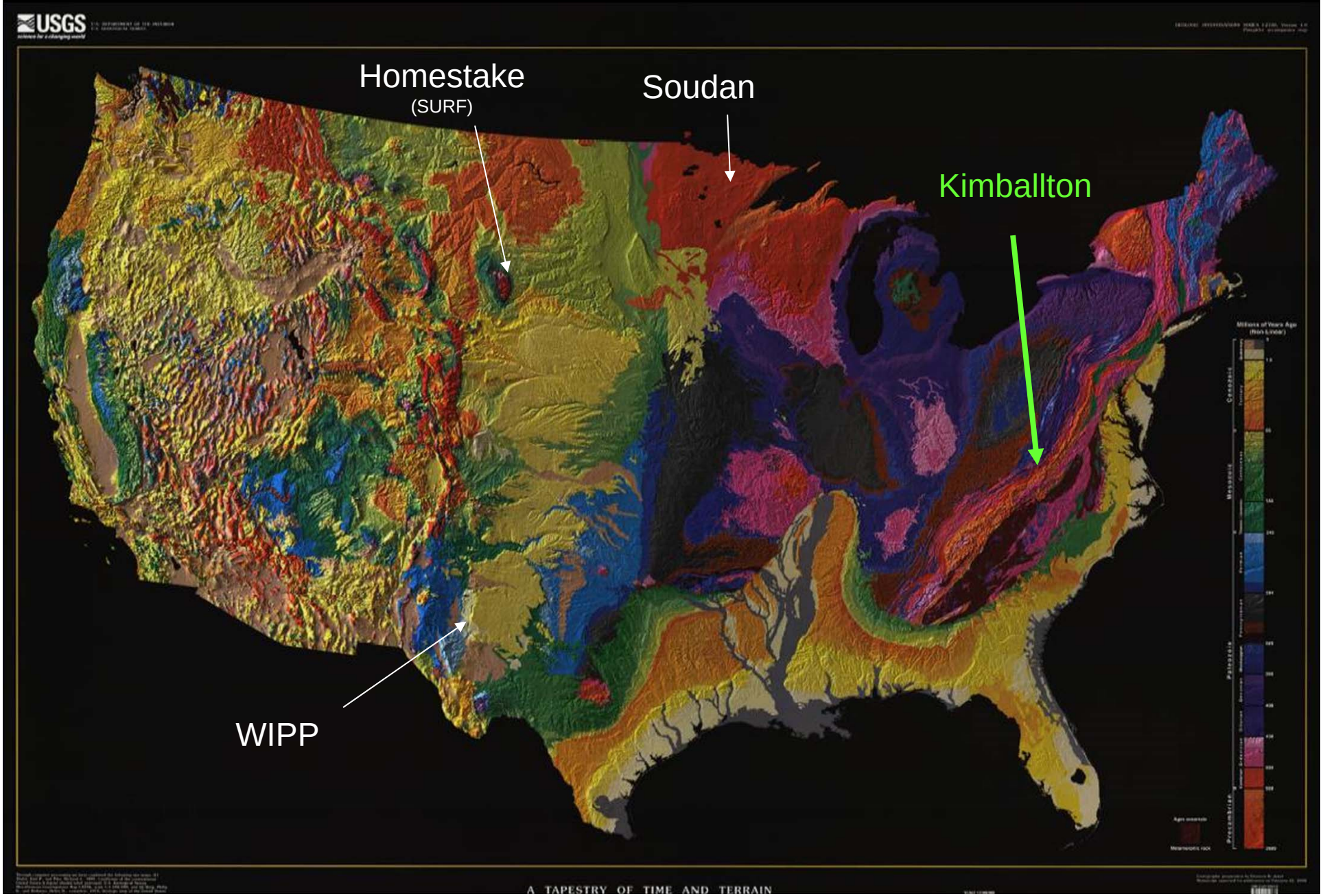
Kimballton Underground Research Facility

www.phys.vt.edu/~kimballton

US Deep Underground Laboratories



Key KURF Features

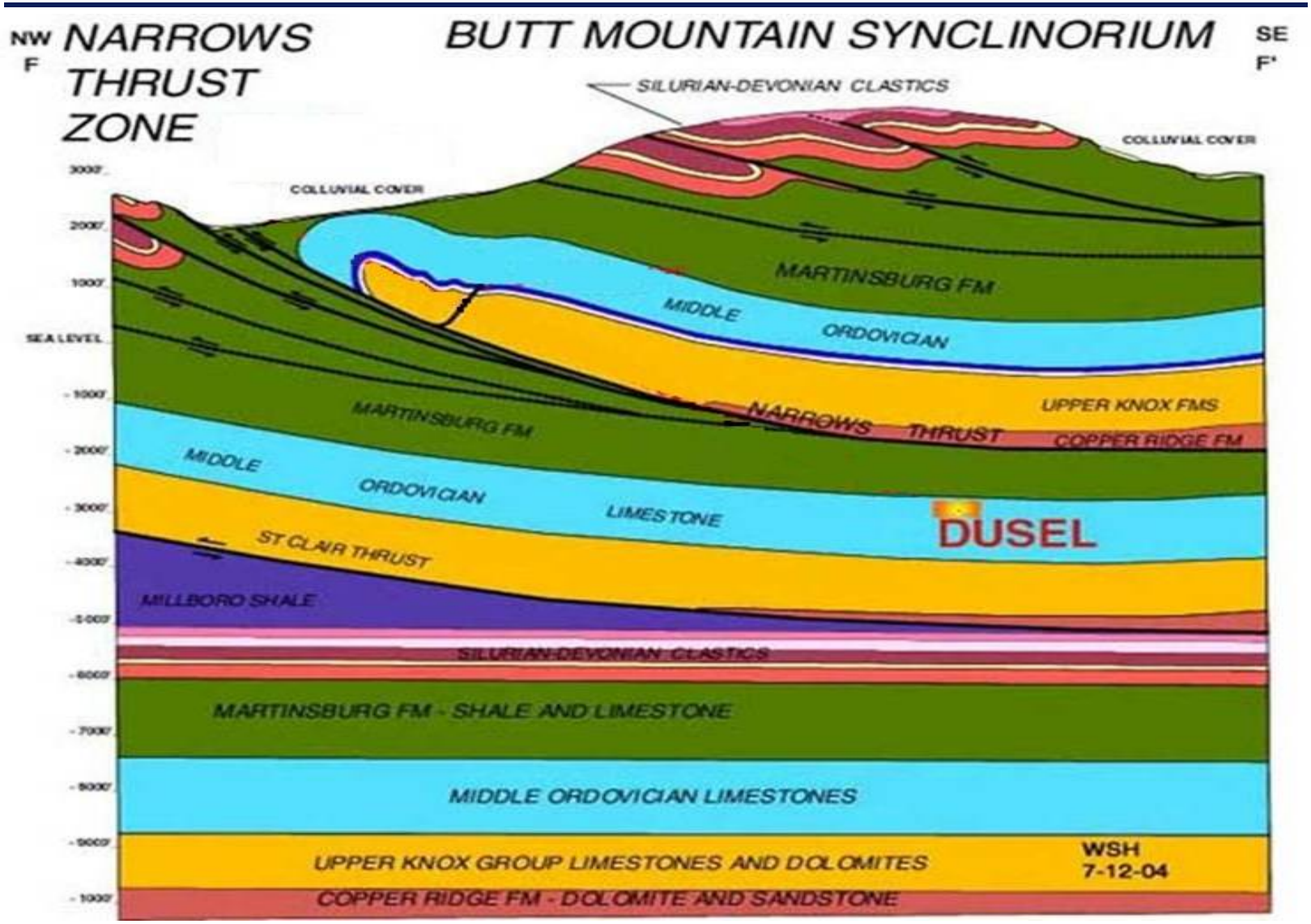
- 1450 mwe shielding
- drive in access
- ample space
- ½ hour from major research university
- currently 13 user institutions on 8 projects
- potential site for DIANA program

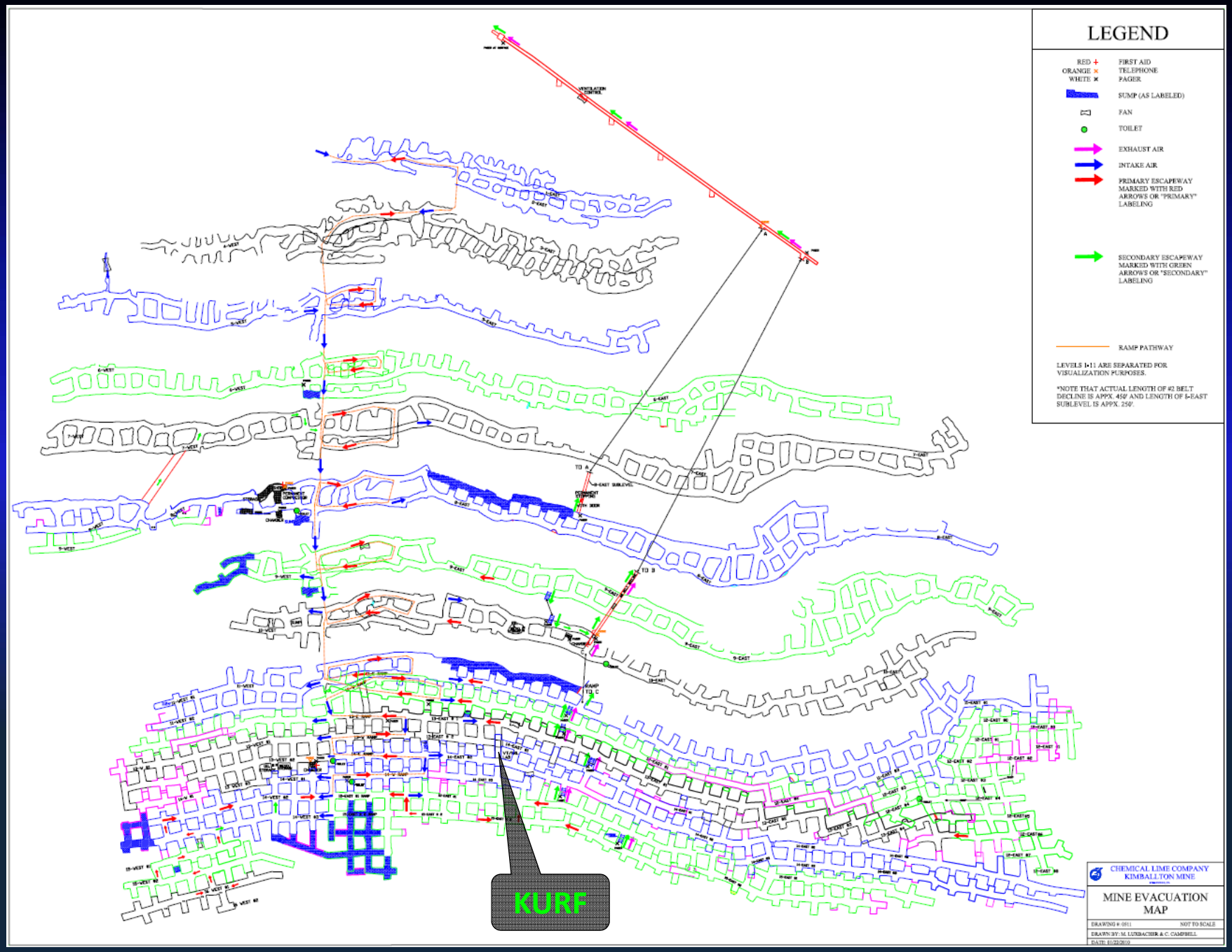
Kimballton Underground Research Facility

Three potential locations for surface office/assembly building

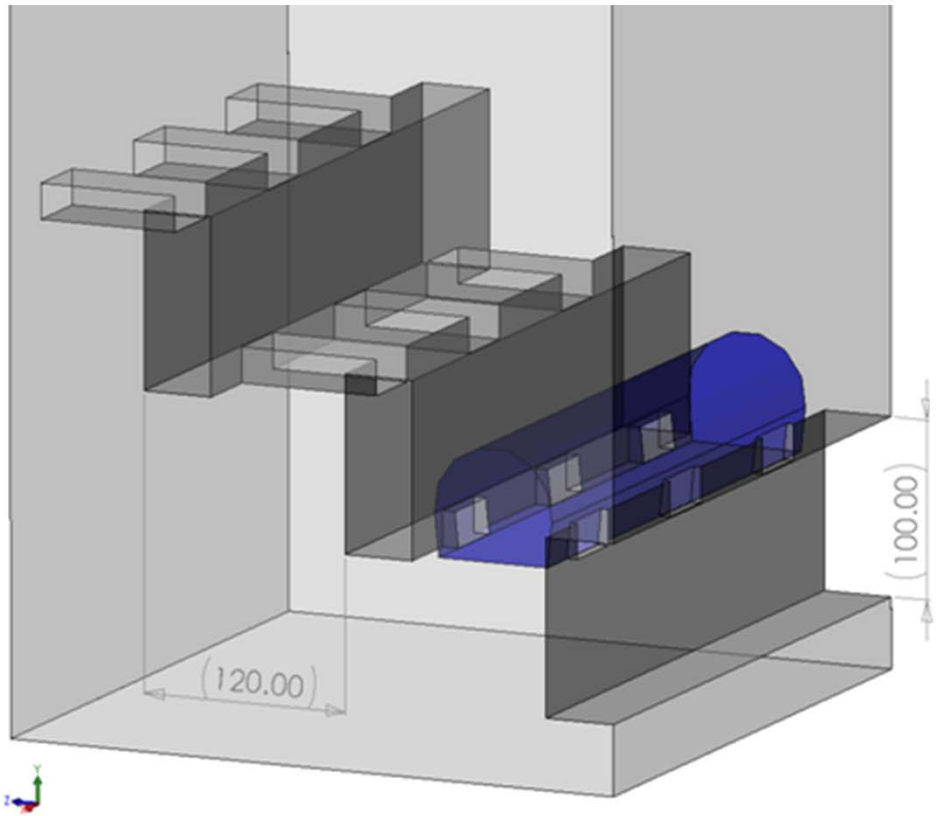
KIMBALLTON

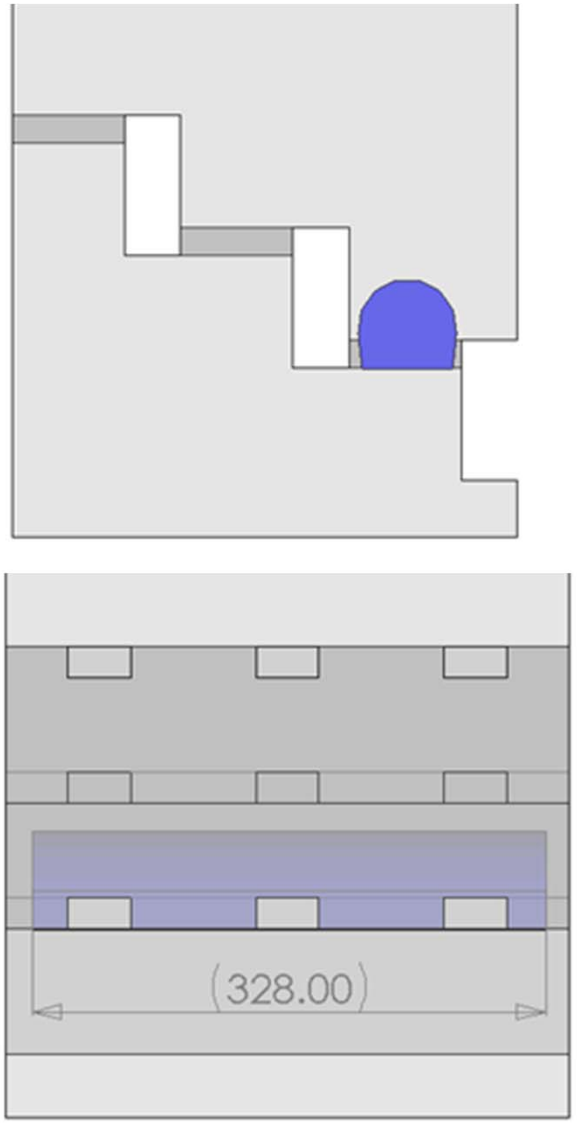
Kimballton Geologic Setting




LEGEND
RED + FIRST AID
ORANGE × TELEPHONE
WHITE × PAGER
SUMP (AS LABELED)
FAN
TOILET
EXHAUST AIR
INTAKE AIR
PRIMARY ESCAPEWAY MARKED WITH RED ARROWS OR "PRIMARY" LABELING
SECONDARY ESCAPEWAY MARKED WITH GREEN ARROWS OR "SECONDARY" LABELING
RAMP PATHWAY
LEVELS 1-11 ARE SEPARATED FOR VISUALIZATION PURPOSES.
*NOTE THAT ACTUAL LENGTH OF #2 BELT DECLINE IS APPX. 450' AND LENGTH OF 8-EAST SUBLEVEL IS APPX. 250'.
KURF
CHEMICAL LIME COMPANY
KIMBALLTON MINE
MINE EVACUATION MAP
DRAWING #: 0011
NOT TO SCALE
DRAWN BY: M. LUNDACHER & C. CAMPBELL
DATE: 01/25/2010

Kimballton Interior



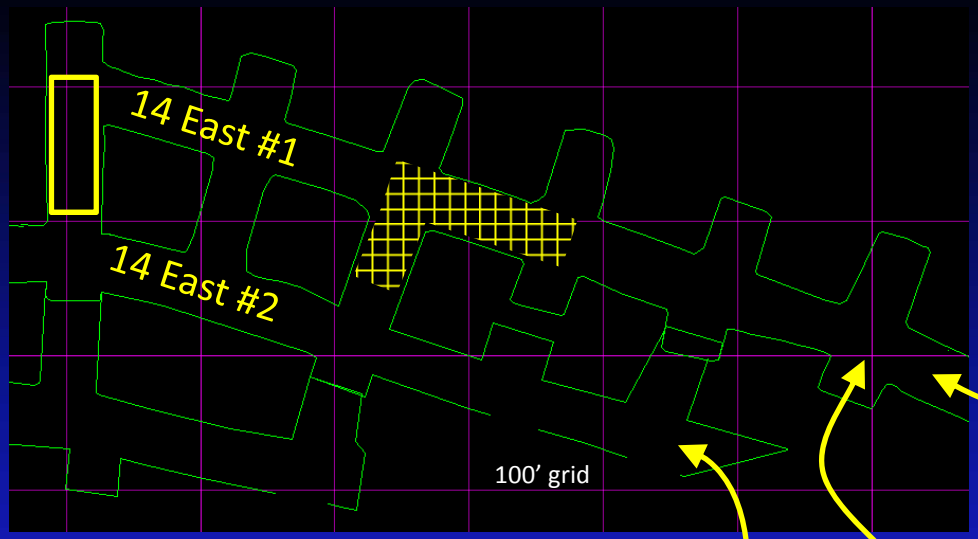


dimensions in feet

(blue inset is size of Hall C in Gran Sasso)


TRD


ABBOTT
ABBOTT



looking down 14 East #2
(top of escape-way ladder from 15th level seen on left)

looking down 14 East #1
(40 ft wide, 90 ft high typ.)
tripod is **600 ft** from KURF
(seen in the background)

escape-way ladder
to 13th level

Building KURF (for < $200k; funds from Provost, College of Science, Research Division)

Backgrounds in Kimballton

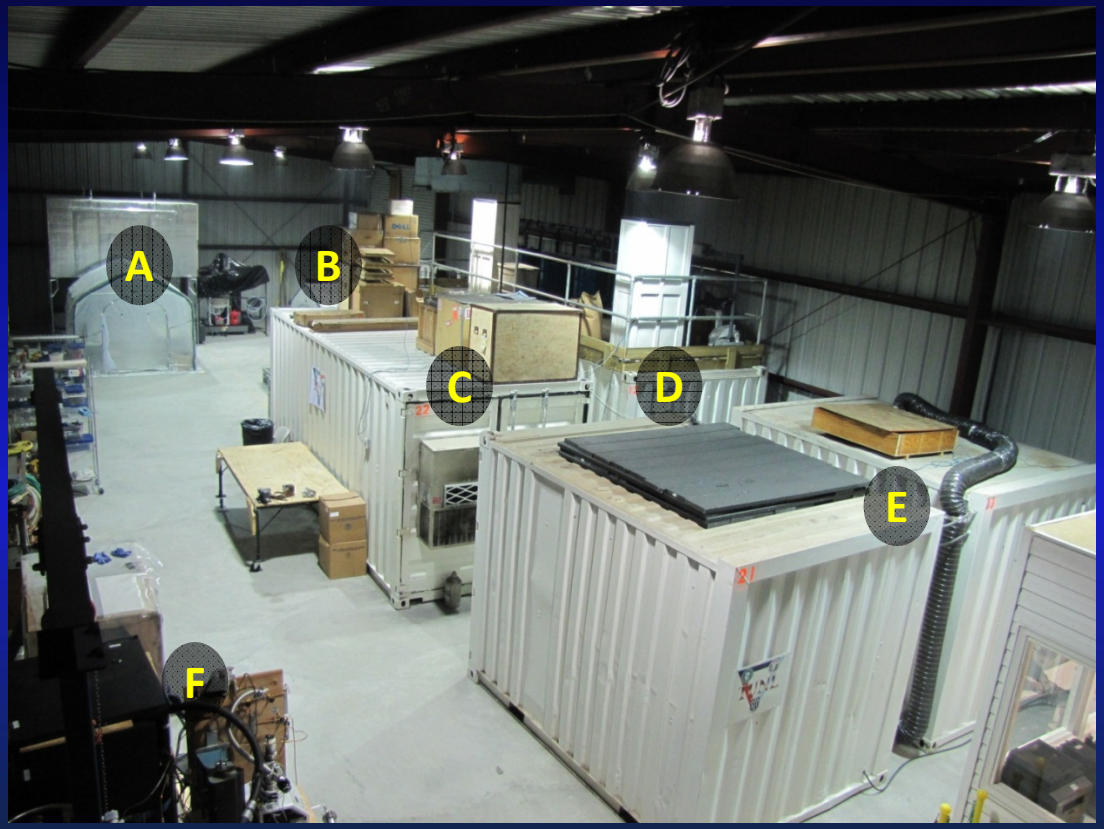
- Kimballton (limestone) (Bq/kg)
  - $^{40}K \rightarrow 18\pm1, 13\pm1$
  - $^{226}Ra \rightarrow 1.2\pm0.1, 1.9\pm0.2$
  - $^{226}Th \rightarrow 0.6\pm0.1, 0.9\pm0.2$
- Radon concentration
  - $^{222}Rn < 14.8$ Bq/m^3

- Gran Sasso (Dolomite rock) (Bq/kg)
  - $^{40}K \rightarrow 15$
  - $^{226}Ra \rightarrow 5$
  - $^{226}Th \rightarrow 0.3$
- Radon concentration
  - $^{222}Rn \rightarrow 40 – 70$ Bq/m3

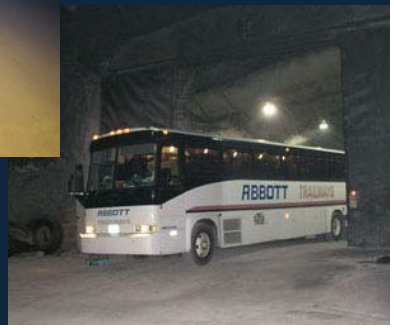
Rock Strength:

~150 MPa

Current KURF *Users*

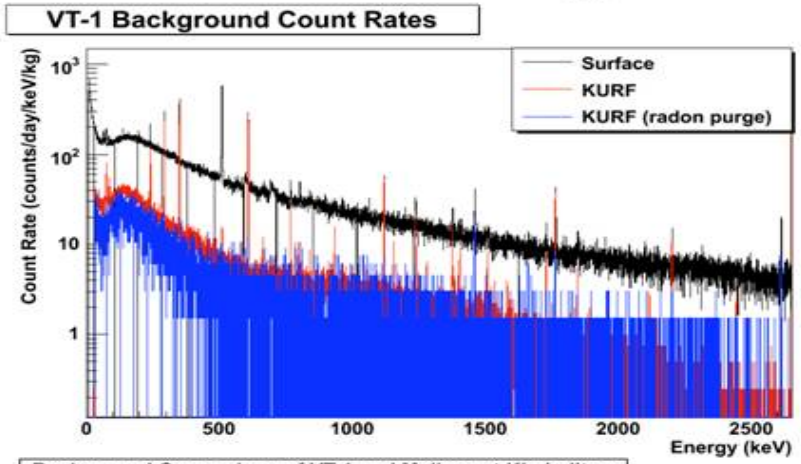


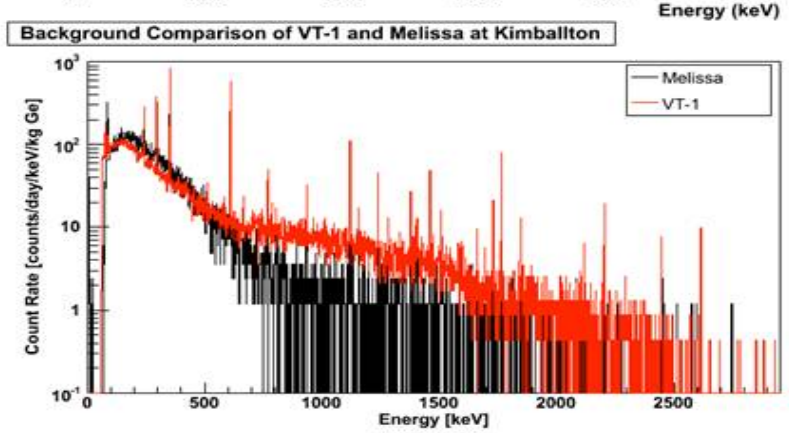
A. mini-LENS (Low Energy Neutrino Spectroscopy)
   Virginia Tech, Louisiana State University, BNL (Vogelaar)
B. Neutron Spectrometer
   University of Maryland, NIST (Nico)
C. ββ Decay to Excited States
   Duke University (Turnow)
D. HPGe Low-Bkgd Screening
   North Carolina State University (Henning), University of North Carolina, Virginia Tech
E. MALBEK (Majorana 0νββ)
   University of North Carolina (Wilkerson)
F. ^{39}Ar Depleted Argon
   Princeton University (Calaprice)
G. Watchman
   LLNL (on 2nd level - Bernstein)
H. Proposals
   Berkeley (Bolometry - Kolomensky)
   FNAL (CENNS - Yoo)



Sub-set of about 60 trained users for biannual refresher

"VT-1" and "Melissa" Low-Background Detectors





HPCu and Pb shield being installed for the Melissa detector

Species	E [keV]	Melissa	VT-1	Surface
^{214}Pb	352	840	60	100
^{214}Bi	609	470	30	100
^{40}K	1460	30	30	30
^{208}Tl	2614	4	10	70
Integral (cpd/kg)	**40-2700**	**40k**	**7.3k**	**380k**

"Low-Background gamma counting at the Kimballton Underground Research Facility." P. Finnerty, et al., **Nucl.Instrum.Meth.A642:**65-69,2011. [arXiv:1007.0015]
Muon flux in J. Xu, et al. "A Study of the Residual ^{39}Ar Content in Argon from Underground Sources," [arxiv:1204.6011].

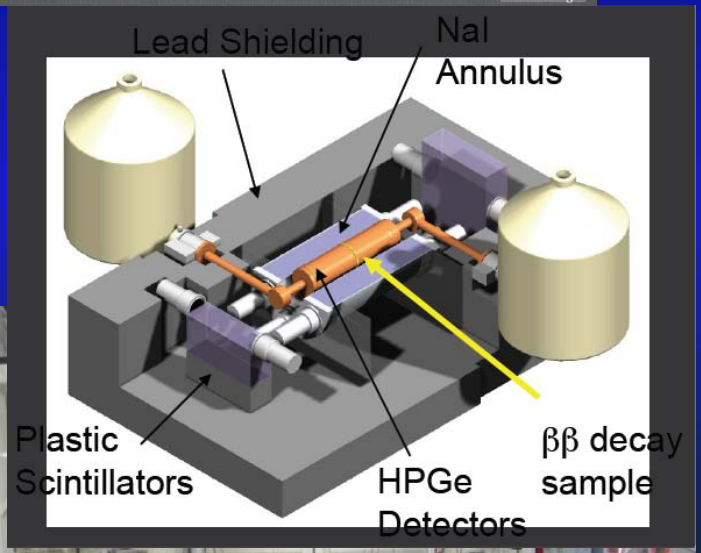
DOUBLE-BETA DECAY OF ^{150}Nd TO EXCITED FINAL STATES

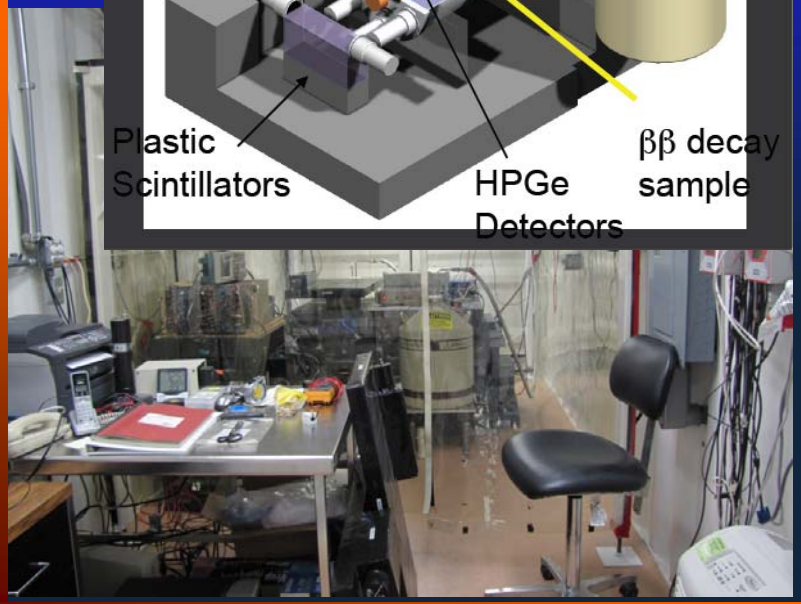
APS Division of Nuclear Physics
Santa Fe, NM
November 5, 2010

M.F. Kidd*, J. H. Esterline, S. W. Finch, W. Tornow

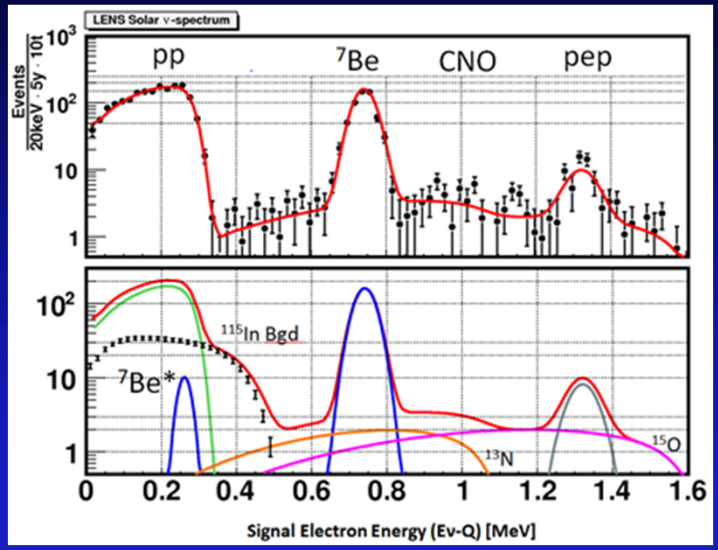
LAUR 10-07157

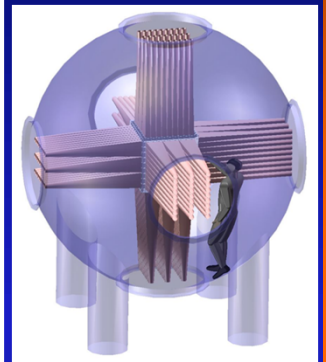
*now at Los Alamos National Laboratory
mkidd@lanl.gov

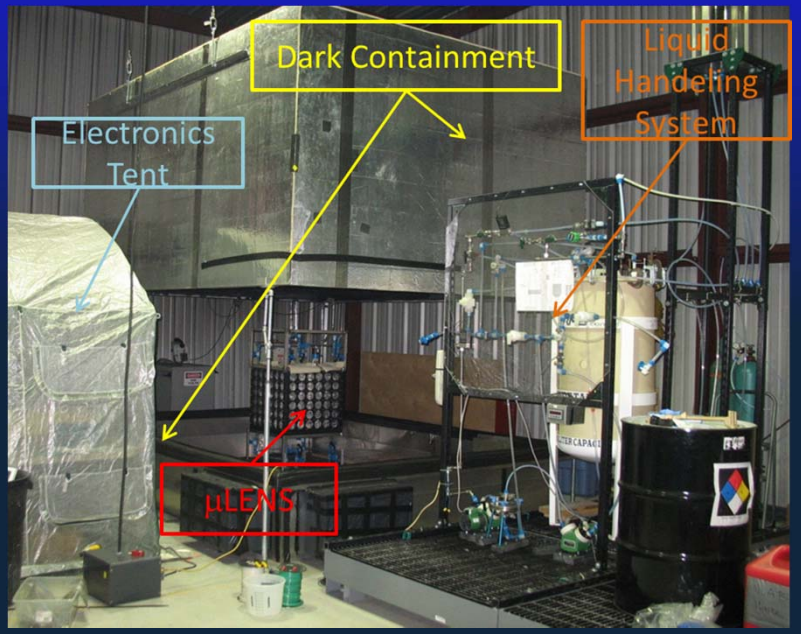




Low-Energy Neutrino Spectroscopy (LENS)



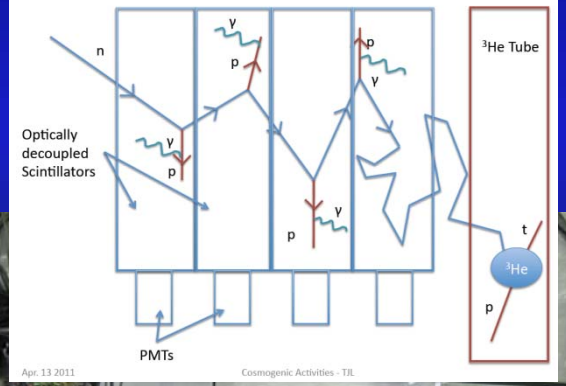


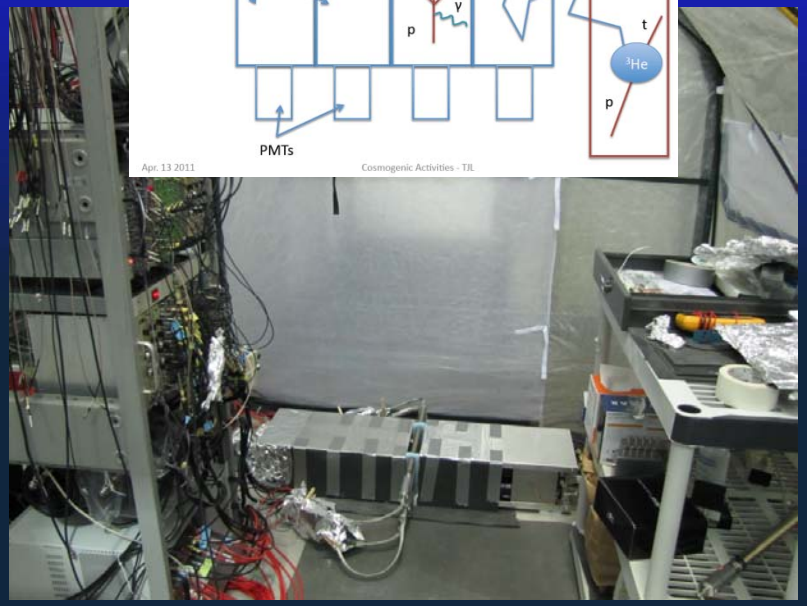


The UMD-NIST Fast Neutron Spectrometer

T. Langford, E. J. Beise, H. Breuer
University of Maryland
C. Heimbach, J. Nico
National Institute of Standards and Technology
April 13, 2011

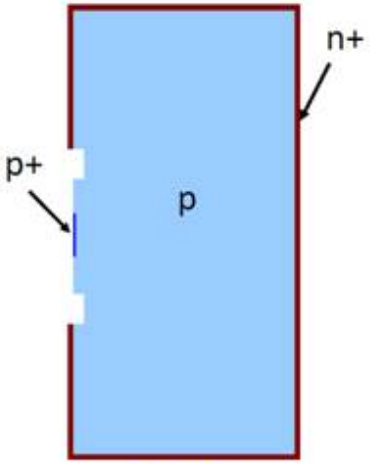
Revised Neutron Detection



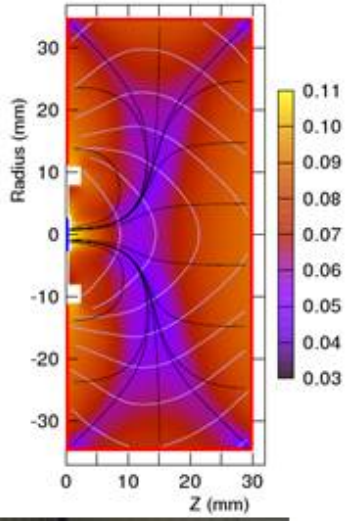


PPC Detectors

UNC (Majorana Collaboration)

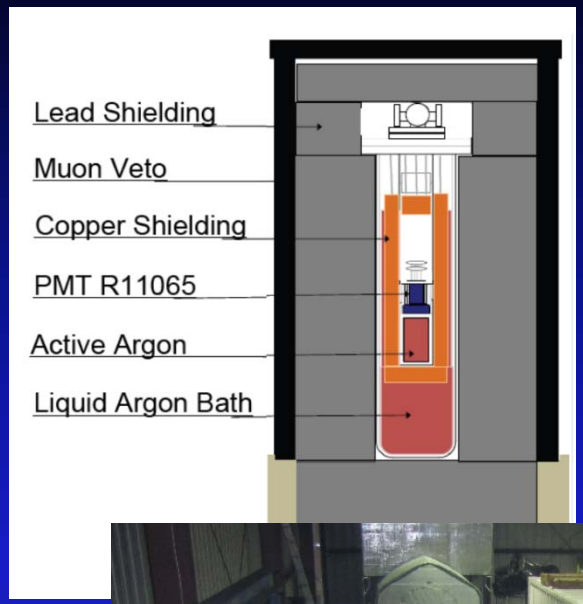


BEGe

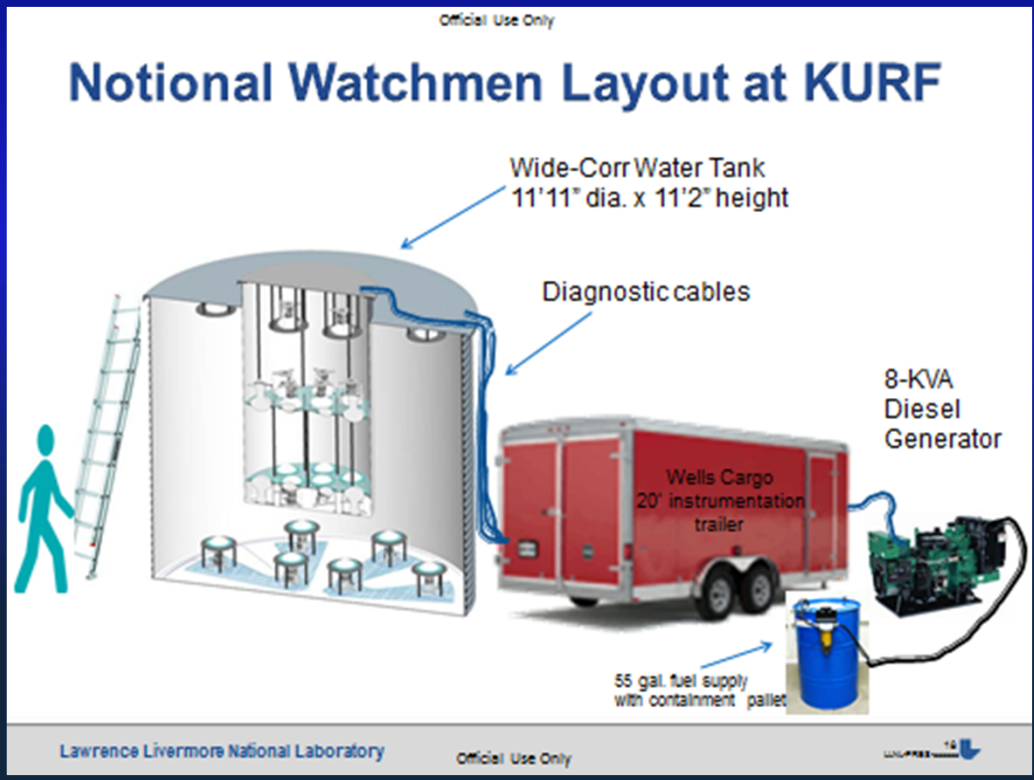


P-type Point Contact HPGe detectors

^{39}Ar depleted Argon



National Security Detection and monitoring of reactors

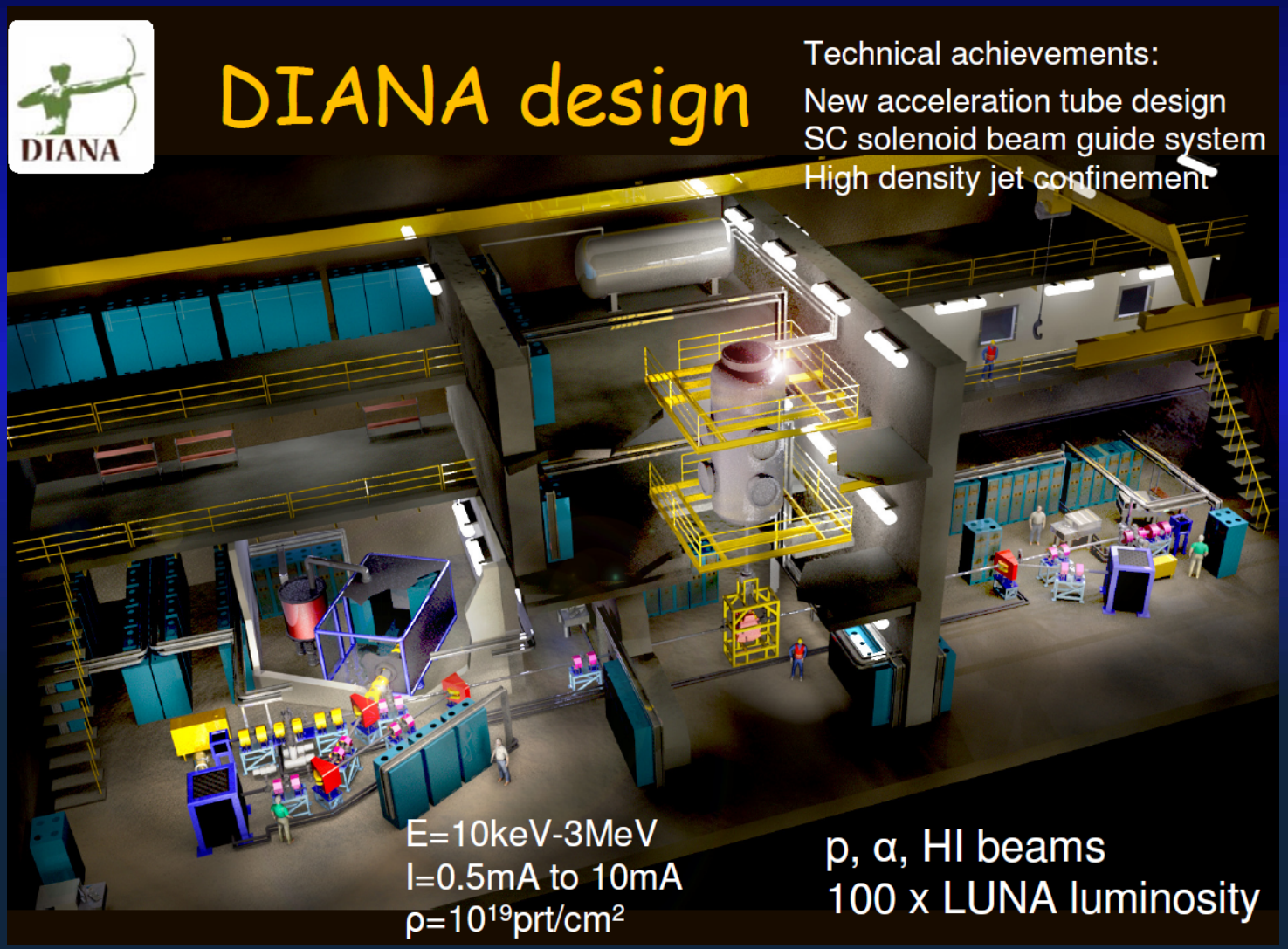


Future Directions

Nuclear Astrophysics

LENS

Artist Concept of Complete Facility



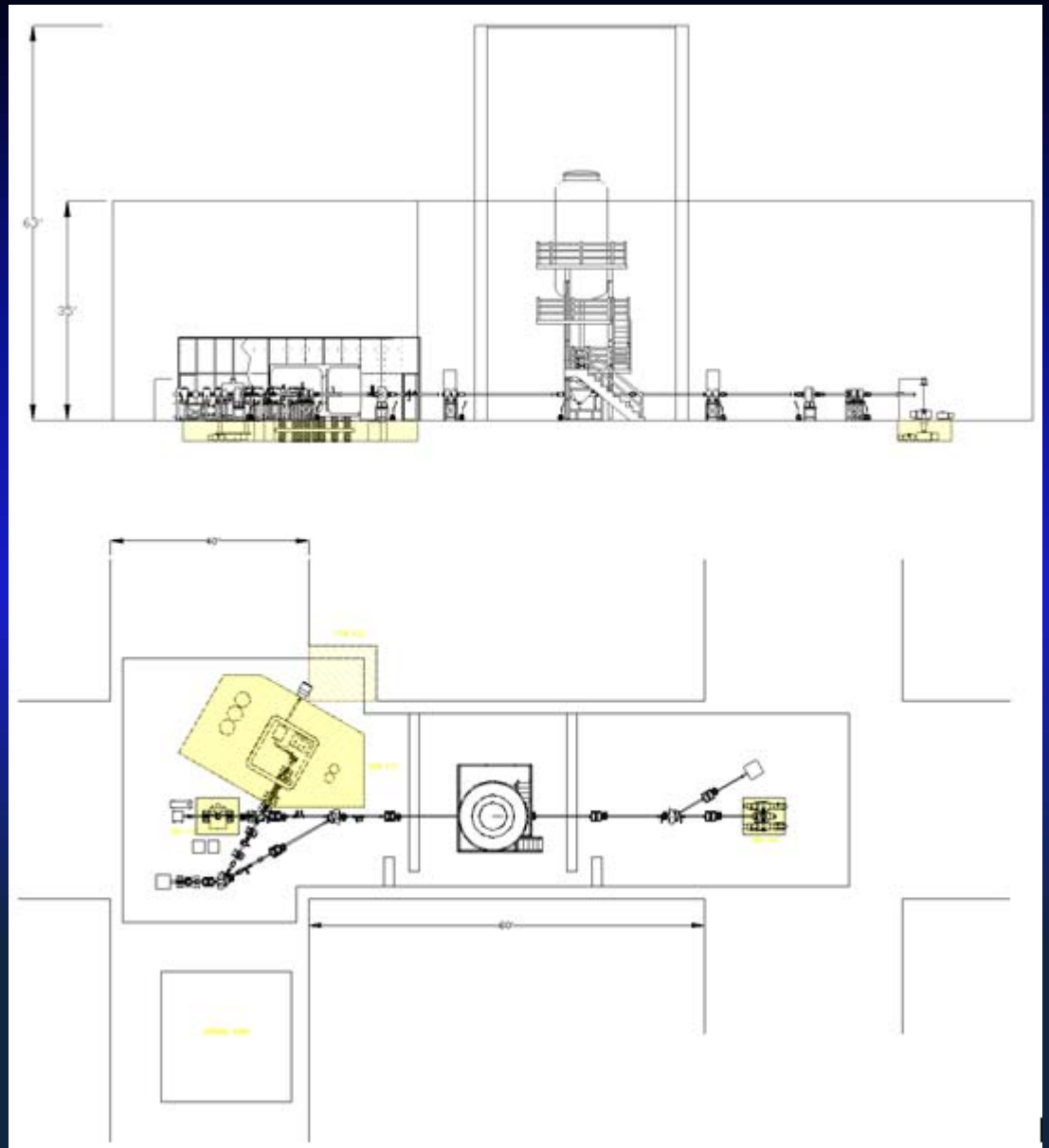
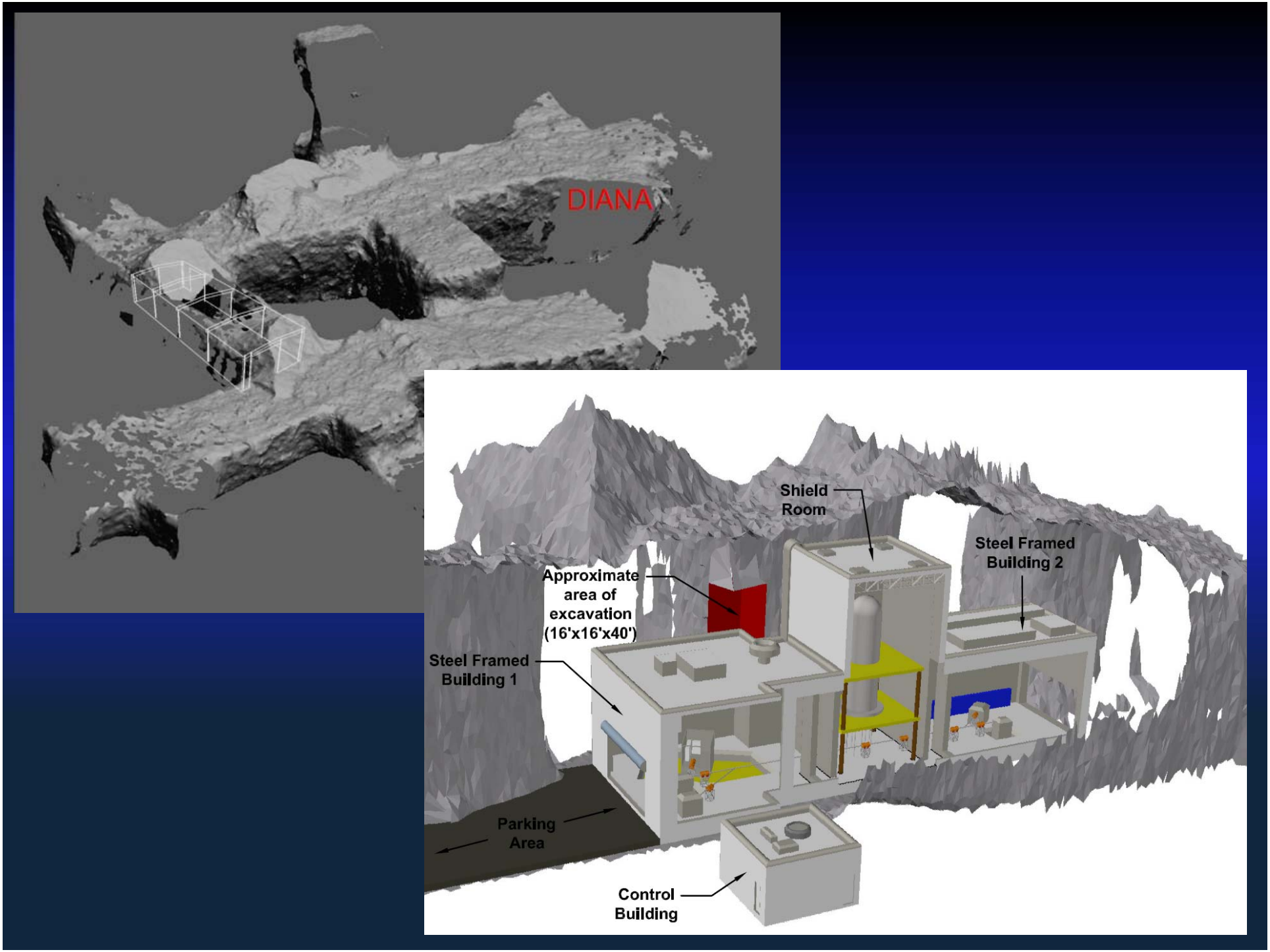
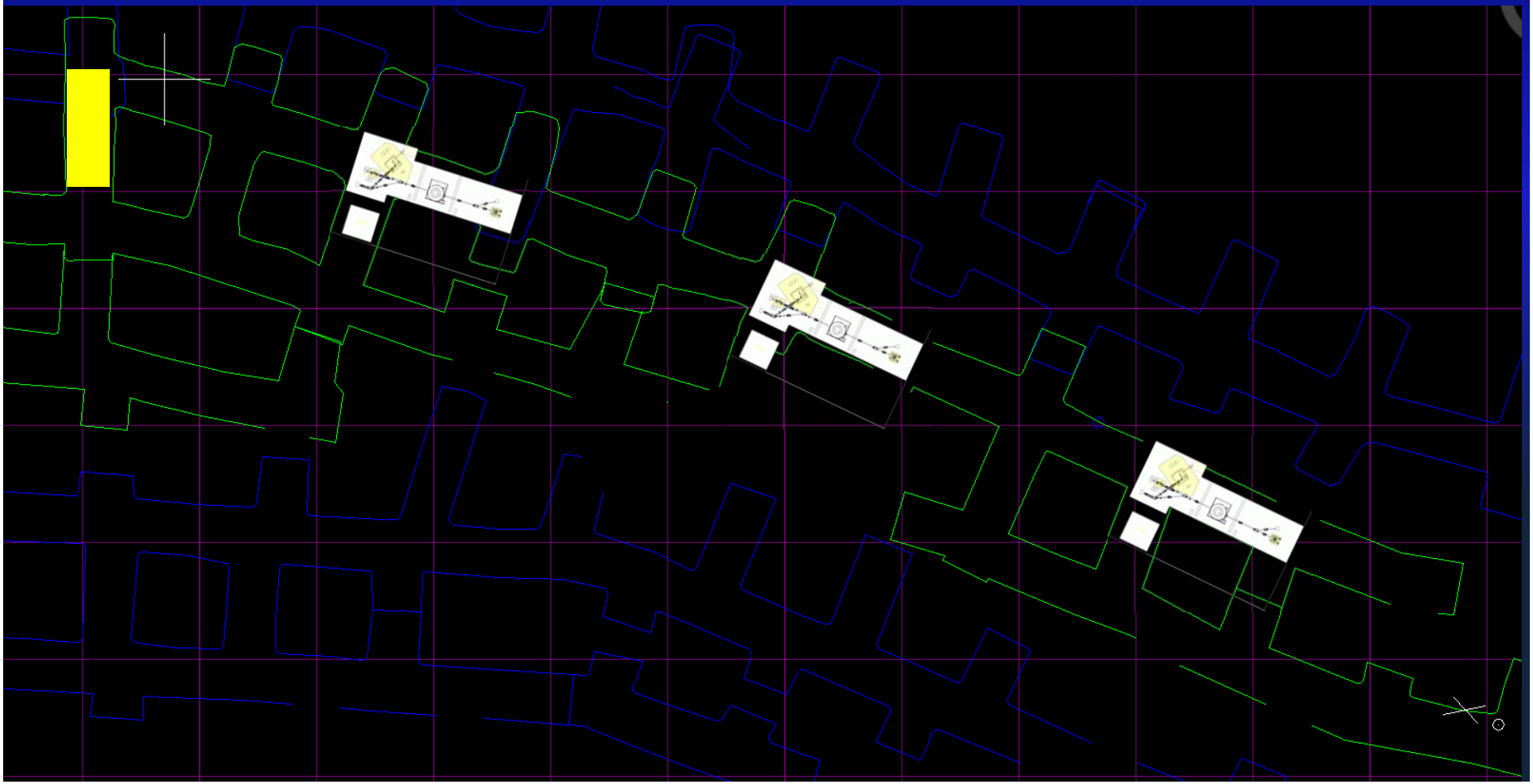
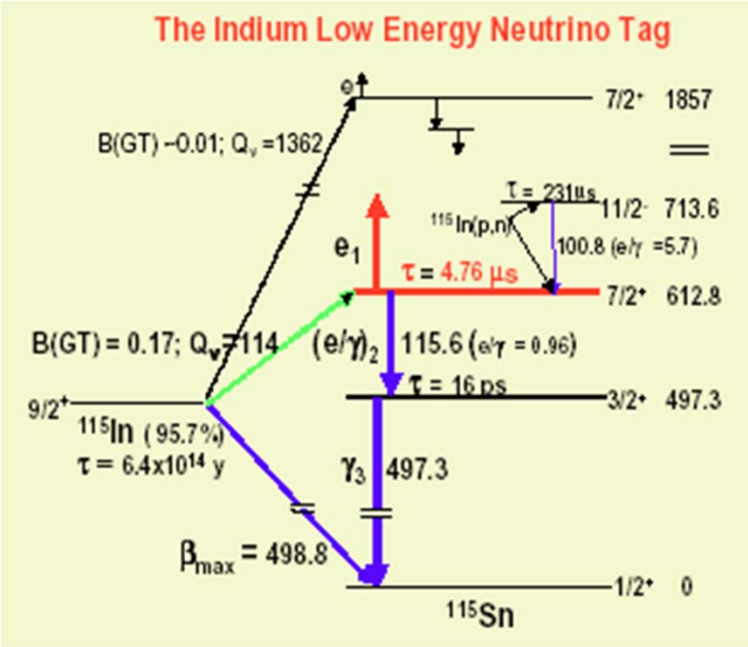


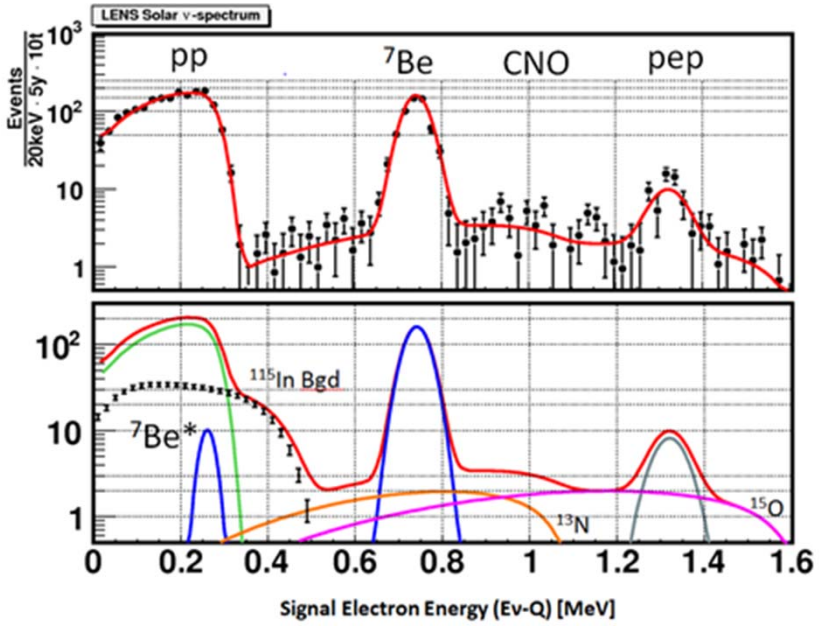
Figure 2 (continued): Cross-section and floor plan for DIANA located at KURF.

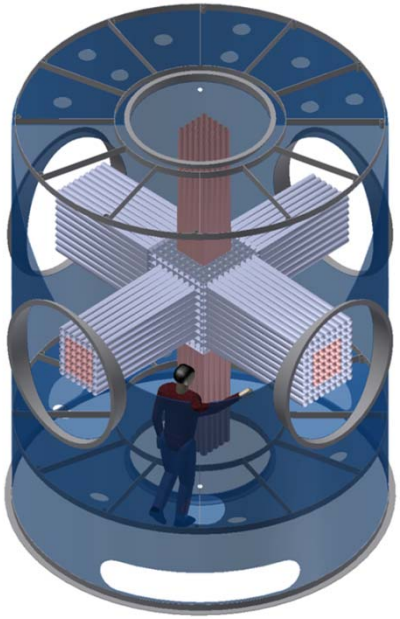

DIANA
Shield Room
Steel Framed Building 2
Approximate area of excavation (16'x16'x40')
Steel Framed Building 1
Parking Area
Control Building

Three (of many) Underground locations for DIANA

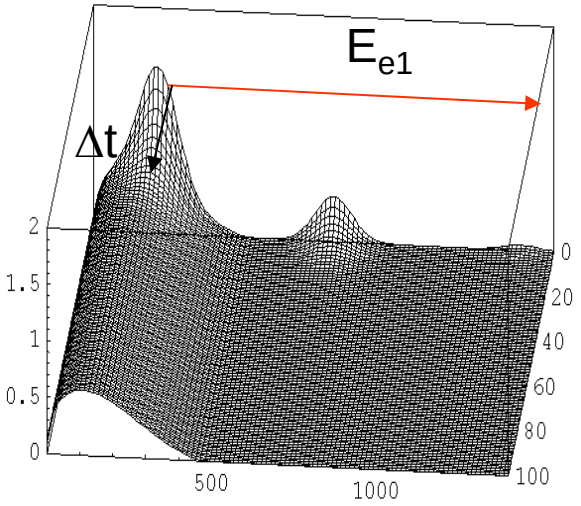


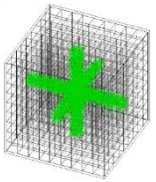

The Indium Low Energy Neutrino Tag
B(GT) ~0.01; Q$_\nu$ =1362
7/2$^+$ 1857
τ = 231μs
^{115}In(p,n)
11/2$^-$ 713.6
100.8 (e/γ =5.7)
e$_1$
τ = 4.76 μs
7/2$^+$ 612.8
B(GT) = 0.17; Q$_\nu$=114
(e/γ)$_2$
115.6 (e/γ = 0.96)
τ = 16 ps
9/2$^+$
3/2$^+$ 497.3
^{115}In (95.7%)
τ = 6.4x10^{14} y
γ$_3$ 497.3
β$_{max}$ = 498.8
1/2$^+$ 0
^{115}Sn

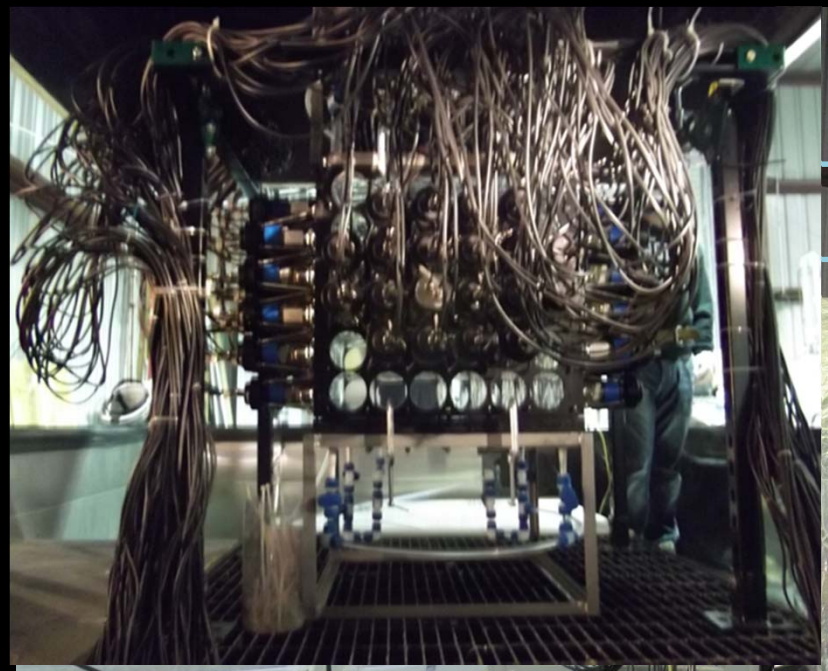

LENS Solar ν-spectrum
Events 20keV · 5y · 10t
pp
^{7}Be
CNO
pep
^{115}In Bgd
^{7}Be*
^{13}N
^{15}O
Signal Electron Energy (Ev-Q) [MeV]

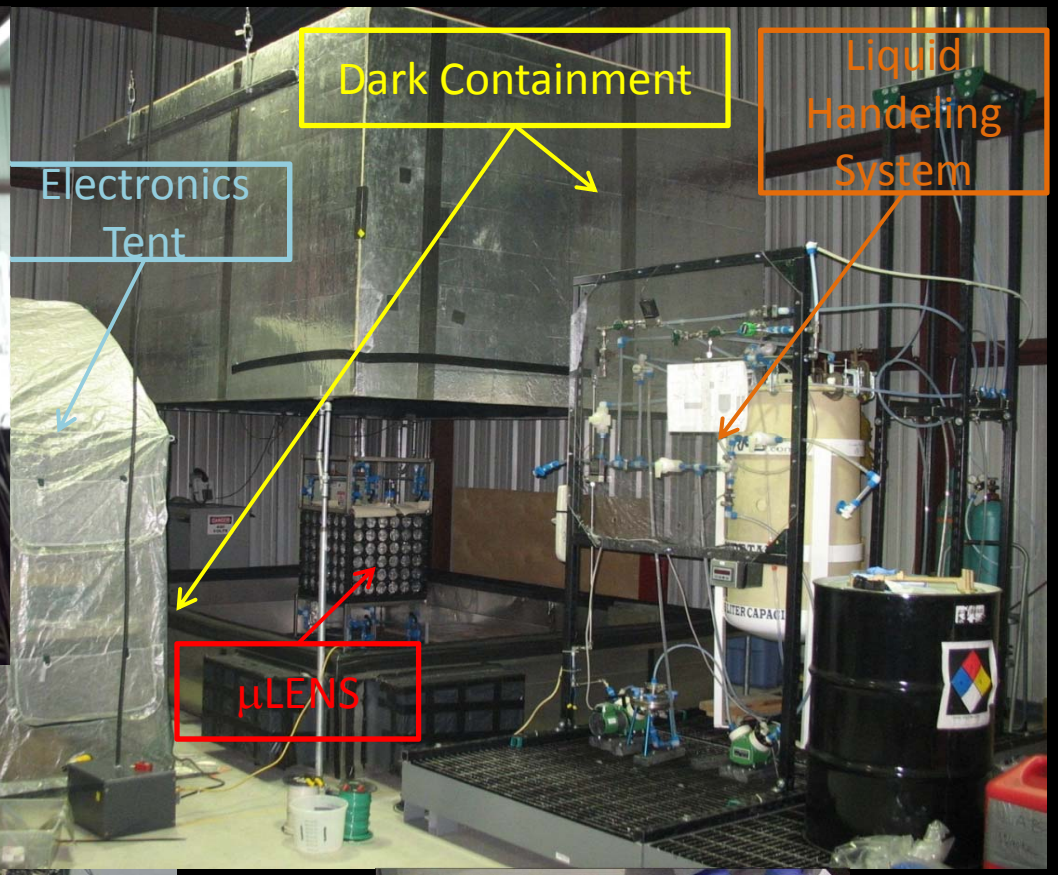


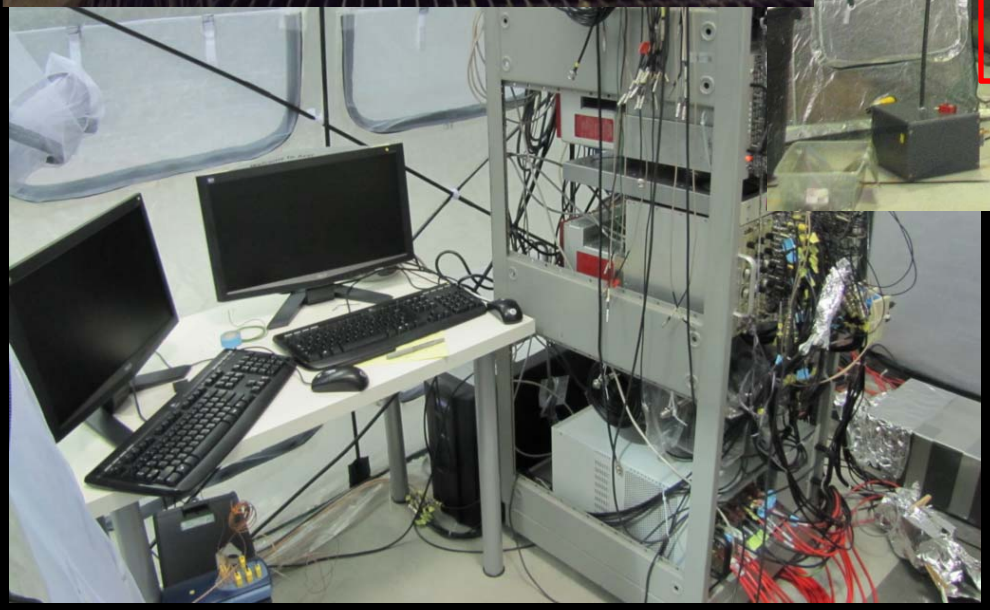
^{13}N vs ^{15}O ??


E$_{e1}$
Δt









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