

Hydrostatic Leveling System (HLS) at ATF2

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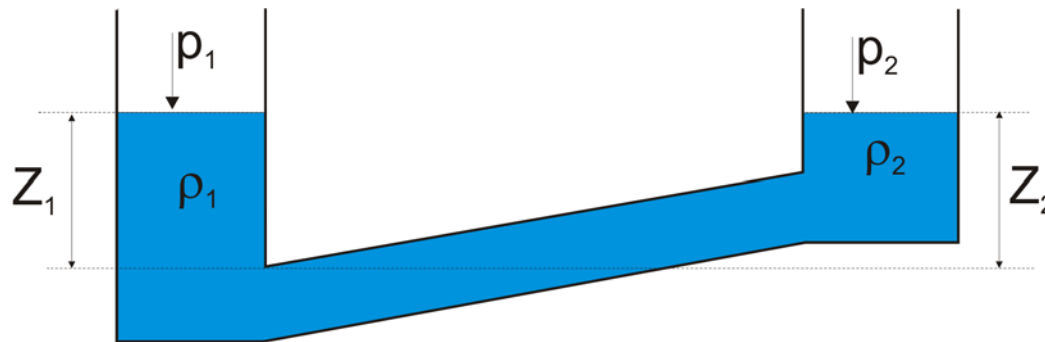
[SLAC] G. Gassner

What is HLS?

HLS Principle (1)

Hydrostatic Leveling Systems are based on the principle of communicating vessels or more precisely on the equilibrium of the pressure of the fluid in the communicating vessels. This is mathematically described by the Bernoulli equation.

$$p + g \rho Z = \text{const.}$$



$$\Delta p = 0.10 \text{ hPa} \quad \Rightarrow \quad \Delta Z = 1.02 \text{ mm}$$

$$\Delta \text{Temp} = 1^\circ \text{ C}; \quad Z = 100 \text{ mm} \quad \Rightarrow \quad \Delta Z = 67 \text{ } \mu\text{m}$$

HLS Principle (2) - Capacitive Sensor

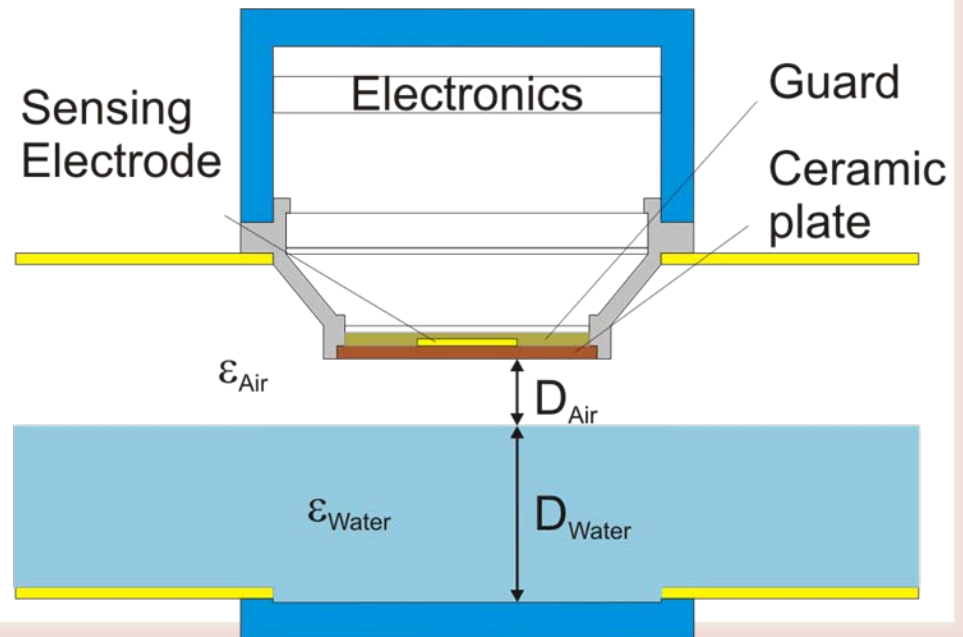
- Principle
Measures the Capacity C of the System

$$\frac{1}{C} = \frac{1}{C_{Air}} + \frac{1}{C_{Water}}$$

$$C = \frac{A \cdot \epsilon}{D} + \text{fringe capacitance}$$

$$\therefore \frac{1}{C} = \frac{1}{A} \left(\frac{D_{Air}}{\epsilon_{Air}} + \frac{D_{Water}}{\epsilon_{Water}} \right) + K_{fringe}$$

$$\text{where } D_{Air} + D_{Water} = D_0$$



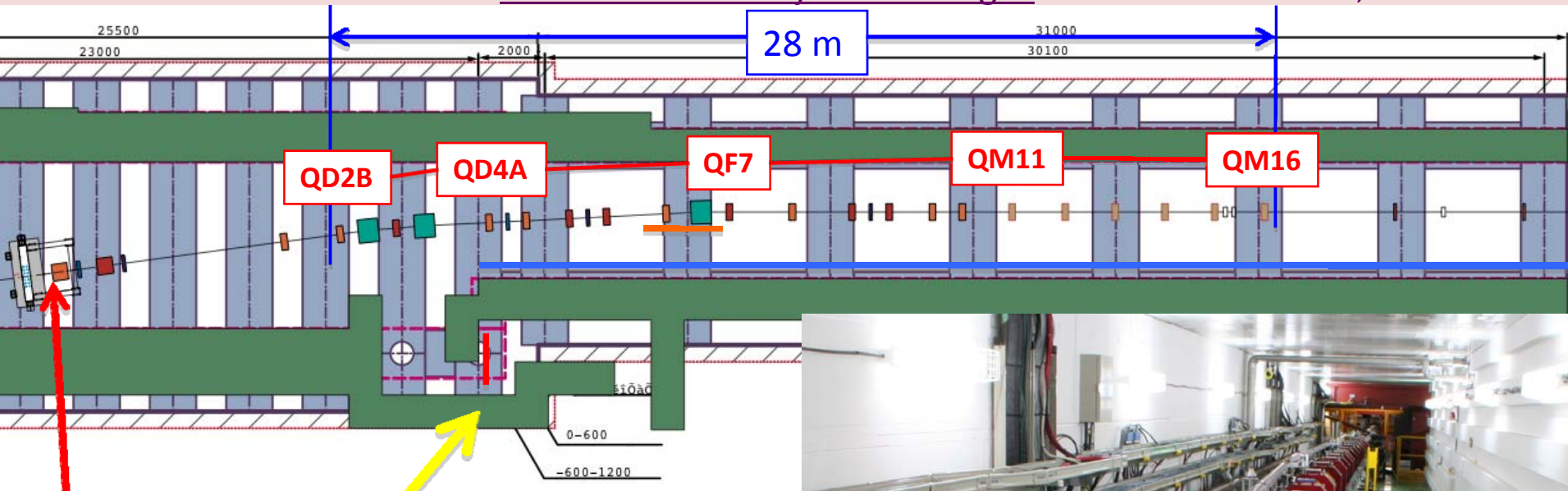
Masuzawa attended the CLIC pre-alignment workshop held at CERN in April 2009

She asked for support to install HLS at ATF2 beam line in this meeting

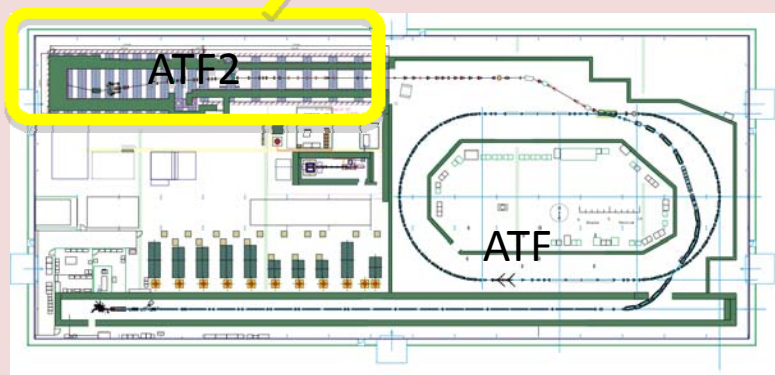
SLAC agreed to supply KEK with 5 HLS sensors

G. Gassner came to KEK on August 3rd with 5 HLS sensors, and stayed for a week

He helped installing HLS at ATF2 beam line, and constructed the data acquisition system for KEK system



FD system

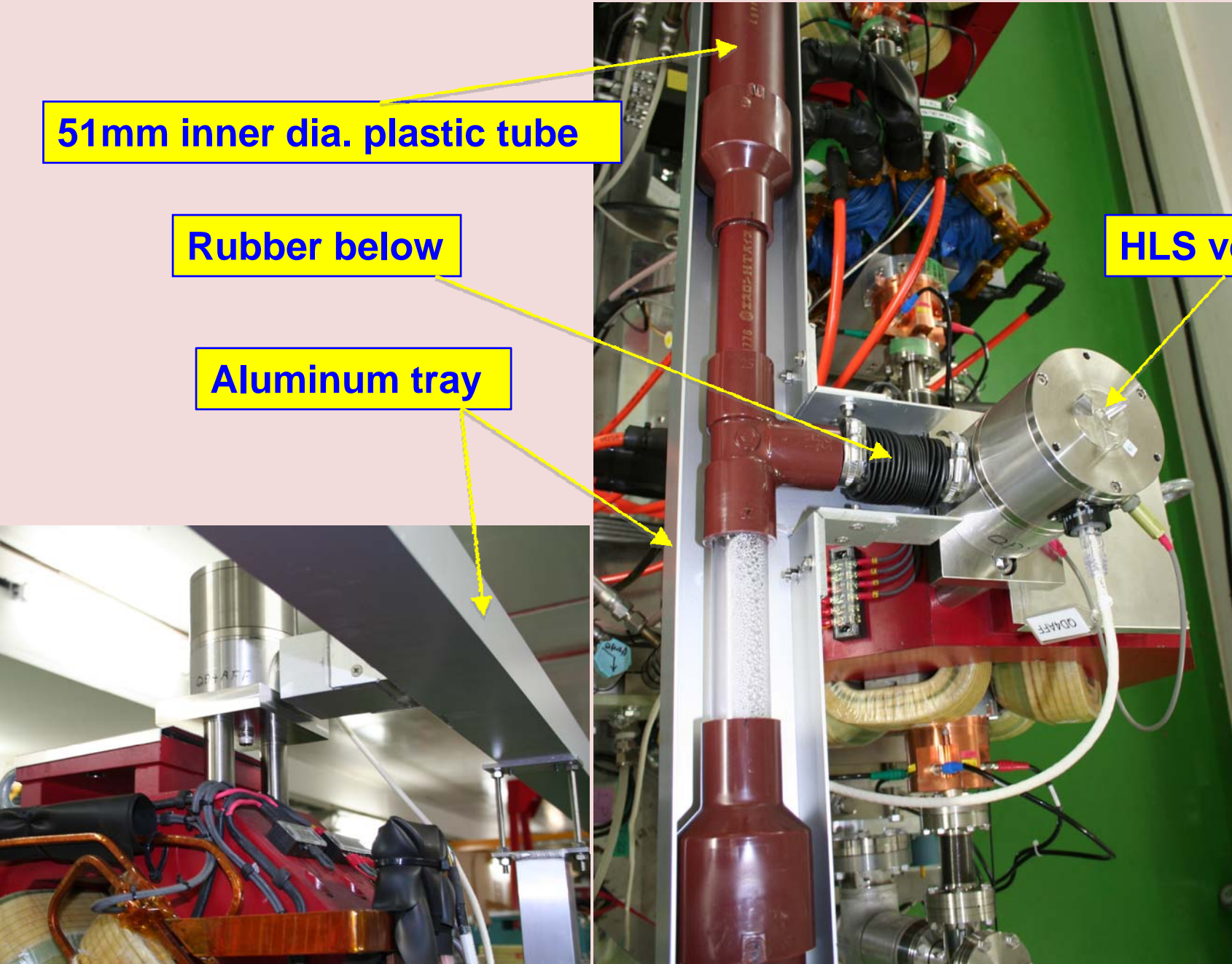


51mm inner dia. plastic tube

Rubber below

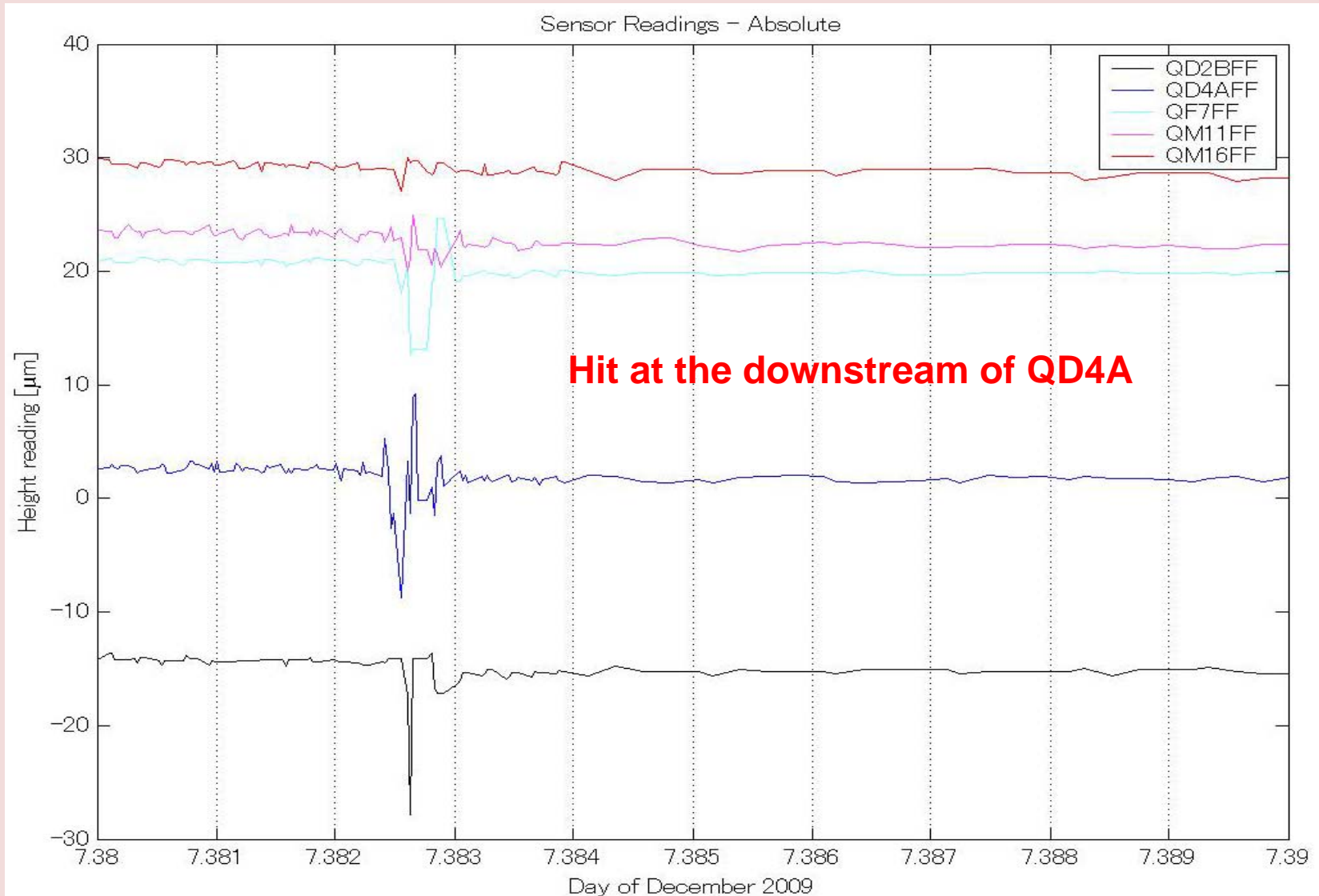
Aluminum tray

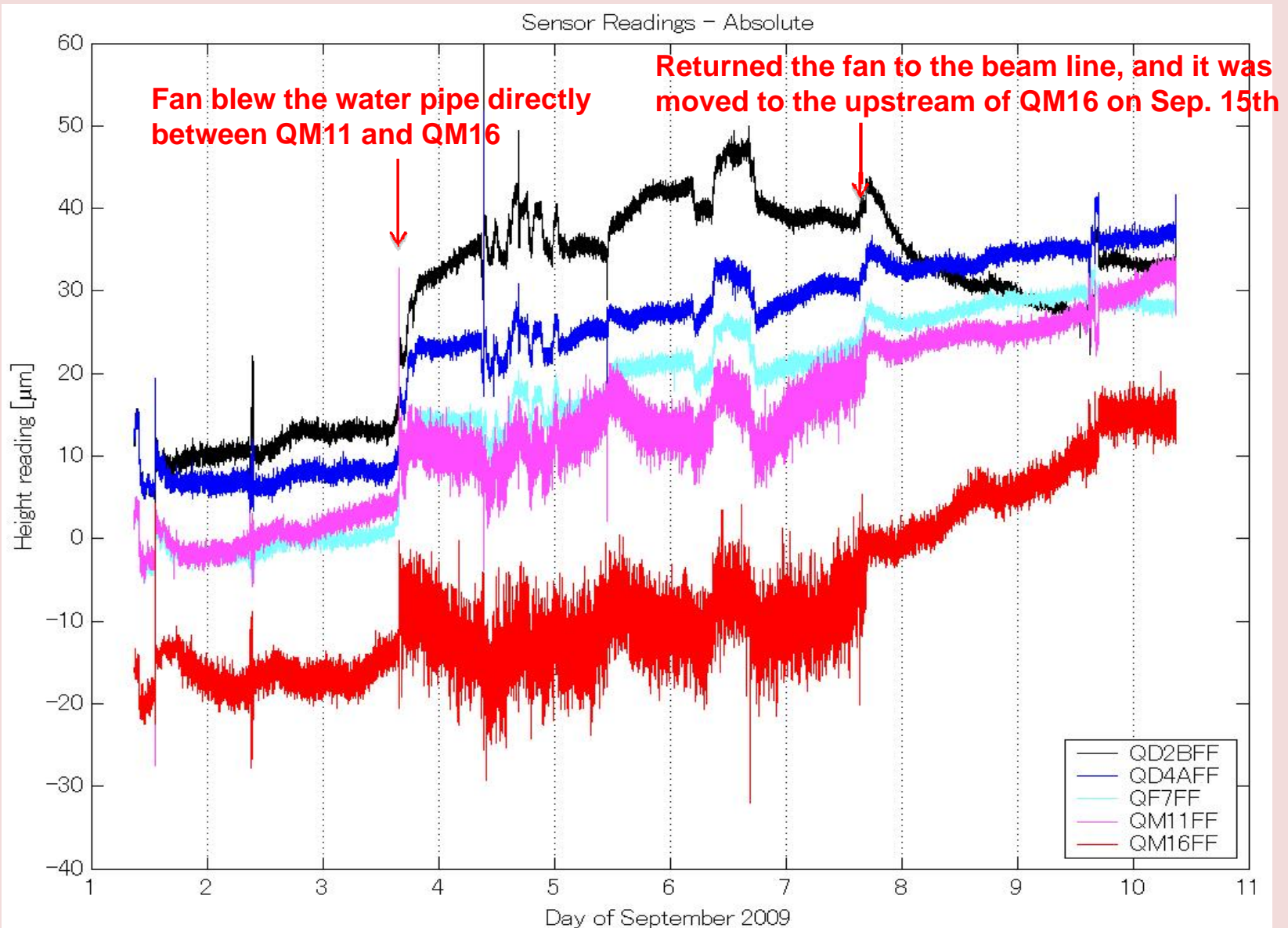
HLS vessel



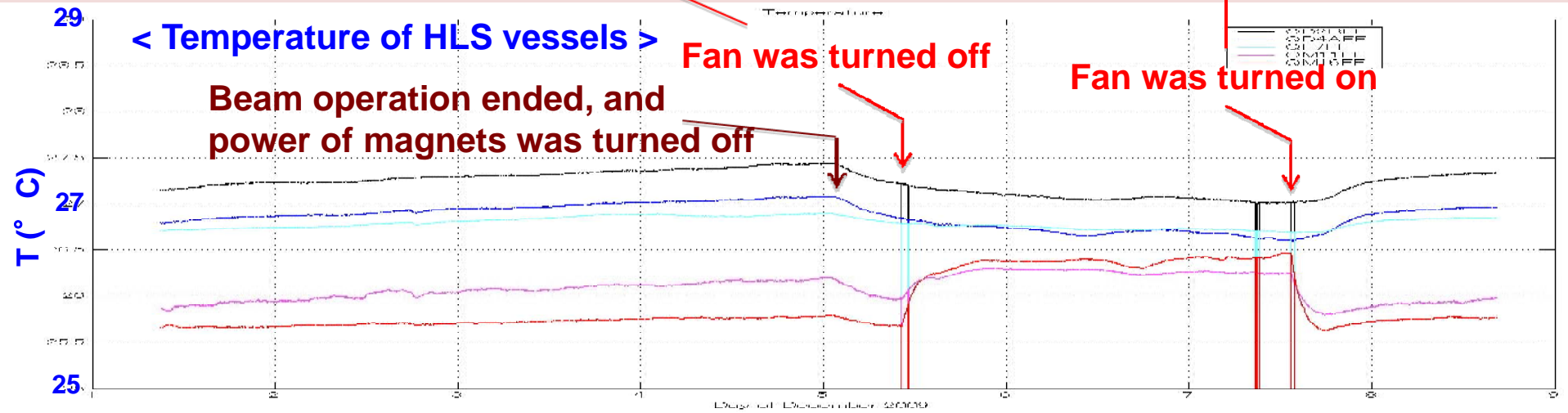
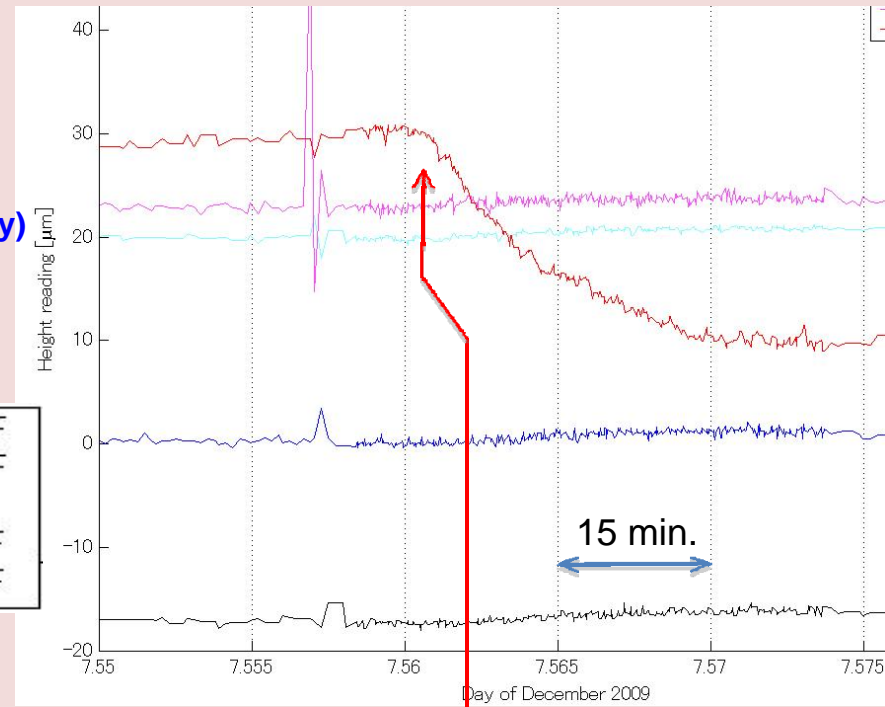
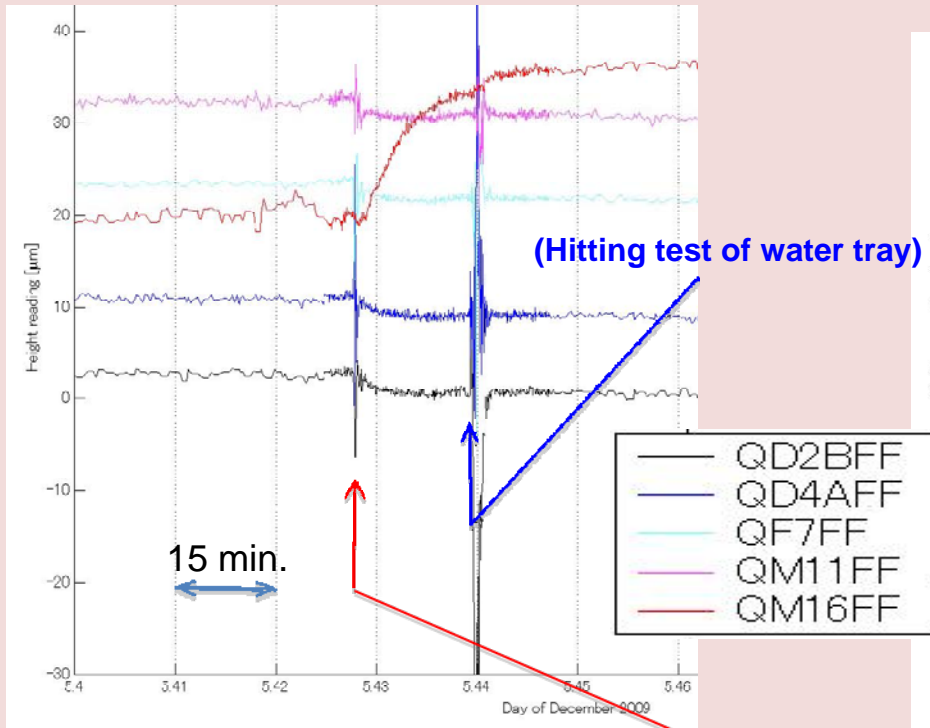
We met various problems

Problem 1: People sometimes hit the tray for water pipes



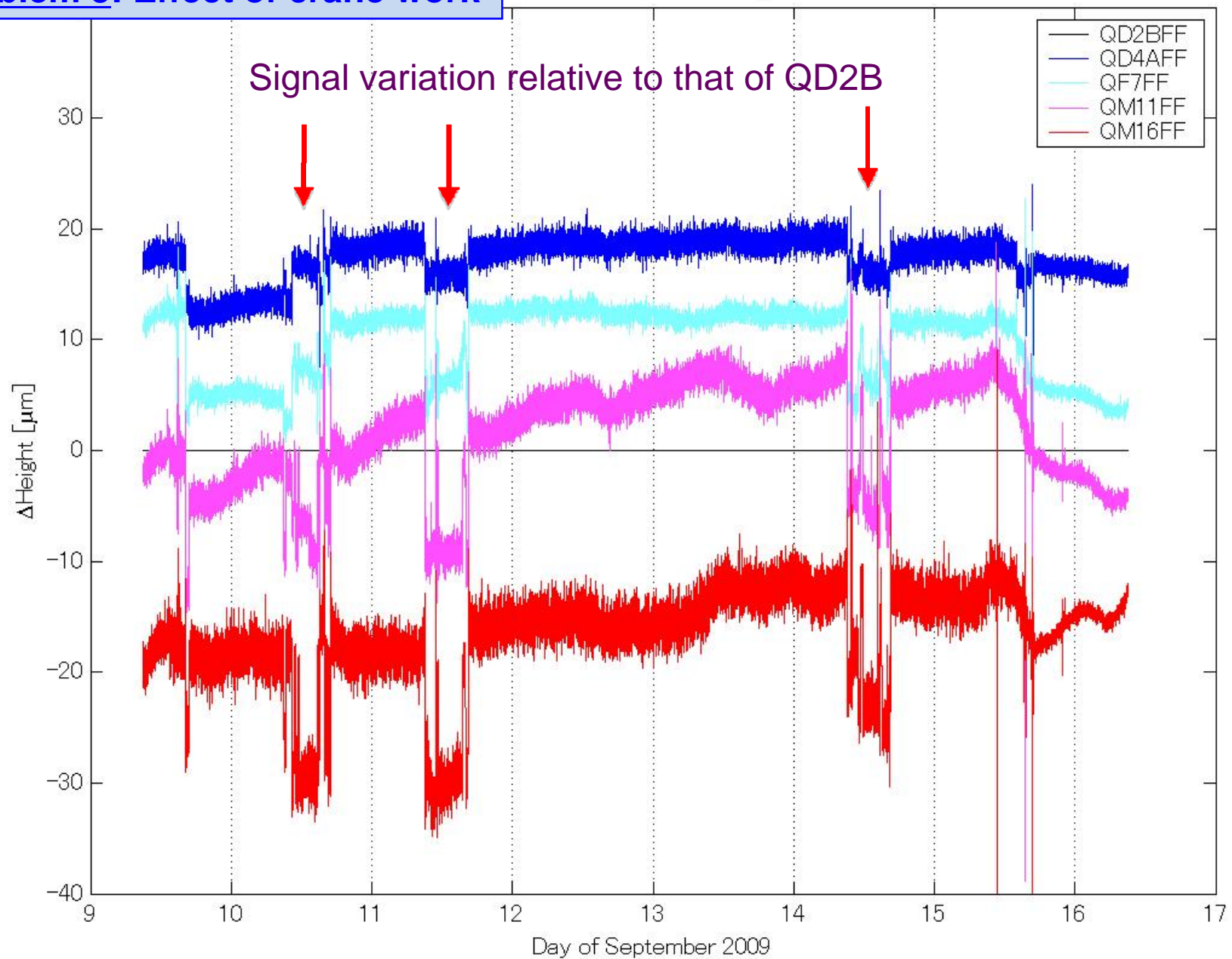
Problem 2: Fan problems

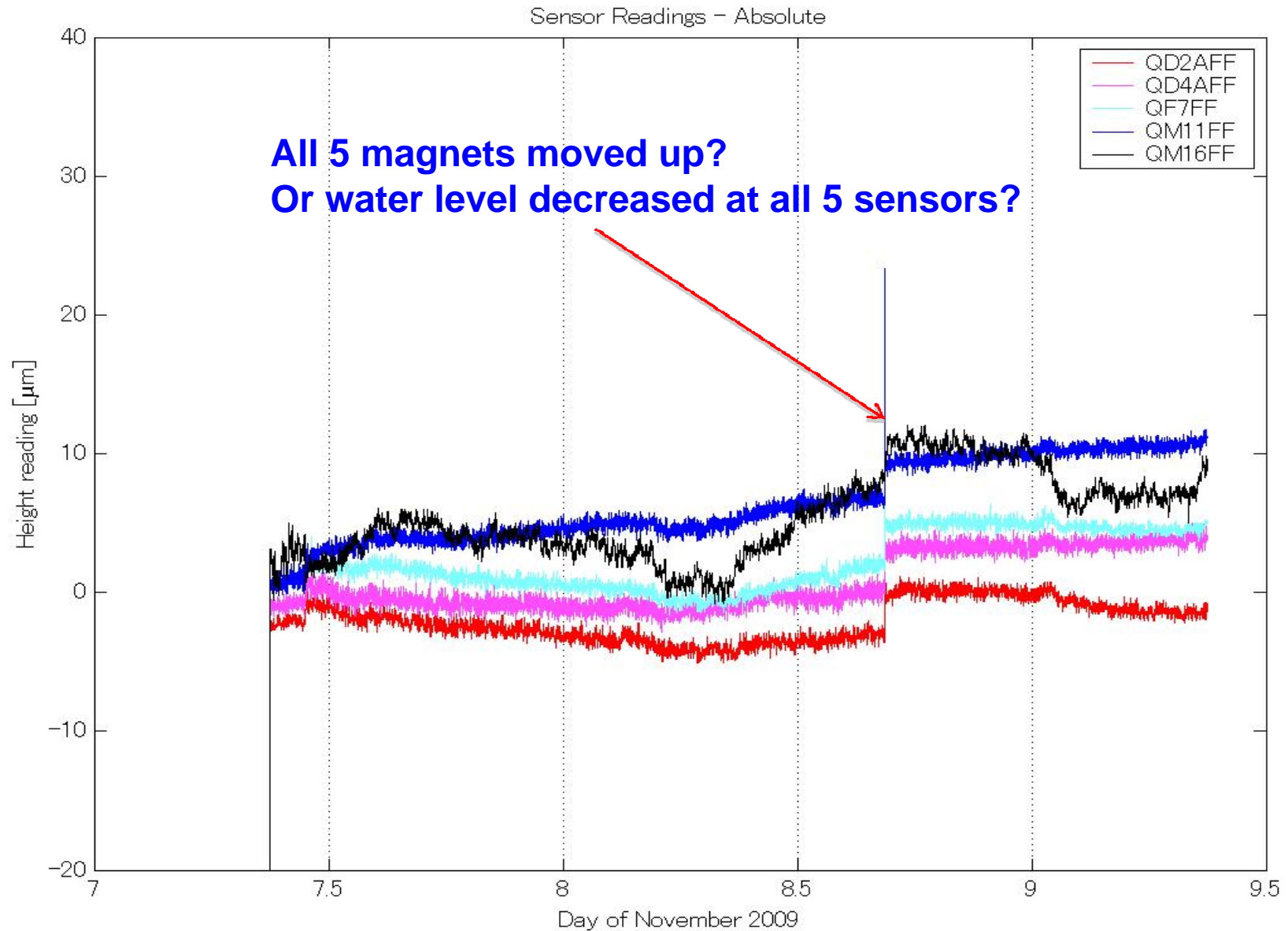
Problem 2: Fan problems (cont.) : Effect of ON / OFF of the fan



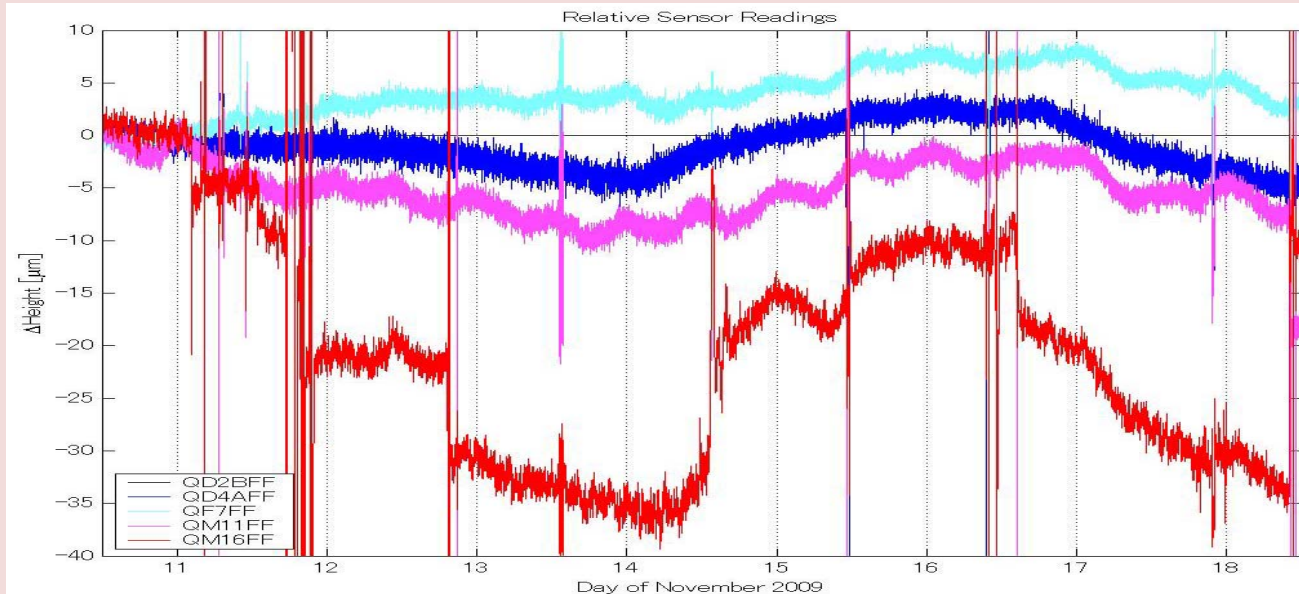
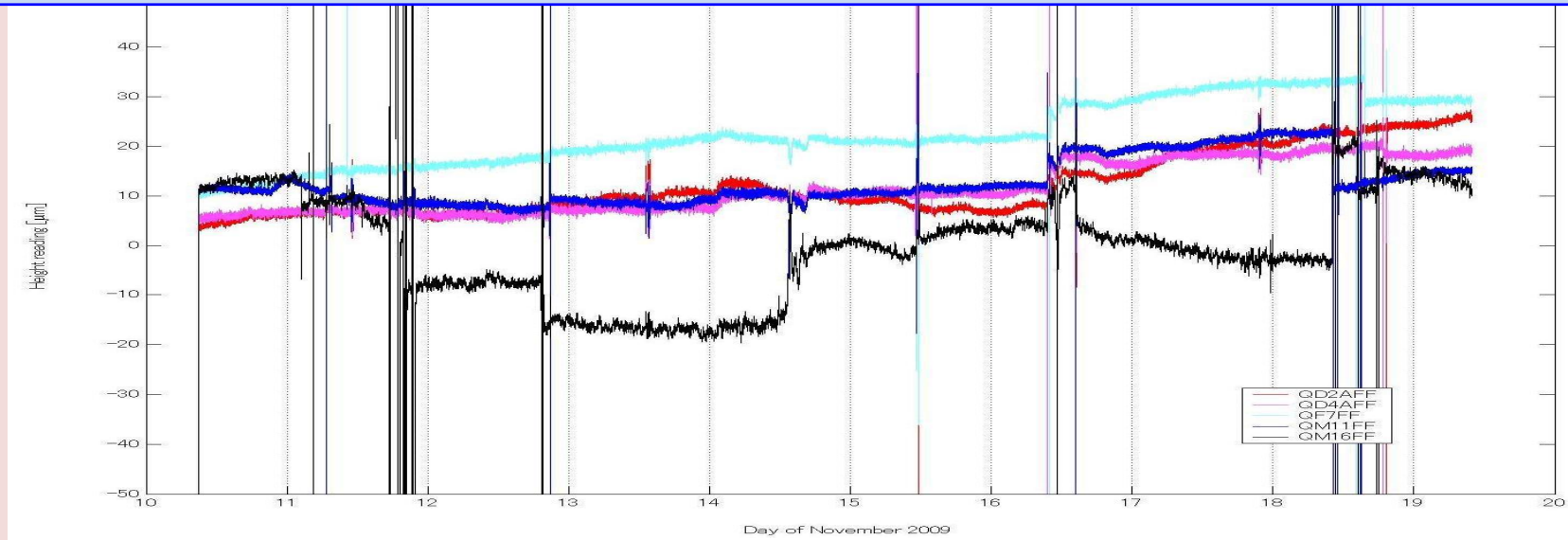
Problem 3: Effect of crane work

Relative Sensor Readings



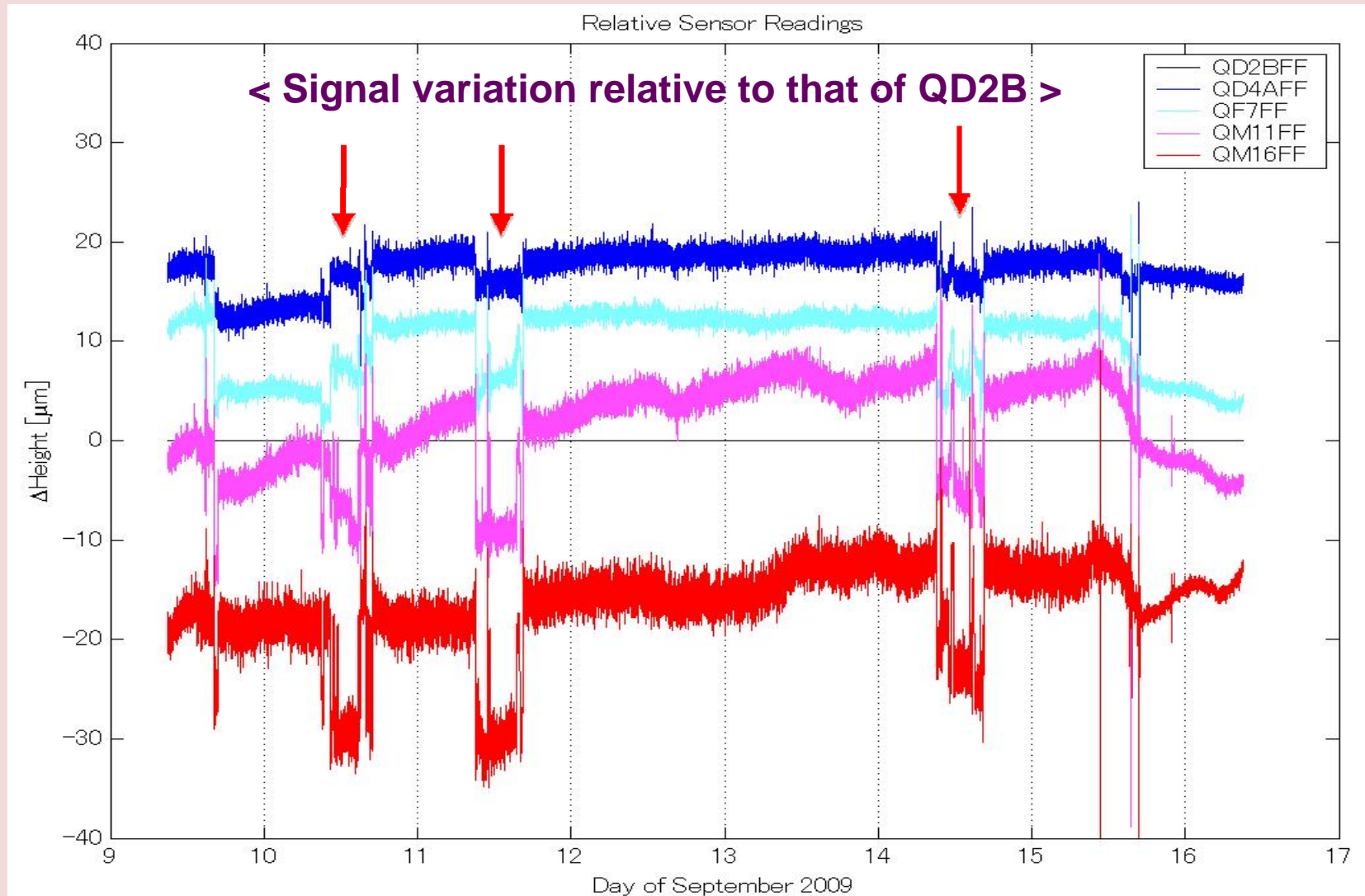
Problem 4: Signal levels of all 5 sensors sometimes jump up

Problem 5: QM16 sensor sometimes does not work properly – has to be solved, and all the sensors feel spike noises frequently – line noise or radio noise?

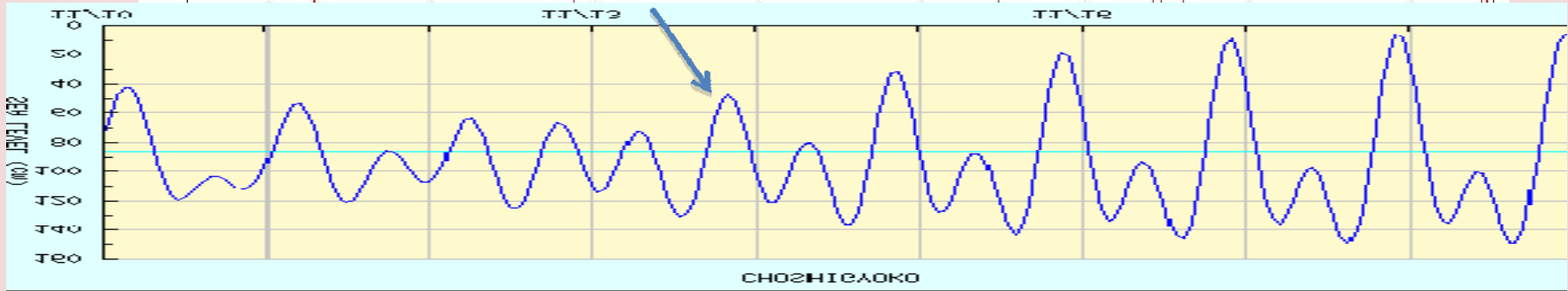
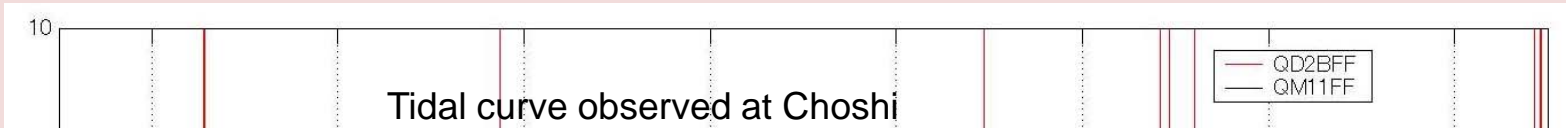


What we have observed with HLS

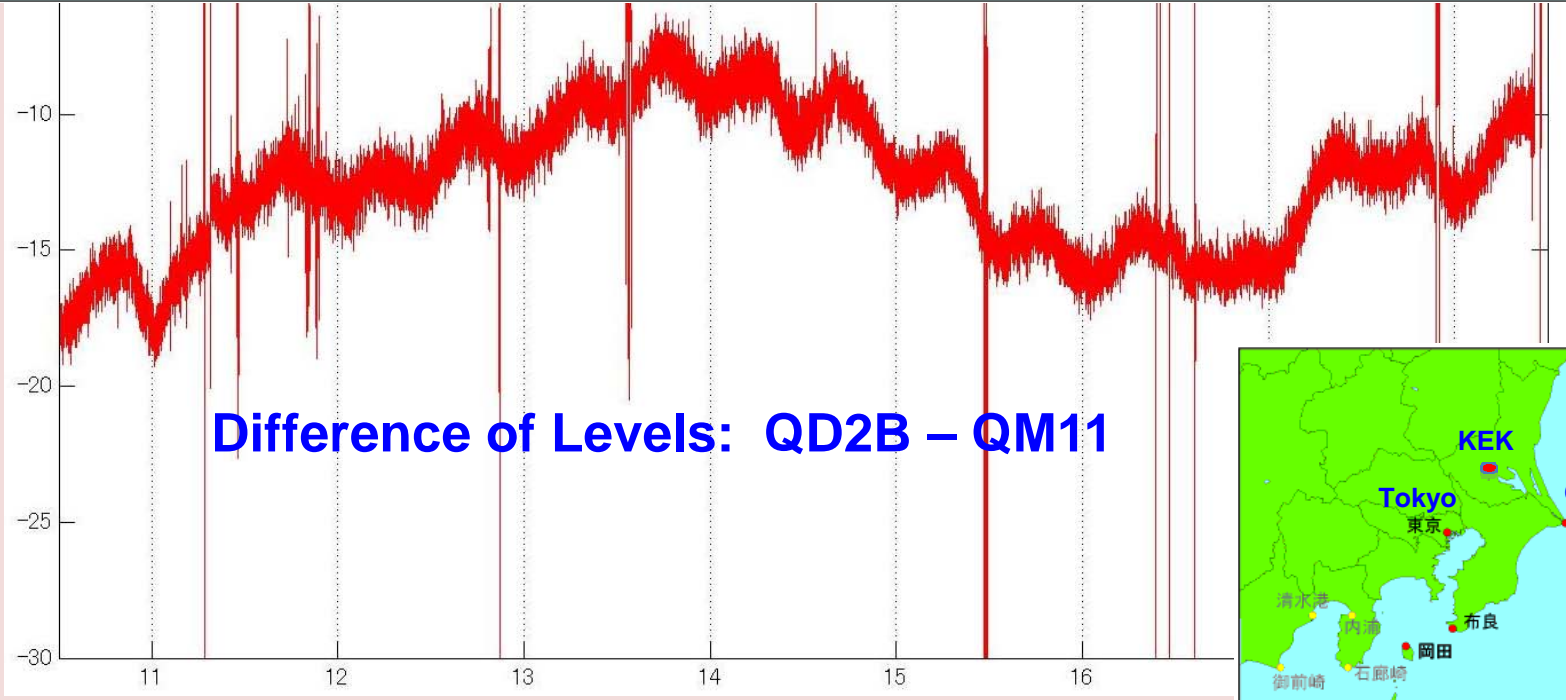
Observation 1: Tilting of the floor



Observation 2: Earth tide and the tilt of the floor



Level difference (μm)



Day of November 2009



SUMMARY

We met various problems such as:

- **People sometimes hit the tray for the water pipes**
- **Fan blew water pipe directly**
- **Crane work changes the floor tilt and the level of HLS as well**
- **Levels of all sensors sometimes jump up – cannot be understood yet**
- **All the sensors feel spike noises rather frequently. What is the source?**
- **Output from QM16 sensor sometimes does not work properly**
 - **has to be solved soon**

We observed:

- **Variation of the floor tilt**
- **Earth tide**

REMARKS

- Using the fan is too rough. We'd better prepare calm air conditioning system for ATF2
- Should we restrict or forbid the crane work during the beam operation?
- The current span is too short. We would like to extend the span toward the ATF Ring

We thank SLAC alignment group for supplying us with HLS sensors and helping us to construct HLS system at ATF2 beam line.