ATF2 project: Investigation on the honeycomb table vibrations

Laboratories in Annecy working on Vibration Stabilization

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Presentation

✓ **ATF2 constraint:** Relative motion between the Shintake monitor and the final magnets < 6nm

✓ **ILC configuration:** Final magnets and Shintake monitor on 2 separate supports

✓ **ATF2 floor:** Coherence of ground motion good up to a distance of 4-5m (4m: distance between Shintake monitor and the last magnets)

✓ **First idea:** Shintake monitor and last magnets movement same than the ground

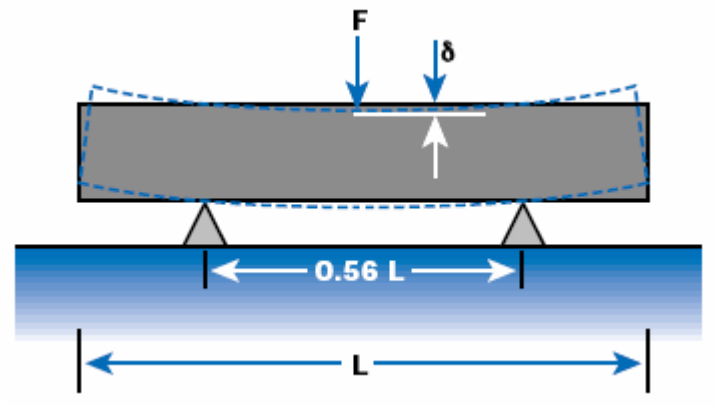
→ Necessity of having stiff supports well fixed on the floor in order that these supports move like ground motion

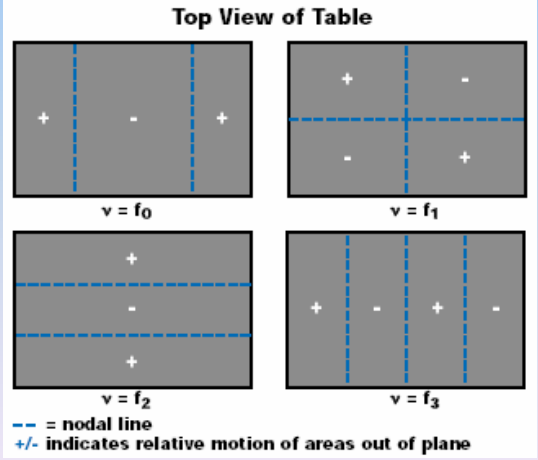
Presentation

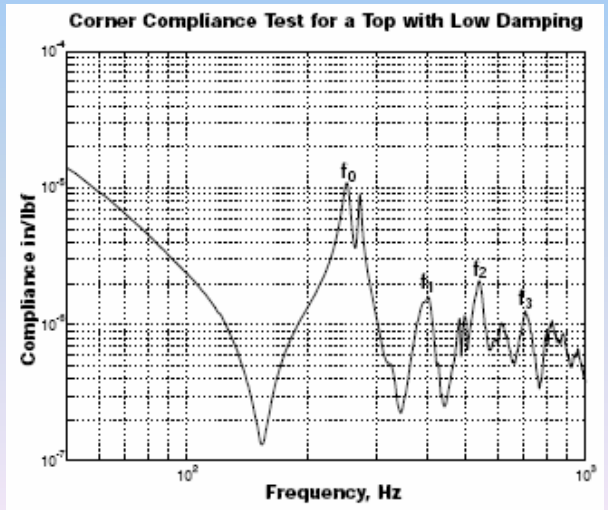
✓ **At LAPP: Very stiff honeycomb table with a first eigenfrequency guaranteed to be at 230Hz by TMC company**

→ Measurements done with an impact testing hammer

→ Table supported at four points, along the 2 nodal lines of the lower mode situated at 22% from the ends of the table







Presentation

- ✓ **Honeycomb table:** Good candidate as a support for magnets

  → **But need to find a way to fix this table on the ground**

- ✓ **LAVISTA team: Investigation on our honeycomb table**
  - ➢ Fixation of the table on the ground
  - ➢ Table transfer function measurement
  - ➢ Coherence between the floor and the table measurement
  - ➢ Relative motion between the table and the floor measurement

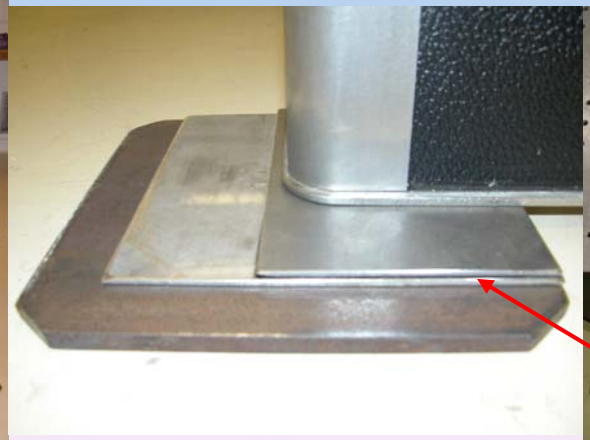
    → We are still working on (try to find a way to calculate it)

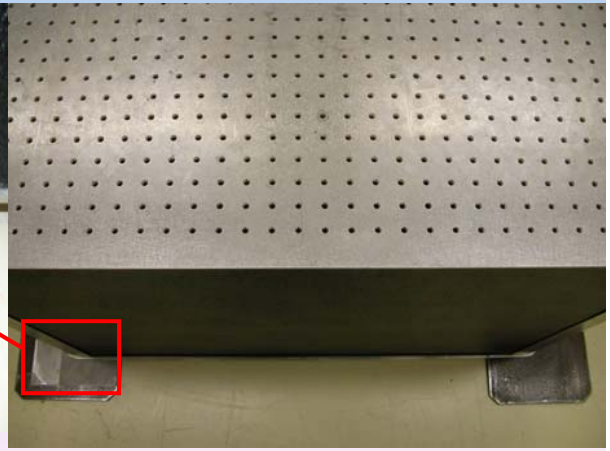
Experimental set-up

✓ **Ground not flat at all:** Positioning of 4 high steel supports of the same layer (with a thickness precision of 0.1mm) between the ground and the four corners of the table

→ Gap of 5mm between the top of a support and the bottom of one table corner

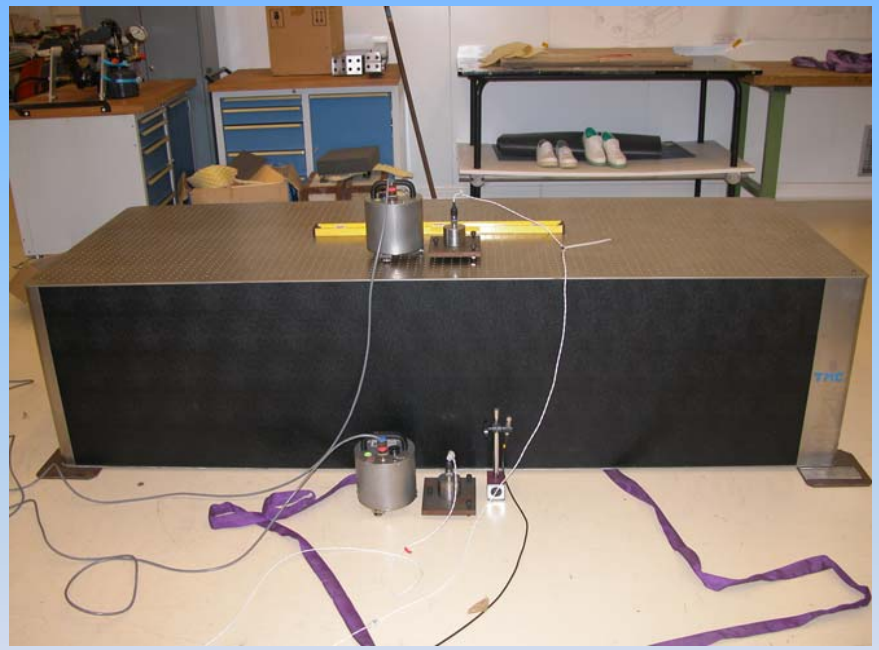
✓ Not to have this gap anymore: positioning of 2 home-made spacers with a thickness precision of 0.1mm

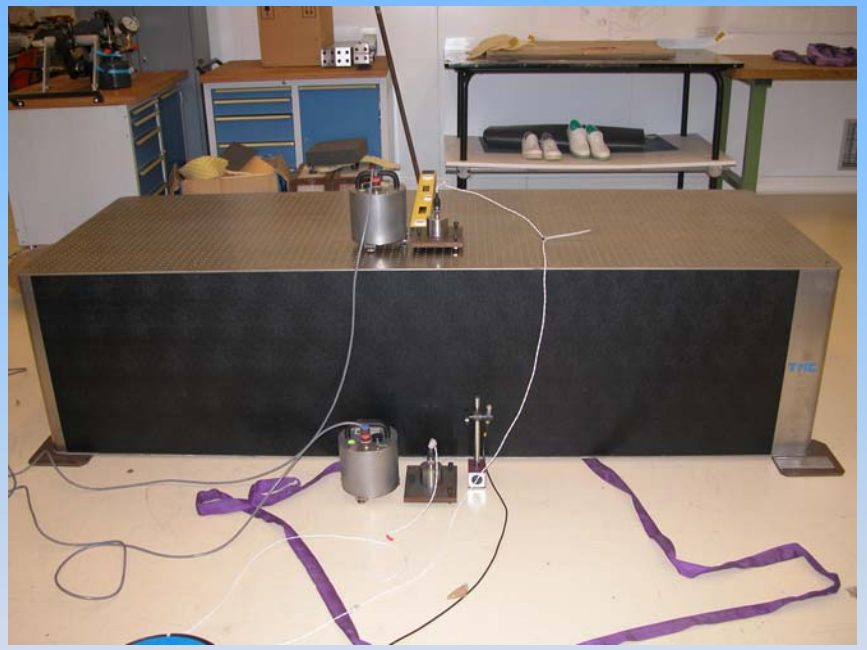




Experimental set-up

- ✓ Checking that the table is leveled thanks to a spirit level





Experimental set-up

Sensors	Guralp CMG-40T	ENDEVCO86
Measurement directions	X, Y, Z	Z
Sensitivity	2000V/m/s	10V/g
Frequency range	[0.033–50]Hz	[0.01–100]Hz
Quantity	2	2

✓ **Limitation of the measurement:**

→ **Guralp sensors:**

- **From 0.1Hz:** Electronic noise too high below
- **To 50Hz:** Frequency response not flat above

→ **ENDEVCO sensors:**

- **From 10Hz:** Electronic noise to high below
- **To 100Hz:** Frequency response not flat above

Experimental set-up

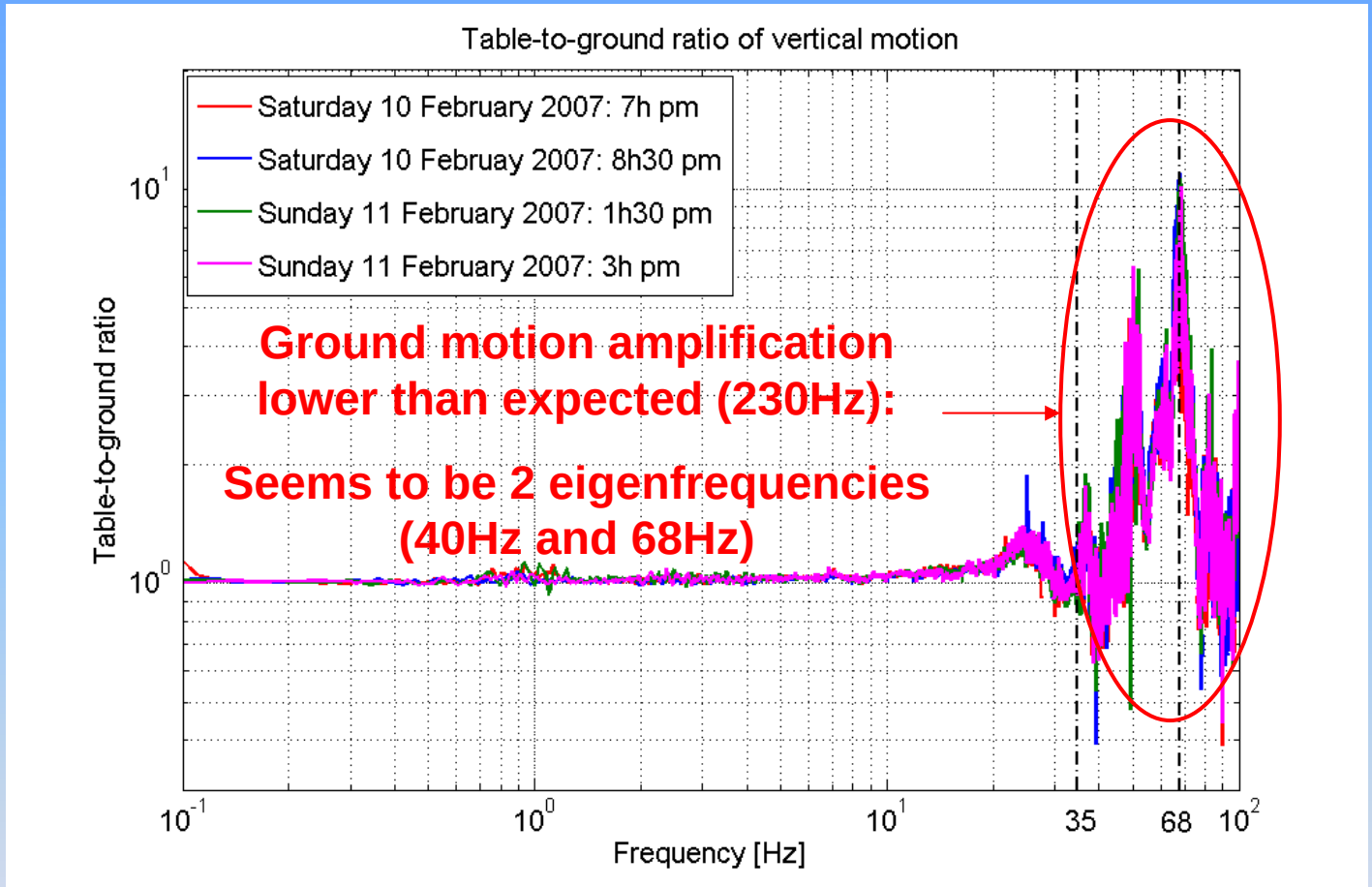
✓ One Guralp velocity sensor on the floor and the other one on the table to measure low frequency vibrations in the X, Y and Z directions (0.1Hz to 50Hz)

✓ One ENDEVCO accelerometer on the floor and the other one on the table to measure medium frequency vibrations in the Z directions (10Hz to 100Hz)

✓ One microphone on the floor to study acoustic effect on the table behaviour

✓ Simultaneous measurements of the 4 sensors in the Z direction

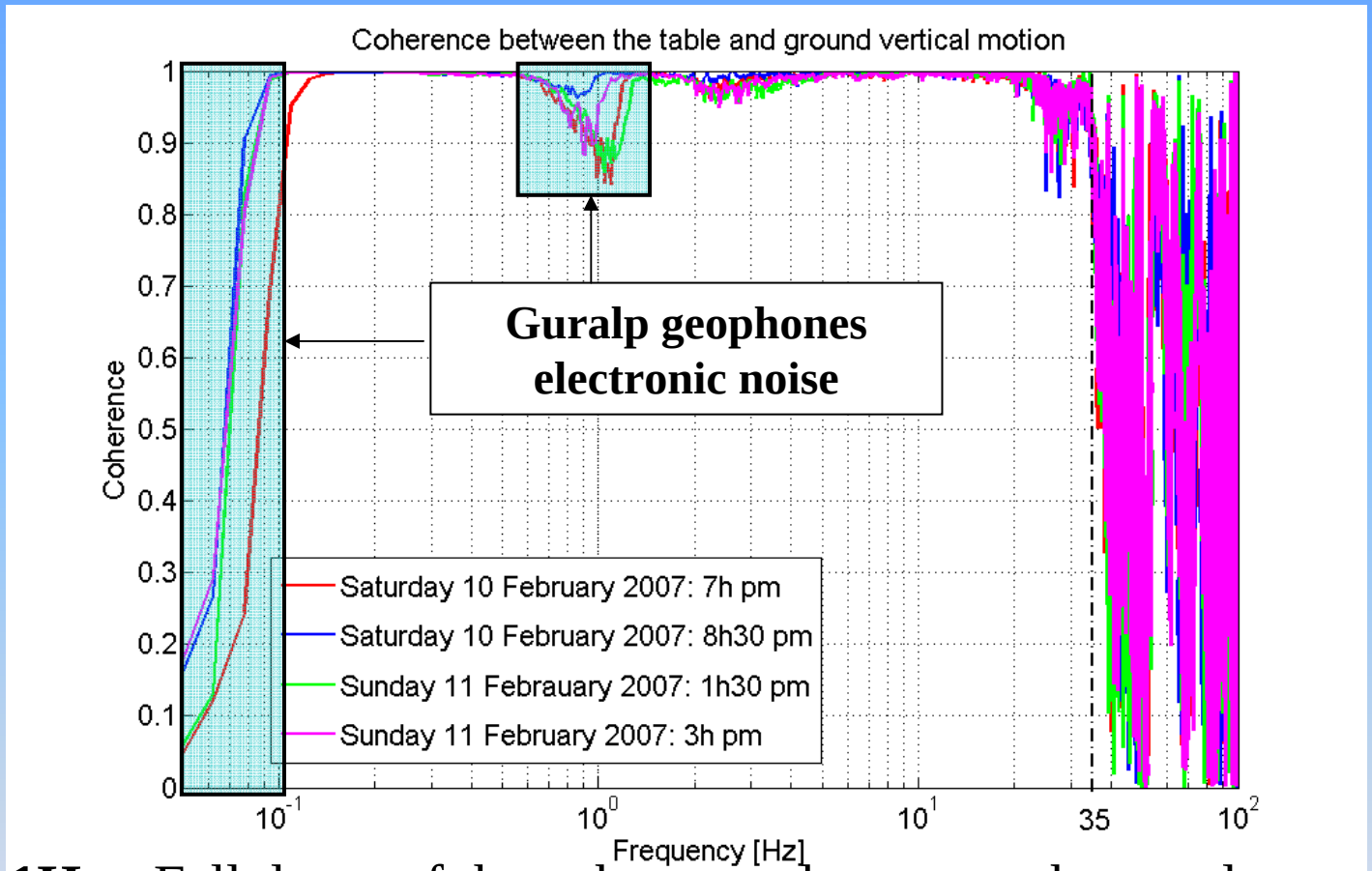
Table-to-ground ratio of vertical motion



- ✓ **Up to 35Hz:** Table-to-ground ratio around 1
  → No big amplification or damping done by the table

- ✓ **Above 35Hz:** Increase of table-to-ground ratio
  → Ground motion amplification done by the table up to a factor 11 at 68Hz

Coherence between the table and ground vertical motion



✓ **Below 0.1Hz:** Fall down of the coherence due to geophones electronic noise

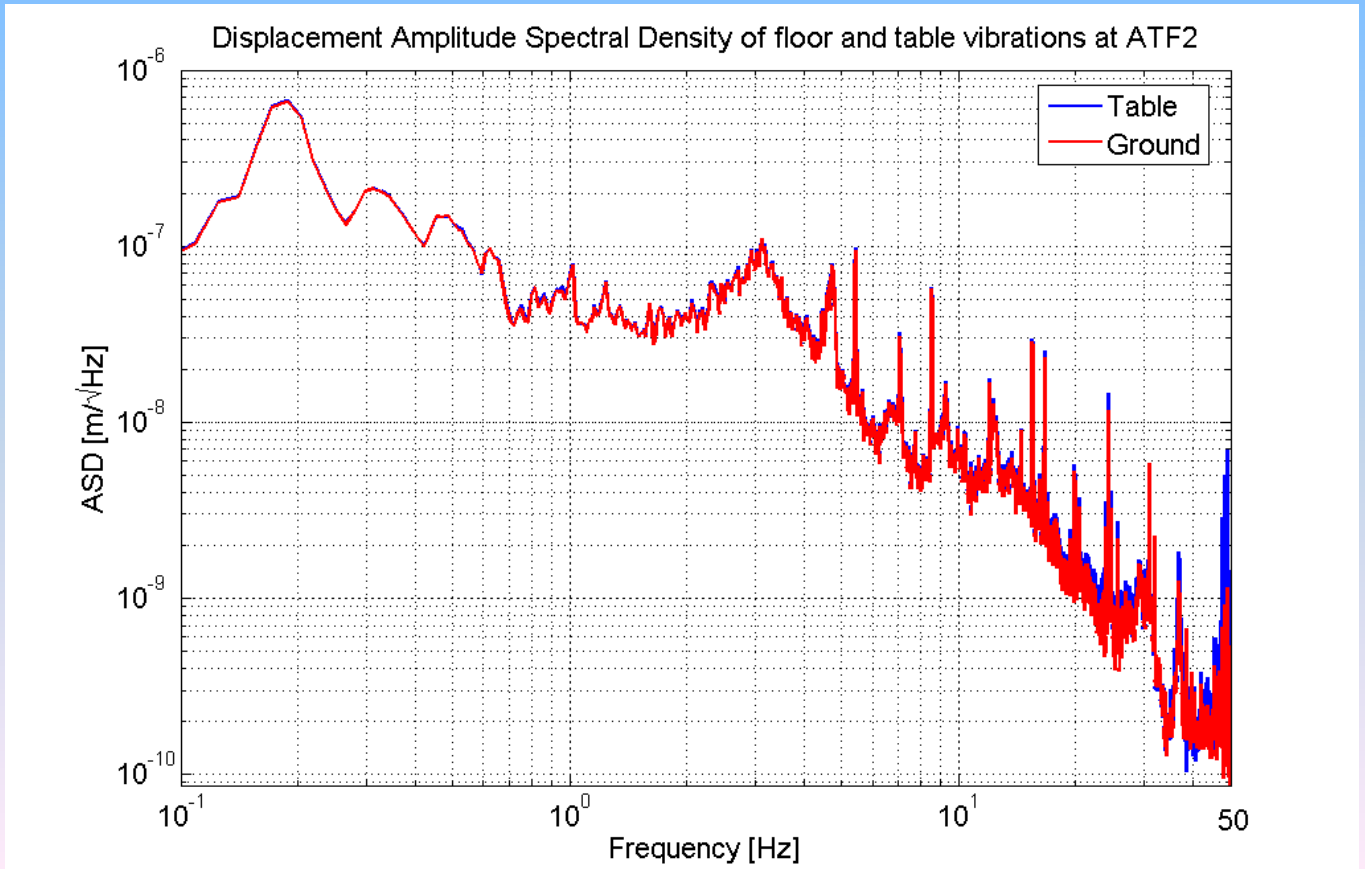
✓ **Up to 35Hz:** Coherence very good (except around 1Hz because of geophones electronic noise)

✓ **Above 35Hz:** Fall down of the coherence because of the big ground motion amplification by the table

Expected table vibrations on the ATF2 floor

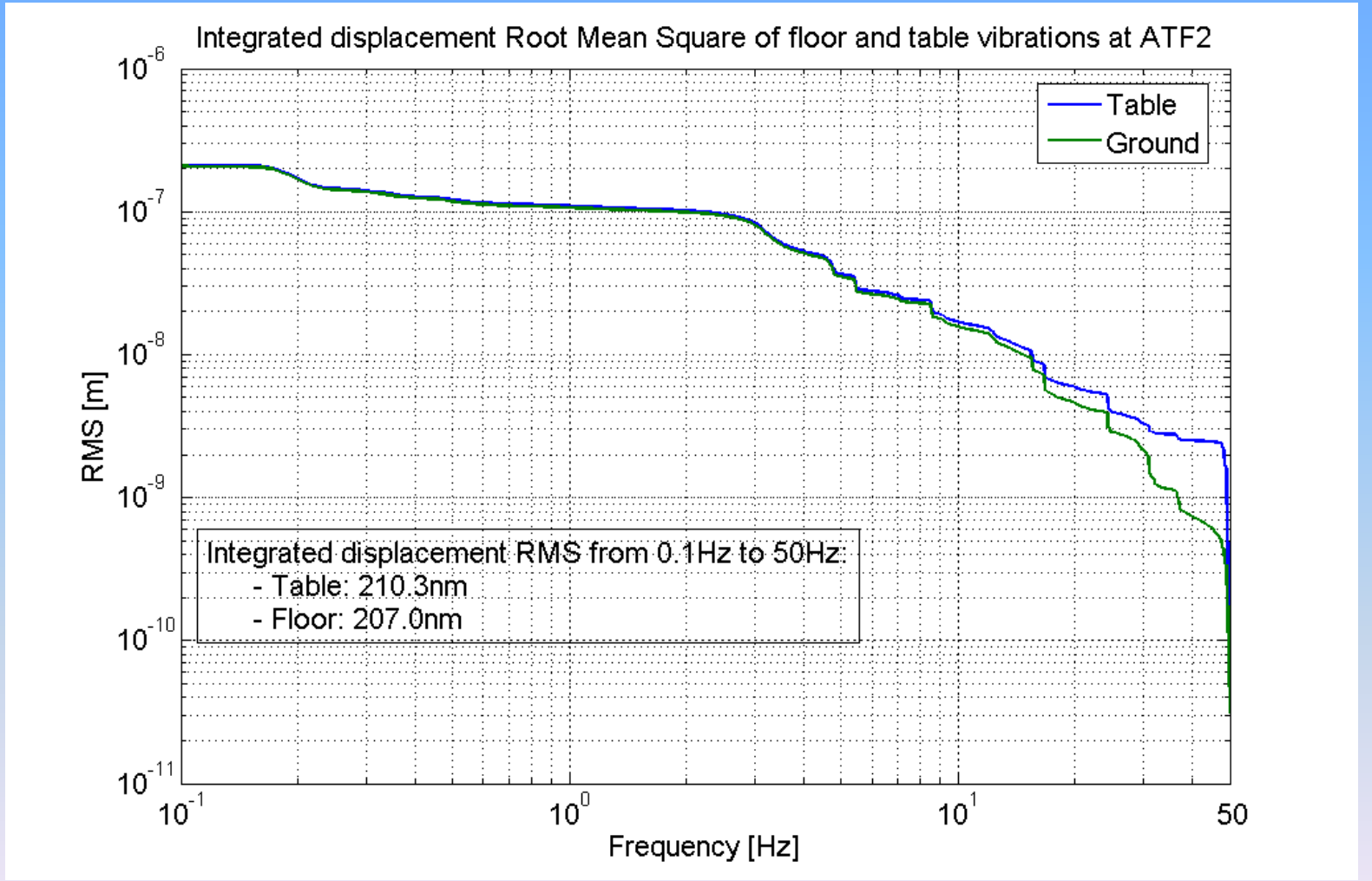
- ✓ **Data taken: File 011**
- ✓ **Amplitude spectral Density (ASD) of the table vibrations at ATF2**

  = Transfer function of the table*ASD of ATF2 floor vibrations



Expected table vibrations on the ATF2 floor

✓ Integrated displacement Root Mean Square (RMS):

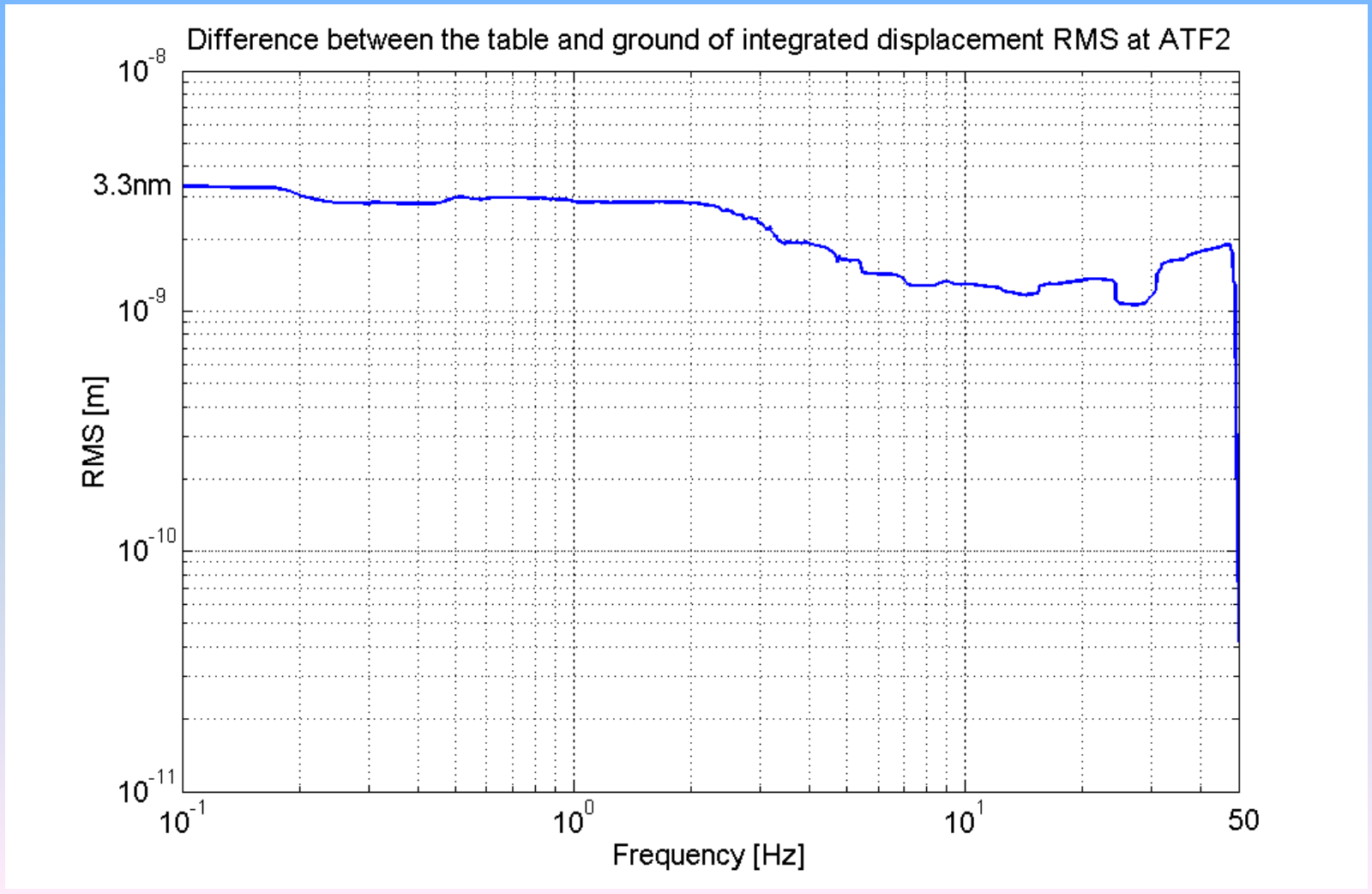


✓ Difference of integrated displacement RMS from 0.1Hz to 50Hz: 3.3nm!!!

Expected table vibrations on the ATF2 floor

✓ Difference of integrated displacement RMS between the table and the floor

= integrated displacement RMS of the table - integrated displacement RMS of the table



Conclusion of these measurements

✓ Difference of integrated displacement RMS from 0.1Hz to 50Hz: 3.3nm!!!

✓ Relative motion tolerance between Shintake monitor and final magnets: 6nm

→ **Good results of relative motion obtained but are worse in reality:**

- Coherence not at 1 up to 50Hz (but at 1 up to 35Hz): Need to know how to calculate the relative motion which takes into account the phase
- Ground motion at ATF2 measured up to 50Hz: Need to measure it up to 100Hz because ground motion amplification is from 35 to 100Hz

- Necessity to understand why the first eigenfrequency is at so low frequency and to try to push it at higher frequency

→ Goal: To get a good coherence at least up to 50Hz

Why does the table amplify ground motion at low frequency?

✓ First eigenfrequency table guaranteed to be at 230Hz by TMC company

✓ Ground motion amplification on the table begins at 35 Hz with its maximum at 68Hz

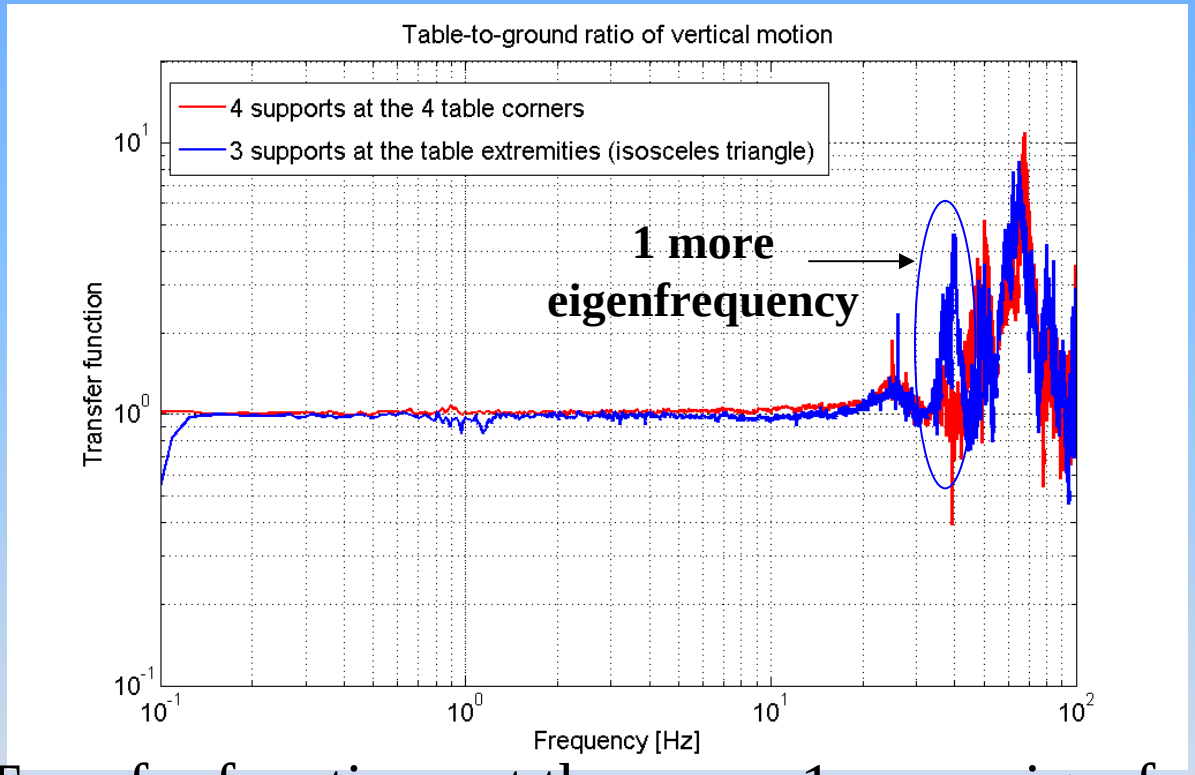
✓ Reason: probably because of the way the table is put on the floor

→ Rocking motion of the table on the support

→ Insufficient rigidity at the contacts of intermediate supports

Why does the table amplify ground motion at low frequency?

✓ **For the rocking motion of the table : 3 supports put instead of 4**



➢ Transfer function not the same: 1 more eigenfrequency at 40Hz

→ Confirm that ground motion amplification is due to the way the table is put on the floor

➢ Results not better with 3 supports instead of 4

Why does the table amplify ground motion at low frequency?

✓ TMC company: Table supported at 4 points to find the first eigenfrequency at 230Hz

- ➢ But no details about supports used to do their tests

→ TMC company has been contacted

- ➢ They will respond us soon about supports for honeycomb table

✓ But in TMC internet site, rigid supports suggested for honeycomb table

- ➢ Low price, adjustable height
- ➢ In the installation set-up of these supports:
  - → Need to fix these supports on the ground with bolts
  - → Need to fix these supports on the table with bolts

Rigidity at the contacts of intermediate supports

http://www.techmg.com/products/posts/4postsystem.htm

General conclusion and future prospects

✓ First good results of relative motion obtained with the honeycomb table and our supports but with the assumption that coherence is at 1

- ➢ Necessity to find a better way to put the table on the ground in order not to have ground motion amplification anymore and to have a coherence at 1 at least up to 50Hz

→ For that:

- ➢ Necessity to have very rigid supports
- ➢ Necessity to fix supports on the ground with bolts
- ➢ Necessity to fix the table on these supports with bolts

✓ Try to make better home-made supports and to fix as described below supports on the ground and the table on supports

✓ Or we can buy supports at TMC company and fix them on the ground