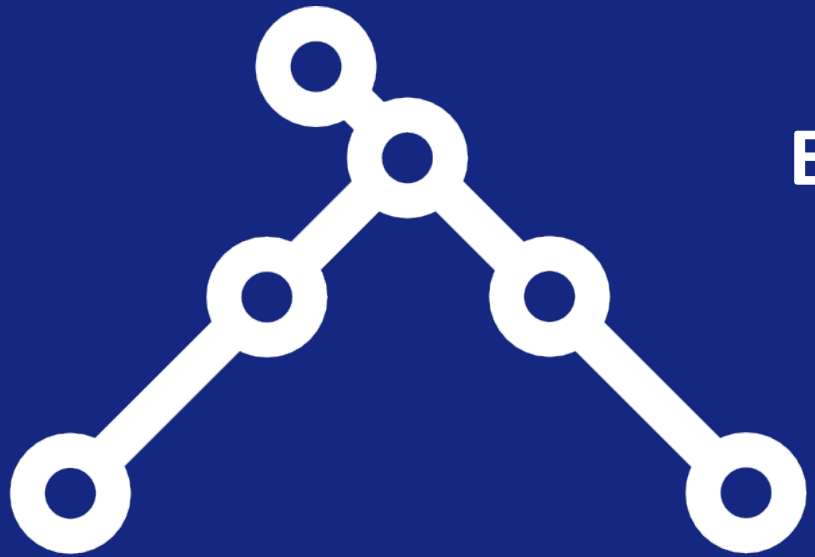


ETpathfinder status update

ET Symposium, May 2023

L. Kranzhoff for ETpathfinder team

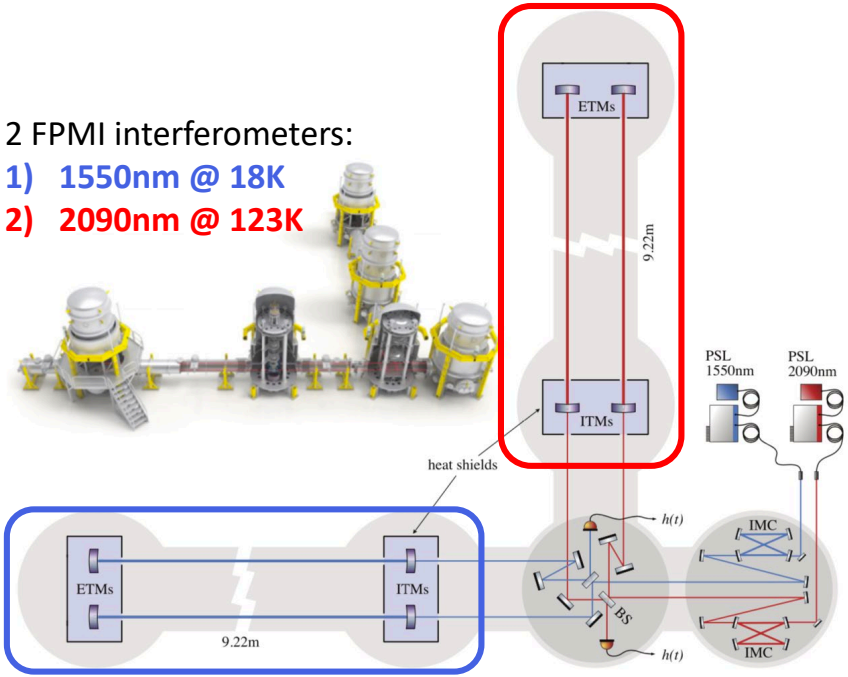
Interreg
EUROPESE UNIE
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling

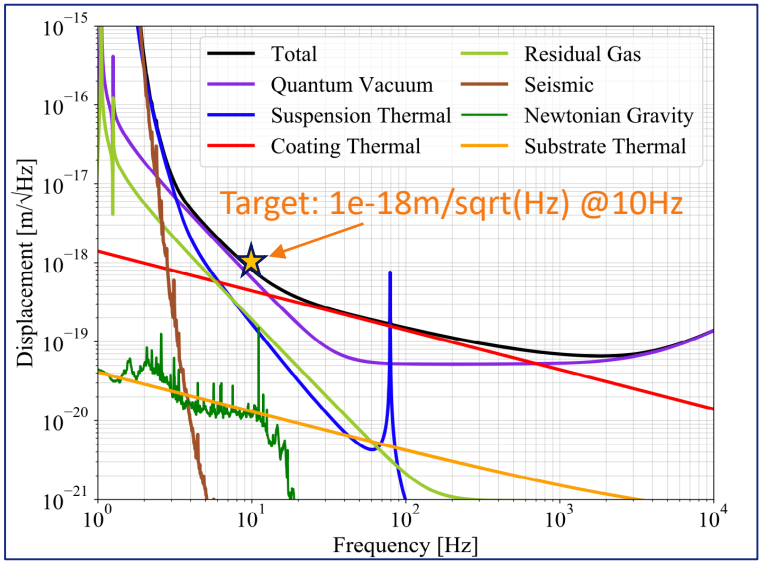
ETpathfinder overview

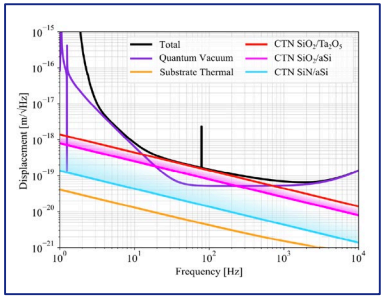
Main target: provide a testbed for ET technologies/concepts and qualify them in low-noise environment.

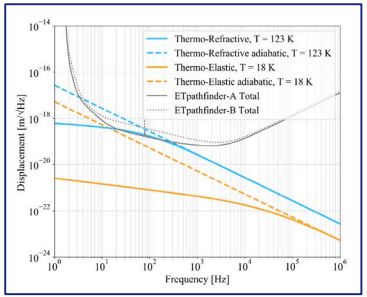
2 FPMI interferometers:

1) 1550nm @ 18K
2) 2090nm @ 123K





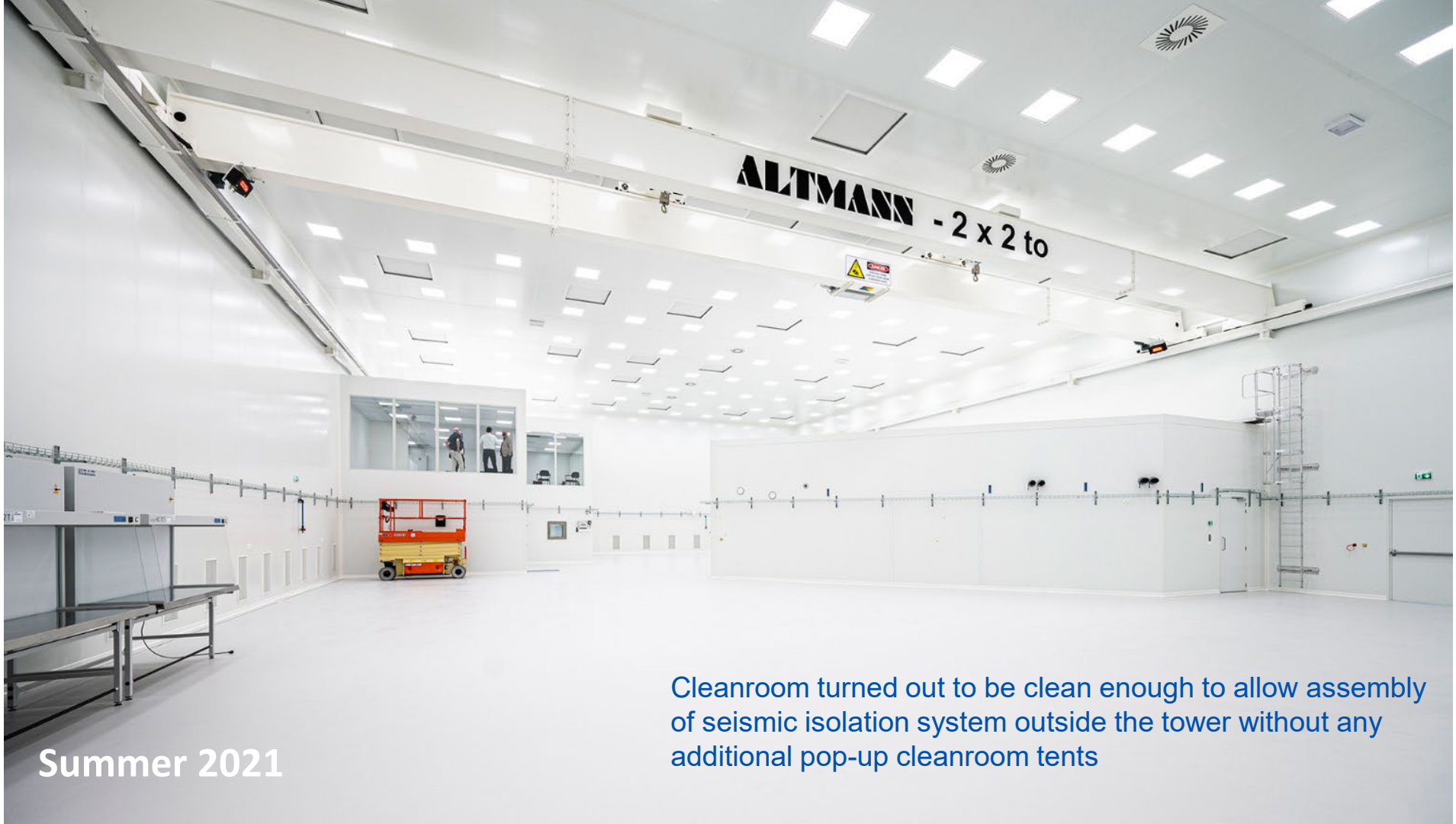





January 2020



Spring 2020



Summer 2021

Cleanroom turned out to be clean enough to allow assembly of seismic isolation system outside the tower without any additional pop-up cleanroom tents


Spring 2022


ALTMANN - 2 x 2 to
Summer 2022



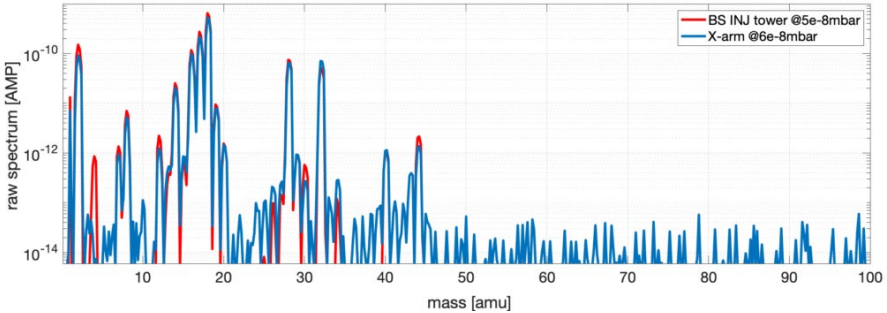
Now



WP4: Vacuum and cryogenics

Vacuum

- 190 cubic meters of UHV, target pressure <1e-9mbar
- status: towers and arms installed, leak chasing
- Kurt Lesker gate valves came dirty and UHV-incompatible
- empty towers: measured 5e-8 mbar after installation
- clean RGA-spectra: hydrogen, water, air components



Cryogenics

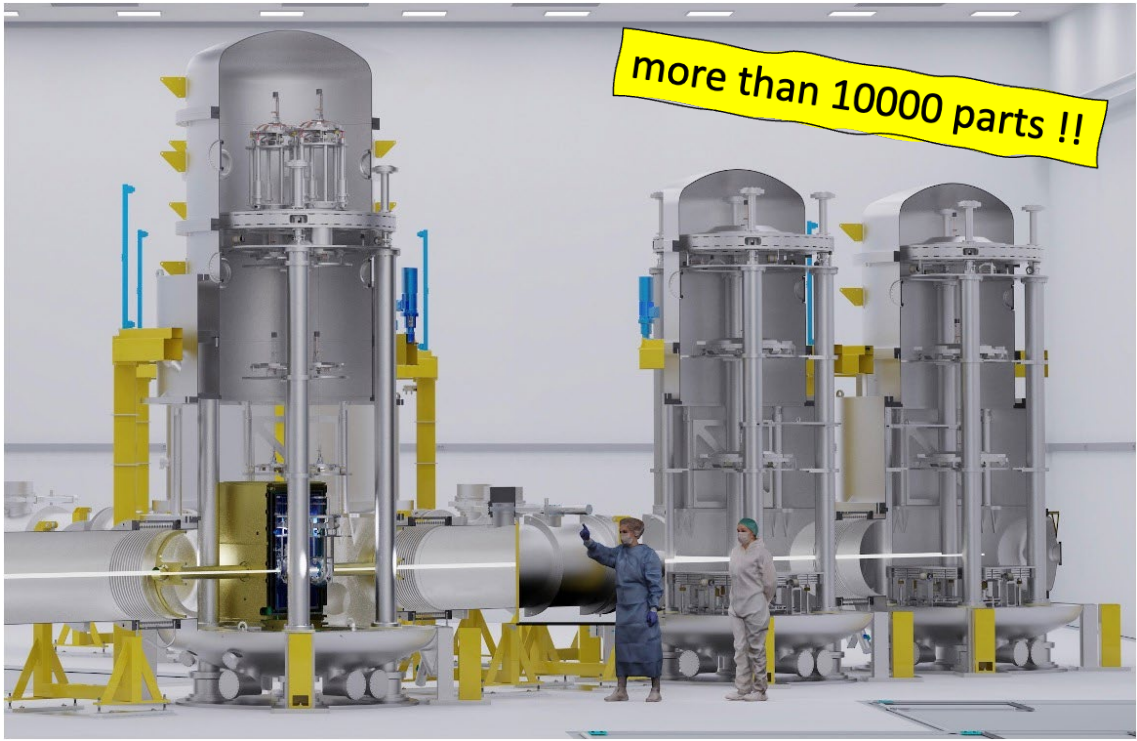
- LN2 system in Maastricht installed
- cryo-shields: design and production drawings (Barcelona)
- test of cryogenic system in Twente:
  - installation of test vessel and instrumentation (Feb)
  - multiple cool-downs of subcooler and test vessel
  - problems: moist influx into exhaust line, leakage



WP5: Seismic isolation

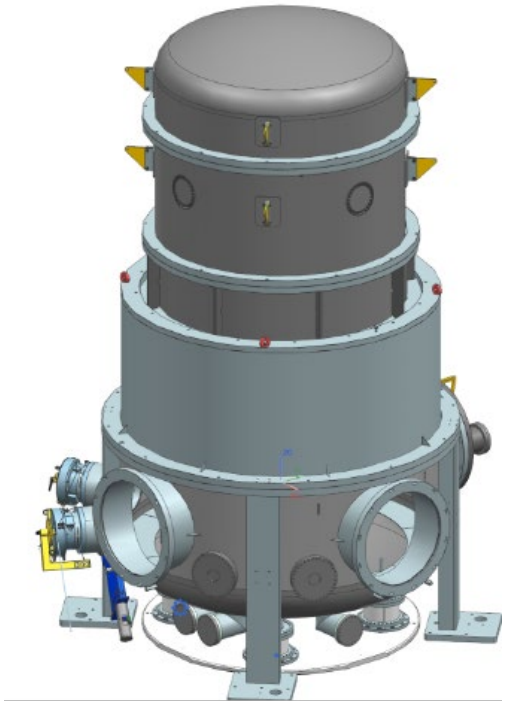
Internal mechanics production

- mirror suspension chains, payloads, optical benches, etc. already in the hands of the companies for precision cleaning;
- some accessory parts for the in-vacuum benches still being made;
- design of blade springs for GAS filters finalized after prototype testing; production is in progress;
- detailed workflow/plan for logistics, assembly and storage has been devised.

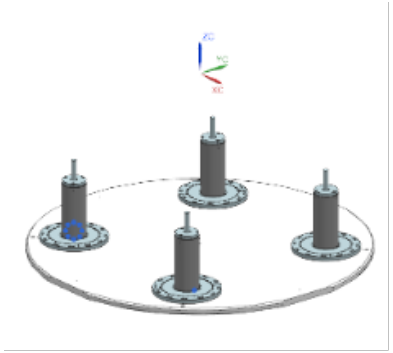


WP5: Seismic isolation

Installation will begin after summer: the Beam Splitter Tower



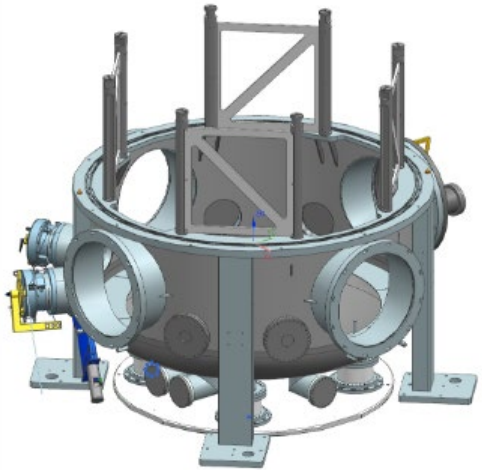
Dummy IP feet and baseplate for installation



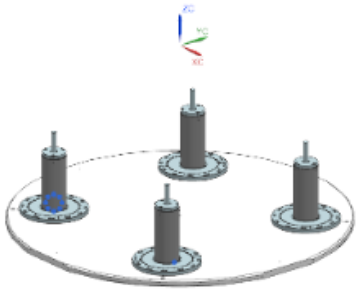
WP5: Seismic isolation

Installation will begin after summer: the Beam Splitter Tower

Dismantle the vacuum tower up to the bottom vessel



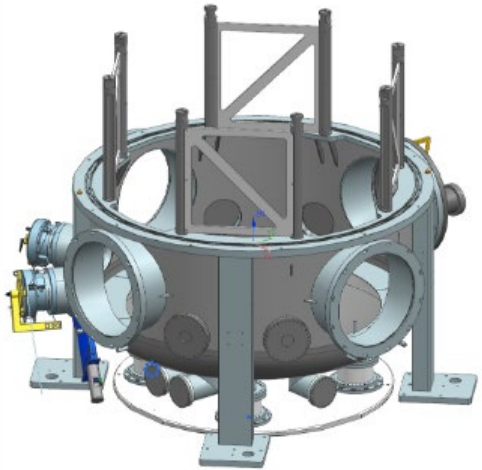
Dummy IP feet and baseplate for installation

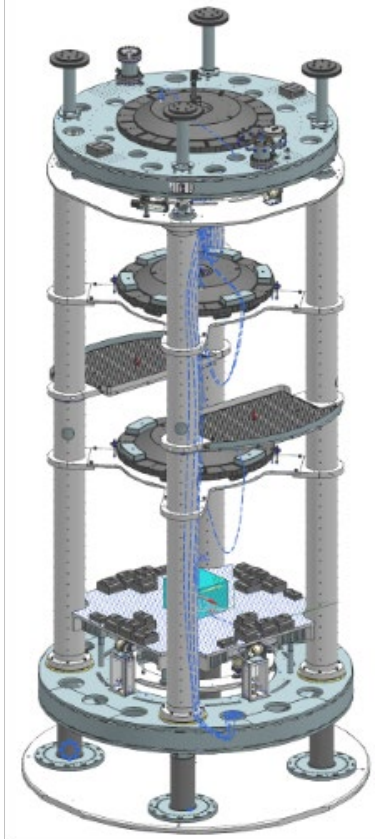


WP5: Seismic isolation

Installation will begin after summer: the Beam Splitter Tower

Build the internal mechanics on dummy IP feet

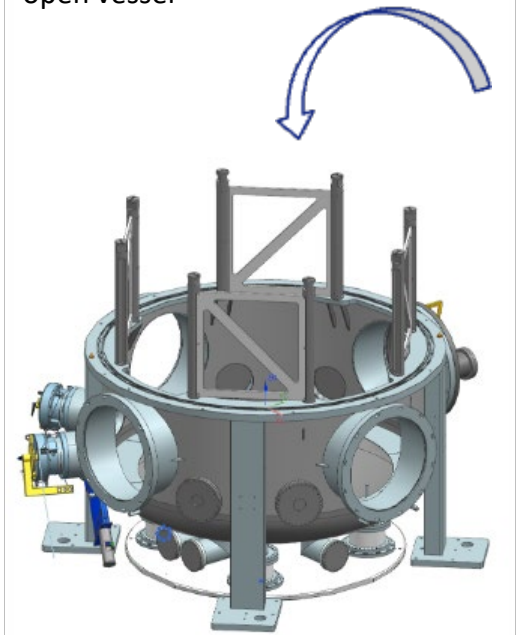


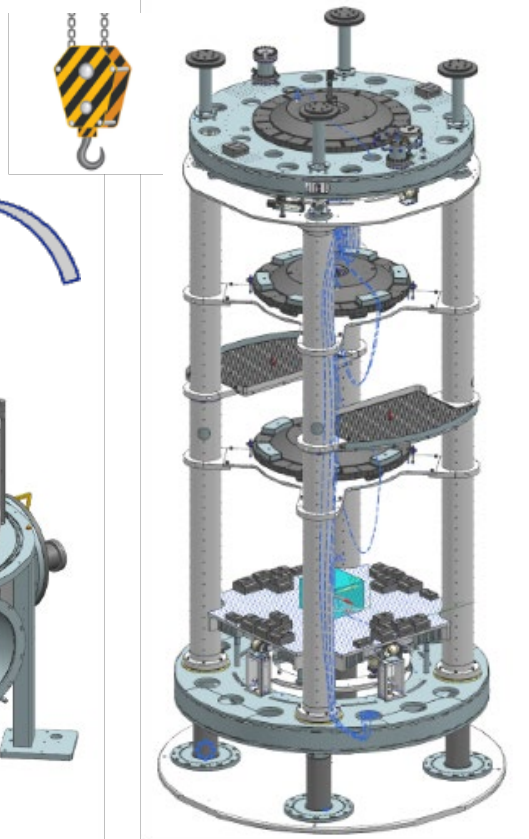


WP5: Seismic isolation

Installation will begin after summer: the Beam Splitter Tower

Hoist the whole assembly into the open vessel

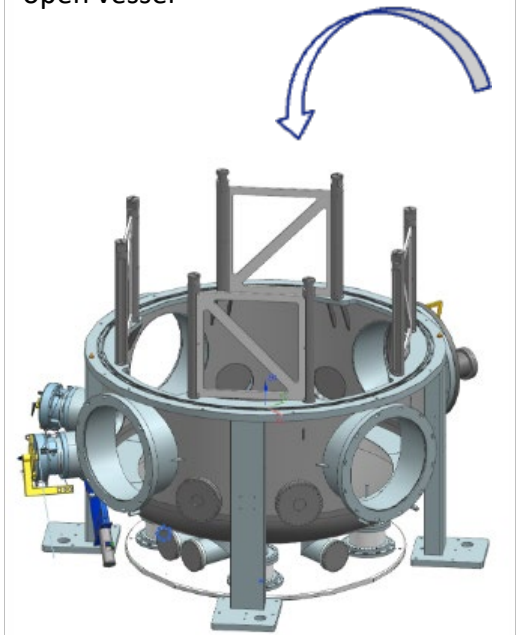


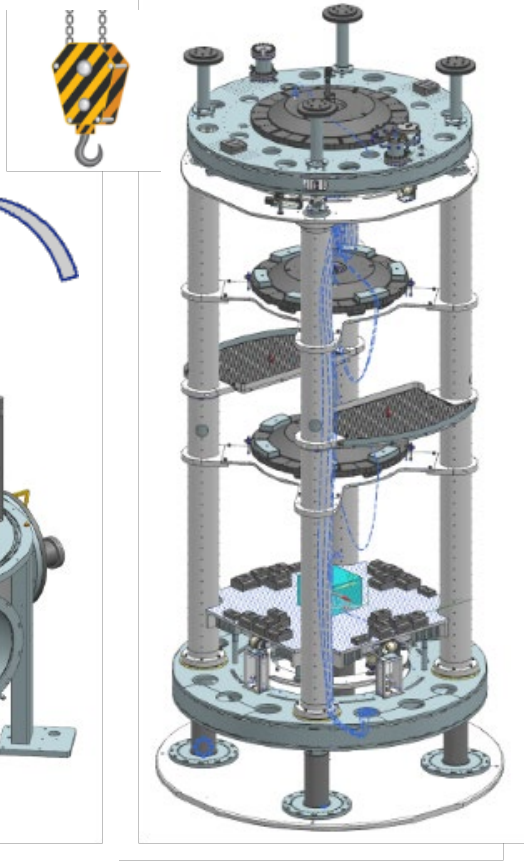


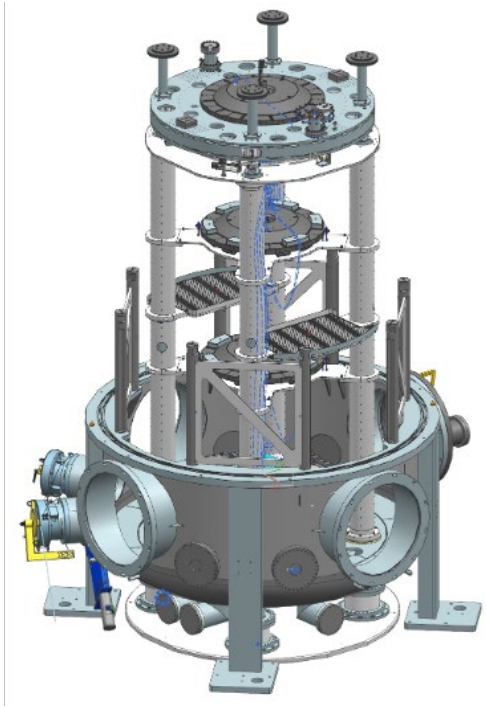
WP5: Seismic isolation

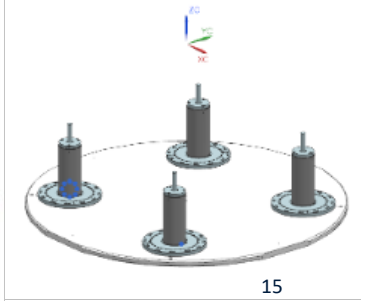
Installation will begin after summer: the Beam Splitter Tower

Hoist the whole assembly into the open vessel



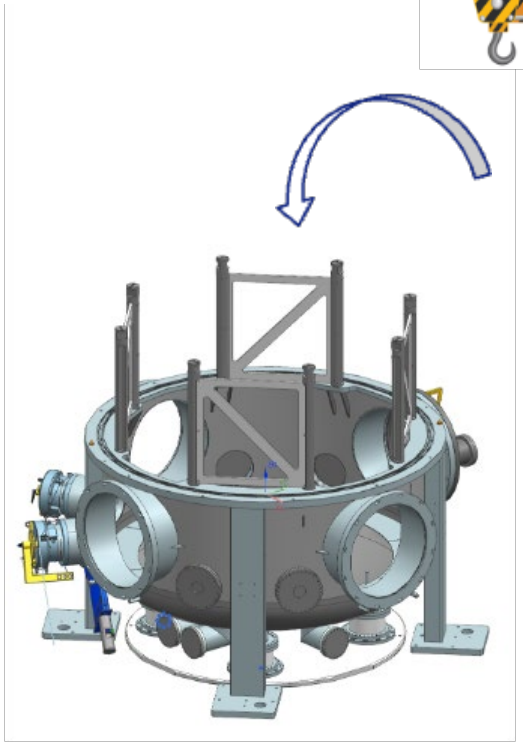


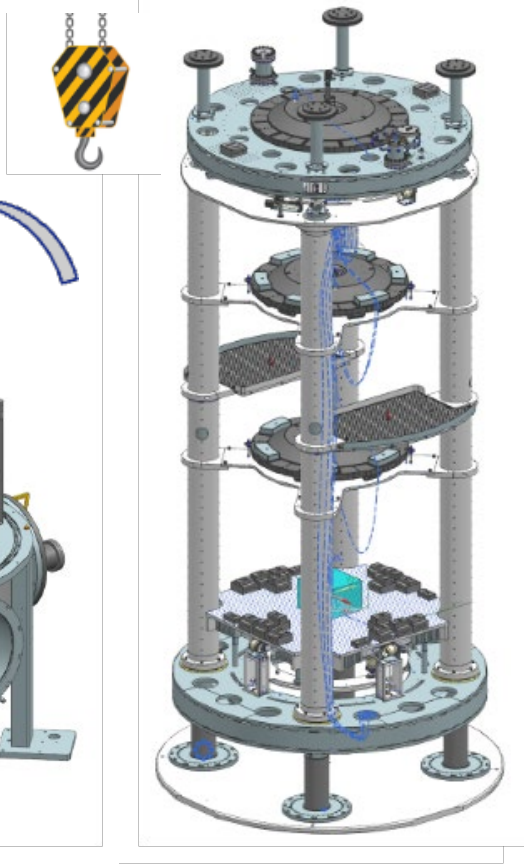


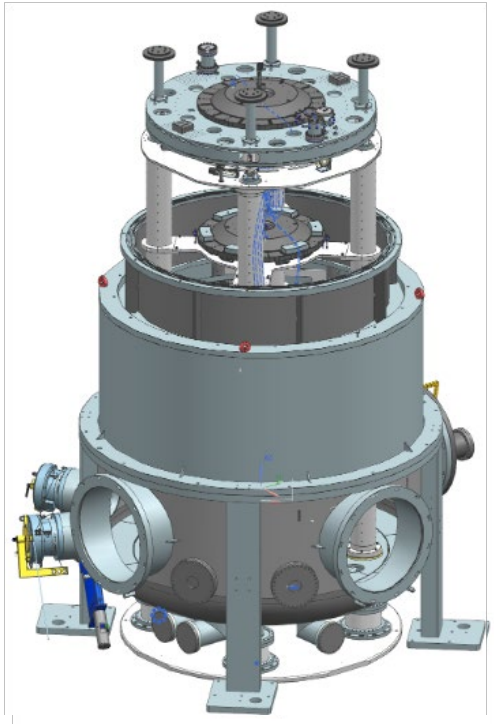


WP5: Seismic isolation

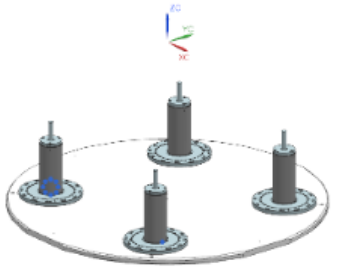
Installation will begin after summer: the Beam Splitter Tower







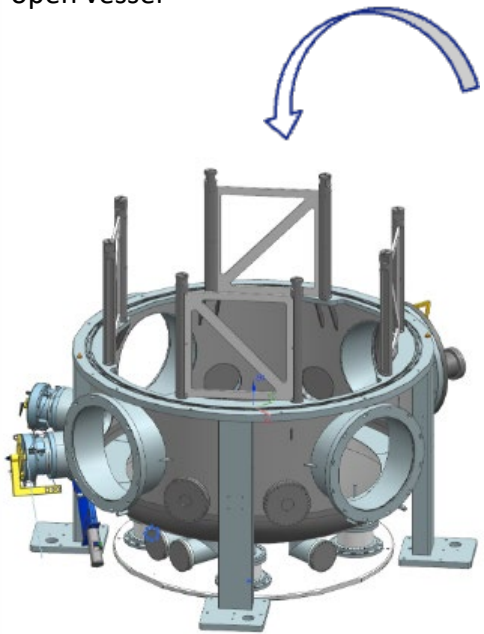
Close the tower

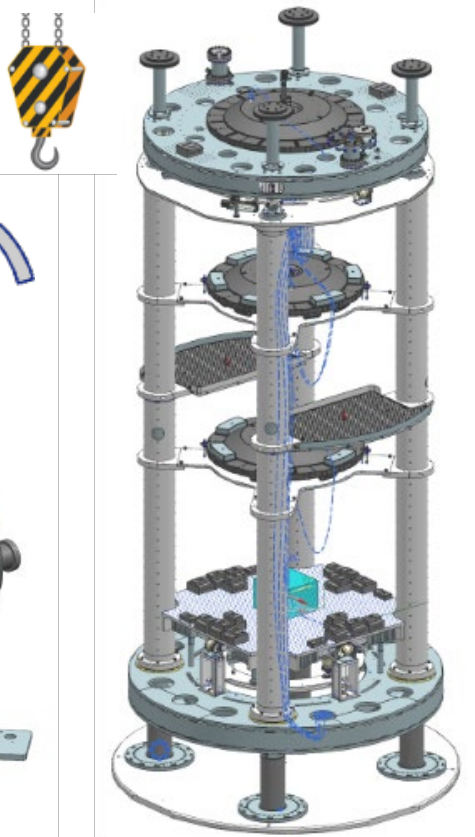


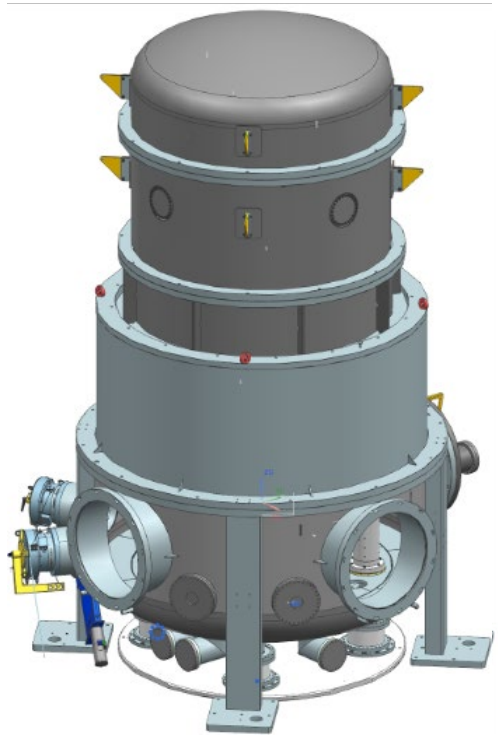
WP5: Seismic isolation

Installation will begin after summer: the Beam Splitter Tower

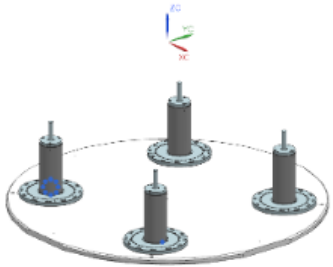
Hoist the whole assembly into the open vessel







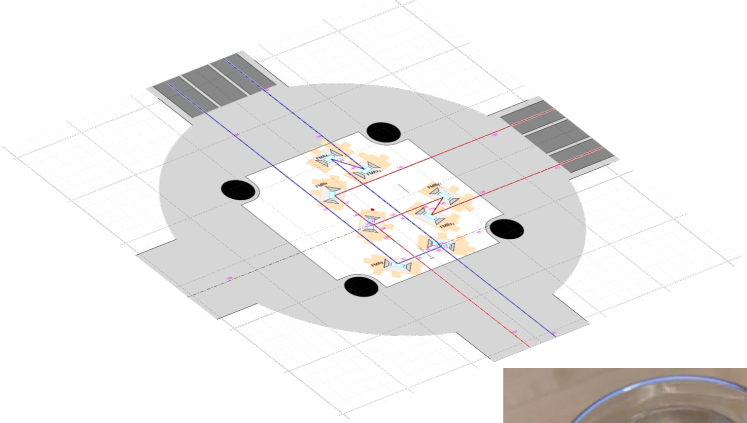
Close the tower



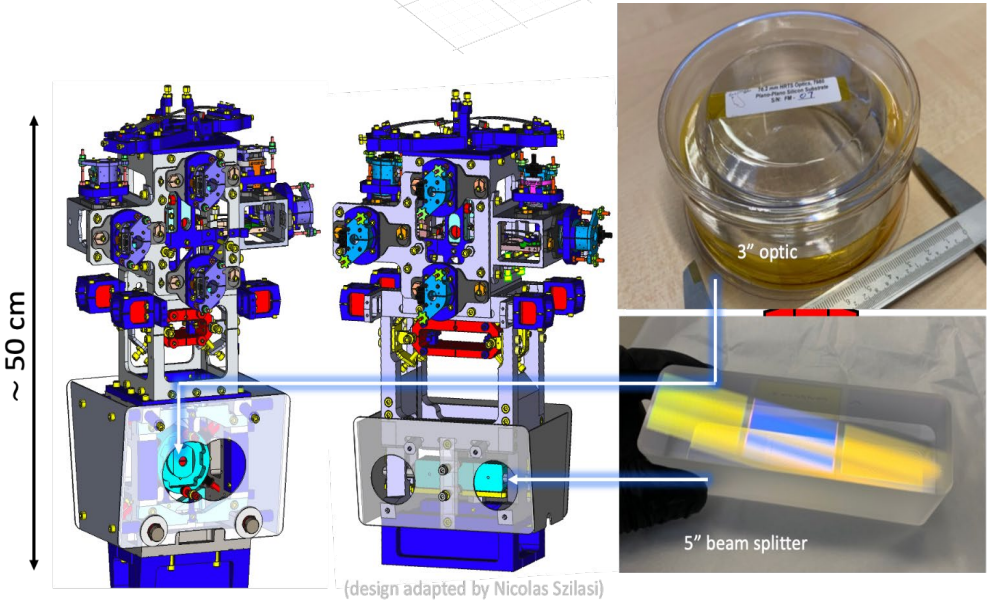
WP5: Seismic isolation

HRTS table-top (triple) suspensions

- for the six 3” folding mirrors and the two 5”beam splitters in the Central Tower, HRTSs (LIGO A+ design) and an adapted version
- all parts produced, cleaned for UHV and ready for assembly.

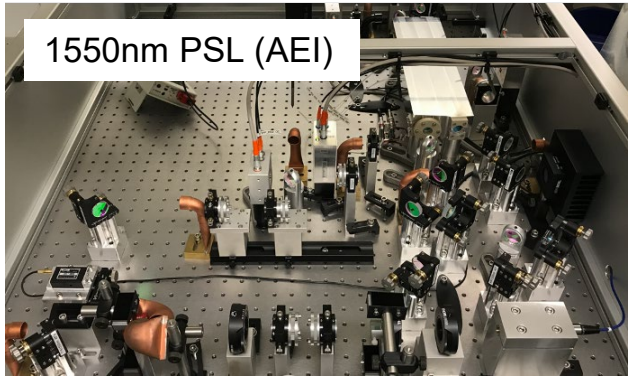




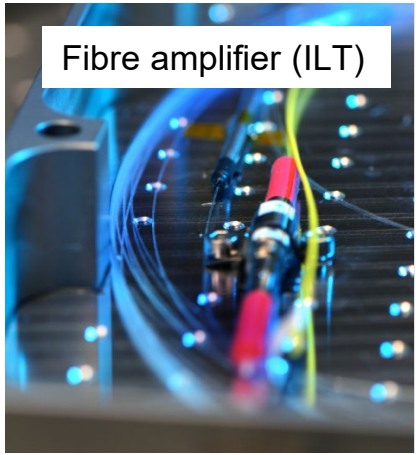


WP6: Optics

- laser sources under development
  - 1550nm PSL progressing well at AEI
  - 2090nm commercial seed arrived; 2090nm fibre amplifier almost completed by Fraunhofer ILT
- establishing laser corner in cleanroom to be able to start experiments w/o disturbing vacuum system commissioning
- two (so far…) silicon main mirrors under polishing by Zeiss SMT
- simulations on locking scheme, mode matching etc. ongoing

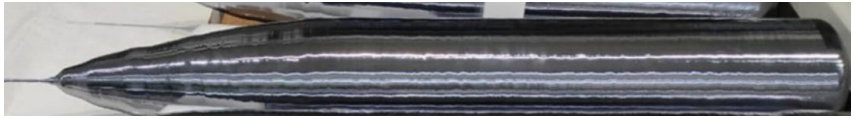






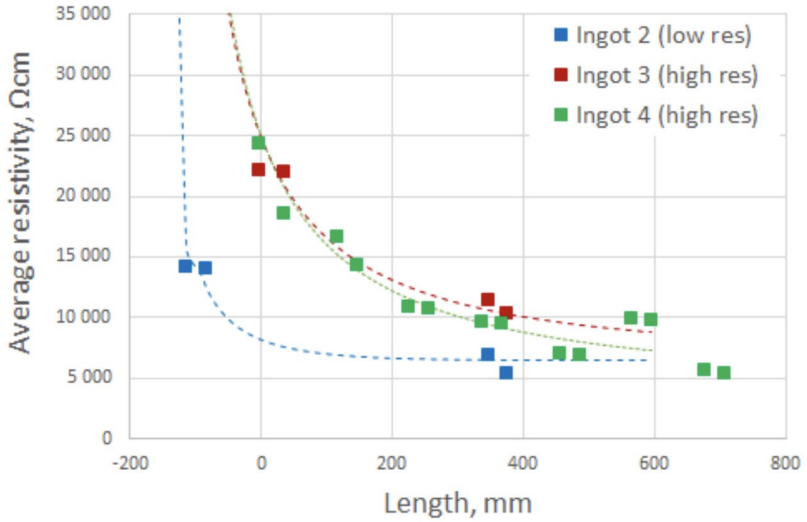
WP6: Optics





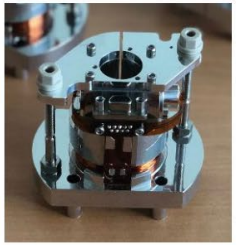
- next steps for optics:
  - integration of 1550nm PSL with LAPP control system
  - stabilisation of PSL onto IMC on suspended input bench
  - this way, progress on optics does not interfere with critical path for cold mirror suspensions
- further understanding silicon as optical material
  - polishing of small samples for absorption measurements
  - correlation of absorption with measured resistivity (IKZ - Institute for Crystal Growth, Berlin)
  - investigating paths to more and larger test mass mirrors
- finalising procurement of remaining optics (e.g. coating of HRTS substrates)

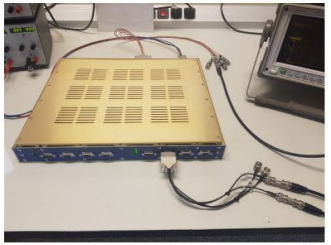
Floatzone silicon (IKZ)



WP7: Controls



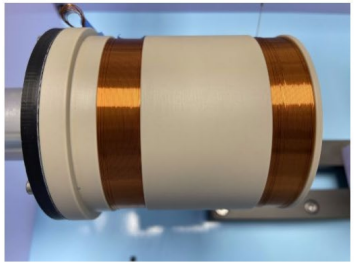






- **suspension electronics**
  - 12x Trillium120 seismometer
  - BOSEMs produced by Birmingham, delivered
  - readout electronics finished by VU Amsterdam
  - stepper motors received, driver design (Nikhef)
  - LVDTs and electronics produced by Antwerp
  - LVDT coil-winding machine in Maastricht
- **in-air cabling** (DSub25): quality issues, strain reliefs
- ordered 15km of **in-vacuum cable**, connectors (Antwerp)
- setting up general computing and network
- **data acquisition**: based on Adv Virgo+ DAQ, not yet running
  - received ADCs, DACs, DAQboxes (LAPP), 14 RTPCs
  - configured 3 standalone RTPC + DAQbox systems
- **vacuum control system interface** with Siemens PCS7 (KIT)
- several sensors for **environmental monitoring** acquired
- **now: priorities driven by commissioning of first suspension tower**









ETpathfinder Partners





Thanks for your attention!
Questions?

ETpf design report

Research – ETpathfinder

ETpf sensitivity paper

ETpathfinder: a cryogenic testbed for interferometric gravitational-wave detectors - IOPscience