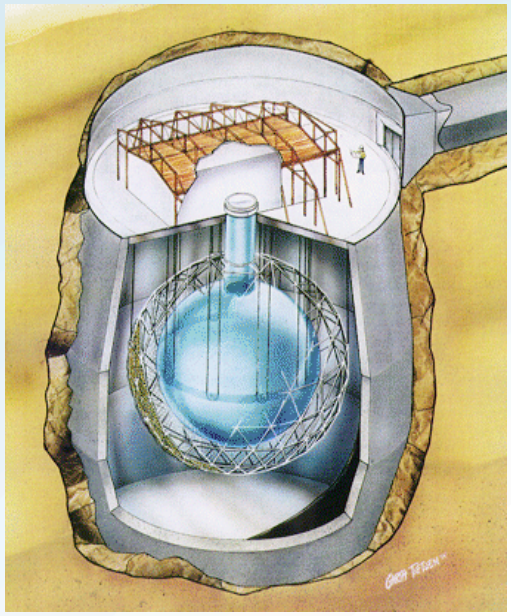
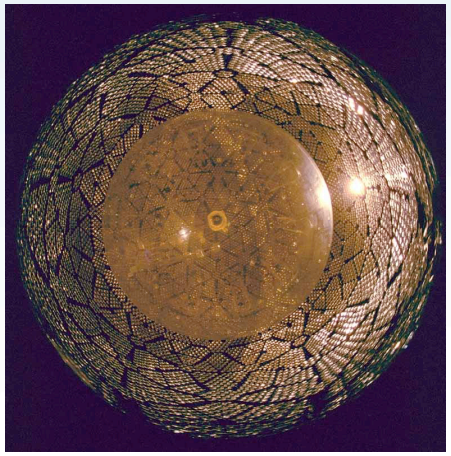
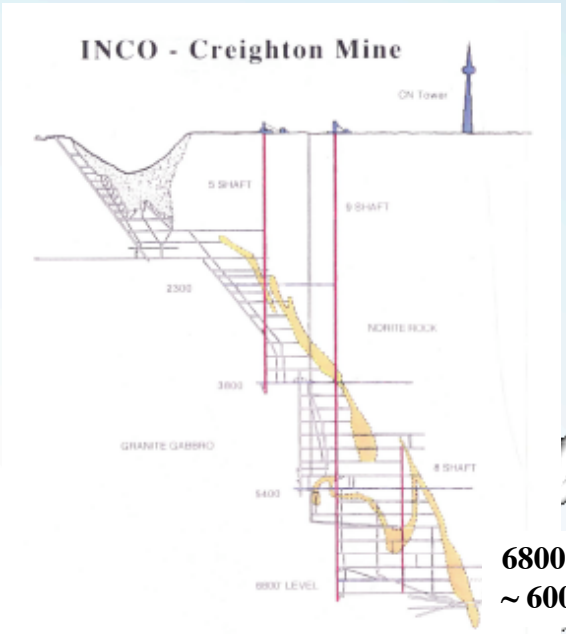
SNOLAB
An International Facility for Underground Science

Andrew Hime
with
Fraser Duncan & David Sinclair

PANIC, 2005

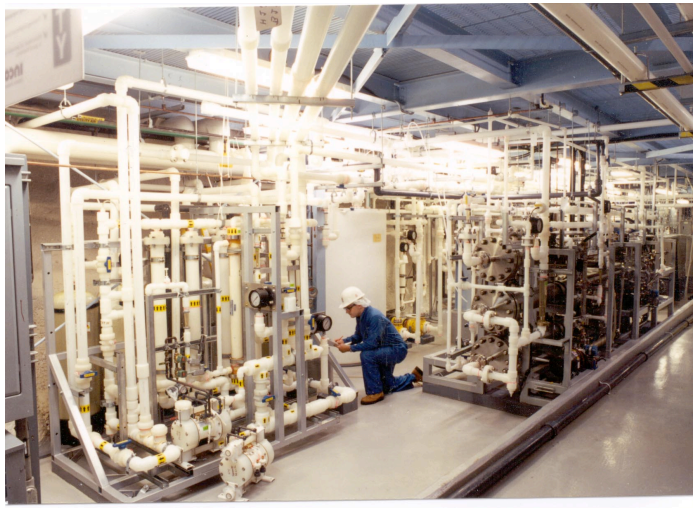






6800 ft
~ 6000 m.w.e.

SNO



Expansion to SNOLAB

2001 - CFI Solicitation for Facilities Proposals

2002 - SNOLAB Proposal Accepted

2003 - CFI + Provincial Funding Released (~ $50M)

Workshops

I. August 20, 2002 (Sudbury)
Science & Information Gathering

II. November 21-22, 2002 (Ottawa)
Prospective Experiments & Infrastructure Needs

← Call for LOI's Jan.26, 2004

III. May 12-14, 2004 (Sudbury)
Refine Infrastructure Needs & Kick-Off
Experiment Evaluation Process

IV. August 15-17, 2005 (SNOLAB)
Define Initial Suite of Experiments & Scientific Roadmap
Begin Formation of User's Group

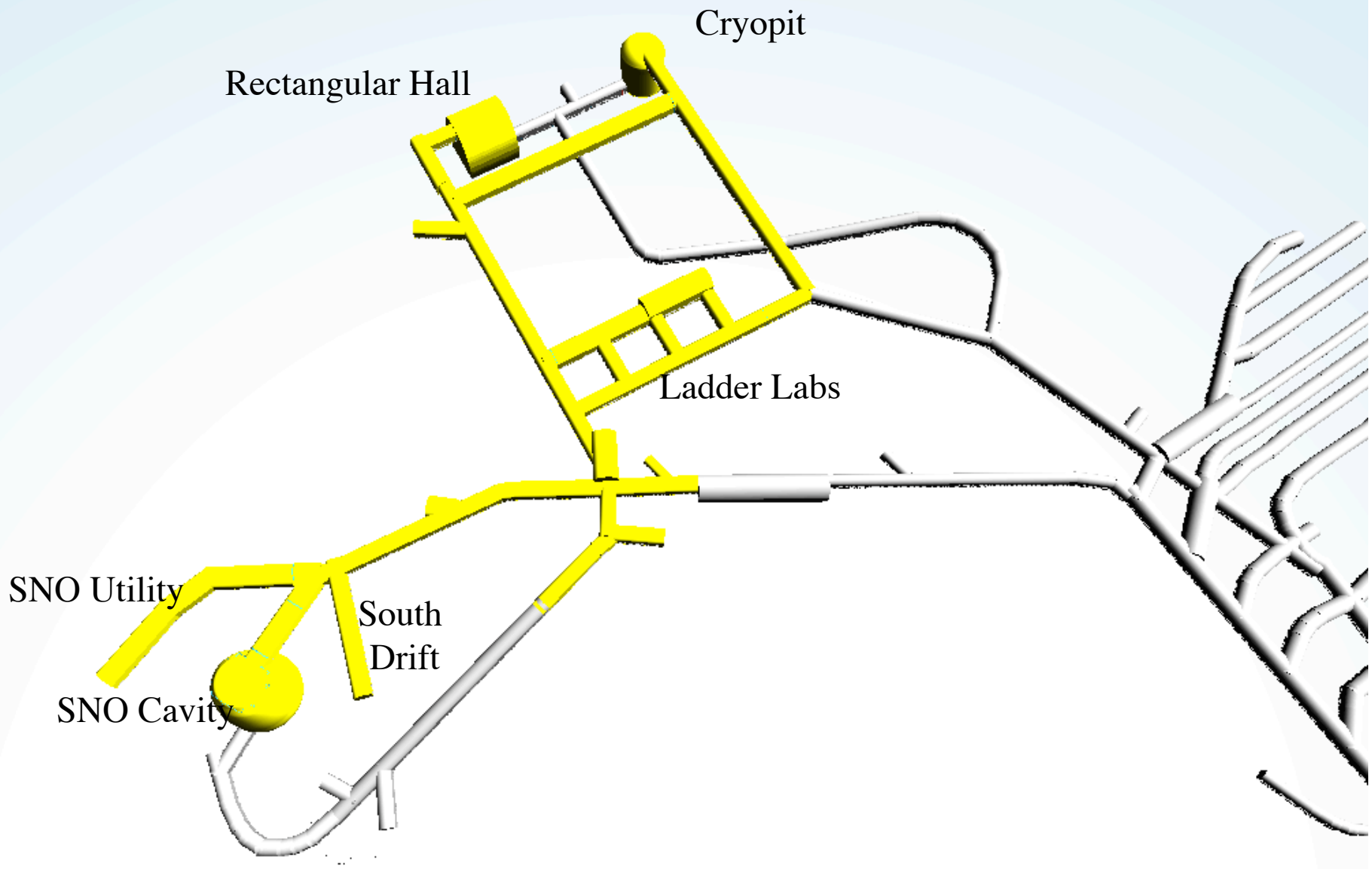
Office Space
Meeting Rooms & Auditorium
Computing Facilities
Regular & High Bay Laboratories
Clean Assembly & Transport

24 11 2004

SNOLAB Workshop IV, 15 Aug 2005

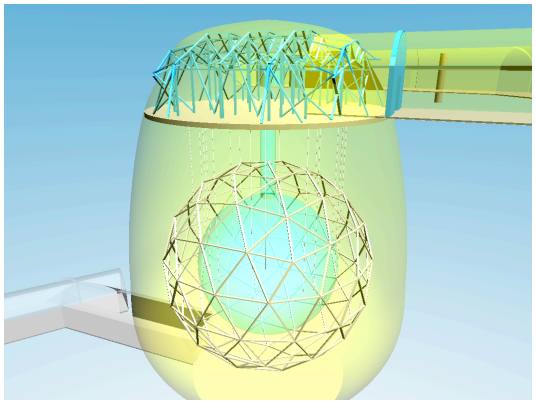
Experimental Interest in SNOLAB

SNO	**Solar Neutrinos**
SNO + & SNO ++	**Solar Neutrinos & Double Beta Decay**
Lithium Detector	**Solar Neutrinos**
CLEAN	**Solar Neutrinos & Dark Matter**
Majorana	**Double Beta Decay**
GerDA	**Double Beta Decay**
EXO	**Double Beta Decay**
COBRA	**Double Beta Decay**
SuperCDMS	**Dark Matter**
ZEPLIN	**Dark Matter**
XENON	**Dark Matter**
DEAP	**Dark Matter**
PICASSO	**Dark Matter**
COUPP	**Dark Matter**
DRIFT	**Dark Matter**
Noble Liquid Tracking Detectors	**Solar Neutrinos**
HALO	**Supernovae Neutrinos**
LENA	**Proton Decay, Solar Neutrinos, Supernovae Neutrinos**
NOSTOS	**Neutrino Oscillations (θ_{13})**
TRIGA	**Neutron-Antineutron Oscillations**



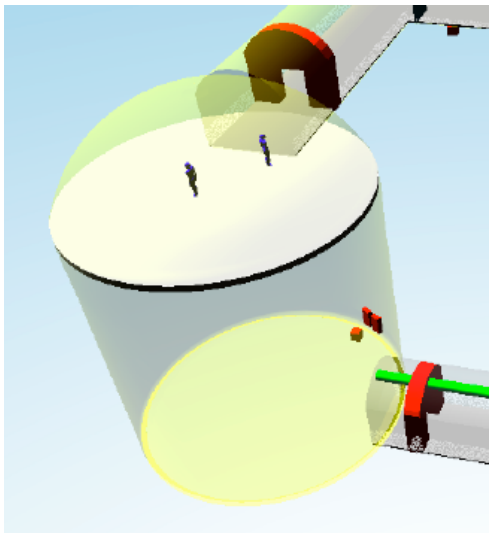
Laboratory Space

Experimental Space		Length (ft)	Width (ft)	Height Shoulder/Back	Area (sq ft)
Ladder Labs	Drift C1	105	20	12'/19'	2100
	Drift C2	75	25	17'/25'	1875
	Drift B&D	360	15	10'/15'	5400
Cube Hall	Hall	60	50	50'/65'	3000
	Utility Drift	115	20	10'/17'	2300
	Staging Area	45	16	10'/15'	720
	Control Rm/ Office	62	18	10'/16'	992
Cryopit	Cavern	50 (dia)		50'/65'	1963
	Utility Drift	141	20	10'/15'	2820
	Staging Area	66	16	10'/15'	1056
	Control Rm/ Office	64	16	10'/15'	1024
SNO Cavern	Cavern	70(dia)		85	3848
	Utility Drift	187	23		4300
	Control Rm	57	20		
South Drift	Drift	106	17	10'/16'	1802
Total					34340



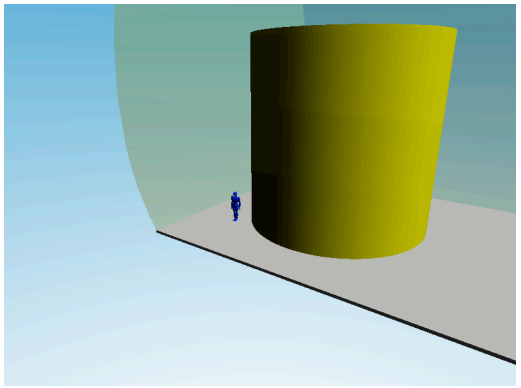
SNO Cavity

1 Large Exp't
of ~ 22 m Scale



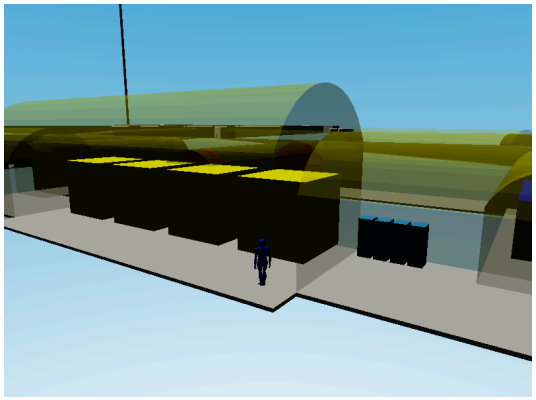
Cryopit

1 Large Exp't
of ~ 15 m Scale



Rectangular Hall

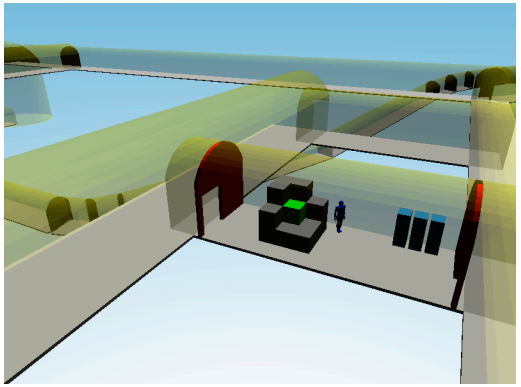
1 Large Exp't
of ~ 15 m Scale



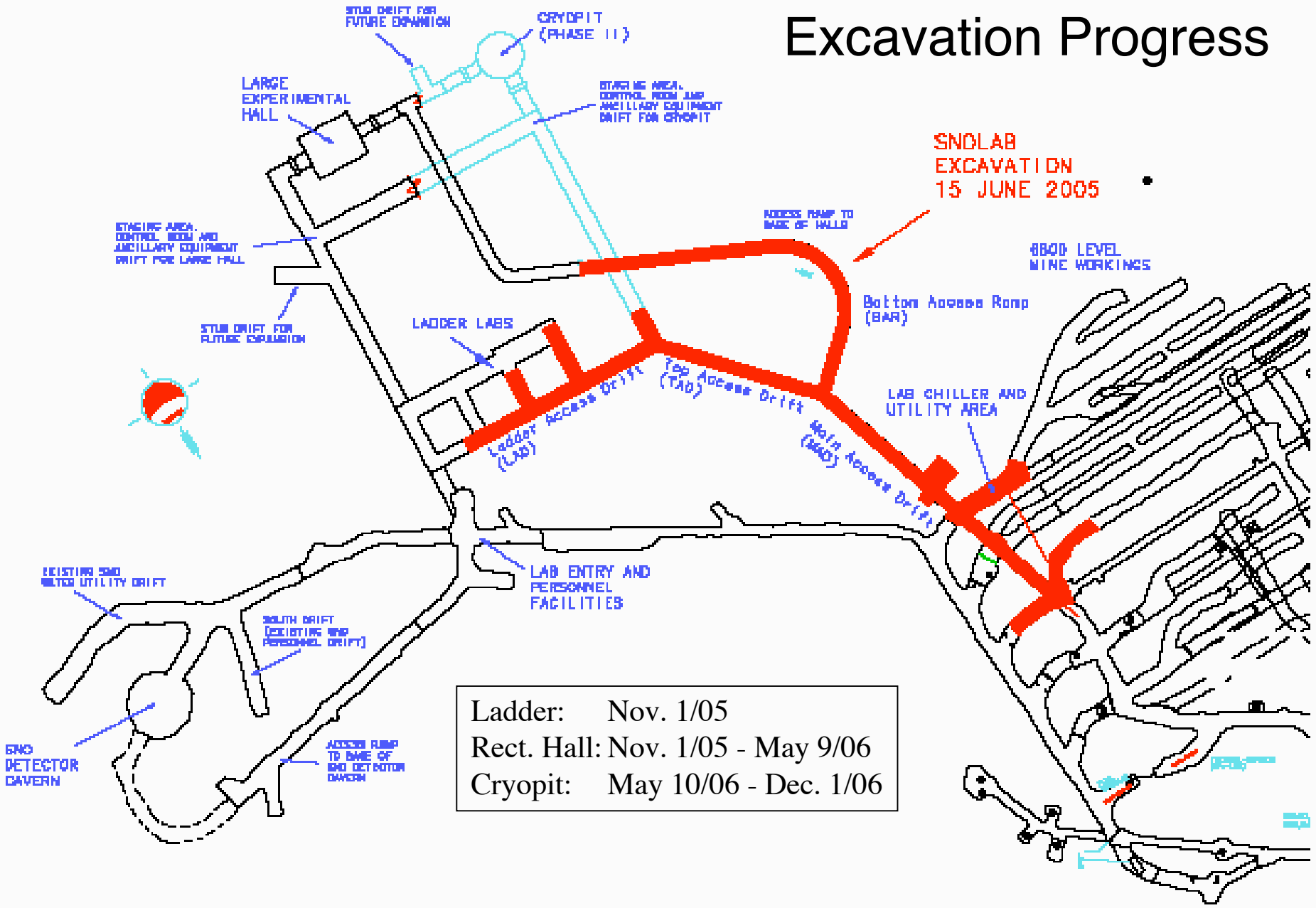
Ladder Labs
+ South Drift

2-3 Medium Exp'ts
of ~ 4-6 m Scale

+ 2-3 Small Exp'ts
of ~ 1-2 m Scale



Excavation Progress



Ladder:	Nov. 1/05
Rect. Hall:	Nov. 1/05 - May 9/06
Cryopit:	May 10/06 - Dec. 1/06

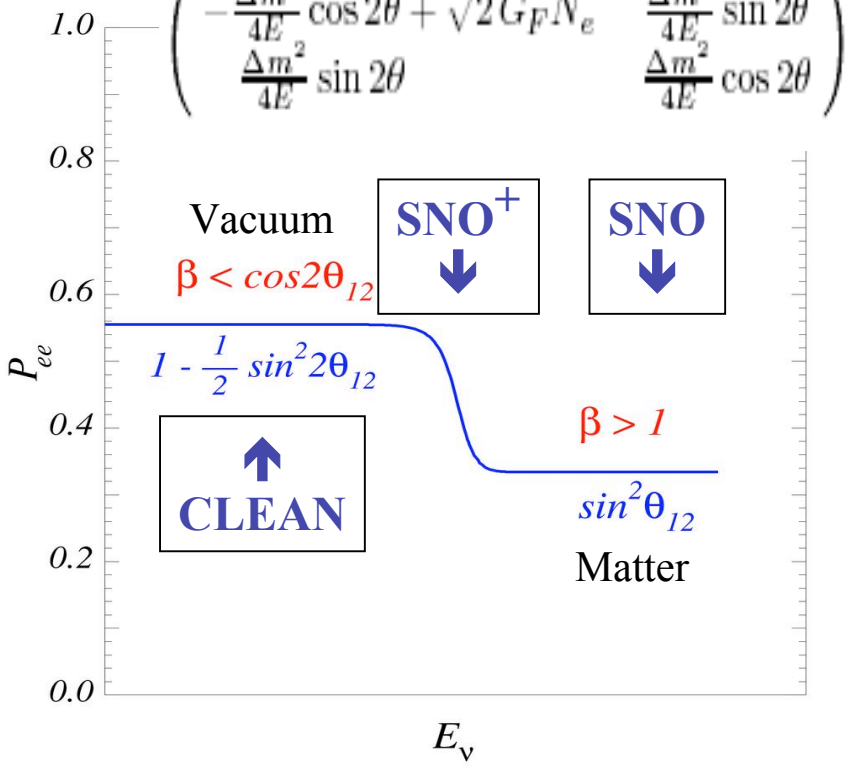
U_{MNSP} Matrix

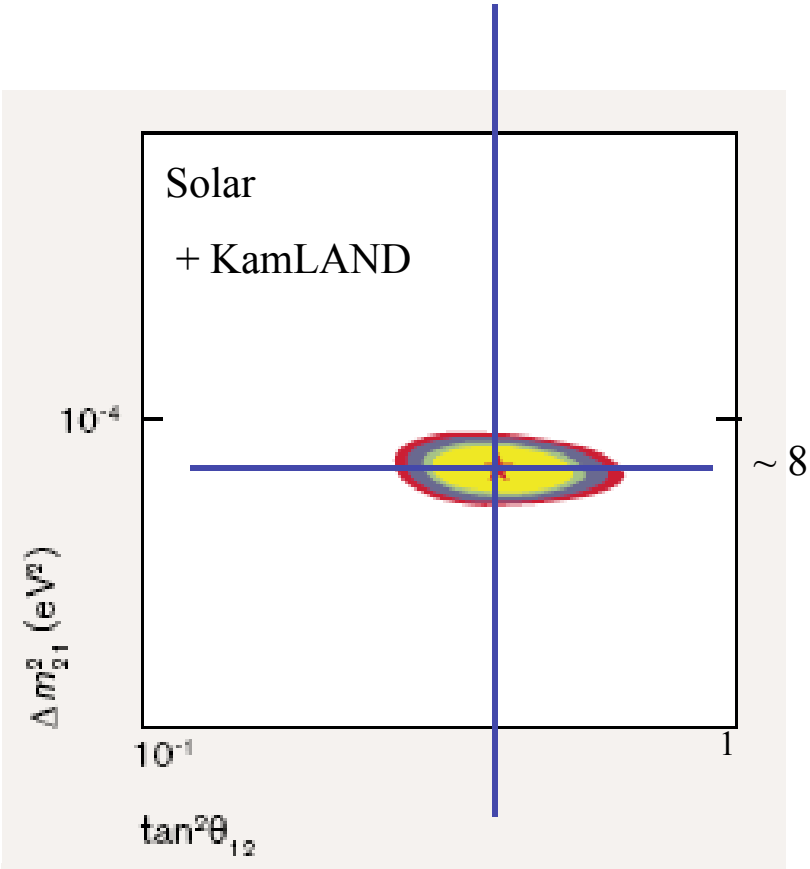
$$U = \begin{pmatrix} U_{e1} & U_{e2} & U_{e3} \\ U_{\mu 1} & U_{\mu 2} & U_{\mu 3} \\ U_{\tau 1} & U_{\tau 2} & U_{\tau 3} \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta_{23} & \sin\theta_{23} \\ 0 & -\sin\theta_{23} & \cos\theta_{23} \end{pmatrix} \times \begin{pmatrix} \cos\theta_{13} & 0 & e^{-i\delta_{CP}}\sin\theta_{13} \\ 0 & 1 & 0 \\ -e^{i\delta_{CP}}\sin\theta_{13} & 0 & \cos\theta_{13} \end{pmatrix} \times \begin{pmatrix} \cos\theta_{12} & \sin\theta_{12} & 0 \\ -\sin\theta_{12} & \cos\theta_{12} & 0 \\ 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} 1 & 0 & 0 \\ 0 & e^{i\alpha/2} & 0 \\ 0 & 0 & e^{i\alpha/2+i\beta} \end{pmatrix}$$

$\theta_{23} \sim 45°$ $\quad \tan^2\theta_{13} < 0.03$ at 90% CL $\quad \theta_{12} \sim 32°$

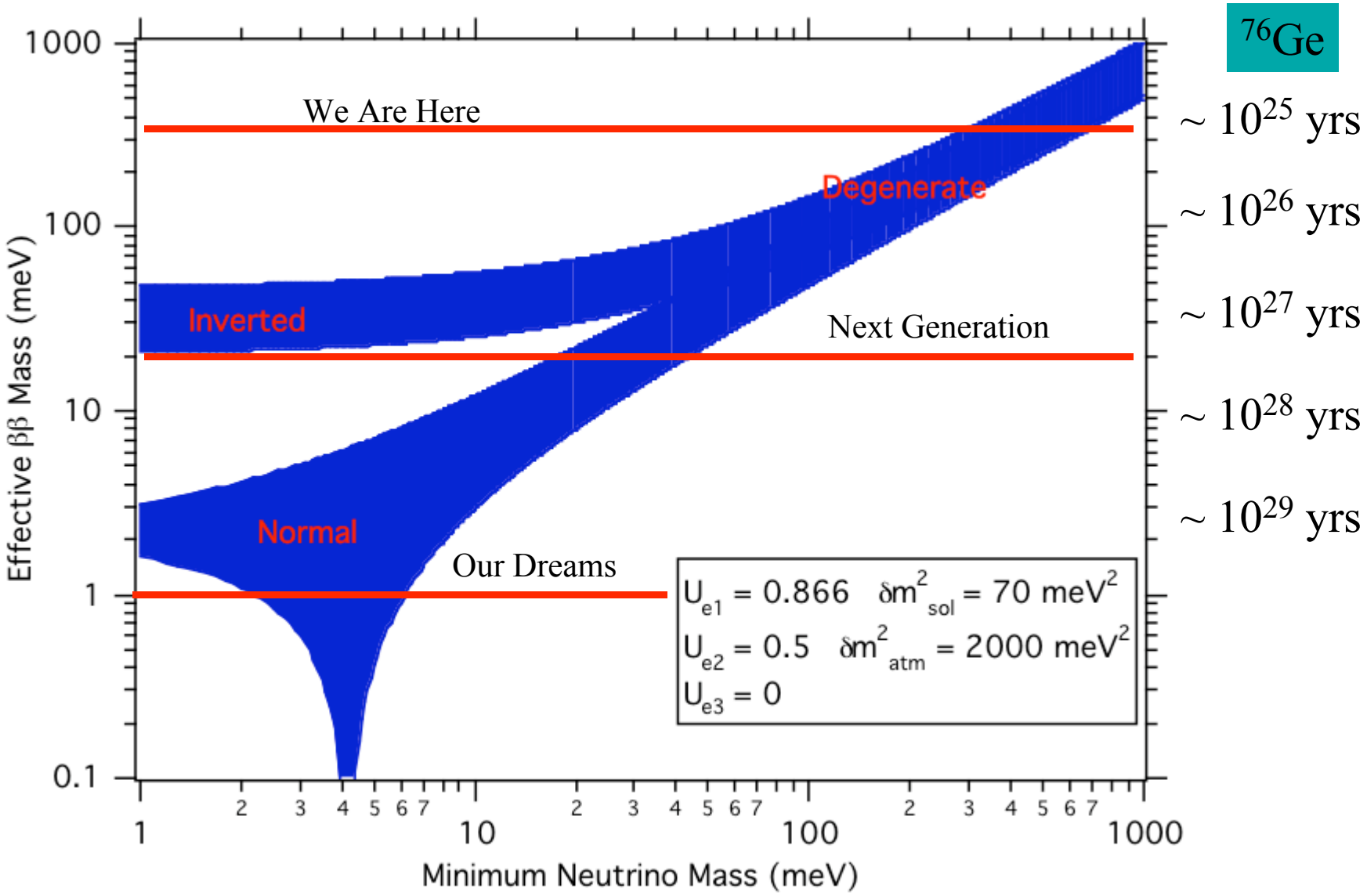
$$\begin{pmatrix} -\frac{\Delta m^2}{4E}\cos 2\theta + \sqrt{2}G_F N_e & \frac{\Delta m^2}{4E}\sin 2\theta \\ \frac{\Delta m^2}{4E}\sin 2\theta & \frac{\Delta m^2}{4E}\cos 2\theta \end{pmatrix}$$



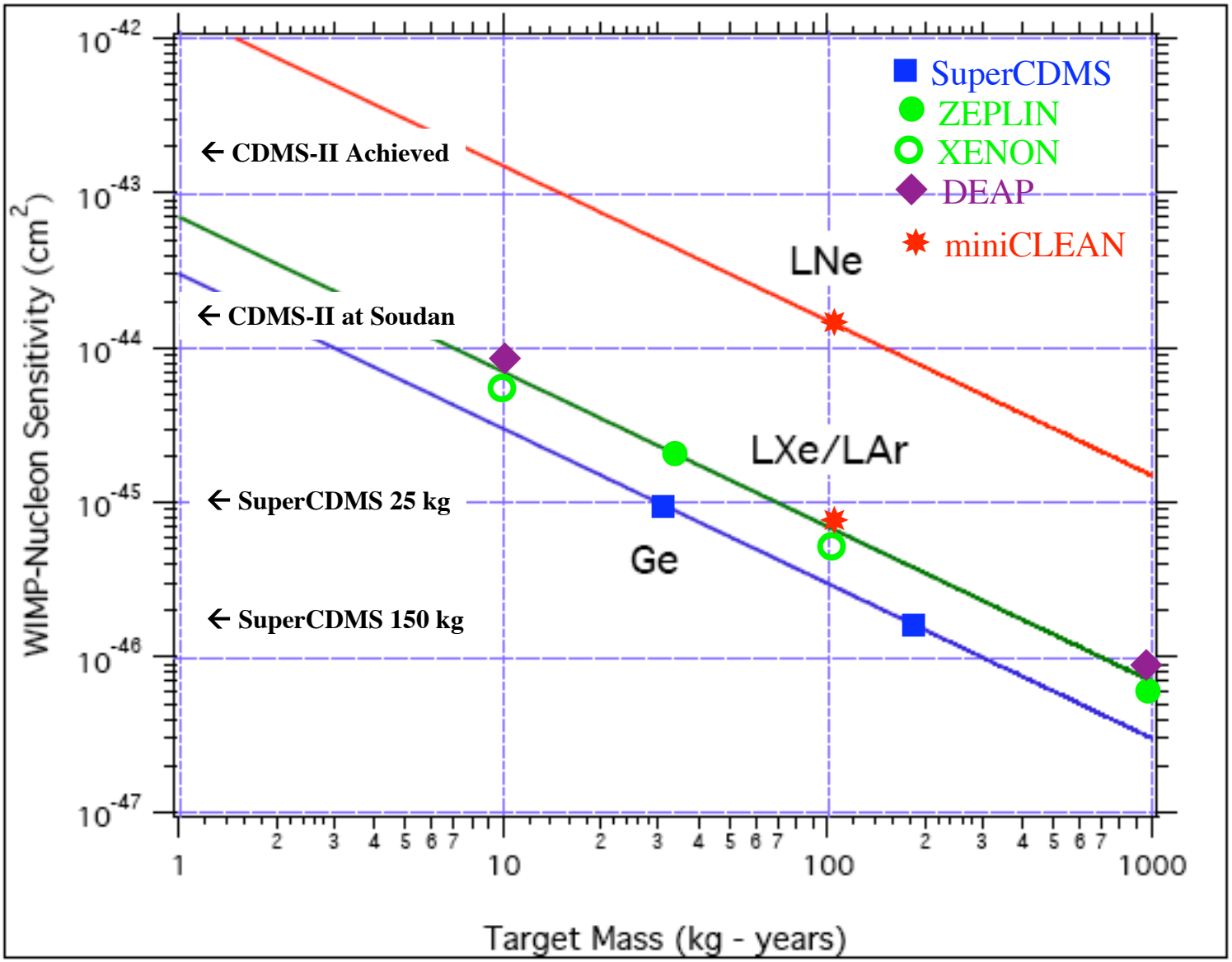


~ 8 x 10^{-5} eV^2

Allowed Phase Space for a Majorana Neutrino Mass



Relative Sensitivities for BGND-Free Searches for Spin-Independent WIMPs



Experiment Advisory Committee

Chair: Barry Barish
Secretary: Andrew Hime

Baha Balantekin (US)
Cliff Burgess (CND)
Ken Ragan (CND)
John Martin (CND)
Kate Scholberg (US)
Takaaki Kajita (Japan)
David Wark (UK)

Scientific Merit

Infrastructure Needs

Progress on R&D
Technical Feasibility
Safety
Funding & Schedule
Participation & Management

www.snolab.ca

✶SNOLAB Excavation & Infrastructure Proceeding Well

IV'rth SNOLAB Workshop

Status & Development (David Sinclair)

Infrastructure & Operations (Fraser Duncan)

✶Longer Term Scientific Roadmap Evolving

IV'rth SNOLAB Workshop

Development of Scientific Roadmap (Andrew Hime)

Experiments (Workshop Participants / PI's)

✶Scientific Recommendations for Initial Suite of Experiments Delivered

IV'rth SNOLAB Workshop

Recommendations for Science (Andrew Hime)

✶SNOLAB Users-Group Under Development

Solar Neutrinos	Double Beta Decay	Dark Matter
SNO	Majorana	SuperCDMS
SNO+	Gas-EXO	ZEPLIN
CLEAN		DEAP/CLEAN
		PICASSO