Vibration Measurements of a TESLA-XFEL Cryomodule

Type-II Tesla Superstruktur Module



Experimental Setup



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



Sensor SM-6 vertical geophone placed on the cryostat

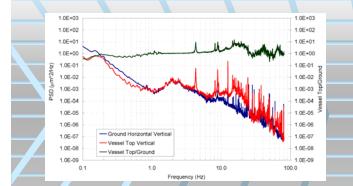


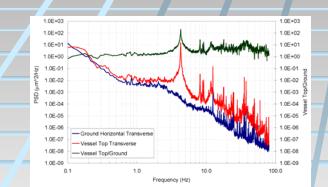


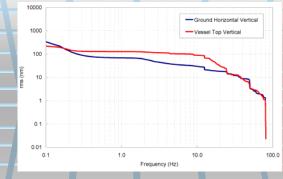
Quadrupole support structure (shown without the quad)

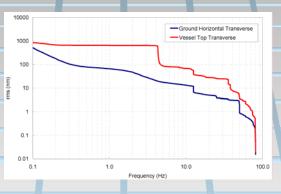
2 Seismometers, one on the vessel top, the other, on the ground; simultaneous geophone measurements

Ground to Vessel Top









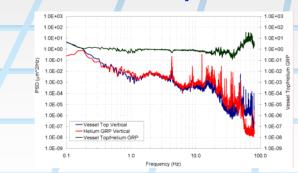
PSD (vertical) and integrated rms of motion > 1 Hz; amplification factor @

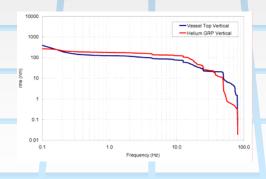
top/ground~1.84:support girder not rigid

1 Hz.

PSD (horizontal transverse) and integrated rms of motion > 1 Hz; amplification factor @ 1 Hz, top/ground~10.0: support girder resonance

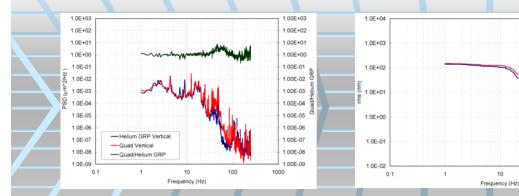
Vessel Top to Helium GRP





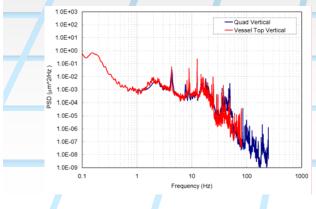
PSD (vertical) and integrated rms of motion > 1 Hz; amplification factor @ 1 Hz, Helium/top~1.42: prone to vertical vibrations

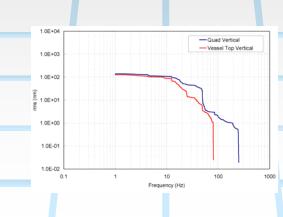
Quad to Helium GRP



1.0E+03 1.00E+02 1.0E+02 1 00E+01 1.0E+01 1 00E+00 1.0E+00 1.00E-01 1.0E-01 1.00E-02 1.0E-02 1.00E-03 1.0E-03 1.00E-04 1.0E-04 1.00E-05 1.0E-05 1.00E-06 1.0E-0 Quad Horizontal (Transver 1.00E-07 1.0E-07 Helium GRP Horizontal (Trans 1.00E-08 1.0E-08 ad/Helium GRI 1.0E-09 1.00E-09 0.1 10 100 1000 Frequency (Hz)







1.0E+04

1.0E+03

1.0E+02

1.0E+01

1.0E+00

1.0E-01

1.0E-02

0.1

Helium GRP Vertical

-Quad Vertical

100

Quad Horizontal (Transverse

10

Frequency (Hz)

Helium GRP Horizontal (Transverse

100

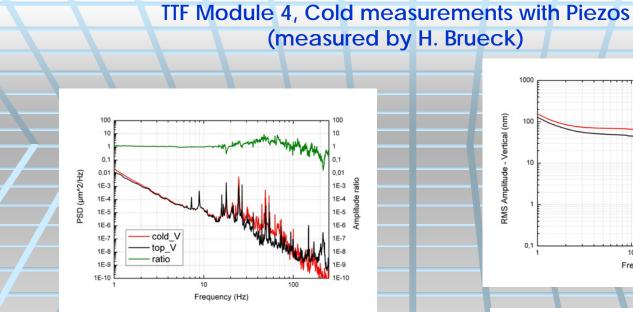
1000

1000

PSD (vertical) and integrated rms of motion > 1 Hz; amplification factor @ 1 Hz, quad/Helium~1.11: rigid, no resonances

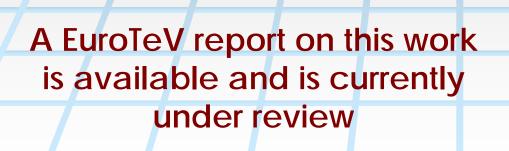
PSD (horizontal transverse) and integrated rms of motion > 1 Hz; amplification factor @ 1 Hz, quad/Helium~0.83: rigid, no resonances

PSD (vertical) and integrated rms of motion > 1 Hz; amplification factor @ 1 Hz, quad/top~1.14: rigid



Quad and the vessel move as a whole. Results are consistent with the warm measurements SVP Protection (UII)

cold_V top_V



As seen from the coherence of the signals, piezos are noisy below 10 Hz

Frequency (Hz)