

# HLS systems at Fermilab and DUSEL

(there are no WPS systems)

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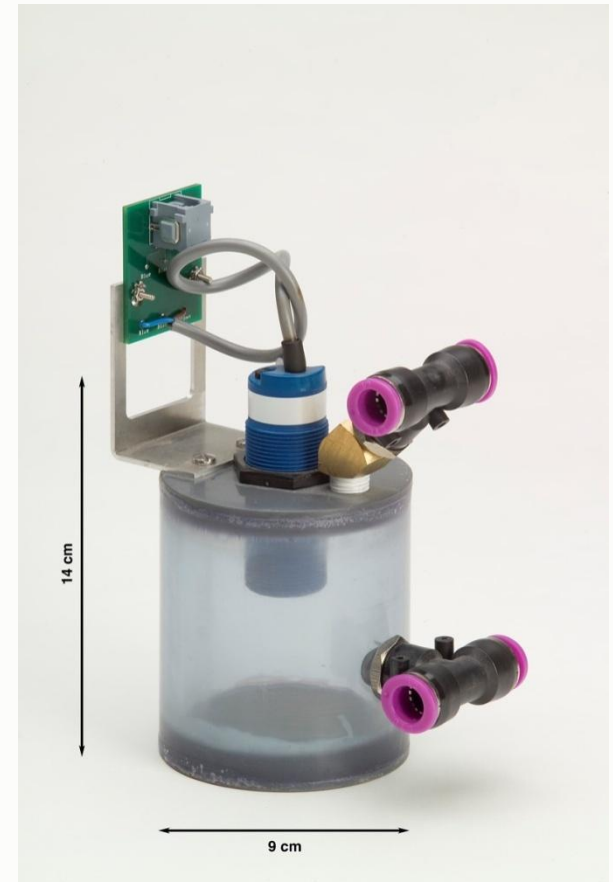
Sanford Lab

# There are two types of HLS systems in use



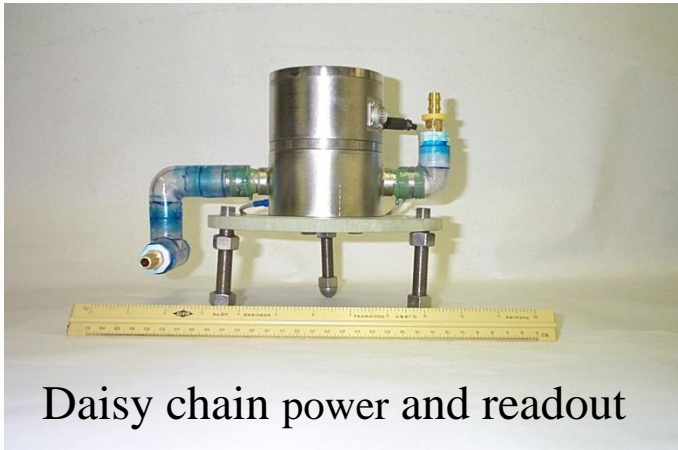
Budker Institute of Nuclear Physics

Fermilab designed  
Tevatron style



# Three types of Budker Institute sensors

Capacitive sensors



Daisy chain power and readout

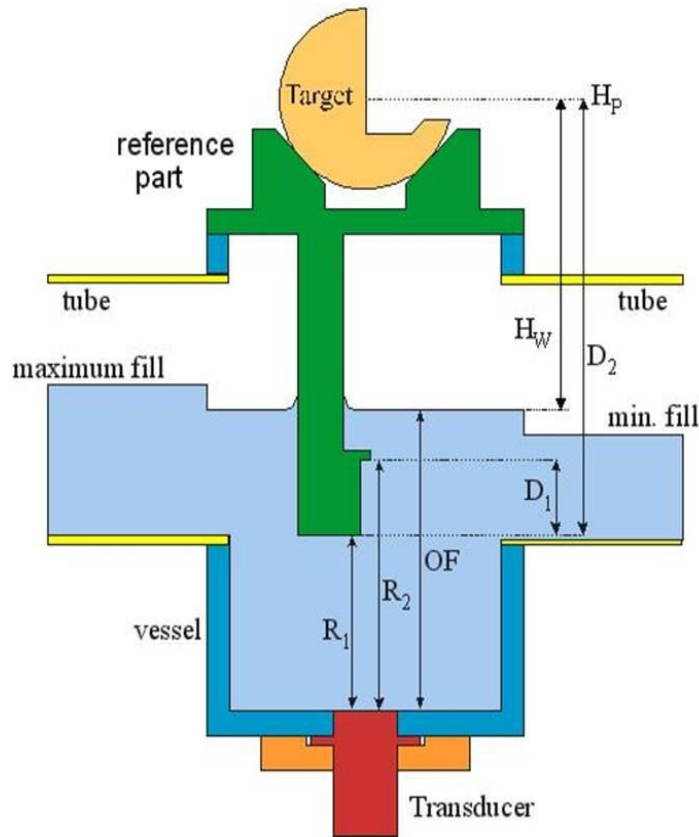


Power and signal over Ether net



Ultra Sonic sensors power and signal over Ethernet

# Cross section of Ultra Sonic sensor



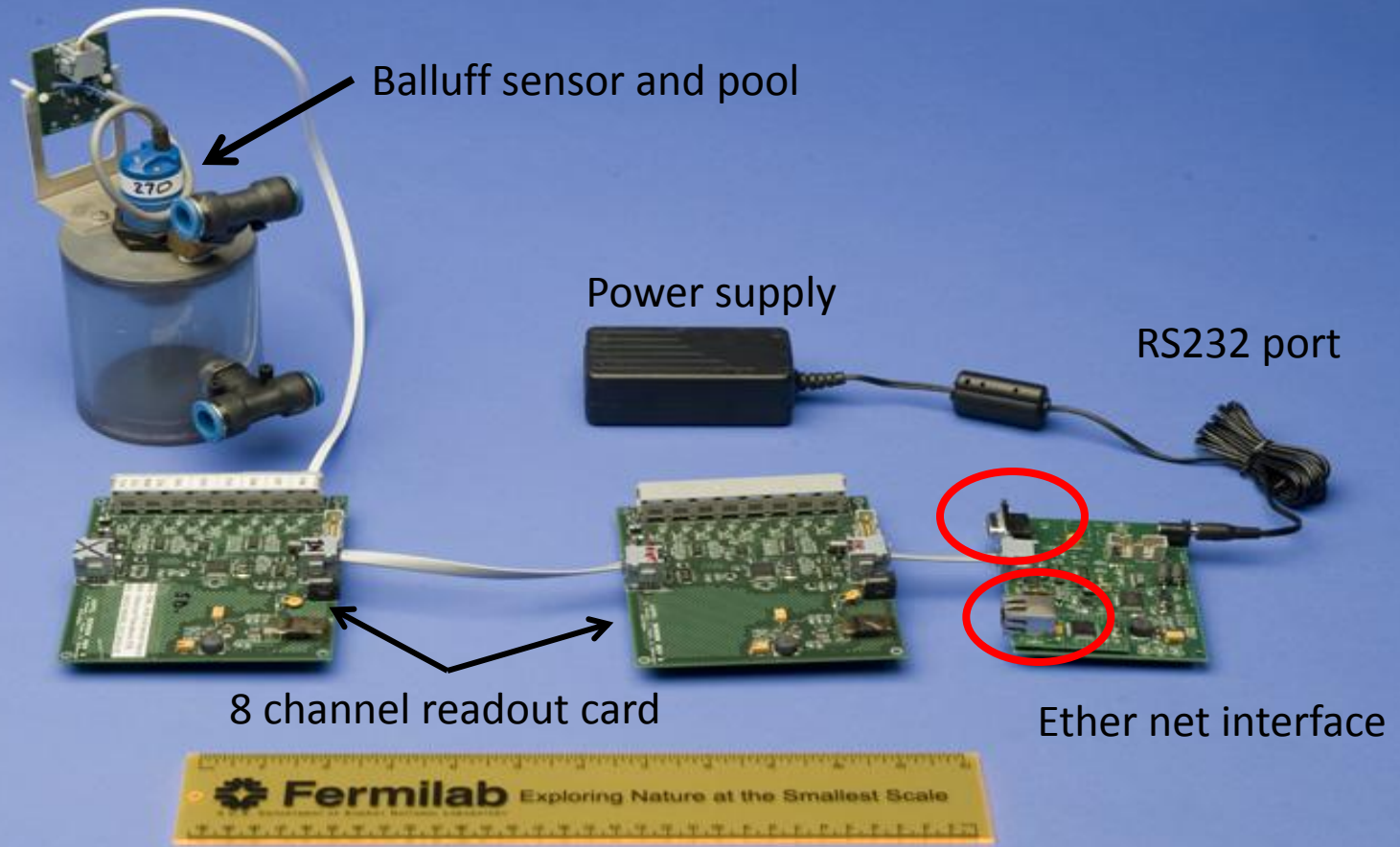
Green is stainless steel post with precision machined steps and nest for survey target

Red is the transducer in the bottom of the pool

The velocity of sound is calculated for every pulse

Paper in IWAA-08  
A Chupya session 4

# Fermilab design Tevatron style

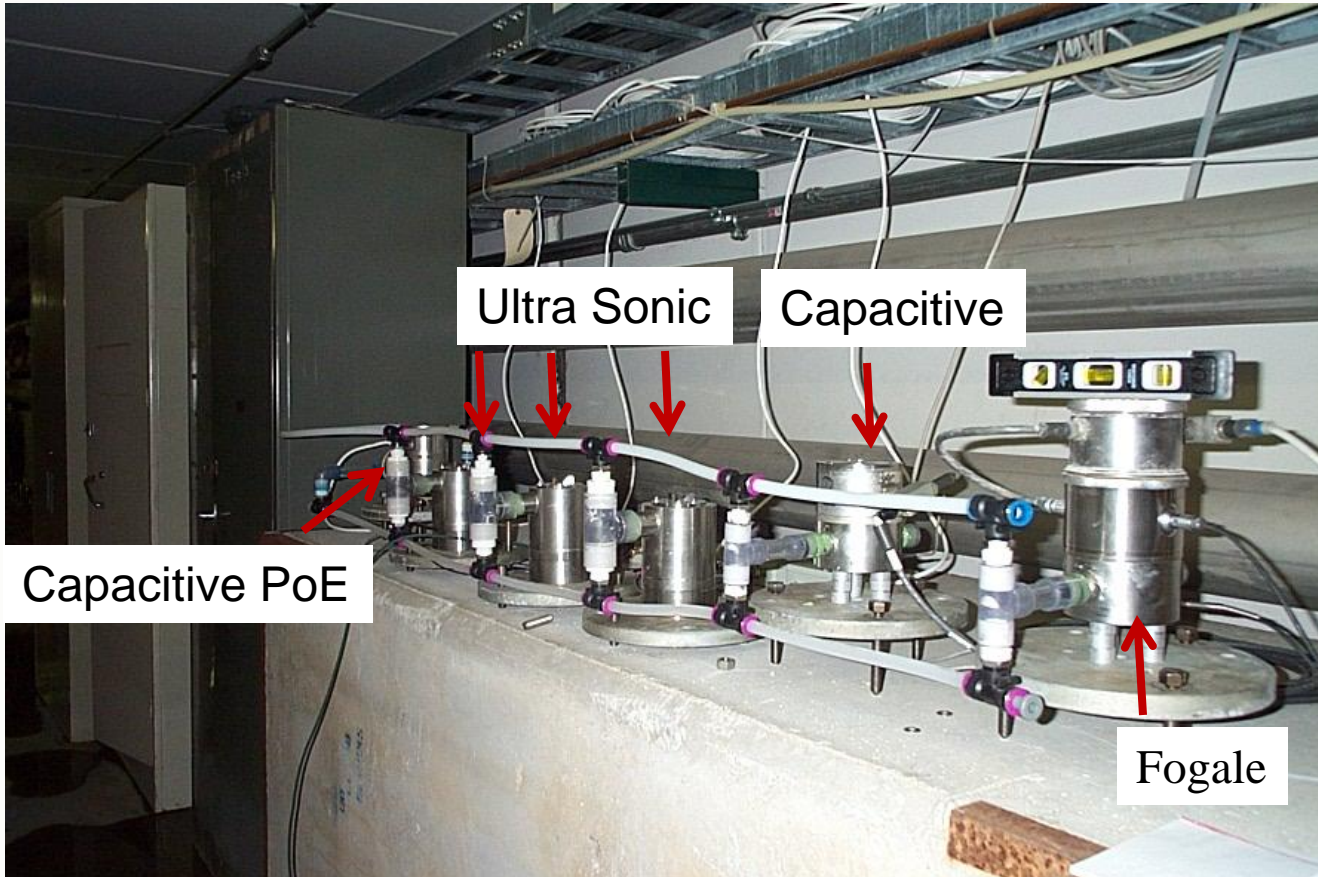


# Systems at Fermilab

1. 9 Budker sensors on the low beta quads at each interaction region
2. 204 Tevatron style sensors one on each Tevatron quadrupole
3. 5 Budker sensors in the LaFarge mine North Aurora Illinois
4. 7 Budker sensors in the near MINOS hall Fermilab
5. 11 Tevatron style sensors on floor in NMS hall photo injector test
6. 6 sensors various types stability test at MP-8 Fermilab
7. 12 Tevatron style sensors 200 ft level Homestake Gold mine Lead SD
8. 12 PoE and 3 Capacitive “hot” spares at MP-8
9. 9 Legacy Fogale sensors I have collected from old installations
10. 8 Fogale sensors (soon to be) on loan from Argonne Lab



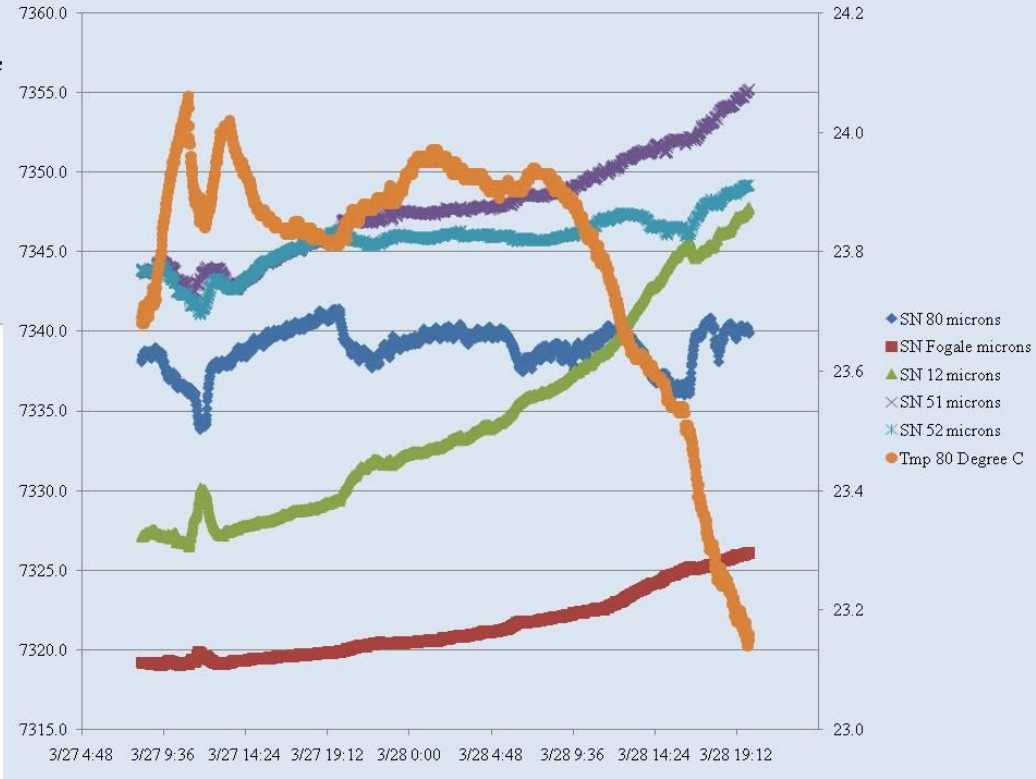
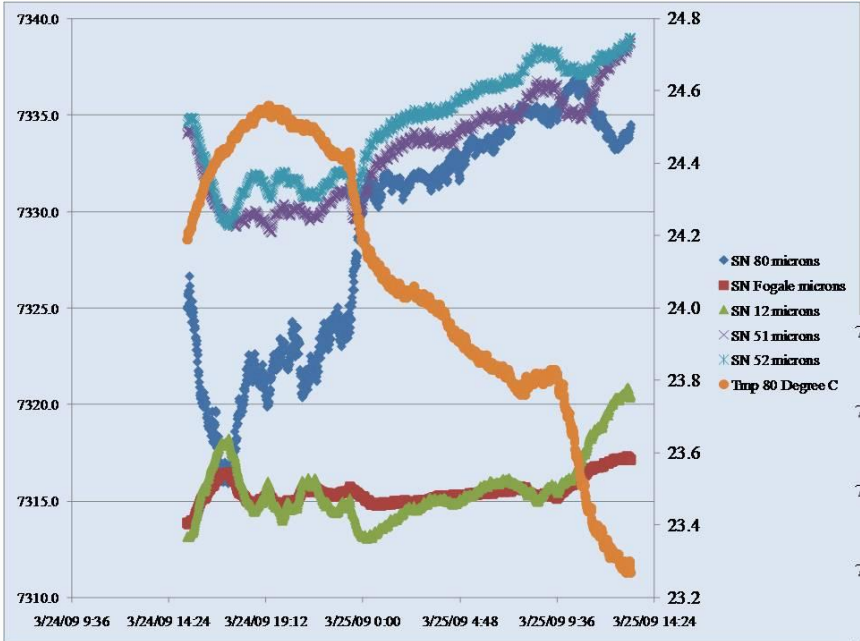
# Stability test stand



All sensors common water system on concrete block in surface tunnel

# Stability Data

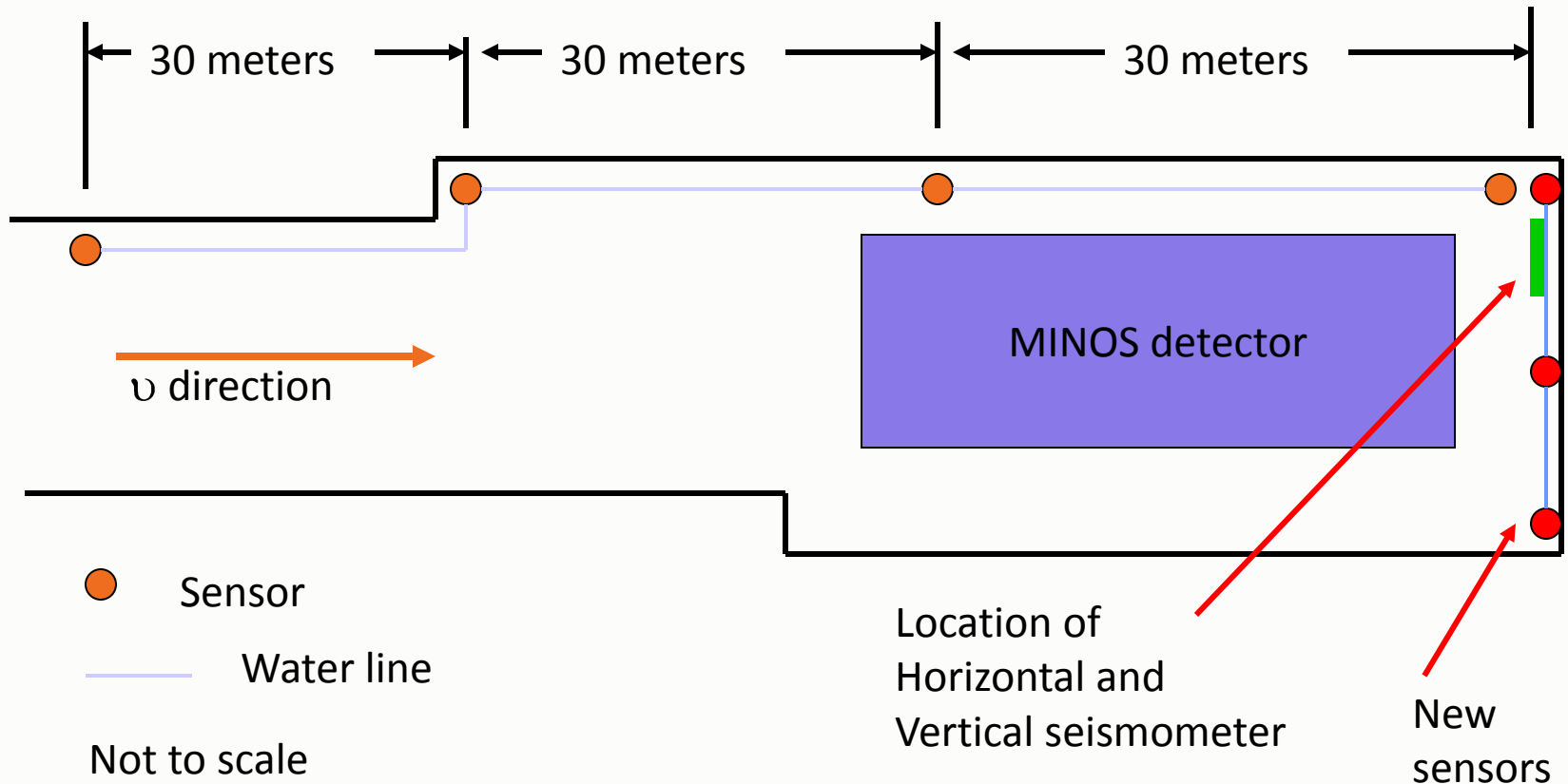
SN 80 Budker PoE Capacitive  
 SN 12 Budker Capacitive  
 SN 51 & 52 Budker Ultra Sonic





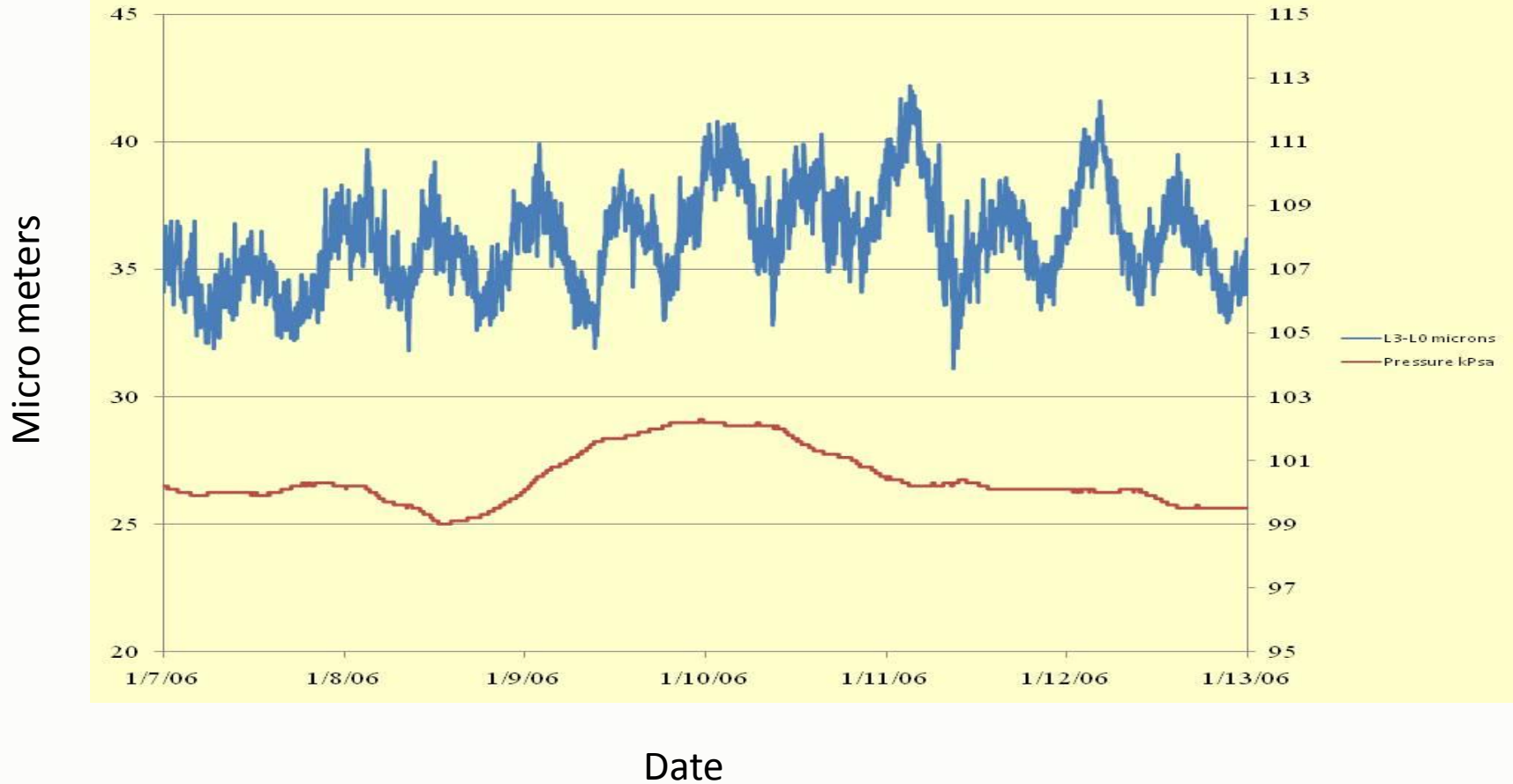
# Layout of MINOS water level

Depth of floor 100 meters below grade  
406 feet above sea level Maquoketa shale



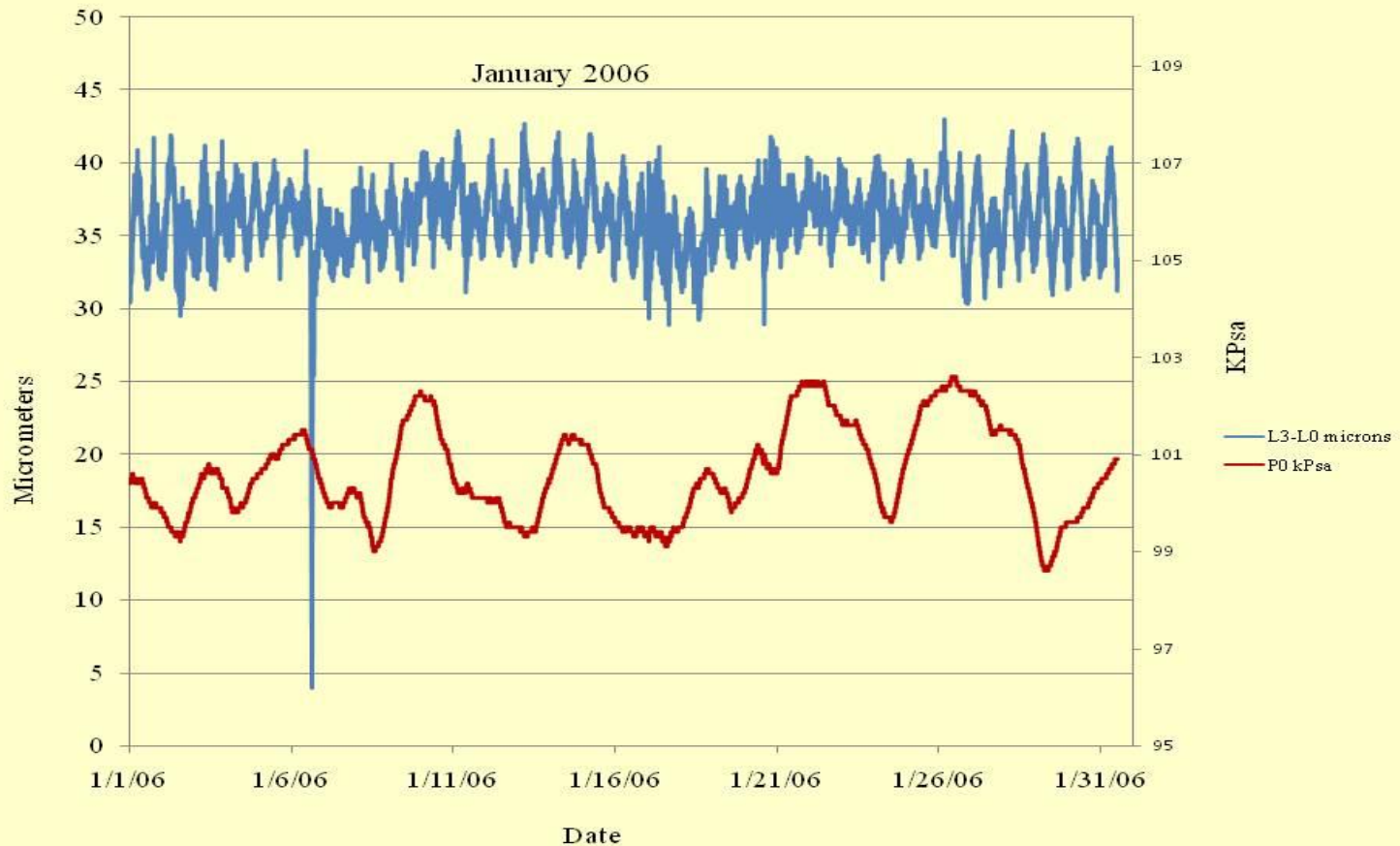
# MINOS Tidal Data

Difference in two sensors 90 meters apart

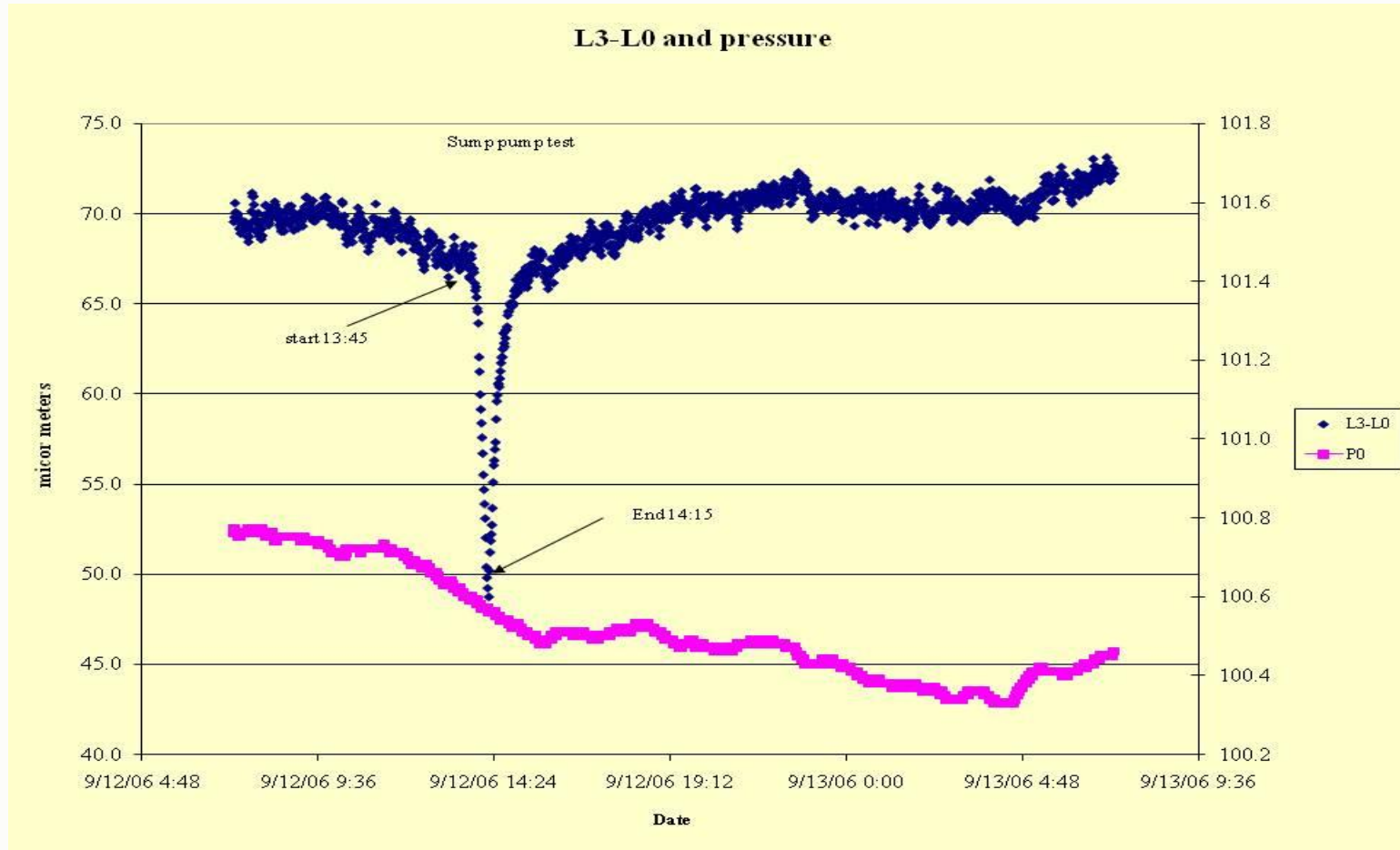


# January 2006 MINOS

Difference in two sensors 90 meters apart

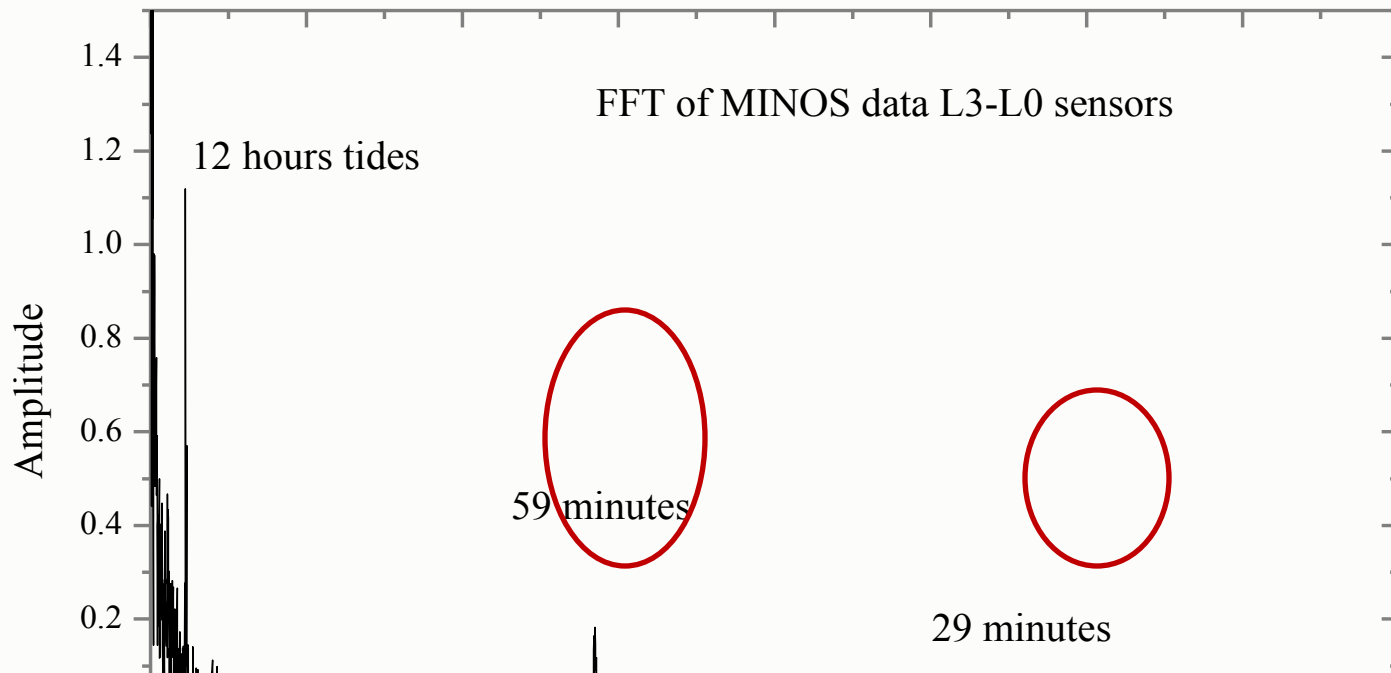


# Sump Pump Test



# FFT of MINOS data difference between two sensors

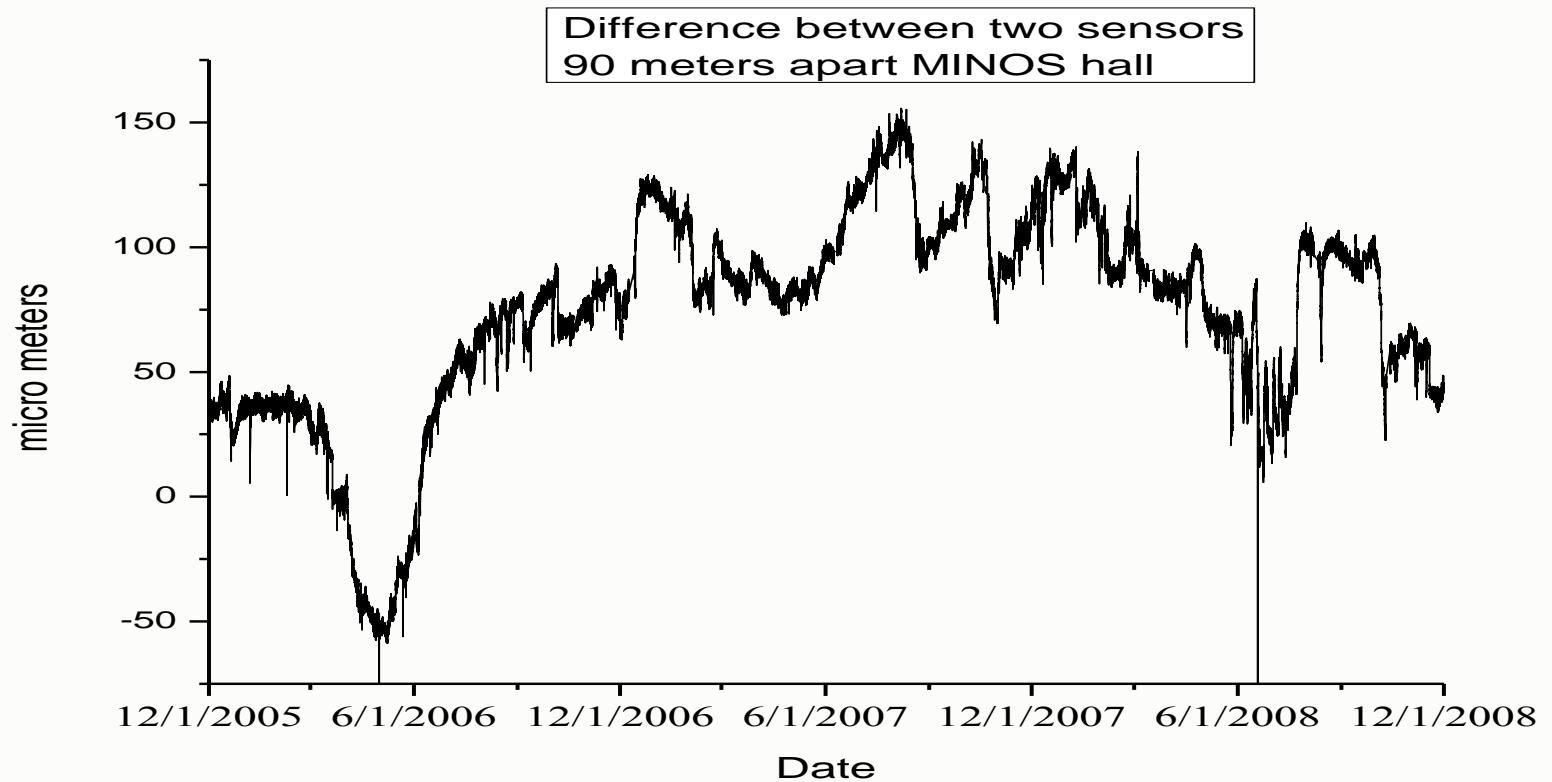
## December 2007





# Difference in two sensors 90 meters Apart MINOS hall

36 months of data



# The LaFarge Mine North Aurora Ill



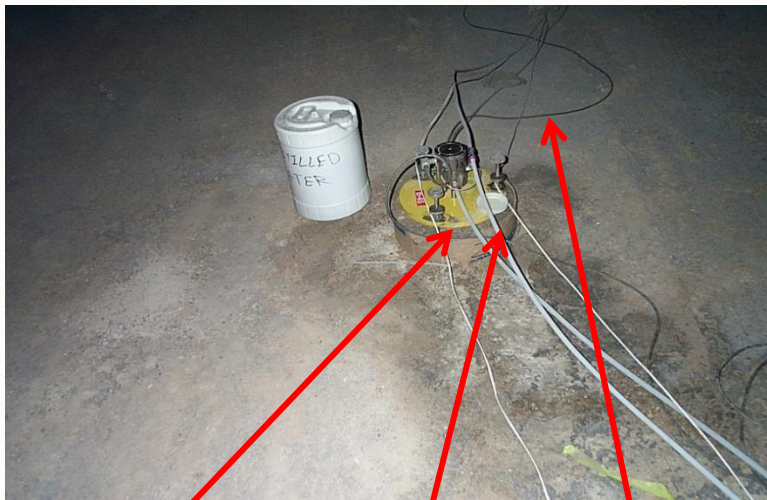
Entrance to mine 1200 meter decline

In the Galena Platteville dolomite 120 meters below grade

If the ILC were built at Fermilab this would be the preferred depth and strata

# Budker Sensors in South 5 drift

Station 3



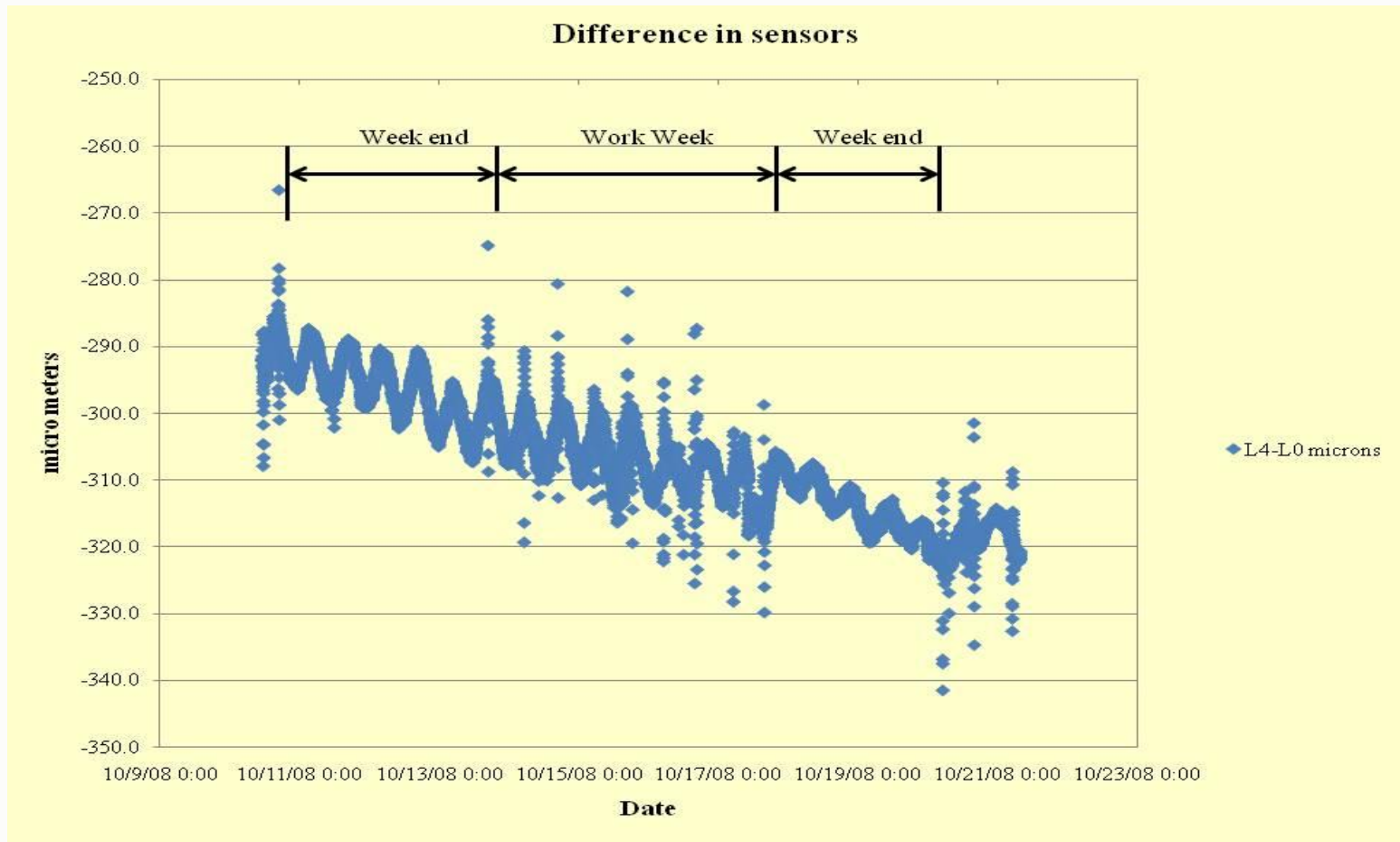
Water line   Air line   Data cable

Station 4

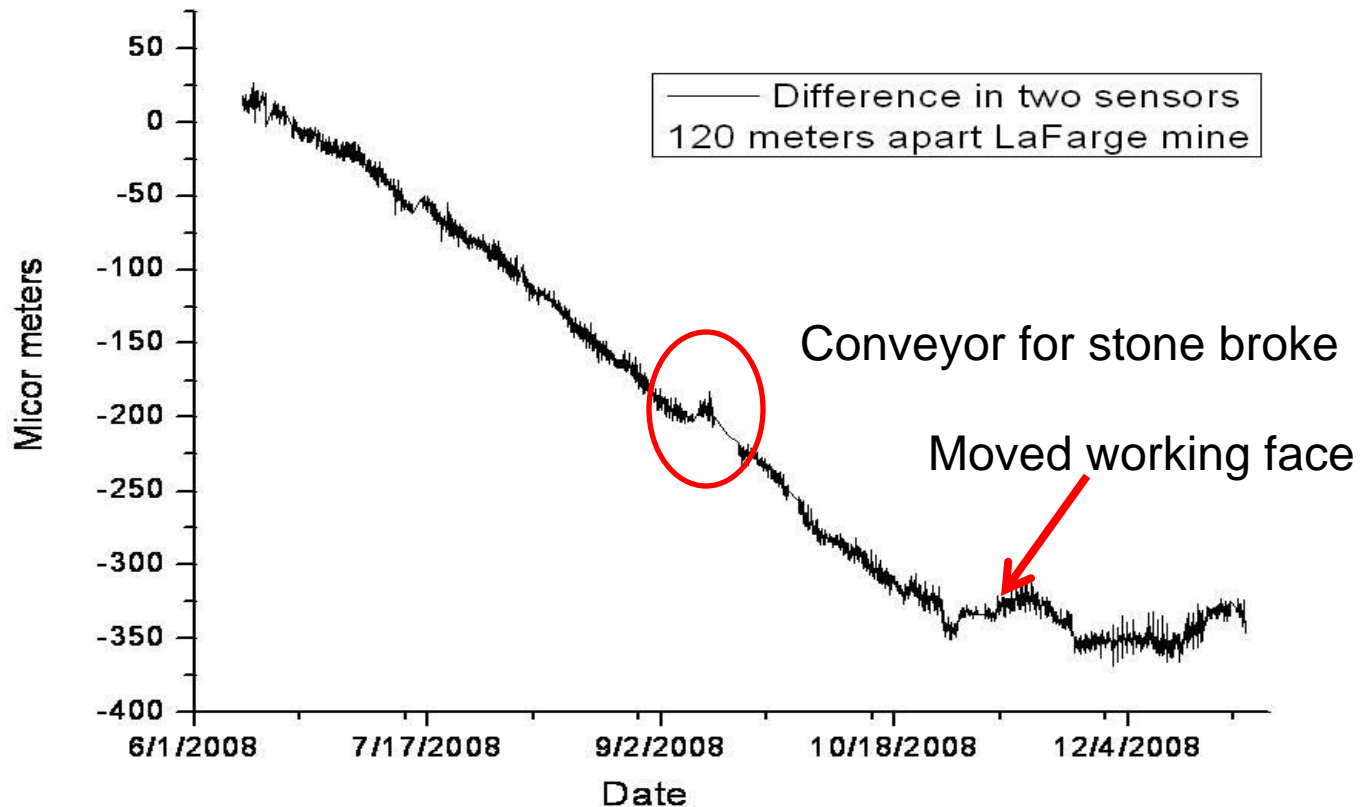


Note built up concrete pillar this is to make up for difference in floor elevation

# Difference in two sensors 60 meter apart



# 10 months of Lafarge Data





# MINOS and AURORA Data

The data for MINOS and the LaFarge mine are available at  
<http://dbweb1.fnal.gov:8100/ilc/ILCGroundApp.py/index>

ILC Ground Motion Database - Mozilla Firefox

http://dbweb1.fnal.gov:8100/ilc/ILCGroundApp.py/index

ILC ground motion database

Source: Aurora (2006-09-01 - 2009-02-28)  
Minos (2005-11-21 - 2009-02-28)

From date: mm/dd/yyyy, yyyy-mm-dd

To date: mm/dd/yyyy, yyyy-mm-dd

or month: 2009-02 yyyy-mm

Go

[read@fnal.gov](mailto:read@fnal.gov)

ILC Ground Motion Database - Mozilla Firefox

http://dbweb1.fnal.gov:8100/ilc/ILCGroundApp.py/Minos/display\_csv\_file?K\_gm\_2009-02.csv

Most Visited Getting Started Latest Headlines

Measurement Date, L0, L1, L2, L3, L5, L6, L7, T0, T1, T2, T3, T5, T6, T7, P0

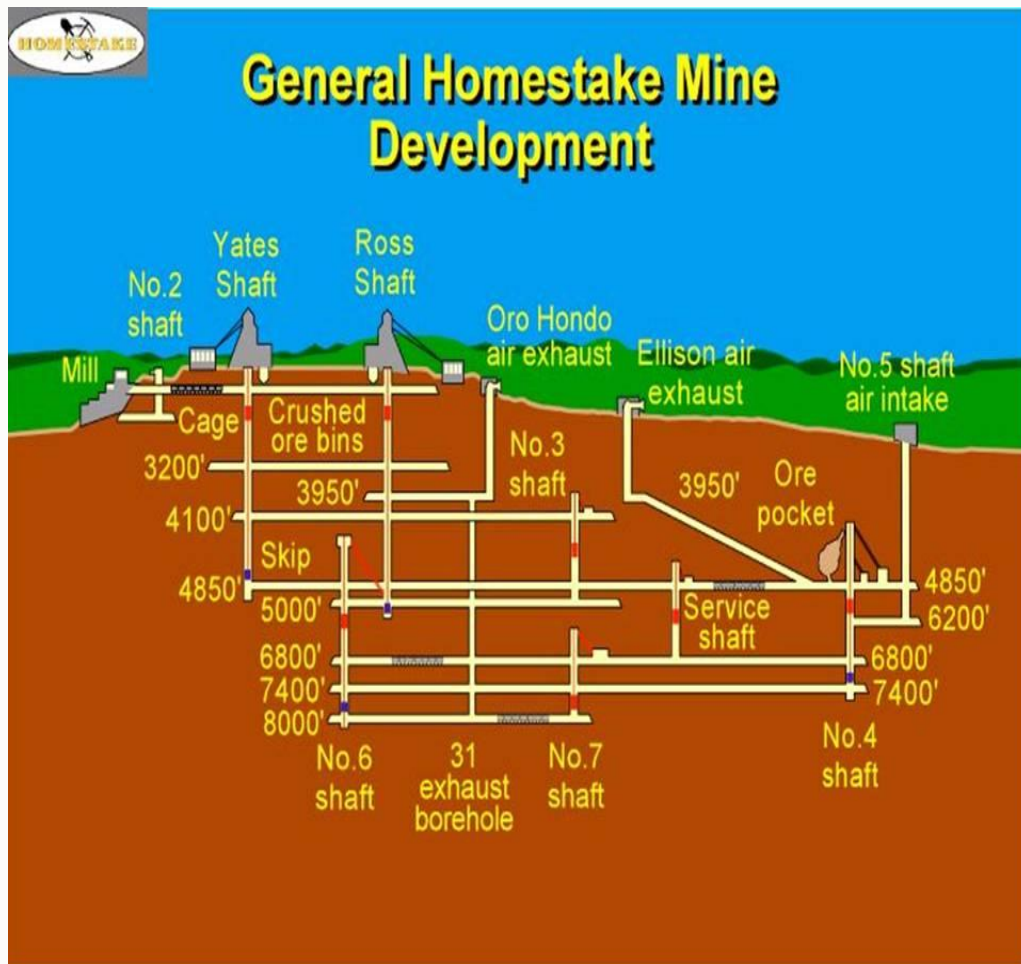
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Transferring data from dbweb1.fnal.gov.

# A dependence values from Vladimir Shiltsev

Location		Value of A $1*10^{-6}$	Length of data collection	Length of sensors	Separation of sensors
FNAL PW7	<i>T</i>	6.4±3.6	3 months	180 m	$\Delta L=30\text{m}$ , $t^0$ -effects
FNAL MI8 line	<i>T,L</i>	1-10	1 month	285m	$\Delta L=15\text{m}$
FNAL Tevatron	<i>T,L</i>	2.2±1.2	1 week	600m	$\Delta L=30\text{m}$
FNAL MINOS hall	<i>T,L</i>	0.18	1 month	90m	$\Delta L=30\text{m}$ , ~100 m deep
Aurora mine (IL)	<i>T,L</i>	0.6±0.3	2 weeks	210m	$\Delta L=30\text{m}$ , ~100 m deep

# DUSEL



Deep Underground Science and Engineering Lab

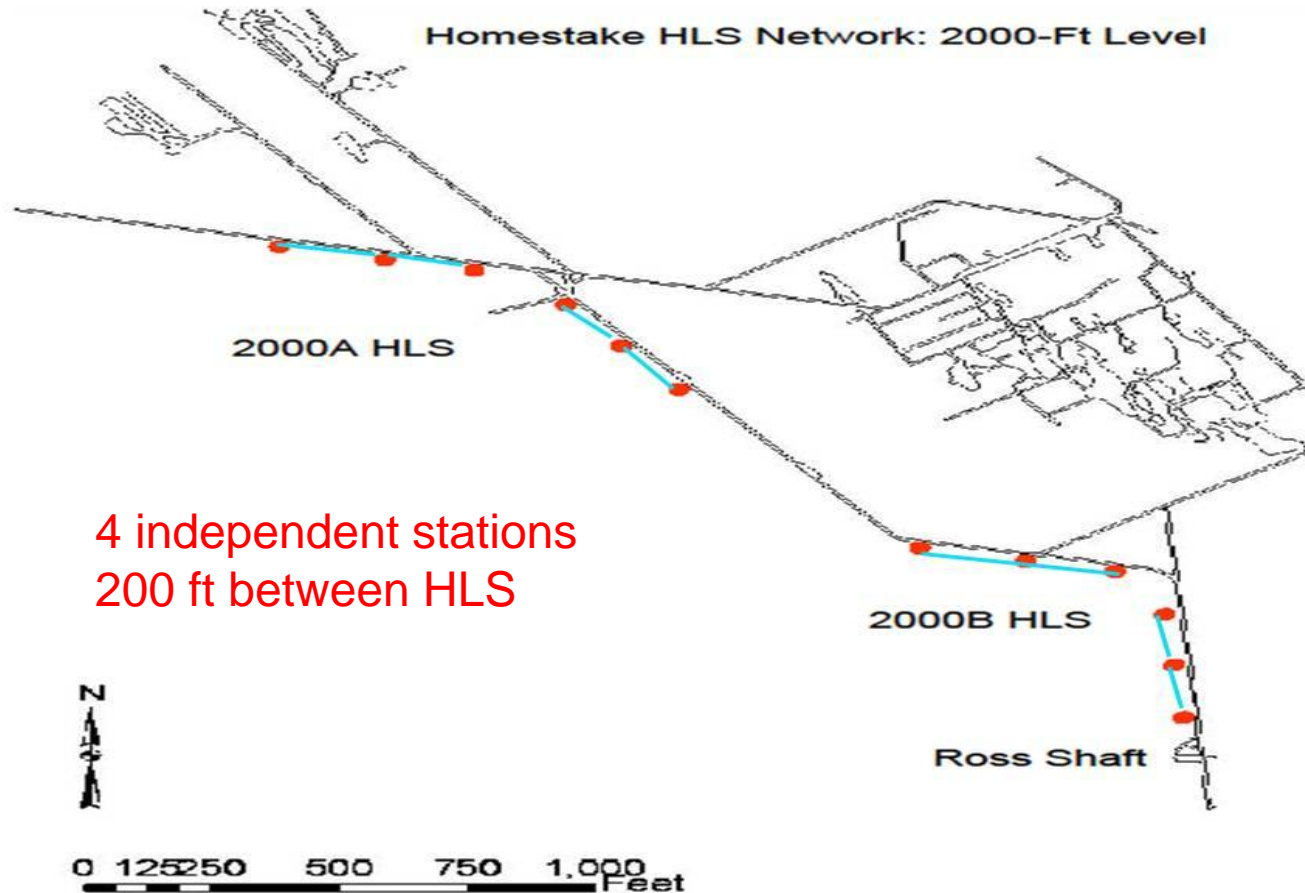
In the Homestake Gold mine in Lead SD

Lowest drifts 8000 ft (2400 meters) flooded to 4850 ft (1470 meters)

In January 2009 there 12 Tevatron style HLS installed at 2000 ft

In the summer 12 HLS at the 4100 ft (1242 m) to monitor tilt during dewatering process

# HLS layout at 2000 foot level



# HLS at DUSEL



Tom Trancynger filling system with water



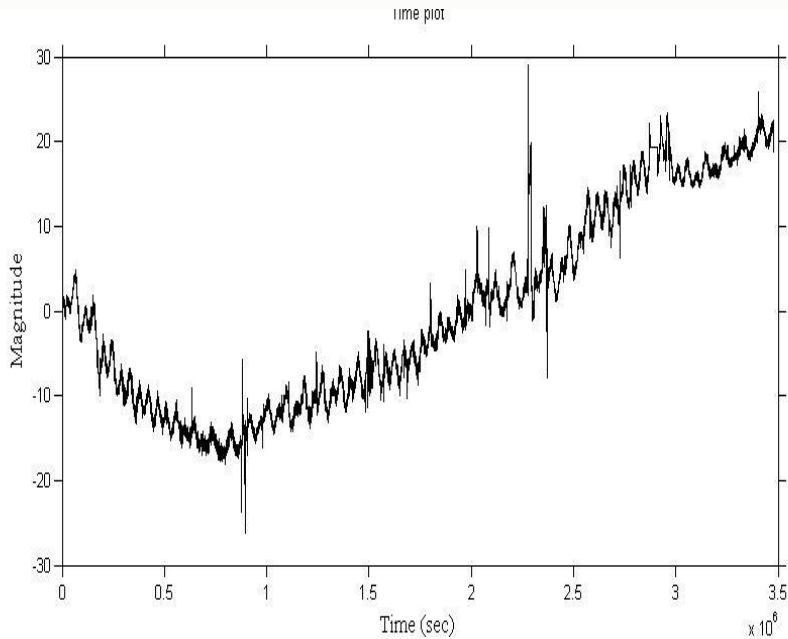
Jason Van Beek terminating data cable



Larry Stetler of SDSM&T and Jim Volk



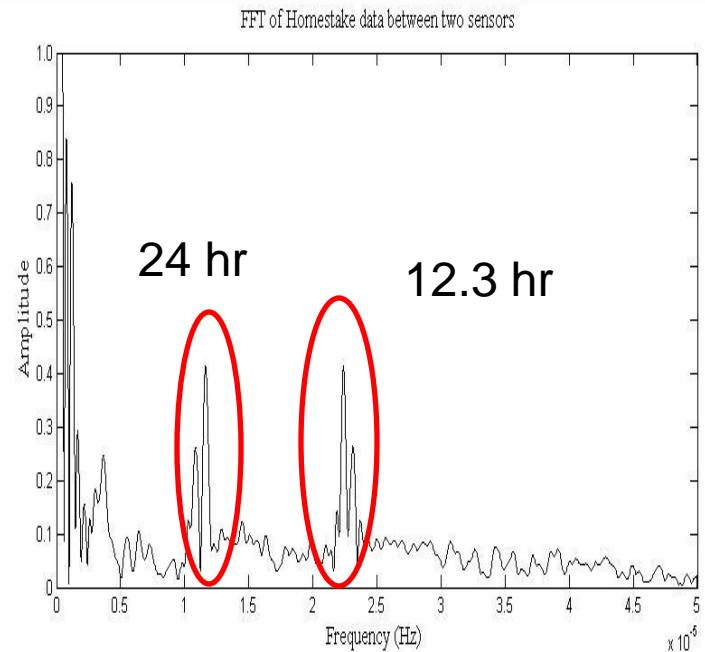
# DUSEL Data



Time

Difference in two sensors  
120 meters apart  
at the 2000 foot level

FFT of 1200 ft level data



Hertz  $10^{-5}$

# Future

We will install 32 Tevatron Style sensors in the Fermilab Main Injector

To monitor motion during construction this summer

12 more Tevatron style sensors will be installed at the DUSEL 4100 ft level

Montana Tech has order 12 Budker Capacitive and 12 Budker Ultrasonic Sensors to install in DUSEL

This summer re work of low beta quad systems and MINOS at Fermilab

Continue LaFarge mine and MINOS data collection

Trying to hire student to work on these data

Merci Beaucoup

Thank you