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

FD support

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Outline

- Summary of results presented at the May 31st meeting in Hamburg by Dr. Benoît Bolzon
- FD support
- What we are defining
- Schedule

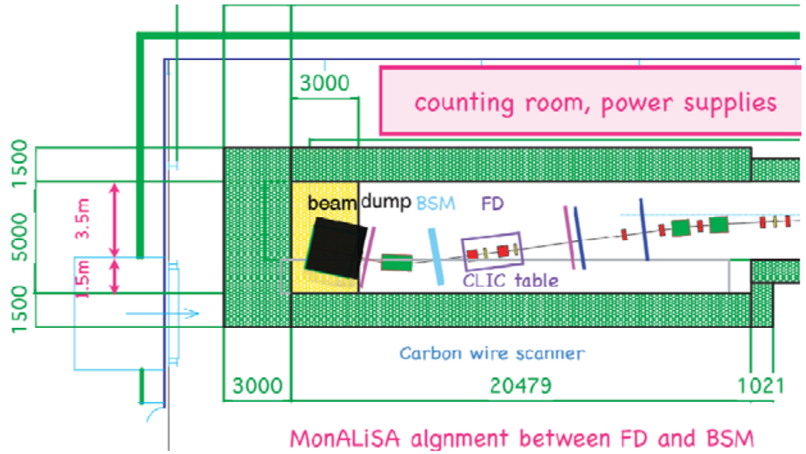
Introduction : ATF2 constraints

✓ Beam-based feedback only **below 0.1Hz (repetition rate: 1Hz)**

➔ **Above 0.1Hz:** Relative vertical motion between the Shintake monitor and the last magnets < 6nm (Horizontal motions: tolerances of a factor 10 to 100 less strict) for a frequency below 30Hz

=>Rigid support both for Shintake monitor and FD

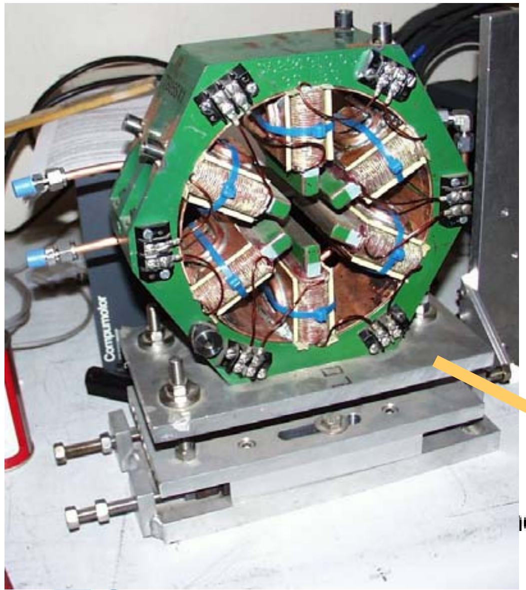
✓ Final magnets and Shintake monitor separated by 4 m on 2 separate supports

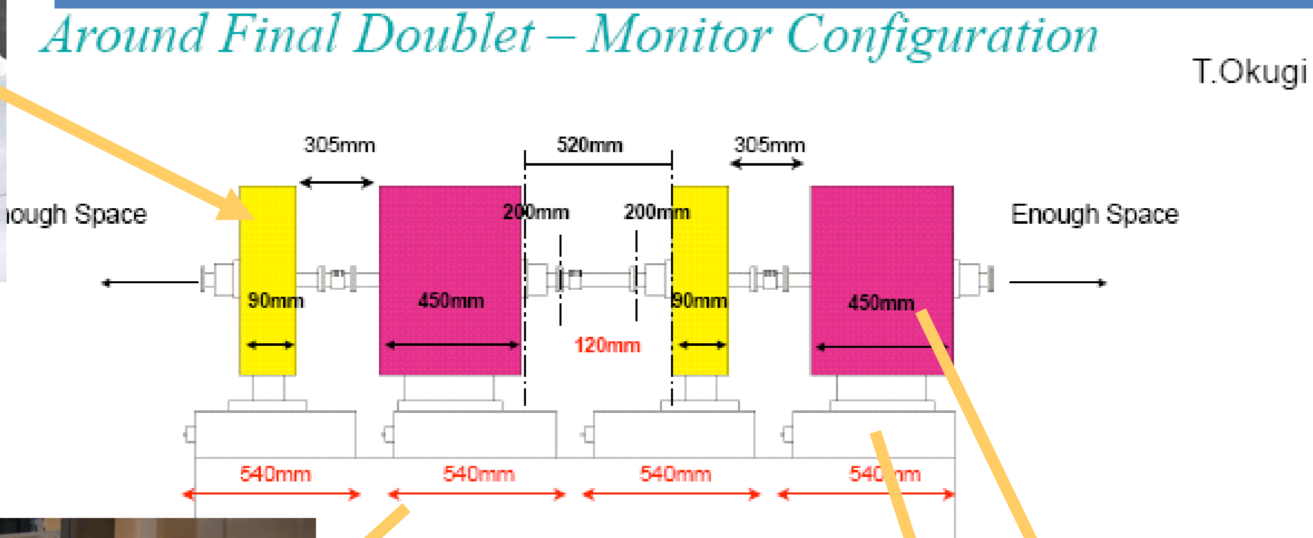


✓ **ATF2 floor:** Ground motion coherence good up to a distance of 4-5m

FD layout

Total weight on table: ~1400kg (without Monalisa)

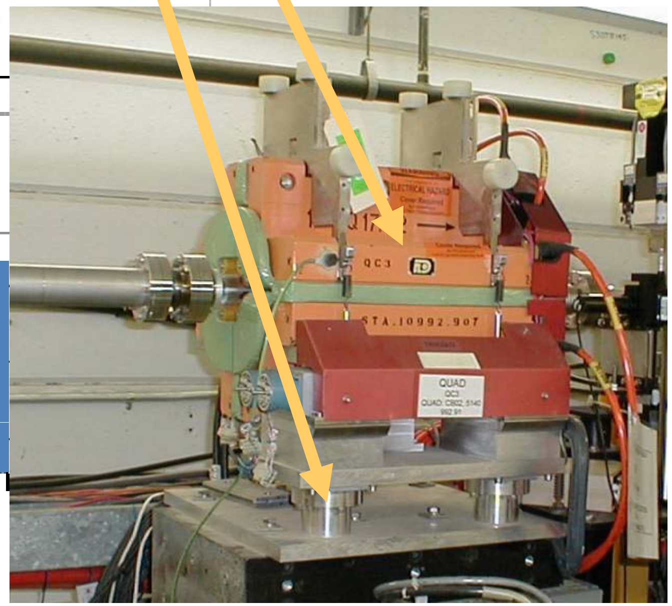




QD0: 400kg
mover: 25kg
T-plate: 10kg

Honeycomb table

Rigid support so no “feet”



Minimum resonant frequency

Choice of honeycomb block:
- Length needed to put everything on the support
- Maximum height for beam height of 1.2m
- Standard model for price and delay

Guaranteed Minimum Resonant Frequency (Hz)
All series of TMC Tops

Free configuration of honeycomb block:

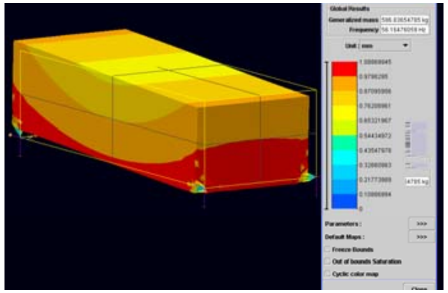
Top Thickness

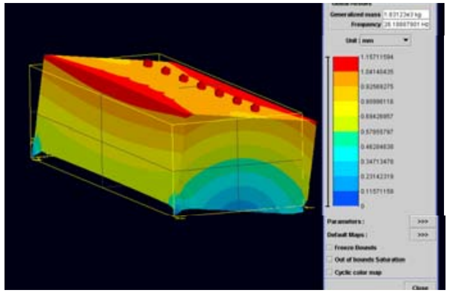
Top Length	6' (1.8 m)	8' (2.4 m)	10' (3.0 m)	12' (3.6 m)	14' (4.2 m)	16' (4.8 m)
8 in.(200 mm)	160	135	110	85	65	55
12 in. (300 mm)	200	170	135	110	85	70
18 in. (450 mm)	230	200	165	130	100	80
24 in. (600 mm)	250	230	185	150	120	90

230Hz for 2400mm table and goes down to 185Hz for longer table

“simple”Simulation: just a block with the right boundary conditions=> to see the evolution

Boundary conditions: table put on / fixed to 4 rigid supports at its corners





Too low!

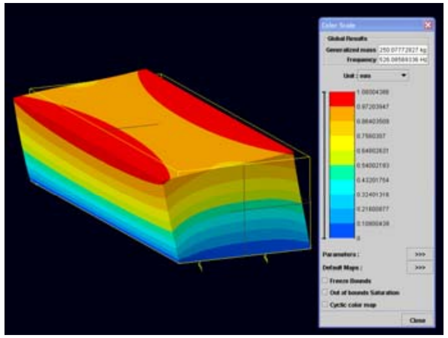
- **Without any masses: 56.2Hz**

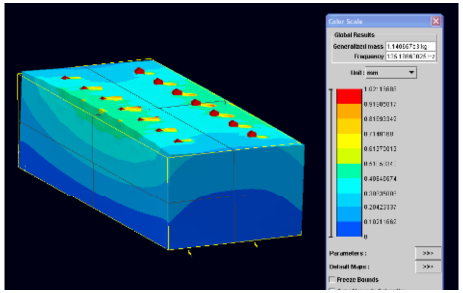
→ Well lower than in free configuration!

- **With masses: 26.2Hz**

→ Fall of the eigenfrequency

Boundary conditions: table fixed directly to the floor <u>**on 1 entire side**</u>





- **Without any masses: 526.1Hz**

→ Well higher than in free configuration!

- **With masses: 135.2Hz**

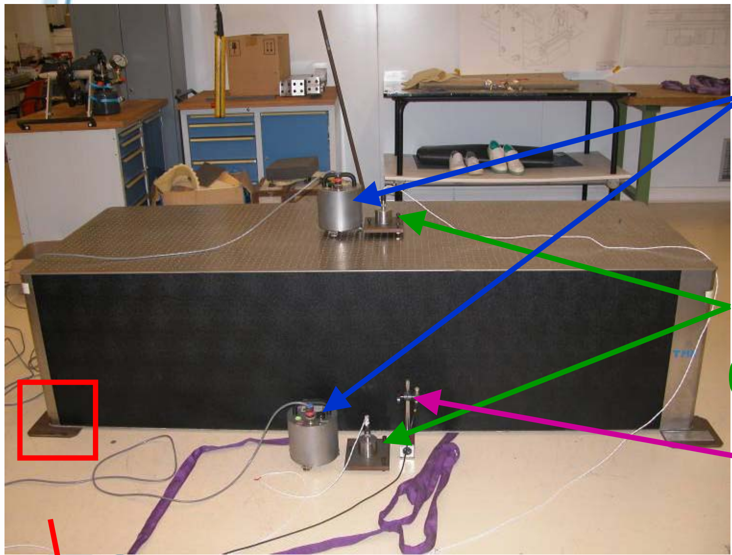
→ Fall of the eigenfrequency but still enough high

Experimental set-up

✓ Simultaneous measurement acquisition of the 5 sensors with/without masses

Table with no masses

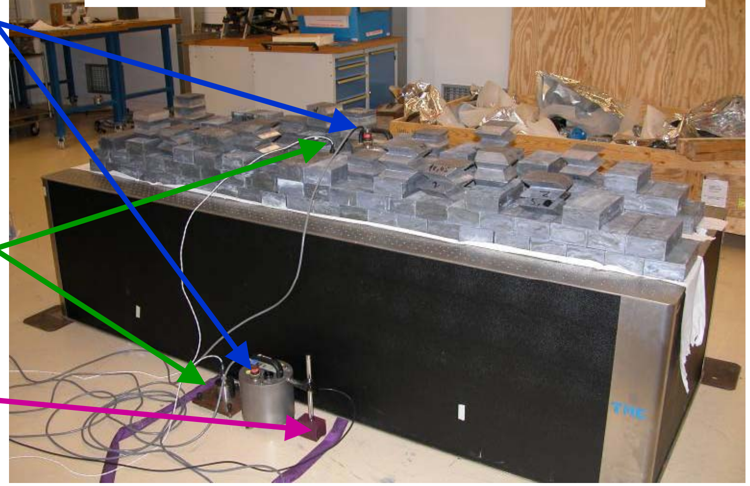
Table with lead masses of 1400Kg



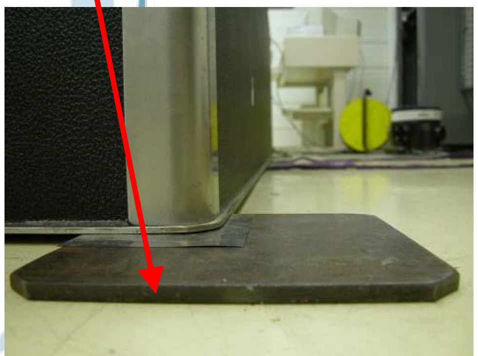
Guralp velocity sensors (0.033Hz-40Hz)

ENDEVCO accelerometers (40Hz to 100Hz)

Microphones



Sensors put on middle of table where vibrations biggest at first eigenfrequency



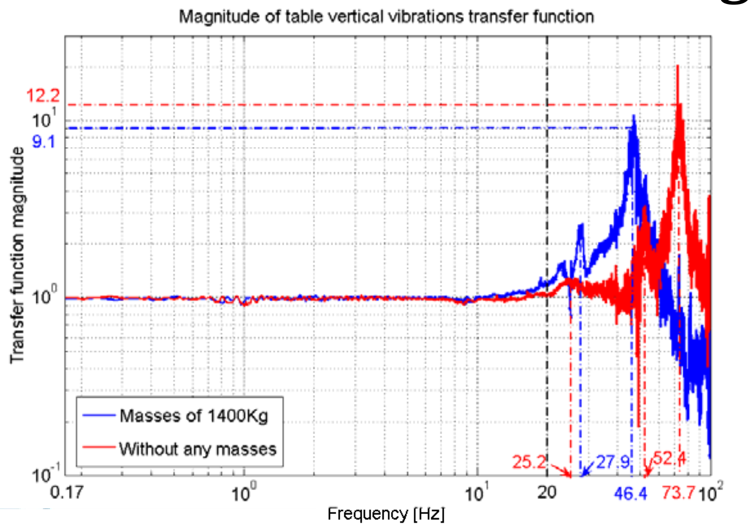
✓ 4 high steel supports (thickness precision: 0.1mm) at corners

✓ Ground not perfectly flat: One spacer of 0.1mm at one corner

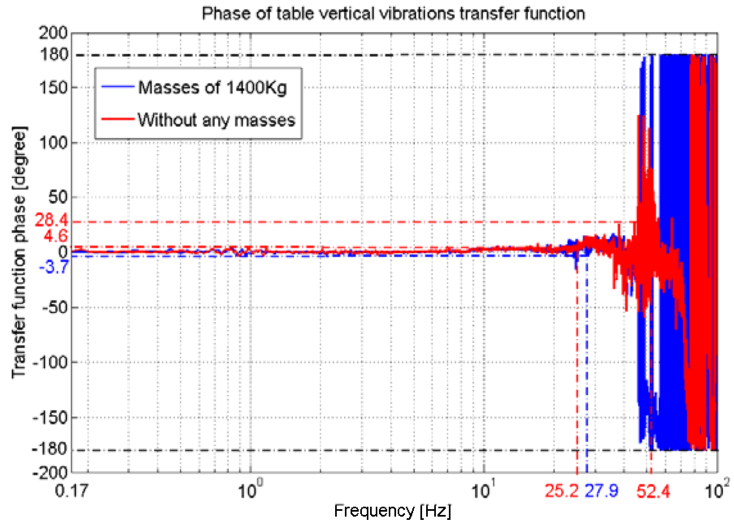
→ **May not be sufficient:** gap of **1um** can impair vibrations transmissibility between table and floor

Vibrations transmissibility study between table and floor

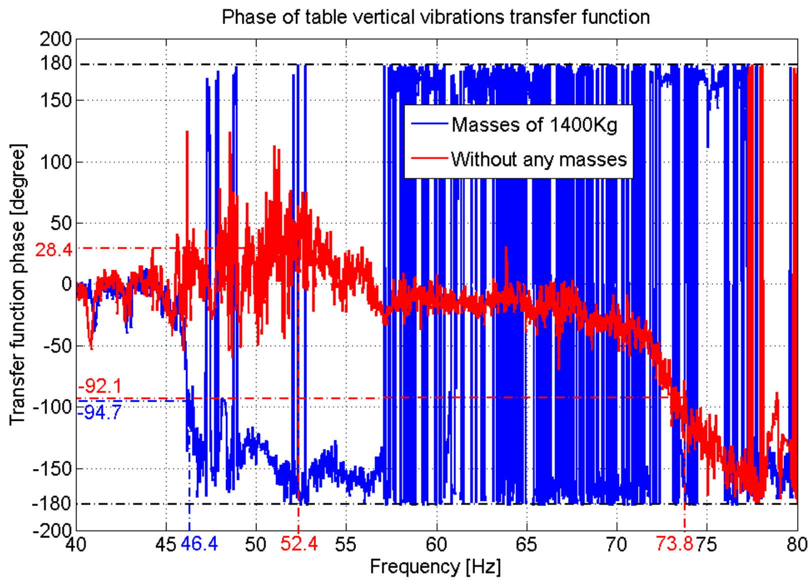
✓Table transfer function magnitude



✓Table transfer function phase



✓Table transfer function phase (zoom)



➢ **First eigenfrequency: phases of 90°**

- **Masses: 46Hz (Factor Q=9)**
- **No masses: 74Hz (Factor Q=12)**

➢ **Other peaks: not eigenfrequencies**

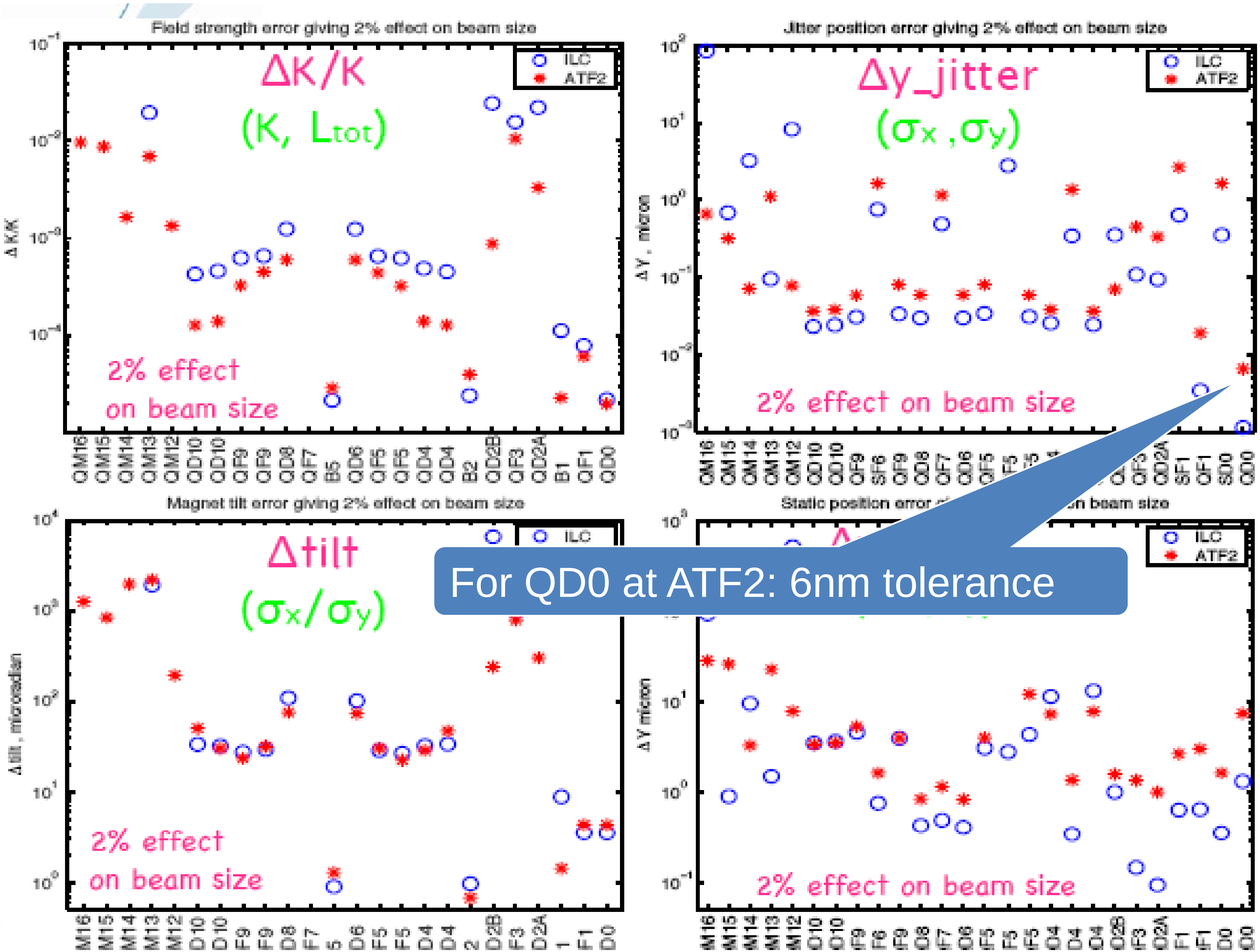
SUMMARY: Vibrations transmissibility study

- ✓ **First eigenfrequency measured:**
  - ➢ **With no masses: 74Hz (Q=12)**
  - ➢ **Masses of 1400Kg: 46Hz (Q=9)**
- ✓ **First eigenfrequency simulated:**
  - ➢ With no masses: 56Hz
  - ➢ Masses of 1400Kg: 26Hz

➔ Simulations done: gives a good idea of eigenfrequency evolution with masses and boundary conditions

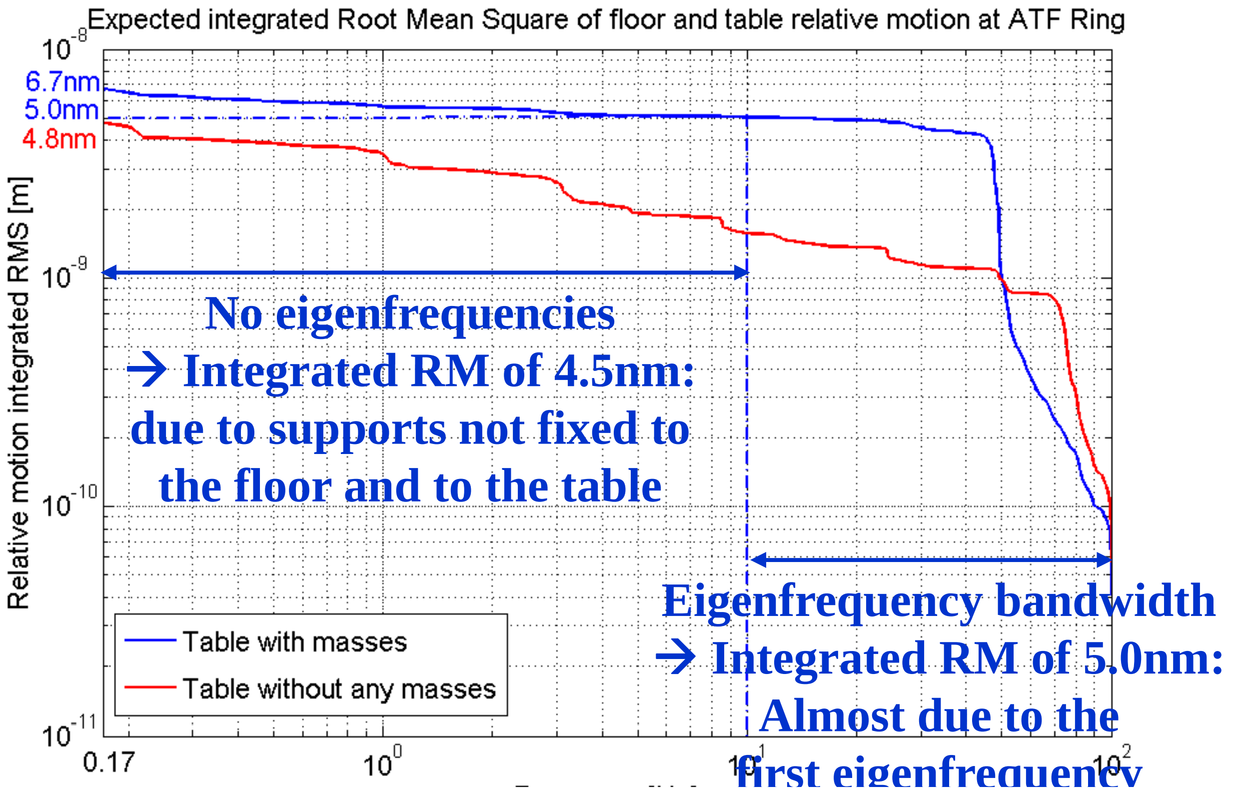
✓ **Other table transfer function peaks: Due to the fact that supports are not fixed to the table and to the ground**

lapp



Field strength error giving 2% effect on beam size
ΔK/K
(K, Ltot)
ILC
ATF2
2% effect
on beam size
Jitter position error giving 2% effect on beam size
Δy_jitter
(σx ,σy)
2% effect on beam size
Magnet tilt error giving 2% effect on beam size
Δtilt
(σx/σy)
2% effect
on beam size
2% effect on beam size
For QD0 at ATF2: 6nm tolerance

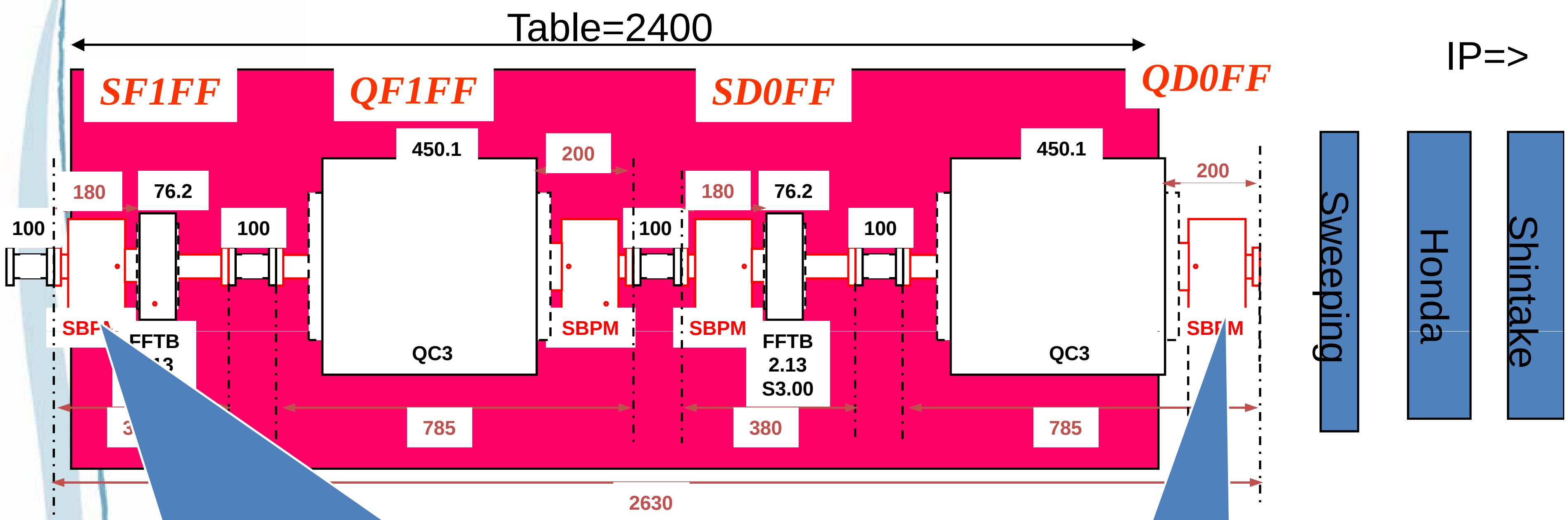
Relative motion between table and floor at ATF Ring



- **Integrated RMS of relative motion with masses of 1400Kg:**
  - **From 0.17Hz to 100Hz: 6.7nm → Above ATF2 tolerances (6nm)!!**
  - **From 10Hz to 100Hz (first eigenfrequency bandwidth): 5.0nm→ Tight**

Mainly due to "low" eigenfrequency from 4 supports=>better with whole surface support: e-f will be above 100Hz and will not enhance in frequency range of interest

FD configuration (T.Okugi's presentation)



S-band BPM slightly outside table on a "light" Sextupole=> how will the S-band BPM be supported?

Does this BPM need to be supported?

What we need to define

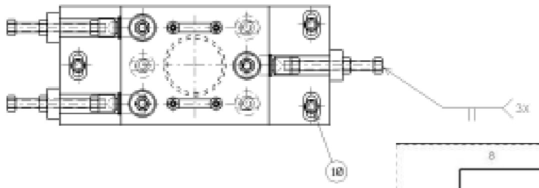
How do we attach the movers to the table?

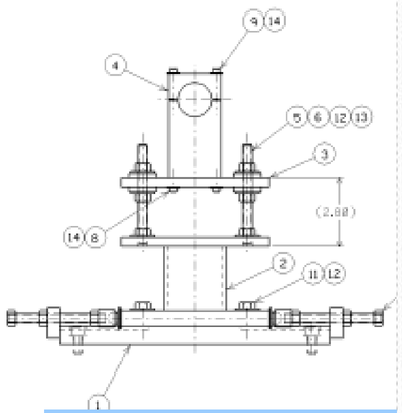
How do we compensate for the height difference to the beam?

How do we attach the table to the floor?

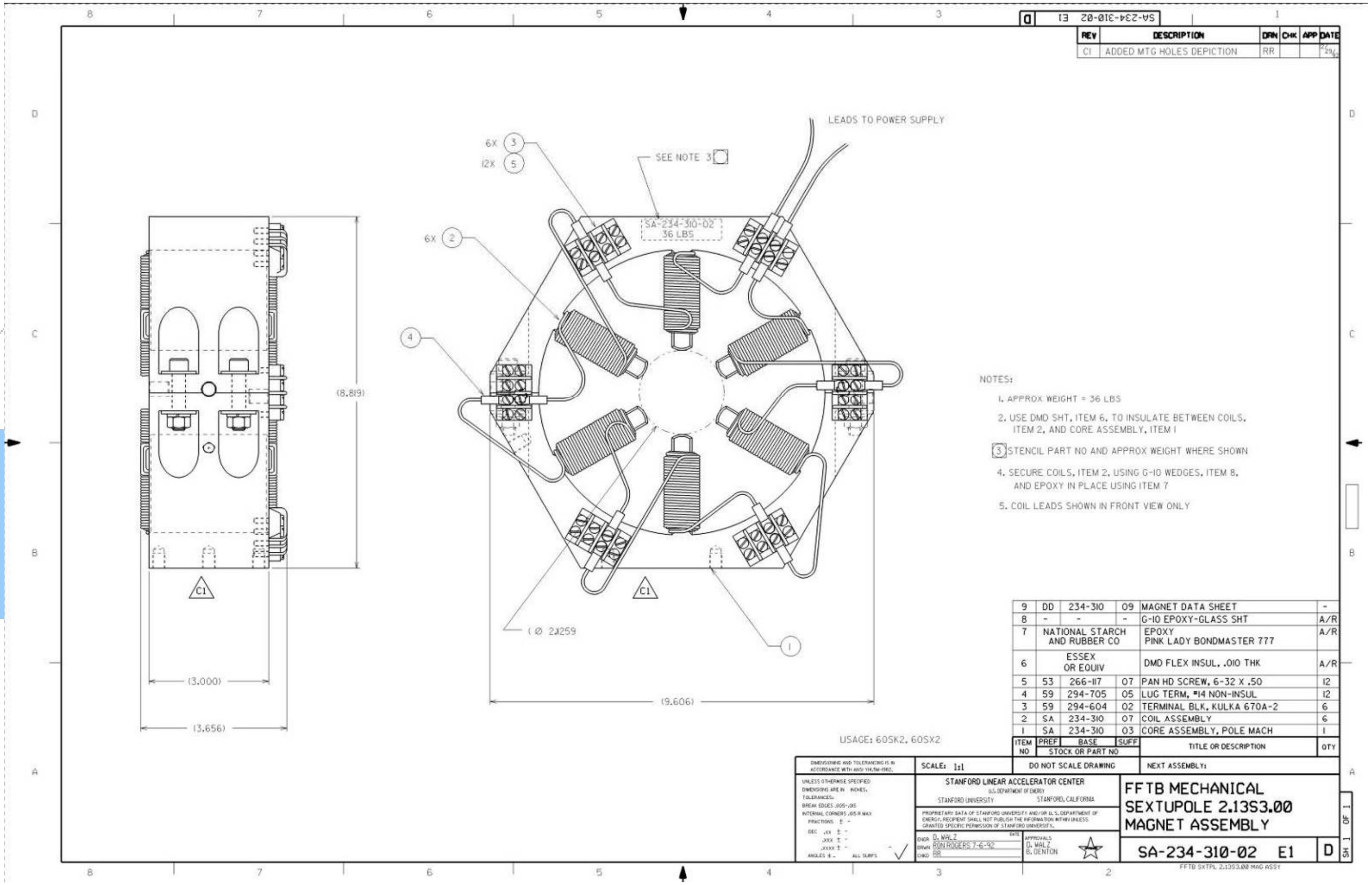
These two items will be solved with the same mechanical "assembly"

Still defining the sextupole support

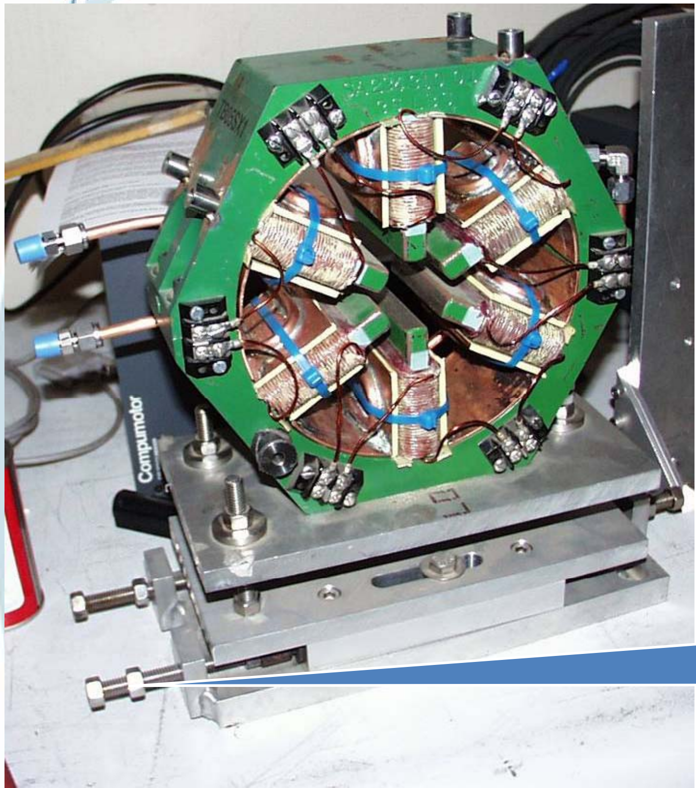




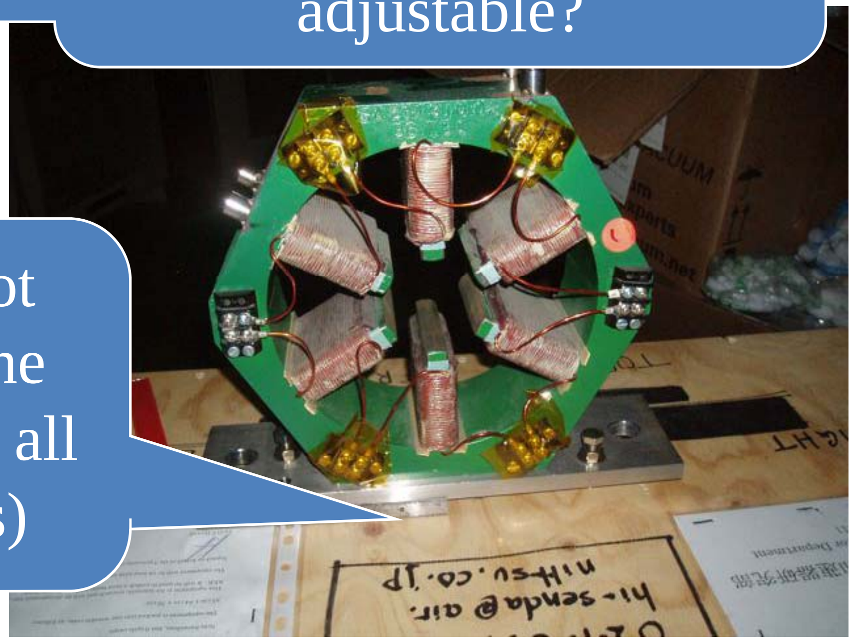
Adjustable support: existing?



Solid Wire Sextupoles

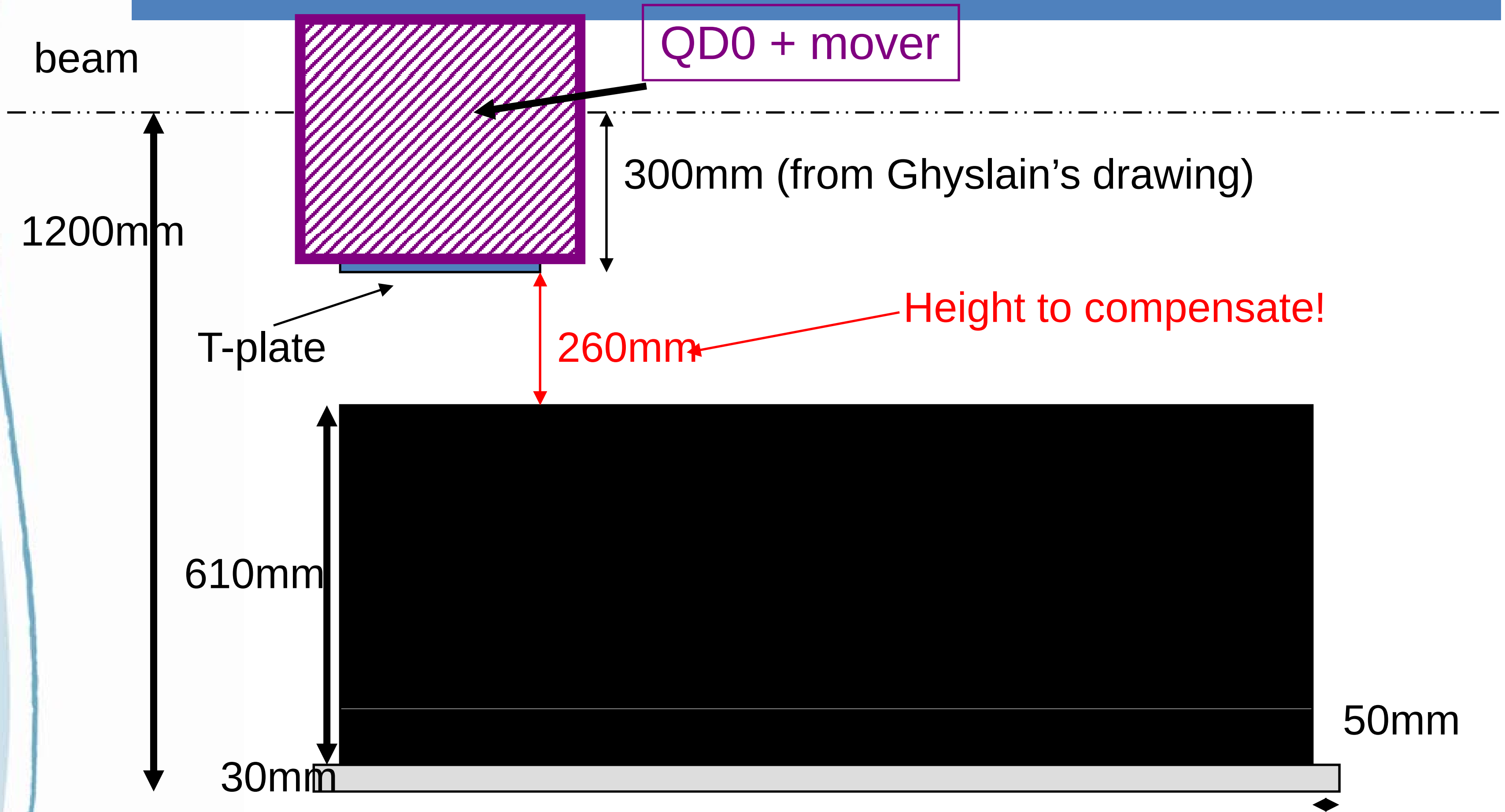


Already adjustable: our support will not need to be adjustable?



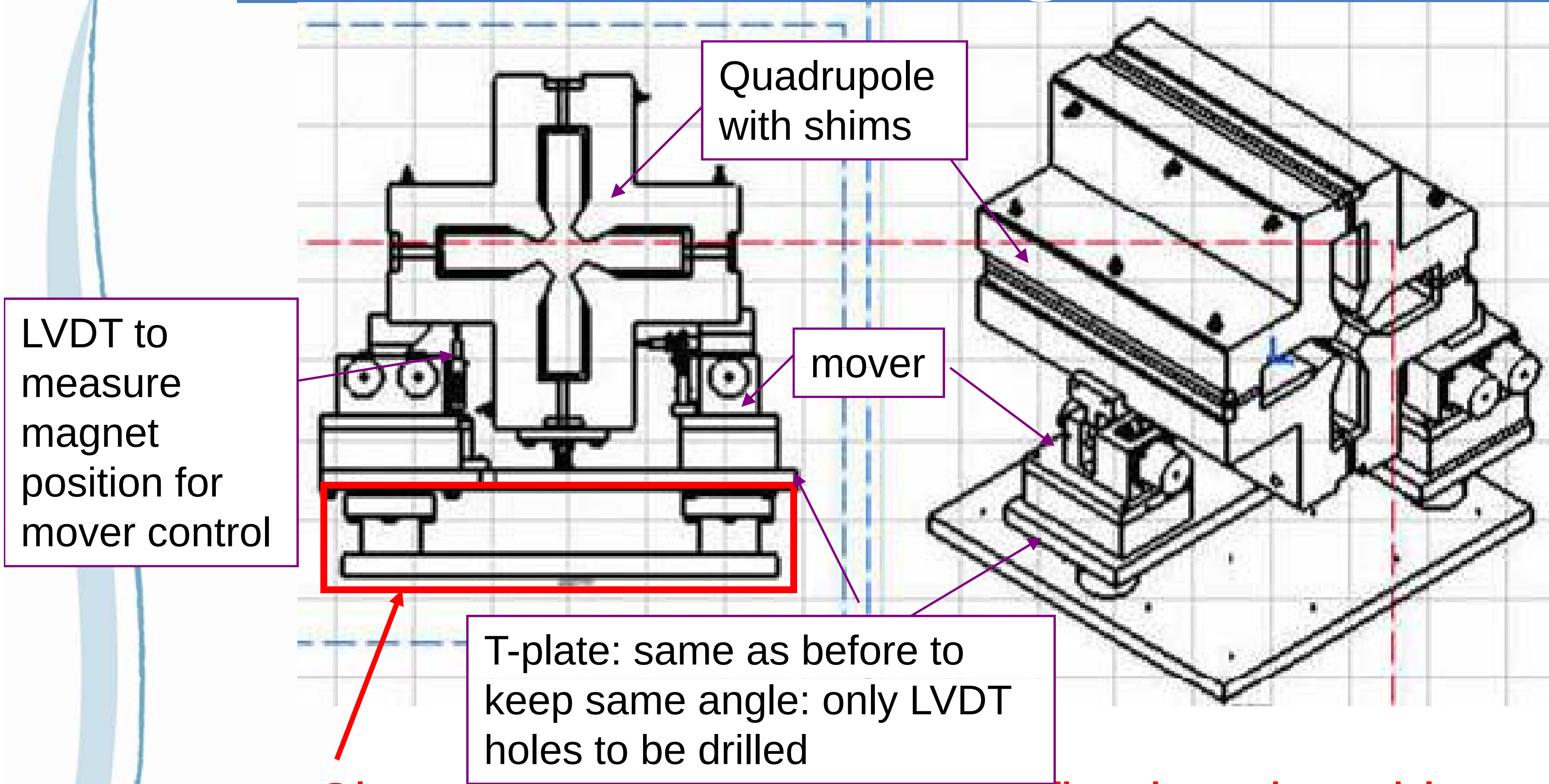
New supports that are not adjustable: we will use the "quad" support design for all FD magnets (next slides)

Current QD0 configuration



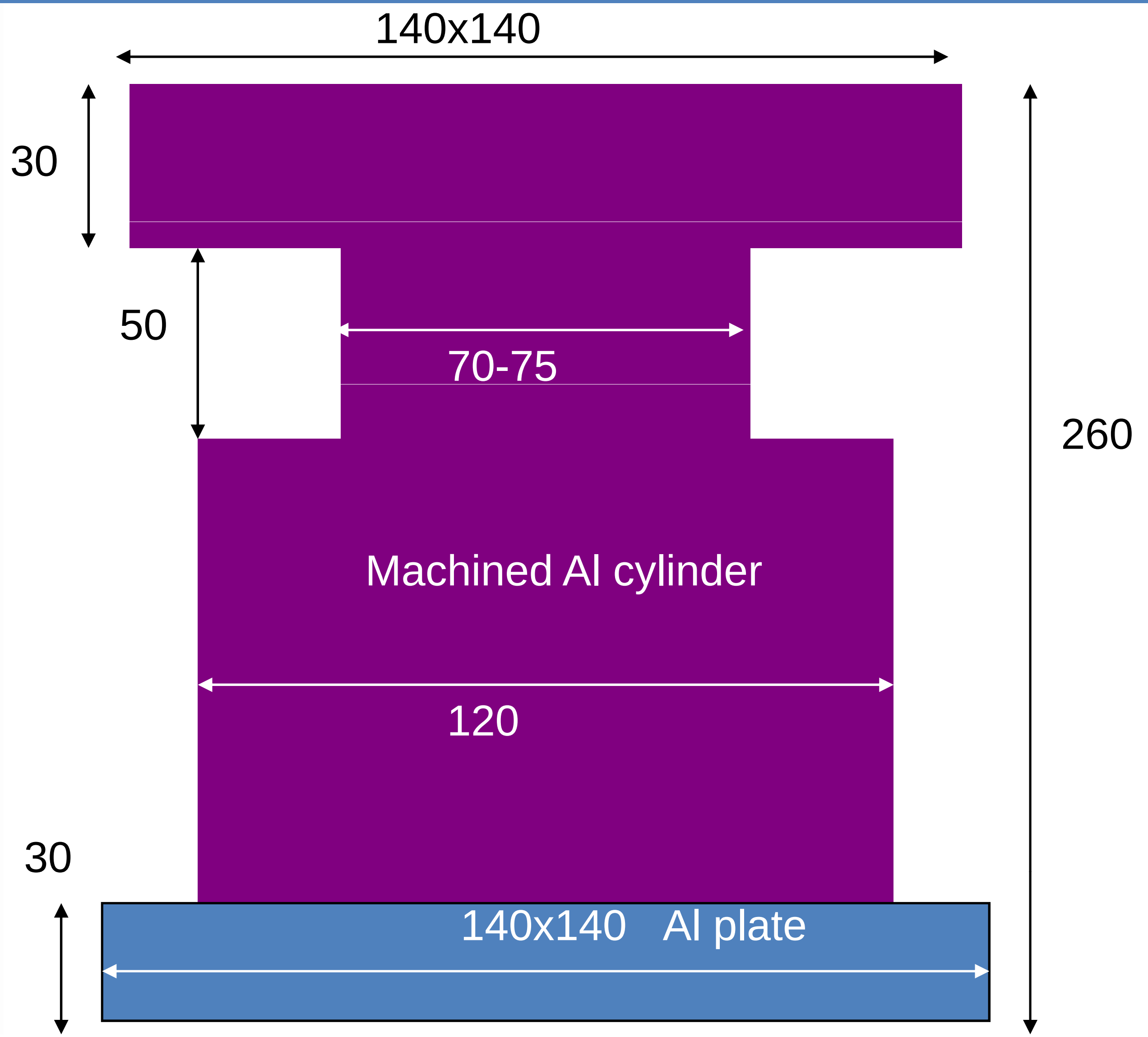
Idea for 260mm support is to have a bottom plate clamped to the bloc with some possibility of adjusting the position with big screws

Compensate the height to reach beam height

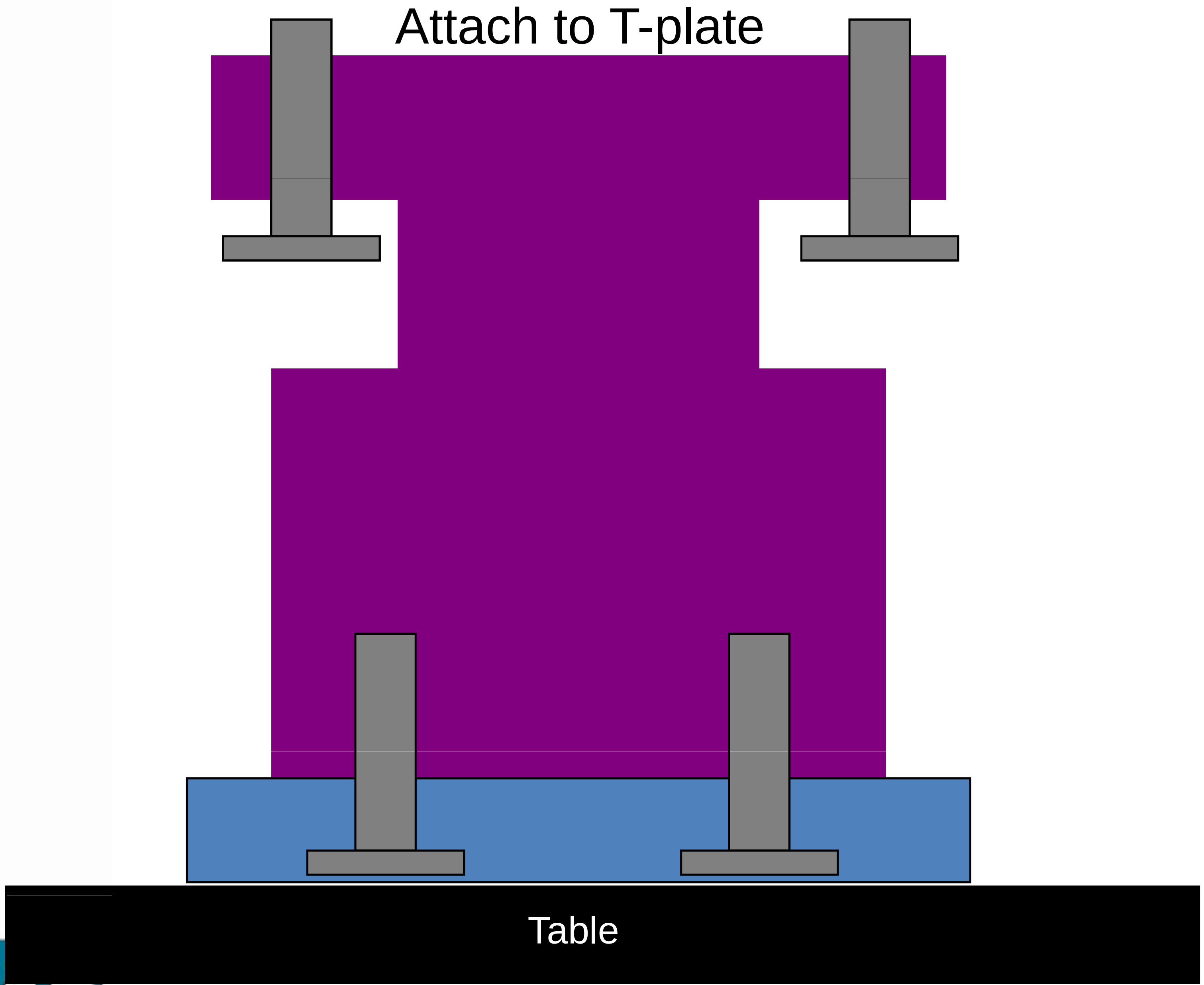


Change the way the mover is fixed on the table

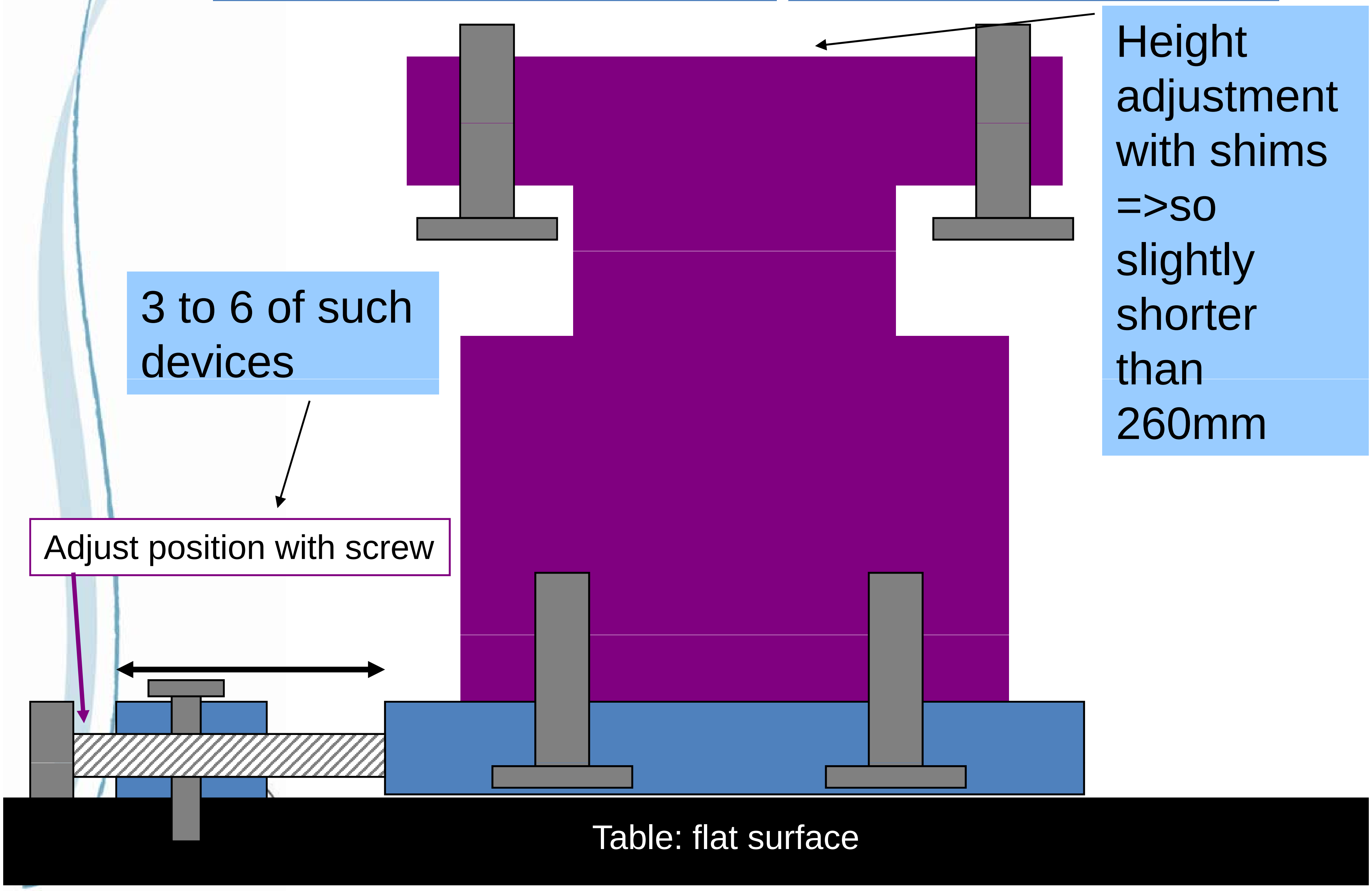
“base-plate” and “foot”



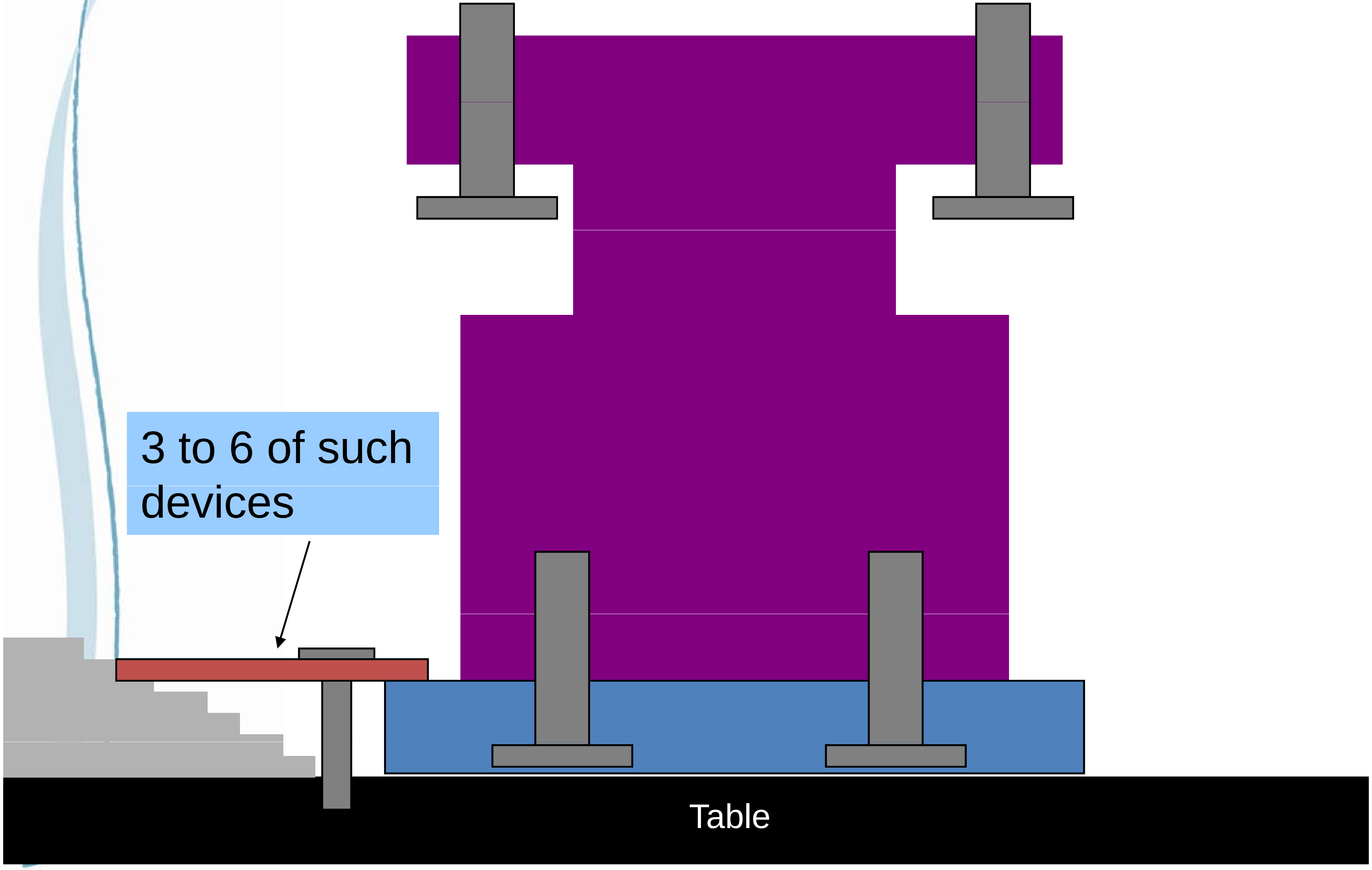
Assembly



Position adjustment

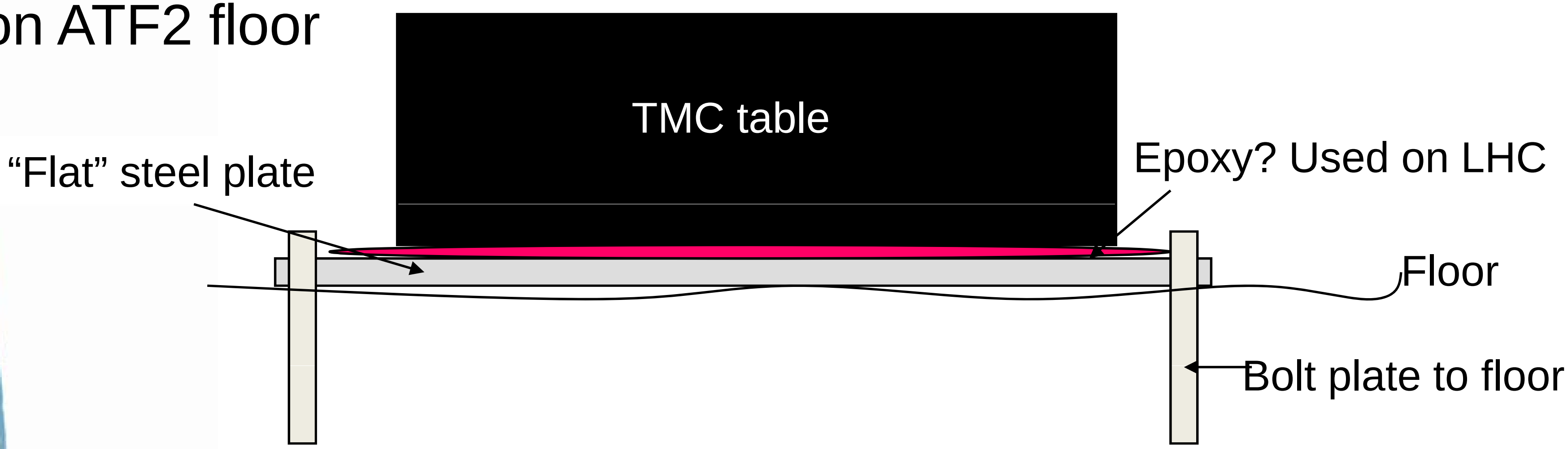


Final position: clamped to table



How to attach the table to the floor

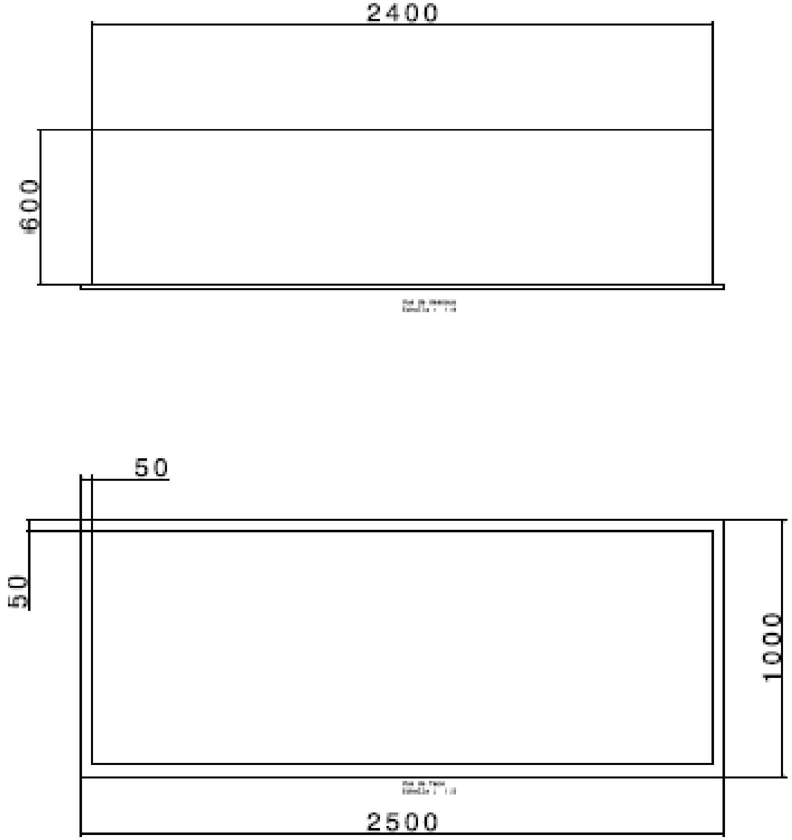
Glue table to large plate, and bolt plate to floor:
- Follow block simulation to attach on whole surface
- Bolt all around the table to keep some flexibility for position on ATF2 floor

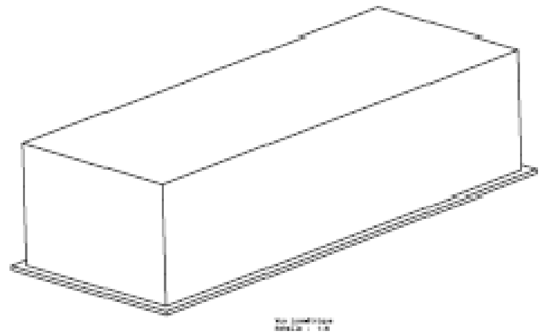


When do we "glue" the plate to the block?
- At LAPP to do the measurements?
- At KEK to follow the final floor "imperfections"?

Table base plate drawing

Need to fit with the Shintake monitor support: see next talk

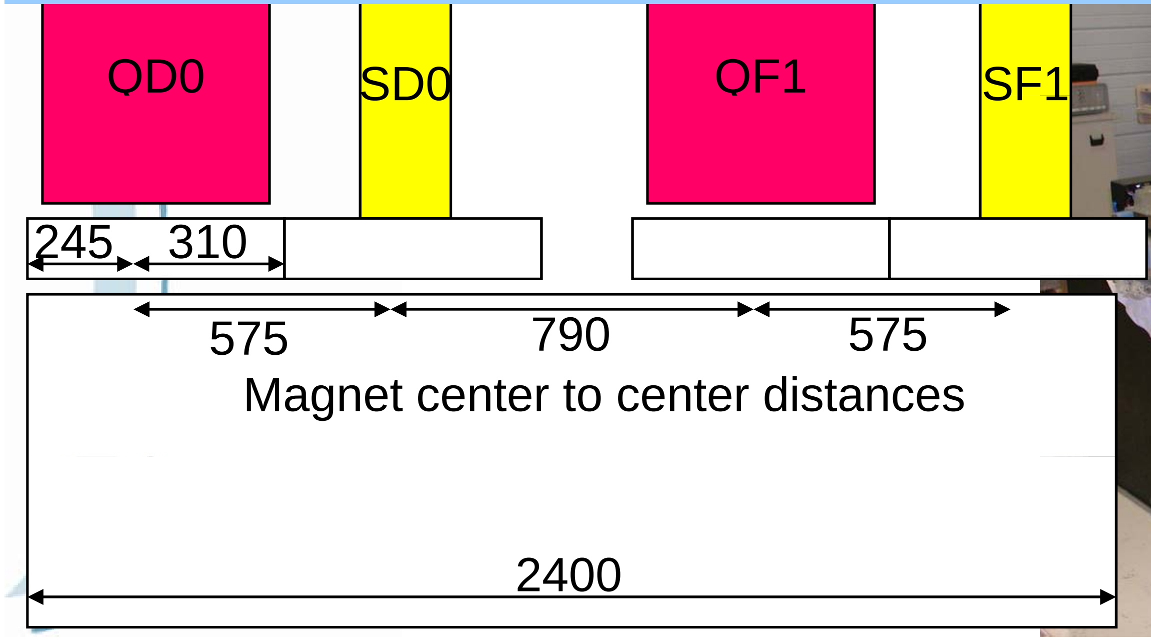




Next step: vibration measurements

Measurement with final “real” objects at LAPP (easier to measure or modify at LAPP than at KEK during the installation rush! Redo once installed at KEK):

- New higher supports
- Movers
- Quadrupoles and sextupoles
- Waterflow?
- Final steel plate underneath?



Schedule (subject to discussion)

- February: arrival of new table ("old" belongs to CERN)
- February: vibration measurements
- March: arrival of new mover parts
- March-April: vibration measurements with magnets
- May: vibration measurements with water flow? Do we need with Cherrill's vibration measurements?
- May-June: shipment to KEK
- June-July: installation => but what about access while Shintake monitor commissioning?
- If magnets to be shipped by June, need one month to prepare and ship and receive at KEK, need about two months of measurements so everything should be at LAPP before March.

Candidate as stiff support

✓ **Candidates as stiff support for the last magnets (for large sizes)**

	Steel lightweight honeycomb table	Solid-composite laminate	Granite table
Stiffness	Very stiff	Very stiff	Very stiff
Amplification factor Q	High level of dry damping → Q~4	Moderate levels of damping	Low levels of damping → Q~460
Mounting to surfaces	Best for bolt-down mounting	Difficult to securely mount object to	No large number of mounting holes
Nonmagnetic properties	Nonmagnetic stainless steel	Ferromagnetic stainless steel	Yes
Weight	light	heavy	heavy
Thermal proper.	very good	good	bad
Cost	high	Very high	Very very high

→ **Steel honeycomb table: Good candidate as a support for magnets**