HLS systems at Fermilab and DUSEL
(there are no WPS systems)

James T Volk

Applications Physicist II

Fermilab

Andrey Chupyra, Shavkat Singatulin,
Budker Institute of Nuclear Physics
Vladimir Shiltsev, Sten Hansen, Terry Kiper
Fermilab
Larry Stetler and Jason VanBeek
South Dakota School of Mines and Technology
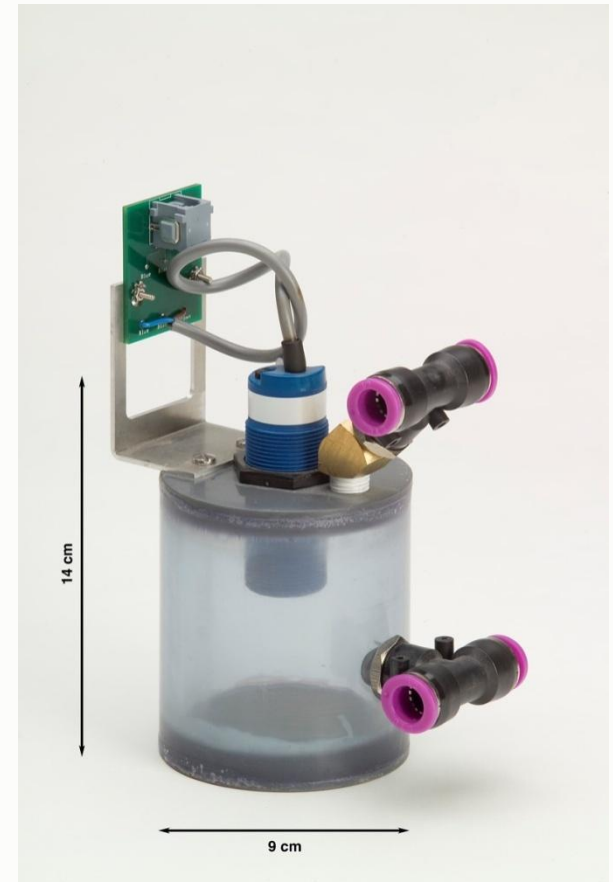Tom Trancynger
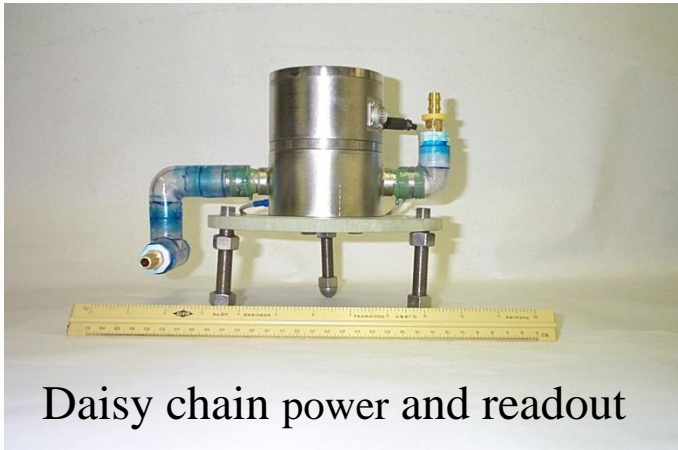Sanford Lab

There are two types of HLS systems in use

Budker Institute of Nuclear Physics

Fermilab designed
Tevatron style

James T Volk April 2009

Three types of Budker Institute sensors

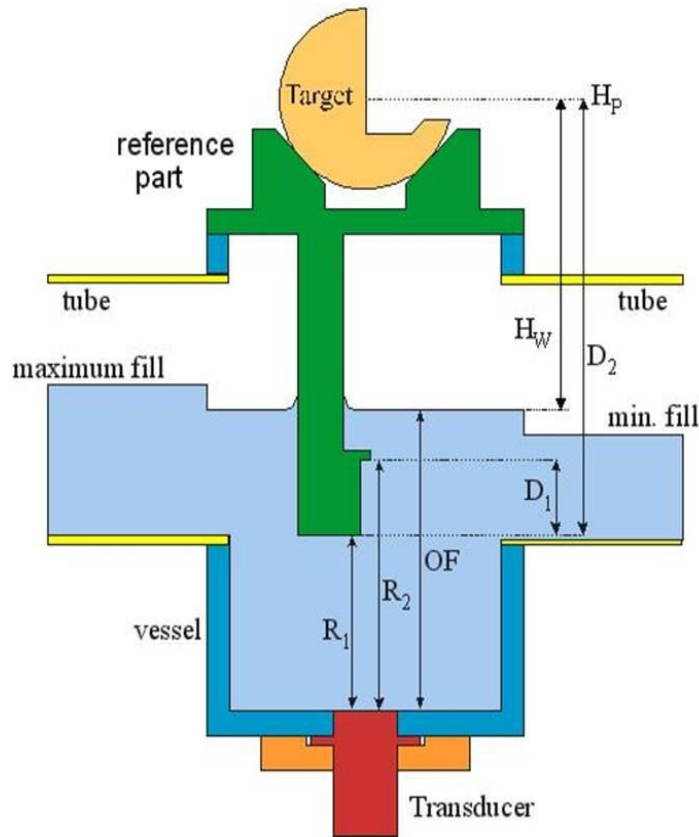Capacitive sensors

Daisy chain power and readout

Power and signal over Ether net

Ultra Sonic sensors power and signal over Ethernet
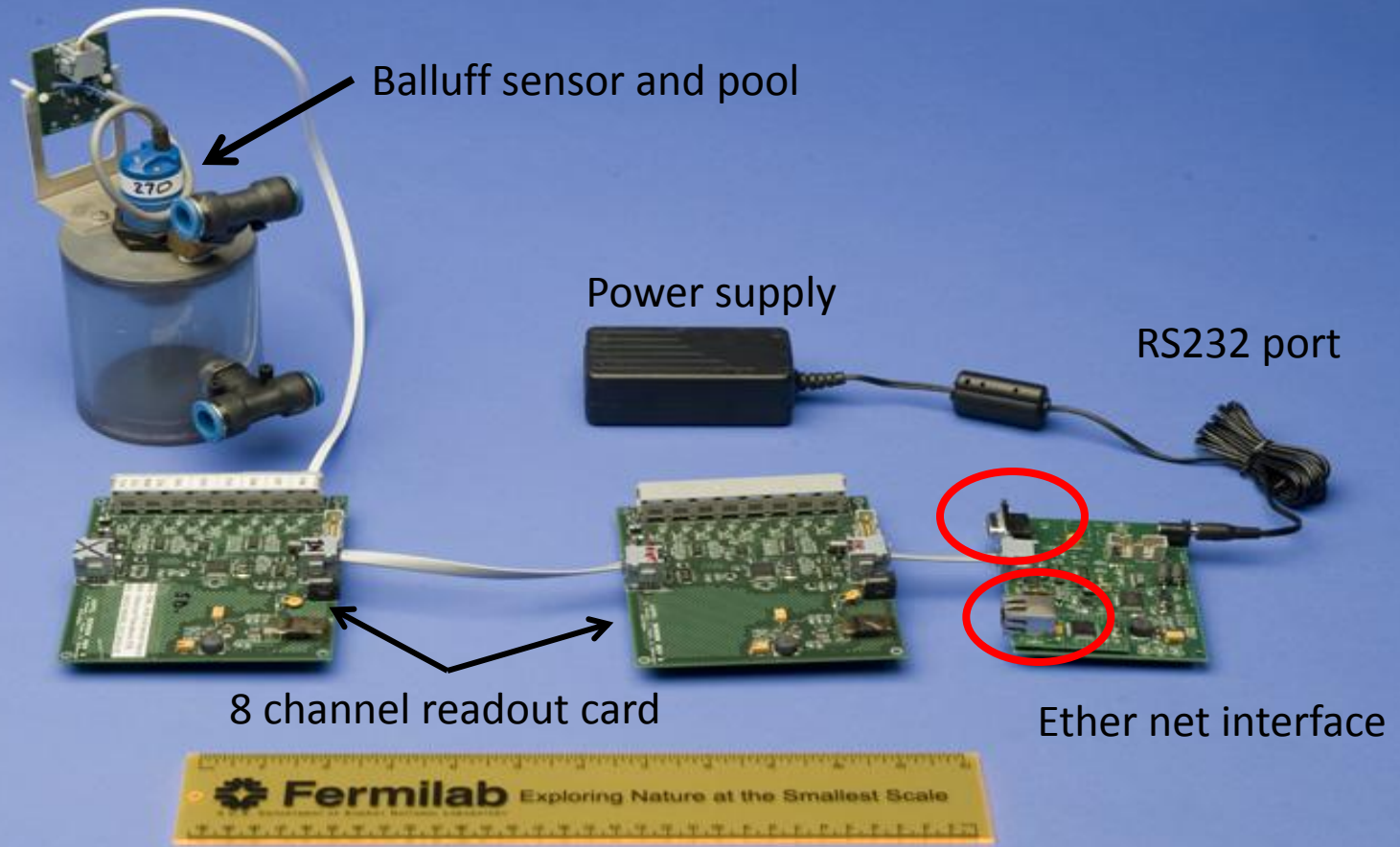
Cross section of Ultra Sonic sensor

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 Chupyra session 4

Fermilab design Tevatron style

Balluff sensor and pool

Power supply

RS232 port

8 channel readout card

Ether net interface

Fermilab Exploring Nature at the Smallest Scale

Paper in IWAA-08 J Volk

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
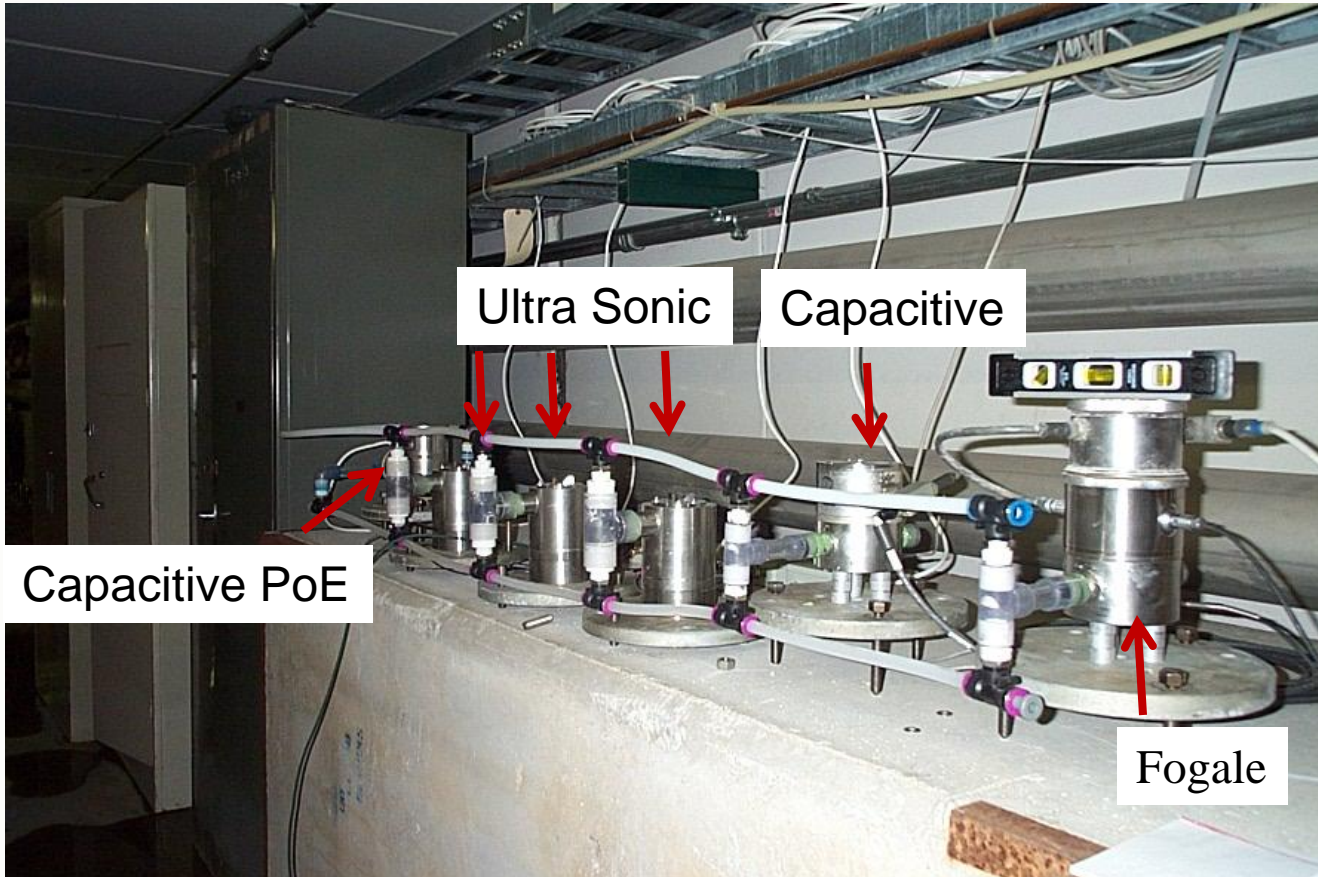
All sensors common water system on concrete block in surface tunnel

Ultra Sonic

Capacitive

Capacitive PoE

Fogale

Stability Data

SN 80 Budker PoE Capacitive
SN 12 Budker Capacitive
SN 51 & 52 Budker Ultra Sonic
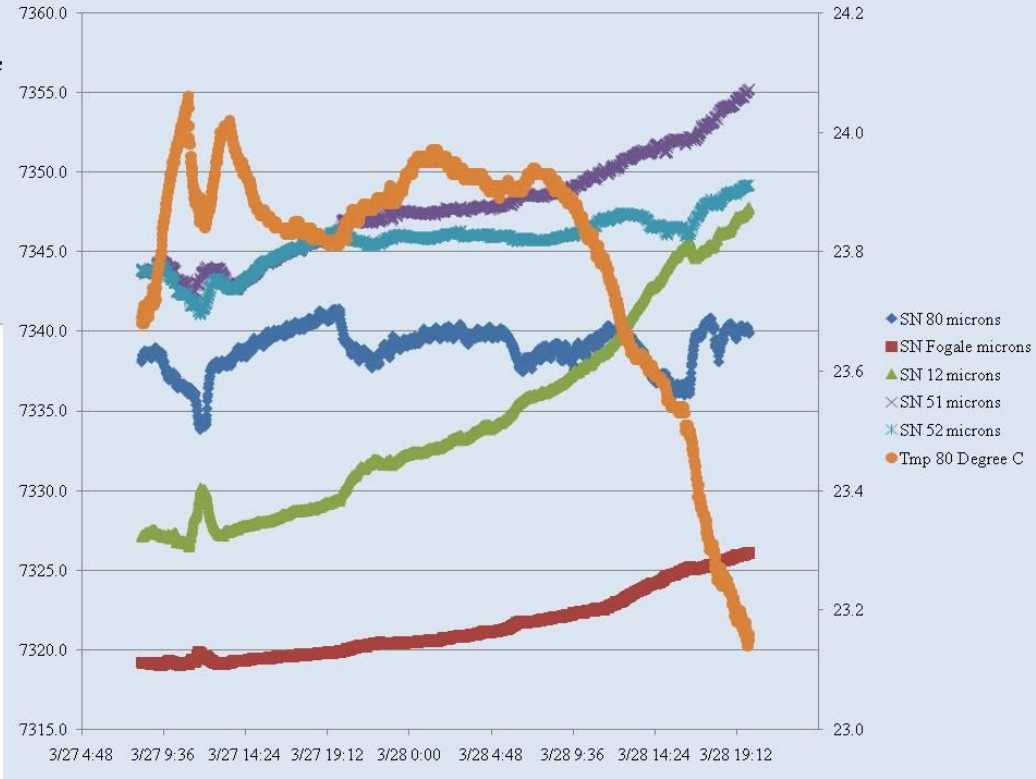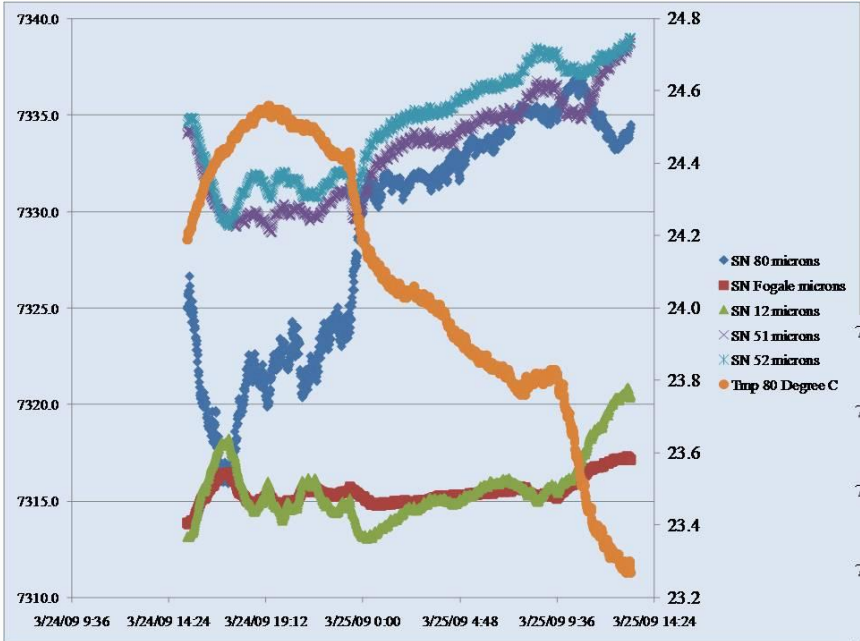
Layout of MINOS water level

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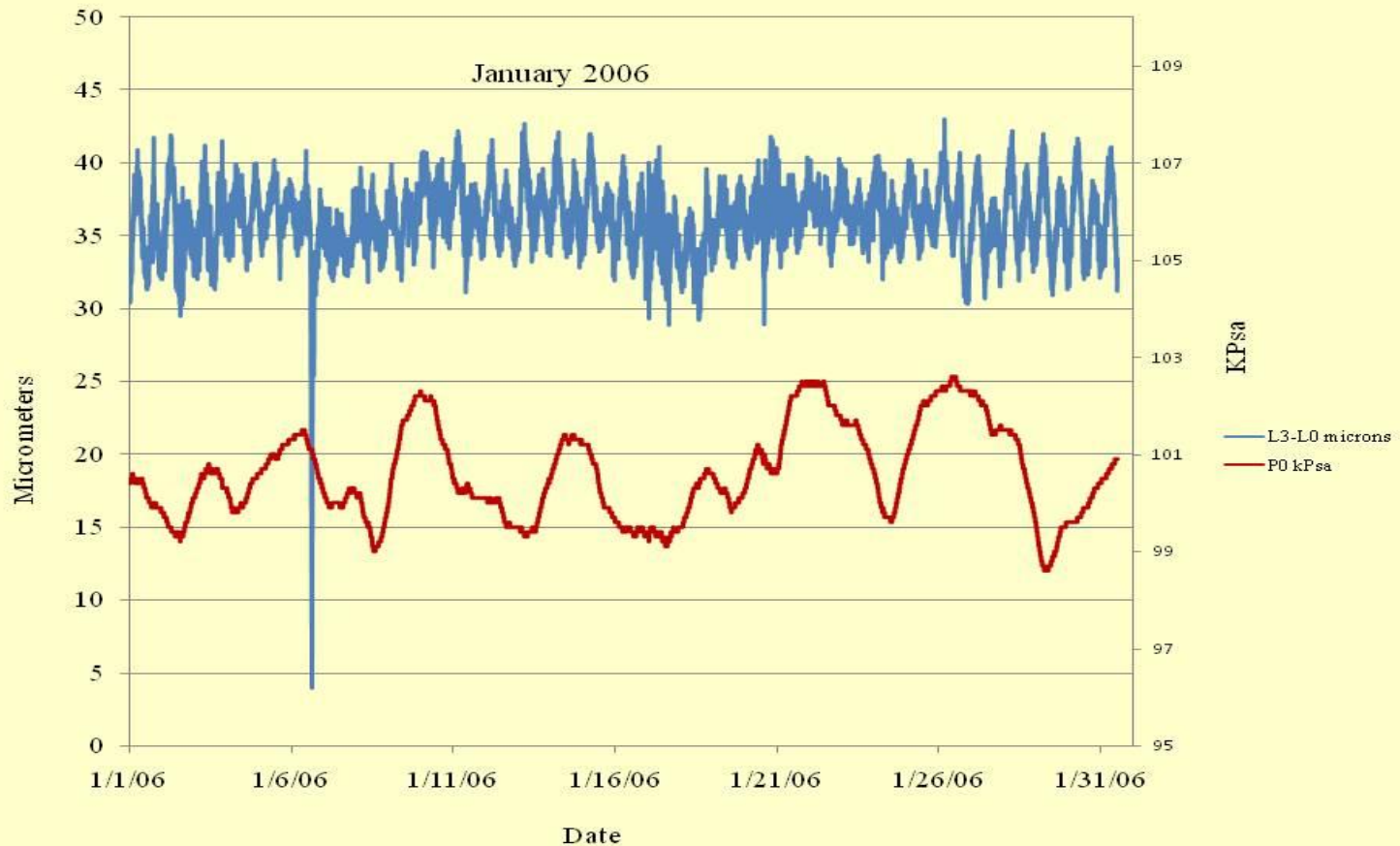406 feet above sea level Maquoketa shale

⟵ 30 meters ⟶   ⟵ 30 meters ⟶   ⟵ 30 meters ⟶

υ direction

MINOS detector

● Sensor

—— Water line

Not to scale

Location of
Horizontal and
Vertical seismometer

New
sensors
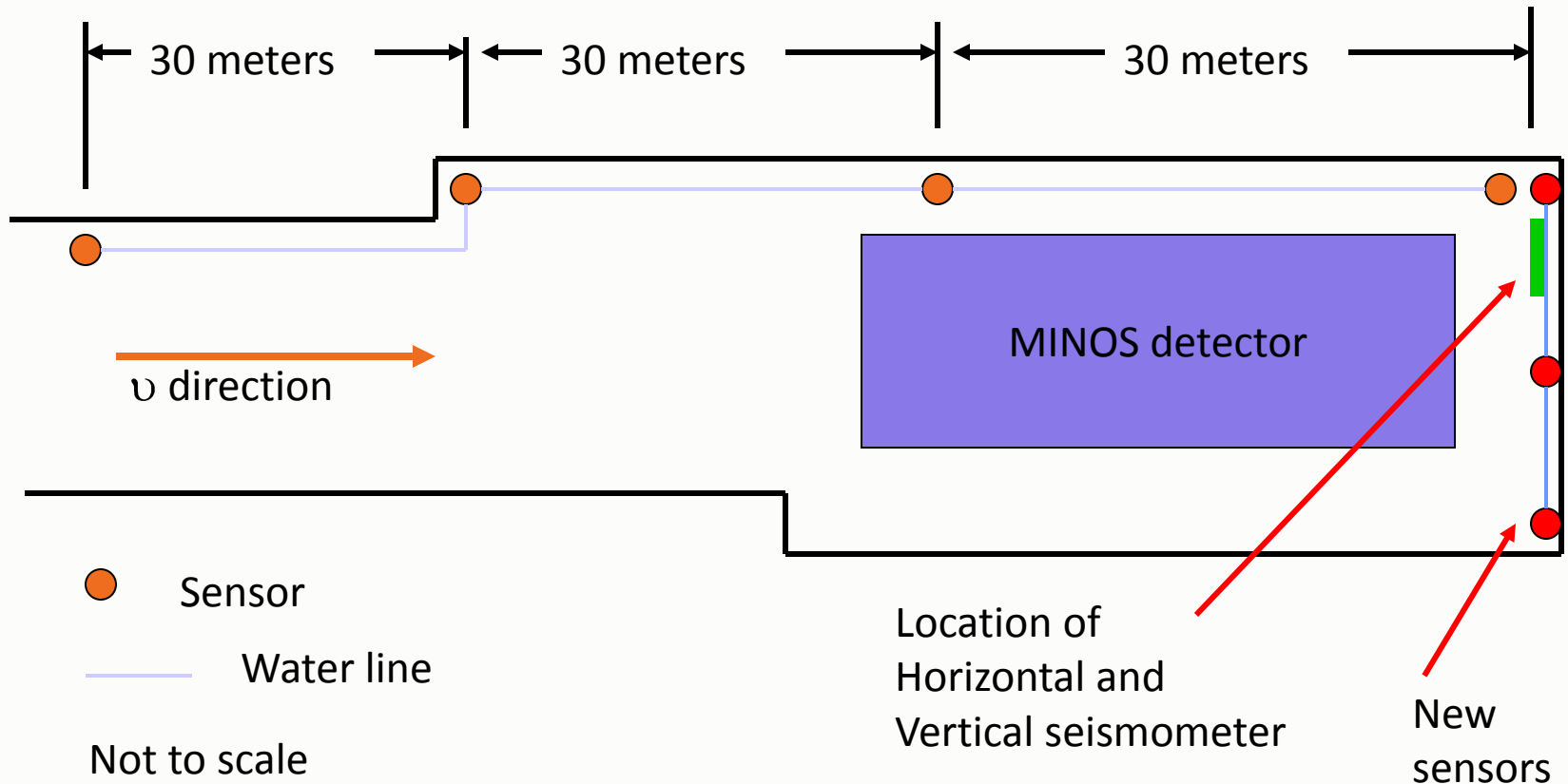
MINOS Tidal Data

Difference in two sensors 90 meters apart
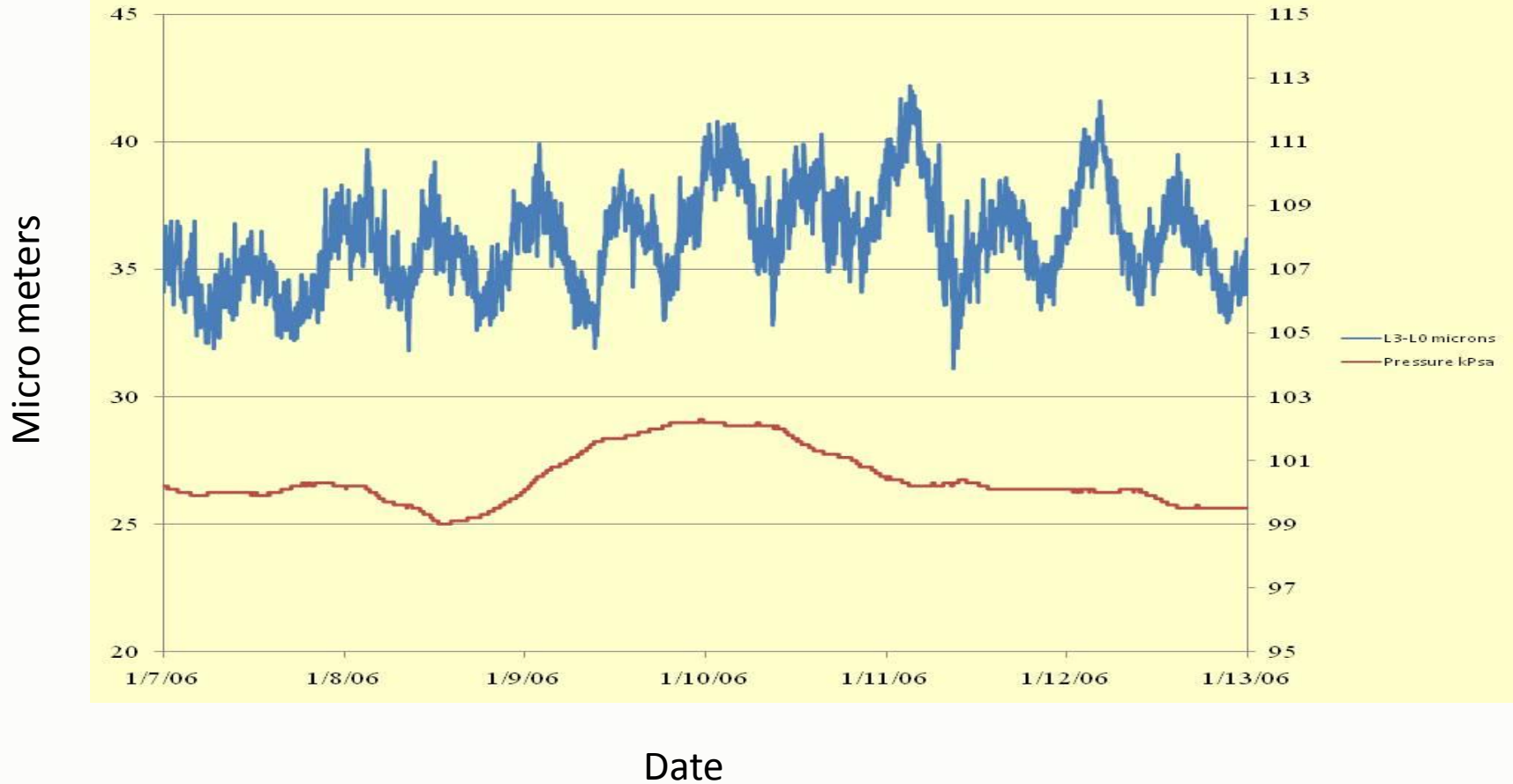
January 2006 MINOS

Difference in two sensors 90 meters apart

Sump Pump Test
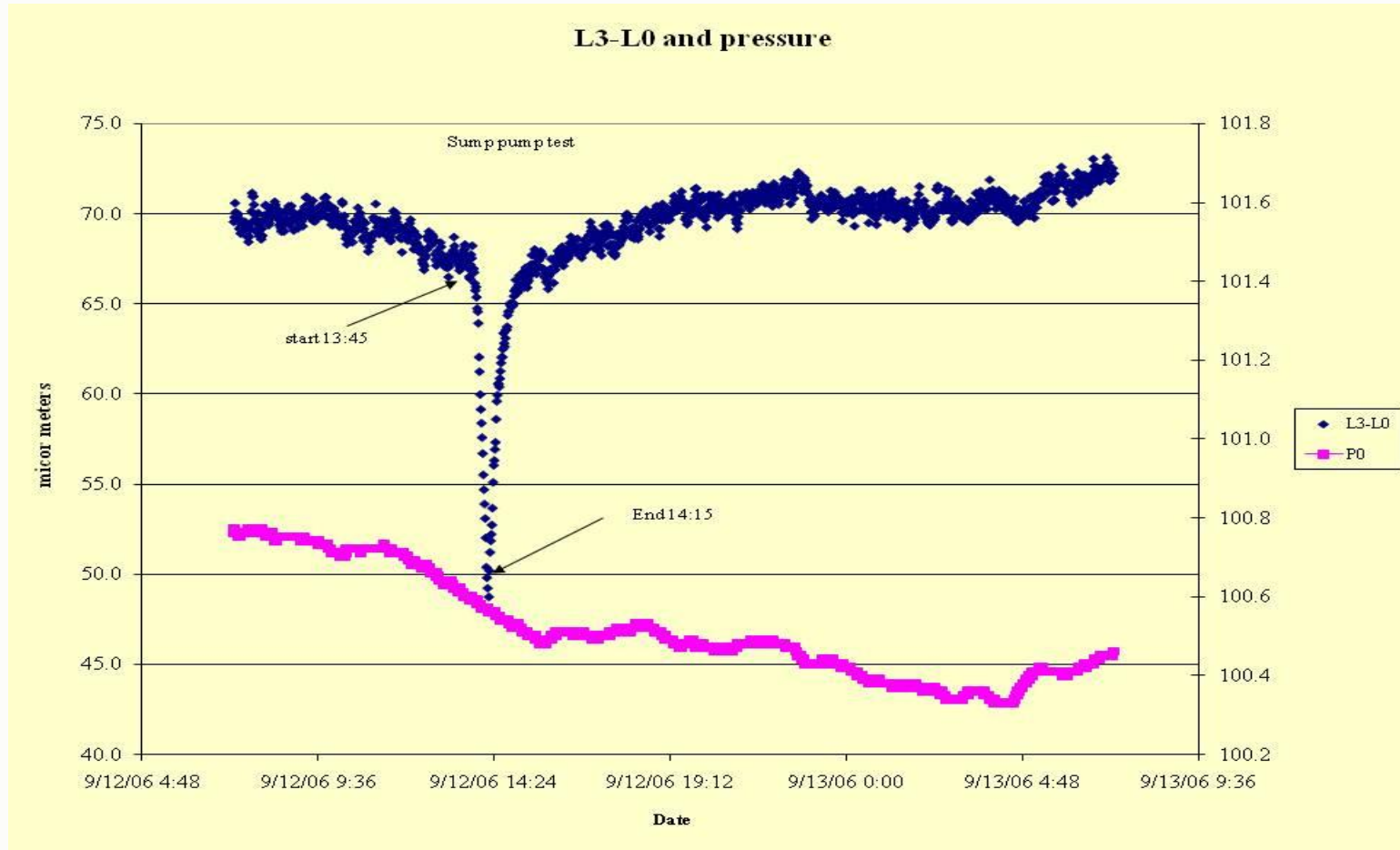
FFT of MINOS data difference between two sensors
December 2007
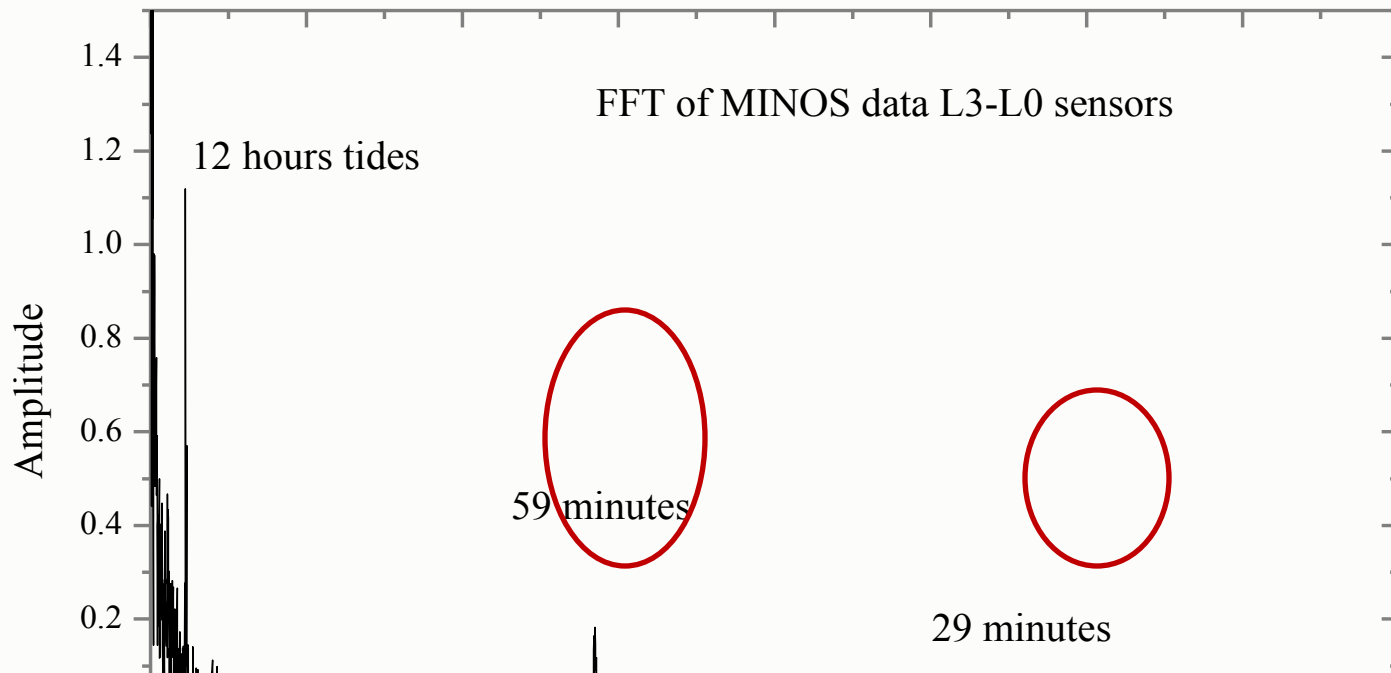
Difference in two sensors 90 meters Apart MINOS hall

36 months of data

Difference between two sensors 90 meters apart MINOS hall
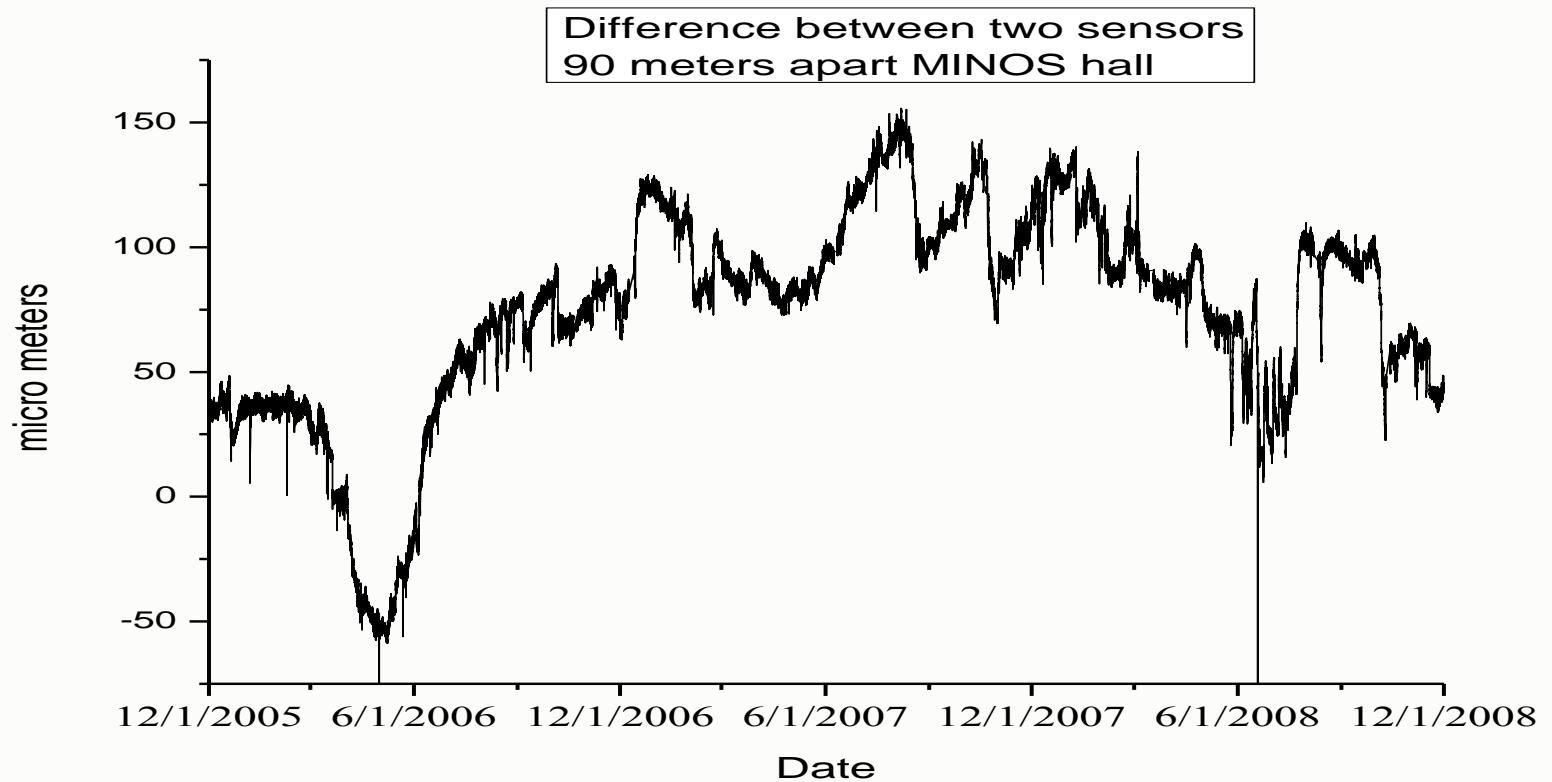
The LaFarge Mine North Aurora Ill

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
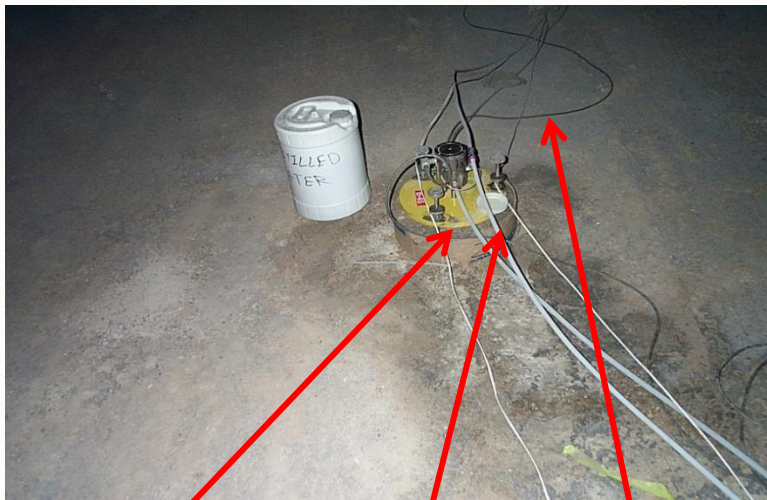
Station 4

Water line   Air line   Data cable

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

Difference in two sensors 60 meter apart

J T Volk Fermilab Dec 2008
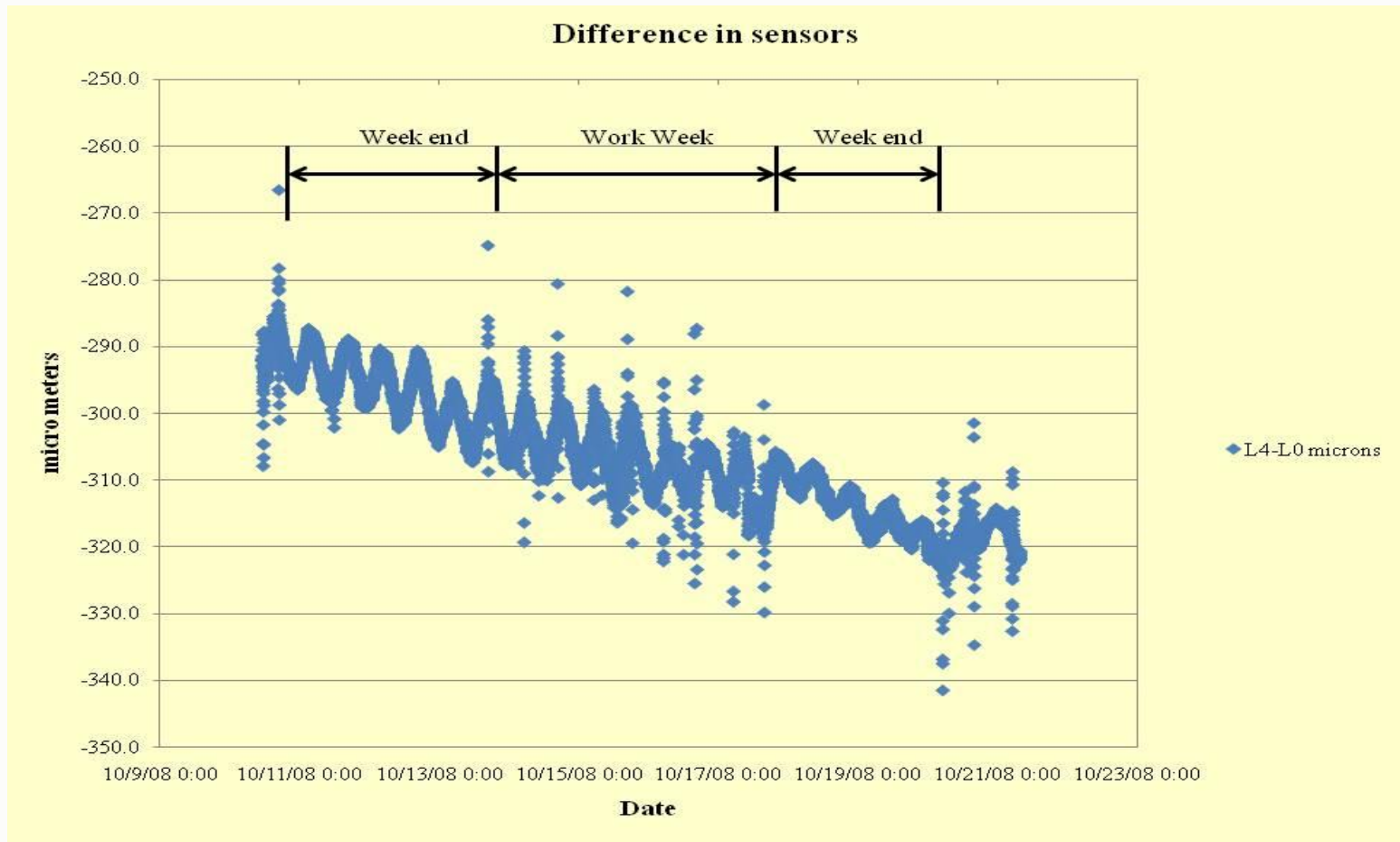
10 months of Lafarge Data

James T Volk April 2009
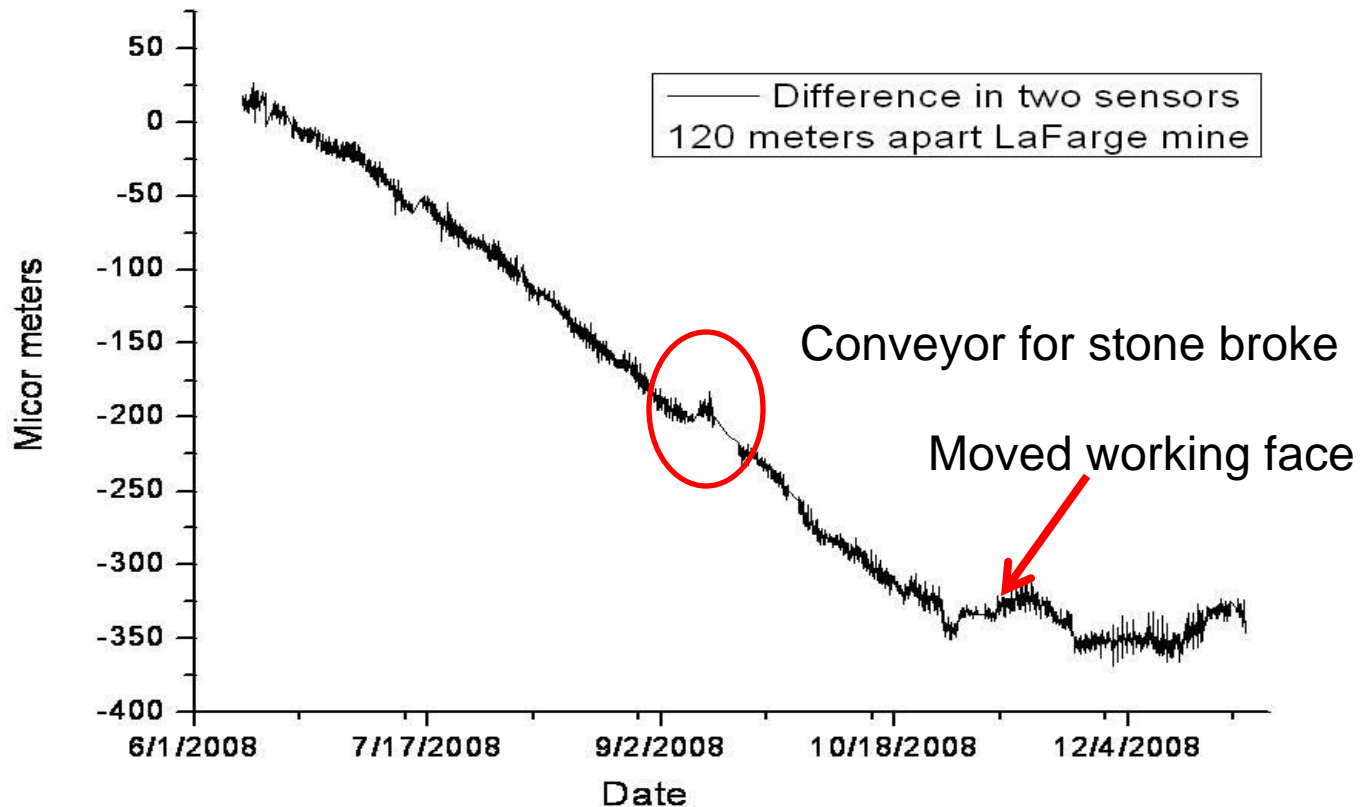
MINOS and AURORA Data

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

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	T	6.4±3.6	3 months	180 m	ΔL=30m, t^o-effects
FNAL MI8 line	T,L	1-10	1 month	285m	ΔL=15m
FNAL Tevatron	$T.L$	2.2±1.2	1 week	600m	ΔL=30m
FNAL MINOS hall	T,L	0.18	1 month	90m	ΔL=30m, ~100 m deep
Aurora mine (IL)	T,L	0.6±0.3	2 weeks	210m	ΔL=30m, ~100 m deep

DUSEL
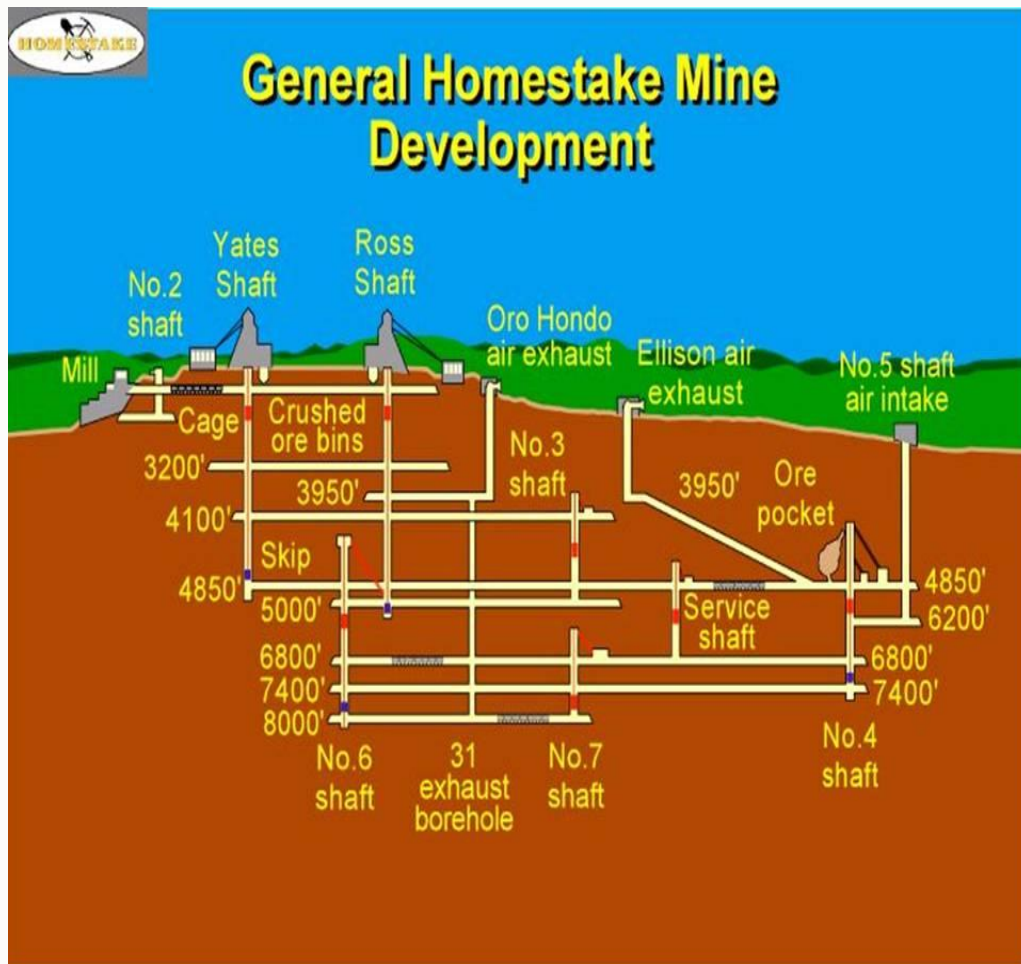
Deep Underground Science and Engineering Lab

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

Homestake HLS Network: 2000-Ft Level

2000A HLS

4 independent stations
200 ft between HLS

2000B HLS

Ross Shaft

N

0 125 250   500   750   1,000
                                     Feet
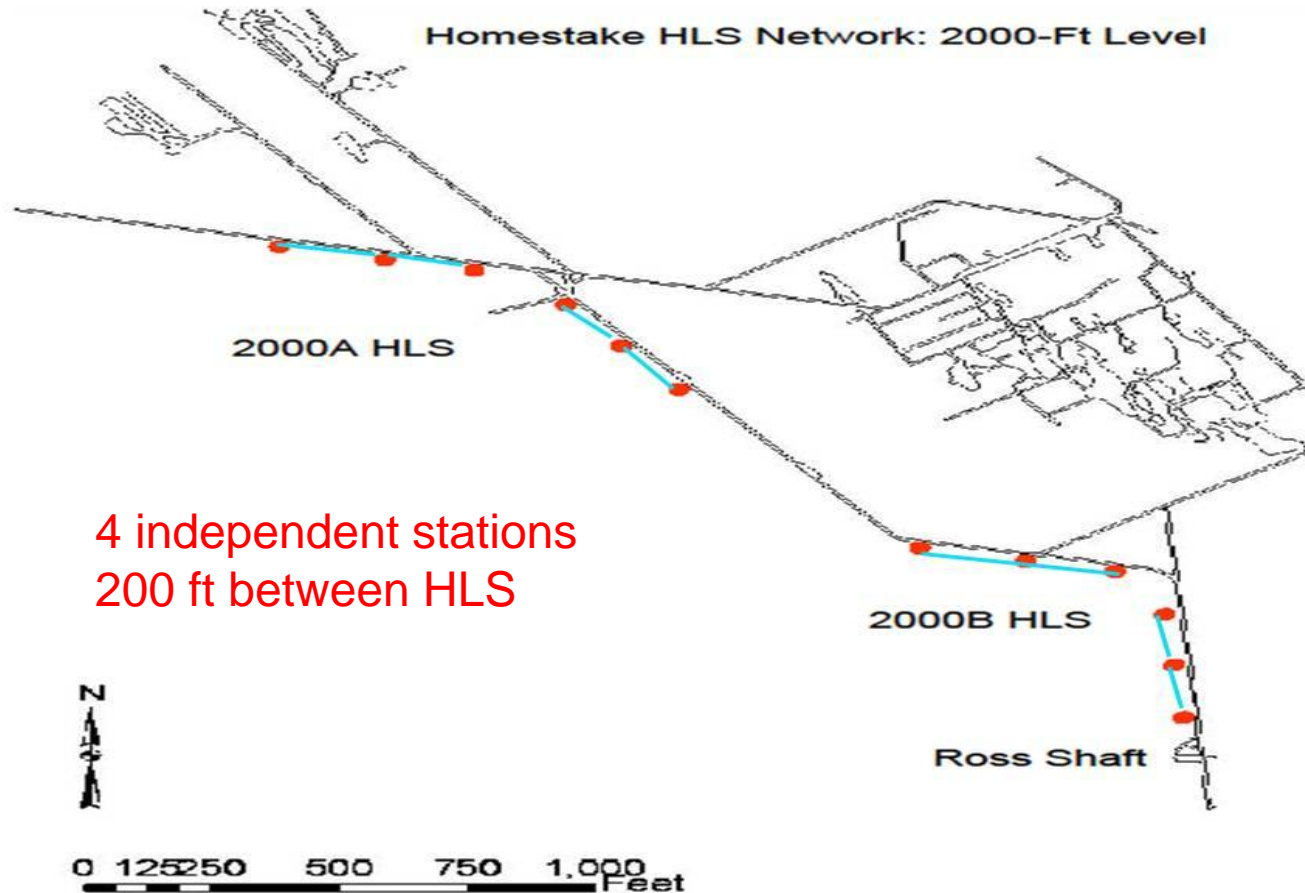
HLS at DUSEL

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
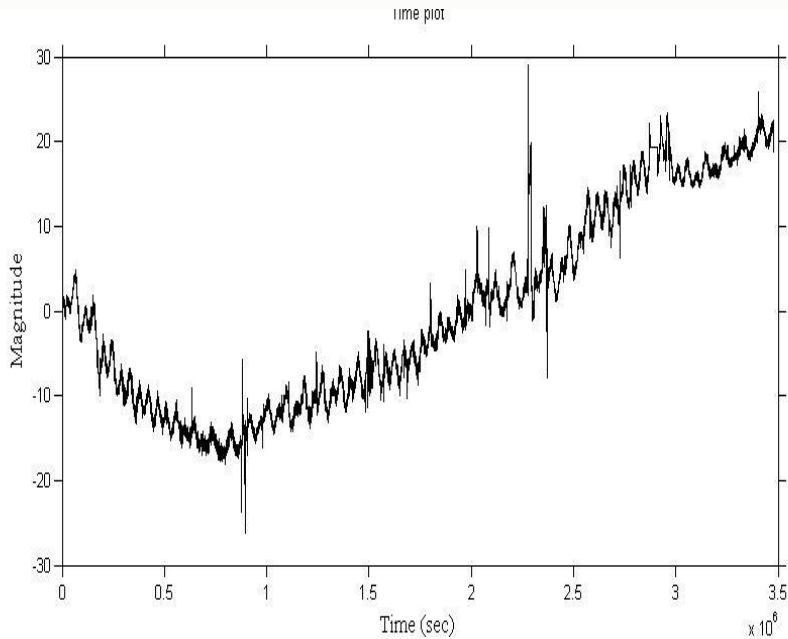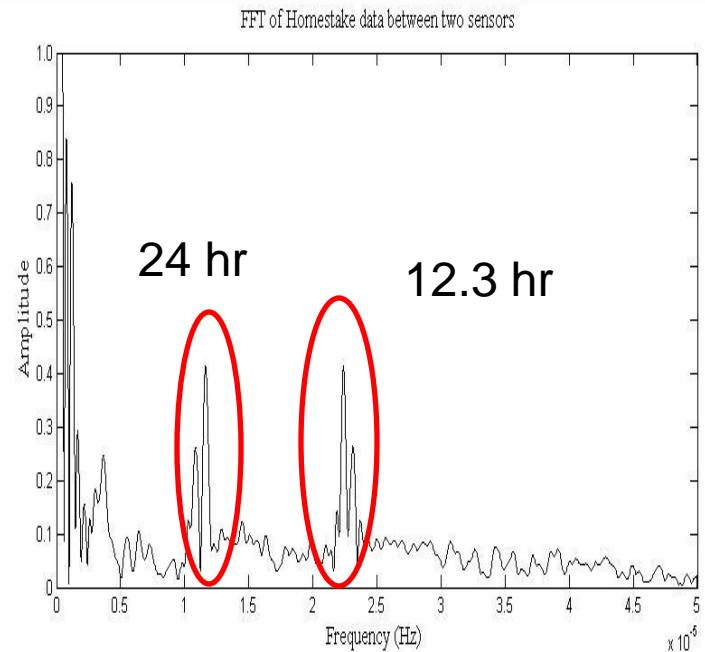
FFT of 1200 ft level data

24 hr   12.3 hr

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