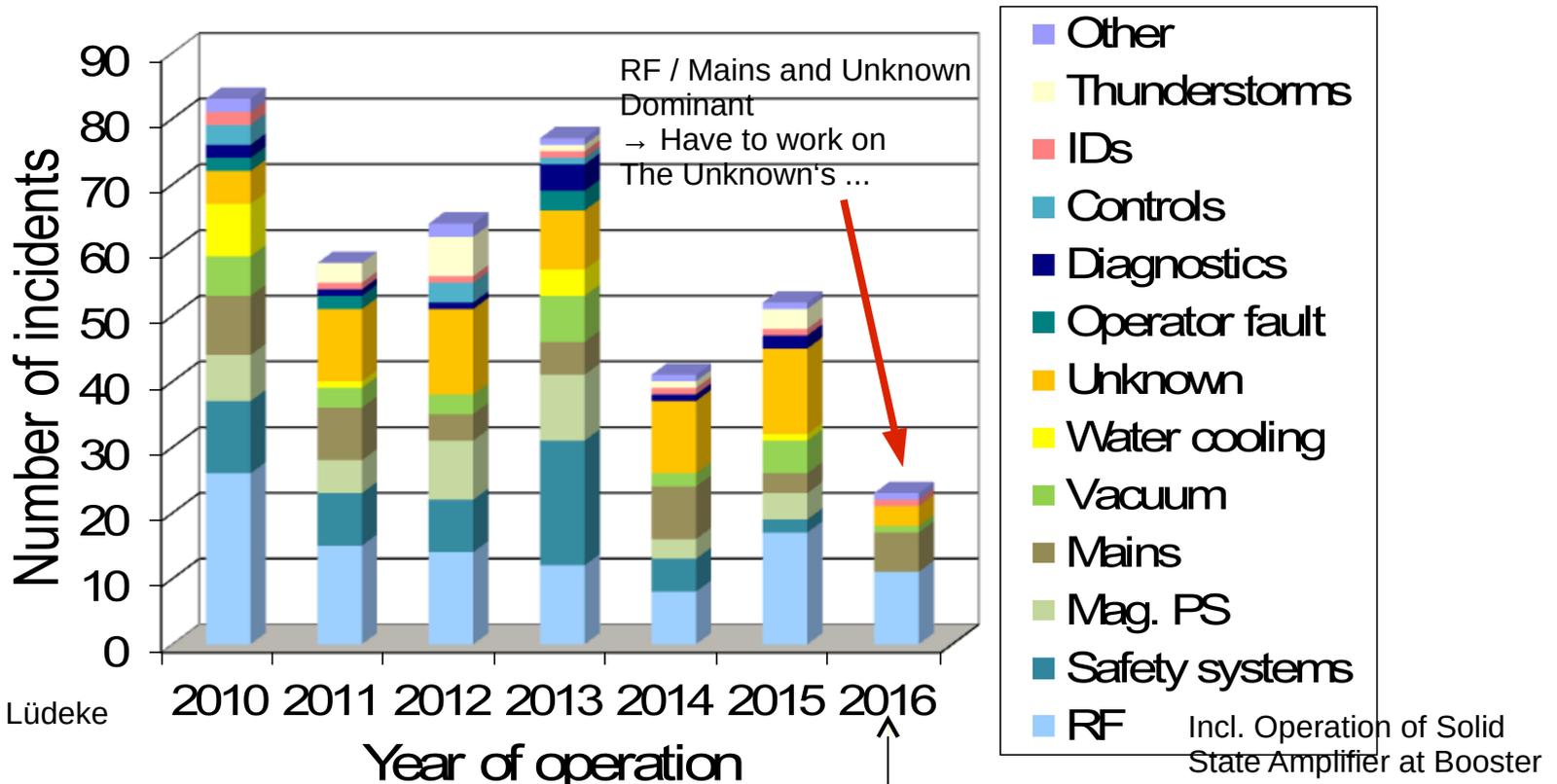


SLS Operation Statistics I

Excellent Year 2016 (so far):

- Beam availability 99.2%
- Mean time between failures of 11 days (wait for next slide) !

Mean time between distortions with 66 hours twice as long as last year
 → Excellent Performance of the Injector Chain and the aging FOFB :-)

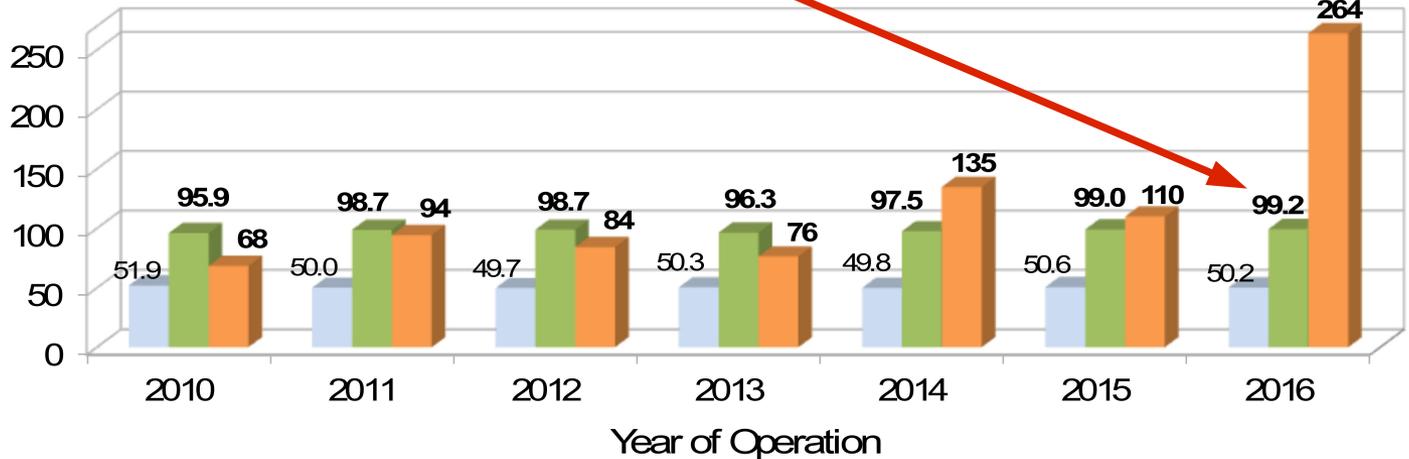


Courtesy: A. Lüdeke

Year 2016 until 15/11/2016:

- Mean Time Between Failures 264 Hours (11 Days) !
- Beam Availability 99.2% !

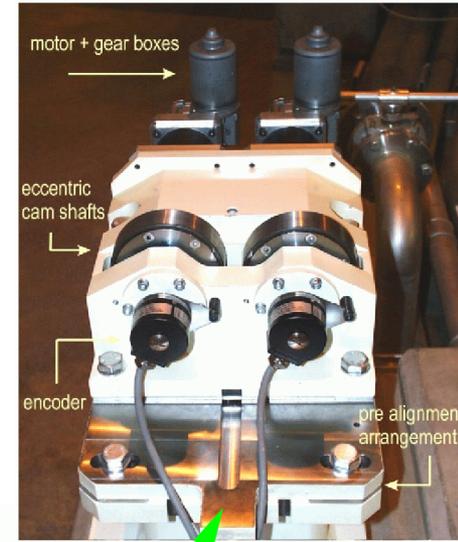
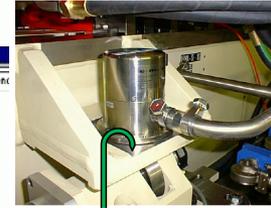
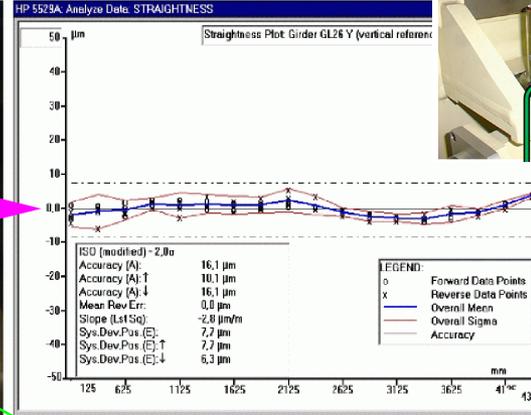
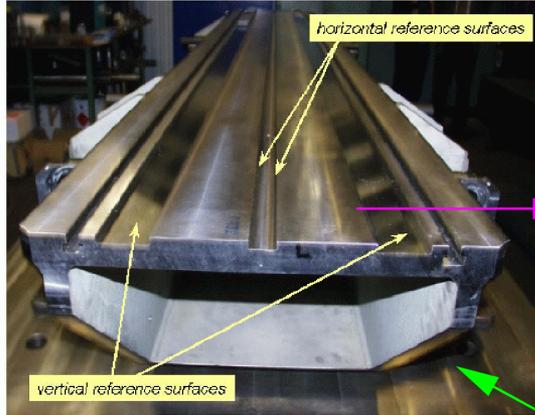
■ User operation [100h]
 ■ Availability [%]
 ■ MTBF [h]



Courtesy: A. Lüdeke

SLS Girder System with HLS Monitoring

Magnet mounted rigidly onto girders ("MAX-2 concept")

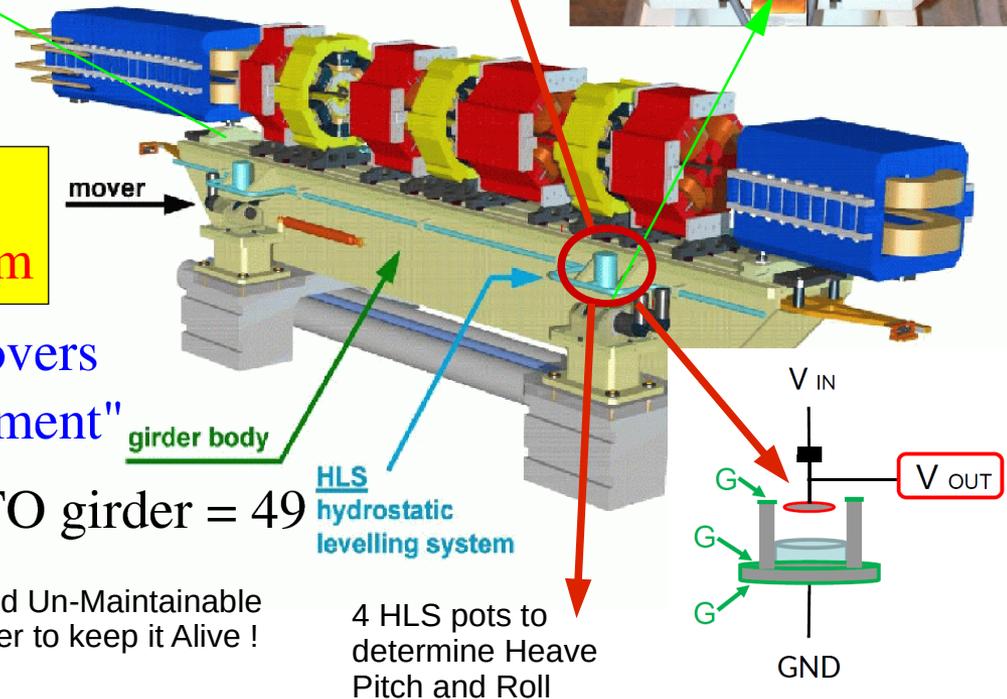


Girders movable in 5 degrees of freedom
Position monitoring systems on girders

Girder Rail Precision: 15 µm
Magnet Axis Calibration: 30 µm

Remotely Controlled Girder Movers
→ "Beam-Based Girder Alignment"

12 sectors x 4 girders + 1 FEMTO girder = 49

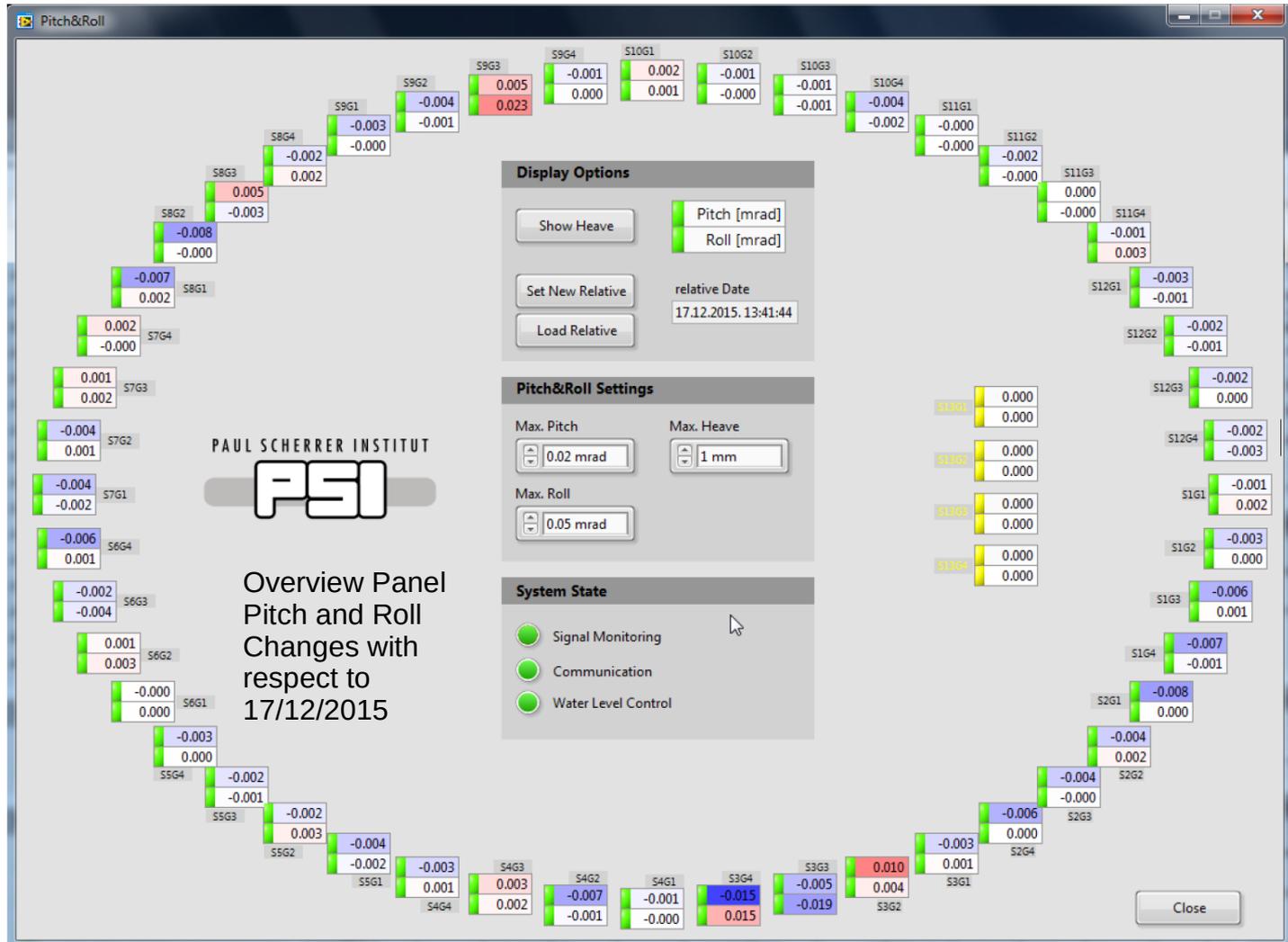


The System is Aging: Hardware Defects, Un-Portable and Un-Maintainable
Software → The System needs to be Refurbished in order to keep it Alive !

4 HLS pots to determine Heave Pitch and Roll

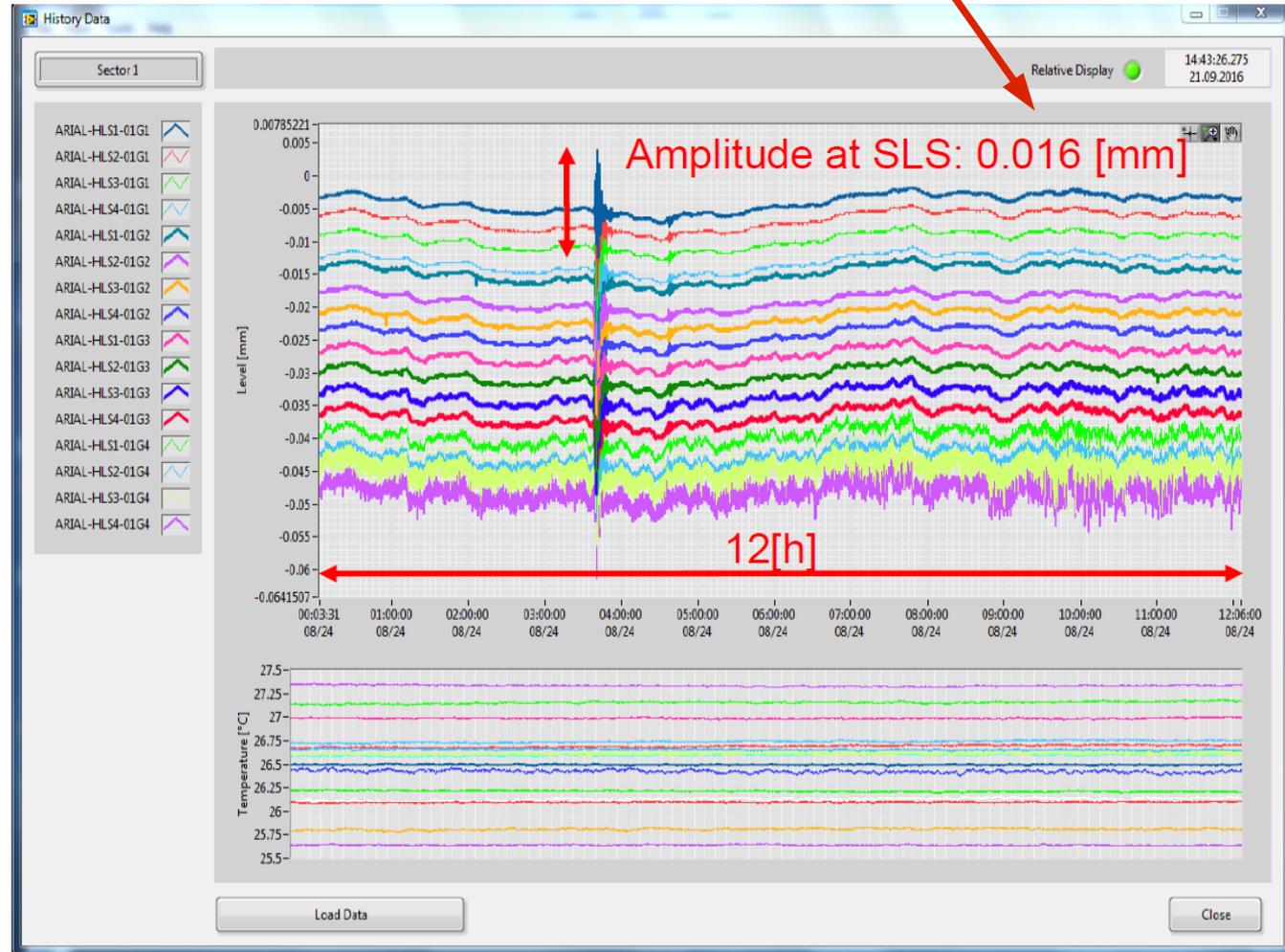
SLS Hydrostatic Leveling System Overview I

- New Software for Hydrostatic Leveling System (HLS) supporting High Resolution Readout Hardware (24-bit)
- Pitch/Roll and Heave data are now directly available in EPICS (LabVIEW EPICS Server)



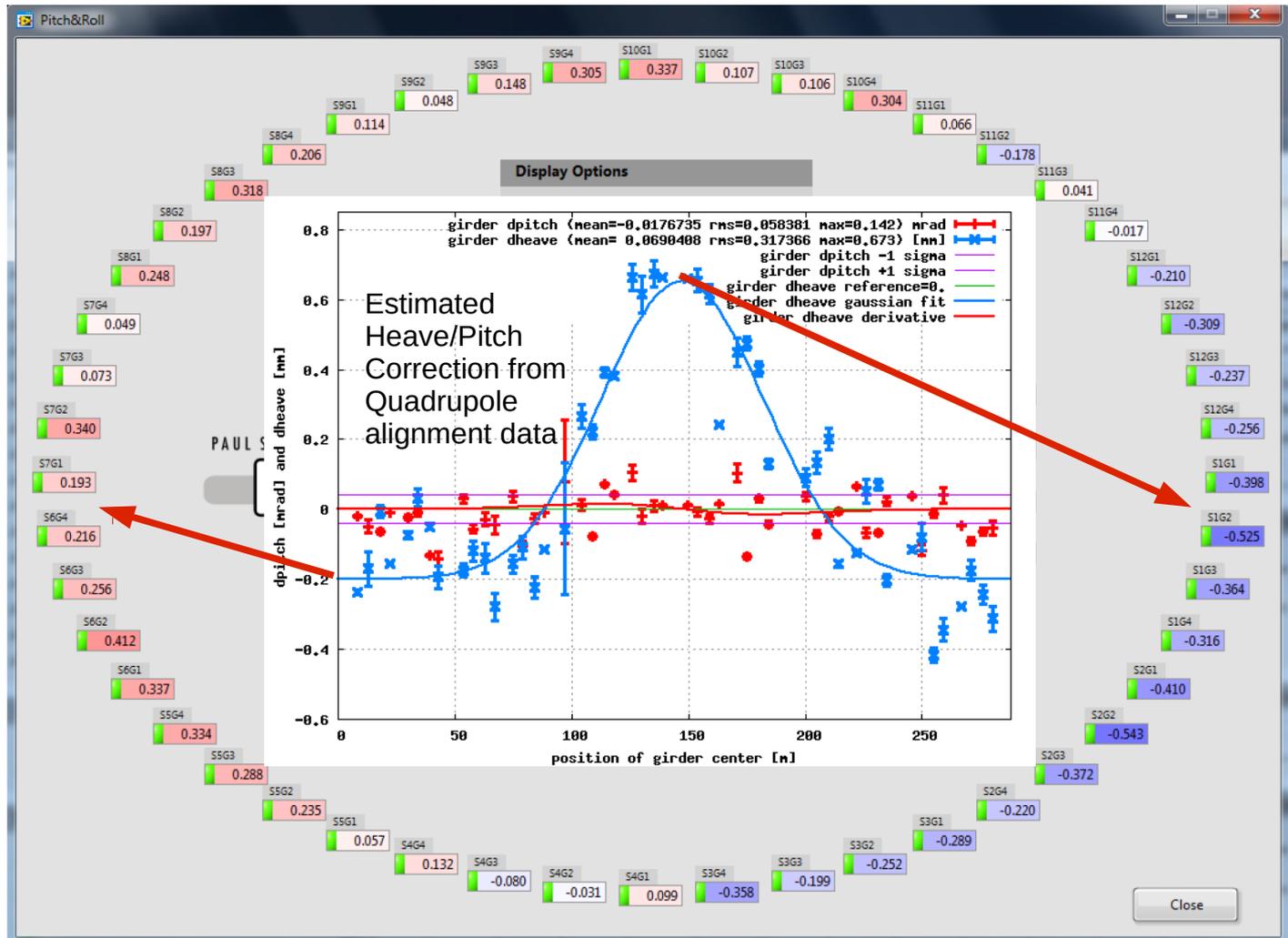
- All the data are permanently available in EPICS
- History data
- Earthquake in Italy, 24.8.16
- Average of selectable interval, e.g. 1h
- Output format in ASCII or Excel

The high precision of the HLS makes it a perfect seismometer



SLS Hydrostatic Leveling System Overview III

- Since the beginning of SLS Operation in 2001 the HLS is delivering Reliable Vertical Girder Alignment Data !
- Here is a Comparison of the Heave changes according to the HLS compared to Vertical Survey Data for the Quadrupoles:



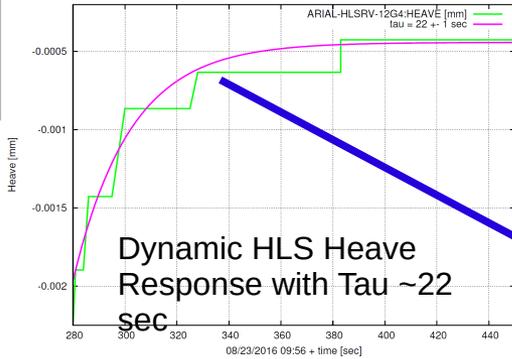
Overview Panel:
Heave Changes
with respect to initial
HLS reference
Taken in 2001

The SLS features
Heave Variations
Of ~800 um !

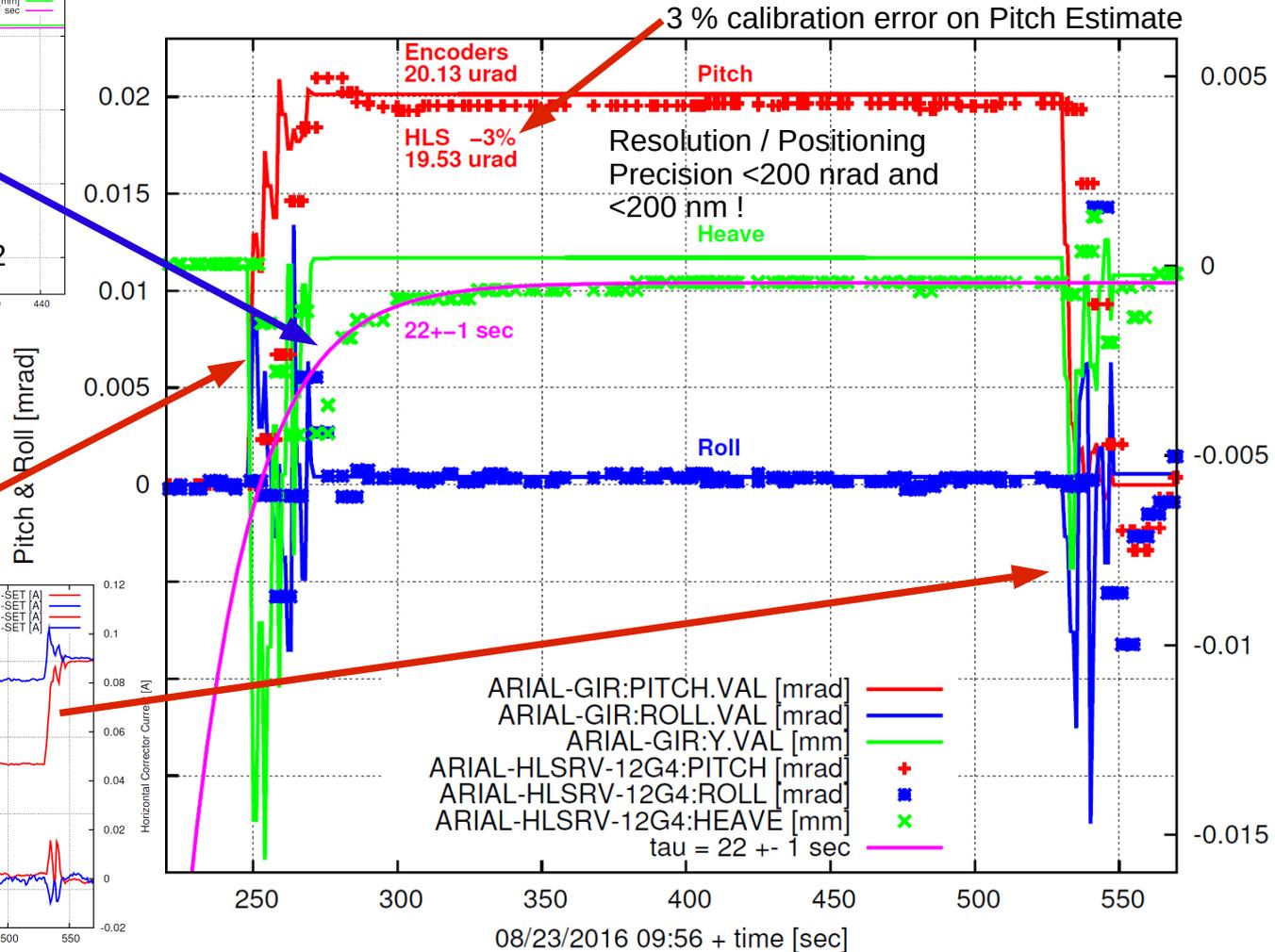
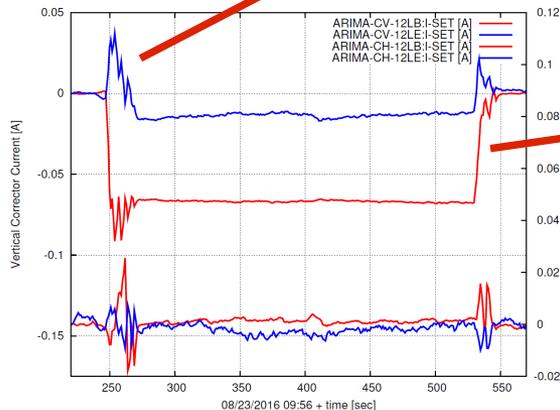
The HLS data are
Fully Consistent
With Heave Changes
Calculated from
Quadrupole Survey
Data.

Test of New Encoder Hard- and HLS Software

- New 19-bit Encoder Hardware and HLS Software on Girder 12G4 by with a deliberate Pitch change of +20 urad
- Conditions: 400 mA Top-up, FOFB running to keep the reference orbit
- Surprisingly short Response Time of the HLS system (Tau ~22 sec!), Excellent Agreement of Encoders and HLS !

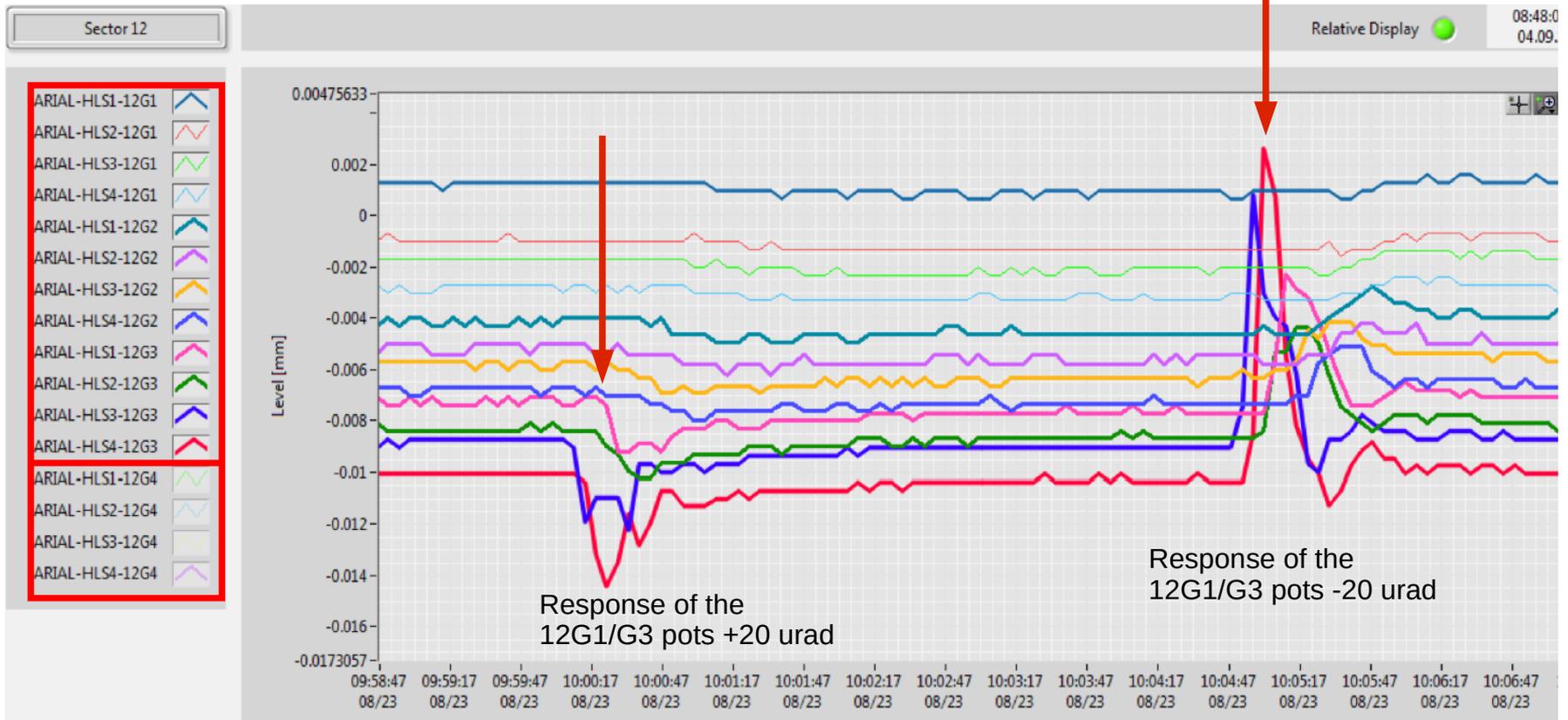


Vertical Corrector Response
In the FOFB loop during
girder
Adjustment by +20 urad and
Back by -20 urad:



HLS Response at Adjacent Girders 12G1/G3

- The HLS system is a system of communicating pipes. Thus the water flows to neighbouring girders 12G1/G3.
- After settlement of girder 12G4 position the water flows back in order to get back to equilibrium (Tau ~22 sec).



- * We had an Excellent Year 2016 so far with a MTBF of 11 Days :-)
- * We started to refurbish some of our „Alignment Hard- and Software“ in order to keep the Systems alive, improve further on the present vertical SLS Alignment and make the Systems fit for a possible reuse at SLS-2.

W	January	W	February	W	March	W	April	W	May	W	June
53	Fri 1	05	Mon 1	09	Tue 1	13	Fri 1	17	Sun 1	22	Wed 1
	Sat 2		Tue 2		Wed 2		Mon 2		Thu 2		18
	Sun 3		Wed 3		Thu 3		Sun 3		Tue 3		Fri 3
01	Mon 4		Thu 4		Fri 4		Mon 4		Wed 4		Sat 4
	Tue 5		Fri 5		Sat 5		Tue 5		Thu 5		Sun 5
	Wed 6		Sat 6		Sun 6		Wed 6		Fri 6		23
	Thu 7		Sun 7		Mon 7		Thu 7		Sat 7		Tue 7
	Fri 8		Mon 8		Tue 8		Fri 8		Sun 8		Wed 8
	Sat 9	06	Tue 9		Wed 9		Sat 9		Mon 9		Thu 9
	Sun 10		Wed 10		Thu 10		Sun 10		Tue 10		Fri 10
02	Mon 11		Thu 11		Fri 11		Mon 11		Wed 11		Sat 11
	Tue 12		Fri 12		Sat 12		Tue 12		Thu 12		Sun 12
	Wed 13		Sat 13		Sun 13		Wed 13		Fri 13		24
	Thu 14		Sun 14		Mon 14		Thu 14		Sat 14		Tue 14
	Fri 15		Mon 15		Tue 15		Fri 15		Sun 15		Wed 15
	Sat 16	07	Tue 16		Wed 16		Sat 16		Mon 16		Thu 16
	Sun 17		Wed 17		Thu 17		Sun 17		Tue 17		Fri 17
03	Mon 18		Thu 18		Fri 18		Mon 18		Wed 18		Sat 18
	Tue 19		Fri 19		Sat 19		Tue 19		Thu 19		Sun 19
	Wed 20		Sun 20		Mon 20		Wed 20		Fri 20		25
	Thu 21		Sun 21		Mon 21		Thu 21		Sat 21		Tue 21
	Fri 22		Mon 22		Tue 22		Fri 22		Sun 22		Wed 22
	Sat 23	08	Tue 23		Wed 23		Sat 23		Mon 23		Thu 23
	Sun 24		Wed 24		Thu 24		Sun 24		Tue 24		Fri 24
04	Mon 25		Thu 25		Fri 25		Mon 25		Wed 25		Sat 25
	Tue 26		Fri 26		Sat 26		Tue 26		Thu 26		Sun 26
	Wed 27		Sat 27		Sun 27		Wed 27		Fri 27		26
	Thu 28		Sun 28		Mon 28		Thu 28		Sat 28		Tue 28
	Fri 29	09	Mon 29		Tue 29		Fri 29		Sun 29		Wed 29
	Sat 30		Wed 30		Thu 30		Sat 30		Mon 30		Thu 30
	Sun 31		Thu 31						Tue 31		

W	July	W	August	W	September	W	October	W	November	W	December	
26	Fri 1		31	Mon 1	35	Thu 1	39	Sat 1	44	Tue 1	48	Thu 1
	Sat 2		Tue 2		Fri 2		Sun 2		Wed 2		Fri 2	
	Sun 3		Wed 3		Sat 3		Mon 3		Thu 3		Sat 3	
27	Mon 4		Thu 4		Sun 4		Tue 4		Fri 4		Sun 4	
	Tue 5		Fri 5		Mon 5		Wed 5		Sat 5		49	Mon 5
	Wed 6		Sat 6		Tue 6		Thu 6		Sun 6		Tue 6	
	Thu 7		Sun 7		Wed 7		Fri 7		Mon 7		Wed 7	
	Fri 8		Mon 8		Thu 8		Sat 8		Tue 8		Thu 8	
	Sat 9		Tue 9		Fri 9		Sun 9		Wed 9		Fri 9	
	Sun 10		Wed 10		Sat 10		Mon 10		Thu 10		Sat 10	
28	Mon 11		Thu 11		Sun 11		Tue 11		Fri 11		Sun 11	
	Tue 12		Fri 12		Mon 12		Wed 12		Sat 12		50	Mon 12
	Wed 13		Sat 13		Tue 13		Thu 13		Sun 13		Tue 13	
	Thu 14		Sun 14		Wed 14		Fri 14		Mon 14		Wed 14	
	Fri 15		Mon 15		Thu 15		Sat 15		Tue 15		Thu 15	
	Sat 16		Tue 16		Fri 16		Sun 16		Wed 16		Fri 16	
	Sun 17		Wed 17		Sat 17		Mon 17		Thu 17		Sat 17	
29	Mon 18		Thu 18		Sun 18		Tue 18		Fri 18		Sun 18	
	Tue 19		Fri 19		Mon 19		Wed 19		Sat 19		51	Mon 19
	Wed 20		Sat 20		Tue 20		Thu 20		Sun 20		Tue 20	
	Thu 21		Sun 21		Wed 21		Fri 21		Mon 21		Wed 21	
	Fri 22		Mon 22		Thu 22		Sat 22		Tue 22		Thu 22	
	Sat 23		Tue 23		Fri 23		Sun 23		Wed 23		Fri 23	
	Sun 24		Wed 24		Sat 24		Mon 24		Thu 24		Sat 24	
30	Mon 25		Thu 25		Sun 25		Tue 25		Fri 25		Sun 25	
	Tue 26		Fri 26		Mon 26		Wed 26		Sat 26		52	Mon 26
	Wed 27		Sat 27		Tue 27		Thu 27		Sun 27		Tue 27	
	Thu 28		Sun 28		Wed 28		Fri 28		Mon 28		Wed 28	
	Fri 29		Mon 29		Thu 29		Sat 29		Tue 29		Thu 29	
	Sat 30		Tue 30		Fri 30		Sun 30		Wed 30		Fri 30	
	Sun 31		Wed 31				44	Mon 31			Sat 31	