Work plan for CLIC-ATF2 collaboration about final focus system stabilization

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Context

- ✓ **To have only 2% error on the beam size measurements at the IP, tolerance of vertical relative motion above 0.1Hz between:**
  - Shintake Monitor and QF1: 20nm
  - Shintake Monitor and QD0: 7nm

- ✓ **ATF2 ground motion coherent between Shintake and final doublets**

➔ **Choice of the collaboration:** Shintake Monitor and final doublets fixed to the ground with separate stiff supports (like ILC configuration)

- They move like that in a coherent way

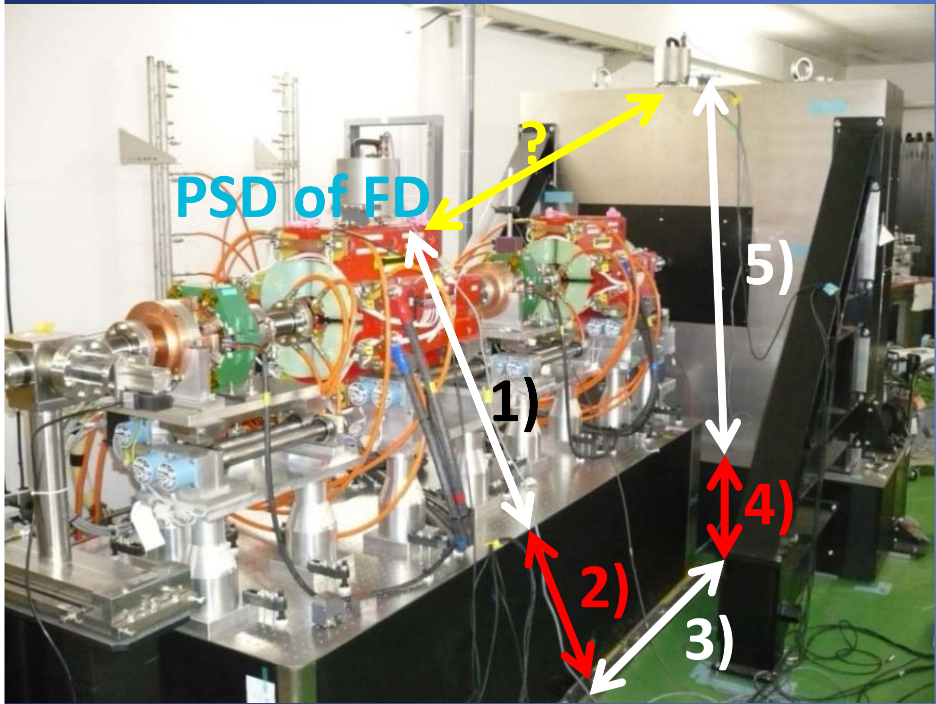
- ✓ **In 2010, we want to actively stabilize final doublets and Shintake Monitor separately in order to have a prototype for CLIC project**
  - Tolerance of CLIC project at the IP: 0.1nm above 4Hz
  - This prototype should be useful for ATF2

Update of the ATF2 ground motion generator

- ✓ **Measurements of ground motion coherence on the whole ATF2 beam line from the Shintake Monitor**
  - ➢ For the following distances: 0m-1m-2m-3m-4m-5m-6m-7m-8m-9m-10m-15m-20m-25m-30m-35m-40m
  - ➢ In the 3 directions of space to analyse correlation between them
  - ➢ With GURALP geophones from 0.2Hz to 50Hz
- ✓ **Fit 2D ground motion generator parameters on measurements with Yves Renier generator**
  - ➢ Reproduction of spatial/temporal spectra to use for ATF2 simulations

Best curve of stabilization for final doublets and Shintake

✓ Relative motion calculation between Shintake Monitor (SM) and Final Doublets (FD) with the Transfer Function (TF) of a stabilization system



1) TF between FD and table (measured)

×

2) TF of active system for FD (to be find)

×

3) Floor TF between FD and SM (measured)

×

4) TF of active system for SM (to be find)

×

5) TF between SM and table (measured)

=

FD motion PSD

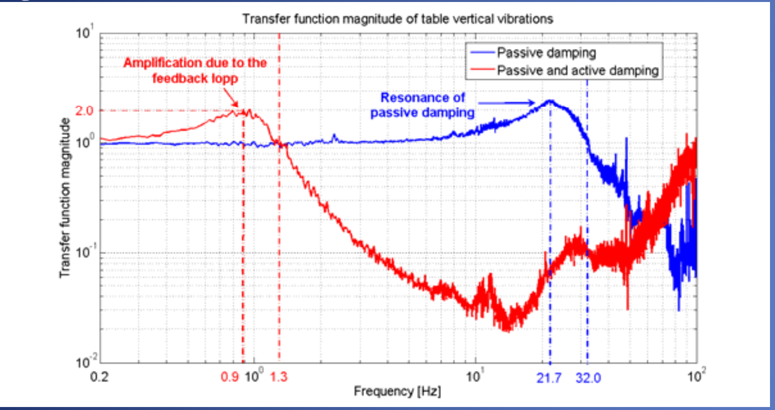
$$RMS_{\text{int y-x}}(k) = \sqrt{\sum_{k_1}^{k_2} [H(k)-1][H^*(k)-1] PSD_x(k) \Delta f}$$

Integrated RMS of relative motion between SM and FD

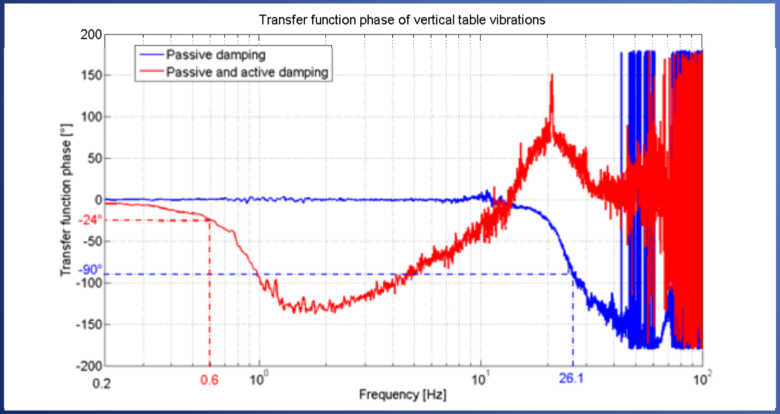
Best curve of stabilization for final doublets and Shintake

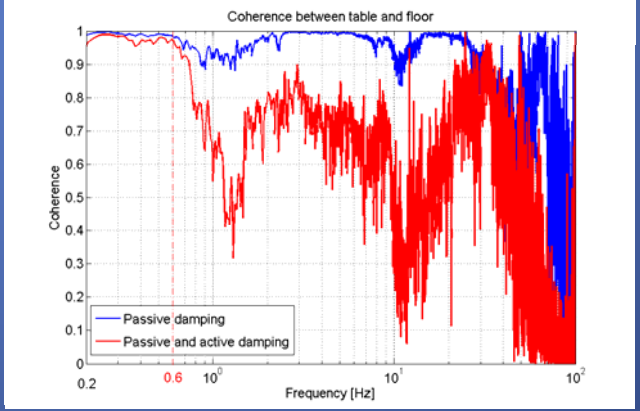
CERN stabilization system (STACIS 2000)

✓ **To determine a realistic transfer function for the stabilization system, the one of the CERN stabilization system can help**



- Amplification below 1.3Hz of factor 2 but constructor data gives one of 1.1 if gains of the system are well adjusted
- Damping above 1.3Hz

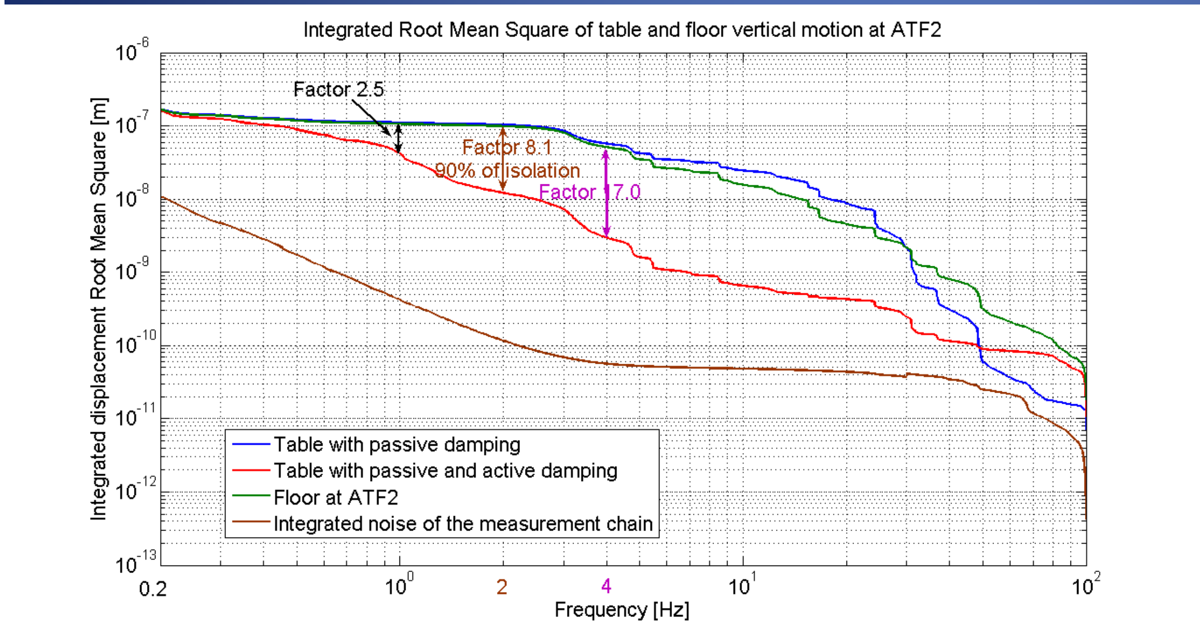




- Where the slope of the amplification is the highest ([0.6; 1.3] Hz) and above 1.3Hz (damping), phase difference is high (and coherence falls)

Best curve of stabilization for final doublets and Shintake

CERN stabilization system (STACIS 2000)



- ✓ **Damping factor of:**
  - ➢ 2.5 above 1Hz
  - ➢ 8.1 above 2Hz (90% of isolation)
  - ➢ 17 above 4Hz

✓ To stay realistic, we should not design a damping factor more than 17 in term of integrated RMS of motion

✓ If the gains of the system are well adjusted, amplification should be lower (1.1 instead of 2.0) and the factor 17 may be achieved above 1Hz

Best curve of stabilization for final doublets and Shintake

✓ Calculation of relative motion between Shintake and final doublets by incorporating the transfer function of an active stabilization system:

1. The one of the CERN (STACIS 2000) which damps vibrations >1.3Hz

2. The same one but with lower amplification factor (constructor data give an amplification factor of only 1.1 if gains of the system are well adjusted)

3. The same one but with no amplification factor if we assume that we can build a such system

4. One which damp vibrations above 10Hz (because coherence between final doublets and Shintake is anyway lost) with/without amplification

➢ **Relative motion should be lower than the one we have now at ATF2 (fixation of final doublets and Shintake Monitor to the floor)**

Usefulness of uspstream magnets stabilization

✓ Simulations of the integrated vibrations at the IP to know which magnets upstream final doublets induce more of beam deflections

✓ In fact, it can be interesting to incorporate an active stabilization for these magnets since coherence is lost between Shintake and them

✓ Simulations can be validated by measuring vibrations between Shintake Monitor and the most sensitive magnets

✓ This last study can help for the stabilization of the CLIC main linac where the vibration tolerance of quadrupoles is of 1nm above 1Hz