Proposal to test the use of HLS at ATF2 beamline

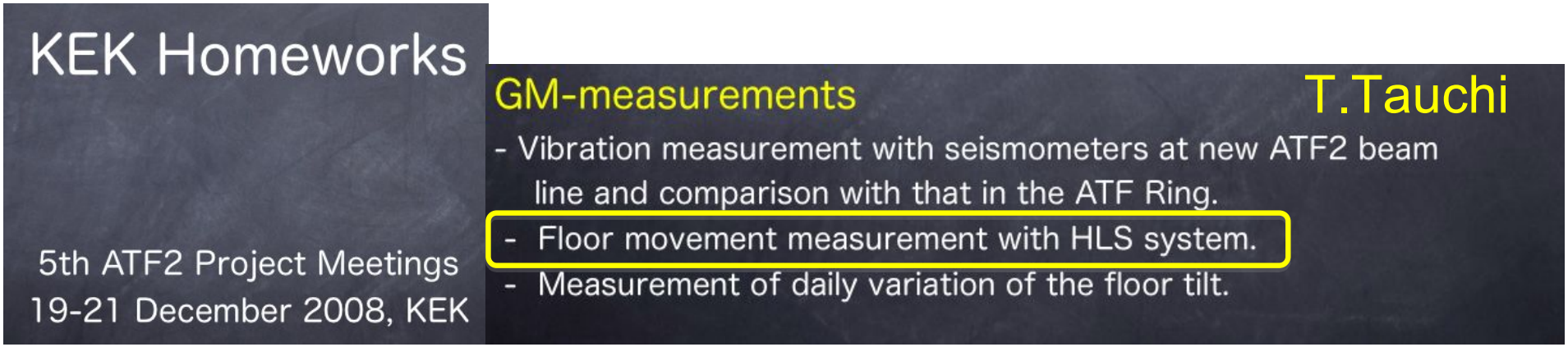
Mika Masuzawa

1. Remind ourselves of our homework from the last ATF2 project meeting.
2. HLS advantages and disadvantages.
3. Answers to some questions raised.
4. Possible approaches for our homework.

advantages of HLS in accelerators

- HLS is a permanent measuring system which requires only little maintenance.
- High accuracy (1µm or even better) is possible
- Could be operated during accelerator runs
- Electronics can be easily separated from sensor, that makes shielding easy
- Could be used to monitor height movement of all (or only critical) components.
- automatic feedback system is possible
- accuracy is NOT influenced by geometric distance (if certain requirements are met – closed system, free surface, etc.)

Homework



We discussed KEK home-work items which were raised at the 5th ATF2 project meeting., where C, Q and A are comments, questions and answers, respectively.

•Vibration measurement with seismometers at new ATF2 beam line and comparison with that in the ATF Ring.
•Floor movement measurement with HLS system.
•Measurement of daily variation of the floor tilt.

Since Sugahara has only 3 HLS systems, he will ask S.Takeda for more HLS systems.

At the project meeting, it was pointed out that FNAL has about 100 HLS systems.
⇦Is this true?
⇒(Answer) Yes, it is. See the next pages.

disadvantages of HLS in accelerators

can't think of any ...

but wait ...

ok, if i try really hard ...

- allocates permanent space in tunnel
- costs money (not much, though)
- HLS detects only vertical movements – which is the main direction of movement for accelerator tunnels
- slow

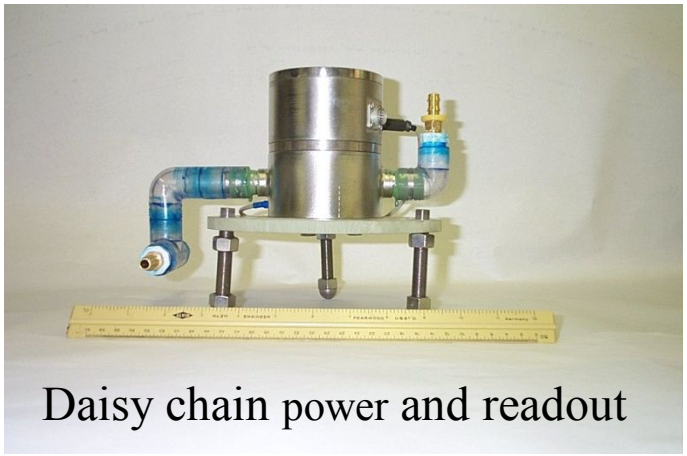
Systems at Fermilab

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 on loan from Argonne Lab

Yes, there are many sensors at Fermilab.

Three types of Budker Institute sensors

Capacitive sensors

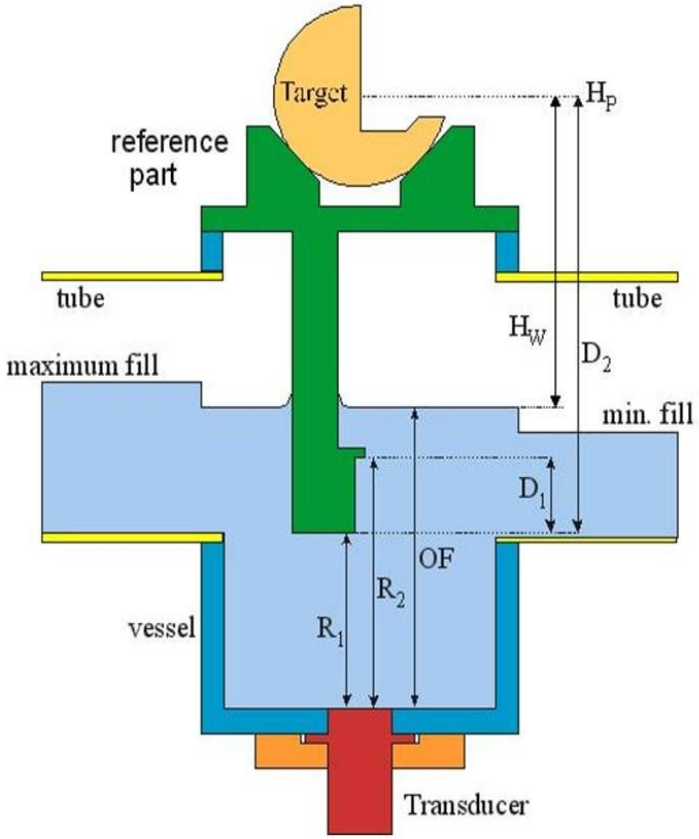


Daisy chain power and readout

Power and signal over Ether net

Ultra Sonic sensors power and signal over Ethernet

Cross section of Ultra Sonic sensor



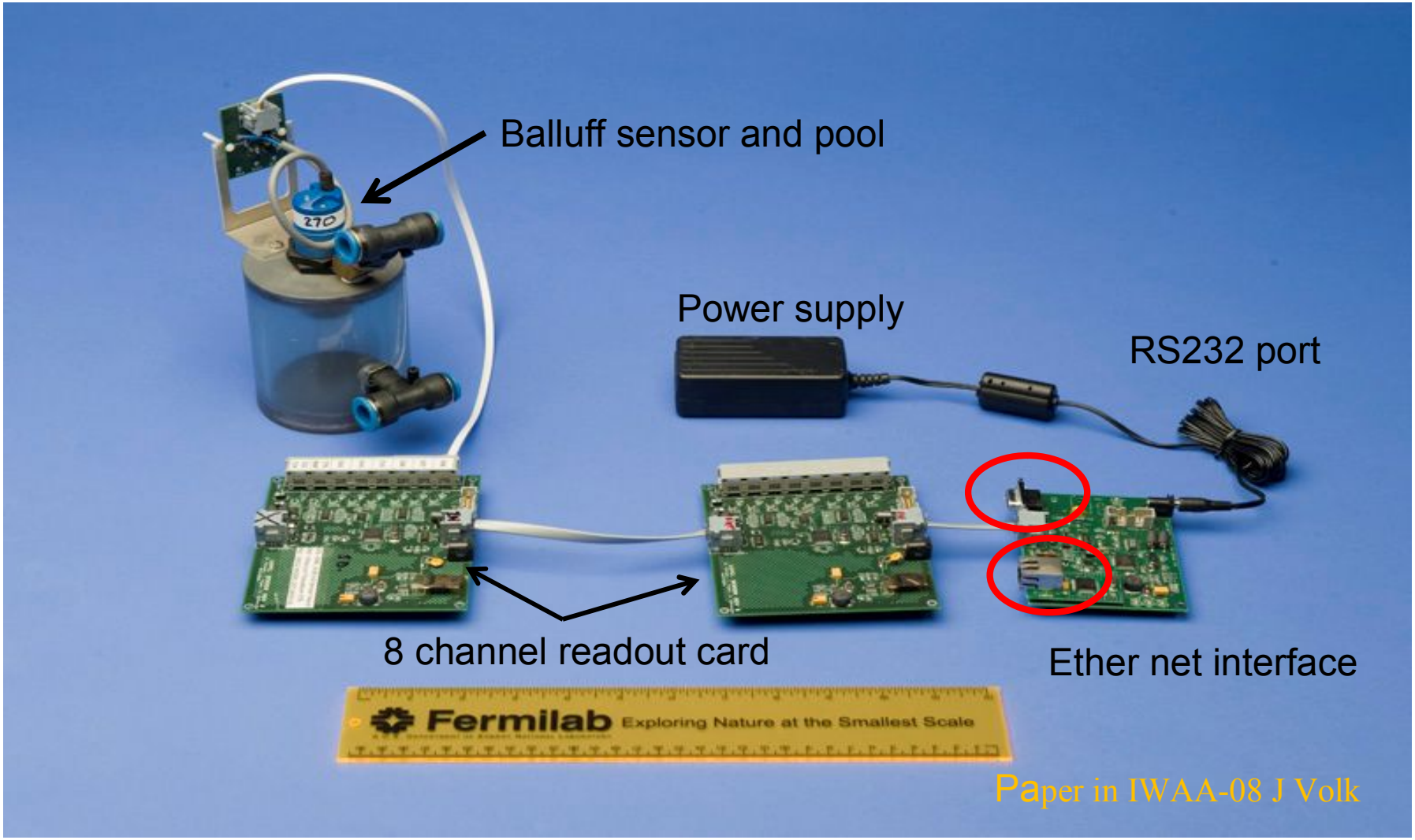
Green is stainless steel post with precision machined steps and nest for survey target

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



Inexpensive

And SLAC has many sensors, too.

SLAC
NATIONAL ACCELERATOR LABORATORY

HLS and WPS at SLAC

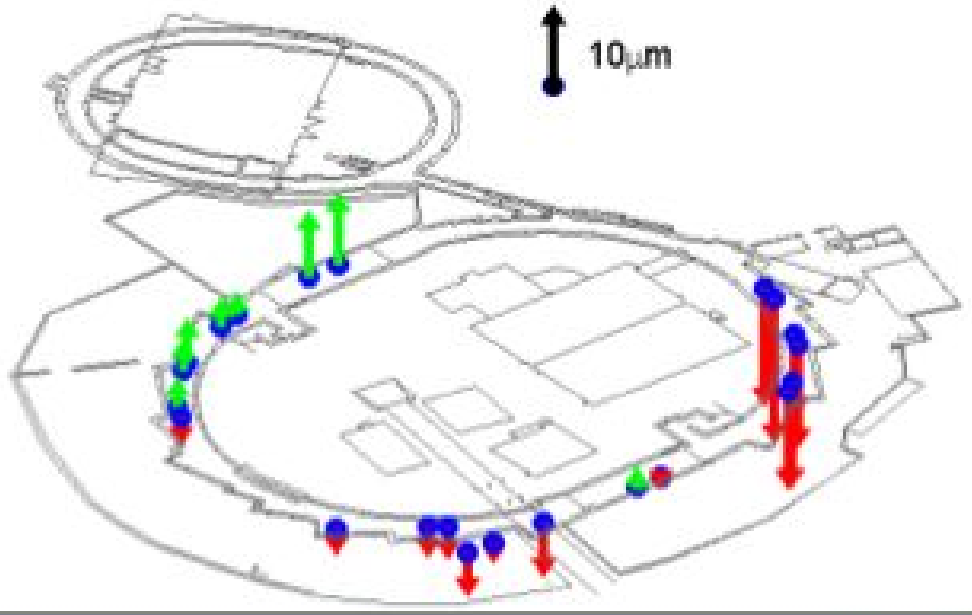
Georg Gassner, Franz Peters, Robert Ruland
SLAC, Metrology

- **WPS and HLS at the BABAR detector (decommissioned system)**
- **HLS in SPEAR3 (22 sensors)**
- **WPS and HLS in LCLS undulator hall (136 HLS and 99 WPS)**

SLAC might give us some of their sensors (private communication with R. Ruland)

HLS in SPEAR3 (1)

- System contains 22 HLS sensors (in various configurations since 2005)
  - Third generation BINP sensors,
    - TCP/IP
    - Power over Ethernet
    - Sensor calibration at SLAC
  - 300 m circumference
  - 2 inch PVC pipe throughout



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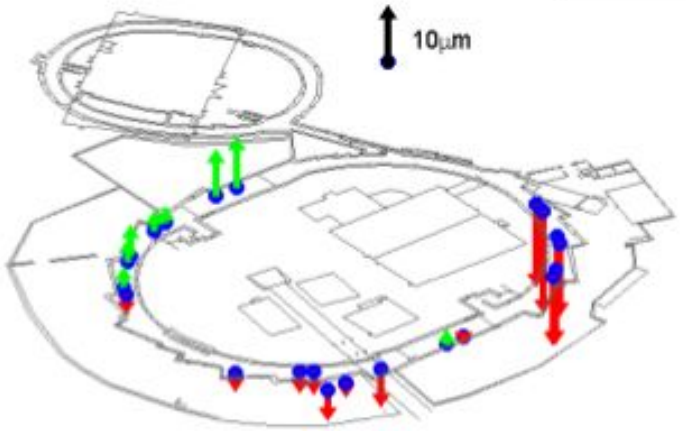
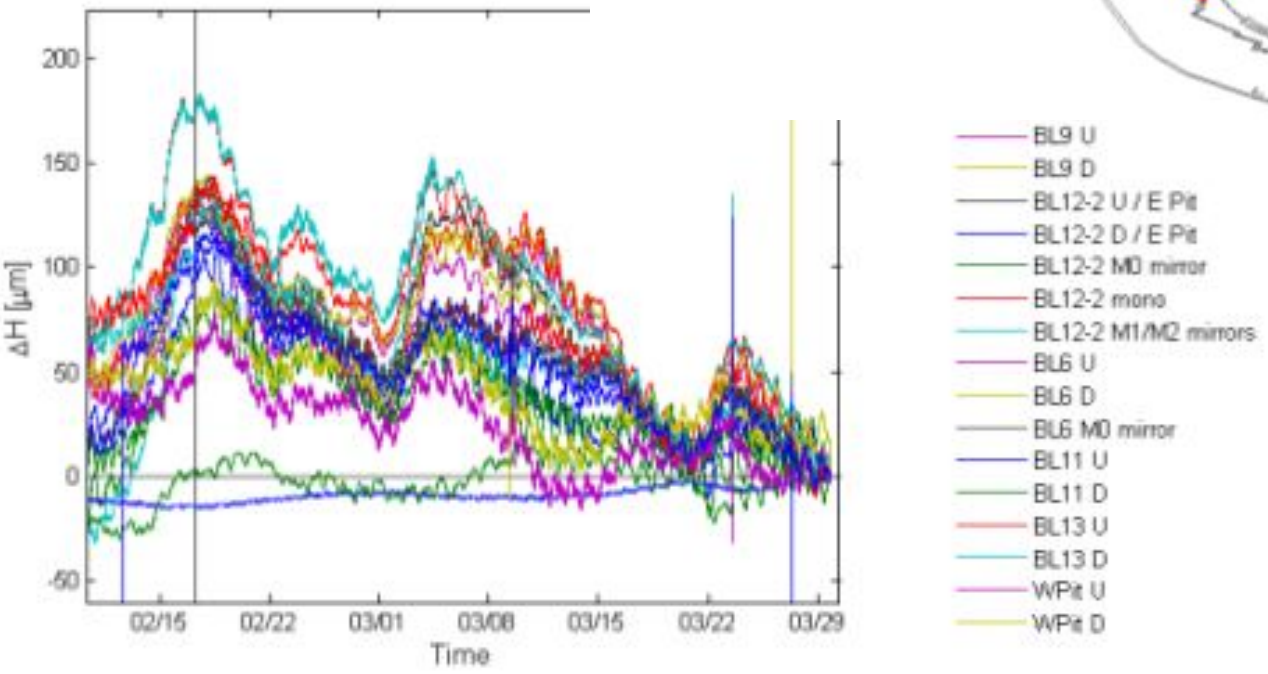
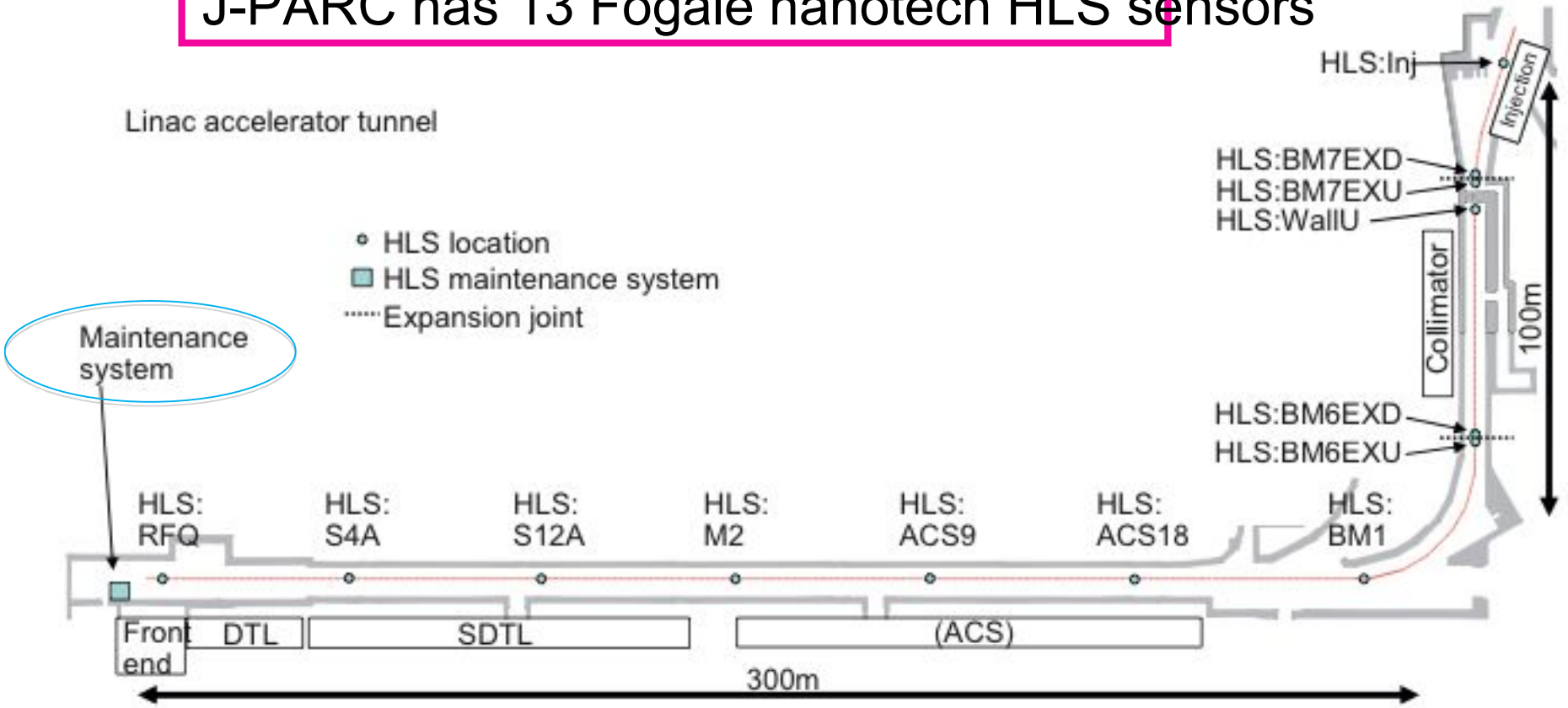


- Latest results



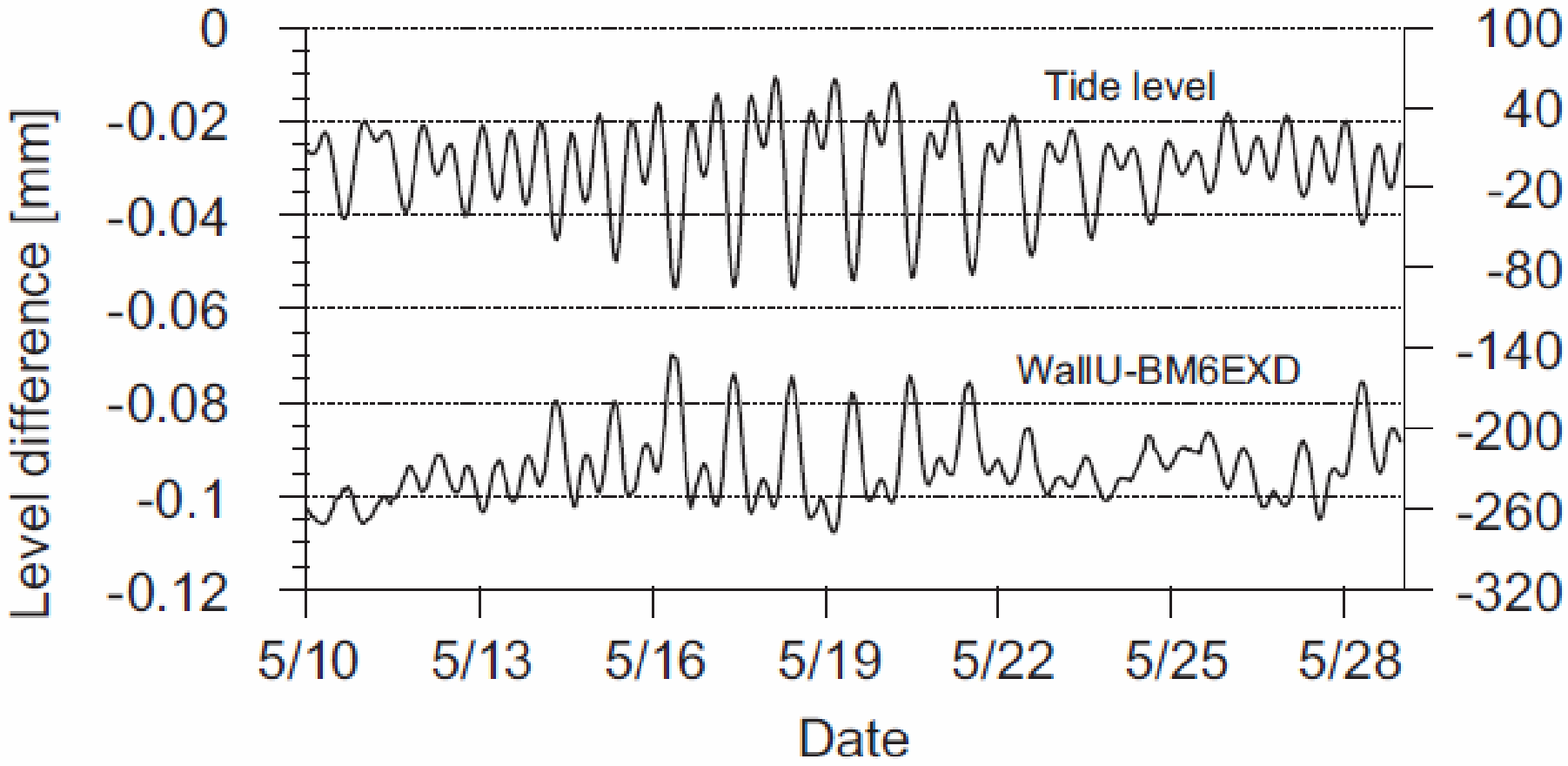
J-PARC has 13 Fogale nanotech HLS sensors



330 m straight section running from north to south
a west-to-east 65 m collimator section.
13 sensors in the linac accelerator tunnel with intervals of about 50 m.

Temperature variation ~1 degree/day, ~ 2 degree over months
Temperature spacial variation ~ 2 degree.

Slow ground motion observed at J-PARC linac



Relative water-level difference of two neighboring sensors and tidal level.
Data aquisition 1.5 seconds.
This monitoring system based on the hydrostatic leveling system is useful for monitoring the slow ground motion in J-PARC linac.

Information (not official)

Make	Installed at	Resolutio	Cost /comments
Fogale nanotech	ESRF LHC J-PARC LINAC and many others	◎	Expensive($5500/sensor)
Budker	SLAC	◎	? They may give us several sensors
Balluff	FNAL Tevatron	○	$200/sensor (comm. With J. Volk)
Takeda	Currently not in use		A few of them, each different
Sugahara	Currently not in use		A few

項目	型式	品名	数量	単価	金額
	J-PARCリニアックアライメント用センサー				
1	V.HLS 12-14/4	HLSベッセル	10	40,000	400,000
2	PT100	T/Cプローブ	10	20,000	200,000
3	HLS.REM 5/0-50-J	HLSセンサー	10	594,000	5,940,000
4	WPS-2D-B-10x10	WPS2Dセンサー	2	763,000	1,526,000

Possible approaches for homework

- ☆ Obtain available sensors from SLAC (Budker capacitive type)
- ☆ Purchase a few sensors of various types for R&D at ATF2
  - Fogale nanotech (capacitive)
  - Budker (capacitive or ultra sonic)
  - Tevatron type (capacitive)
  - Sugahara
  - Takeda
- ☆ Investigation of installation location (since it will be semi-permanent)
- ☆ Who will (be nice enough to) help me?
  - $$
  - man power
- ☆ Or do not do anything (forget about HLS for ATF2).

ATF2 Beam Line