# Exploiting the Potential of the Hydrostatic Leveling System (HLS) at the Swiss Light Source (SLS)


Edi Meier

Edi Meier + Partner AG

Winterthur, Switzerland

www.emp-winterthur.ch

edi.meier@emp-winterthur.ch

Michael Boege

SLS Machine Development

Paul Scherrer Institute (PSI)

Villigen, Switzerland

michael.boege@PSI.ch

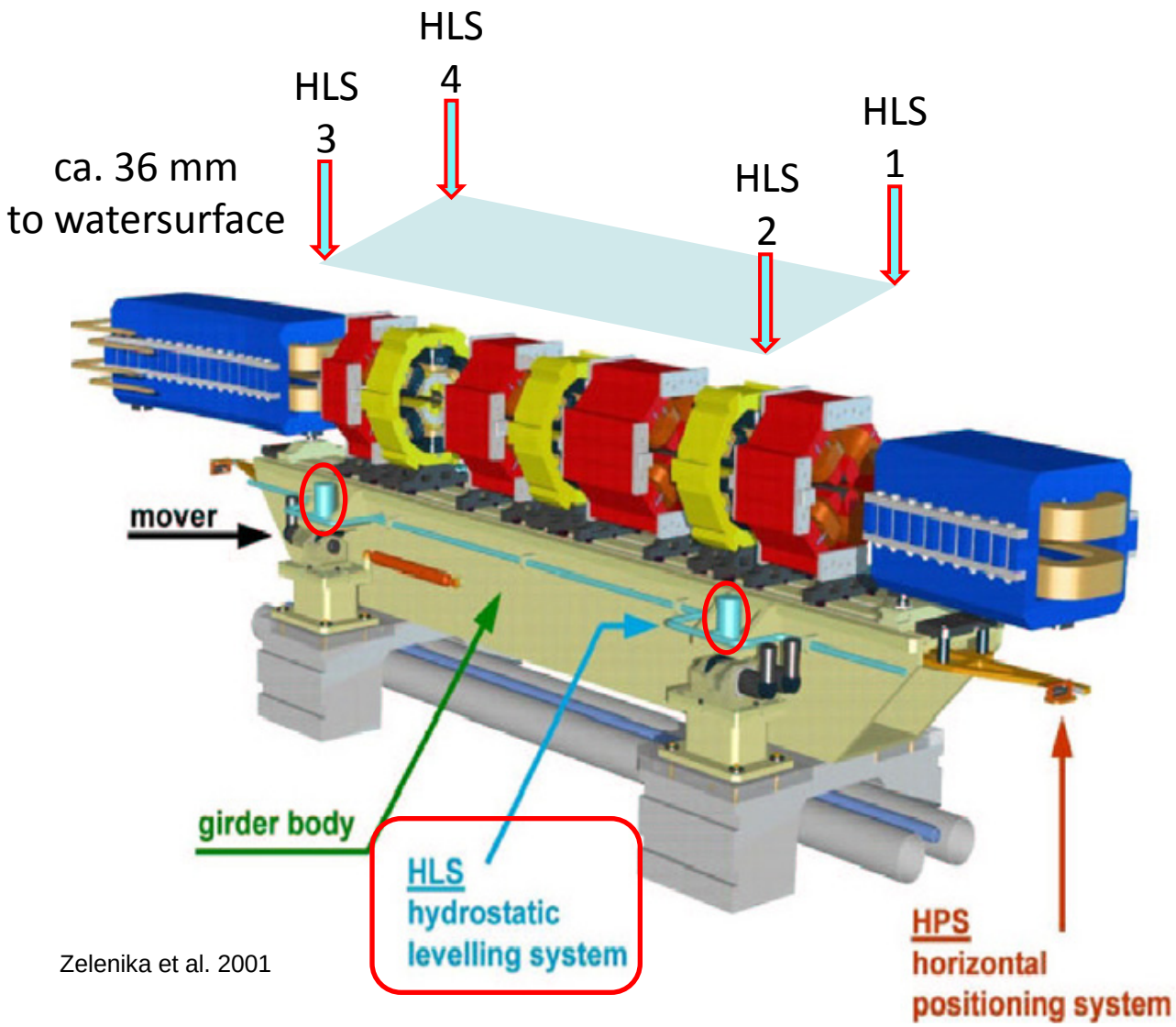
# New Software for HLS at SLS

- Old HLS Software
  - Online graphs of 1 selected sector
  - 1 hour averages of all data were stored
  - Output in Excel

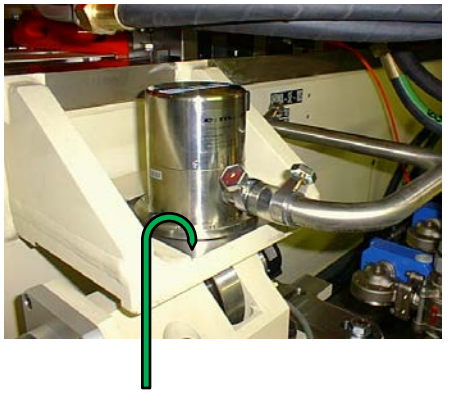
- New HLS Software

  - Data Output in  EPICS Control System
  - All important data are visible on one screen
  - Online data analysis -> red / green light
  - Rawdata, Pitch, Roll, Heave is selectable
  - All data are stored
  - Data playback selectable:  ASCII, Excel

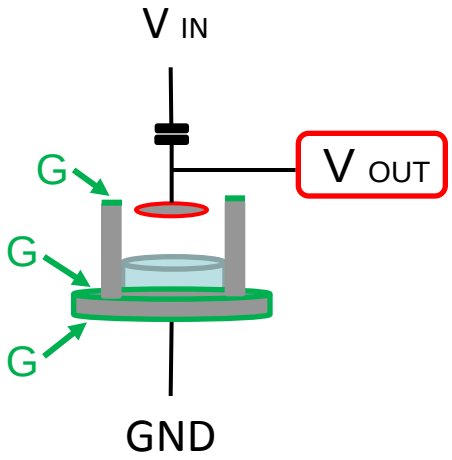
# Girder Layout , total 48 Girders, 192 HLS Sensors




Zelenika et al. 2001



G: +/- 0.002mm
grinded support



# Overview Screen: HEAVE

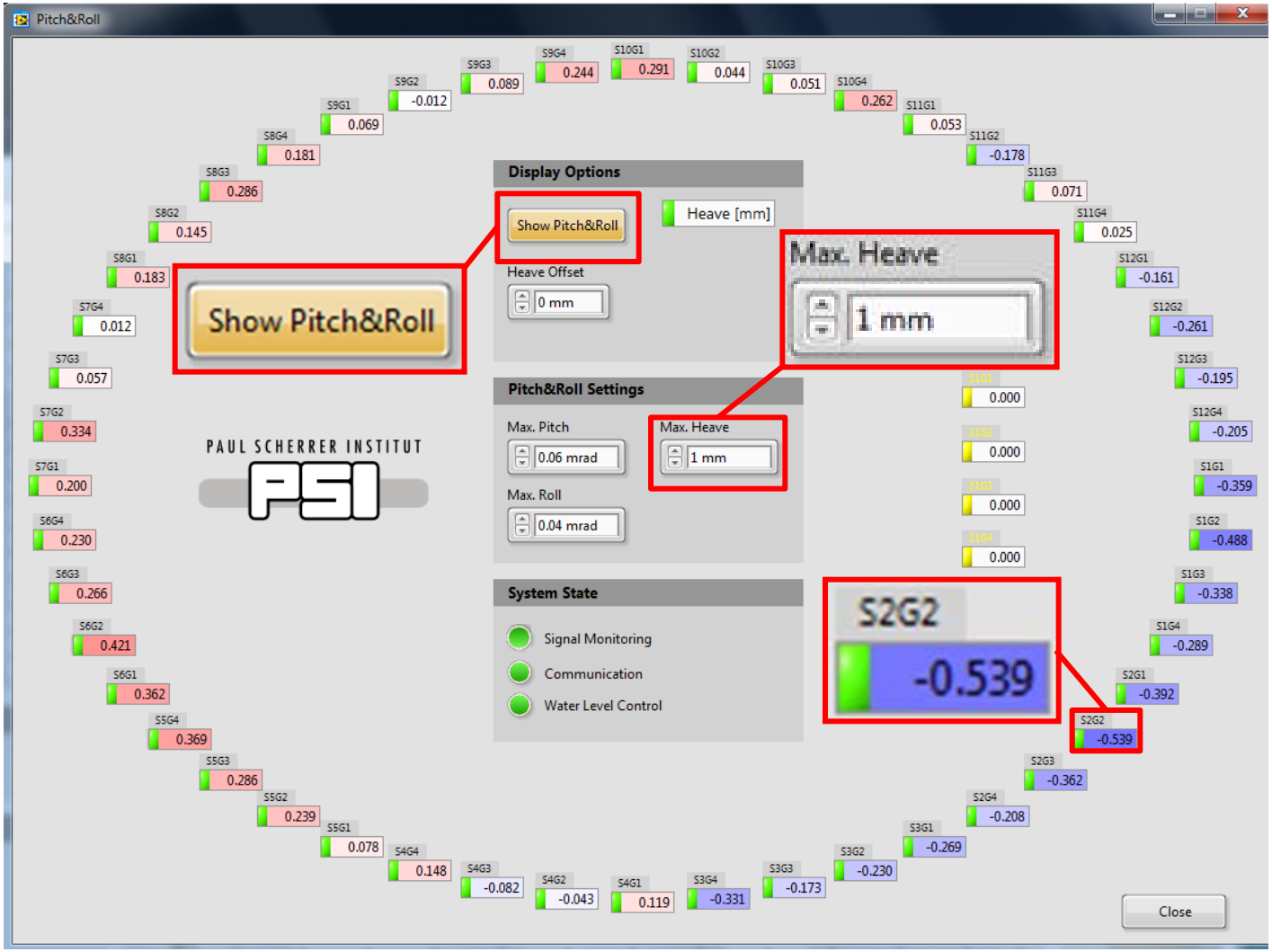
Heave [mm]
since 2005

N

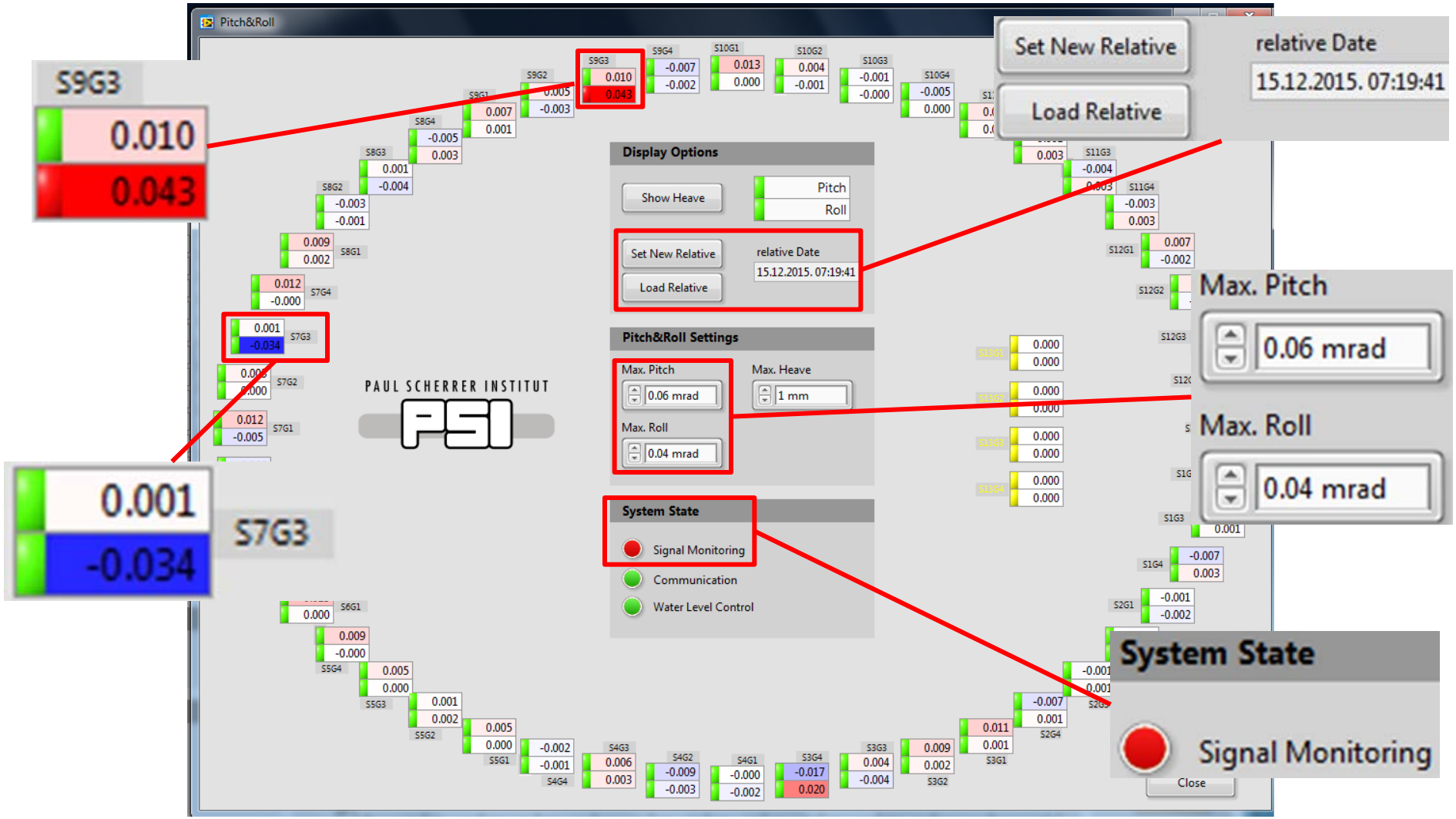
W

E

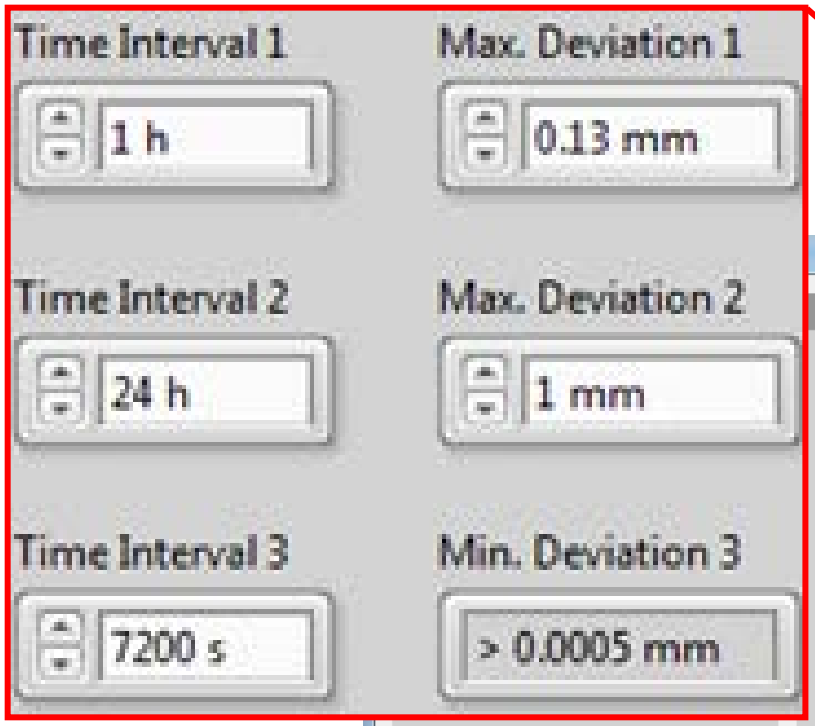
S



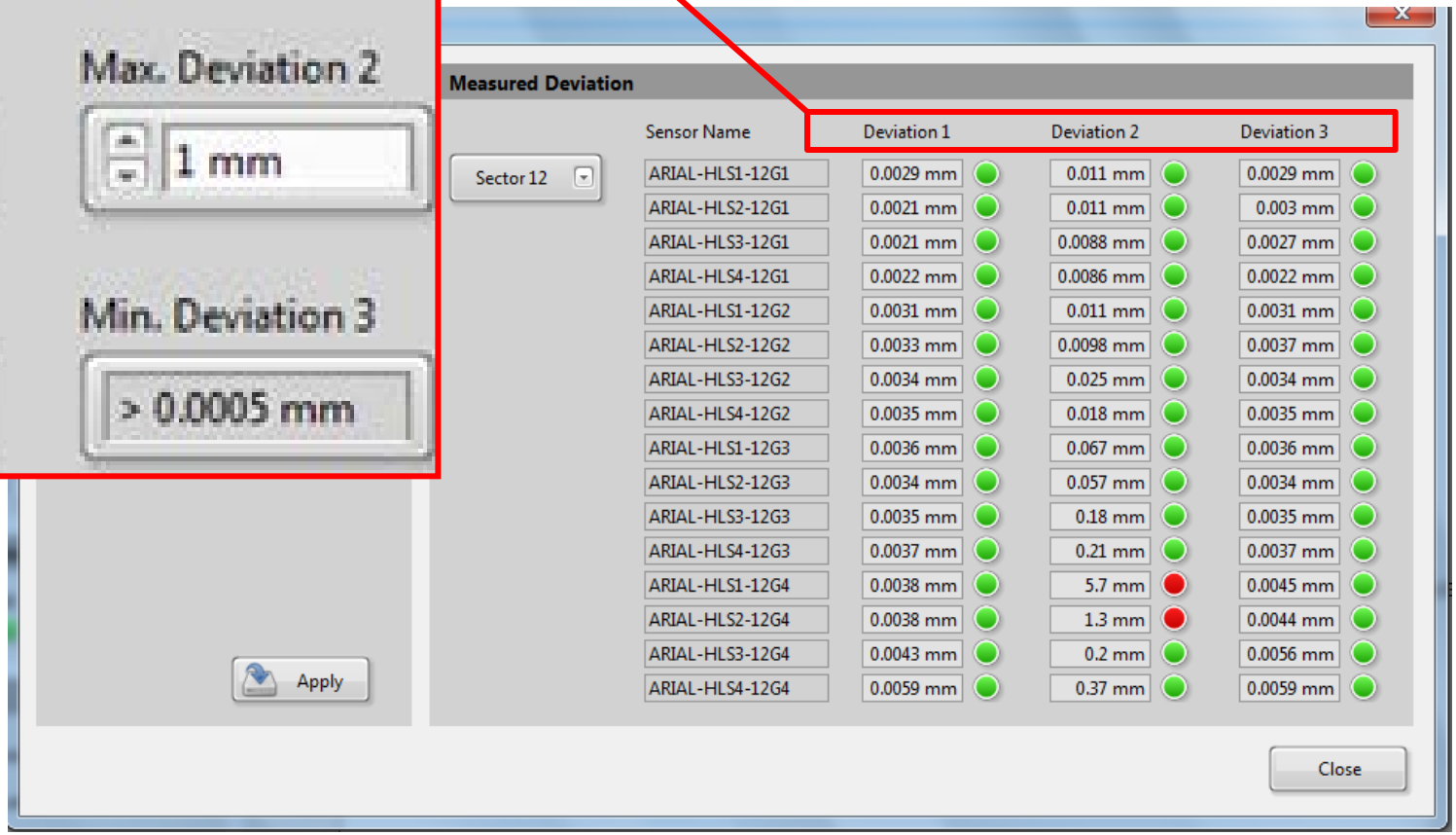
# Overview Screen: PITCH & ROLL



# Signal Monitoring Conditions

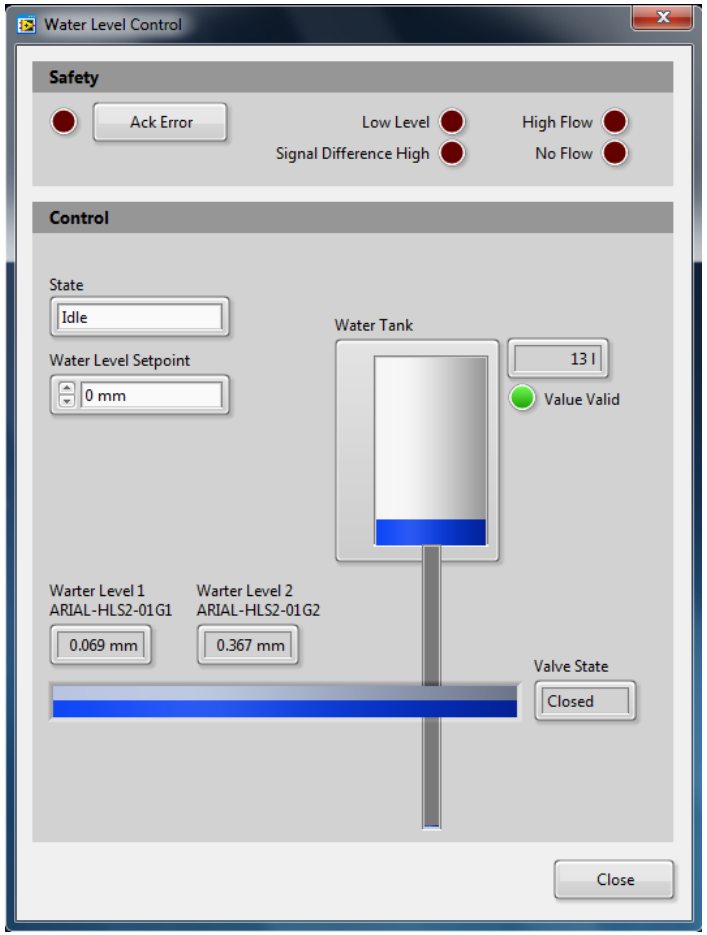


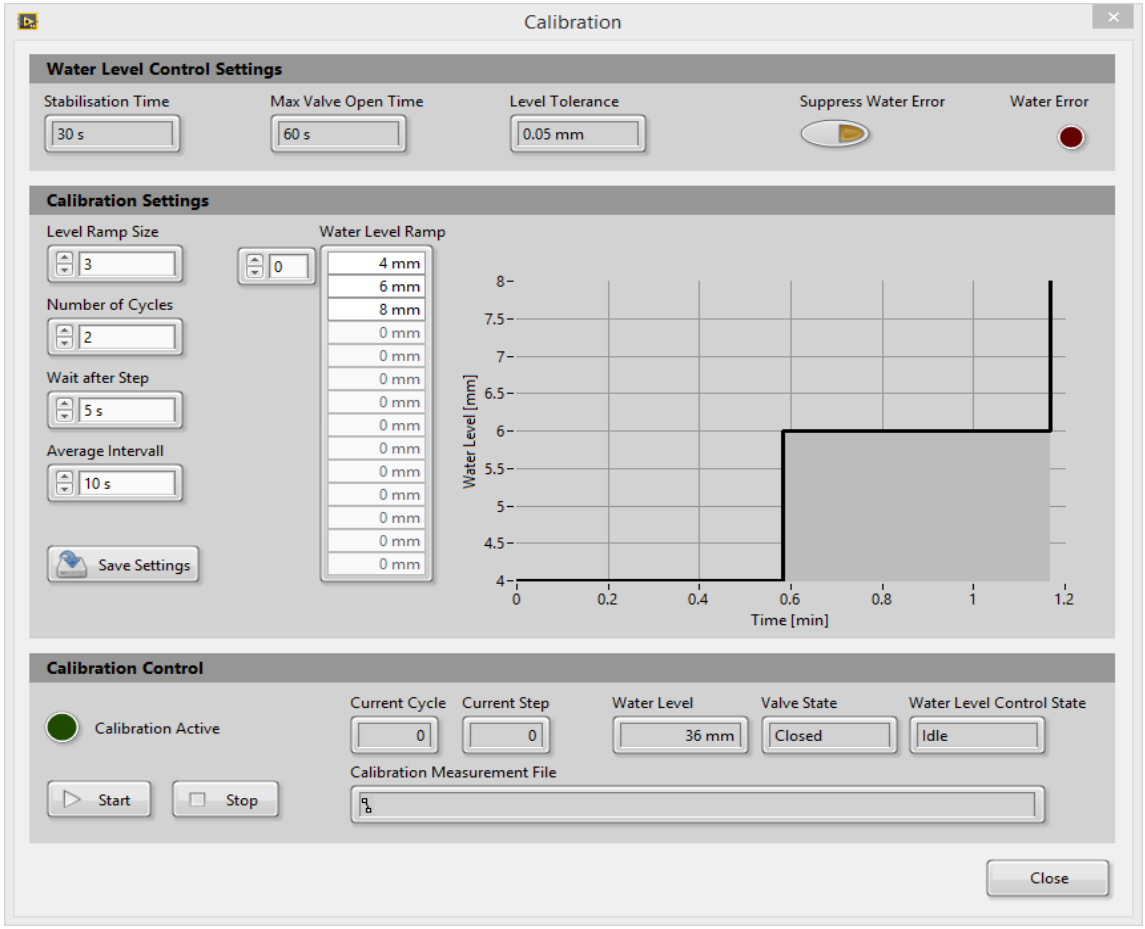

Sector 12




| Sensor Name | Deviation 1 | Deviation 2 | Deviation 3 |
|---|---|---|---|
| ARIAL-HLS1-12G1 | 0.0029 mm | 0.011 mm | 0.0029 mm |
| ARIAL-HLS2-12G1 | 0.0021 mm | 0.011 mm | 0.003 mm |
| ARIAL-HLS3-12G1 | 0.0021 mm | 0.0088 mm | 0.0027 mm |
| ARIAL-HLS4-12G1 | 0.0022 mm | 0.0086 mm | 0.0022 mm |
| ARIAL-HLS1-12G2 | 0.0031 mm | 0.011 mm | 0.0031 mm |
| ARIAL-HLS2-12G2 | 0.0033 mm | 0.0098 mm | 0.0037 mm |
| ARIAL-HLS3-12G2 | 0.0034 mm | 0.025 mm | 0.0034 mm |
| ARIAL-HLS4-12G2 | 0.0035 mm | 0.018 mm | 0.0035 mm |
| ARIAL-HLS1-12G3 | 0.0036 mm | 0.067 mm | 0.0036 mm |
| ARIAL-HLS2-12G3 | 0.0034 mm | 0.057 mm | 0.0034 mm |
| ARIAL-HLS3-12G3 | 0.0035 mm | 0.18 mm | 0.0035 mm |
| ARIAL-HLS4-12G3 | 0.0037 mm | 0.21 mm | 0.0037 mm |
| ARIAL-HLS1-12G4 | 0.0038 mm | 5.7 mm | 0.0045 mm |
| ARIAL-HLS2-12G4 | 0.0038 mm | 1.3 mm | 0.0044 mm |
| ARIAL-HLS3-12G4 | 0.0043 mm | 0.2 mm | 0.0056 mm |
| ARIAL-HLS4-12G4 | 0.0059 mm | 0.37 mm | 0.0059 mm |

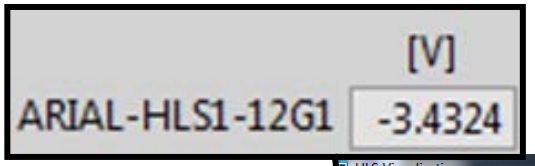
# System Calibration with Filling Station



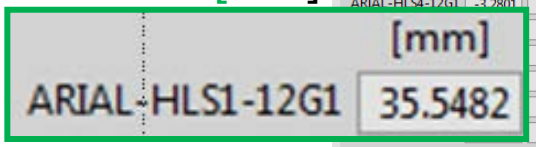



# Online Data «Oscilloscope view»

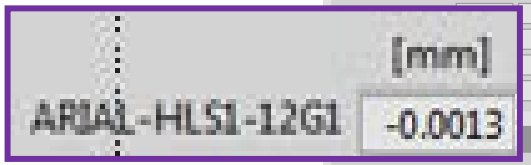
Rawdata [V]

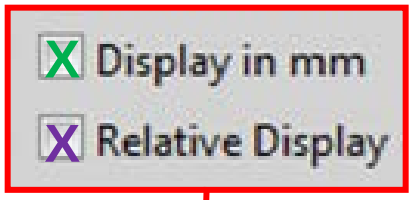



Absolute [mm]



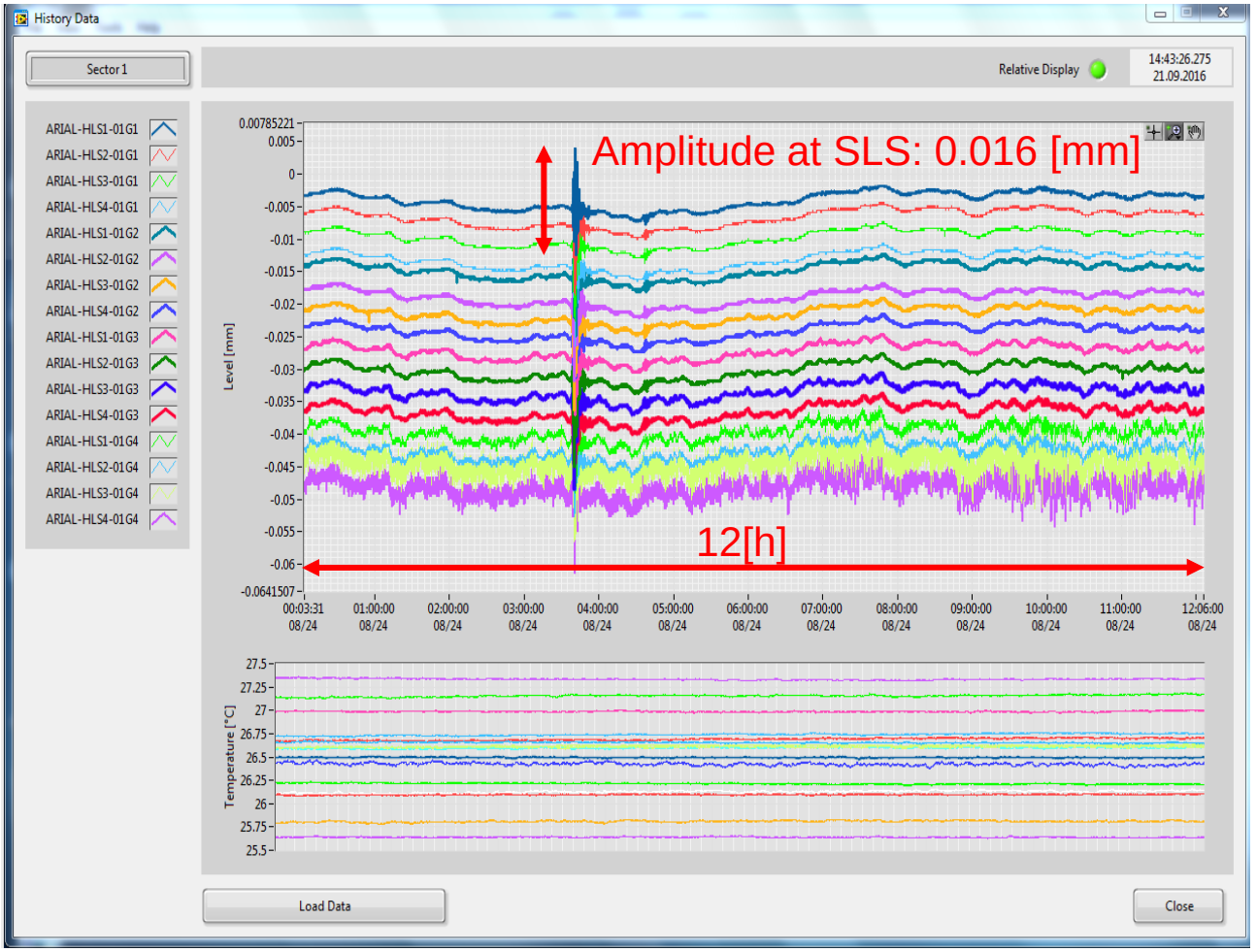

Relative [mm]




# Data output to EPICS and data storage

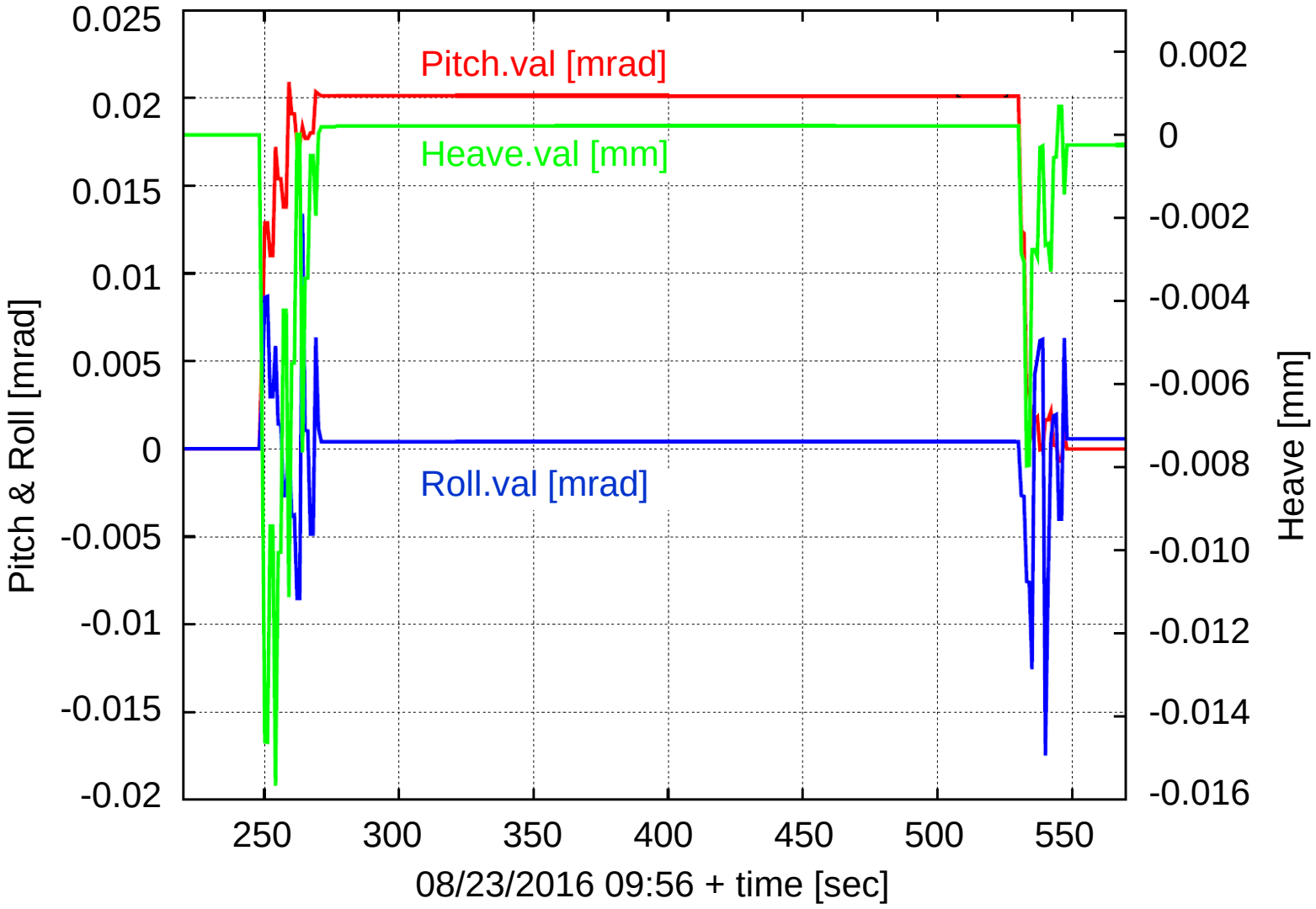
- All the data are permanently available in EPICS
- History data
- Earthquake in Italy, 24.8.16
- Average of select-able interval, e.g. 1h
- Output format in ASCII or Excel



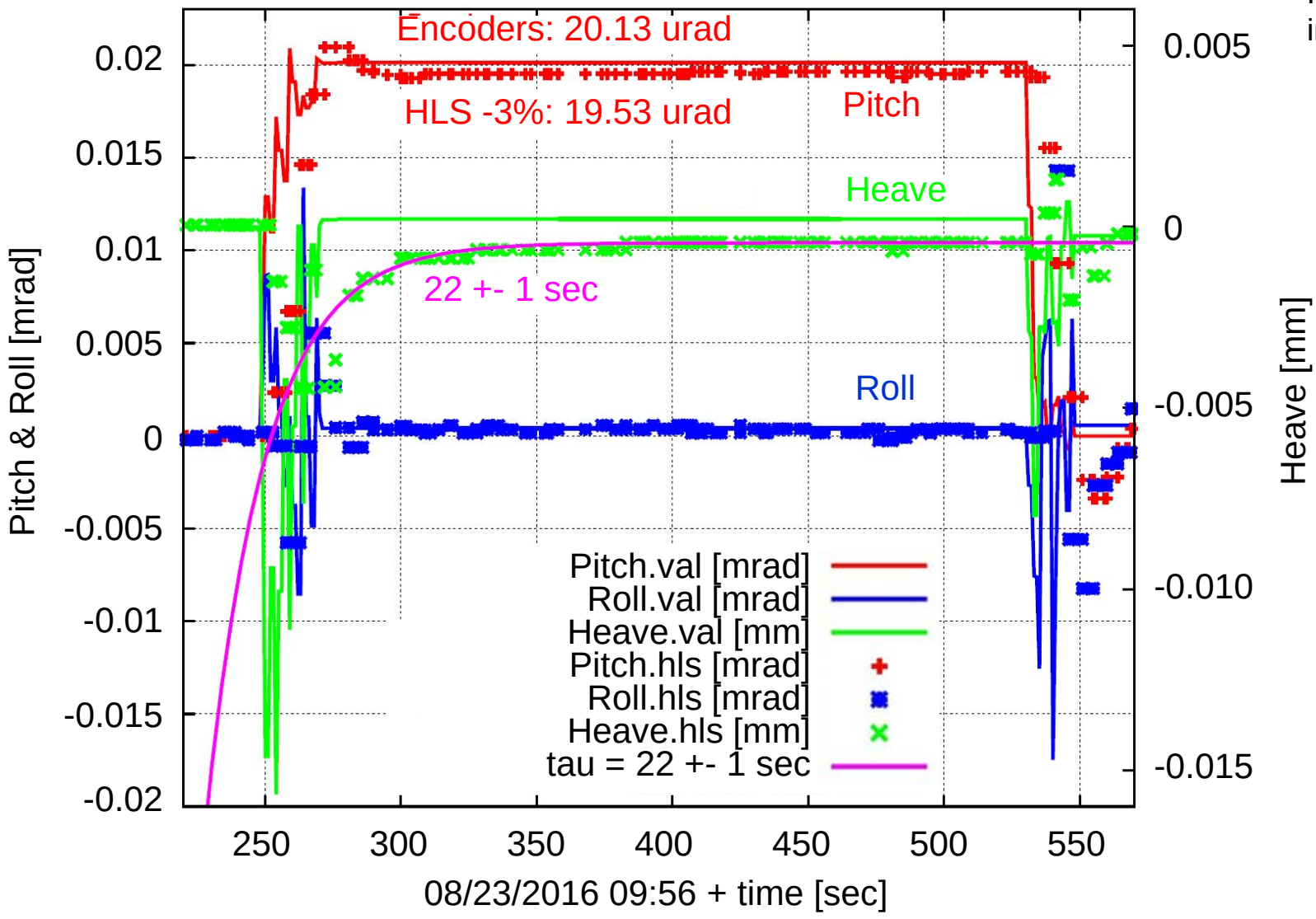
# 20 urad steps performed on the last girder


- Selection of the corresponding HLS sensors in the «History Data» window
- Generation of a data output in ASCII format of the selected channels

# Calculated from motor encoders

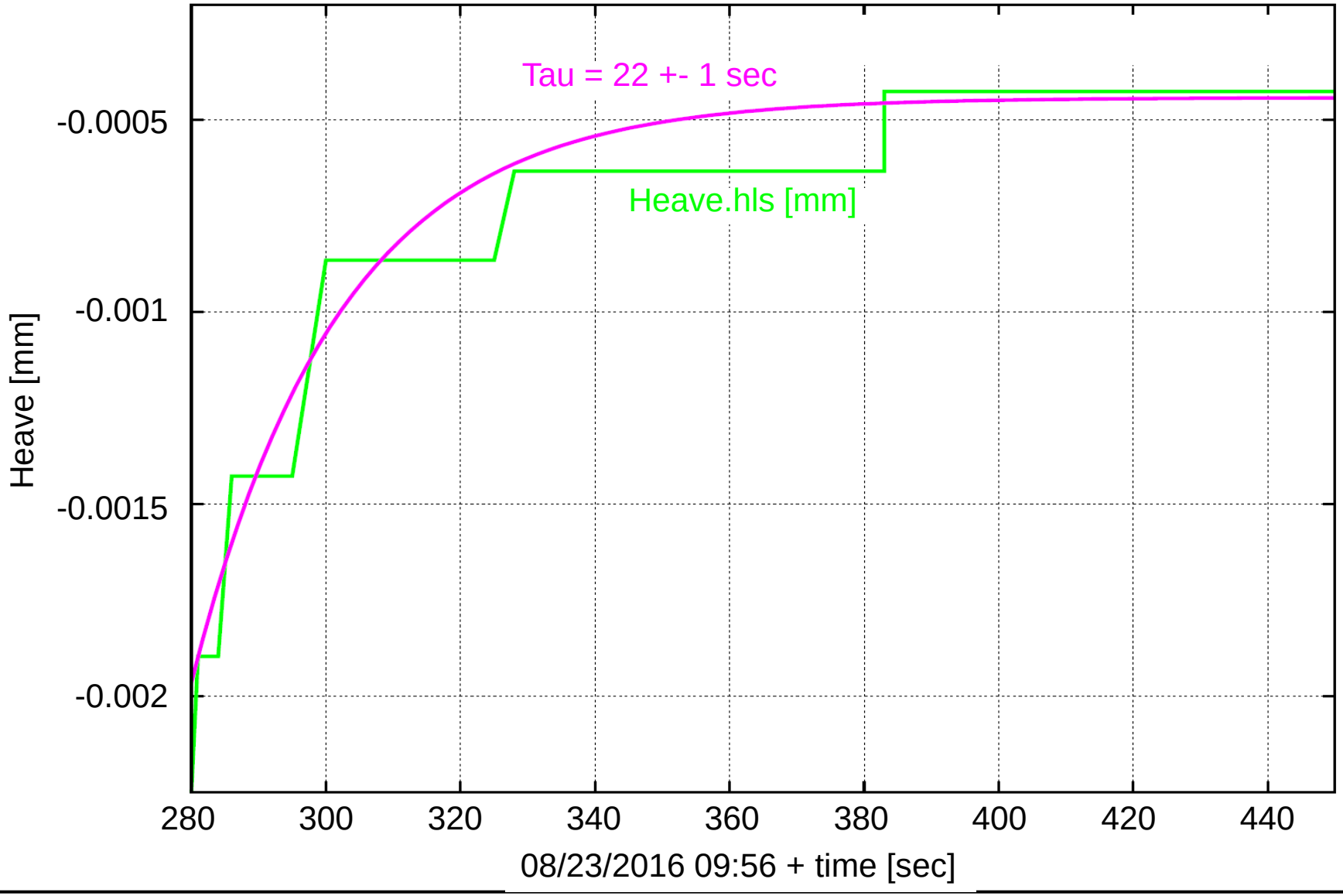


# Comparing motor encoders and HLS




Pitch most important

# Time constant, present Digitizer 16-bit

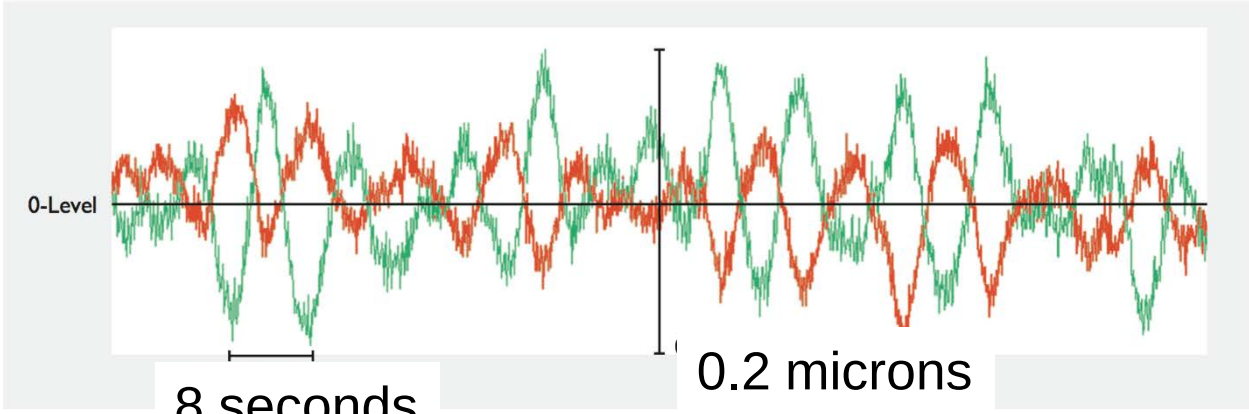


# HLS Resolution: Earthtides and Atlantic waves

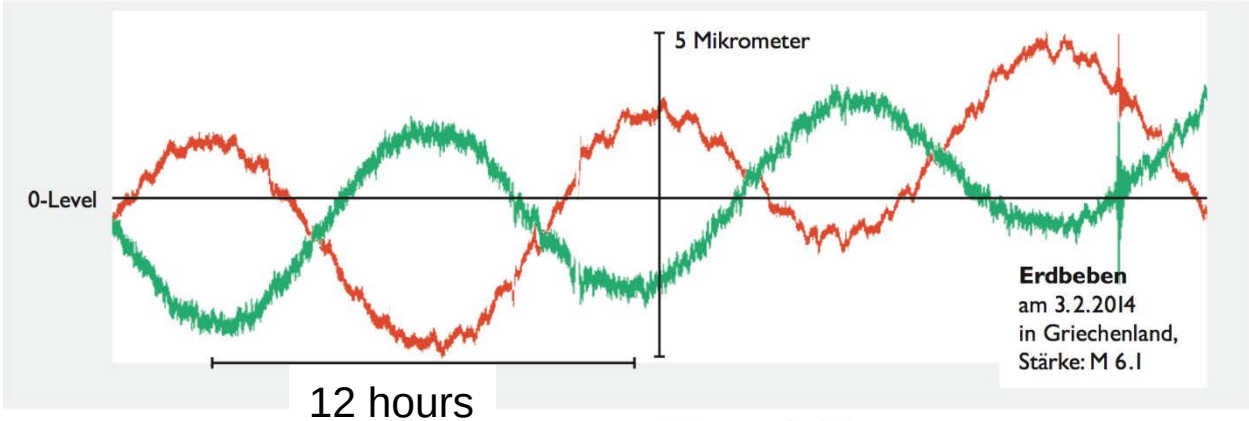
Mont Terri Rocklaboratory:

24 bit Seismic Dataacquisition System „Quanterra“

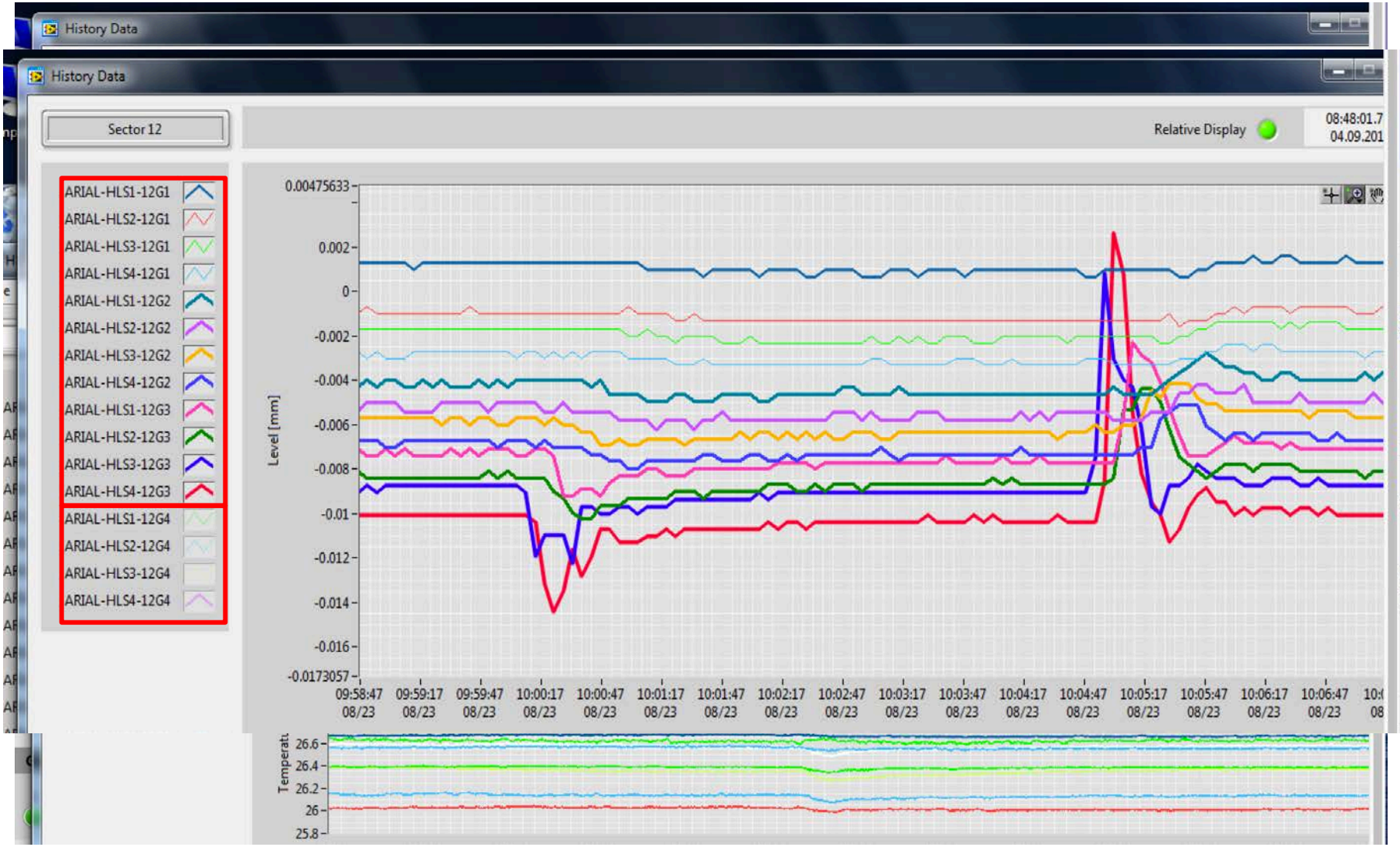
Short term signals: Atlantic waves




Long term signals: Earthtides



# Neighbor signals explain the heave error



# Conclusions

- The new software opened our eyes for future applications
- We learned more about the systematic effects, liquid transport etc. in the HLS tubes
- The HLS system is well integrated with the SLS control system