pre-conceptual
- Primary area of risk
  - DBD experiments at the ton-scale do not exist today. 3-4 years R&D and operating smaller detectors needed to confirm path forward
  - Extensive R&D program currently underway to determine whether additional background at 4850ft compared to 7400ft can be mitigated with additional shielding
  - Risks from being underground

Charge Scenario #5

A 3rd Gen DM Experiment at 7400ft at Homestake

- A 3G DM experiment is considered viable at 7400ft. It is not considered cost effective due to substantial infrastructure costs and uncertainties at the 7400ft level.
  - TPC ~0.7B (FY11$), including 40-50% contingency
- Design Status: Roughly conceptual
- Primary areas of risk
  - The 7400ft level is currently under water, will be for several years, and there has been no site specific site investigation. This leads to high uncertainties in infrastructure costs.

Note: US community consensus is that two complementary DM experiments are needed.

Charge Scenario #6-- A Ton-scale Neutrinoless DBD Experiment at 7400ft at Homestake

- A DBD experiment is considered viable at 7400ft. It is not considered cost effective due to substantial infrastructure costs and uncertainties at the 7400ft level.
  - TPC ~0.9B (FY11$), including 40-50% contingency
- Design Status: Roughly conceptual
- Primary areas of risk
  - The 7400ft level is currently under water, will be for about several years, limiting site specific site investigation. This leads to high uncertainties in infrastructure costs.
  - DBD experiments at the ton-scale do not exist today. 3-4 years R&D and operating smaller detectors needed to confirm path forward.

Charge Scenario #7
A 3rd Gen DM Experiment at 6800ft at the SNOLAB

- A 3G DM experiment is considered viable at SNOLAB and appears to be the most cost effective option.
  - TPC ~0.2B (FY11$) including 40-50% contingency
    - Careful study of infrastructure costs has not been done; only rough estimate included in TPC
- Design Status: Roughly conceptual
- SNOLAB is an operating underground science lab. Much experience with constructing underground science facilities (clean rooms, cryogens)
- Primary areas of risk
  - Canadian cost/liability uncertainties
  - Coordinating with a commercial mining operation (or could be a benefit)

Charge Scenario #8

A Ton-scale Neutrinoless DBD Experiment at 6800ft at SNOLAB

- A DBD experiment is considered viable at SNOLAB and appears to be the most cost effective option.
  - TPC ~0.3B, including 50% contingency
  - Careful study of infrastructure costs has not been done; only a rough estimate included in TPC
- Design Status: Pre-conceptual
- SNOLAB is an operating underground science lab. Much experience with constructing underground science facilities (clean rooms, cryogens)
- Primary areas of risk
  - DBD experiments at the ton-scale do not exist today. 3-4 years R&D and operating smaller detectors needed to confirm path forward.
  - Canadian cost/liability uncertainties
  - Coordinating with a commercial mining operation (or could be a benefit)

Scenario #9 LBNE 1 + 1: WCD Detector @ 4850ft; advancing LAr R&D program to prove scalability; then add LAr detector at 800ft

- 1+1 allows WCD to move forward today while continuing LAr R&D at a modest cost aimed at adding a LAr detector at later time.
  - Each detector would be smaller than in single technology scenarios 1 & 2
  - Should LAr not prove viable, additional WCD detector can be added to do full neutrino physics program.
  - LBNE Collaboration favors 1 + 1
- Total cost of 1+1 is dominated by infrastructure costs and could be significantly larger than scenarios 1 or 2. More study is needed.
  - Fermilab scope of work comparable with scenarios 1 & 2

Scenario #9 LBNE 1 + 1: WCD Detector @ 4850ft; advancing LAr R&D program to prove scalability; then add LAr detector at 800ft

- Opportunities
  - Get physics started at lower initial cost than scenarios 1 or 2
  - WCD and LAr detectors have complementary capabilities- different systematics and sensitivity to different final states.
  - Deciding early on WCD at 4850ft, allows decision to be made for doing DM and DBD at Homestake.
- Risks– see scenarios 1 & 2
  - But smaller detectors mean smaller caverns, and a reduction in associated risk

Review Committee Major Conclusions

- Major conclusions seek to capture the most important findings and results of the committee's evaluation of the extensive input received and reviewed.
- Conclusions summarize the overall time horizon and scale of investment that would be needed to carry forward a cutting edge program in underground science to study CP violation in the neutrino sector, the origin of dark matter, and the neutrino mass and mass hierarchy
- Committee recognizes the advantages and opportunities in developing a common site for these experiments *if the needed infrastructure can be shared in a cost-effective manner.*

Review Committee Major Conclusion #1

- The committee concludes that at the current level of maturity of the cost estimates for the three experiments, the cost estimates for the 3G DM and ton-scale DBD experiments should be taken as accurate to about 1 significant figure.
- The cost estimates for the LBNE and associated infrastructure costs are more mature; however, they are not greater than the conceptual design level.

Review Committee Major Conclusion #2

- The committee's overall evaluation of the likely costs (TPC) of the three experiments is:
  - LBNE
    - Including detectors, beamline, and infrastructure
    - Approximately 1.2-1.5B in FY11$
  - Each 3G DM experiment
    - Approximately 0.1B in FY11$ (infrastructure not included; site dependent-specified in conclusion #3)
  - Each ton-scale DBD experiment
    - Approximately 0.2-0.3B in FY11$ (infrastructure not included; site dependent-specified in conclusion #3)
- Operations costs (FY11$)
  - LBNE detector alone & Homestake infrastructure -- $18-23M/year
  - DM or DBD-- without LBNE, including Homestake infrastructure ~$20M/year; ~$2-3M/year marginal operations cost if LBNE already established
  - DM or DBD at SNOLab ~$2-3M; further work to understand if any shared facility/infrastructure operations costs

Review Committee Major Conclusion #3

- With LBNE at 4850ft level at Homestake, the additional cost of infrastructure to allow construction of 3G DM or ton-scale DBD experiments is:
  - Approximately 0.15B in FY11$ for the first experiment and ~$15M for each subsequent experiment if infrastructure for all is done up front.
- This would exceed the infrastructure costs at SNOLAB for a single DM or DBD experiment by something like $100M.
  - Adding a second DM or DBD experiment at Homestake 4850ft level requires infrastructure cost roughly that of SNOLAB

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Review Committee Major Conclusion #4

- It is not cost effective to consider 3G DM or ton-scale DBD experiments as stand-alone experiments at Homestake because of infrastructure costs, unless there are three or more of these experiments that would be constructed at the same level so the infrastructure costs could be shared.

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Review Committee Major Conclusion #5

- Constructing the 3G DM or ton-scale DBD experiments at the 7400ft level at Homestake appears to be prohibitively expensive because of infrastructure costs and uncertainties.
  - The DM experiments can likely be accomplished at the 4850ft level with additional shielding.
  - Whether shielding can be sufficient for DBD experiments at the 4850ft level will not be known for several years.

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Review Committee Major Conclusion #6

- Significant investments in infrastructure will be necessary to safely construct, commission and operate a modern underground laboratory at Homestake.
  - Modernizing the Yates and Ross shafts at Homestake are necessary prerequisites and should not be considered an opportunity for ‘value engineering’.

Review Committee Major Conclusion #7

- Constructing a 3G DM or ton-scale DBD experiment at SNOLAB appears to be the most cost effective option even if a U.S. investment is needed to dig and outfit a pit and provide utilities and other support. This should be verified by detailed studies.

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Review Committee Major Conclusion #8

- The time needed to carry out the three experiments (LBNE, ton-scale DBD and 3G DM experiments) will extend over two decades or more from now, including about one decade before data taking begins.
  - In each case it is quite likely that there will be upgrades and follow-on experiments that will further extend the time scale of these physics programs.

Review Committee Major Conclusion #9

- Given the scale of investment needed to carry out these experiments and the long timescales and likelihood of follow-on experiments in each of these areas of research, the committee recognizes there are major advantages to developing a common underground site for these experiments.

Review Committee Major Conclusion #9 (cont.)

- Advantages include
  - Opportunities to share expensive infrastructure and coordinate design efforts, construction, management and operations.
  - Significant benefits in training of the next and subsequent generations of scientists by having a common facility serve as an intellectual center in these fields of research.

Locating the facility in the U.S. would help to promote U.S. leadership in these fields for the foreseeable future.

Review Committee Major Conclusion #10

- The LBNE technology choice (water Cherenkov vs. liquid argon TPC) strongly impacts the strategic options for siting 3G DM and ton-scale DBD experiments.
  - If the LBNE choice is a WCD at the 4850ft level at Homestake, then the 3G DM and/or ton-scale DBD experiments at the 4850ft level becomes significantly more cost effective.
  - If the LBNE technology is a LAr detector closer to the surface then this would not be so.

Therefore the committee emphasizes there is a very significant strategic benefit to making the LBNE technology choice as soon as possible.

Review Committee Major Conclusion #11

- A "1+1 Option" for LBNE (WCD at 4850ft level plus a LAr detector at 800ft level) is discussed in the report even though not in the charge.
  - There may be considerable physics advantages due to complementary detectors (different systematic uncertainties for neutrino oscillations and sensitivity to different channels in proton decay and supernova detection, get physics started at lower initial cost), but further study is necessary.
  - Implementing a WCD initially, while continuing with LAr R&D for possibly adding this capability later would be an option that is consistent with sharing infrastructure between LBNE, the DBD and DM experiments at Homestake 4850ft level.

Summary

- The committee believes there are compelling scientific motivations for all three experiments and ***an important opportunity for the U.S. to take a leadership position for the foreseeable future.***
- There are important advantages and opportunities in developing a common site for these experiments *if the needed infrastructure can be shared in a cost-effective manner*.

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Summary (cont.)

- A common site only works in the scenario where LBNE has one or more detectors at 4850ft at Homestake.
  - Either an early technology choice for water Cerenkov or the 1+1 option would support this scenario but it may be several years before known if DBD is feasible at 4850ft
  - If LBNE pays for the infrastructure that LBNE needs, there would be additional infrastructure costs for DM or DBD experiment that would exceed those at SNOLAB by something like $100M; worthwhile considering given the advantages of a common site and the multi-decade timescale

- If no LBNE at Homestake 4850ft level, DBD and DM are not cost effective at Homestake

- The lowest cost option for DM or DBD is SNOLAB.

End

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Backup Slides

1. Summary cost table
2. Incremental infrastructure costs for DM and DBD at Homestake 4850ft level
3. Risk vs. maturity matrix
4. General layout of Homestake and SNOLab showing relative location depths
5. Meeting Agendas (List of presentations)

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Summary of Cost and Schedule for Options

Experiment	Location	Depth	Experiment Cost Range (2011 $M)		Facility Cost Range (2011 $M)		TPC Range (2011 $M)		Committee Adjusted TPC Range (2011 $M)		Schedule Duration (Years)	Annual Operating Cost (avg.) (2011 $M)*
			Low	High	Low	High	Low	High	Low	High		
Scenarios Requested in Review Charge												
LBNE w/WCD	Homestake	4850	414.8 (150kt)	517.1 (200kt)	712.5 (150kt)	959.2 (200kt)	1127.3	1476.3	**1200**	**1500**	10-12	18-23
LBNE w/LAr	Homestake	800	498.6 (24kt)	698.4 (34kt)	478.9 (24kt)	637.0 (34kt)	977.5	1335.4	**1000**	**1400**	10-12	18-23
DM	Homestake	4850	80	100	140	380	220	480	**300**	**800**	8-10	20
DBD	Homestake	4850	200	300	140	380	340	680	**400**	**800**	8-10	20
DM	Homestake	7400	80	100	280	520	360	620	**450**	**700**	8-10	20
DBD	Homestake	7400	200	300	280	520	480	820	**600**	**950**	8-10	20
DM	SNOLAB	6400	80	100	30	30	110	130	**100**	**150**	8-10	n/a
DBD	SNOLAB	6400	200	300	30	30	230	330	**230**	**400**	8-10	n/a
Scenarios that Leverage Potential for Shared Facility, Infrastructure, and other Common Costs												
DM+DBD	Homestake	4850	280	400	160	390	440	790	**560**	**930**	8-10	20
DM+DBD	Homestake	7400	280	400	290	530	570	930	**700**	**1100**	8-10	20
DM+DBD	SNOLAB	6400	280	400	60	60	340	460	**400**	**550**	8-10	n/a
LBNE w/WCD+DM+DBD	Homestake	4850/4850	694.8	917.1	872.5	1119.2	1567.3	2036.3	**1600**	**2100**	10-12	18-23
LBNE w/LAr+DM+DBD	Homestake	800/4850	778.6	1098.4	838.9	997	1617.5	2095.4	**1700**	**2300**	10-12	18-23
LBNE w/WCD+DM+DBD	Homestake	4850/7400	694.8	917.1	1002.5	1249.2	1697.3	2166.3	**1800**	**2300**	10-12	18-23
LBNE w/LAr+DM+DBD	Homestake	800/7400	778.6	1098.4	978.9	1137	1757.5	2235.4	**1900**	**2400**	10-12	18-23
Legend – Color Coding for Overall Experiment and Facility Design Maturity in Above Scenarios												
Pre-Conceptual			**Conceptual**				**Preliminary Design**					

* LBNE annual operating cost for Fermilab near detector and beamline are not included.

Incremental to WC Infrastructure costs of DM and DBD at 4850 level at Homestake

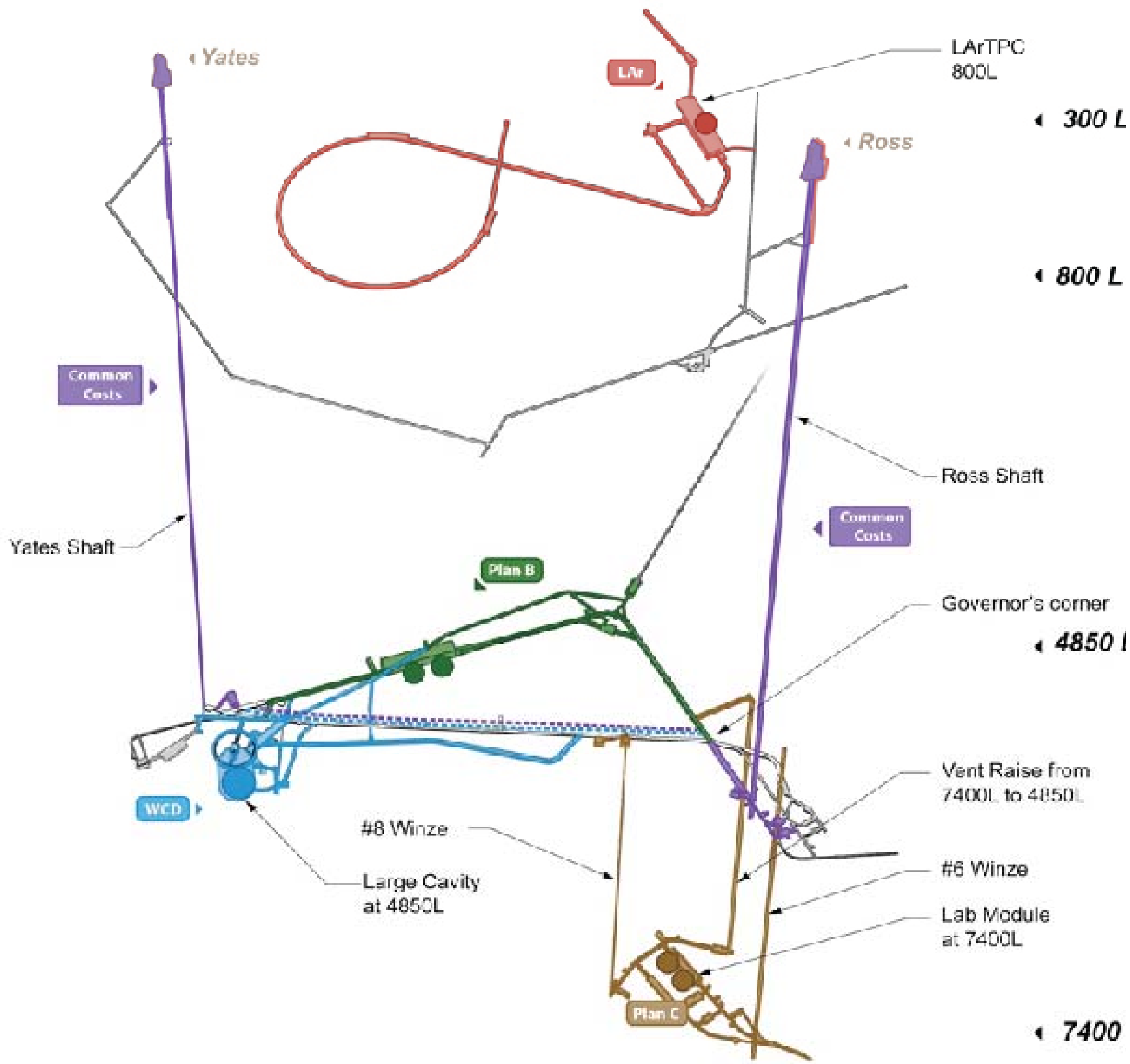
- From UCB DUSEL team plan B
- Cost for 1st experiment ($140M) includes
  - Main utilities, drifts and ramps for access and egress, shops, refuge, management, contractors costs (e.g. construction equipment, shaft access, burdens), etc.
- Incremental (~$15M) for each additional experiment for additional excavation and incremental power

General Homestake Layout

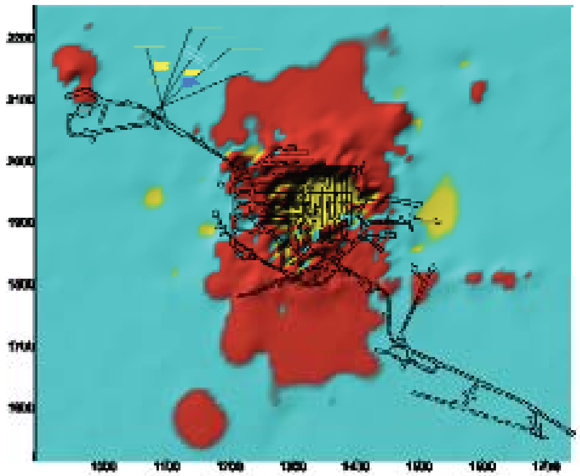
Defining Scope and Interfaces

LEGEND

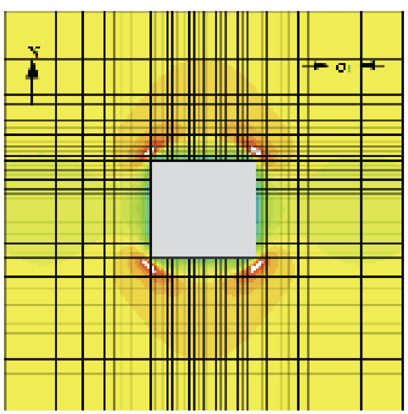
Common Costs	Surface and Infrastructure
	LAr 800L Portion of Common Costs
LAr	Liquid Argon Development at 800L
	Liquid Argon Experiment
WCD	Water Cherenkov Detector @ 4
	Water Cherenkov Detector
Plan B	Lab Module @ 4850L
	DM + ßß Experiments
Plan C	Lab Module @ 7400L
	DM + ßß Experiments



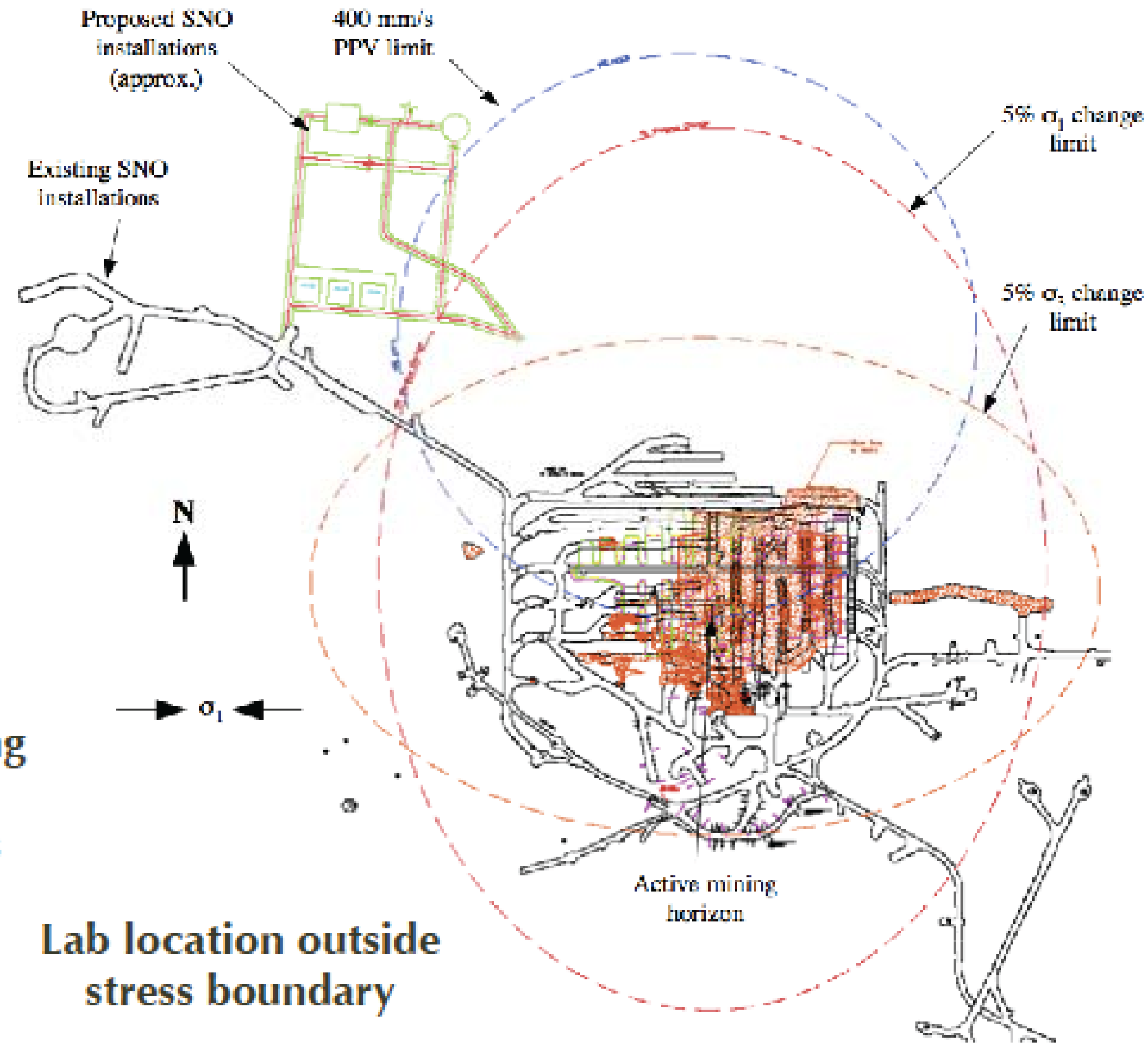
General SNOLab Layout



5 % stress contour



Stress modelling for all cavities



Lab location outside stress boundary

Meeting Agendas

DOE Office of Science Independent Review Of Options for Underground Science

April 13-15, 2011

Wednesday, April 13

Plenary, Kavli Auditorium, Building 51, Room 102

8:00 am	Executive Session	J. Marx, M. Reichanadter
8:45	Welcome	P. Drell
9:00	Underground Science Requirements and Experimental Capability Drivers	R. Svoboda, H. Nelson, E. Beier
10:30	Break	
10:45	Long Baseline Neutrino Experiment	J. Strait
12:15 pm	Lunch	
1:30	3rd Generation Dark Matter Experiment	H. Sobel
3:00	Break	
3:15	Neutrinoless Double-Beta Decay Experiment	J. Wilkerson, G. Gratta
5:00	Executive Session	Executive Committee
7:00	Adjourn	

Thursday, April 14

Plenary, Cypress Conference Room Building 40, Room 147

8:00 am	Input from DUSEL PDR	K. Lesko, J. Yeck, R. Wheeler
10:30	Break	
10:45	SNO Infrastructure Capability Assessment	N. Smith
11:30	Individual Breakouts (see following pages)	

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Agendas, continued

Thursday, April 14

SESSION 1 – 3rd Generation Dark Matter Experiment Redwood Conference Room, Building 48, Room 112A

11:30am	DM Consensus Positions	B. Sadoulet
12:30 pm	Lunch	
1:30	LZ	T. Shutt, R. Gaitskell
1:45	MAX	C. Galbiati, E. Aprile
2:00	GEODM	S. Golwala, B. Cabrera
2:15	COUPP	J. Collar, A. Sonnenschein
2:30	CLEAN	D. McKinsey, A.Hime
2:45	Discussion	Group
3:00	Break	
3:15	Joint Session w0v2β with Nigel Smith	Group
3:45	Joint Session continued	Group
4:15	Continued discussion as needed	Group
5:00	Executive Session	Executive Committee
7:00	Adjourn	

Thursday, April 14

SESSION 2 – Double-Beta Decay Experiment, Redwood Conference Building 48, Room 112B

11:30am	EXO Follow-up	G. Gratta
12:15 pm	Lunch	
1:30	Majorana Follow-up	S. Elliott
2:15	Discussion of Backgrounds	J. Wilkerson
3:00	Break	
3:30	Joint Discussion with Dark Matter Group	Group
4:15	Joint Discussion with Dark Matter Group with	Group
	Nigel Smith	Group
4:30	Final Discussion	Executive Committee
5:00	Executive Session	
7:00	Adjourn	

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Agendas, continued

SESSION 3 – Neutrino Physics Experiment, Redwood Conference Building 48, Room 112C

11:30am	Introduction	M. Diwan, R. Wilson
12:15 pm	Lunch	
12:45	Executive Session	Neutrino Committee
1:15	Liquid Argon: Science Technology Strengths, Risks and Issues Related to Cost and Schedule	J. Urheim, M. Soderberg, B. Baller, S. Pordes, C. Thorn, B. Fleming
3:30	Executive Session	Neutrino Committee
4:05	Beam Design/ Components – Science/Technology Strengths, Risks and Issues Related to Cost and Schedule	M. Bishai, G. Rameika
4:45	Executive Session	Neutrino Committee
5:00	Executive Session	Executive Committee

Thursday, April 14

SESSION 4 – Conventional/Underground Facilities, Cypress Conference Room, Building 40, Room 147

11:30am	Options 1-6 Common Systems	M. Headley, J. Willhite
12:15 pm	Lunch	
1:30	LBNE Conventional Facilities for WCD – Option 1	E. McCluskey
2:00	LBNE Conventional Facilities for LAr – Option 2	T. Lundin
2:30	SNO Conventional Facilities for Dark Matter	N. Smith
3:00	Break	
3:15	LBNE Conventional Facilities for Beam and Near Detector at Fermilab	T. Lundin
4:00	DUSEL Plane B continued	M. Headley, J. Willhite
5:00	Executive Session	Executive Committee
7:00	Adjourn	

Thursday, April 14

SESSION 5 – Cost and Schedule, Redwood Conference Building 48, Room 112D

11:30am	SNOLAB Operation Costs	N. Smith
12:30 pm	Lunch	

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Agendas, continued

Thursday, April 14

SESSION 5 – Cost and Schedule, Redwood Conference Building 48, Room 112D

11:30am	SNOLAB Operation Costs	N. Smith
12:30 pm	Lunch	
1:30	Homestake Facility Design	M. Headley, S. DeVries, D. Vardiman, R. Wheeler
2:00	LBNE Water Cherenkov	J. Stewart, J. Strait
2:30	LBNE Option	E. McCluskey, T. Lundin, J. Strait
2:50	LBNE LAr	B. Baller, J. Strait
3:10	Break	
3:30	Dark Matter Gas Based Experiments	T. Shutt, C. Galbiati
3:50	Dark Matter Ge-Based Experiments	S. Golwala
4:10	Double-Beta Decay EXO	G. Grata
4:30	Double-Beta Decay Majorana	J. Wilkerson, S. Elliott
5:00	Executive Session	Executive Committee
7:00	Adjourn	

Friday, April 15

Executive Session, Redwood Conference Room Building 48, Room 112

8:00 am	Session 4 Continuation: H20 – Science/Technology Strengths, Risks and Issues Related to Cost and Schedule	E. Kearns, C. Walter, J. Maricic, M. Sanchez, M. Vagins
10:00	Executive Session	Session 4 Committee
10:30	Break	
10:45	Executive Session	Executive Committee
1:30 pm	Adjourn	

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Agendas, continued

DOE Site Visit Agenda, Homestake on April 21, 2011

April 20, 2011	Travel to Deadwood, South Dakota (fly to Rapid City)
April 21, 2011	Administration Building @ Sanford Lab, Lead, SD
8:00 am	Coffee and introductions (Ron Wheeler)
8:30	Overview of the Sanford Laboratory
9:30	To Ross Dry for safety training
10:00	Underground tour of 4850 level. (limit 12 people)
12:00pm	Brief tour of LUX surface Lab.
12:30	Lunch and discussion of ongoing costs. Operation and life cycle costs. Risks and Mitigations past, present and future. Above ground civil construction, shaft safety upgrades.
2:00 pm	Surface tour of Hoist room and Water Treatment plant
Adjourn	

DOE Site Visit Agenda, SNOLAB on May 9, 2011

6:30am	Meet at SNOLAB: Safety and PPE	N. Smith
7:30	Descend to 6800ft level	
9:00	Transition to clean room quality SNOLAB	
9:30	Tour of Ladder Labs, Cube Hall, Cryopit, and SNO+, tour of services such as electrical substations, chillers, communications and safety systems	
3:00pm	Lunch and discussion of options for future discussions	

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