NLC - The Next Linear Collider Project

Vibration affecting LINAC components

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Outline

- Past Work on water induced vibration in RF structure and Quadrupole magnet
- Generating RF elements : Vibration transfer
- RF induced vibration in an NLCTA RF structure
- Future work to measure the settling time of an NLC quadrupole after being moved

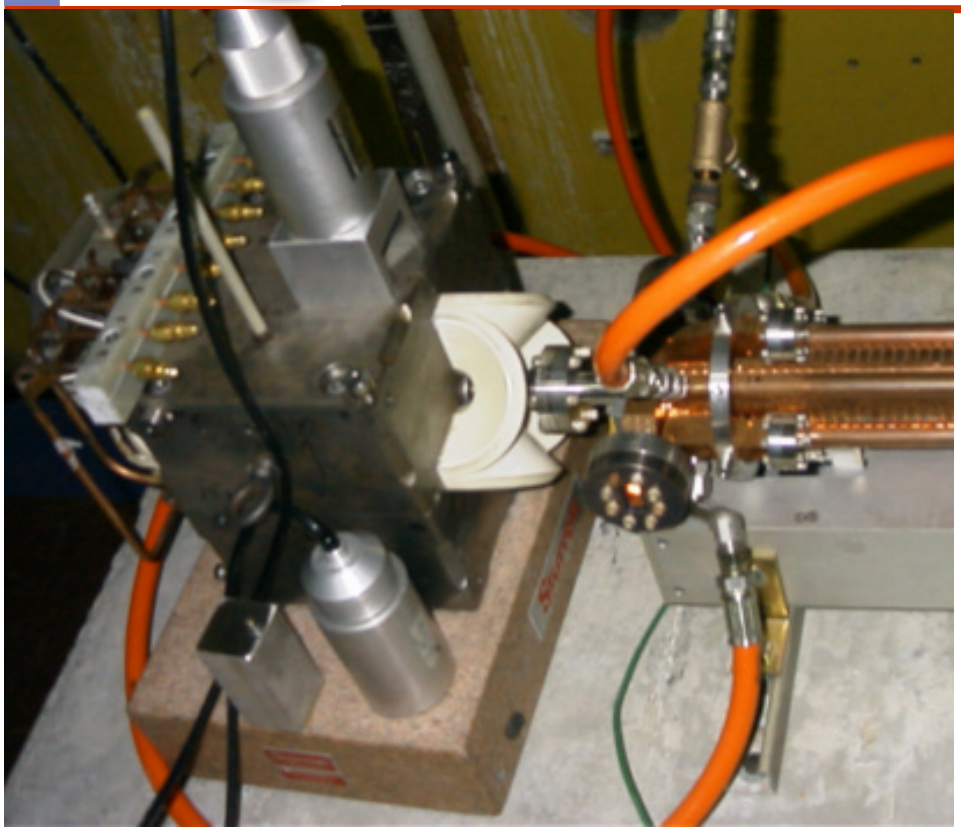
Past Work

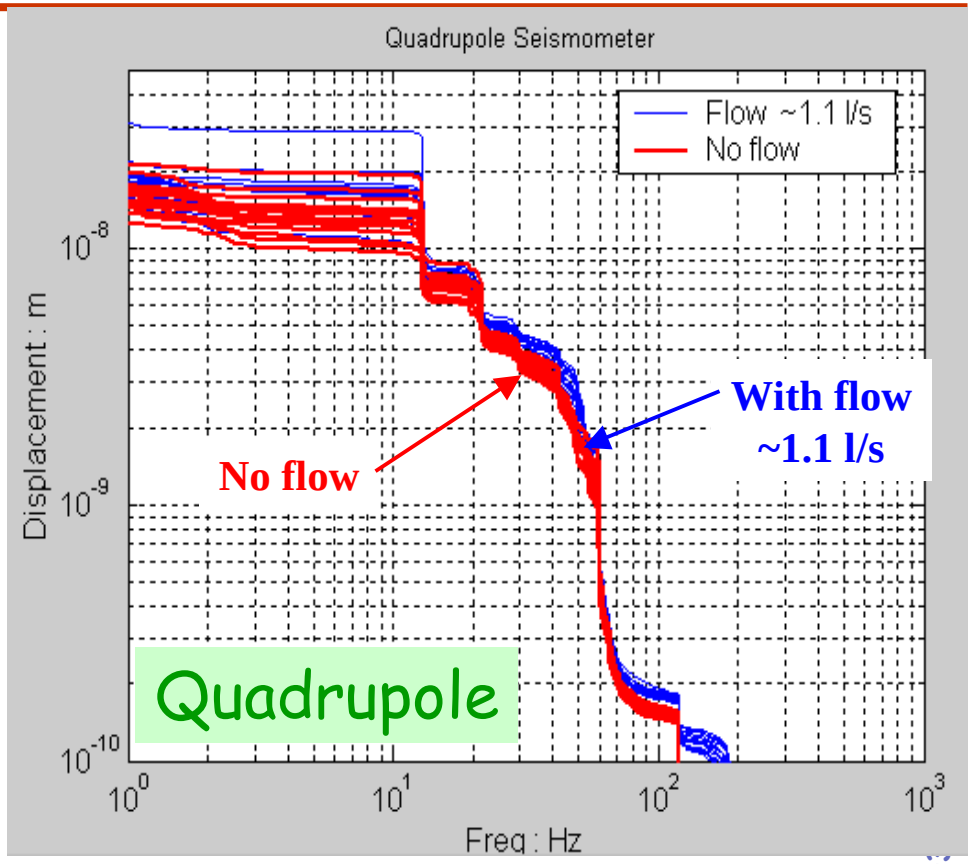
- Vibration of RF structure due to cooling water
  - Measurements in NLCTA and in SLD pit (gravity fed water)
- Vibration of EM quadrupole due to cooling water
- Vibration of RF structure due to cooling water and vibration coupling to linac quadrupole
  - Measurements in SLD pit :
    gravity water fed experiment ; SLD water fed experiment

Most of the results are :

http: //icfa-nanobeam.web.cern.ch/icfa-nanobeam /slides/lepimpec_Nanobeam_vibration5.pdf

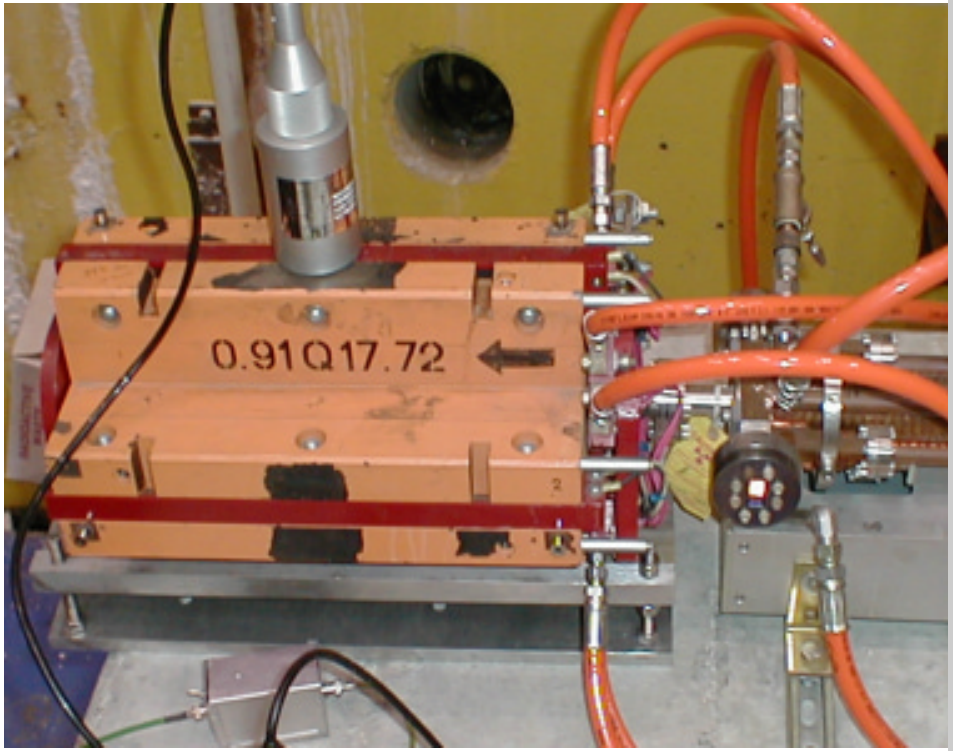
Quad vibration : Gravity water running through the RF structure

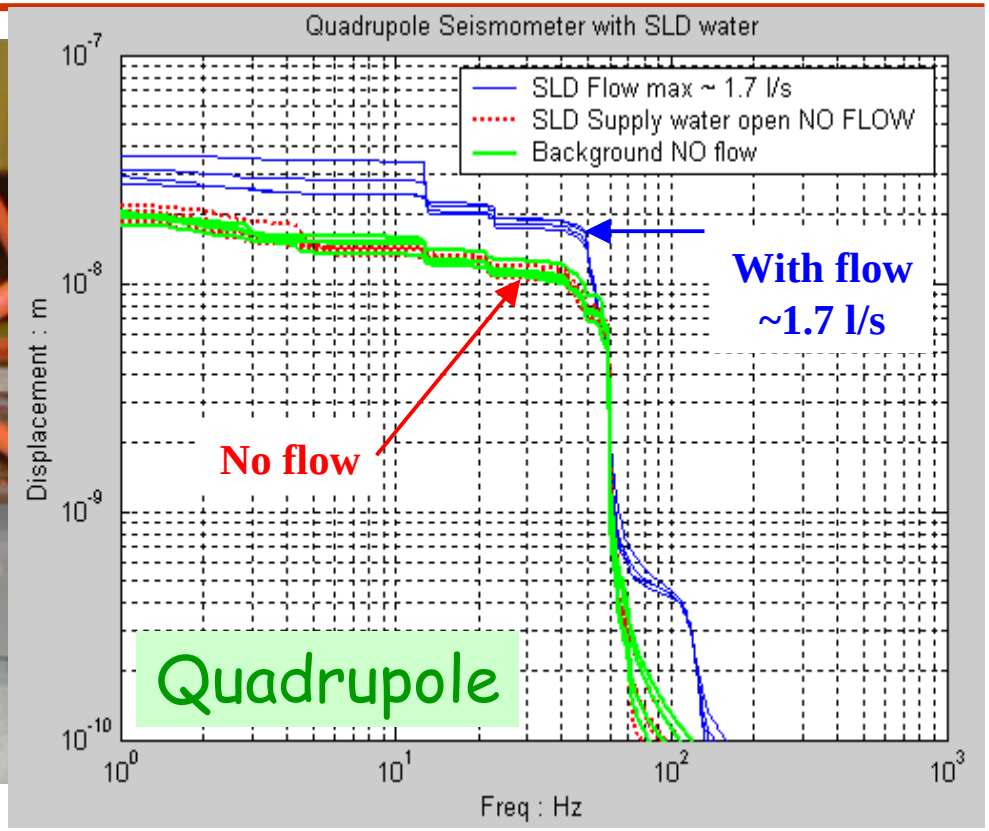




- RF structure vibrates ~150 nm with SLD water and ~ 110nm with gravity water (twice less then in NLCTA)
- **About 2 nm** of vibration **penetrates to the quad at 30Hz** (Nanobeam 2002 talk)

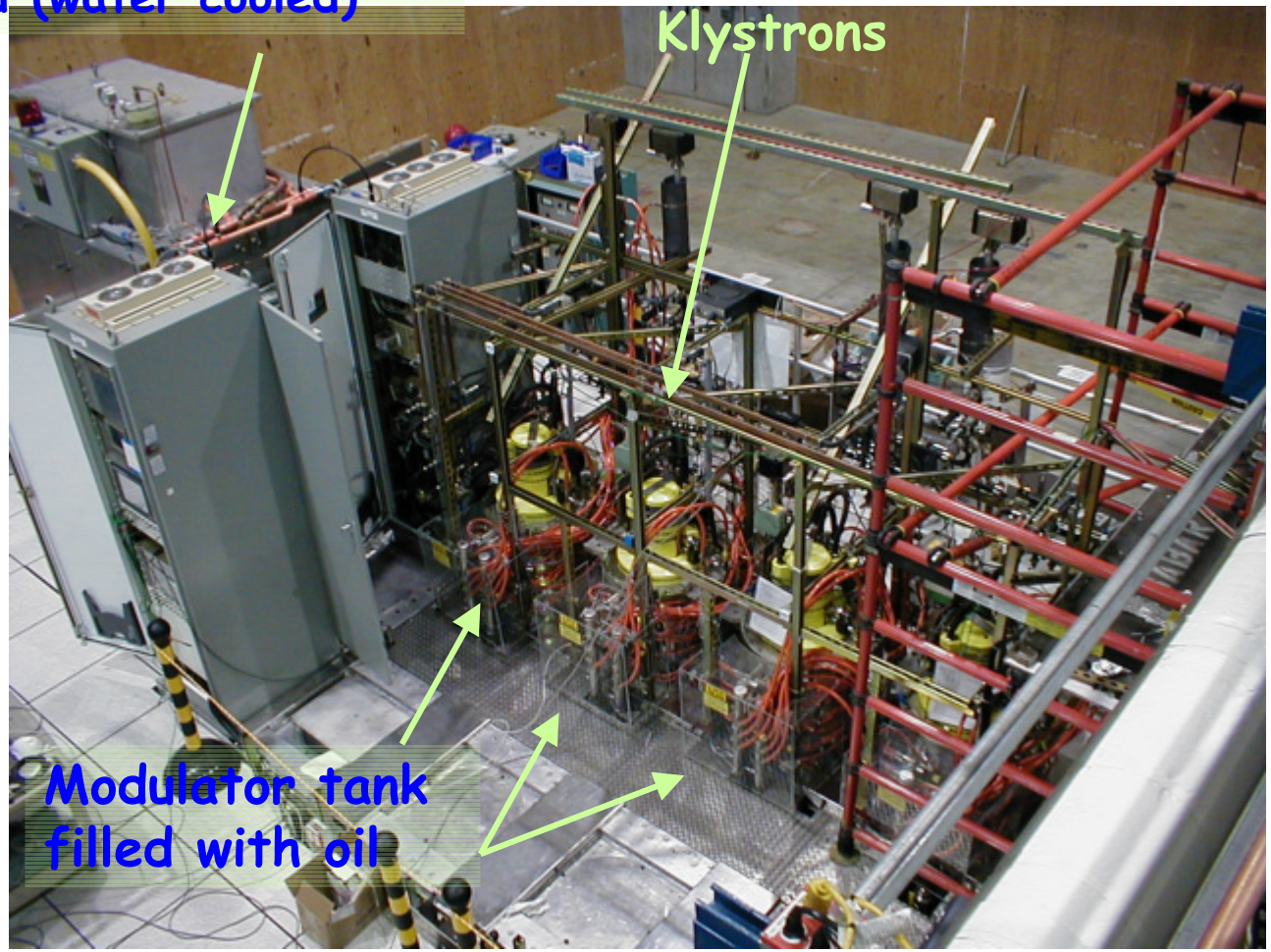
Quad vibration : SLD water running through the RF structure



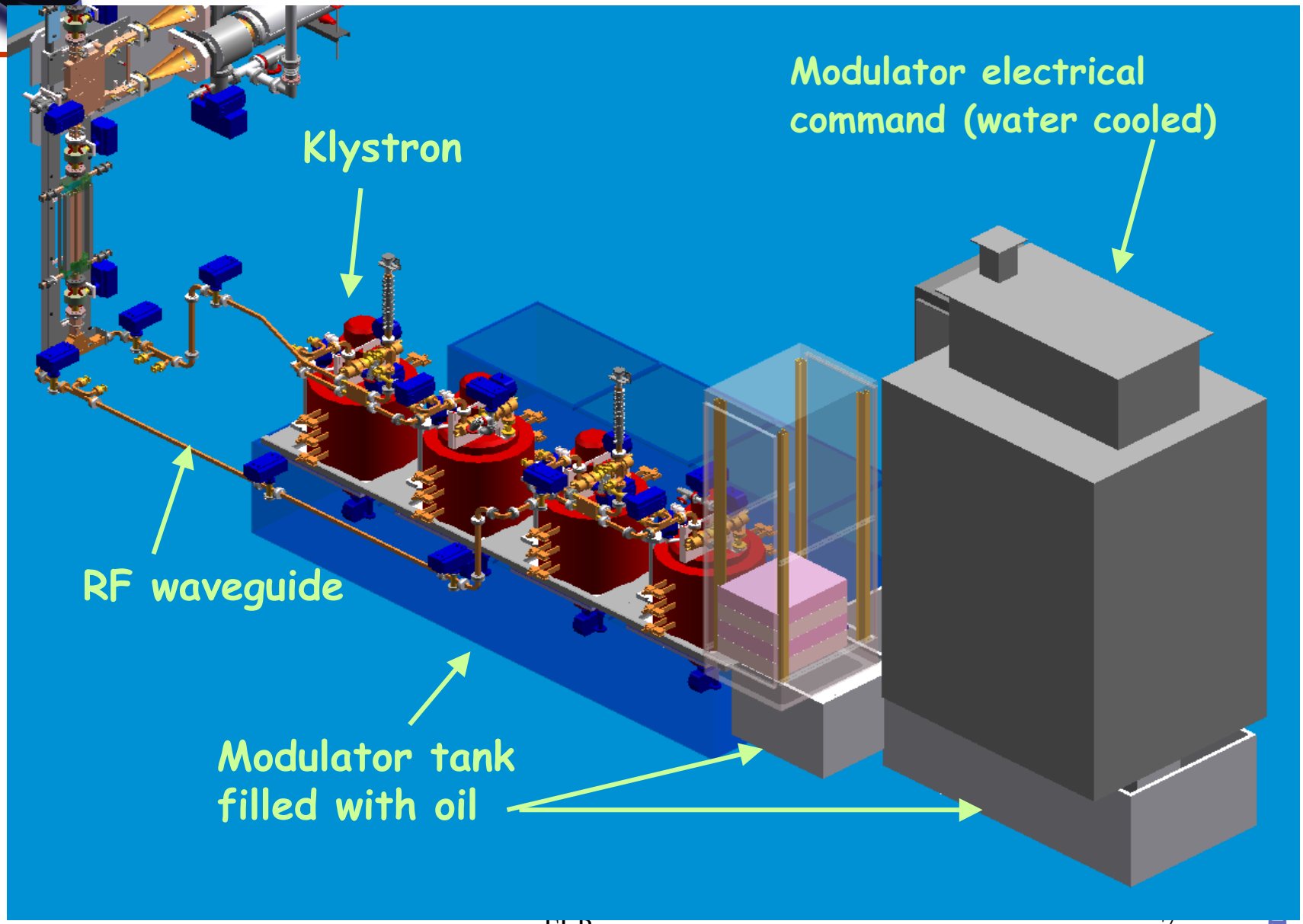


- About 13 nm of vibration penetrates to the quad at 30Hz, 2 nm with gravity fed water
- Due to : Inadequate support – Not stiff enough and hangs out of the concrete. Flow goes from 1.1 l/s to 1.7 l/s

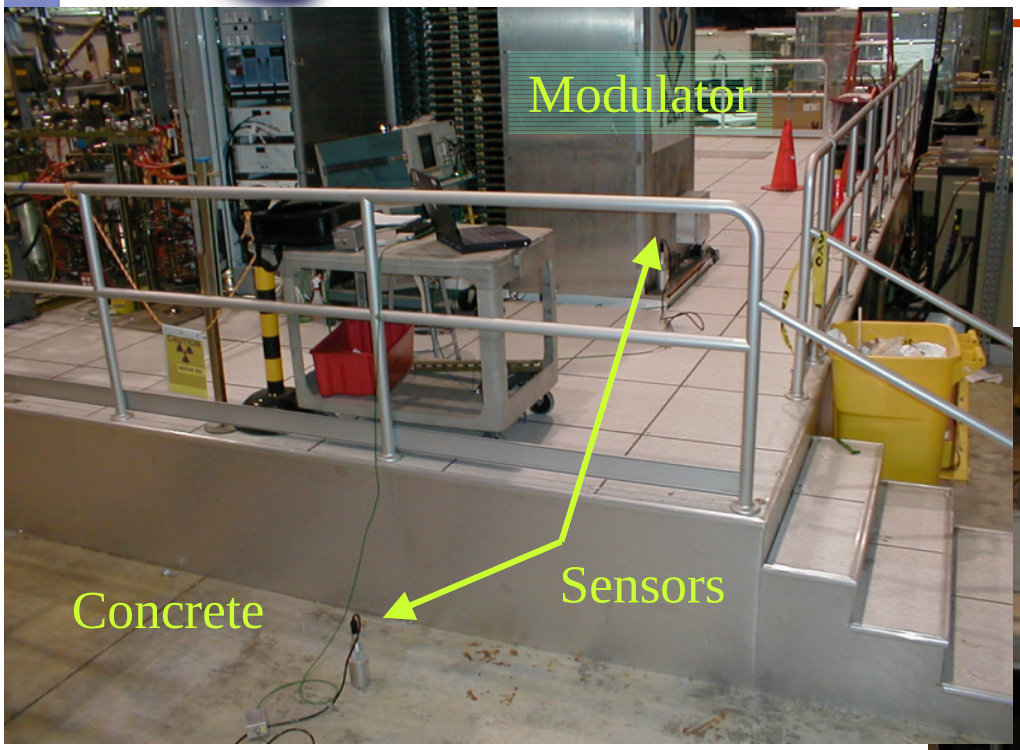
8 Pack Assembly Picture



Assembly schematic 8 Pack

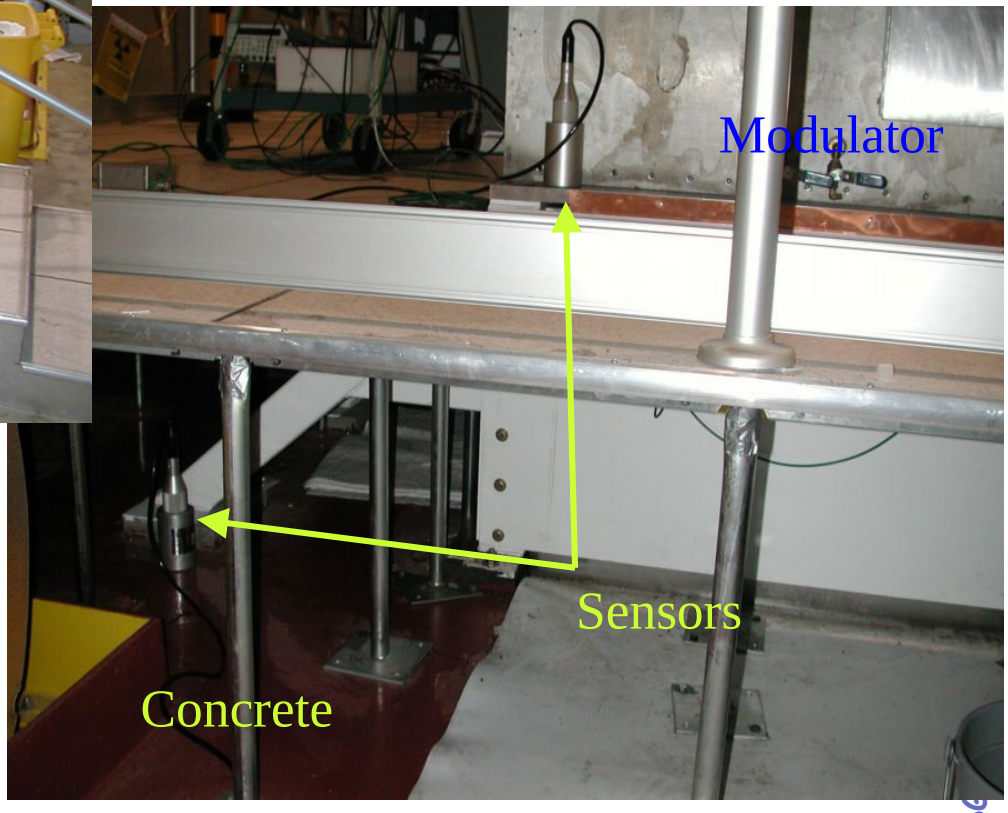


Vibration in 8 Pack (4 Pack)



Picture 1

Picture 2



Only 4 Klystrons are powered by the modulators

Modulator Running :

Picture 1

Modulator is under a voltage of 20KV (low voltage) and running at 30Hz. The modulator is water cooled. Klystrons are not conducting.

The floor sensor is placed at ~1.2m from the platform

All possible cultural noise are ON (working people on the platform)

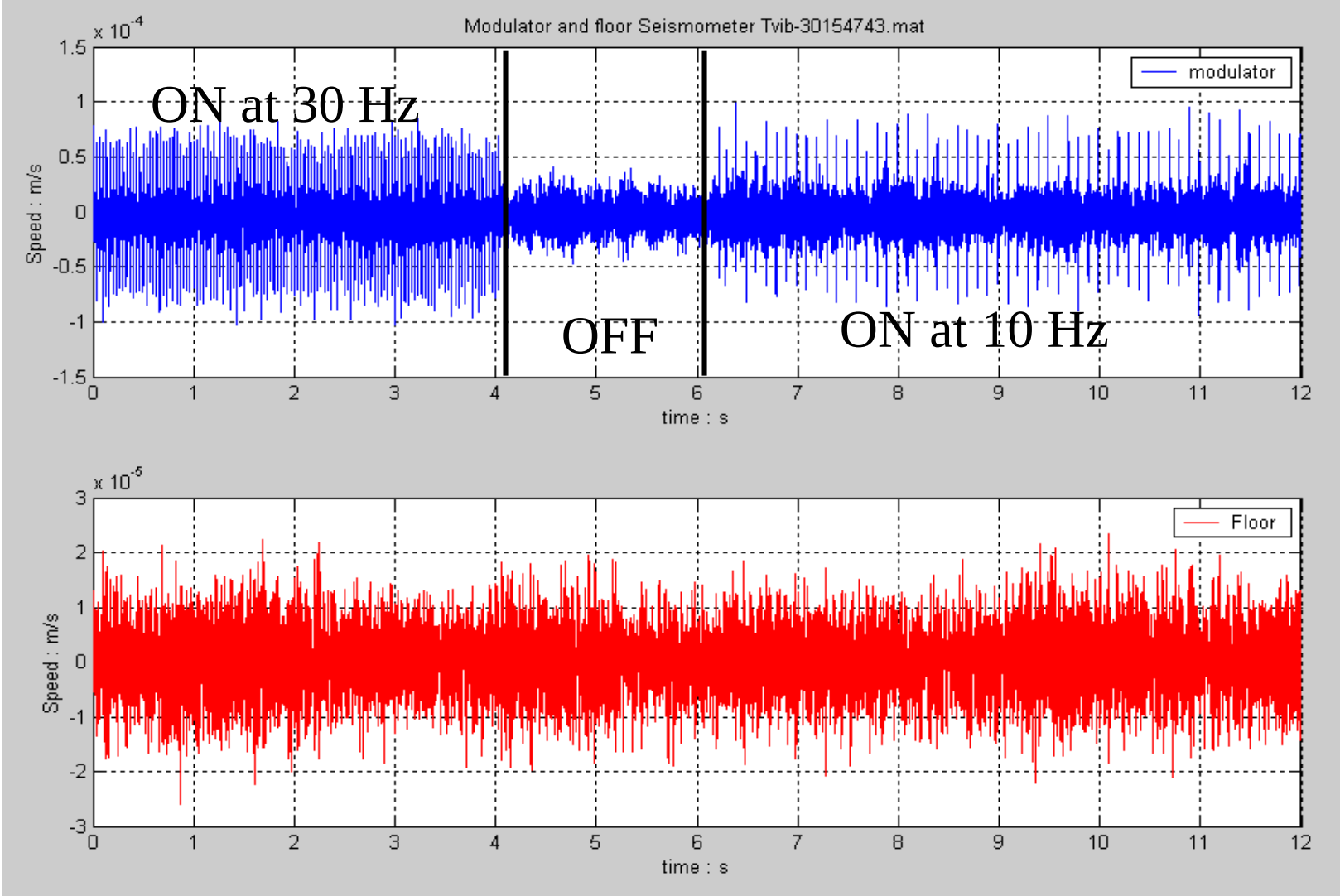
Picture 2

Modulator is under a voltage of 400KV and running at 10 Hz. The modulator is water cooled. Klystrons are conducting (at least 40 MW)

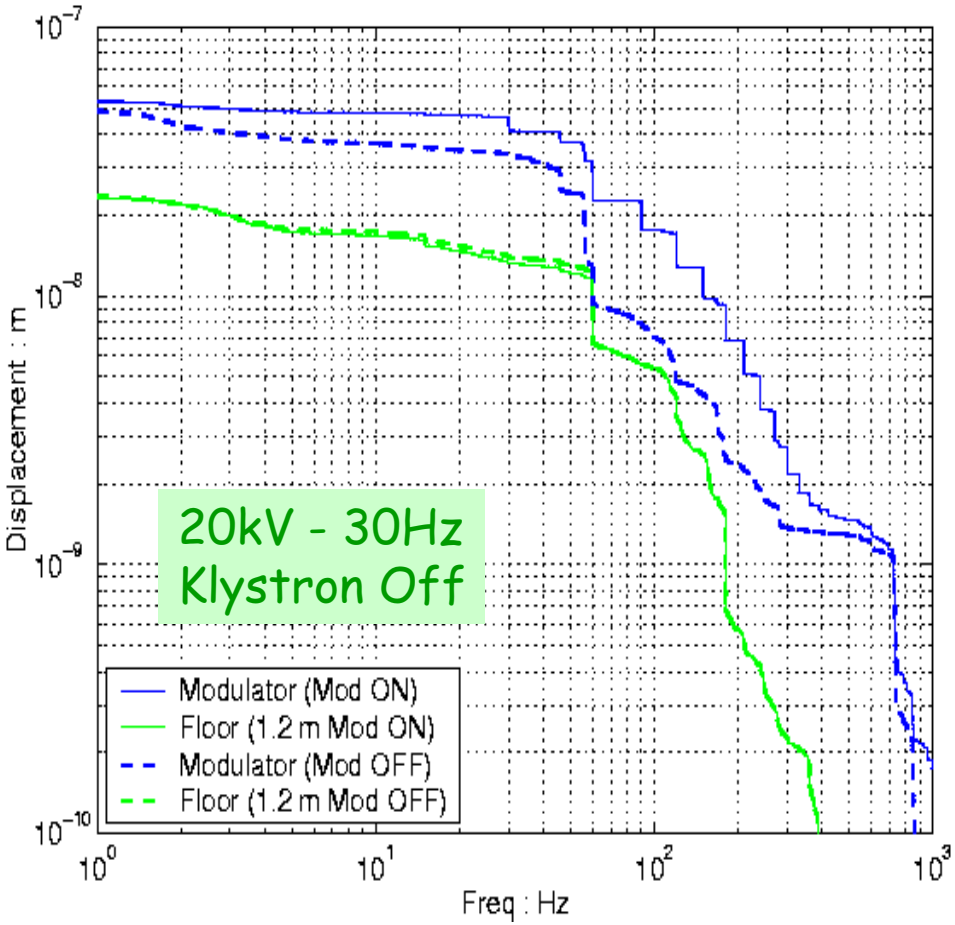
The floor sensor is placed at the proximity of the pod from the platform

All other possible noise are ON

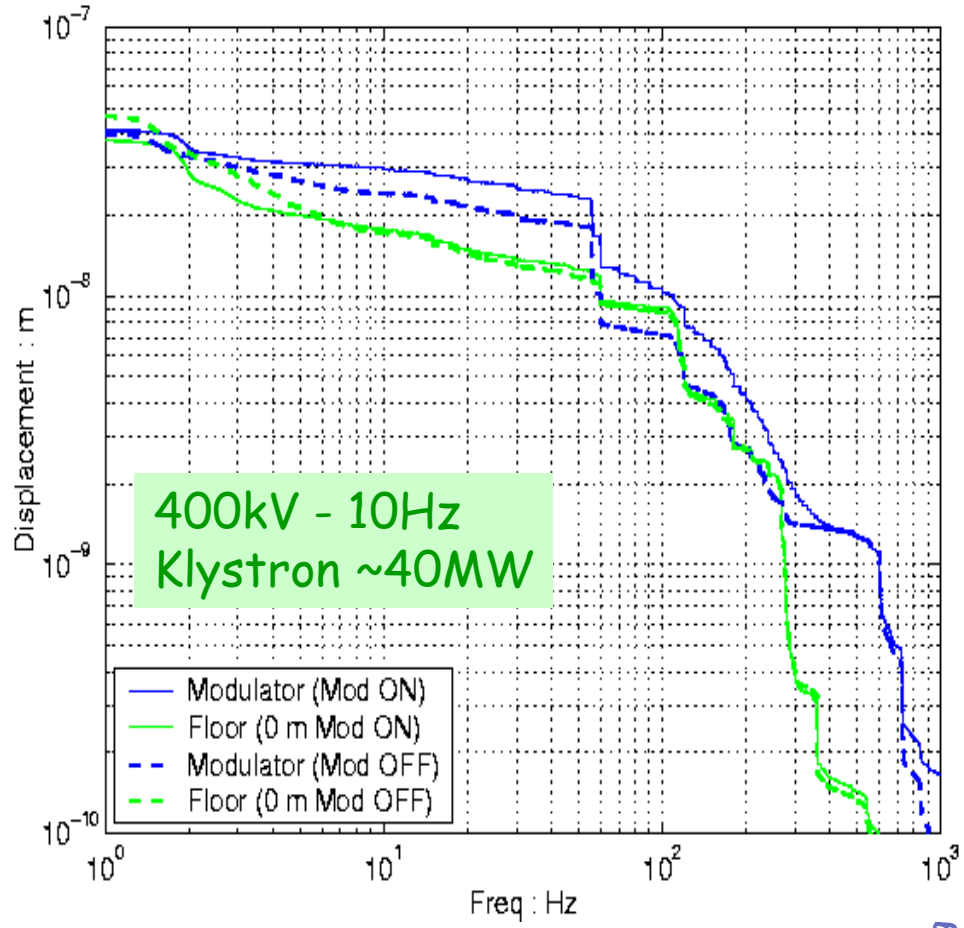
Modulator Vibration On/Off



Integrated Displacement: Modulator - Concrete comparison

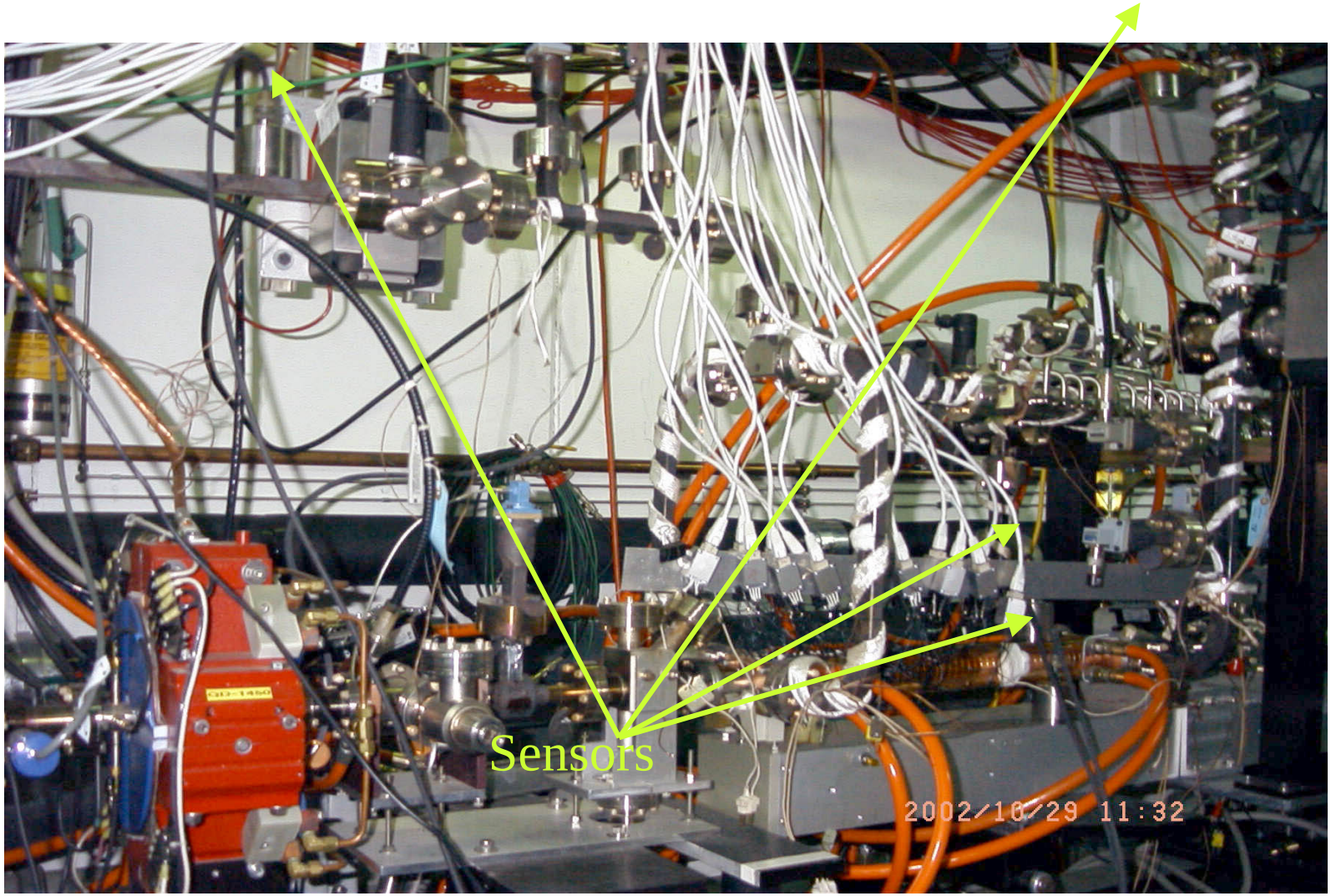


Picture 1

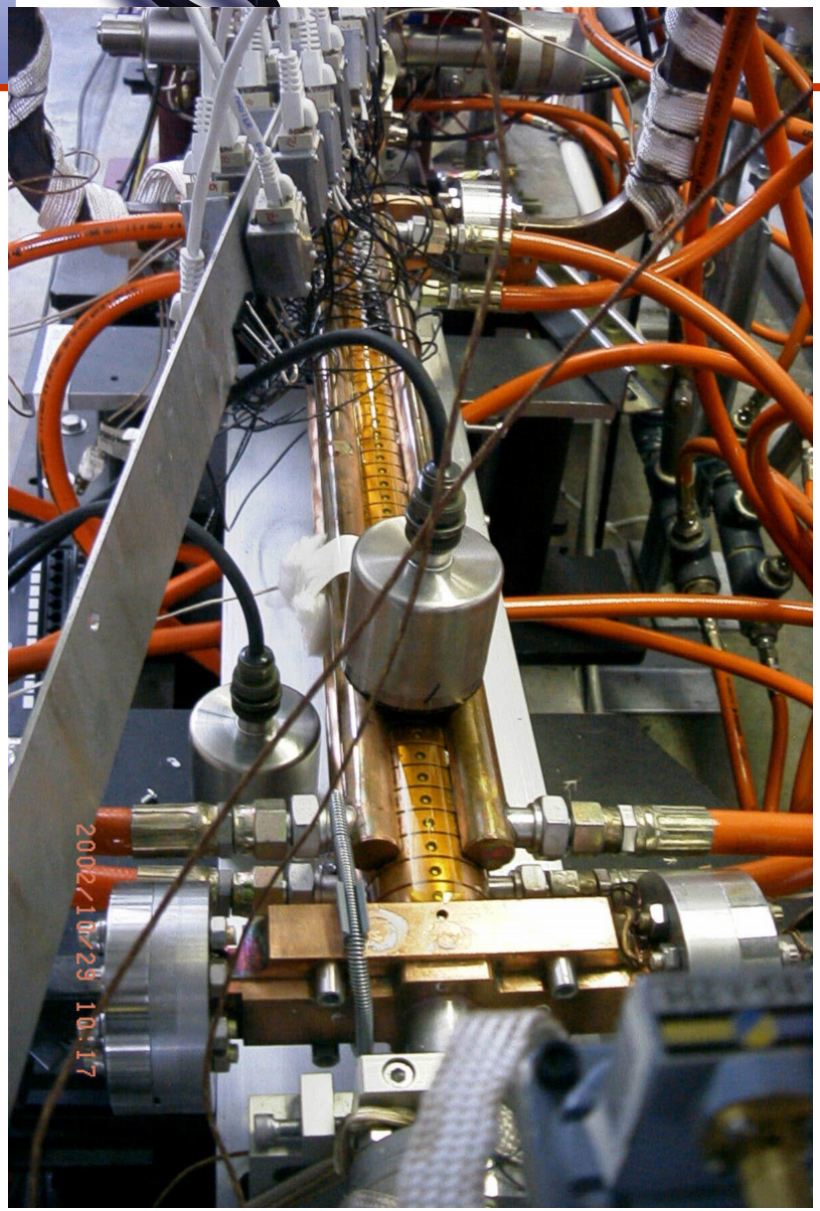


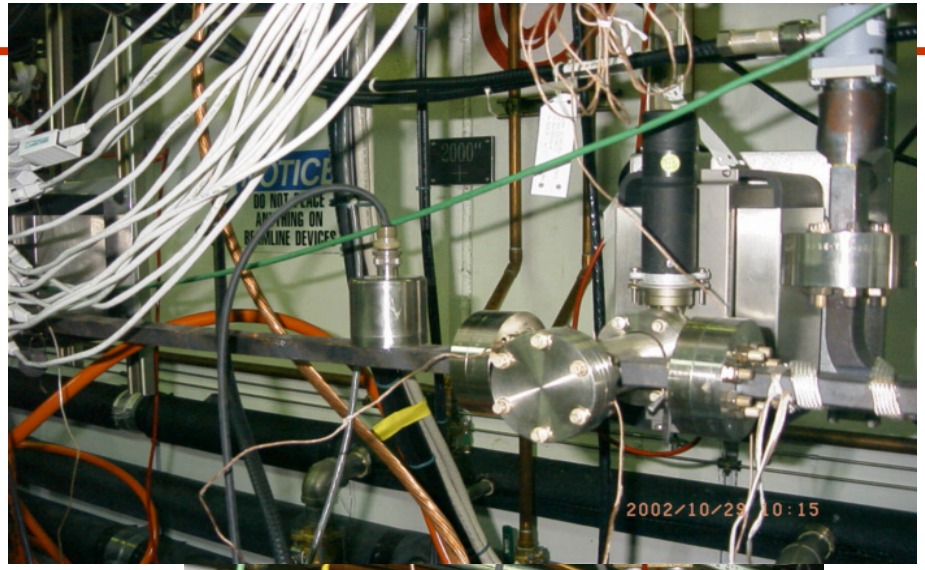
Picture 2

Water + RF induced vibration in H60VG3 RF structure in NLCTA

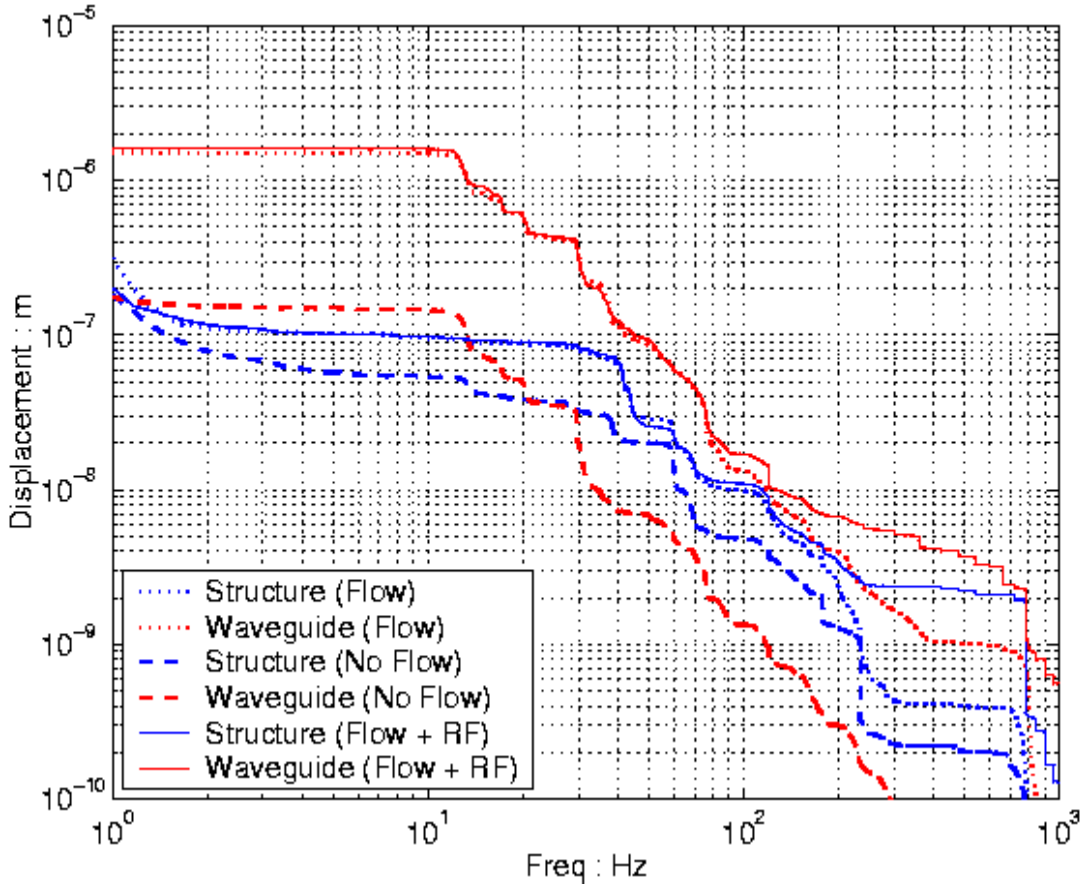


Detailed Setup





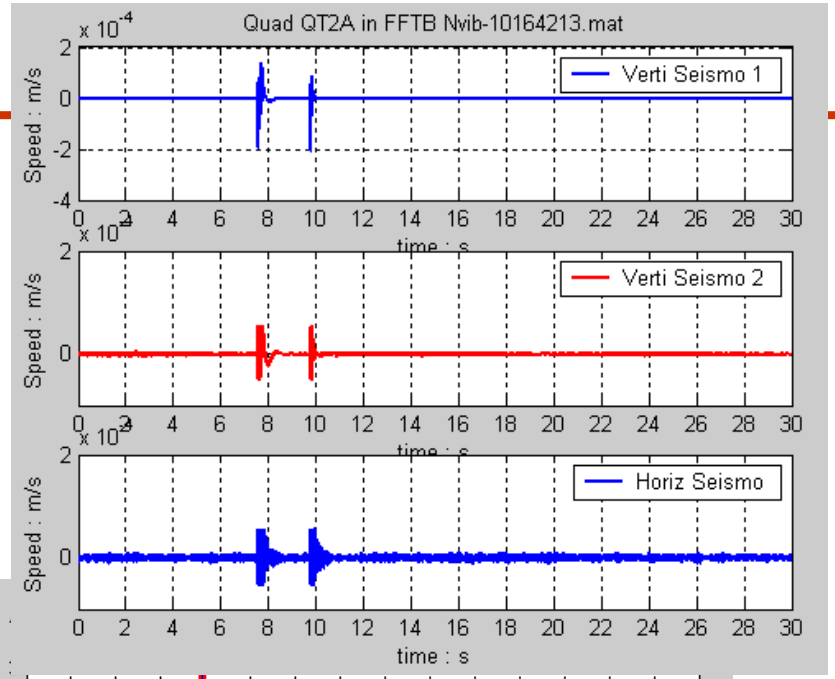
Average Integrated Displacement : H60Vg3N_6C – Waveguide : 29 Oct 2002 - Vacuum

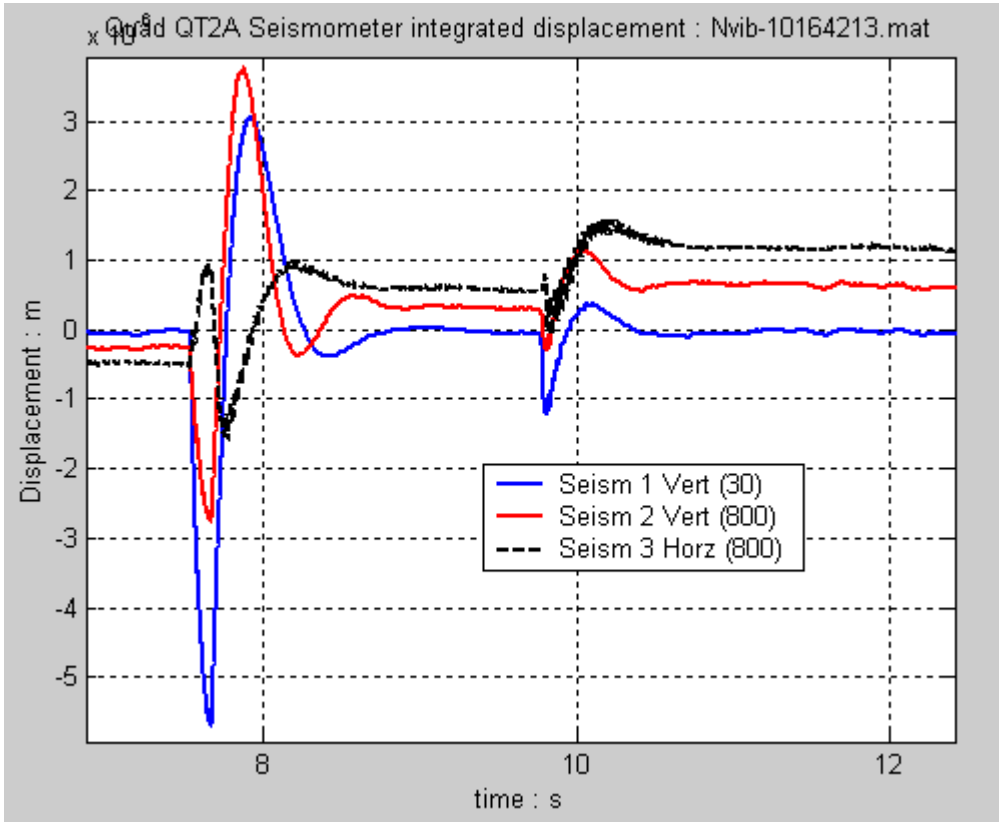


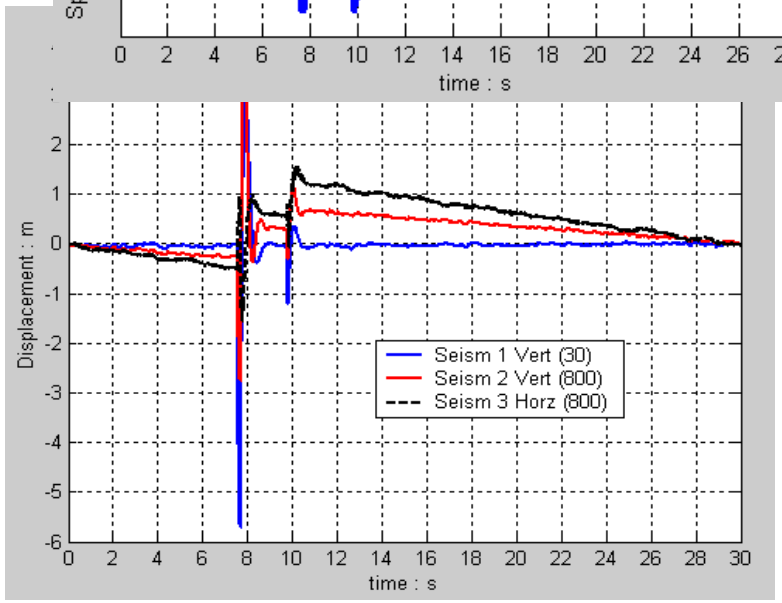
- Flow of water (4 inlet 4 outlet) T ~ 45°C, when ON is between (4 – 5 GPM) 0.25 l/s and 0.3 l/s
- 4 Piezo acoustic Sensors. One on the structure, one on the girder, one on the incoming waveguide (All glued). One dangling in the air- Does radiation induce parasitic reading (NO !!).
- RF Power is coming from SLED line at 400 ns pulse and 100 MW, Electric field ~ 70 MV/m
- Vacuum ~ 2.10^{-9} Torr

FFTB : Settling time of an NLC type quadrupole

Mover move from 2 to 13.7 microns

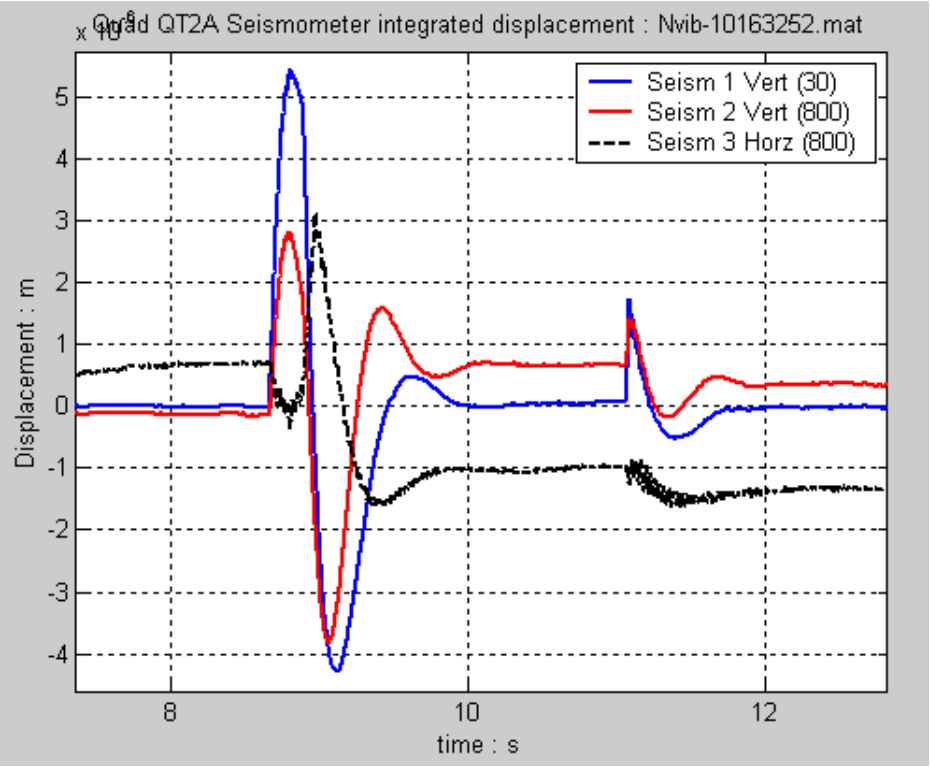


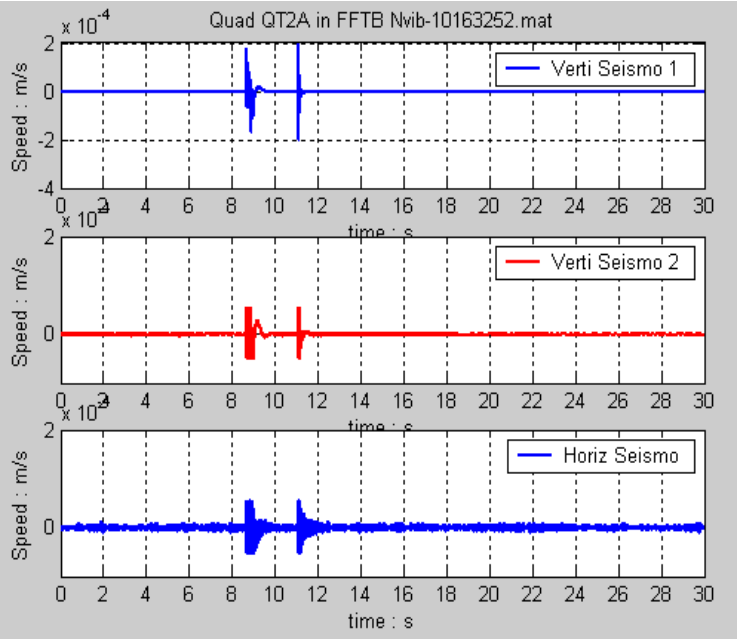


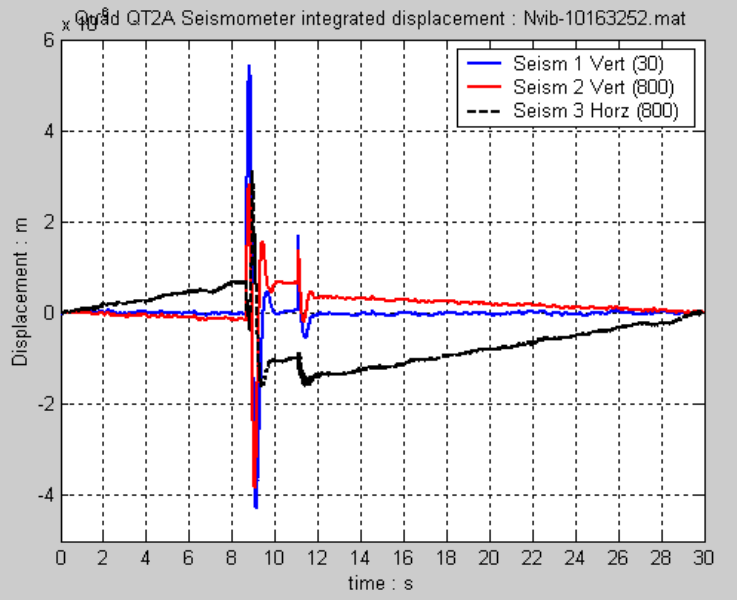


FFTB : Settling time of an NLC type quadrupole

Mover move from 0 to 5 microns







In Conclusion, we studied :

- Vibration of RF structure-girder with NLCTA / SLD water supply
  - And found that external turbulence is important (NLCTA)
  - And found that external turbulence is not important (SLD)
- Vibration of RF structure-girder cooled with gravity fed water
  - And found that internal turbulence gives only 1/3 of the total effect compare to NLCTA
- Vibration coupling from RF structure to Linac quadrupoles when fed with gravity water
  - And found that coupling is small – on a percent level (~2%)
- Designs of cooling water system is very important
  - NLCTA Results vs SLD results

Conclusion, Extra Plans :

- Vibration transmission from the modulator to the concrete is negligible
  - Klystrons or modulators running in the support tunnel of NLC should not affect the alignment of the LINAC components
- No extra vibration induced by an 11.424 GHz RF pulse in a traveling wave structure

- FFTB settling time measurement to be pursued…
  - Use of capacitive sensors to be installed on a quad
  - Team work with outside NLC colleagues