EuroTeV WP7 activities in DESY

Group members:
R. Amirikas, A. Bertolini, W. Bialowons, H. Ehrlichmann
Total man power:
1.5 reaching 2 (maximum)

EuroTeV WP7 projects

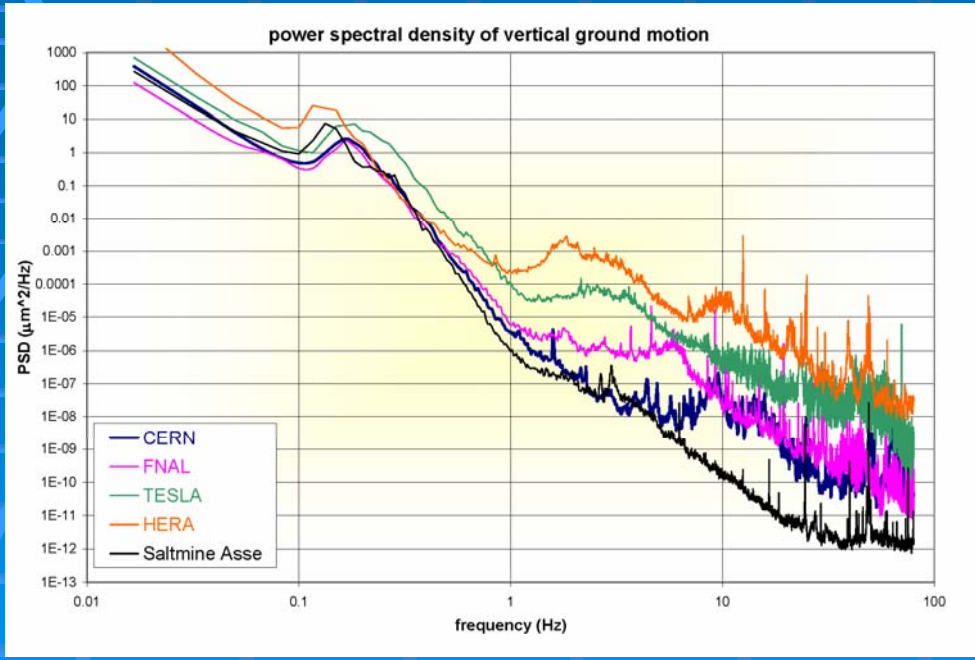
Metrology in DESY

- Site characterization and parameterization of data
- Correlation measurements; related to site characterization
- Floor motion due to building foundation (e.g. piled foundation & floor slabs)

Stabilization in DESY

- Accelerator component vibration studies:
  - ❖ Cryomodule vibration studies in warm and cold environments, geared towards main linac design (one of the main cost drivers for the ILC)
  - ❖ Stability of support structures, such as girders
  - ❖ Facility noise: potential vibration sources in a tunnel, e.g. vacuum pumps, modulators

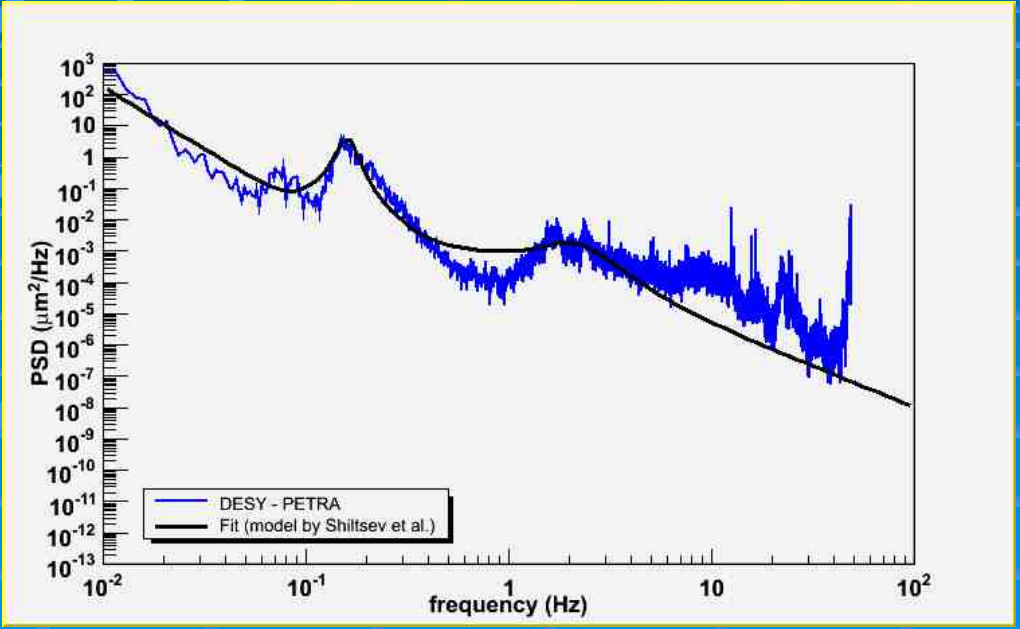
Metrology: site measurement & chracterization



Power spectral densities for five measured sites

- Study the impact of 'cultural noise' @ f >1 Hz, at several accelerator laboratories & synchrotron light sources
- 19 sites are measured so far. Database available: http://vibration.desy.de
- Same equipment and data analysis tools are applied to each case; Therefore, direct comparison is possible
- This work will continue albeit with a lower priority, often combined with other measurements
- Publications: presentations in Nanobeam2005 (EuroTeV report-2005-023) and EPAC06 contribution, in preparation

Metrology: site characterization via parameterization (in collaboration with D. Kruecker (DESY)) & Correlations

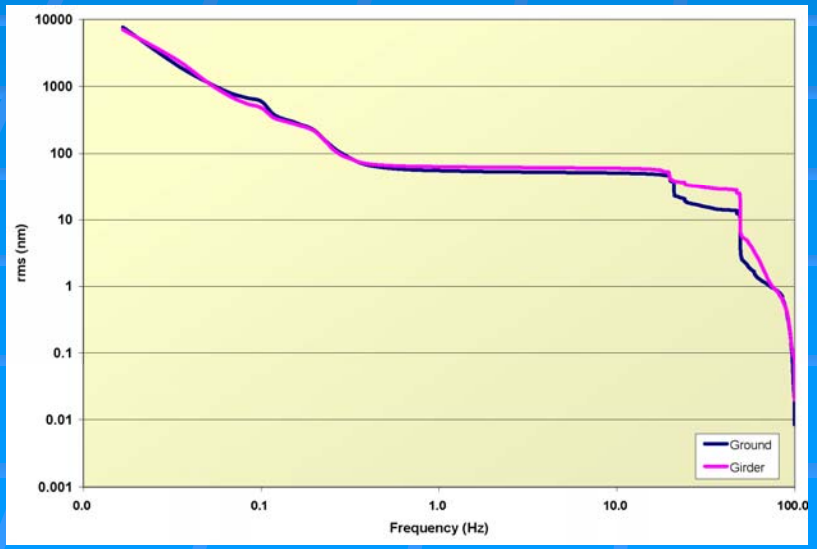


A fit to the power spectral density of Petra (preliminary)

- Parameterization of power spectral densities measured, reperesenting 'noisy', 'quiet' and 'medium' sites; This is done via root; Starting model is obtained from V. Shiltsev et al, DESY HERA 95-06
- Measurement of correlation length of a few sites, including DESY
- Study of floor motion (a civil engineering issue) as opposed to ambient ground motion (influenced by geology in each site)

Stability of accelerator components; case study: MAXLab (Lund) girder

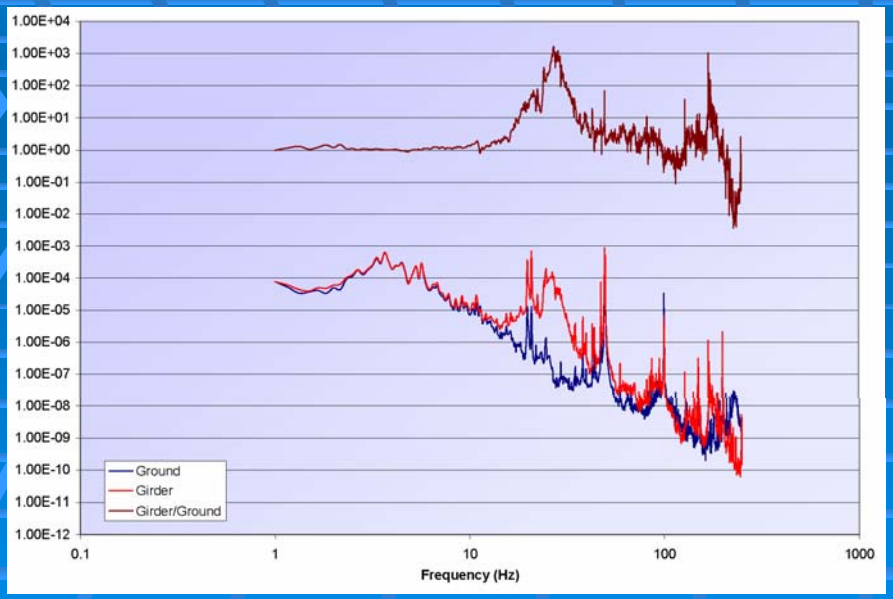
- Study of support structures, e.g. girders is important for the stability of the cryomodules in the ILC; MaxLab girder measurements (visit funded by ALBA)



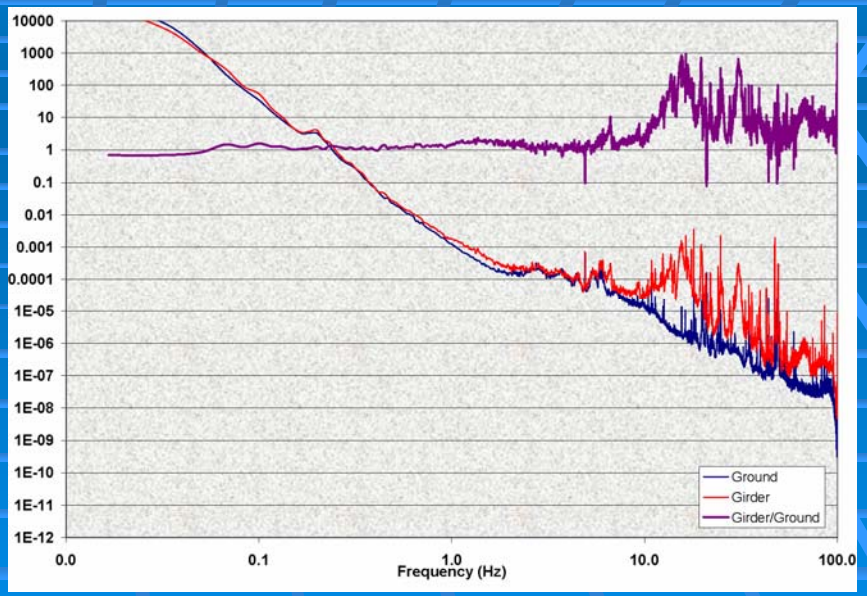
- EuroTeV report 2006-020 submitted to ALBA & MAXLab

Vertical vibration measurement via a seismometer, transfer function girder/ground ~1.2 @ 1 Hz

Stability of accelerator components; case study: MAXLab (Lund) girder



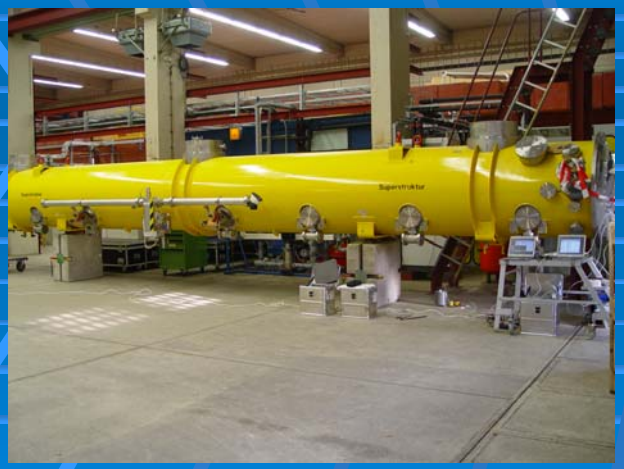
Horizontal vibration (longitudinal to the beam direction) measurement via geophones, Resonance: ~28-30 Hz, transfer function, girder/ground~2 @ 1.7 Hz



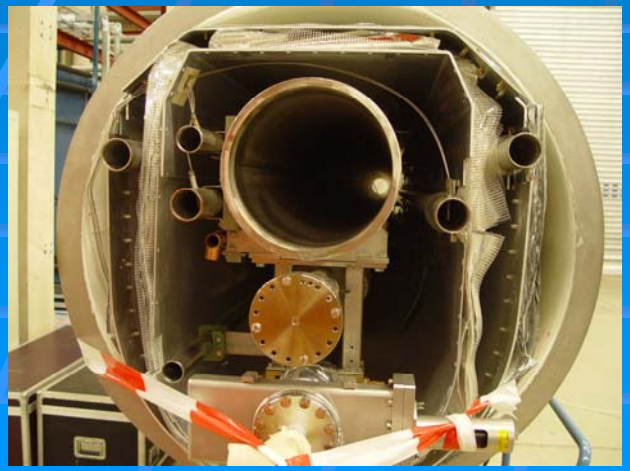
Horizontal vibration (transverse to the beam direction) measurement via a seismometer, resonances: ~15-16 & 30 Hz, transfer function, girder/ground ~2 @ 1 Hz

- Conclusion: MaxLAB girder is stable vertically, but not horizontally; A better girder design should be pursued in the horizontal direction.

Stability of accelerator components: Measurement of the stability of a ‘warm’ cryomodule (Type II Superstruktur)



2 Seismometers, one on the vessel top, the other, on the ground; simultaneous geophone measurements



With quadrupole (back view)

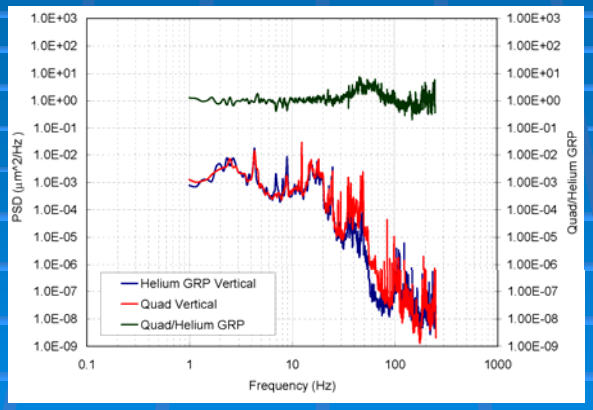
Seismometer Güralp CMG-6TD
inside Helium Gas Return Pipe (GRP)

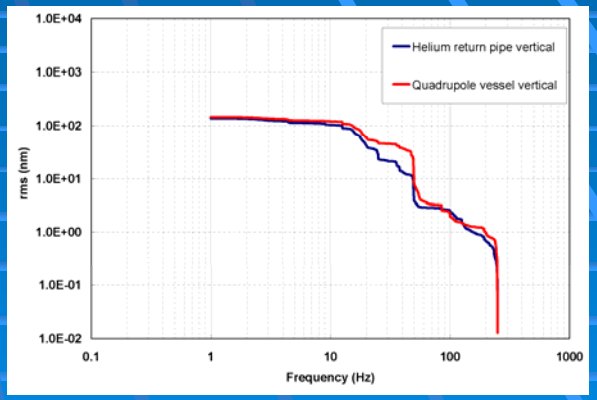
Sensor SM-6 vertical geophone placed on the cryostat

Stability of accelerator components: Measurement of the stability of a 'warm' cryomodule (Type II Superstruktur)

Quadrupole support structure (shown without the quad)

Helium pipe (vertical) to the cryostat



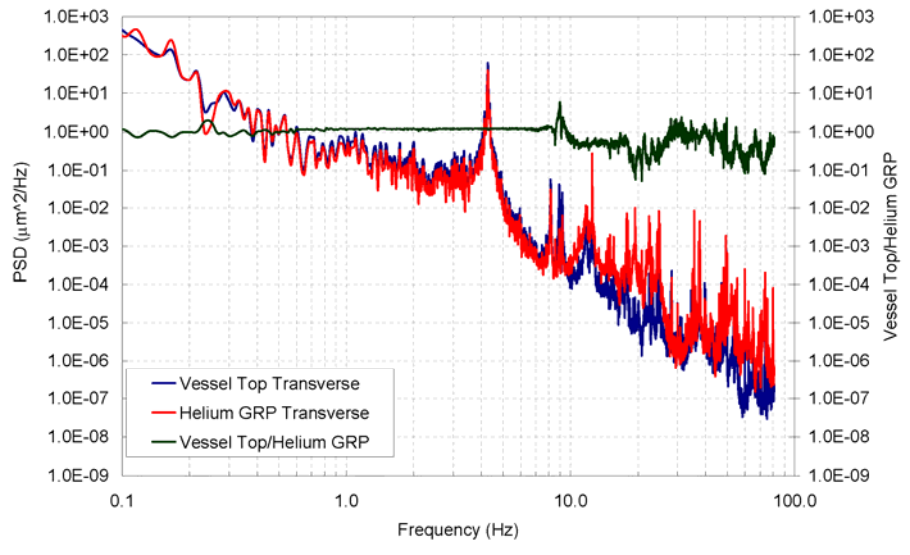


Integrated vertical vibration for f > 1 Hz as measured via geophones of Helium pipe vs. quadrupole, amplification @ 1 Hz: Quad/Helium~1.06 or ~10%
Connection from the Helium pipe to the quad is rigid within 10%

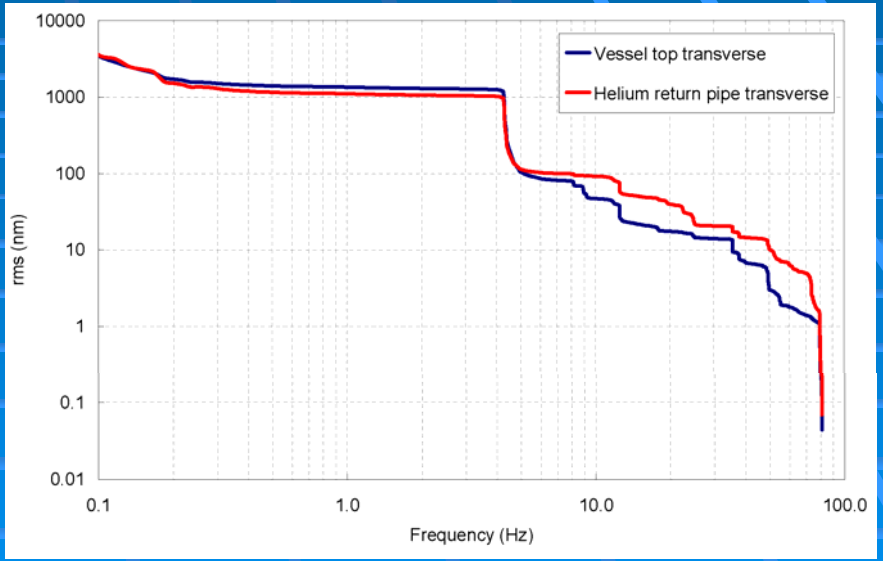
➢EuroTeV report & EPAC06 contribution (in preparation)

Stability of accelerator components: Measurement of the stability of a 'warm' cryomodule (Type II Superstruktur)

Vessel top to Helium pipe (transverse to the beam direction)



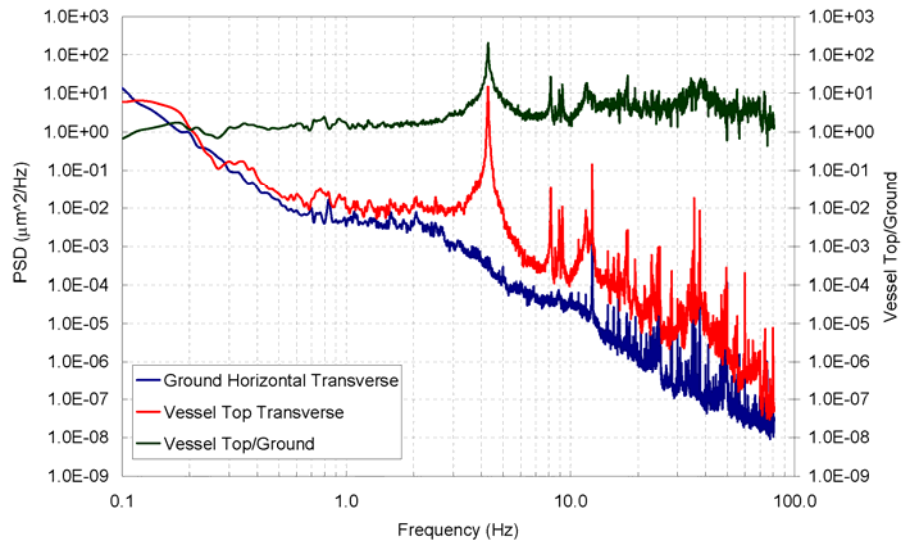
PSD in transverse direction to the beam pipe as measured via seismometers, Vessel top vs. Helium pipe

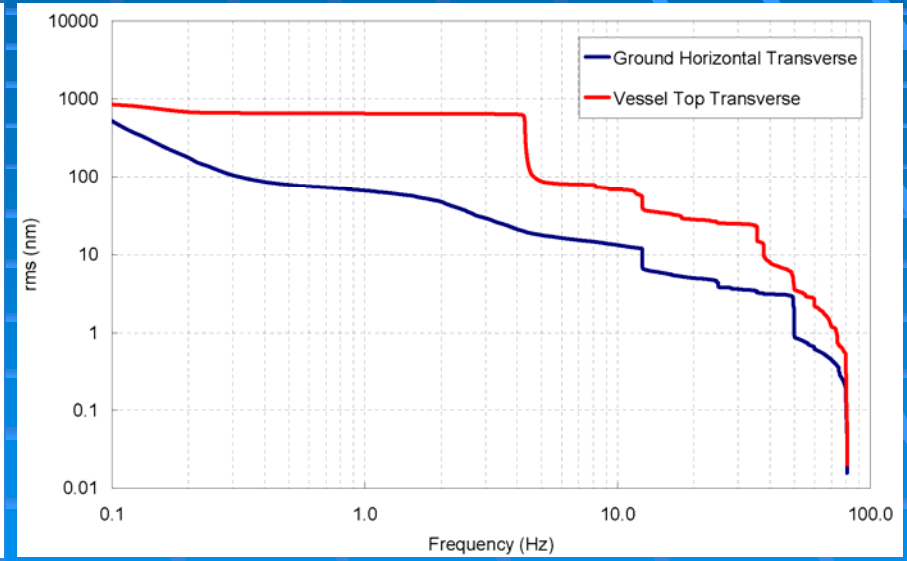


Integrated transverse vibration for f > 1 Hz as measured via seismometers, amplification @ 1 Hz: Top/Helium~1.22, or ~22%

Stability of accelerator components: Measurement of the stability of a 'warm' cryomodule (Type II Superstruktur)

Ground to vessel top (transverse to the beam direction)





PSD in transverse direction to the beam pipe as measured via seismometers, Vessel top vs. Ground,
Vessel resonances: ~4.3, 8.0, 9.0 Hz; vessel rocks due to bad girder support (in this case concrete slabs) & steel pads

Integrated transverse vibration for f > 1 Hz as measured via seismometers, amplification @ 1 Hz: Top/Ground~ 10

Amplification factor for Ground/Quad = Top/Ground*Helium/Top*Quad/Helium =10.0*0.80*1.06= 8.48 ~10

Cold mass test plan

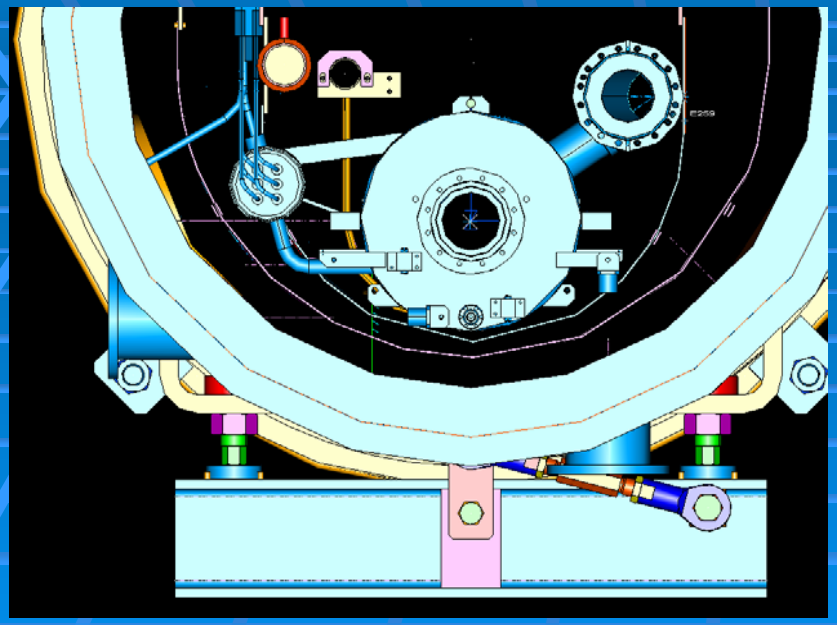
Motivation:

- Evaluate the rigidity of the quad supporting structure to confirm 1:1 vessel to quad transfer function (in warm and cold)
- Evaluate quantitatively return He-flow contribution, perhaps with different flow rates
- Use the same setup to test other interferometric position sensors (Oxford) & POLYTEC

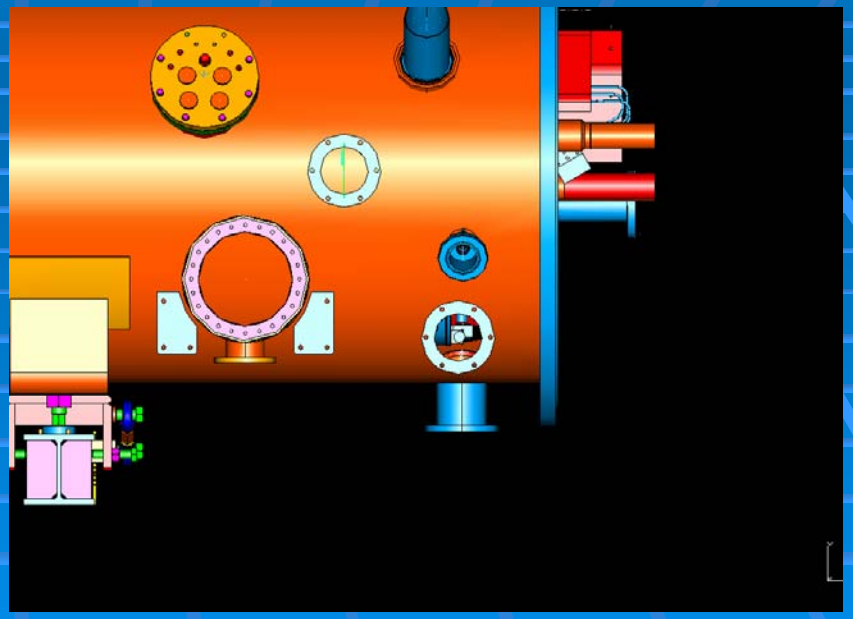
Technique:

- Place two 'mirrors‘ directly on the cold quadrupole He vessel
- Measure their motion with respect to a reference frame by means of a laser interferometer (self-calibrated, sub-nanometer resolution etc.); measure the frame motion with a seismometer
- Use different reference frames can provide different information and offer data-quality check
- Reference frames: ground, inertial platform, cryomodule vessel (essential to measure small amplitude differences, otherwise the vessel rocking modes dominate the dynamics)

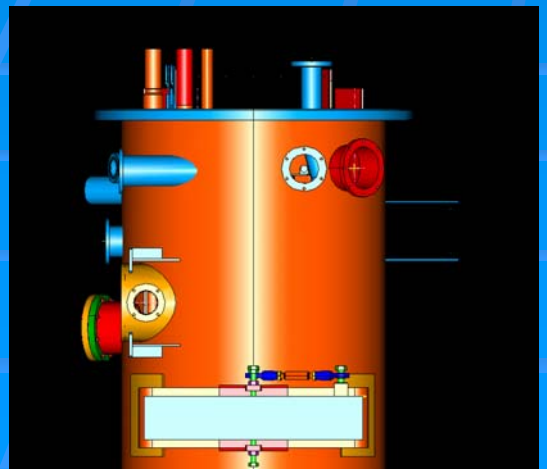
Type III+ cryomodule with the proposed modifications



front view



side view



bottom view

Figures: courtesy of C. Engling (DESY, MKS)