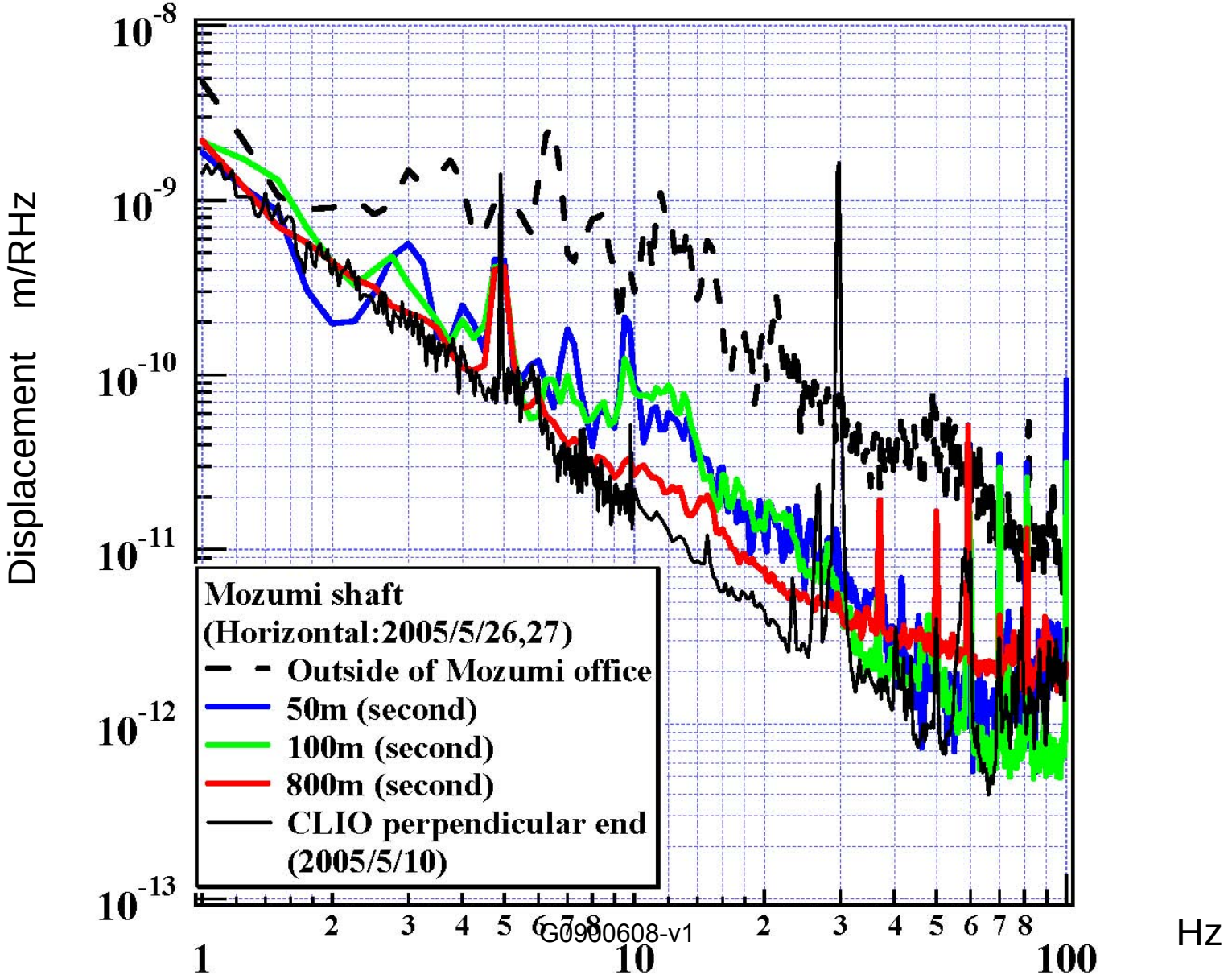
GWDAW@Ft.Dauderdale
13-May, 2009

Underground of Kamioka

Kazuaki Kuroda
ICRR, The University of Tokyo

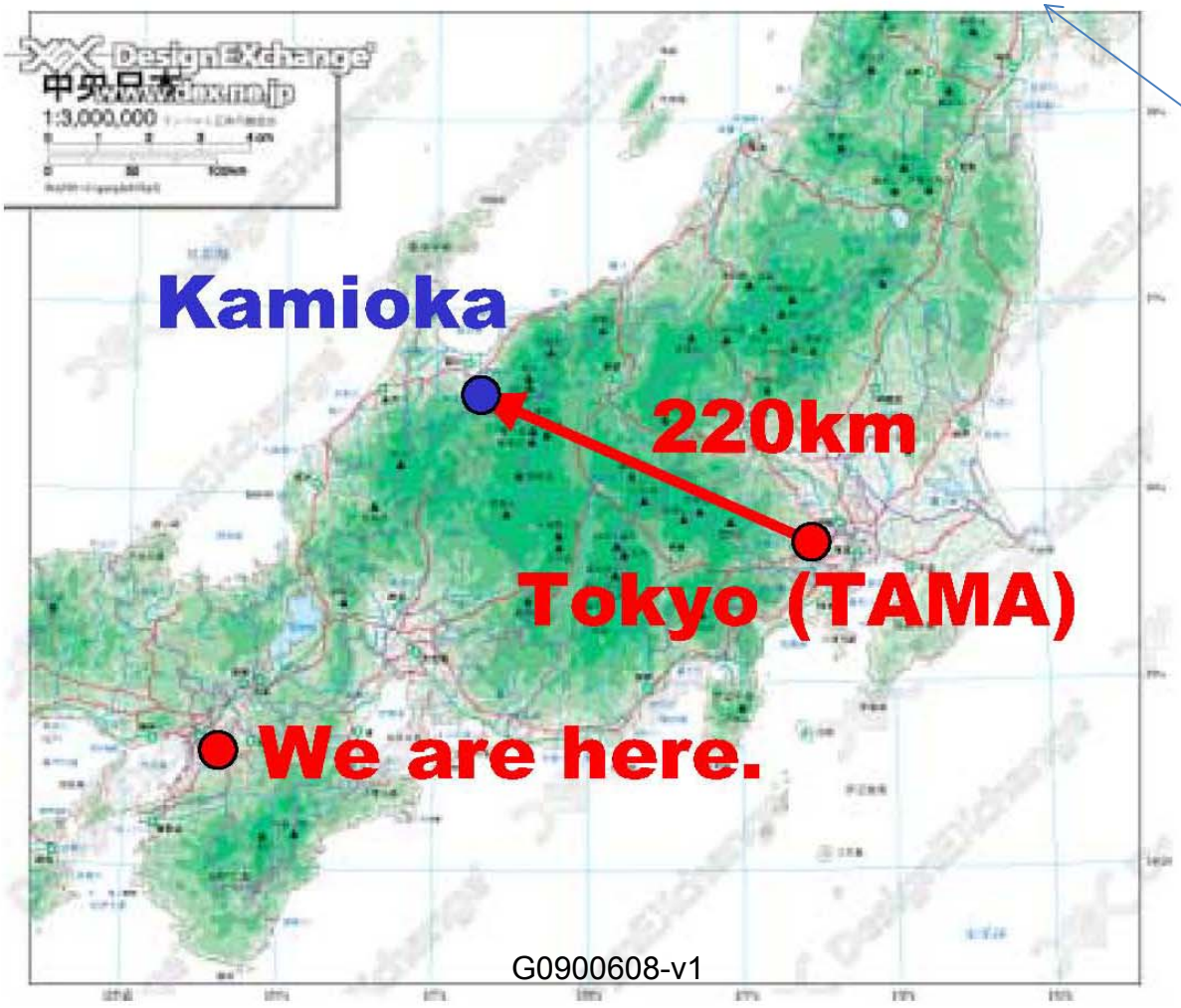
Schematic view of Kamioka Research Facility

Power spectrum of seismic noise along Mozumi mining shaft



Site

Kamioka (LCGT site)
220km west from Tokyo



Outside of Mozumi office

Accelerometer

. Sensor

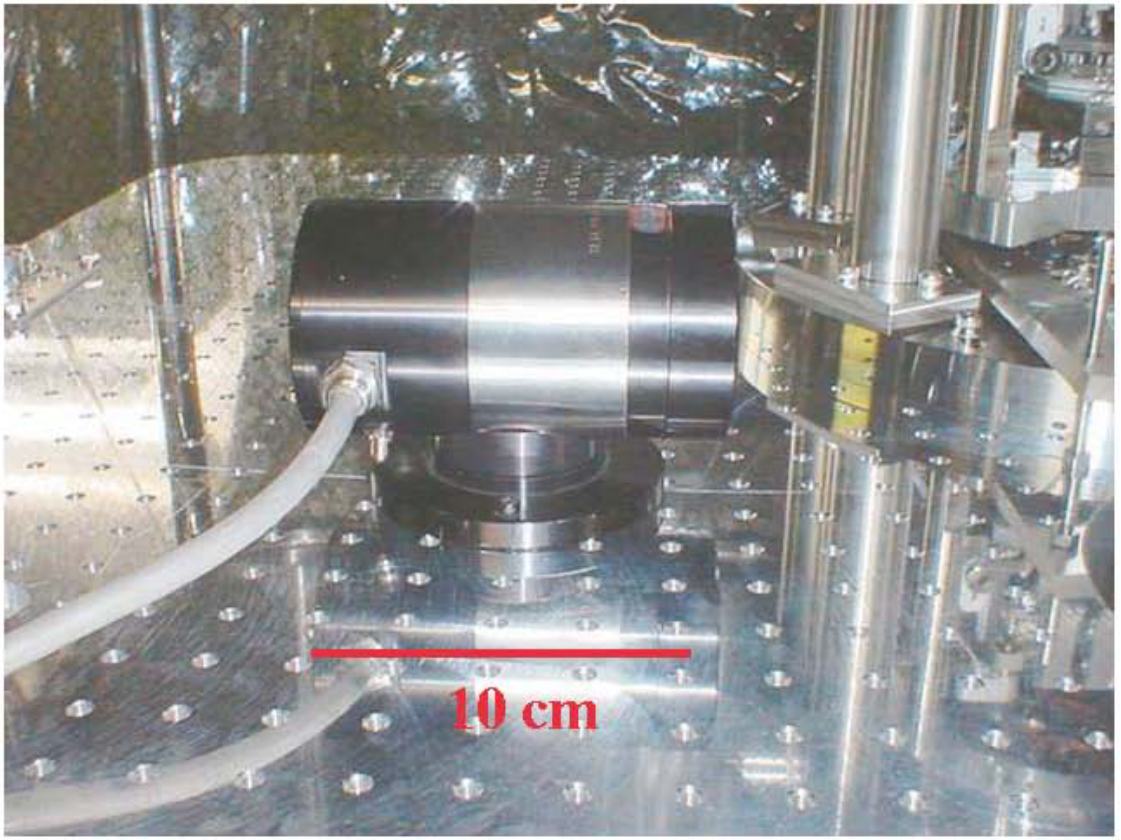
Accelerometer

RION LA-50

Laser Interferometer

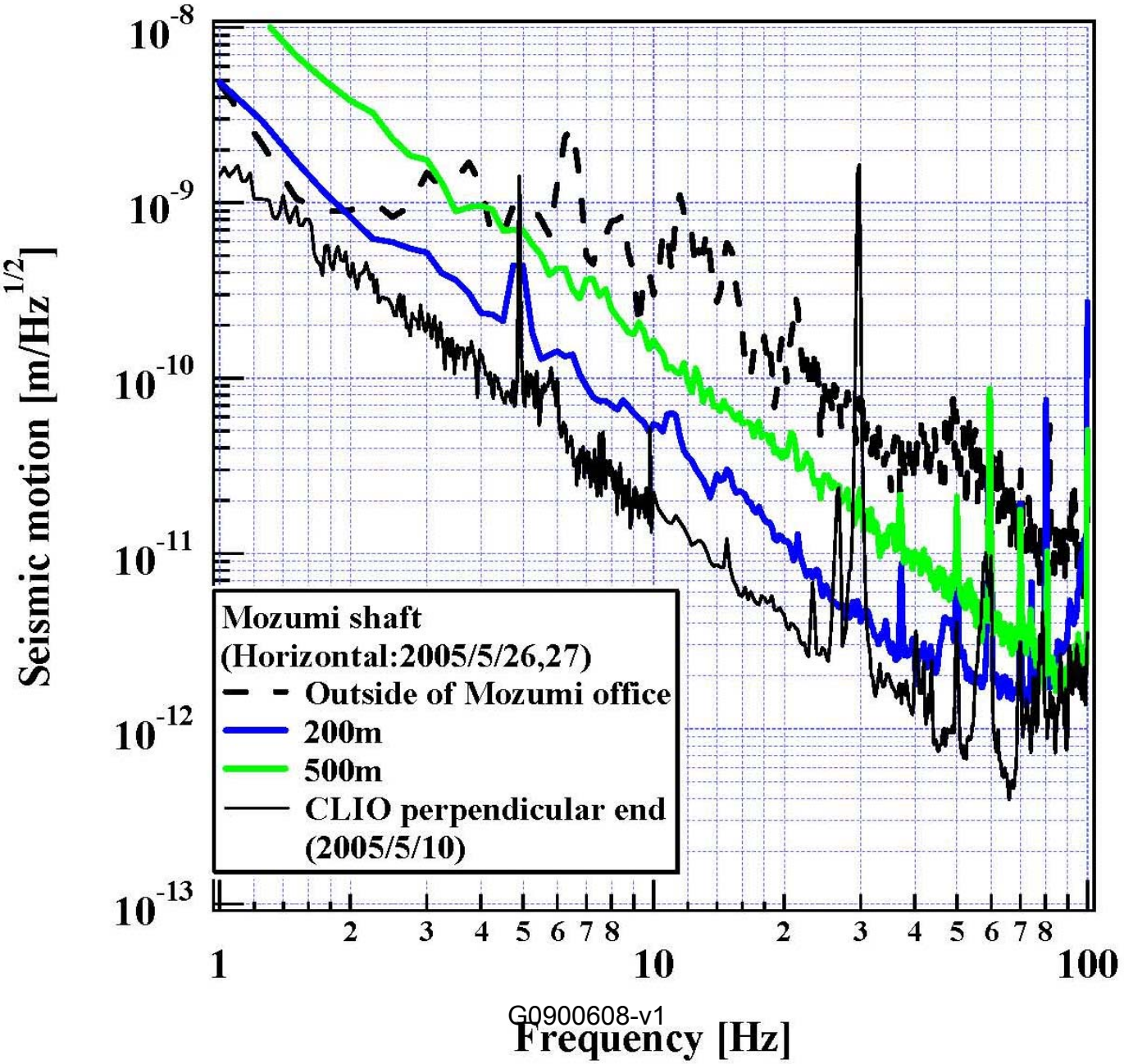
Observation band
0.1 Hz -100 Hz

Horizontal and
Vertical measurement



Fixed accelerometer

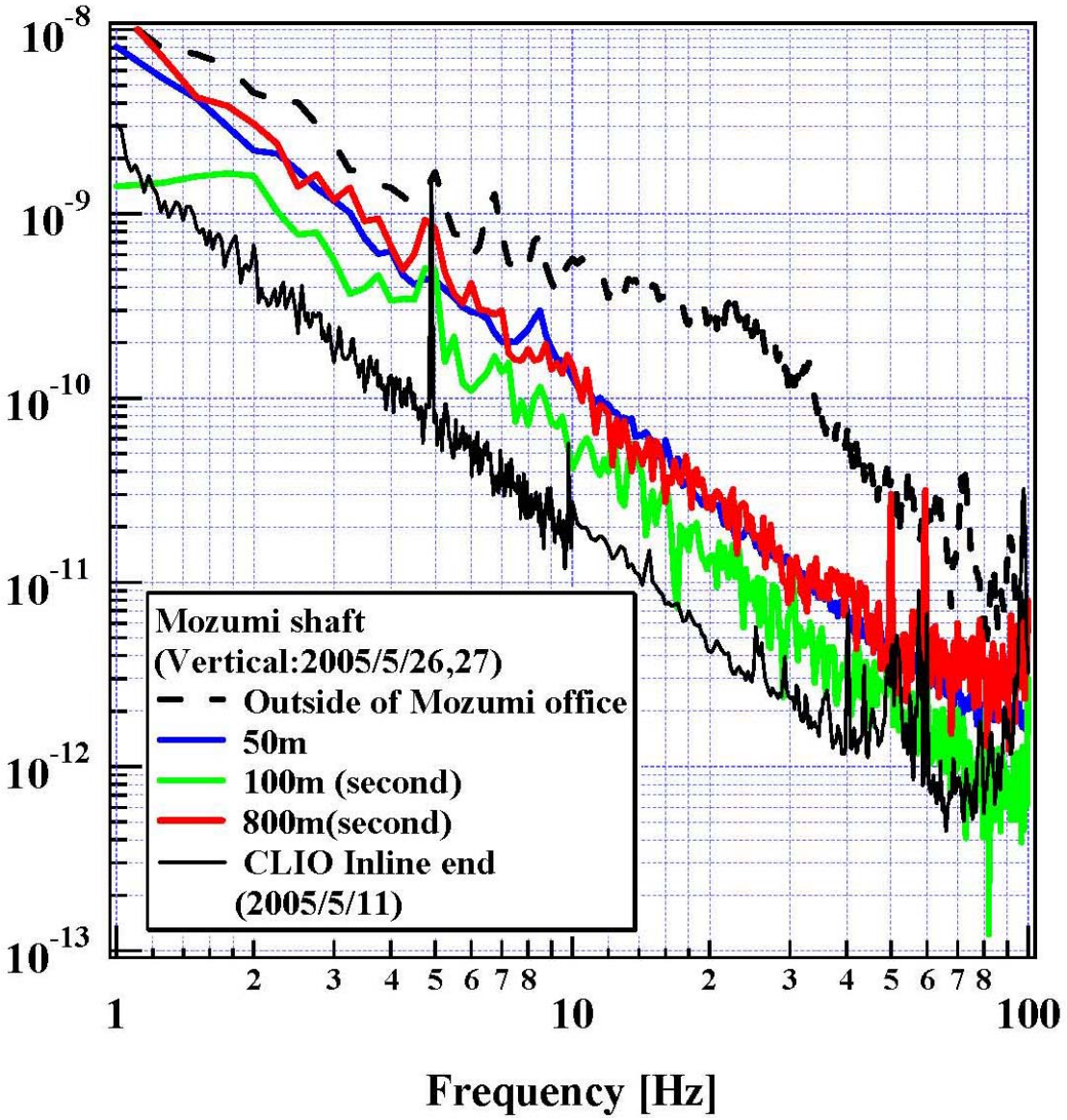
Measurement result (1)



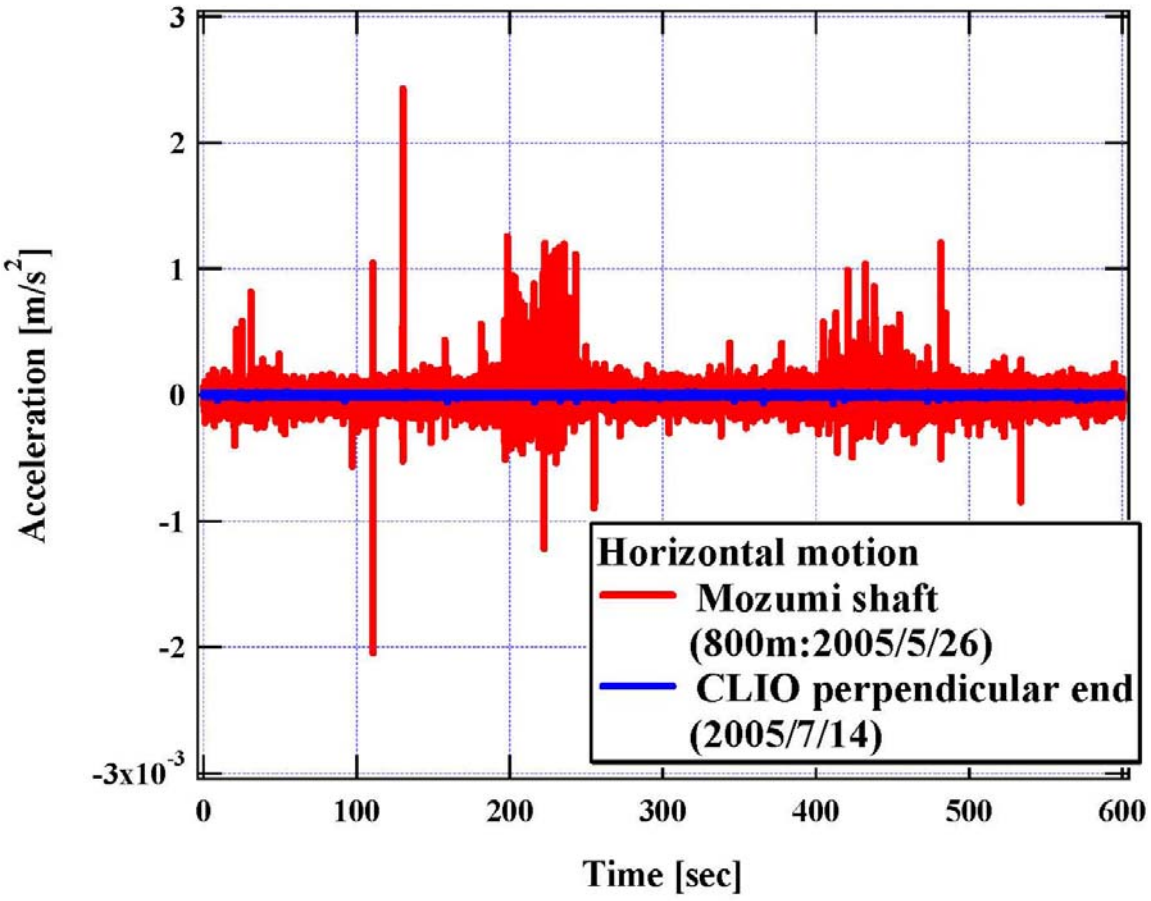
Measurement result (2)

Vertical direction

However, the sensor has some malfunction when the measurement at 800m was done.



Measurement result in time sequence



Comparison with other Undergrounds

(Esashi, Kamaishi, Kamitakara)

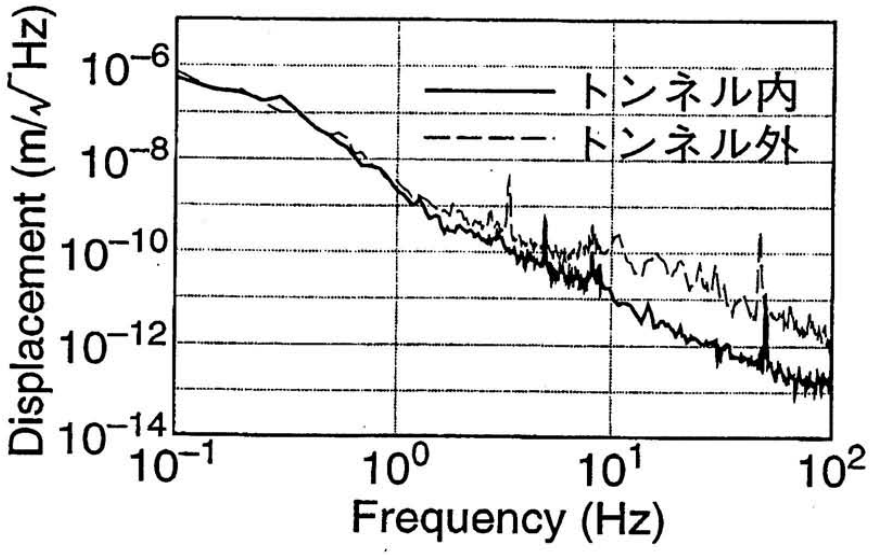


図5　トンネル内外の地面振動スペクトル

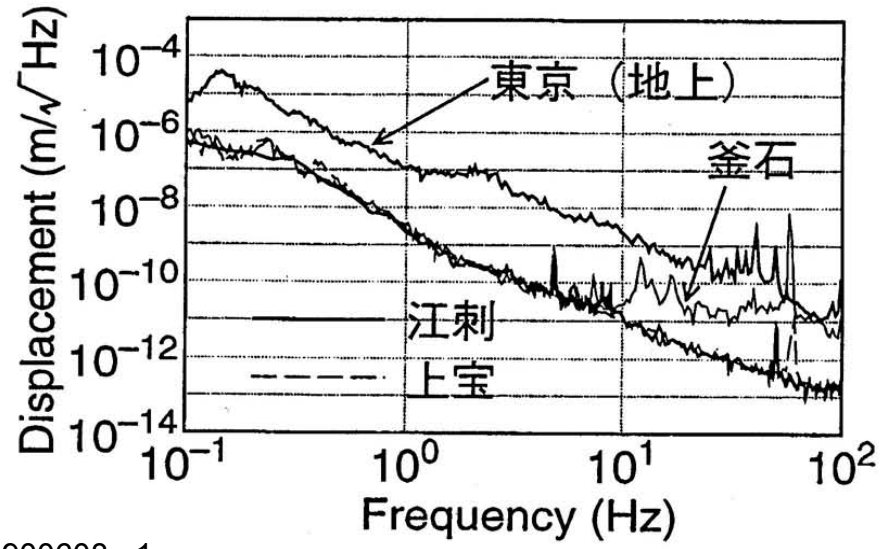


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図6　他の場所の地面振動スペクトルとの比較

参考文献

[1] 坪川恒也、「江刺精密実験室」、国立天文台水沢観測センター技報 (No.3, 1991).

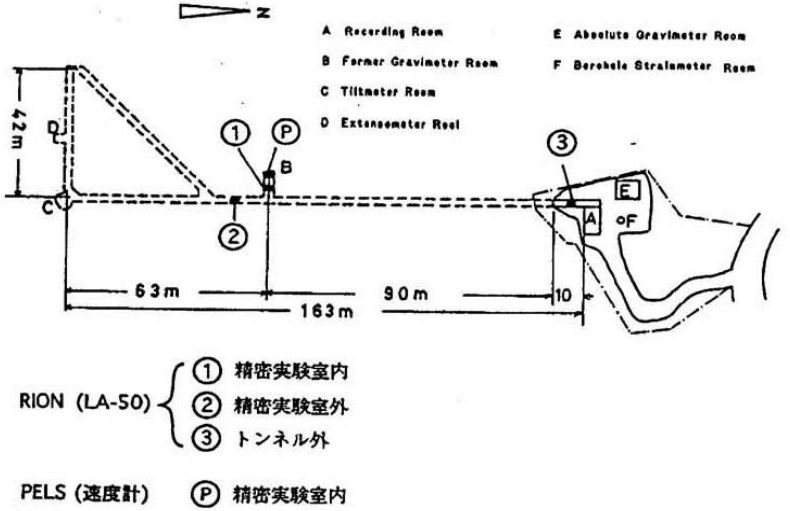

図 3　地面振動測定地点（文献 [1] より転載）

Calibration of the sensor with other seismometer

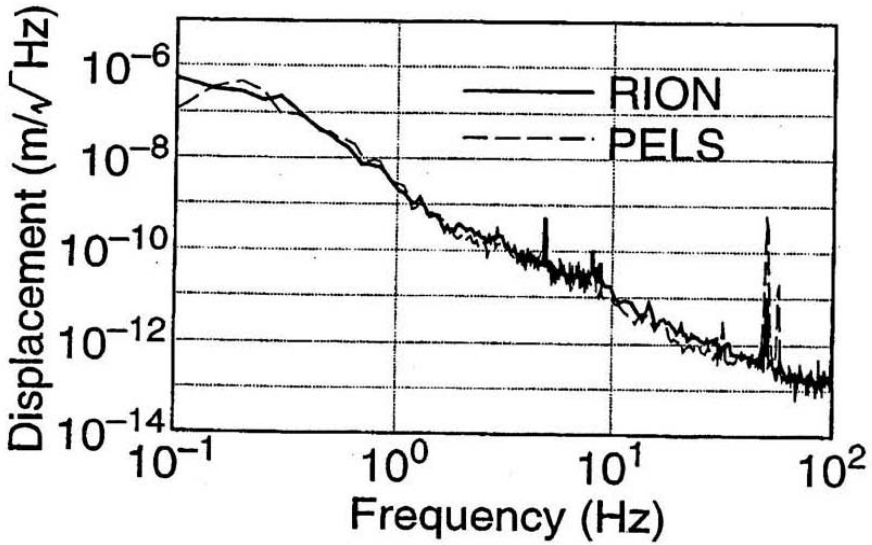

図 4　RION（加速度計）と PELS（速度計）の変位換算出力

The goodness of underground must be tested using interferometers

- Long term stability
  - Checked by a practical interferometer
- Harmful environment of high humidity
  - Vacuum pump and optics
- Dust contamination due to mining history
  - Optics
- Other harmful factors

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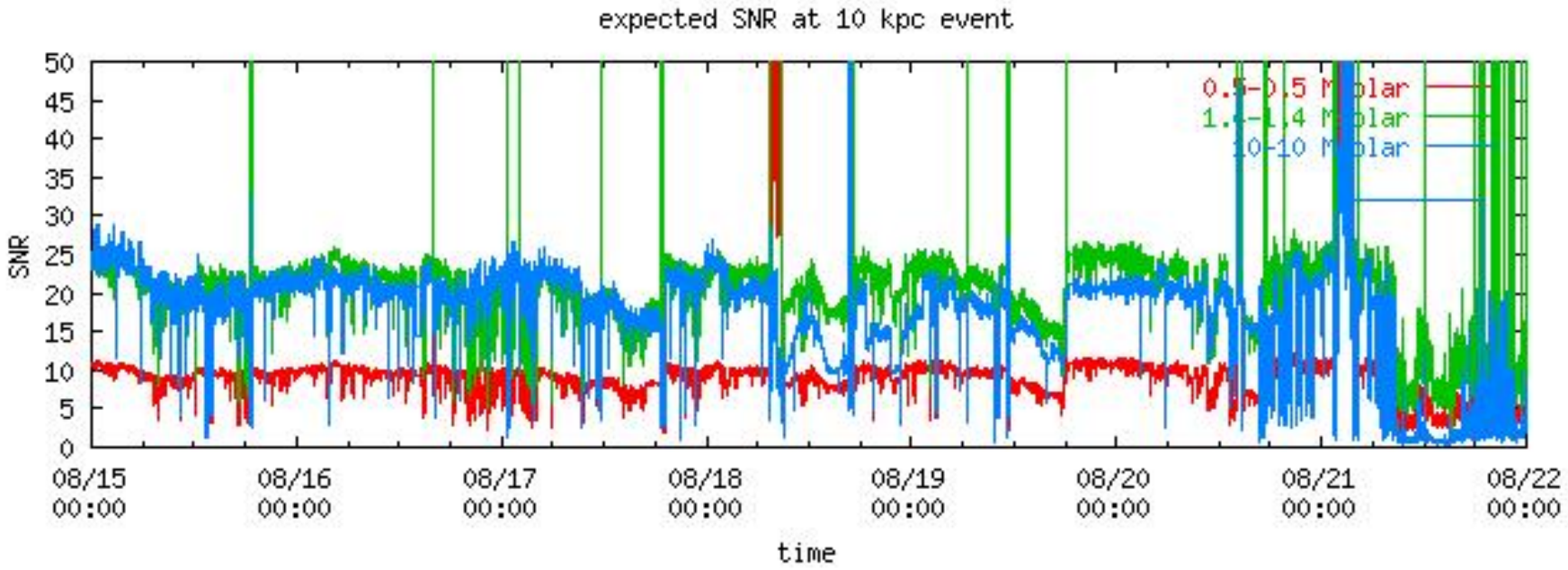
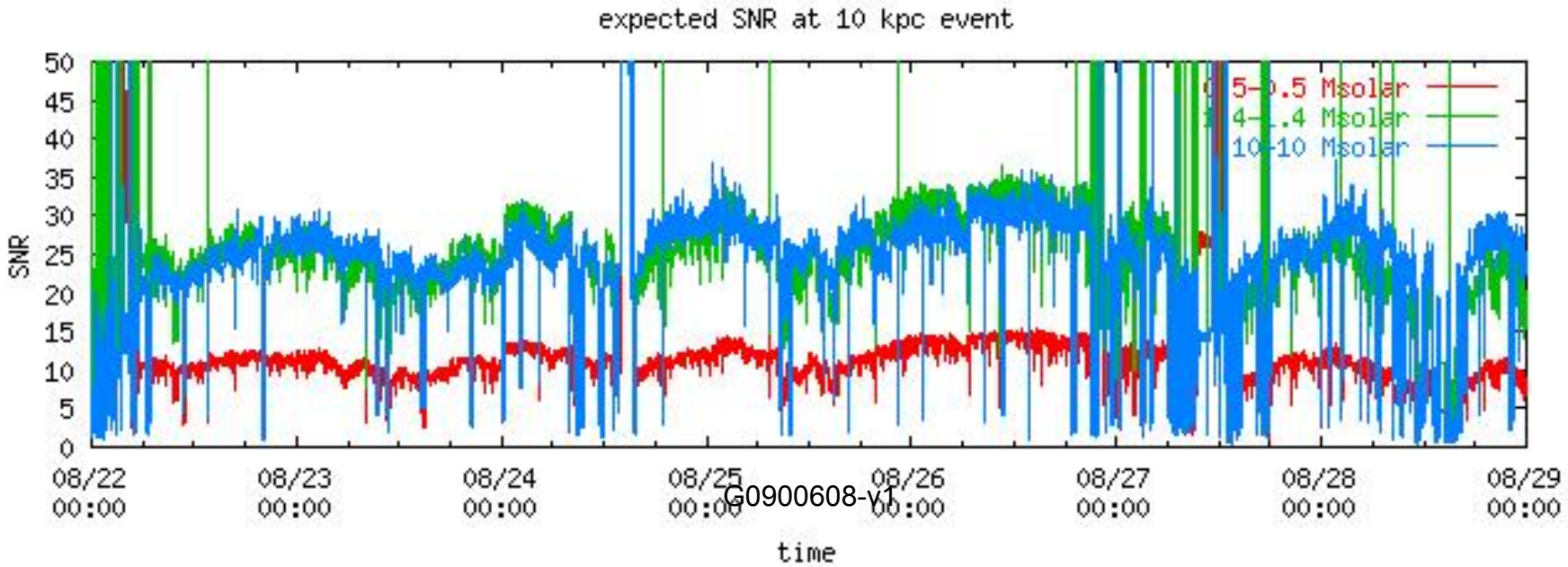
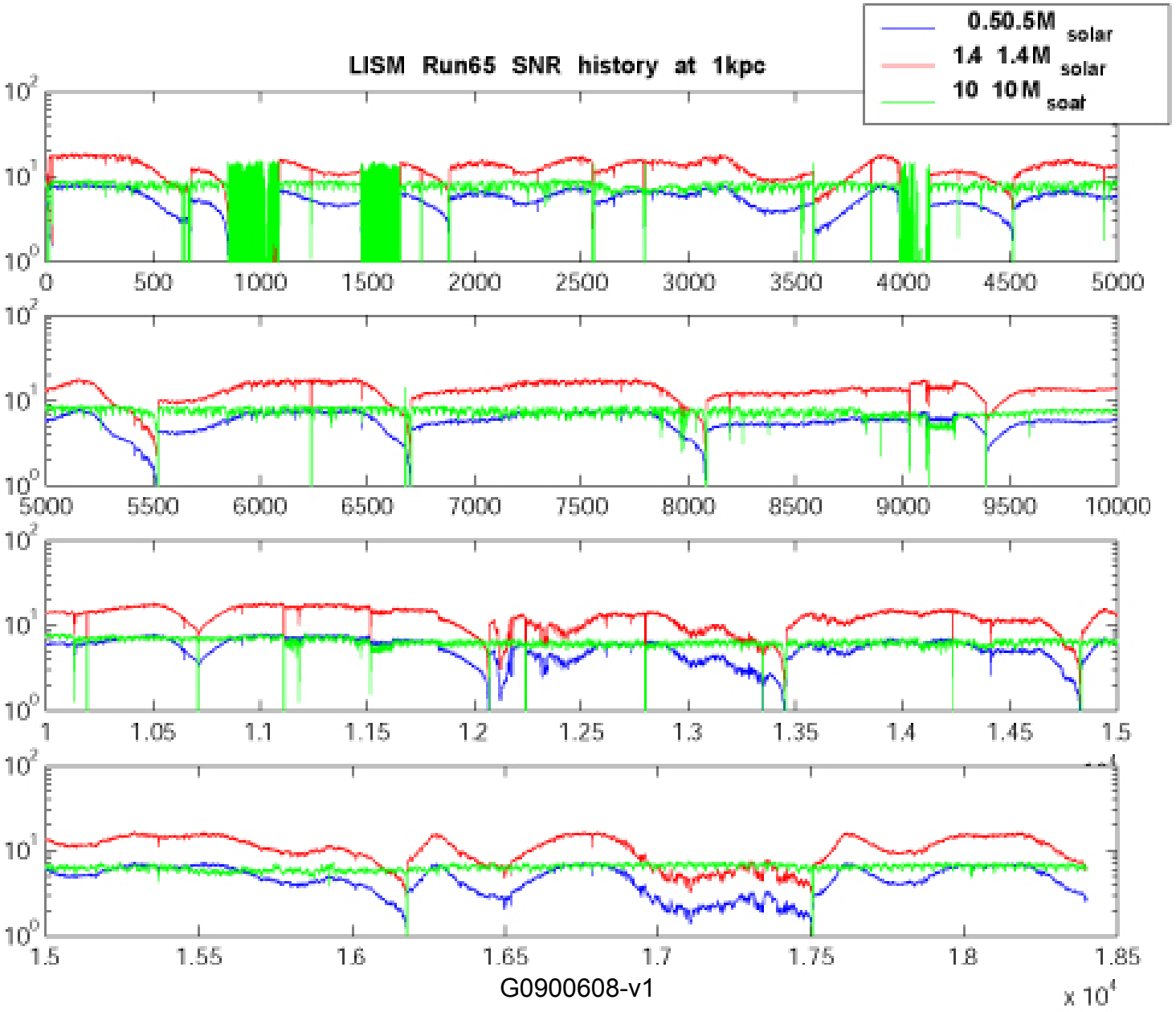
History of TAMA observation for one week





LISM—20m prototype installed underground near CLIO place in 2000



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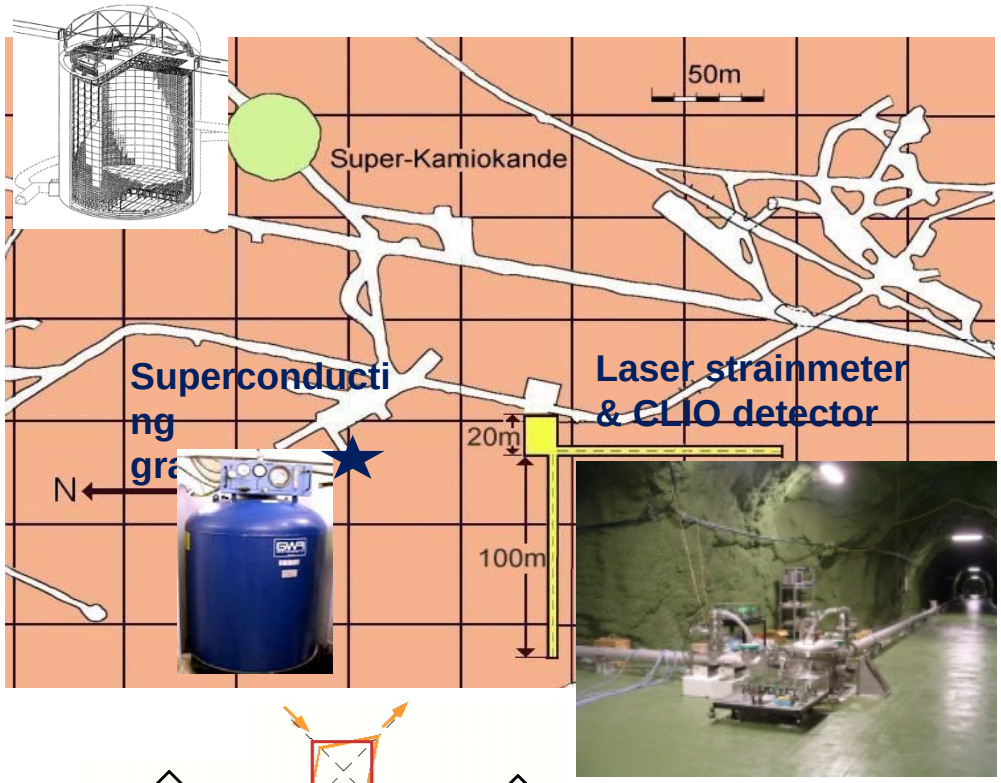
Kamioka 100-m Laser strainmeter for geophysical observations

Geophysical observation in Kamioka, 1000-m-deep underground

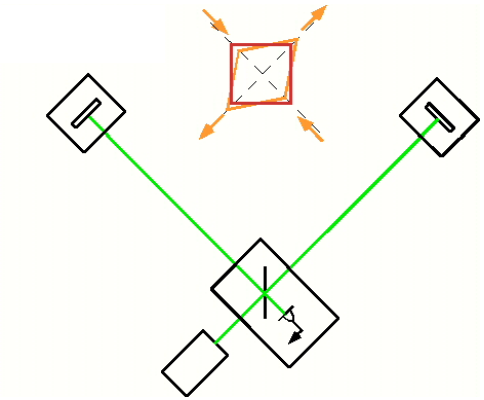
- Low background noise
- Stable in temperature
- Stable hard bedrock (gneiss)

Paralell observation with

- Laser strainmeter
  (10^{-13} in strain resolution)
- Superconducting gravimeter
- Absolute gravimeter
- Broadband seismometer



Laser strainmeter with 100-m arms



Linear and shear strain observation

Observation with a 100-m Laser strainmeter

Features

- Highly stabilized laser
  (10^{-13} in strain resolution)
- Very broadband (DC to 50Hz)

Targets

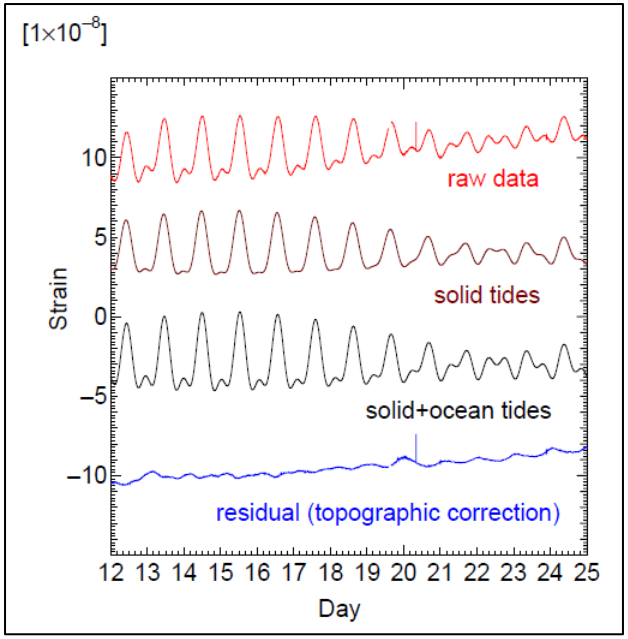
- broadband phenomena
  from geodetic to seismic band
- from surface (fault) to inner core

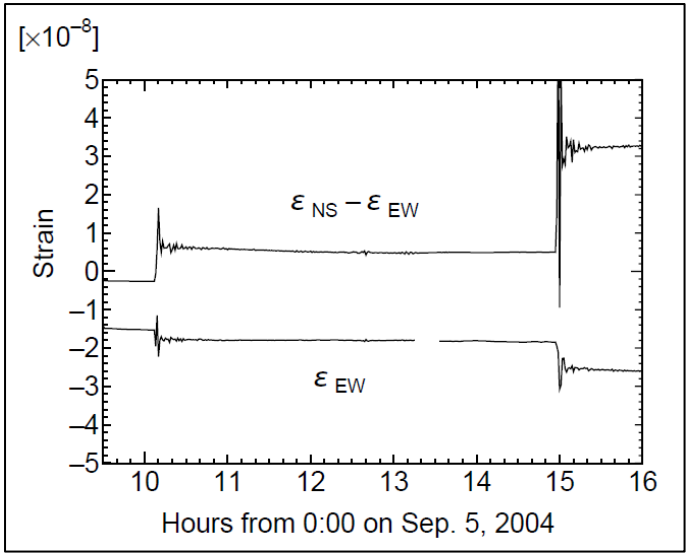
Achievements

- Lowest background noise
- Topographic effects on tides
- Analyses of strain steps
  associated with earthquakes

Evaluation of topographic effects on earth tides

Takemoto et al. (2006)



Co-seismic strain steps of earthquakes (M6.9 and M7.4)

Araya et al. (2007)