GEMINI

A new underground seismic-isolation facility at LNGS

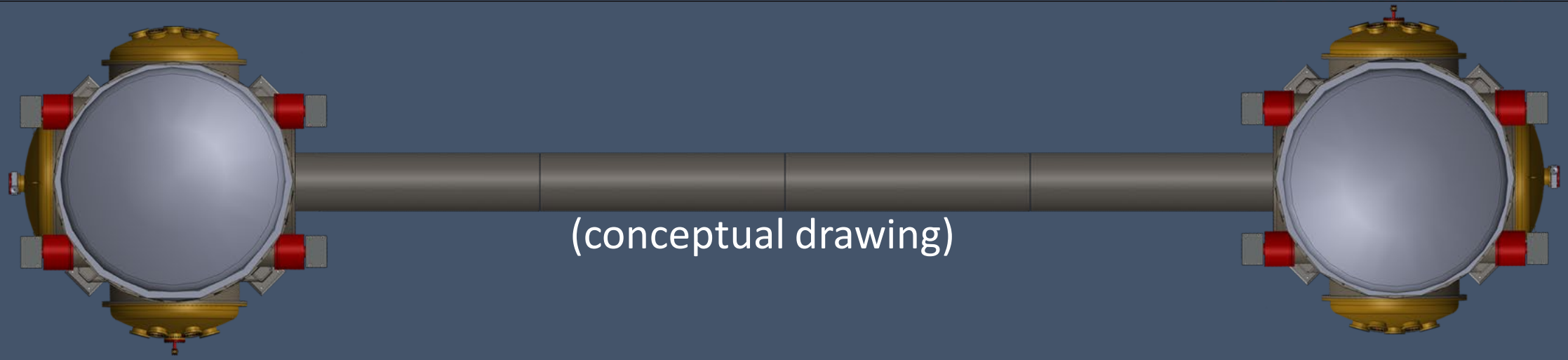
Jan Harms

Gran Sasso Science Institute

Daniele Cortis, Donato Orlandi, Alessandro Lalli, Ilaria Caravella, Carlo Bucci, Stefano Pirro

INFN - LNGS

GEMINI



(conceptual drawing)

- Two vacuum chambers connected by vacuum pipe
- Inertial platform inside each chamber
- Cryocooler and cold box for cryo-temperature payloads on one of the platforms

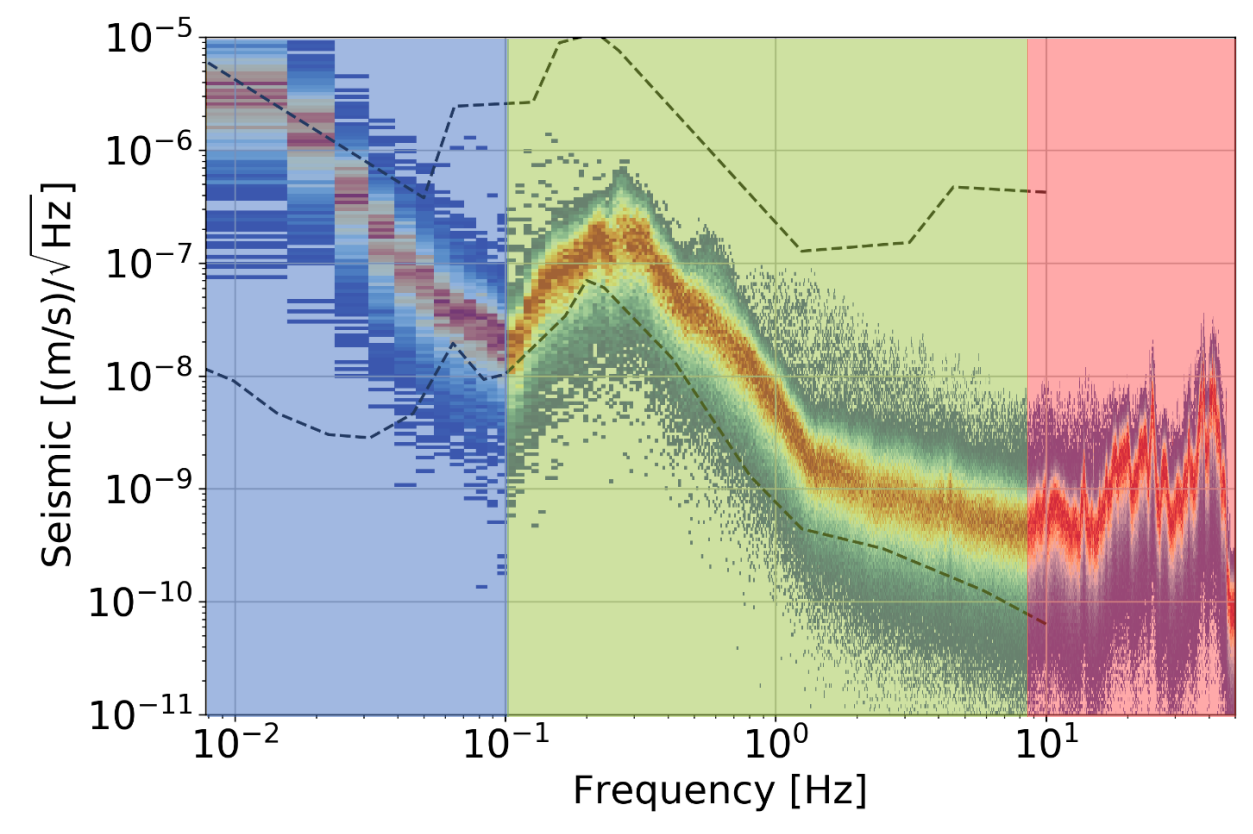
Background

- Experiment at INFN LNGS
- Collaboration between GSSI and LNGS
- Funded through two PNRR projects: ETIC (80%) and ASTRA (20%)

Goals

- Test the limits of active seismic isolation in an underground environment
- Inter-platform motion control
- Underground environmental monitoring
- Test new approaches to controls optimization
- Test new inertial sensors

Underground Environment



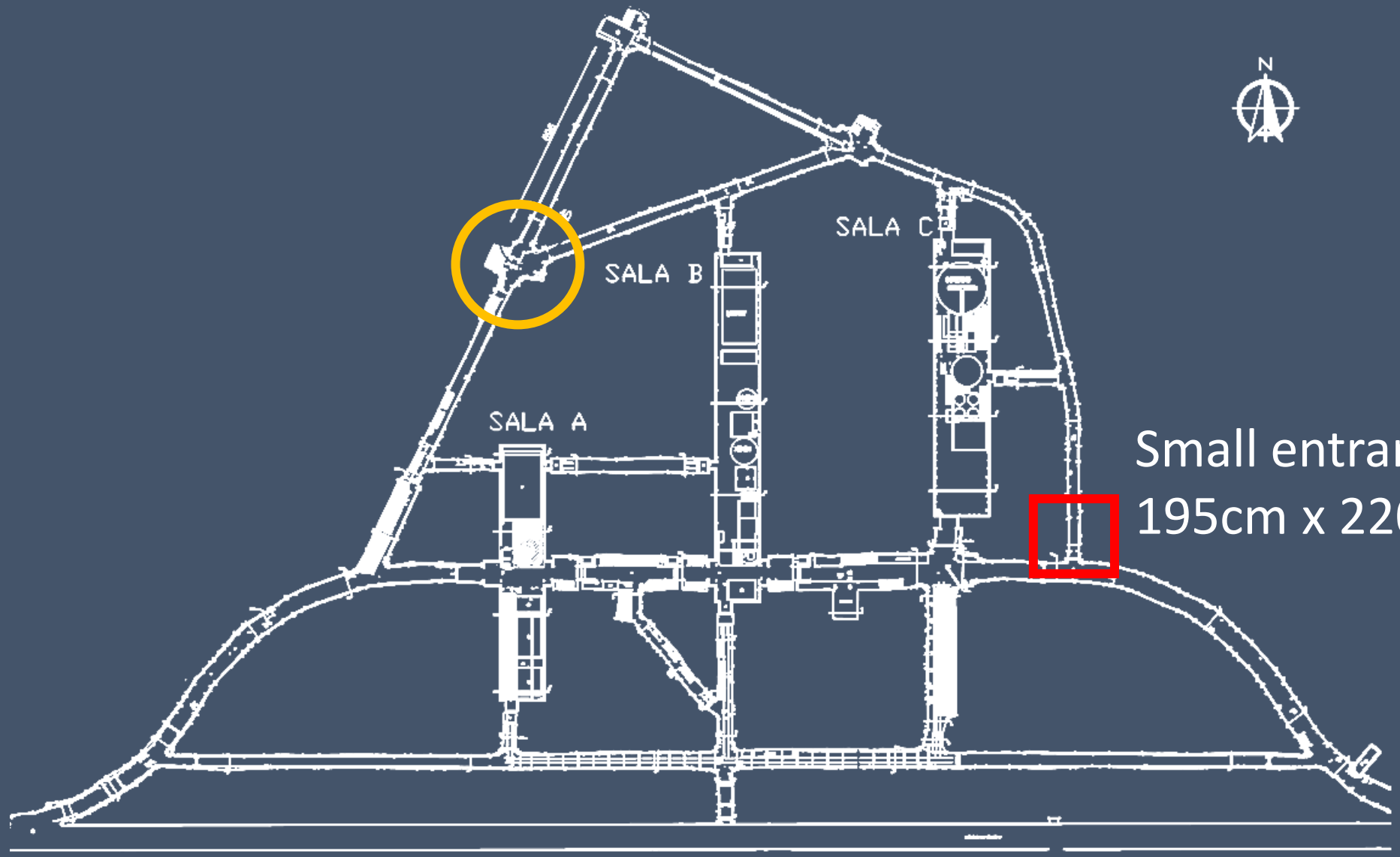
Blue: excess noise, which is probably ground tilt produced by pressure fluctuations

Green: natural low underground seismic noise

Red: excess noise from machines

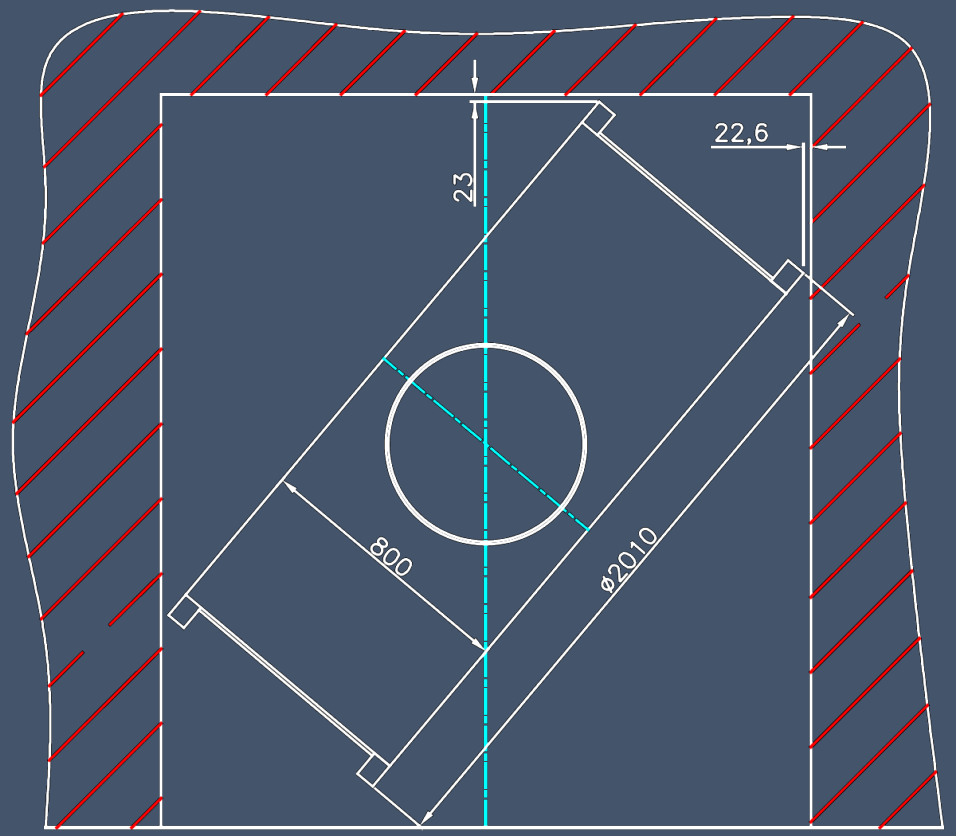
Important: Analyze <0.1Hz excess noise and its impact on active seismic isolation

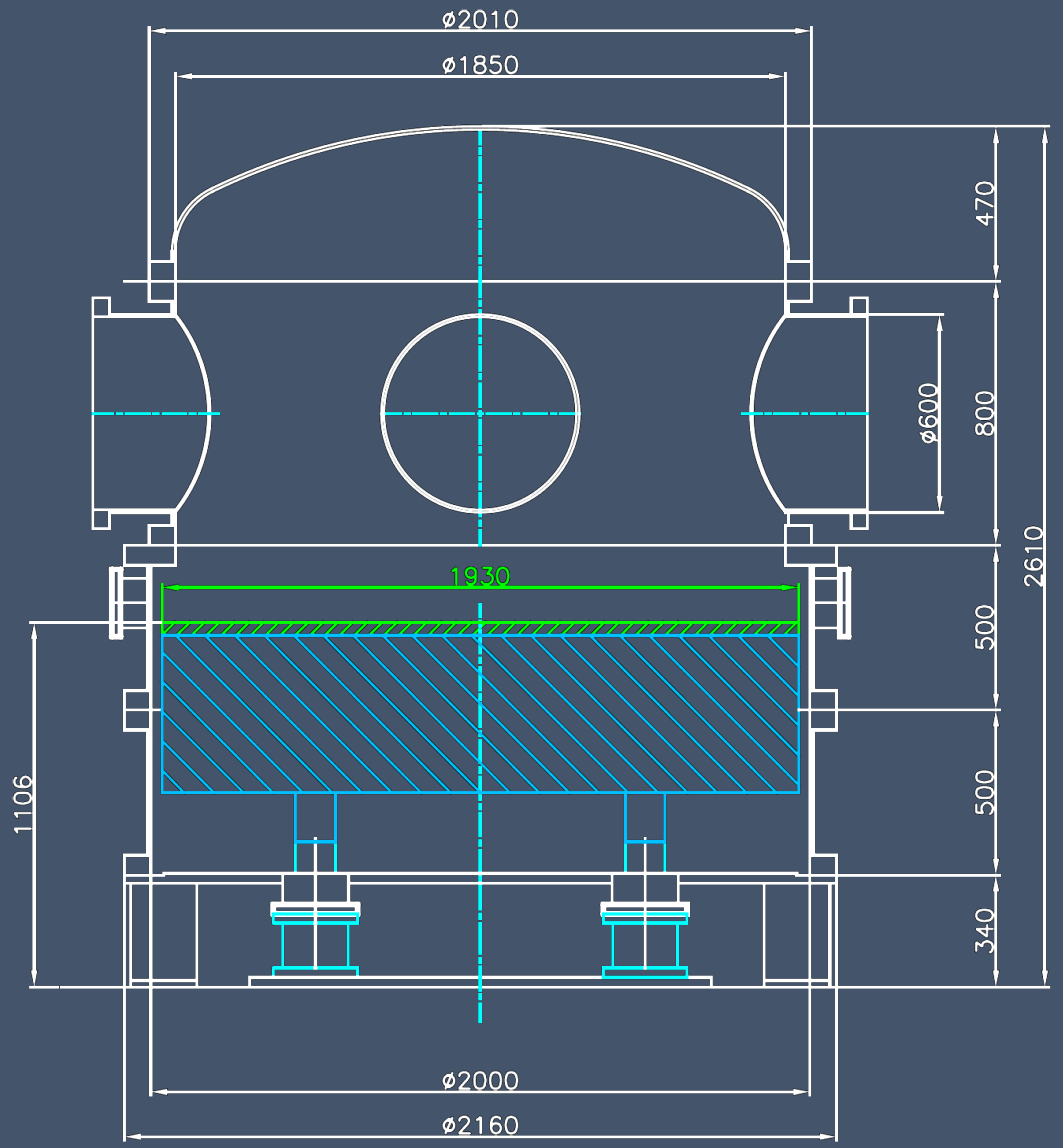
GEMINI Site



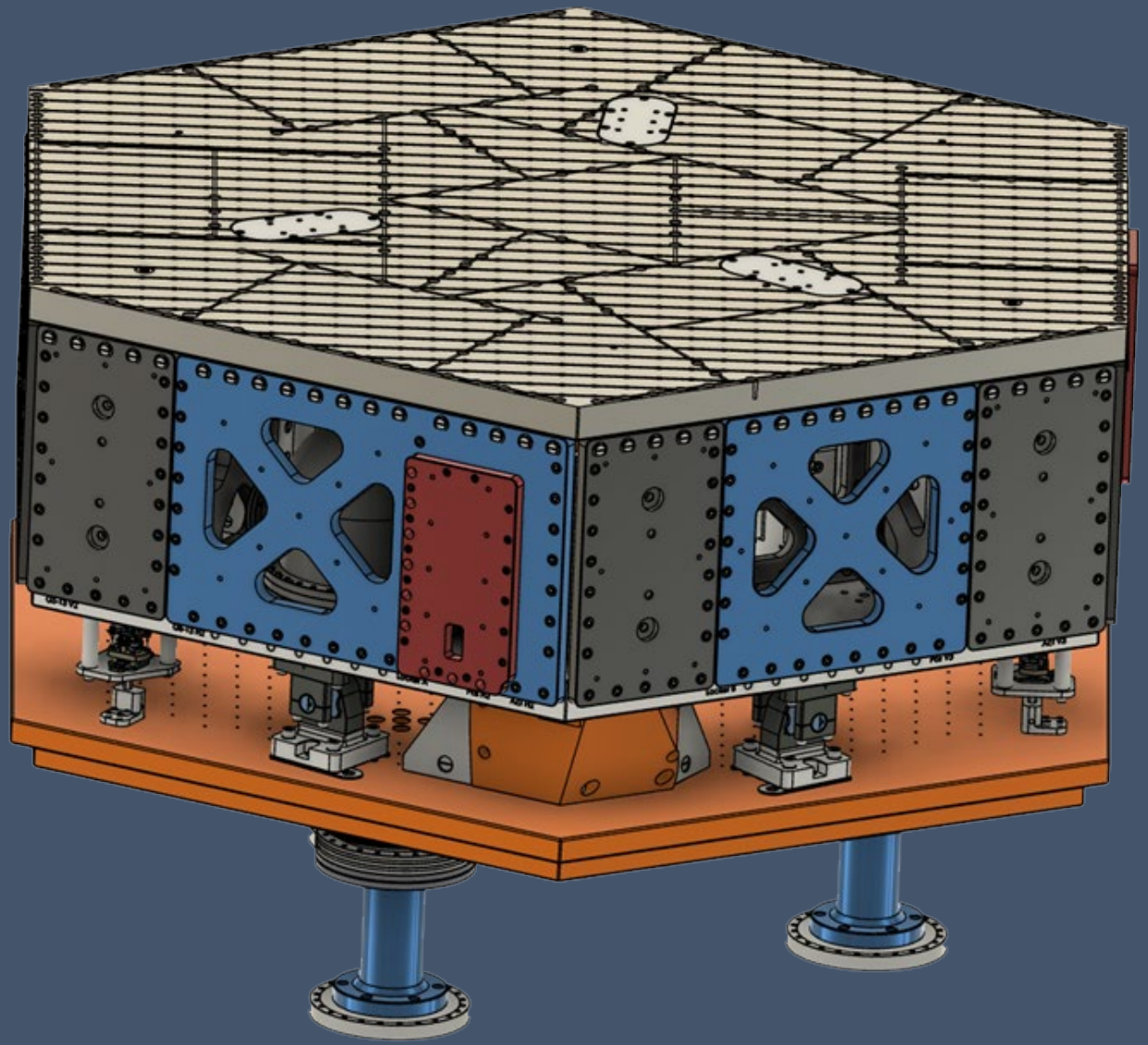
Small entrance:
195cm x 220cm

Challenge: Installation





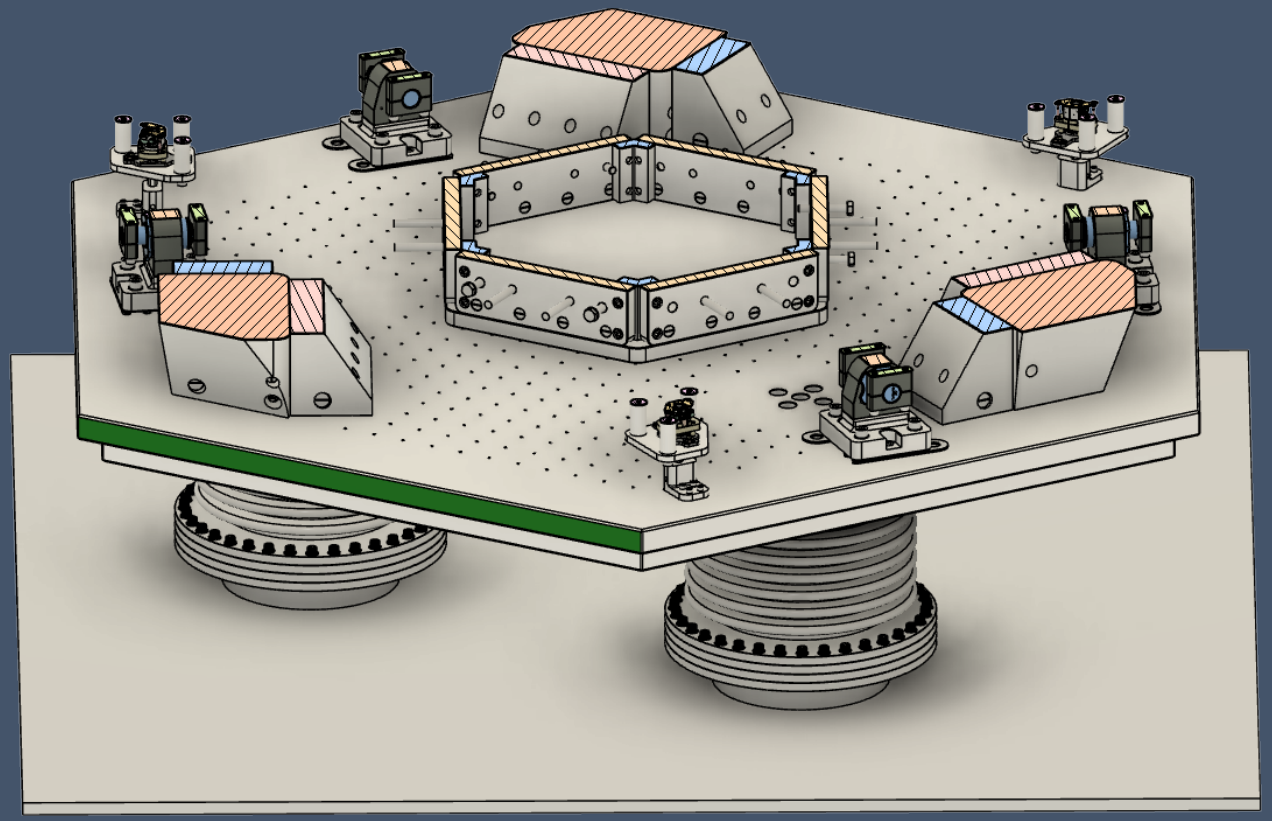
GEM-ISI



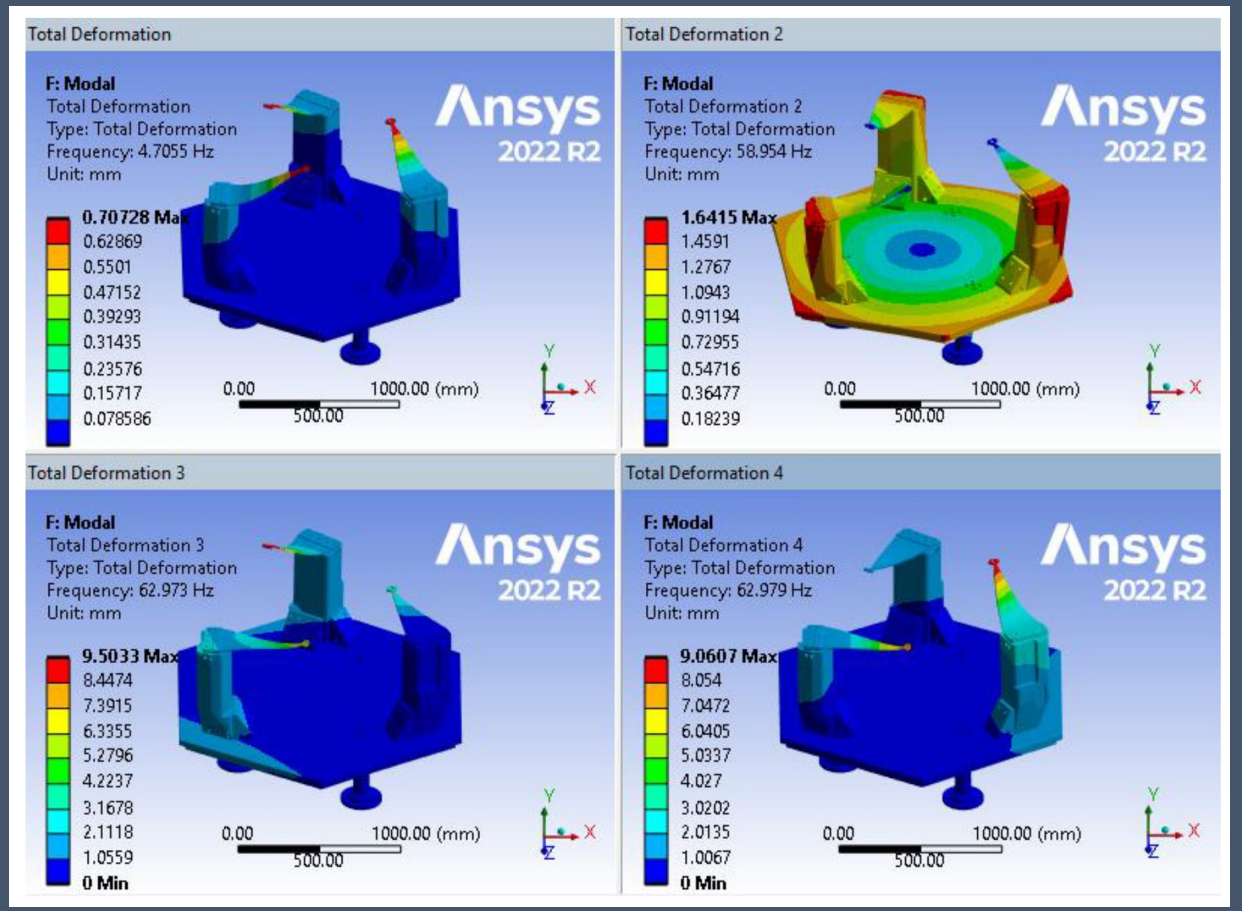
Adopted from LIGO HAM ISI:

- Table edges cut
- Stage-1 sensors exchanged (T360 GSN instead of GS-13)
- Major design modifications of stage-0

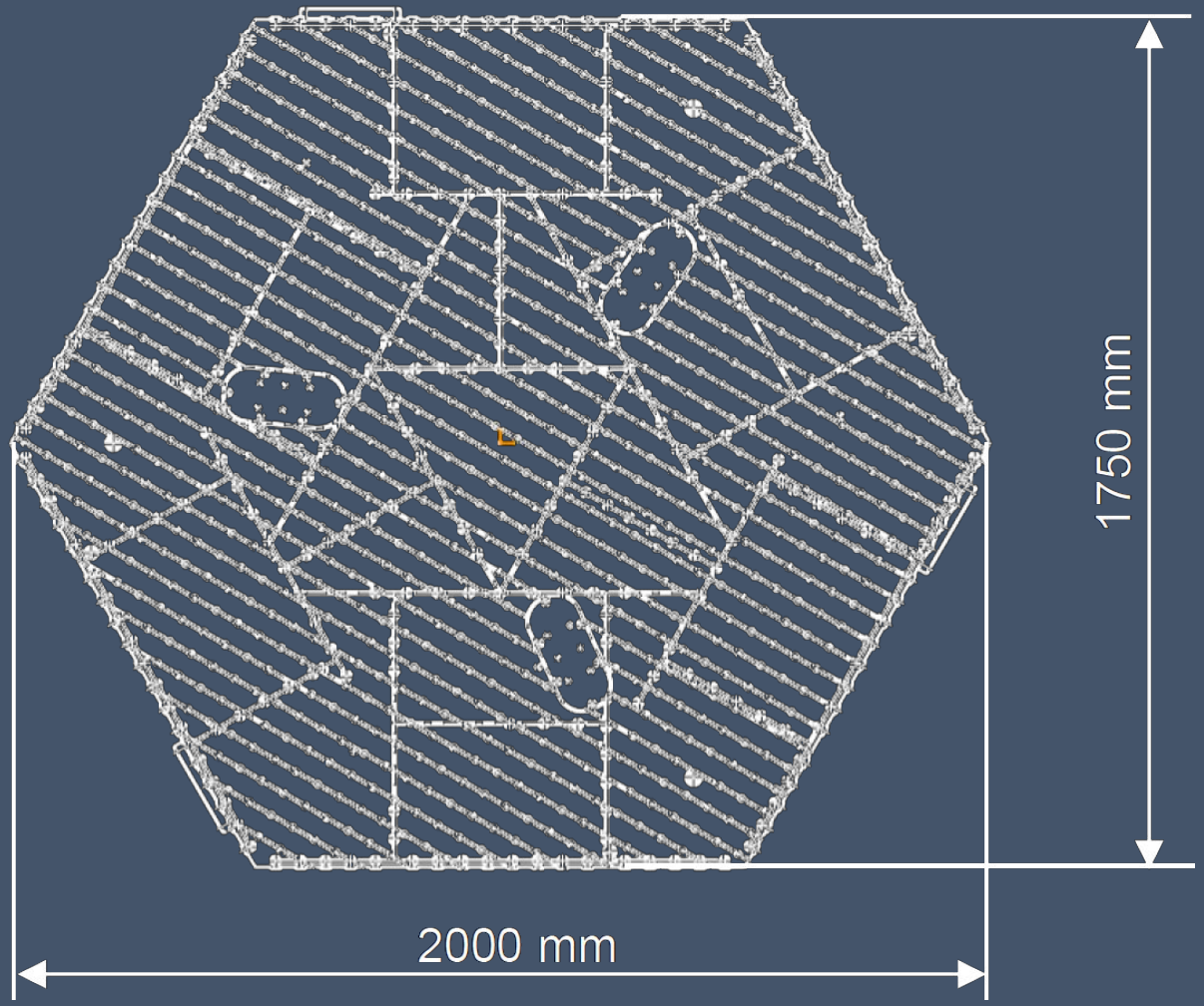
GEM-ISI: Stage 0



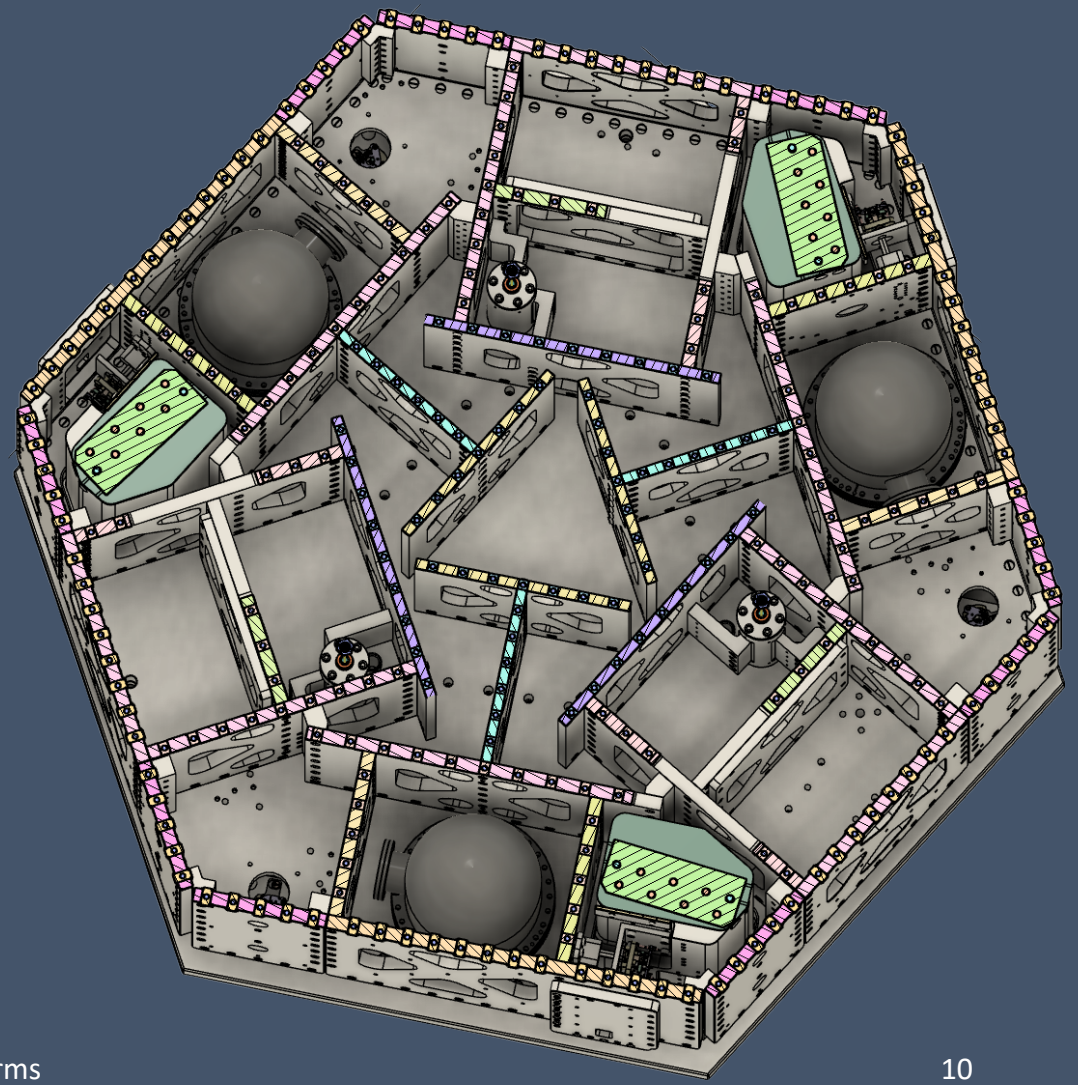
100Hz HAM-ISI (unconstrained)
70Hz GEM-ISI (under load)



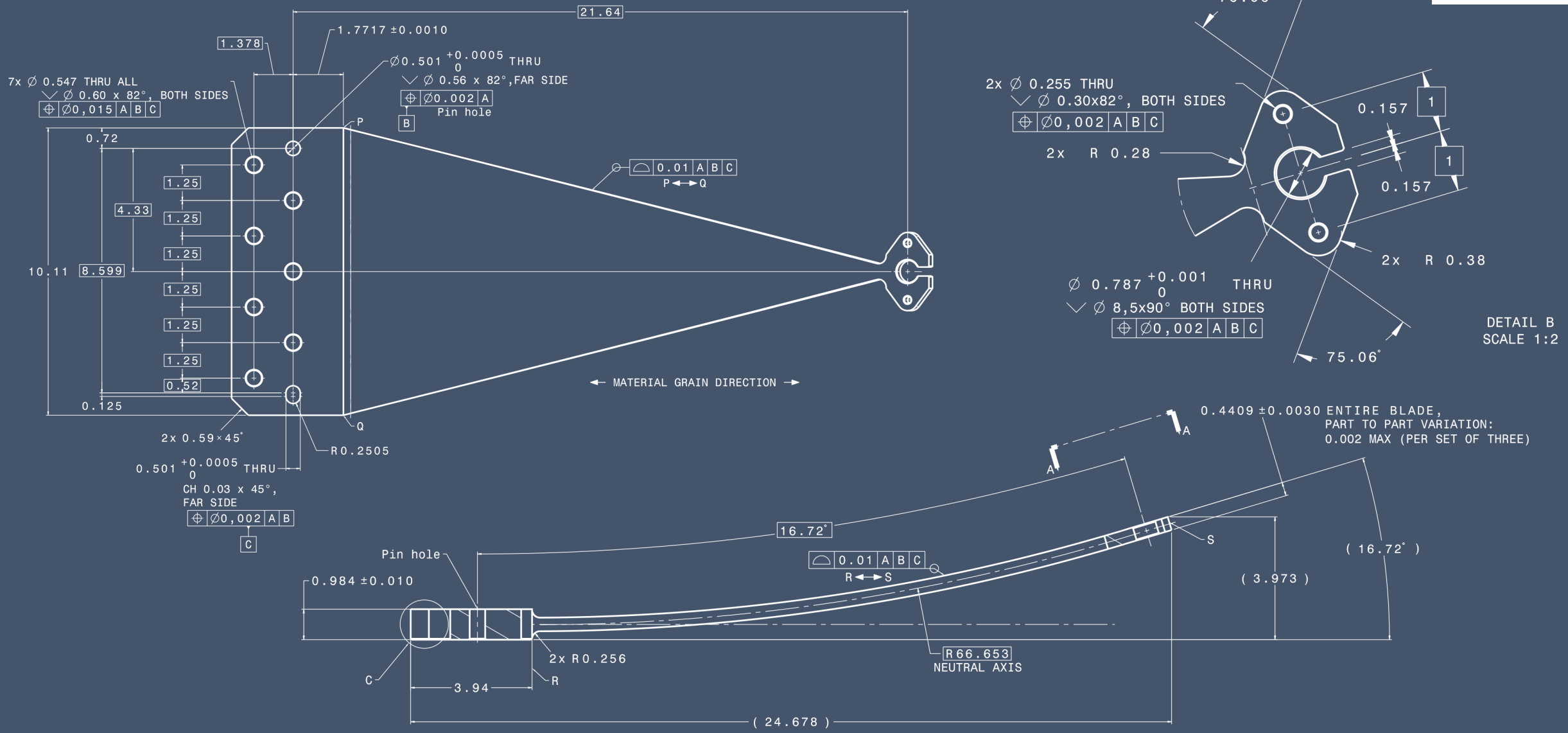
GEM-ISI: Stage 1



GEM-ISI like HAM-ISI (about 350Hz)

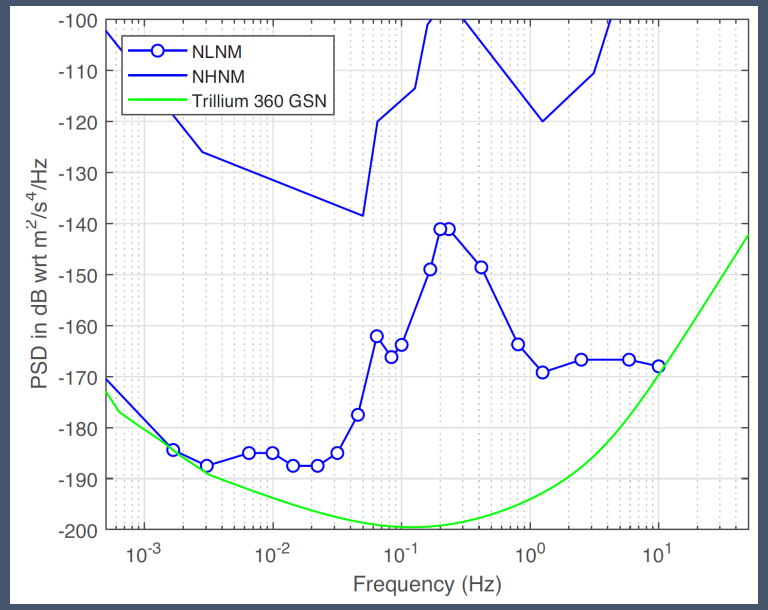


Maraging Steel Spring Blades

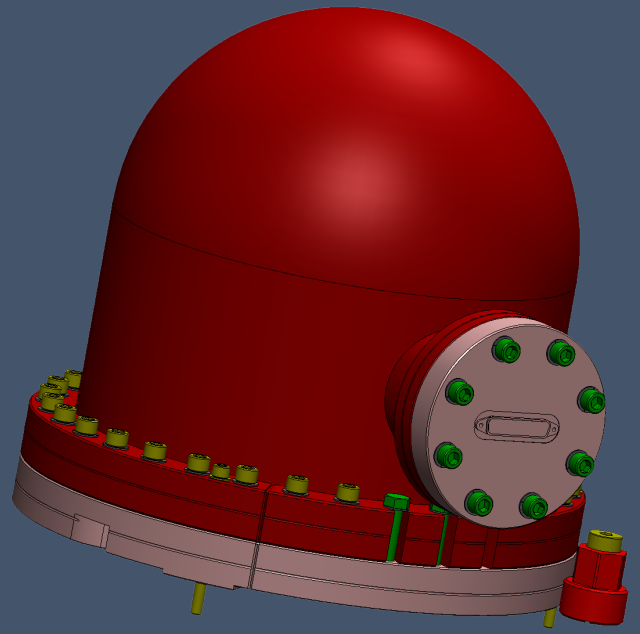


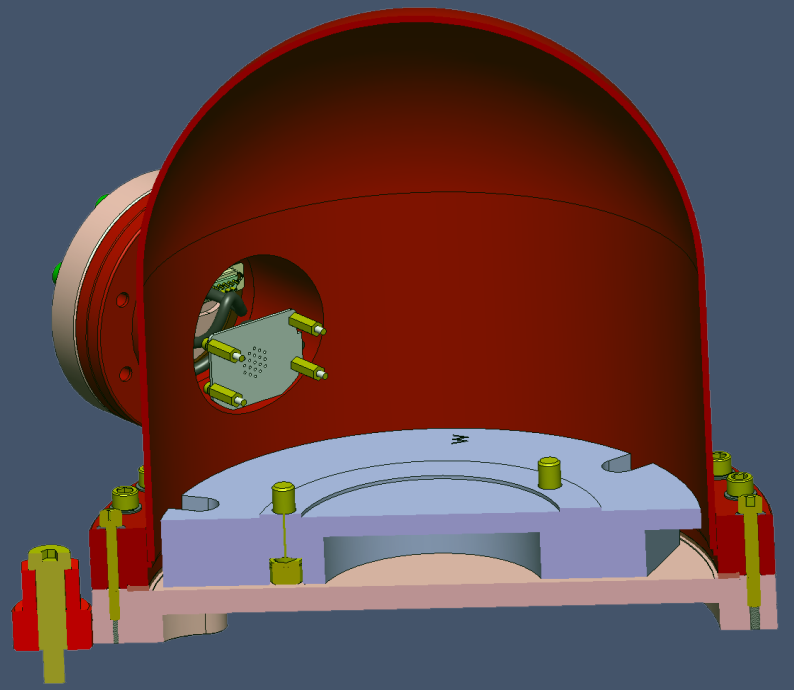
On-platform Seismometers

Nanometrics T360 GSN Vault



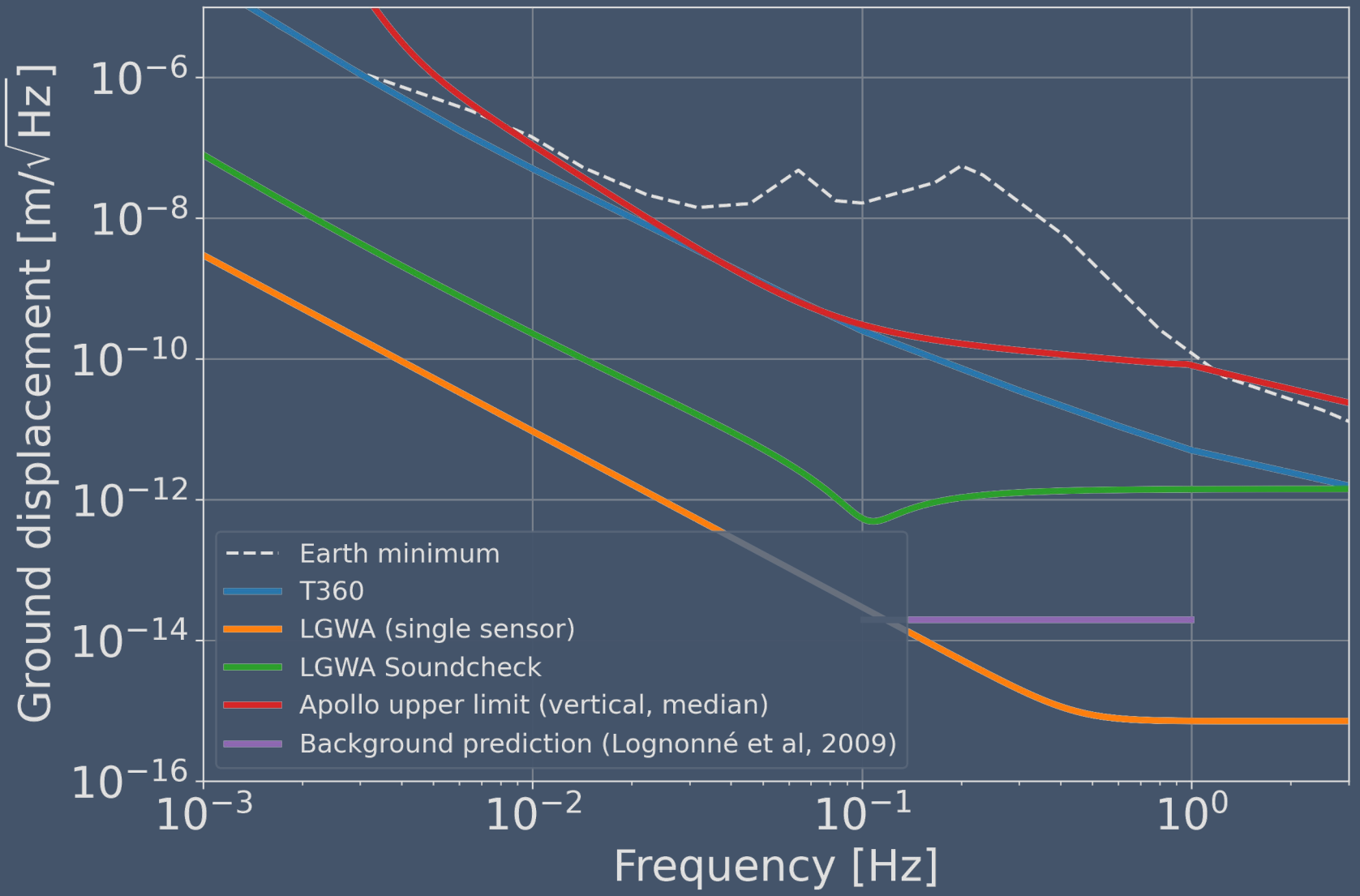
Vacuum pod





The T360 is not designed for in-vacuum operation, and a vacuum pod is required, which keeps a normal pressure.

Seismometer Test Bed



Missing Designs / Components

- Actuators and position sensors
  (maybe something like BOSEMs, but with
  updated coil actuator-design)
- Electronics (likely adopting updated CDS design)
- Cryocooler, cryolink and cryobox
- Barometer/microphone array (**not yet funded**)
- Inter-platform interferometer (**not yet funded**)
- Tiltsensor (**not yet funded**)