

Vibration Studies

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on behalf of

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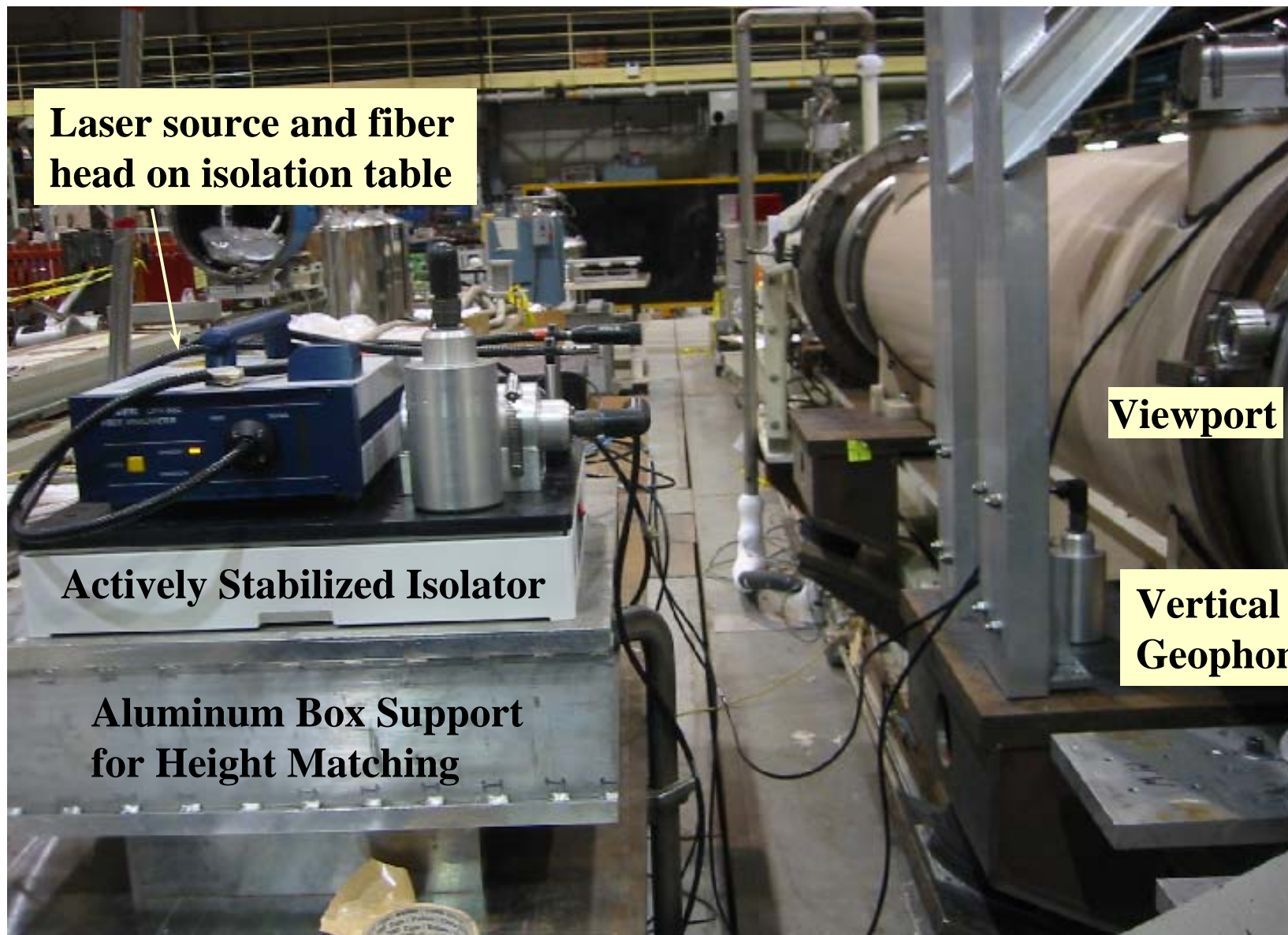
Introduction

- Mechanical stability of final focus quadrupoles is important for proper operation of ILC.
- Typical requirement is that the total (integrated) RMS motion be no more than a few nm above a few Hz. (*Could this be quantified better?*)
- Measurement of magnet vibrations, as well as stabilization, are both challenging problems. (*sensors that are unaffected by magnetic fields, size restrictions, cryogenic environment, etc.*)
- A lot remains unknown about magnet vibrations at nm levels, particularly in superconducting magnets. (*inaccessible cold mass, cryogenic environment, ...*)

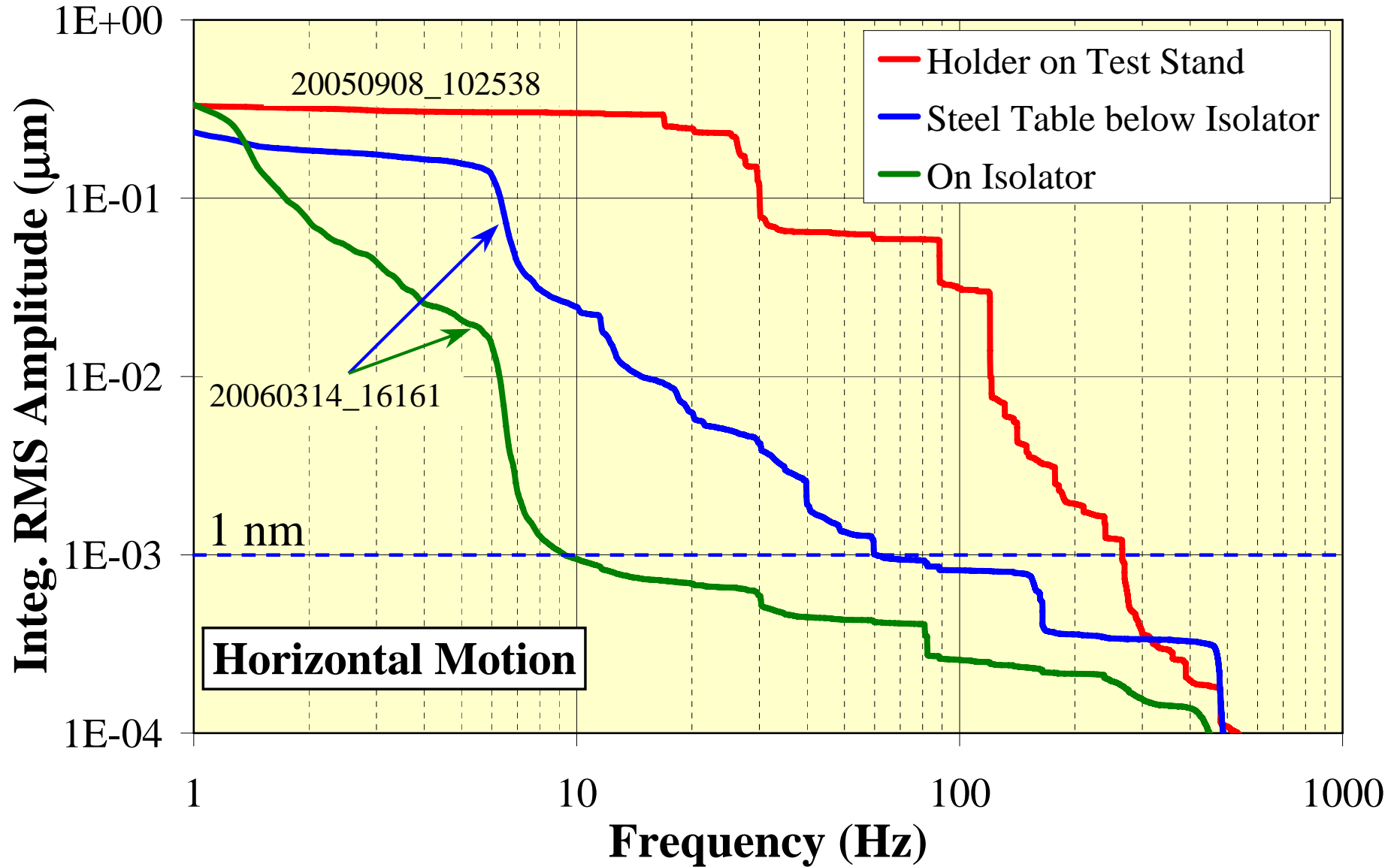
Vibration Work done at BNL

- Superconducting Magnet Division at BNL has been active in carrying out vibration studies in superconducting magnets.
- A measurement system using a Laser Doppler Vibrometer has been developed to measure vibrations with and without cryogen flow in a spare RHIC quadrupole.
- Results so far have been quite encouraging.
(Measurement resolution < 1nm at ~ 9 Hz and above; Only a small effect of cryogen flow seen, but the magnet overall motion was not stabilized, and was large.)
- Preliminary work on a magnetic pick up coil for quads.

Laser Vibrometer Setup for RHIC Quad



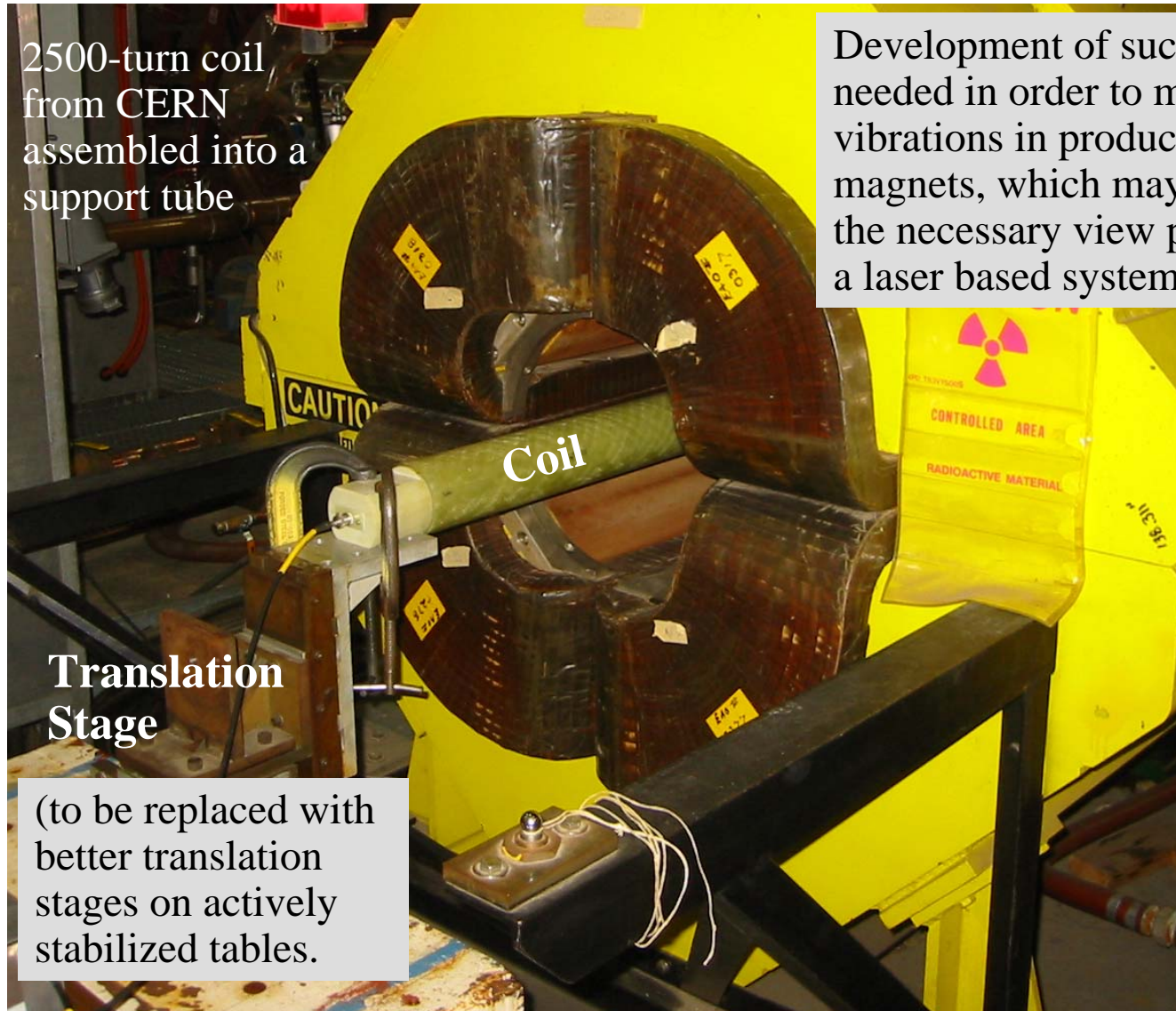
Holder Motion: With & Without Stabilization



Continuation of Vibration R & D

- It is important to study the vibration characteristics of an actual ILC final focus magnet prototype:
 - Very different mechanical structure, as compared to the RHIC quadrupole.
 - Minimize overall magnet motion to achieve better sensitivity to effects of disturbances such as cryogenics.
 - Study whether the cold mass motion is correlated with the cryostat motion in such a structure.
 - Effectiveness of “vibration-wise” design, and iterations.
 - More complex object from a vibration measurement point of view (*laser to go through a cryostat and a heat shield.*)
 - Is it possible to utilize the high gradient of the quadrupole to measure vibrations using a magnetic pick up probe?

Pick-up Coil Setup in Room Temp. Quad



2500-turn coil
from CERN
assembled into a
support tube

Development of such a coil is needed in order to measure vibrations in production magnets, which may not have the necessary view ports to use a laser based system.

**Translation
Stage**

(to be replaced with better translation stages on actively stabilized tables.

Vibration R & D Issues

- A full scale prototype will not be available until several years from now.
- It is desirable to further develop the measurement techniques in the mean time, so that measurements may be made soon after a prototype is built.
(Multiple magnet layers; laser target contamination issues, etc.)
- Measurement methods using a laser vibrometer can be refined using a simple mock-up, with no coils or cryogenics. *(This work has been pushed to FY08.)*
- Time will be needed to allow for any design iterations based on the prototype studies.

Vibration R & D Roadmap

