ILC Metrology Group (MET)

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Mission statement

The Alignment and Metrology Group provides the following services:

- Geodetic network for the whole ILC site
- Tunnel reference networks
- Fiducialization of ILC components
- Precision alignment of ILC components
- Alignment monitoring and stabilization of components
- Ground motion and vibration measurements and analysis
- Geographic information system (GIS)

Results from meeting with EDR-PTF

- Alignment and Metrology group is a global system
- Our single point of contact for the EDR is currently Richard Ford (rickford@fnal.gov)
- There is a need for a complete set of alignment requirements and tolerances from all parts of the ILC
- We need a formal process to transmit this information between the groups

Near term milestones for the EDR

- Define the scope of alignment and metrology effort
- Collect and track requirements for tolerances
- Identify critical machine components
- Define pathways for industrialization
- Support site selection (i.e. geodetic considerations)

Summary of joint session with CFS

- CFS described the layout of the site risers and access shafts for alignment purposes
- Discussion about the facilities needed for Alignment and Metrology
- Discussion about tunnel structure
- Intensive discussion about the tunnel layout of BDS and IP region
- We need to provide more input in order for CFS to accomodate our needs

Summary of joint session with BDS & APY

- Discussion about alignment and stability requirements – how to provide and how to model
- Alignment and stability issues involve lots of people from various groups and disciplines -> we proposed an ad-hoc task force
- Description of push-pull detector system
- Discussion about muon spoilers
- Heard talks on MONALISA and RTRS (Rapid Tunnel Reference Surveyor)

Summary of talks during MET parallel sessions

2. Ground Motion in Various Grounds

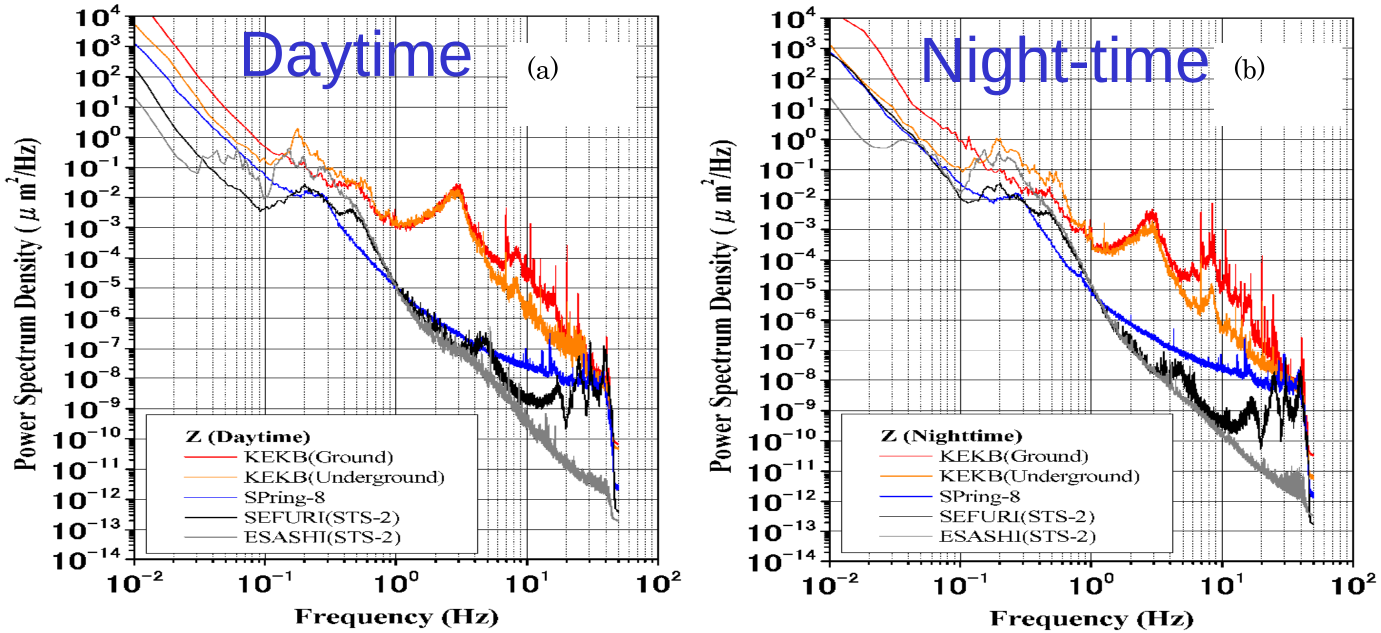


Fig.1 PSD (Power Spectrum Density) measured in 5 areas.

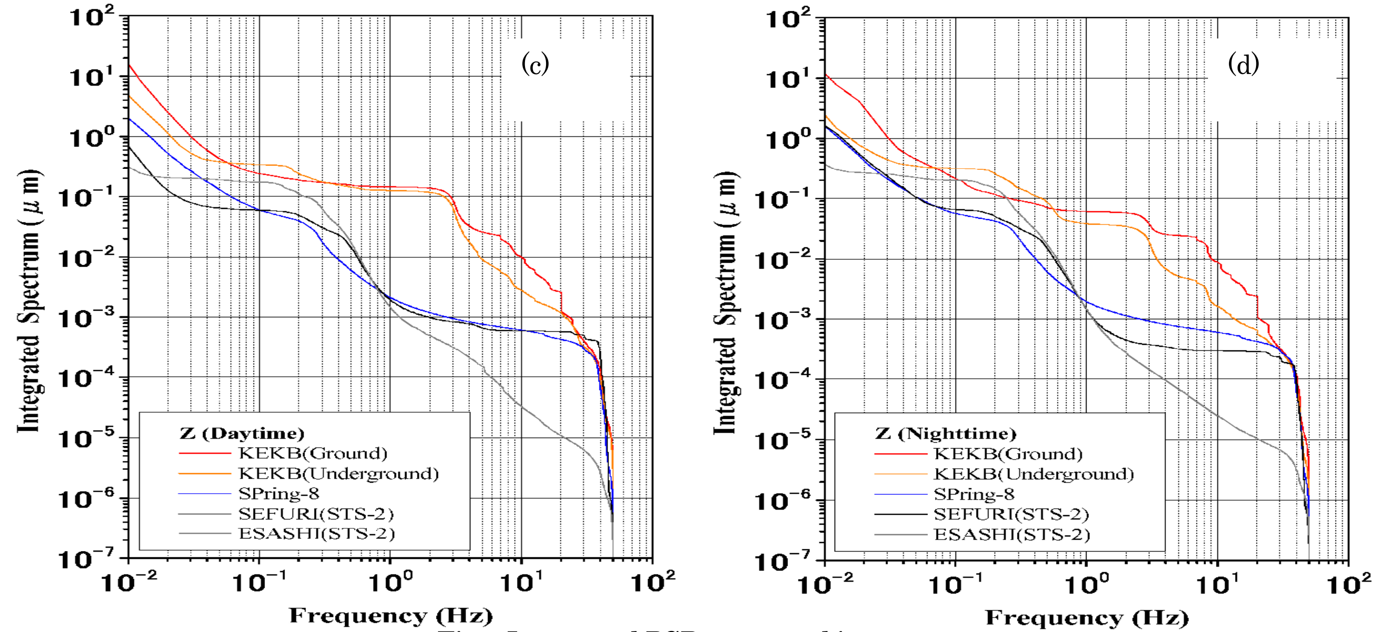
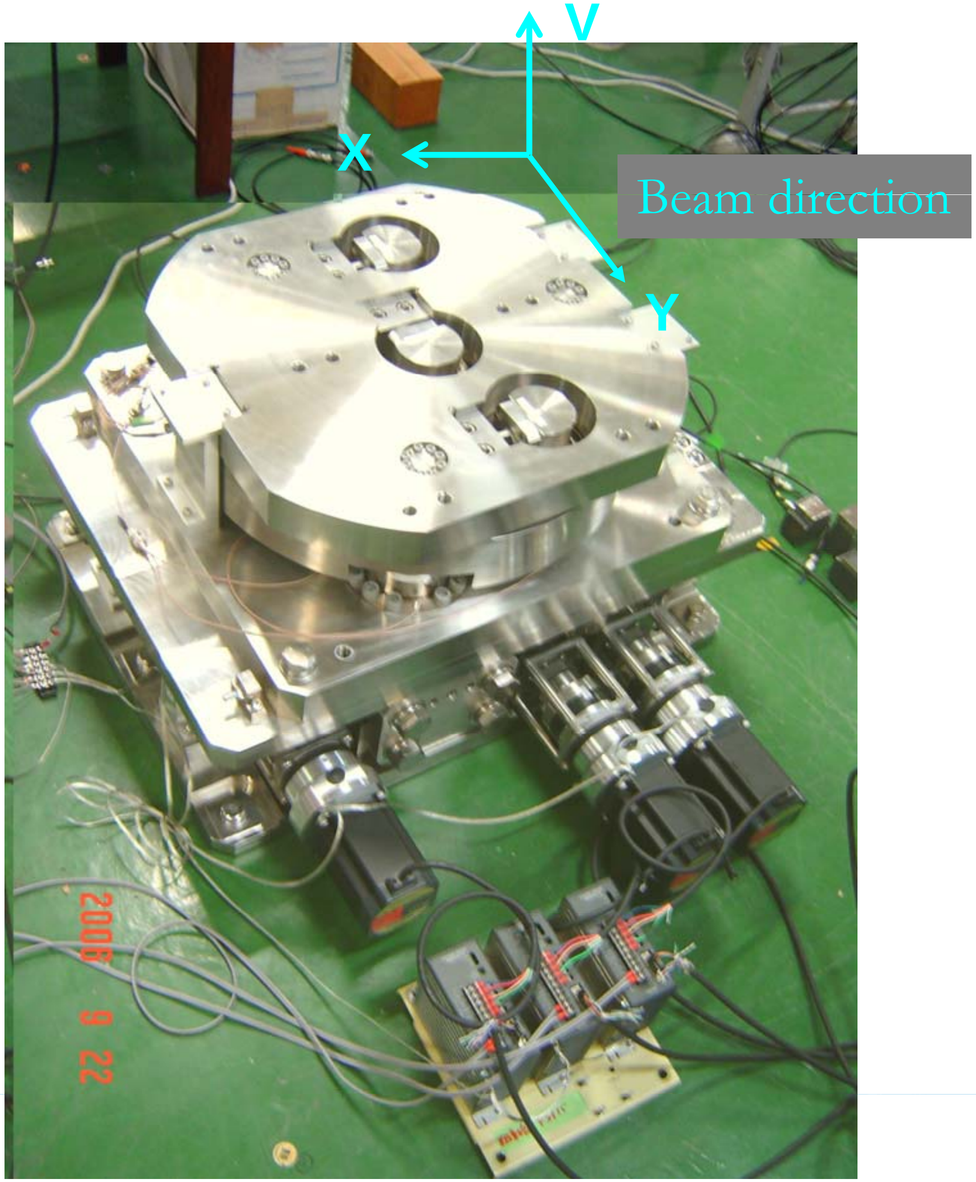
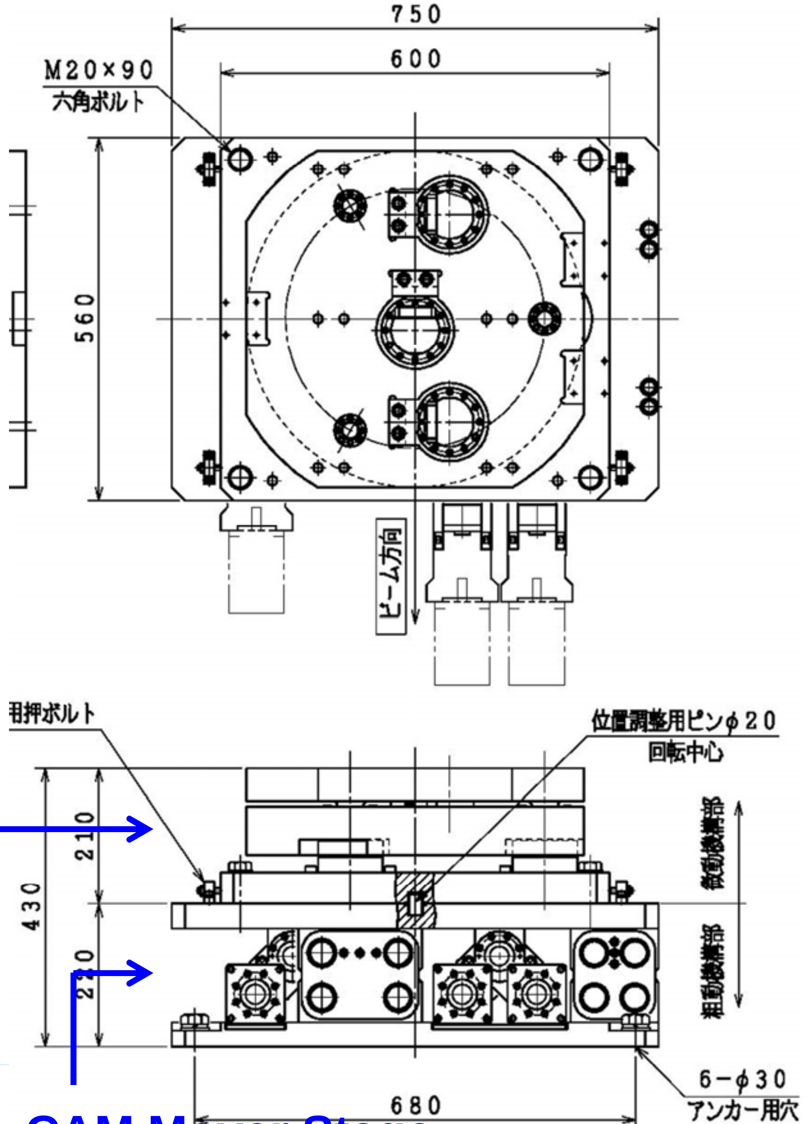


Fig.2 Integrated PSD measured in 5 areas.

3. Vibration isolation table-II

(See Paper [3] in detail)

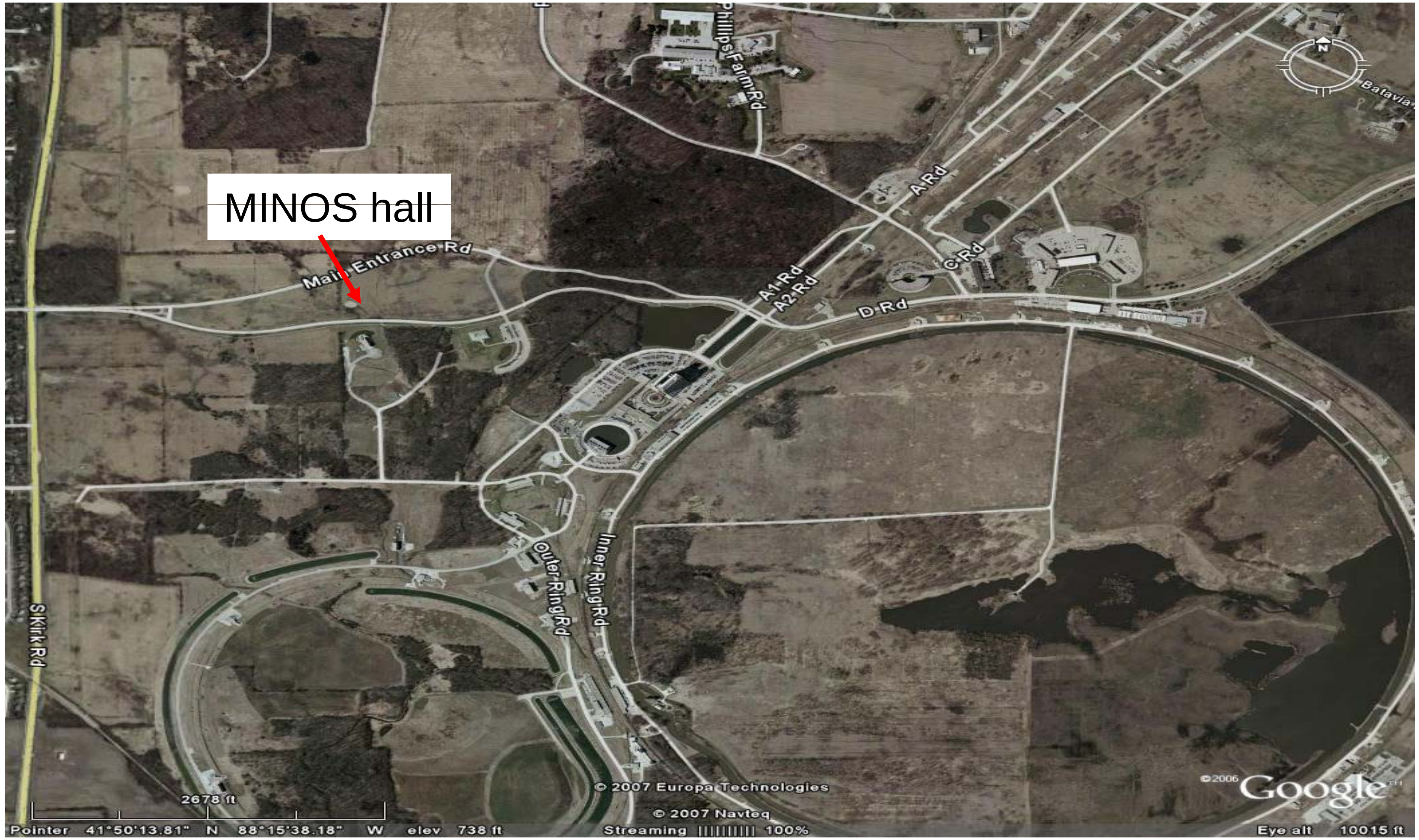




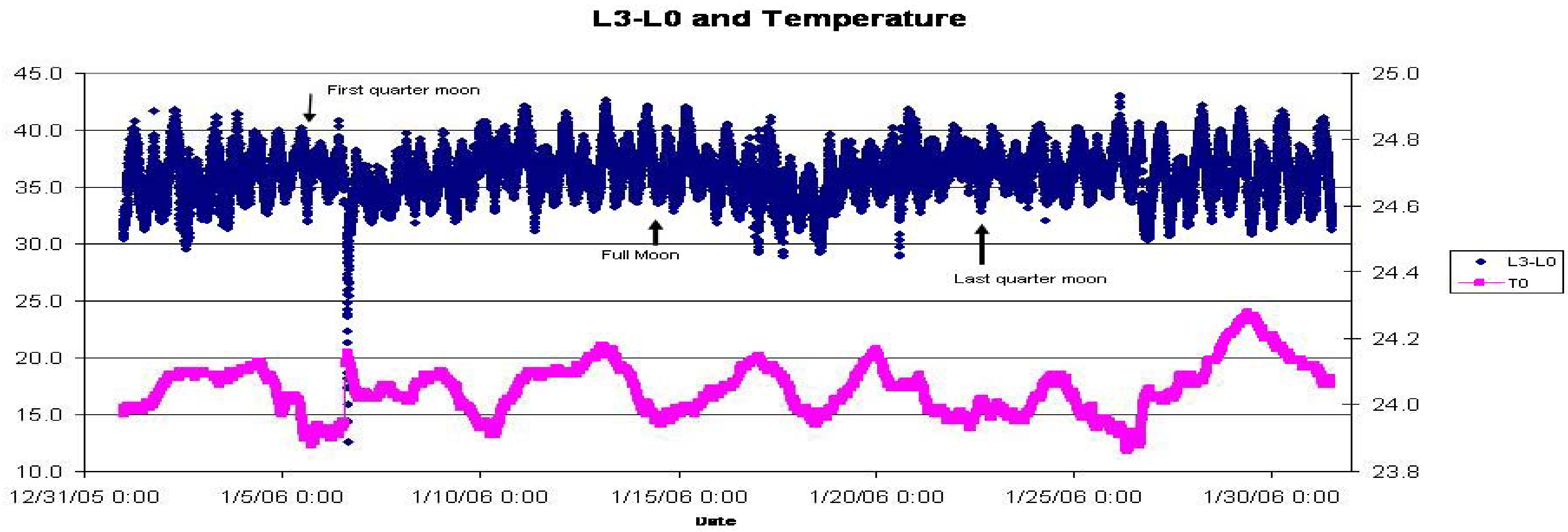
CAM Mover Stage

PIEZO Mover Stage

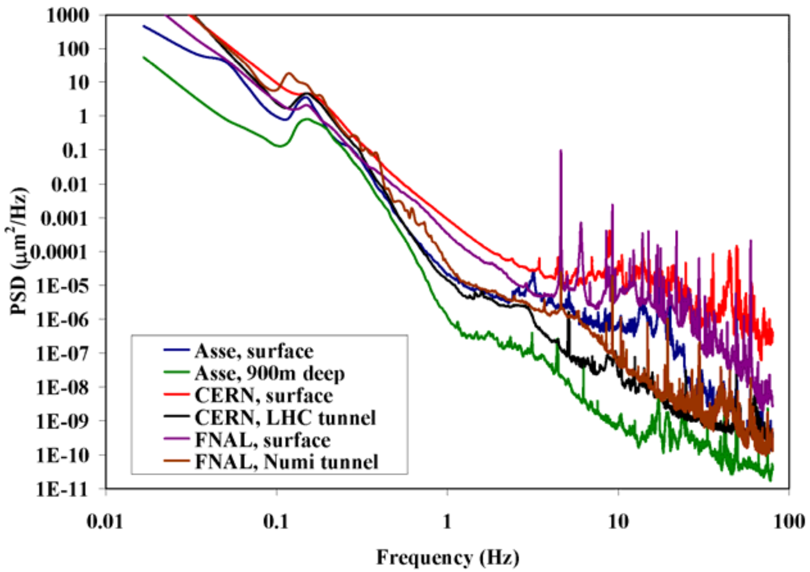
Location of MINOS hall 100 meters below grade

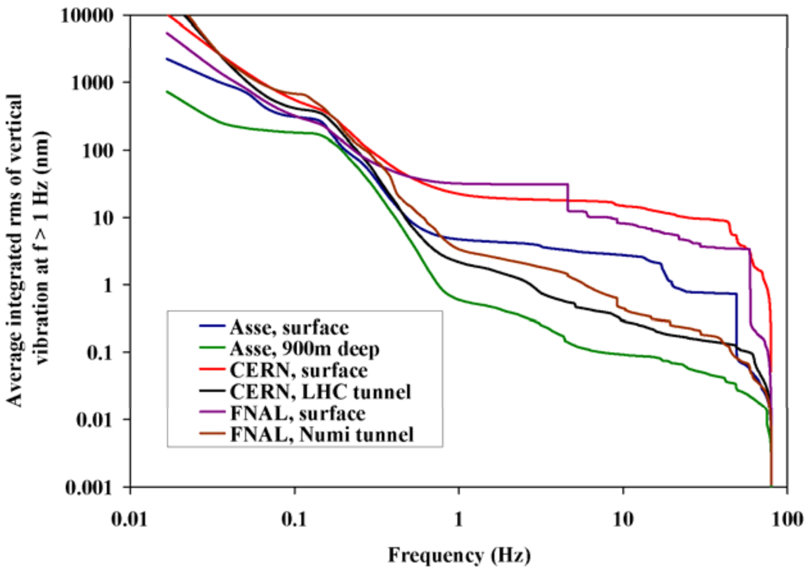


Two sensors 30 m apart MINOS hall



Examples: Variation vs. Tunnel Depth





rms @ f > 1 Hz (surface)
Asse: 5 nm
CERN: 22 nm
FNAL: 32 nm

rms @ f > 1 Hz (depth)
Asse (900 m underground): 0.5 nm
CERN (LHC tunnel): 2 nm
FNAL (Numi tunnel): 3 nm

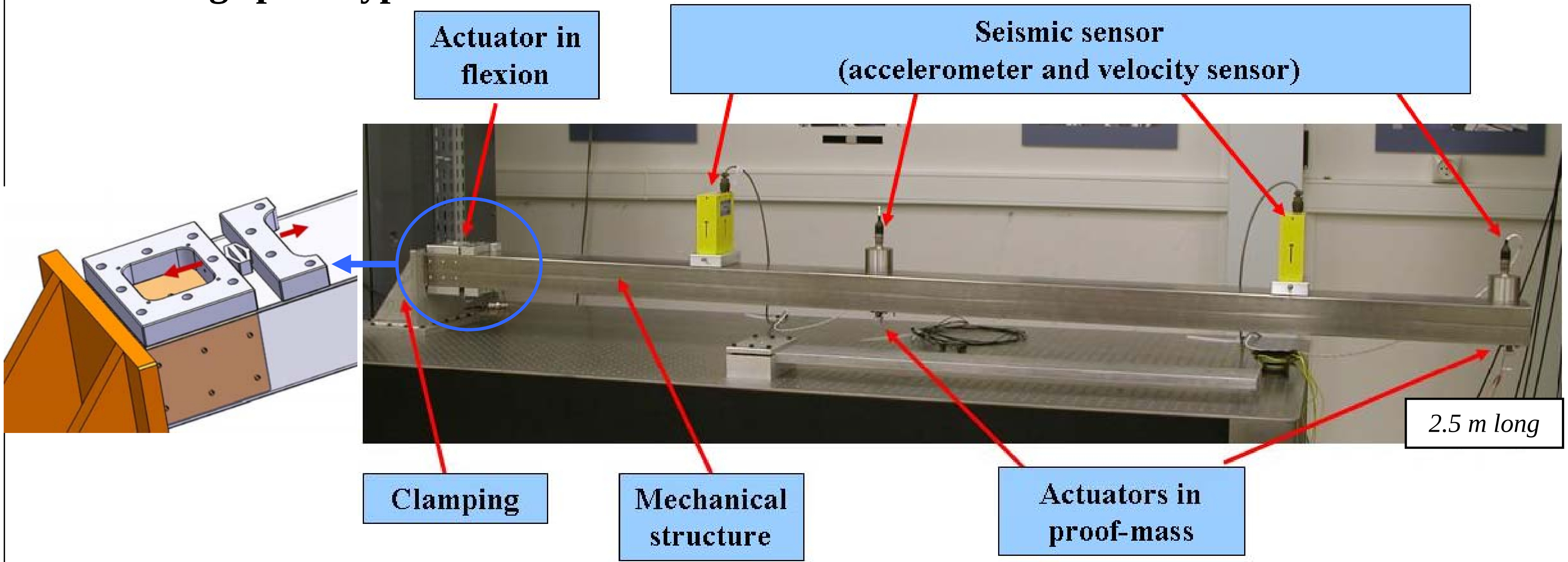
Our Homepage: http://vibration.desy.de

Our homepage is a venue for communication, retrieval & backup of our database. It uses AFS volumes to store our database:

- Raw data, FFT data
- Minute by minute PSDs & averages (15 minutes)
- PSD & rms spectra, variation vs. Time for each site, spectra of noisiest and quietest times of the day for each site and their corresponding rms
- A program to display spectra
- Documents
- Everything is downloadable.

The prototype

✓ **The large prototype and its instrumentation :**



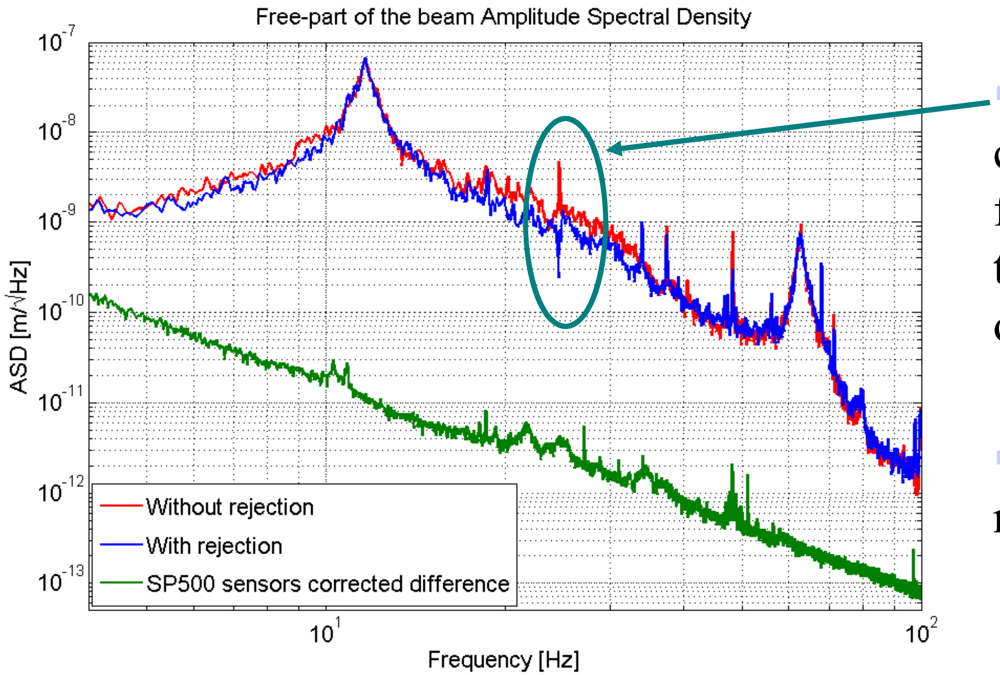
✓ **Actuators used for the active control of vibration :**

- *A stacking of PZT patches* -

- Force = 19.3 N
- Maximal displacement = 27,8 µm
- Resolution = 0,28 nm

Results with the first developed algorithm

✓ **The first results at the nanometer scale :**



- Example of active compensation of an unknown frequency disturbance, excited by the natural environment (motion of the ground + acoustic noise).
- Possibilities to increase the number of rejected disturbances.

➢ **Active compensation is efficient with this initial algorithm for narrow peaks.**

➢ **For eigenfrequencies, the need of controlling a larger bandwidth.**

Summary of MET Talks

(Simulation of LiCAS error propagation - Grzegorz Grzelak, Univ. Warsaw)

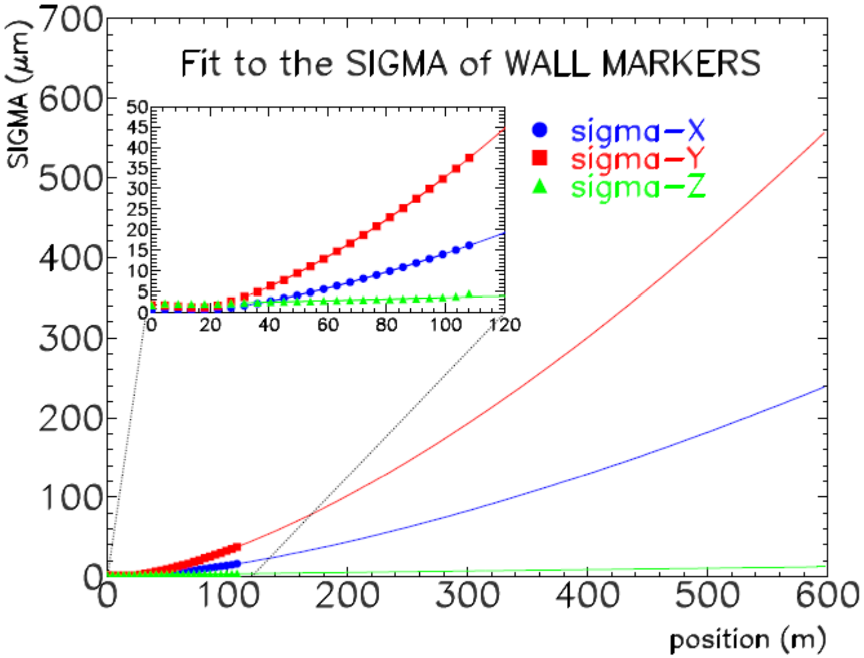
RTRS: Rapid Tunnel Reference Surveyor in DESY "red-green" tunnel

- Tunnel infrastructure ready (tunnel length $60\,m$)
- Mechanics (propulsion, control, etc.) of RTRS ready
- Waiting for Invar sensing modules

Summary of MET talks

(Simulation of LiCAS error propagation - Grzegorz Grzelak, Univ. Warsaw)

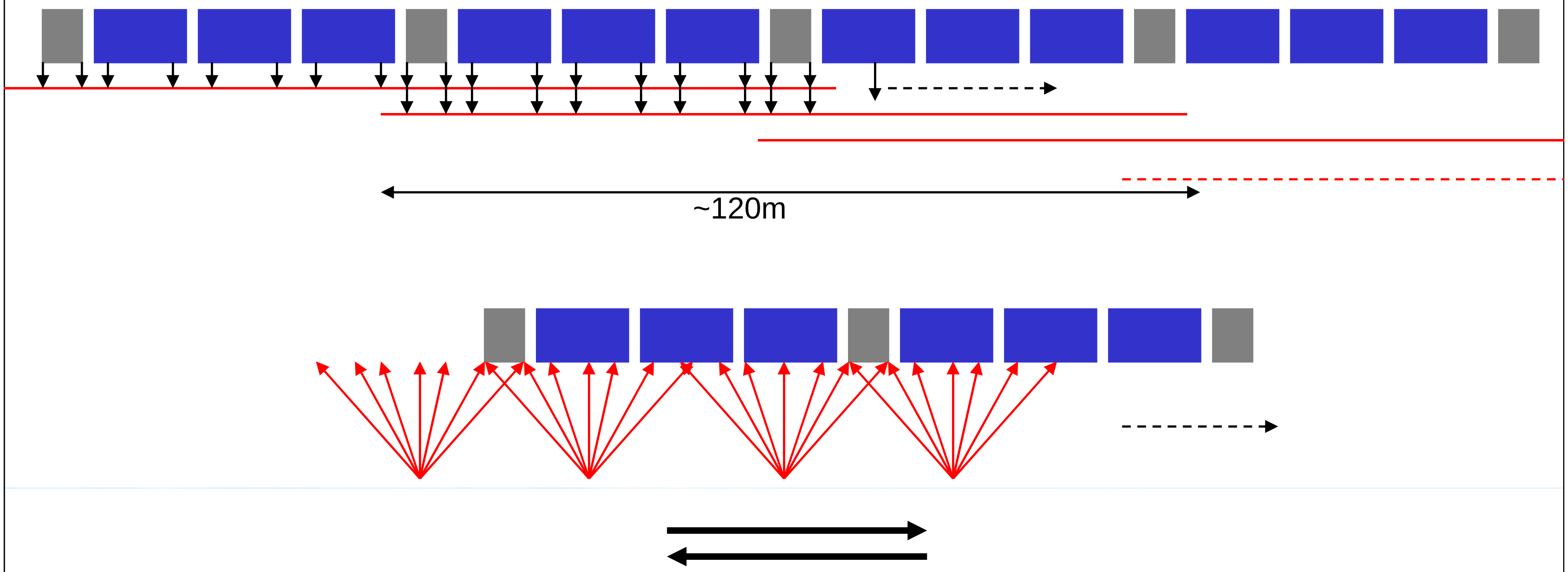
Extrapolation to $600\,m$ tunnel section (TESLA betatron wavelength)



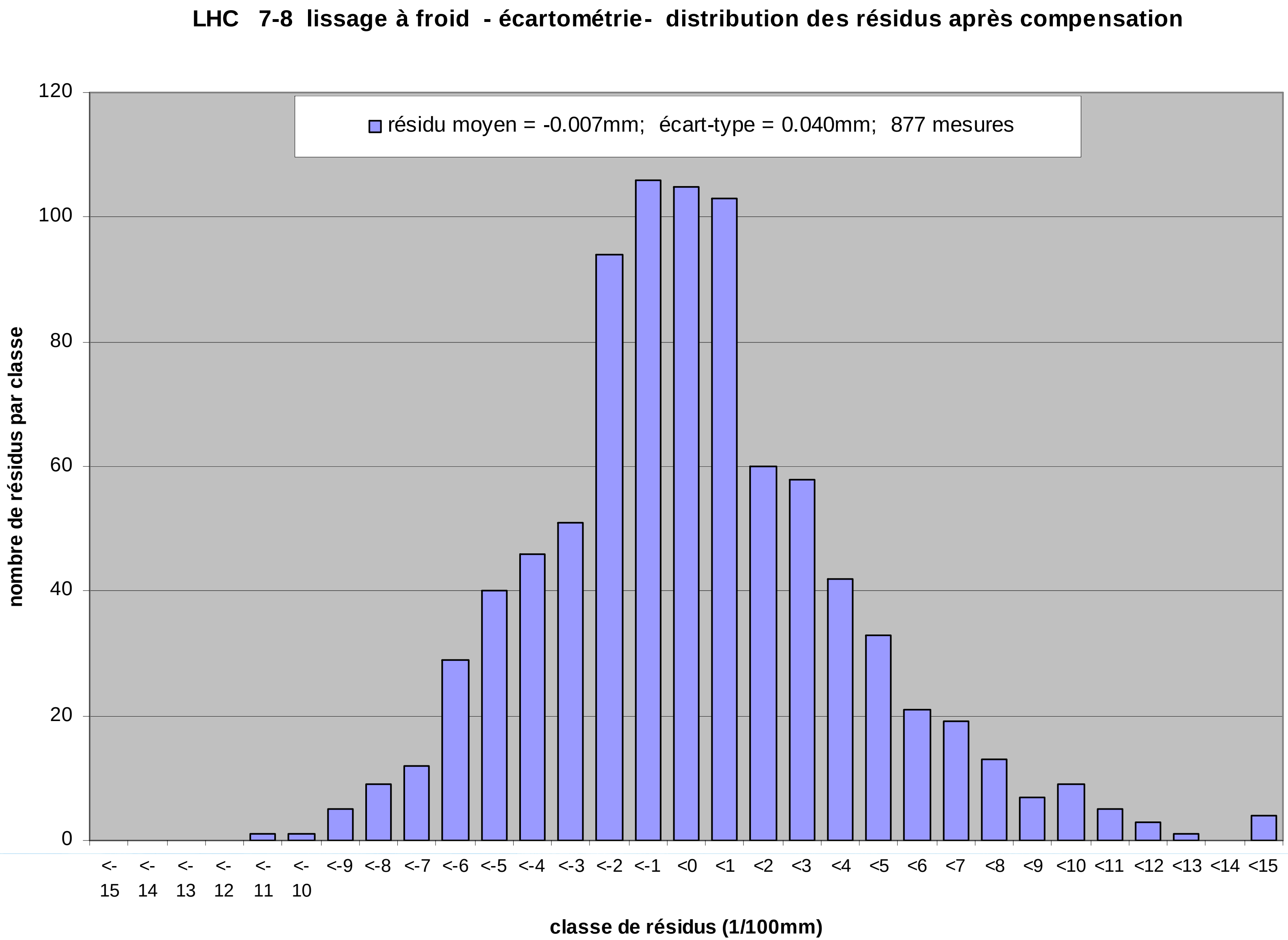
- extrapolation using random walk model, asymptotic behaviour: $\sigma_{xy,n} \sim n^{\frac{3}{2}}$, $\sigma_{z,n} \sim n$
- longitudinal precision promising for dumping rings ($\sim 0.2\,mm/10\,km$, stat. errors only)

Sketch of the measurements

- Radial: ~550 points measured. Redundancy=2, ~450m = ~8 wires /day/2 or 3 pers., including transportation.
- Vertical: ~770 points measured. Go and back. 400m/day/2 pers. , including transportation.
- (for 1 sector)



Wire offset measurements: results



Alignment support for cryomodule

(presented by Virgil Bocean)

- Status of cryomodule test facility at FNAL
- Schedule for assembly of prototypes
- Alignment and Metrology support:
  - Alignment of cryomodule string
  - Measurement of mechanical stability
  - Input for future cryomodule design

Summary

- Communication, communication, communication
  - We need alignment and stability input from ALL the area systems
  - We need to iterate this information from what is desired to what is feasible
  - It is not enough to just say: „Do as good as you can.“
- Having our own parallel sessions greatly increased visibility and flow of information
- We have made good progress over the last year in becoming a global system with involvement from all three regions