Laboratoire d'Annecy-le-Vieux
de Physique des Particules

Installation of FD in September

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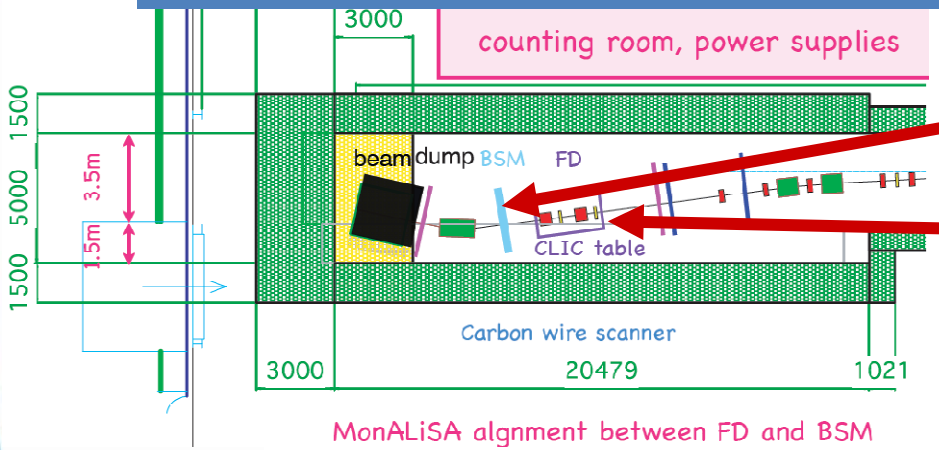
With the help of KEK, SLAC, KNU and CERN colleagues
For measurement details: see Benoit Bolzon's presentation tomorrow

In2p3

Outline

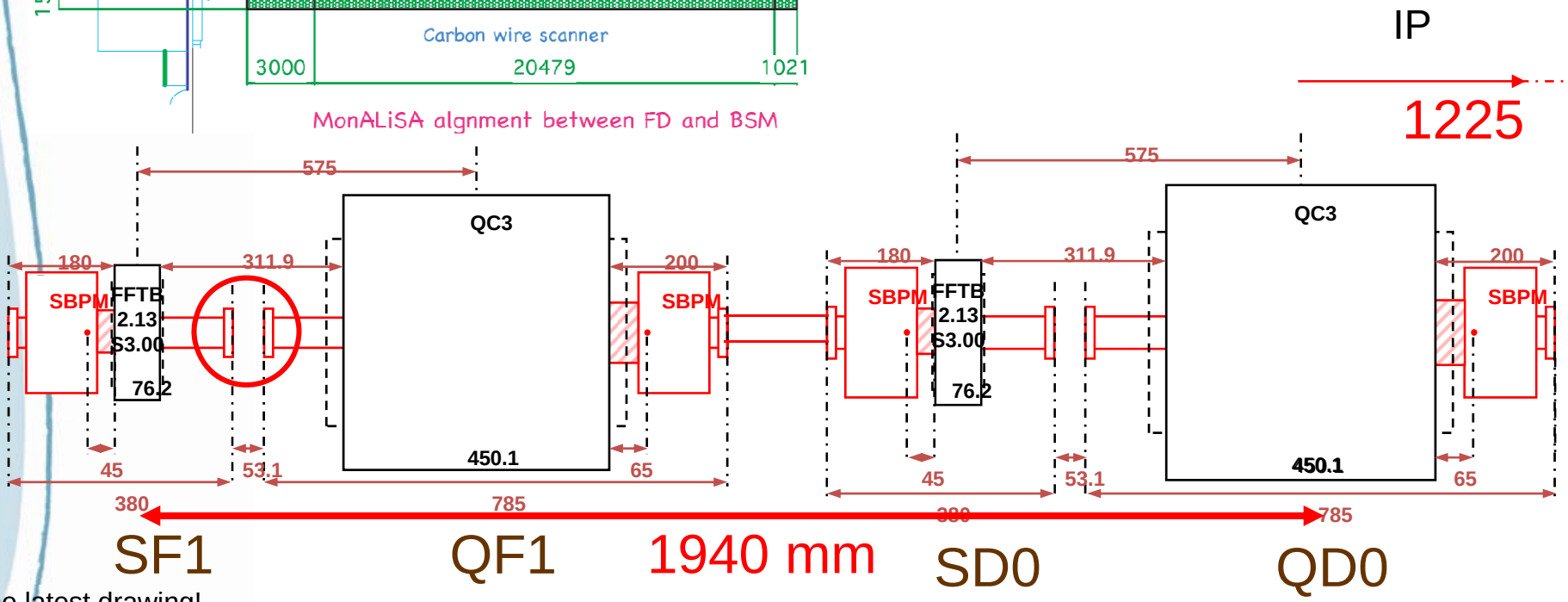
- FD support specifications
- Initial active support study
- Rigid support on intermediate feet
- Final rigid support
- Installation photos
- Conclusion

FD layout



Shintake Monitor: information on the beam size

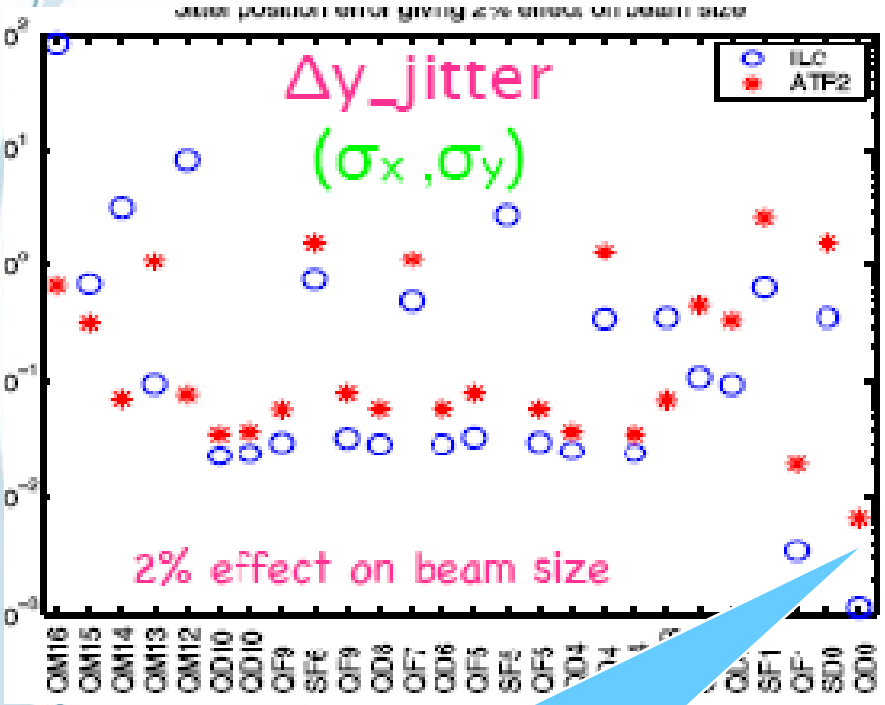
Final doublets

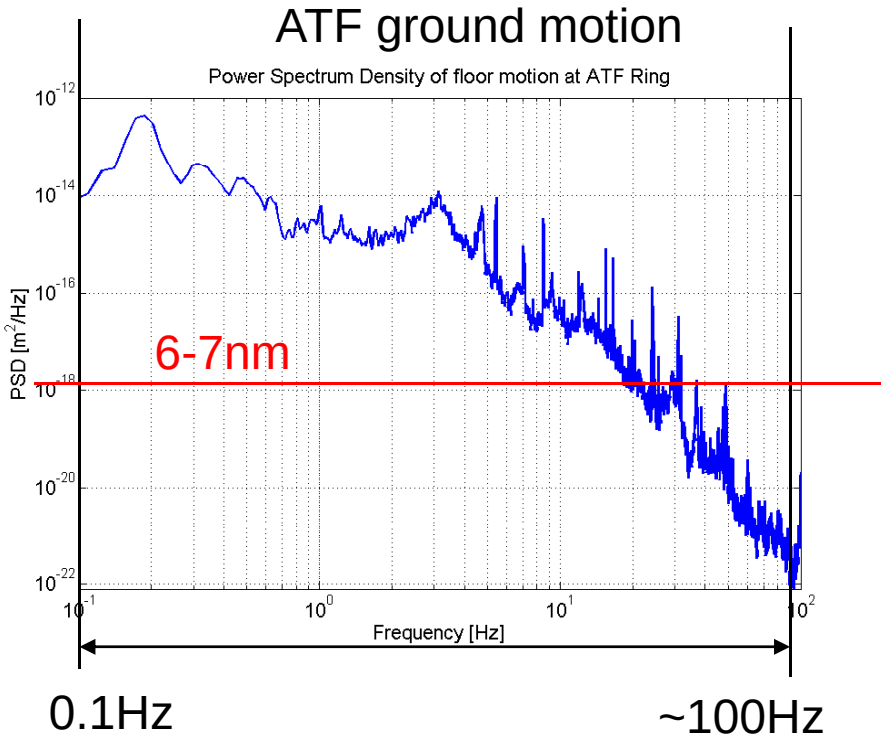


Not the latest drawing!

What is needed to support all these components?

ATF2 specifications





For QD0 at ATF2: 6-7nm tolerance

Repetition rate 1Hz=> need a "mechanical" stabilisation from 0.1Hz (below, the beam based alignment works)

Two solutions possible:

1. Isolate/cut vibrations in the desired frequency range
2. Push the first resonance peaks at higher frequencies where ground motion is lower

FD support specifications

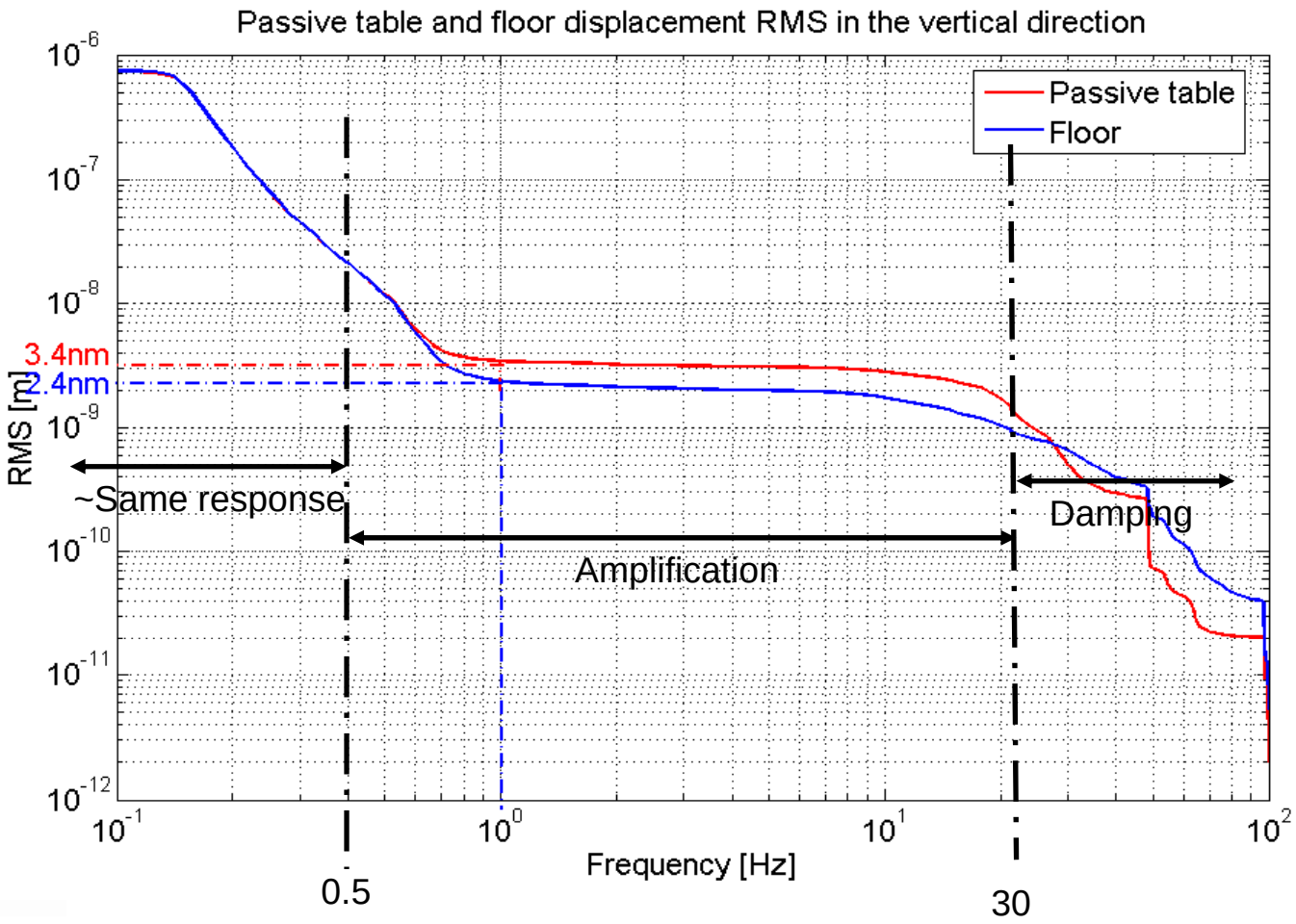
- Desired frequency range : 0.1Hz-100Hz
- Support that can evolve as Final Focus design evolves (should be able to change support)
- 6-7nm jitter tolerance
- 1.2m beam height

Initial suggestion: CERN wanted to contribute by sending the commercial TMC table

Isolator:
Passive => turned OFF
Active => turned ON

Vibrations of the passive TMC table

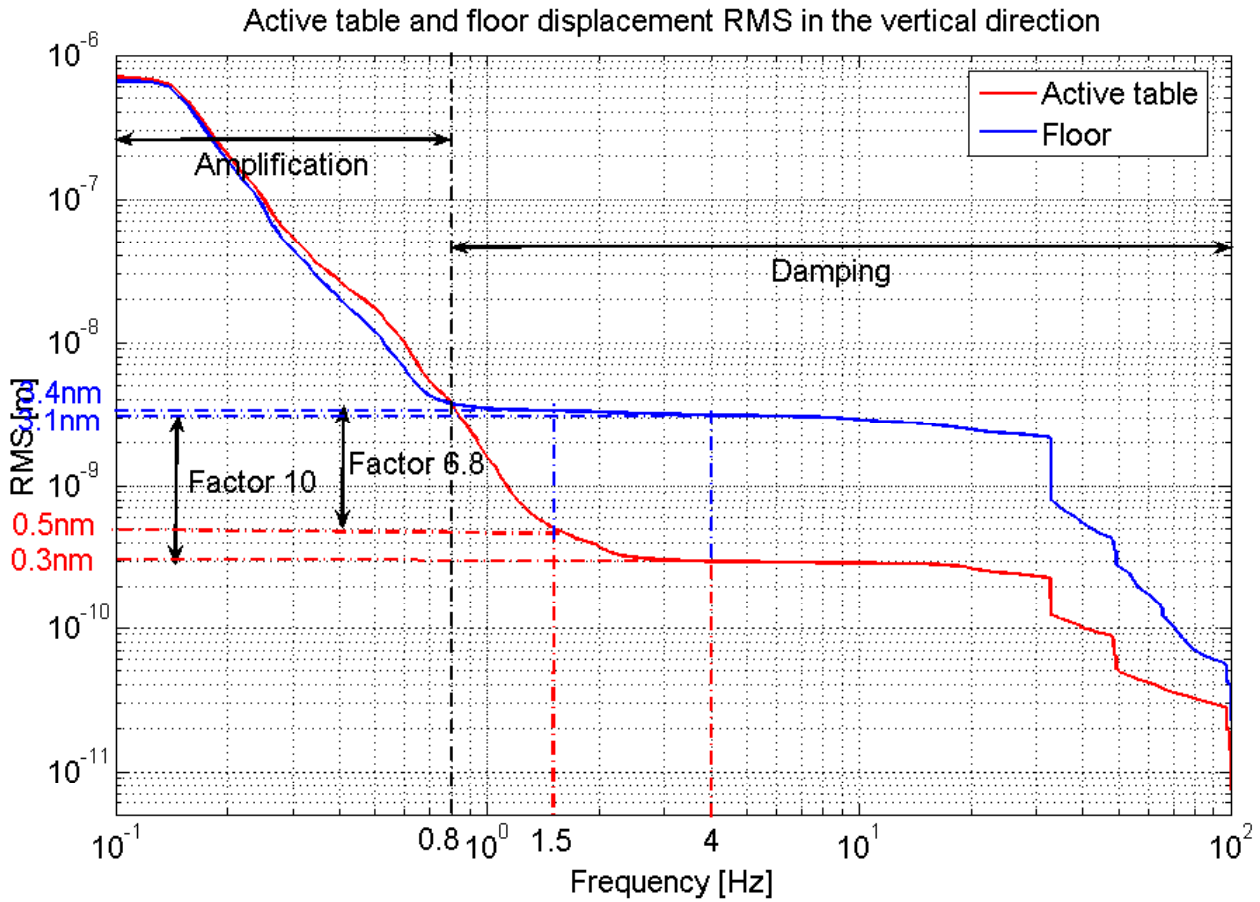
Vertical direction: Integrated RMS



- ✓ **Below 0.5Hz:** No amplification or damping on the table
- ✓**Above 0.5Hz:** Amplification
- ✓Above 30Hz: damping begins

Vibrations of the active TMC table

Vertical direction: integrated RMS



✓ **Below 0.8Hz:** Amplification on the table

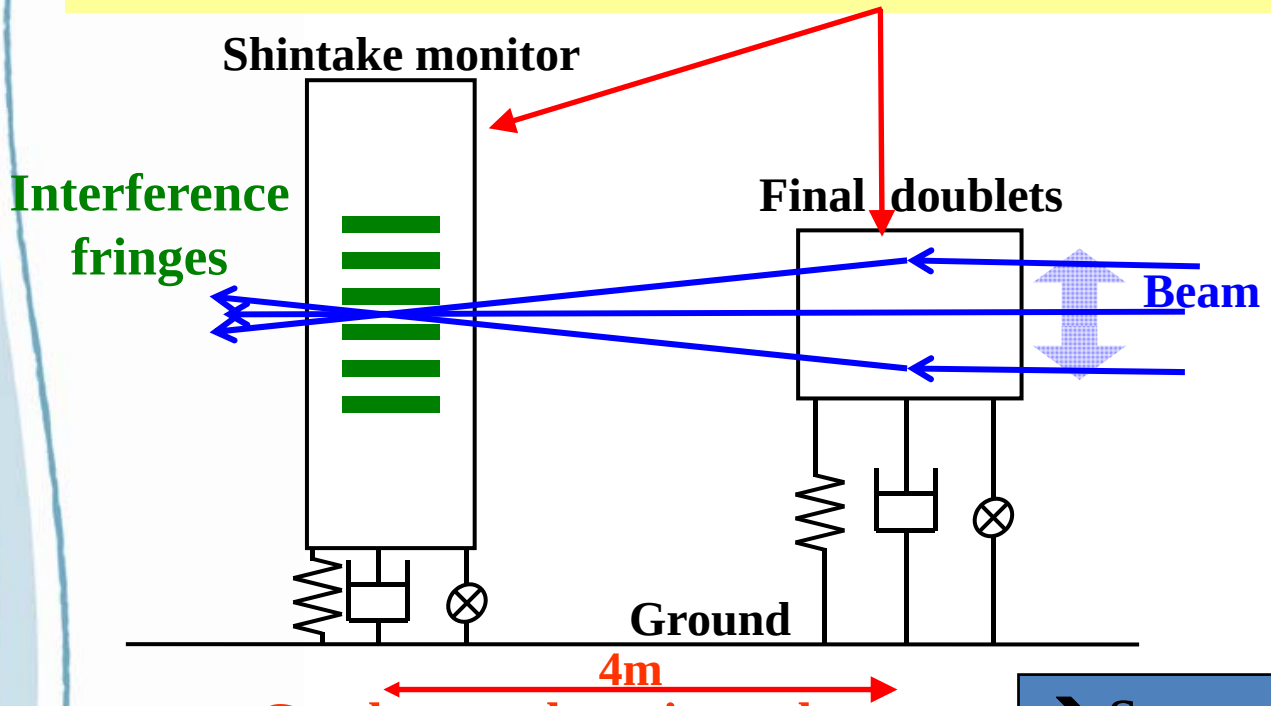
✓ **Above 0.8Hz:** Damping on the table

→ Factor 7 of damping above 1.5Hz

Need to look for an alternative solution

Back to basics: Specifications

We want the measurement to have a coherent behaviour with respect to the "beam" => Relative motion between Shintake monitor and final doublets: 6-7nm in the vertical axis above 0.1Hz



If Shintake Monitor and FD on separate active supports, coherence is lost

Good ground motion coherence: measured on KEK site

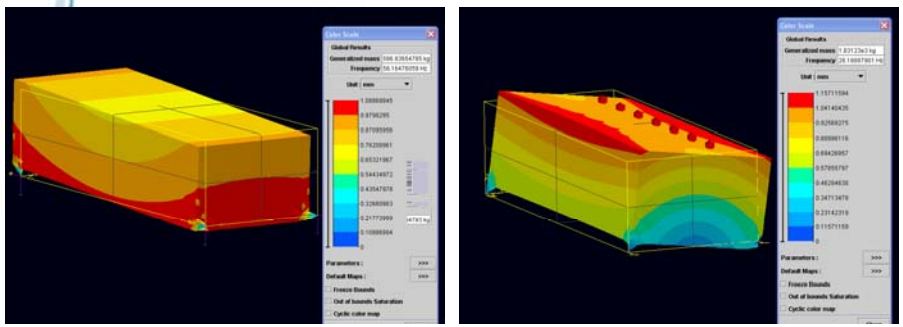
➔ Separate stiff supports rigidly fixed to the floor

Study the honeycomb block but without active feet

Study of the block on 4 feet

(free-free configuration: 1st peak at 230Hz)

Simple simulation (plain block)

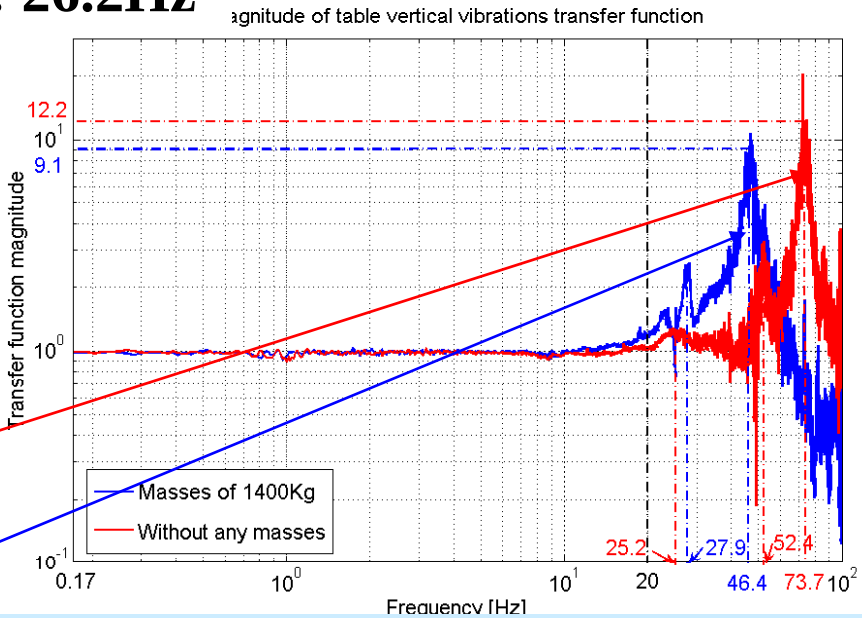


In the middle of : 0.1Hz-100Hz!

✓ **Total relative motion ([0.17; 100]Hz): 6.7nm → Above tolerances (6nm)!**

✓ **Contribution of the peak alone: [10; 100]Hz: 5.7nm**

➢ **Empty: 56.2Hz** ➢ **with FD weight: 26.2Hz**



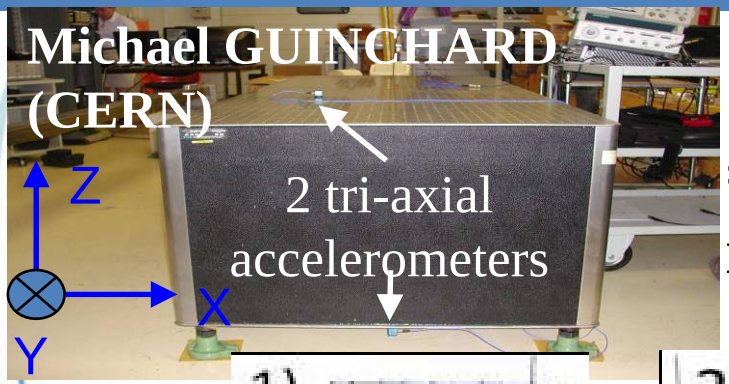
Measurements

- Empty: 74Hz
- With FD weight: 46Hz

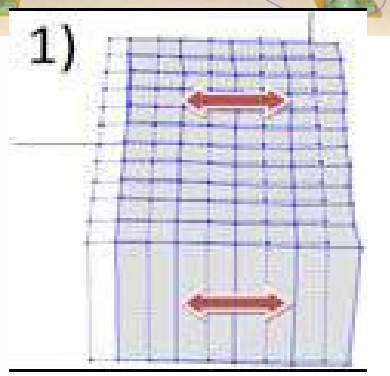
Do these peaks come from the block or the feet?

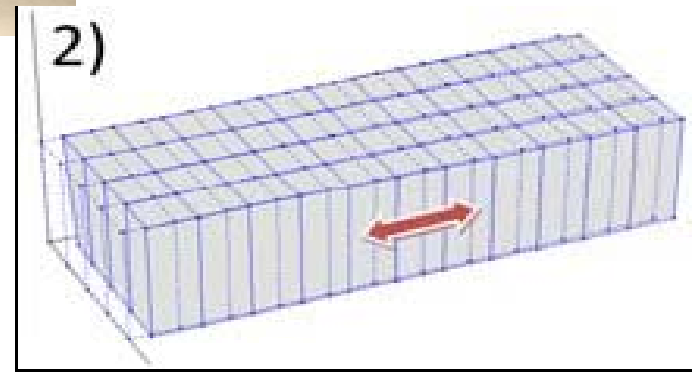
Modal deformation measurements

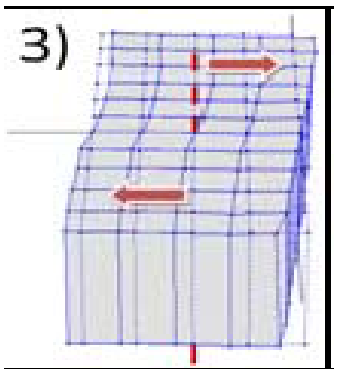
Block fixed on 4 feet

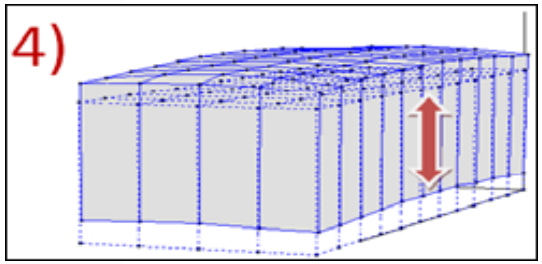


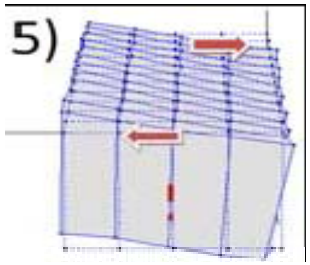
✓ **Impact hammer on different points**
=> Modal deformation for each resonance up to 150Hz in 3 axes

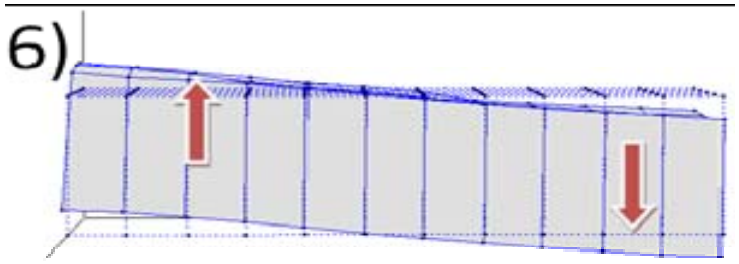












The block is rigid (no deformations) , but the feet allow it to “jump” around

Modal deformation results

✓ **6 first modes:** rigid body modes (6 degrees of freedom)

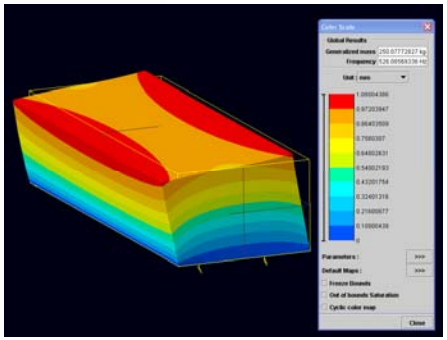
Modes	**1) T-X**	**2) T-Y**	**3) R-Z**	**4) T-Z**	**5) R-Y**	**6) R-X**
Frequency (Hz)	34.8	41.8	60.6	**80.6**	103.9	136.0
Damping (%)	2.8	2.6	2.4	**2.3**	2.1	4.0

T: Translatic

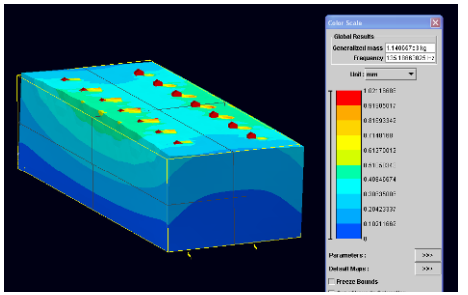
R: Rotation

➔ **Keep the rigid block (no deformation in x,y nor z) but remove the 4 feet to cut these modes**

Block fixed to the floor on its entire surface



simulation



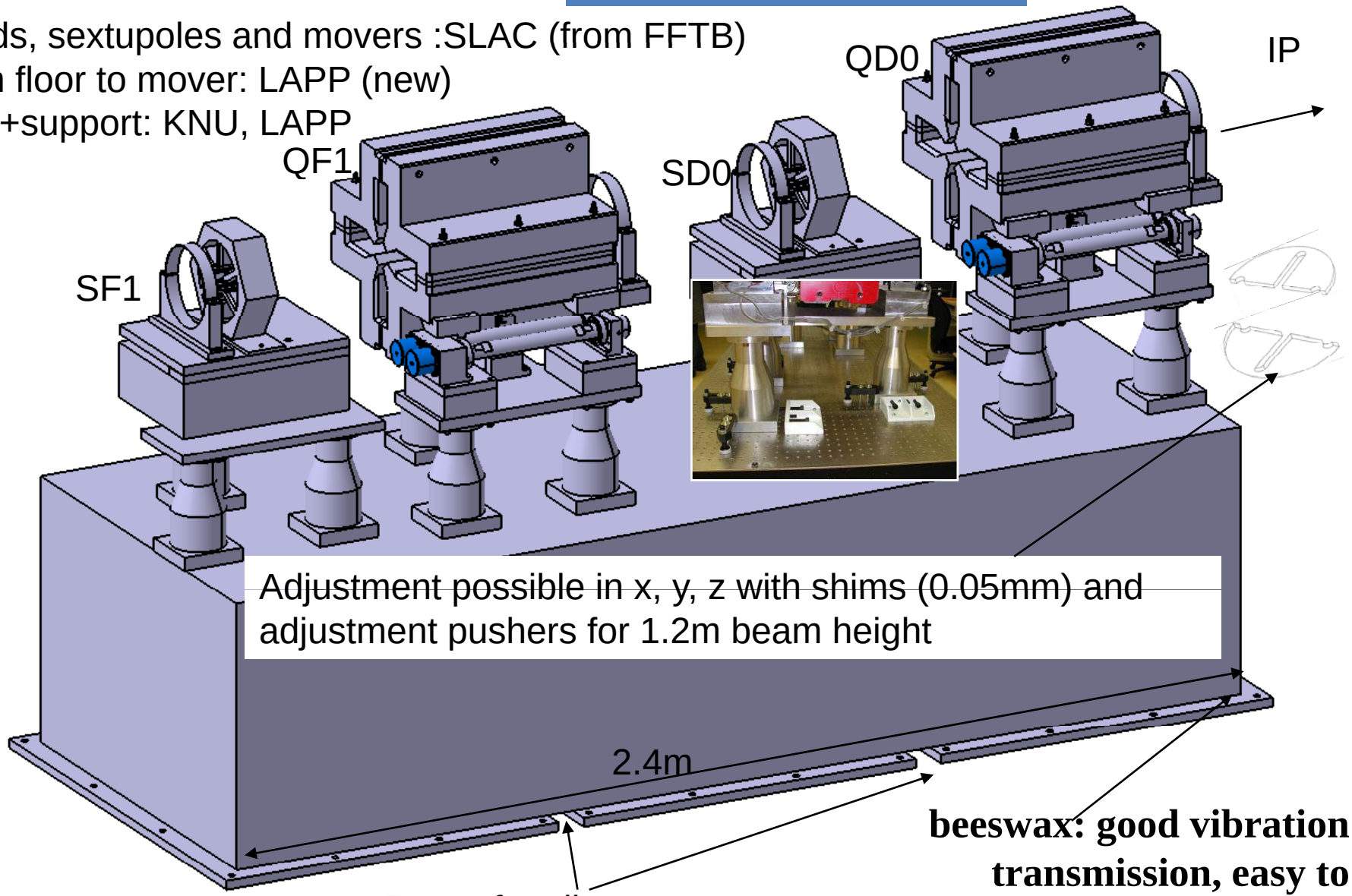
➢ **with FD weight: 135.2Hz**

➢ **Empty: 526.1Hz**

The peaks are outside the interval: 0.1Hz - 100Hz

Final assembly

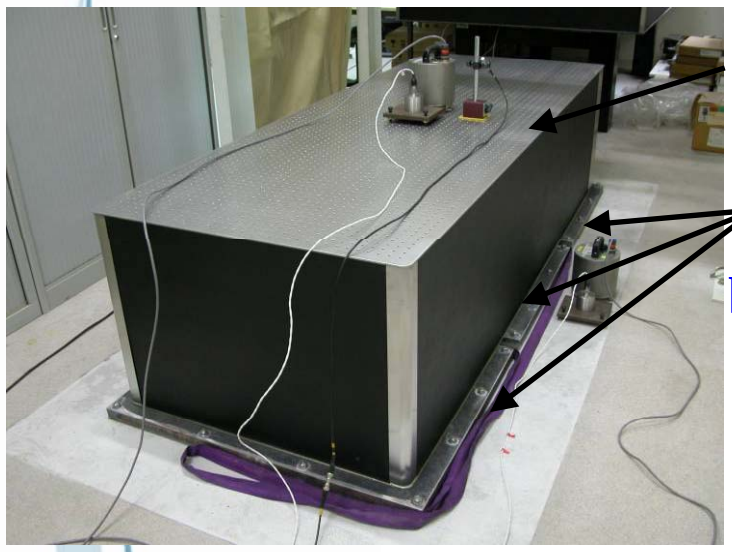
Quads, sextupoles and movers :SLAC (from FFTB)
From floor to mover: LAPP (new)
BPM+support: KNU, LAPP



beeswax: good vibration transmission, easy to unglue, stable in time, rad hard

Block fixed on one entire face to the floor

Experimental set-up

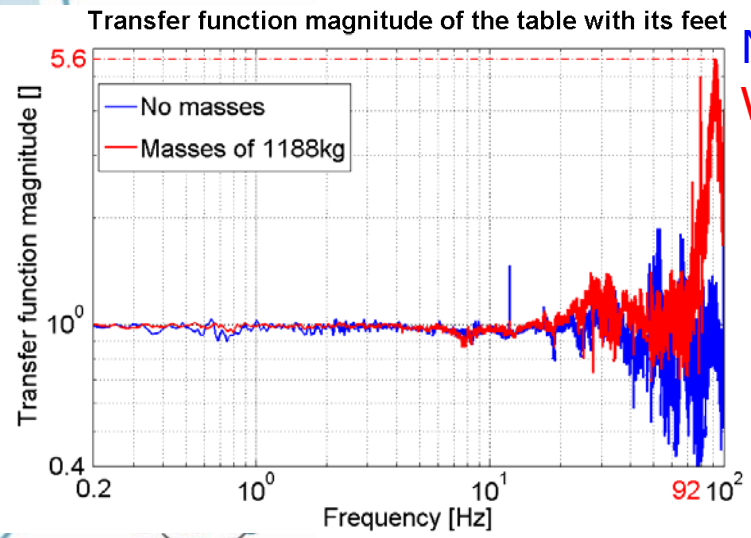


Honeycomb table

Bees wax

3 steel plates

bolted to the floor



No masses: no peak

With masses: 92Hz

➔ **Good boundary conditions chosen for the block:**
Relative motion should be very low compared to tolerances

Impact of the resonance peak on the RMS

Object	Peak position	Integrated RMS
4-feet table with weight	41Hz	5.7nm
Glued table with weight	92Hz	0.3nm
Sextupole on mover/support	100Hz	0.26nm
Quad on mover/support	76Hz	1.1nm

Adding up the integrated rms values keeps us under the 6-7nm tolerances

The honeycomb table fixed to the floor on whole surface, with adjusted movers validated for ATF2 Final Doublet support measured in Annecy

For the measurements at KEK see Benoit Bolzon's presentation tomorrow

Installation at KEK from September 16 to September 25 2008


Unpacking


Shims against floor inhomogeneities


Installing the steel plates


Check height at each step of installation

Installing beeswax on plates bolted to the ground

Great team-work

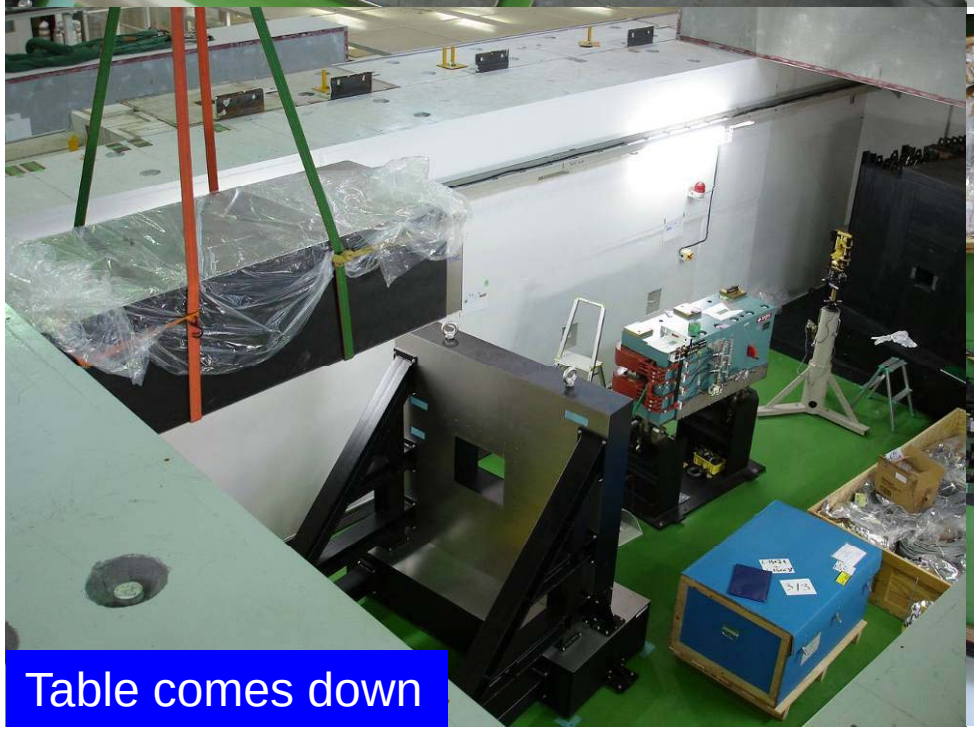
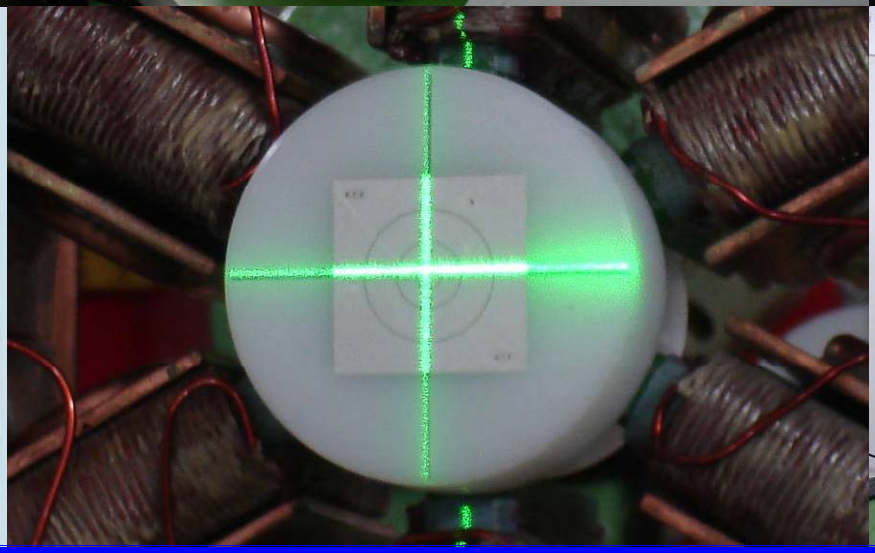


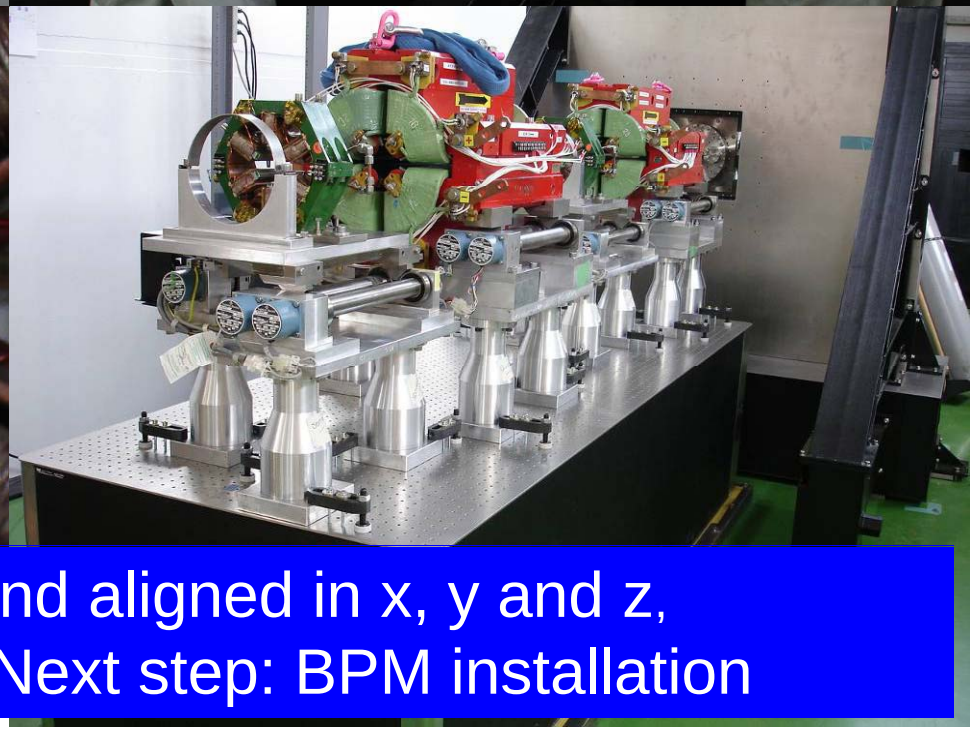
Table comes down

Installing “feet” and movers

QD0 comes down

QD0 installed



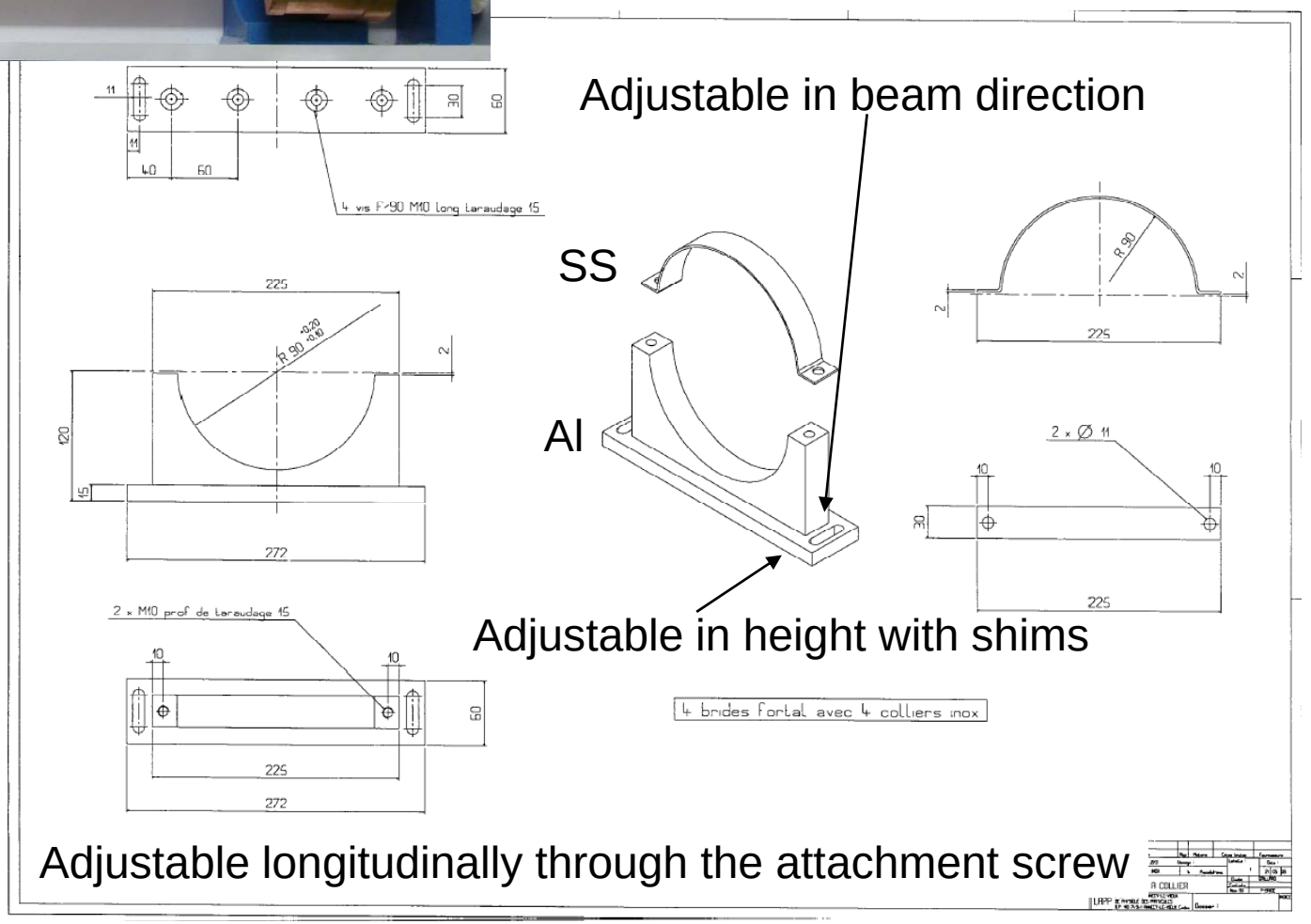


Everything installed, centered and aligned in x, y and z,
Thursday September 25 2008; Next step: BPM installation

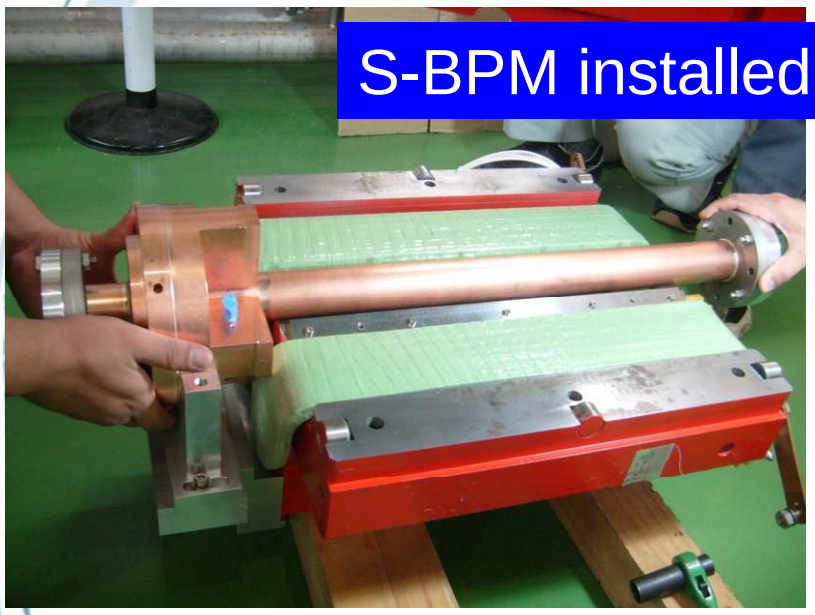
BPM supports

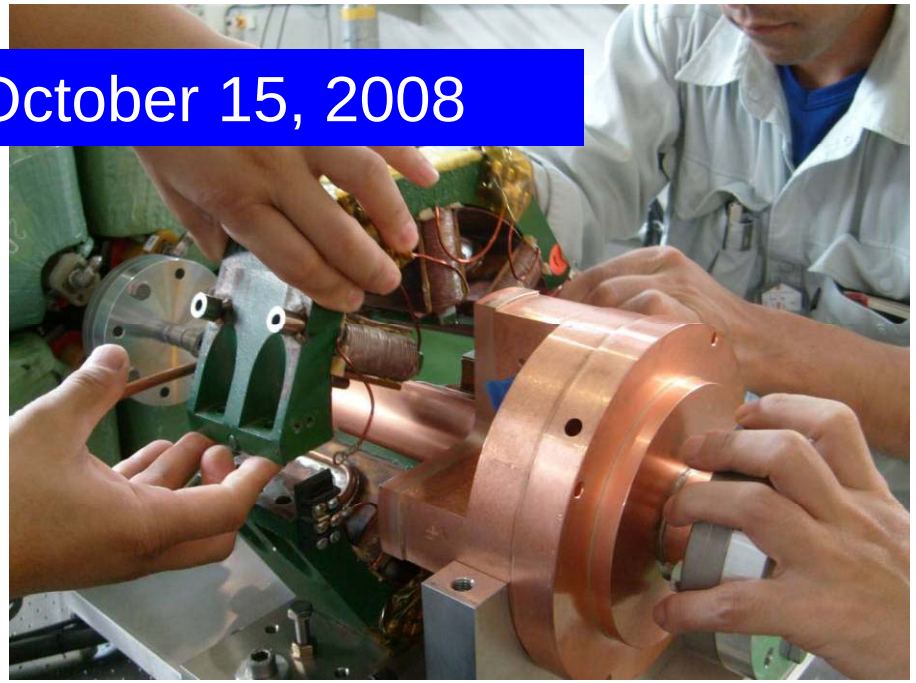
S-BPM machined, tested and delivered by KNU

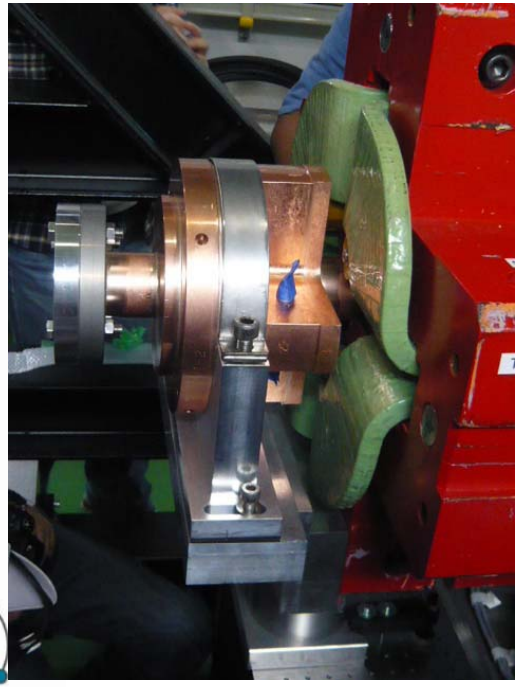
S-BPM ≈ 20kg

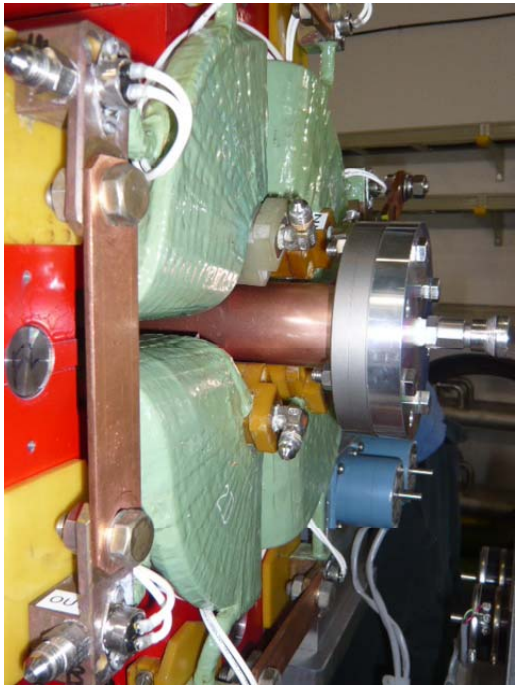


S-BPM installed October 15, 2008



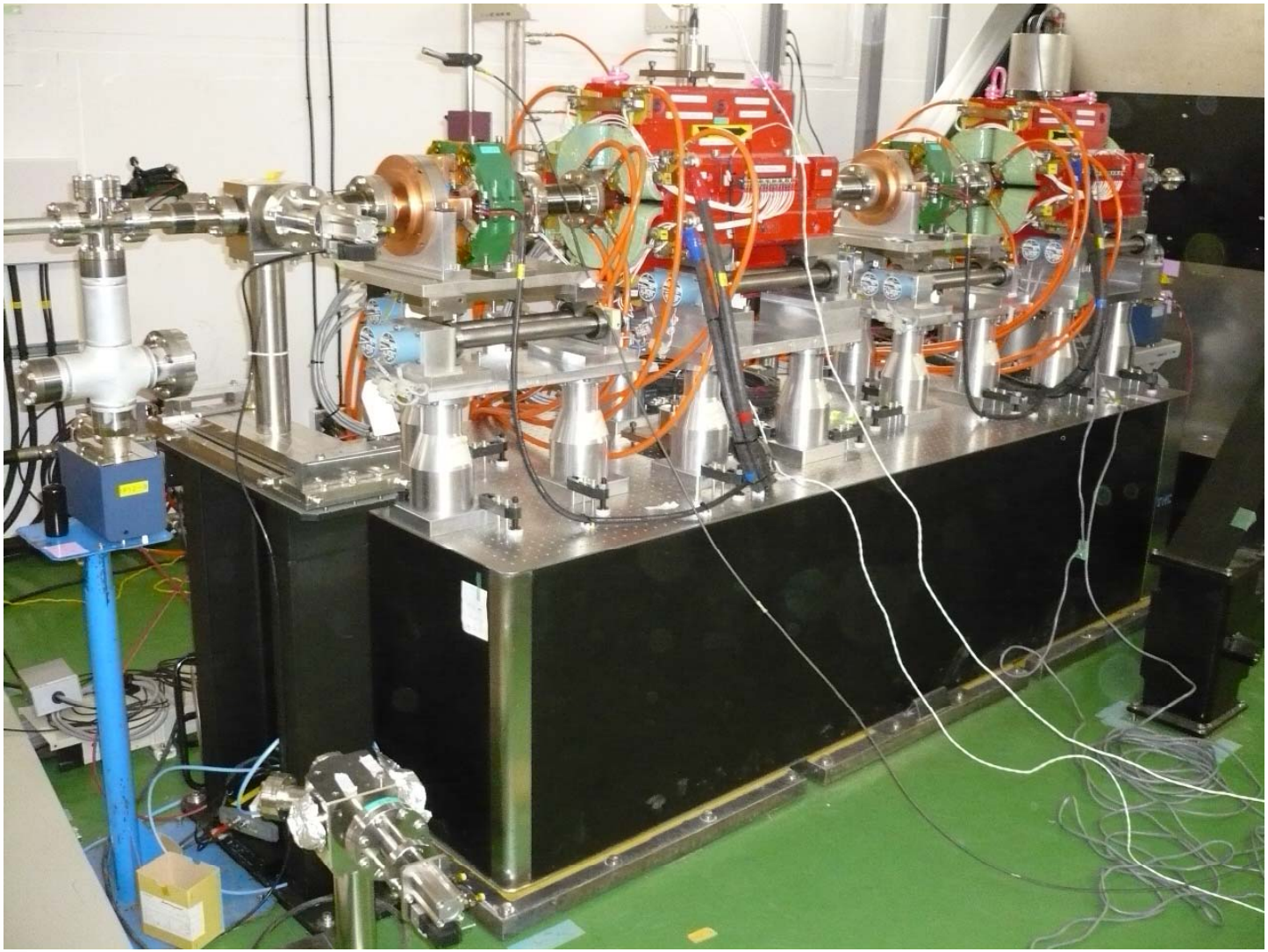






We have to make sure everybody uses the same and correct/measured distances for the S-BPM readout point

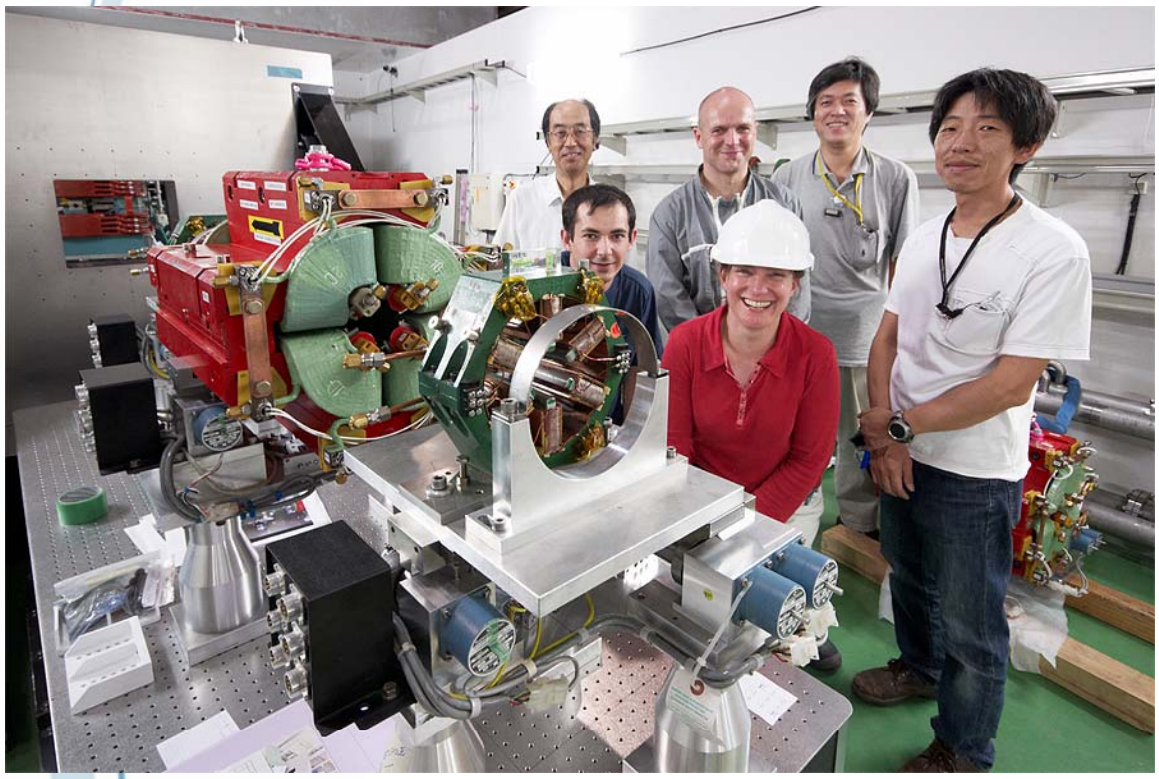
FD mid-november 2008



Conclusion

- ATF2 rigid Final Doublet support chosen (vs. active support)
- SLAC FFTB movers adjusted to meet beam height
- Vibration measurements validate the rigid support choice
- ATF2 Final Doublet support installed at KEK

Conclusion



Thank you for the available, helpful and competent KEK team during our stay

Back-up

Relative motion between table and floor

Integrated RMS of relative motion between table and floor to predict on the ATF site

Calculation to perform by integrating the vibratory behaviour of the table measured at LAPP and the data of ATF ground motion

Calculation performed for these specific needs:

$$RMS_{int\,y\text{-}x}(k) = \sqrt{\sum_{k_1}^{k_2} [H(k)-1][H^*(k)-1]DSP_x(k)}$$