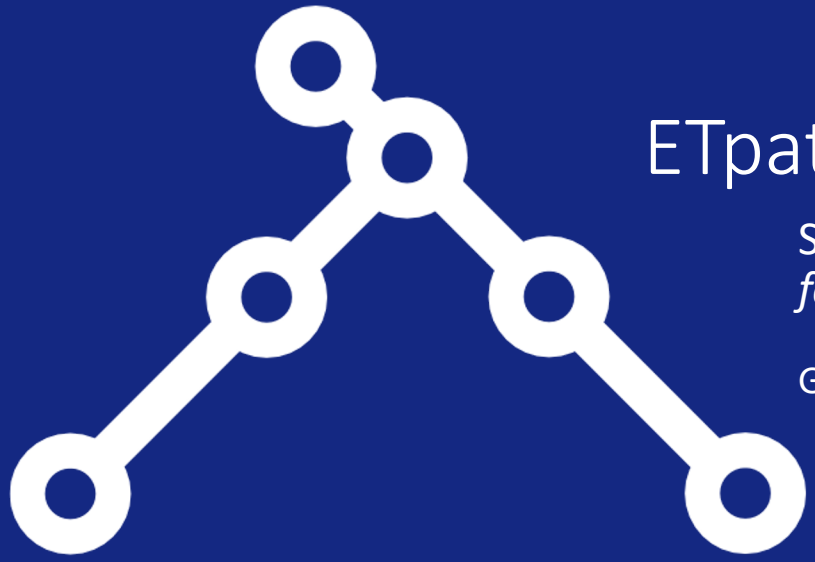
ET-0199A-23



ETpathfinder status update

Sebastian Steinlechner
for the ETpathfinder team

GWADW 2023, Elba

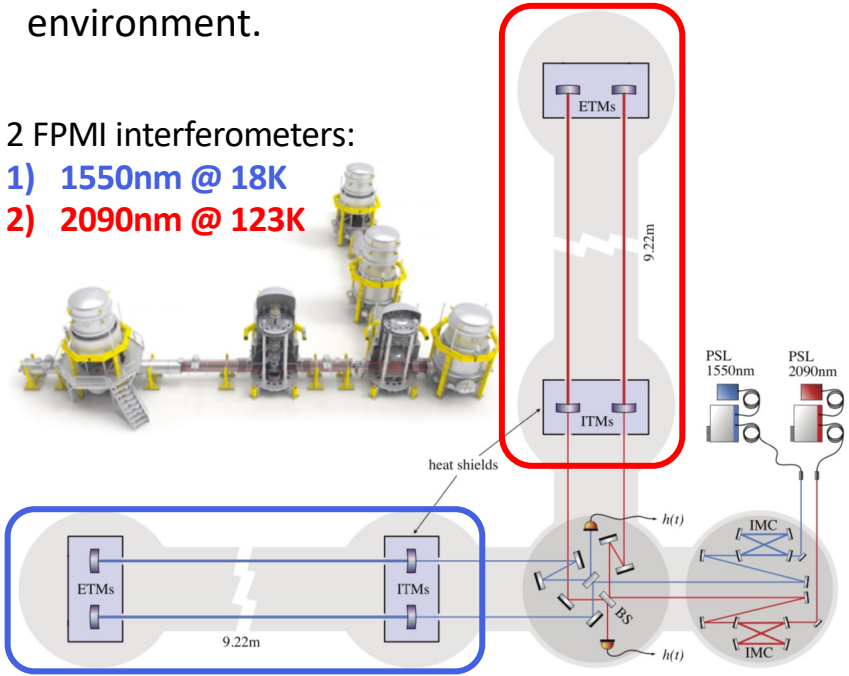
Interreg
EUROPESE UNIE
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling

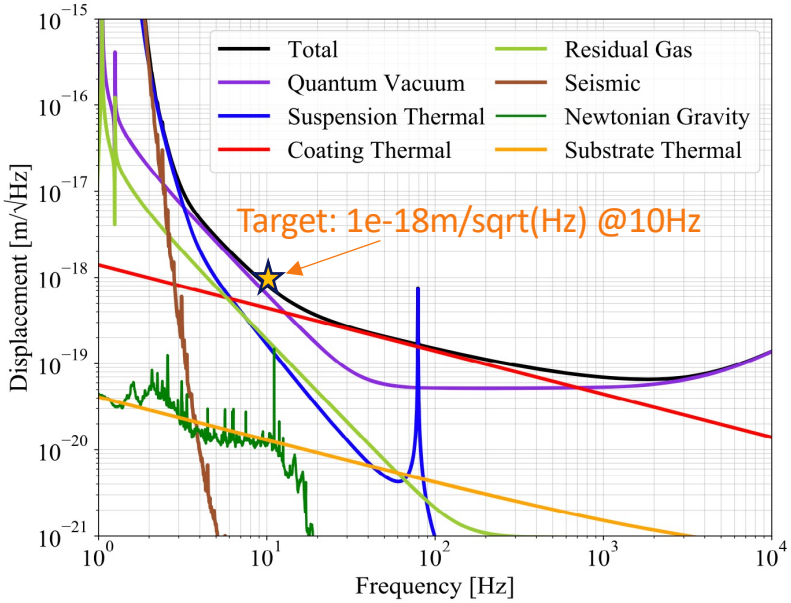
ETpathfinder overview

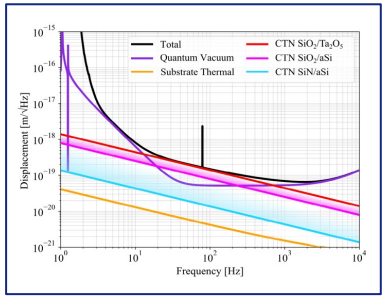
Main target: provide a testbed for ET technologies/concepts and qualify them in low-noise environment.

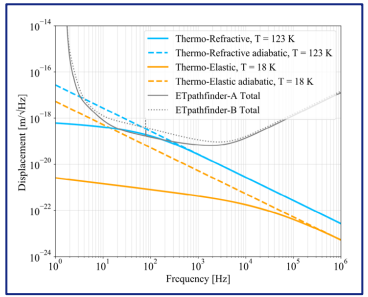
2 FPMI interferometers:

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









January 2020

Spring 2020

Summer 2021

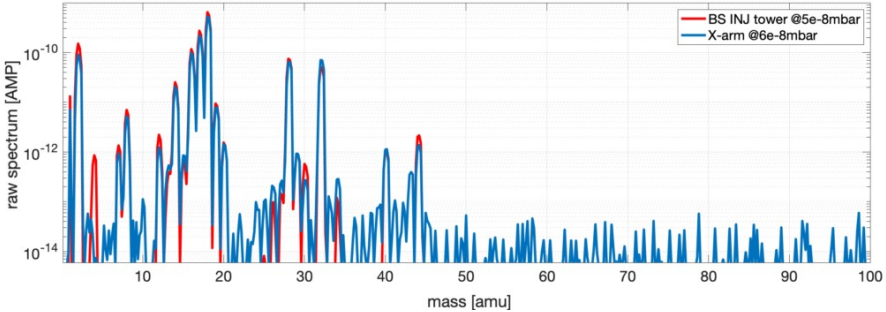

Spring 2022

now

WP4: Vacuum and cryogenics

Vacuum

- 190m^3 of UHV, target pressure <1e-9mbar
- status: towers and arms installed, leak chasing
- Kurt Lesker gate valves came dirty and UHV-incompatible, negotiating cleaning process
- empty towers: measured 5e-8 mbar after installation
- clean RGA-spectra: hydrogen, water, air components



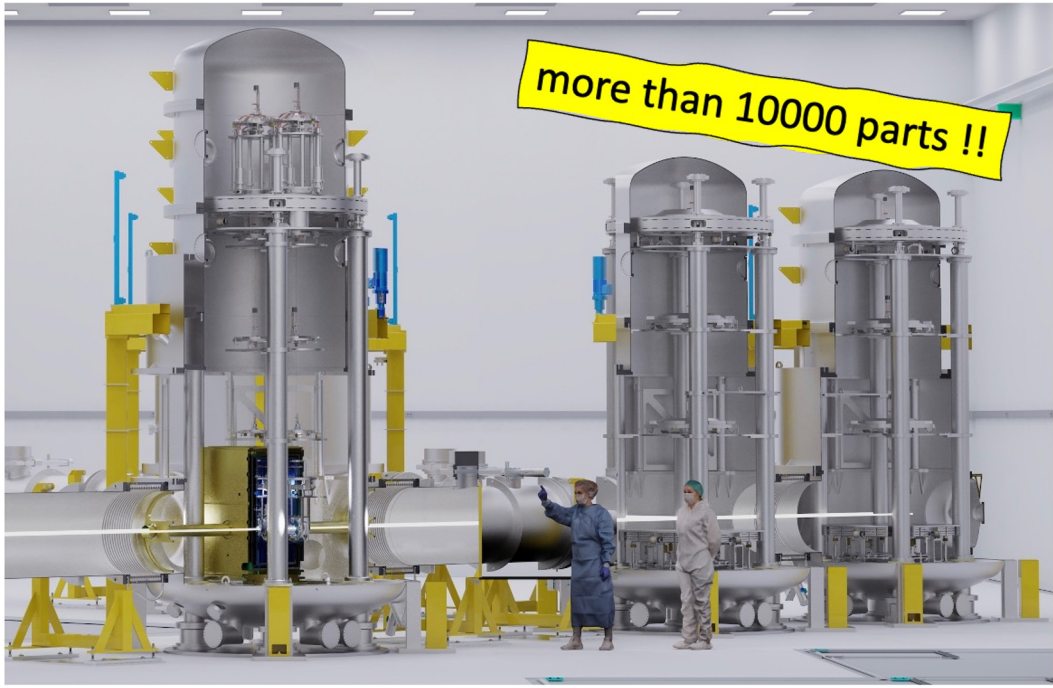
Cryogenics

- 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

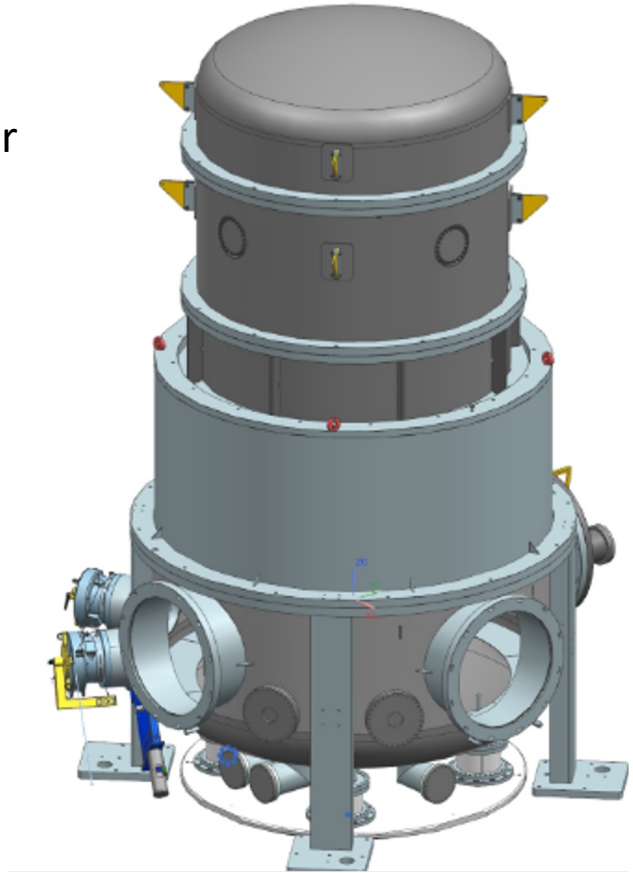
Internal mechanics production

- 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.

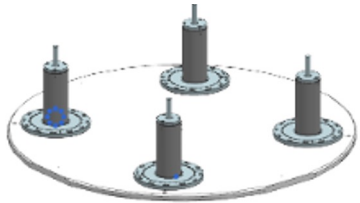


WP5: Seismic isolation

Installation of beam splitter bench tower will begin after summer



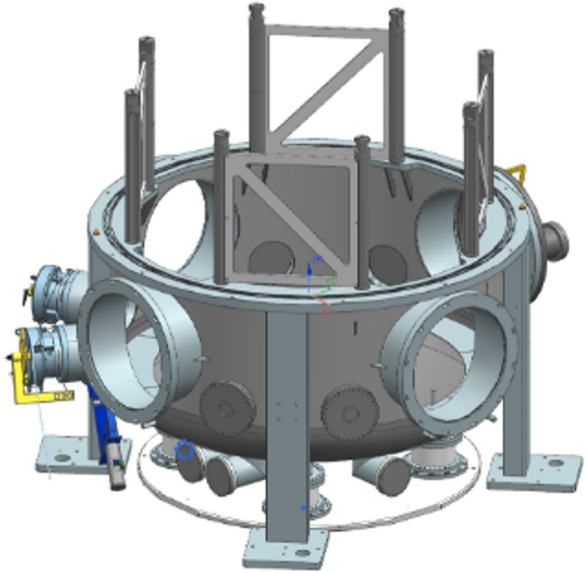
Dummy IP feet and baseplate for installation



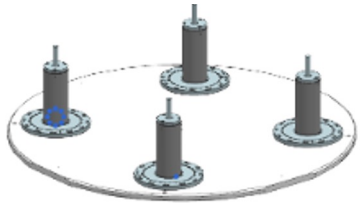
WP5: Seismic isolation

Installation of beam splitter bench tower will begin after summer

- Dismantling tower up to bottom vessel



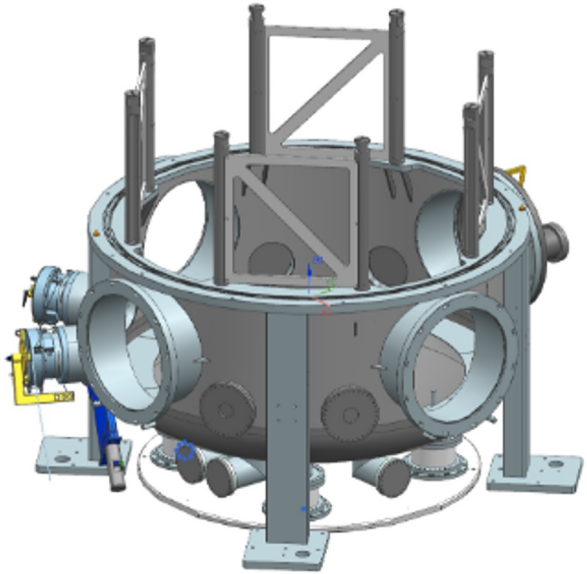
Dummy IP feet and baseplate for installation

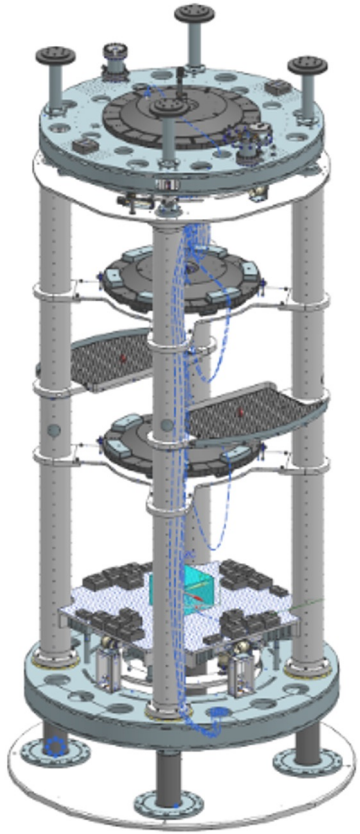


WP5: Seismic isolation

Installation of beam splitter bench tower will begin after summer

- Dismantling tower up to bottom vessel
- Assembly of mechanics on dummy feet

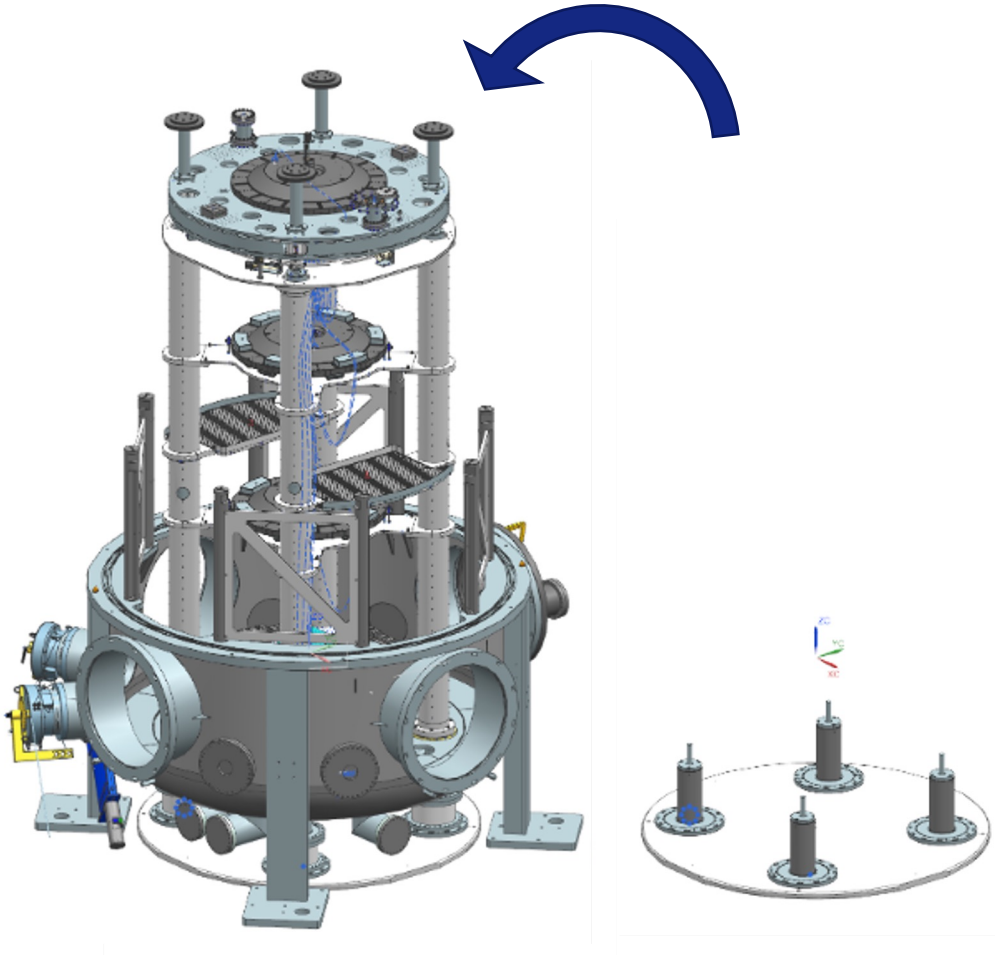




WP5: Seismic isolation

Installation of beam splitter bench tower will begin after summer

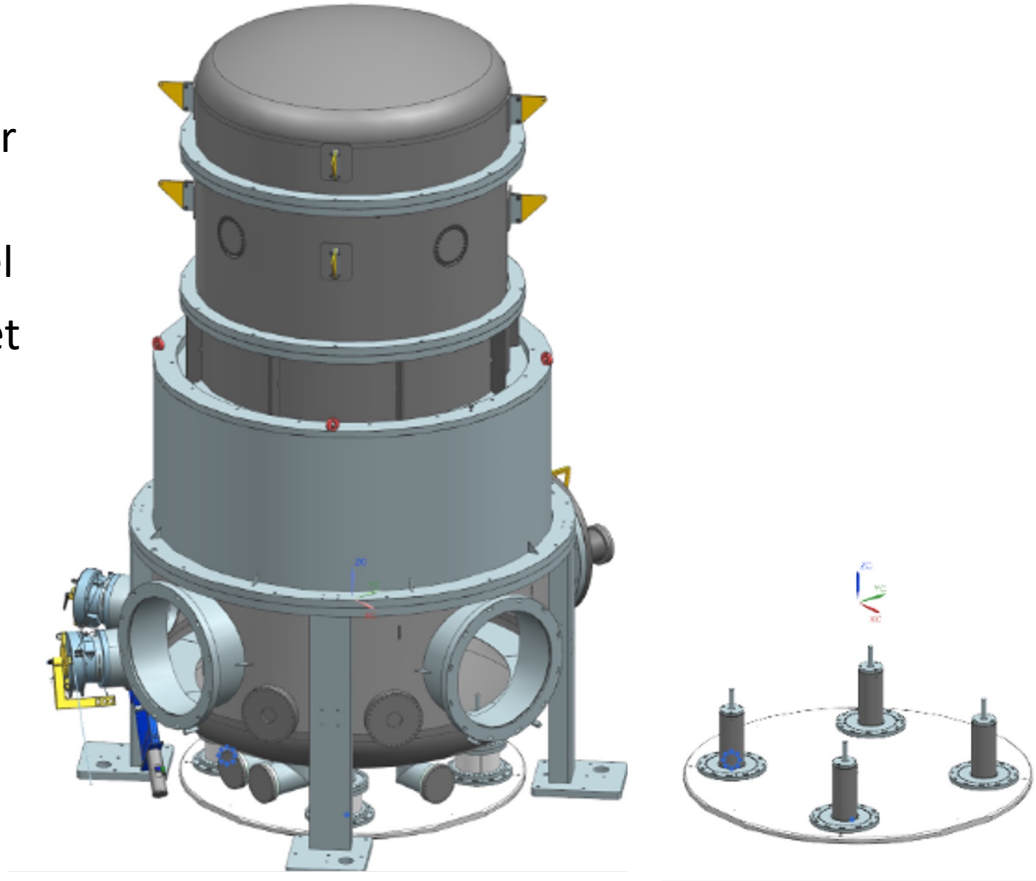
- Dismantling tower up to bottom vessel
- Assembly of mechanics on dummy feet
- Craning in the assembled structure



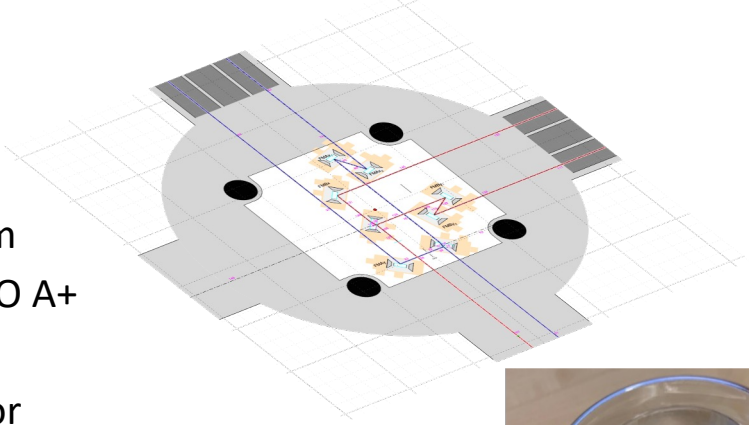
WP5: Seismic isolation

Installation of beam splitter bench tower will begin after summer

- Dismantling tower up to bottom vessel
- Assembly of mechanics on dummy feet
- Craning in the assembled structure
- Closing of tower

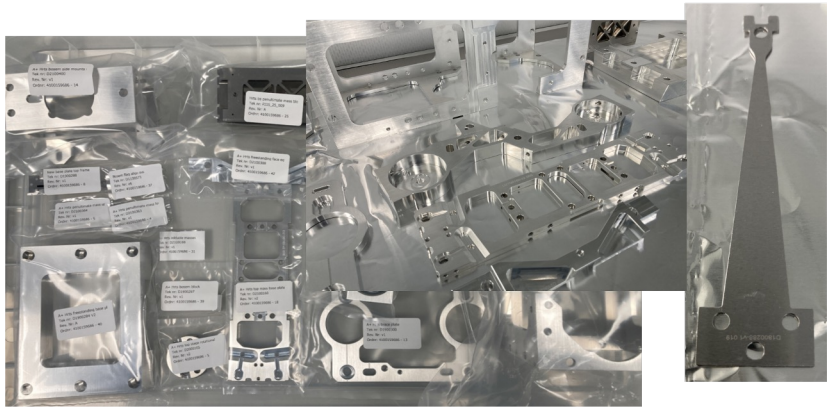


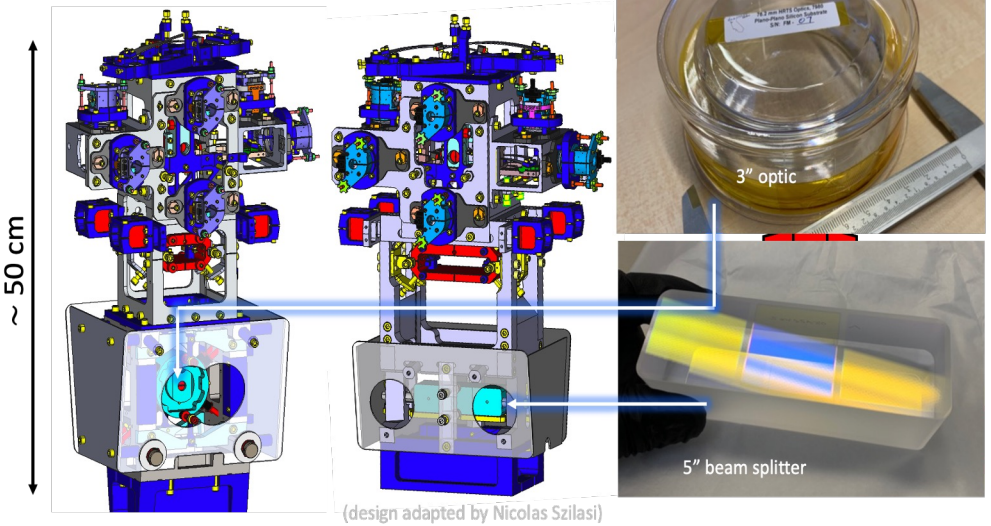
WP5: Seismic isolation



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

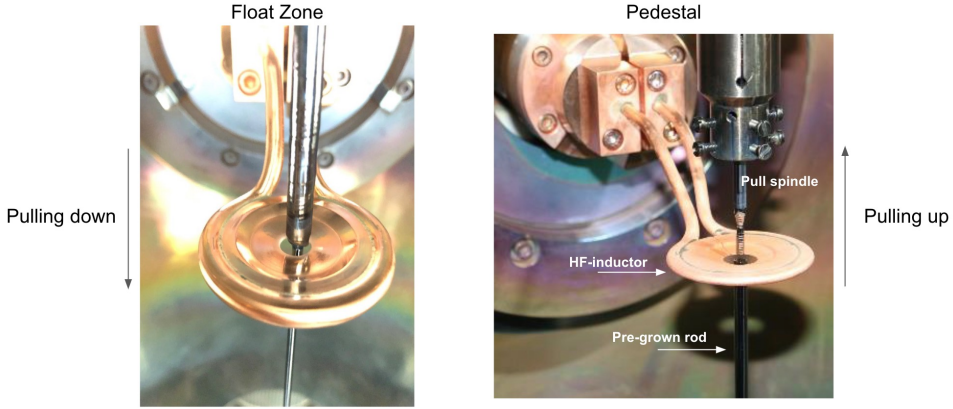
First 4 HRTS to be assembled in summer/fall





WP5: Seismic isolation

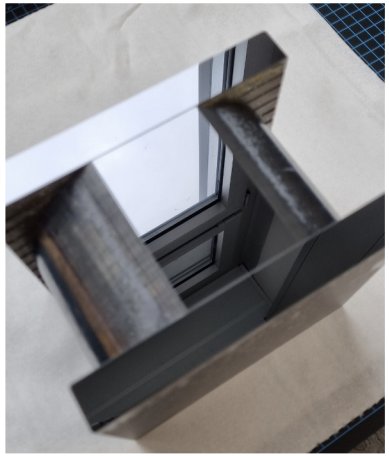
- Initially, will work with metal suspension wires
- Ultimately, want monolithic silicon suspensions
- Recently, IKZ *(Institute for crystal growth, Berlin)* produced ~1mm diameter fibres, 40cm long (ETpathfinder), and also 3mm fibres, >1m long (ET)

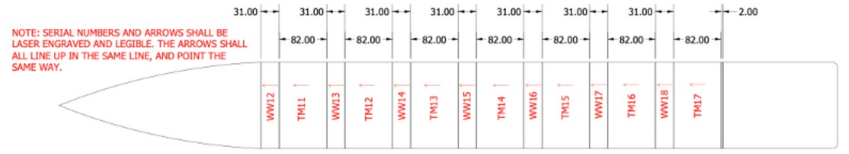


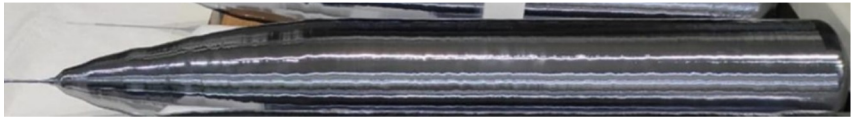
Testing of fibres TBD

WP6: Optics

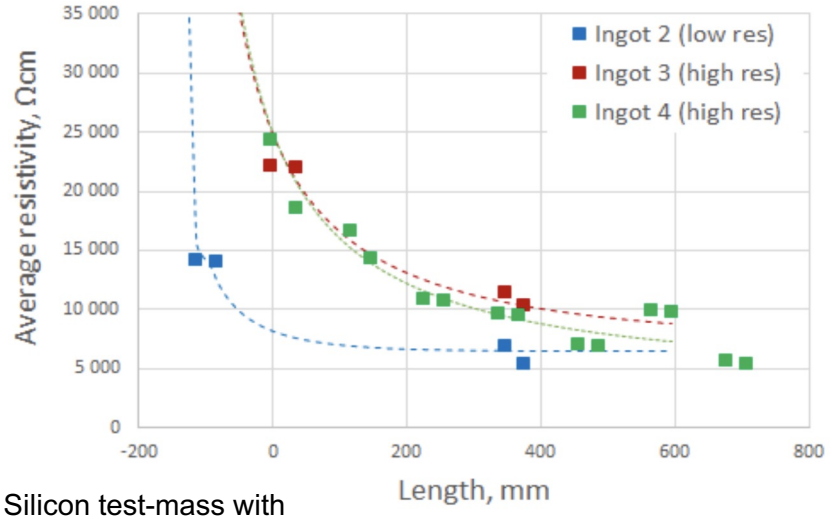
- two (out of 12…) silicon main mirrors under polishing by Zeiss SMT
- further understanding silicon as optical material
  - polishing of small samples for absorption measurements at VUB, to be performed with PCI at Maastricht
  - correlation of absorption with measured resistivity (IKZ)
  - setting up birefringence measurement setup integrated with PCI
  - investigating paths to more and larger test mass mirrors







Floatzone silicon (IKZ)



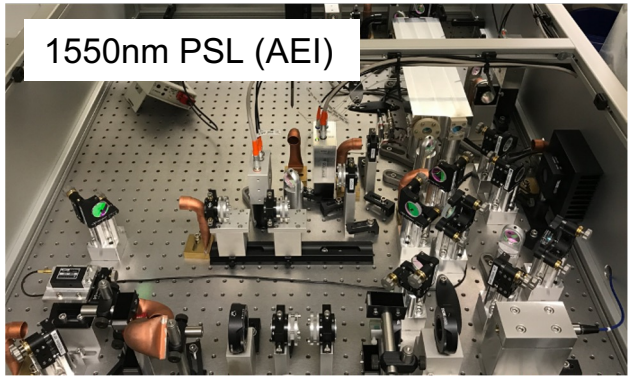
Silicon test-mass with polished flats

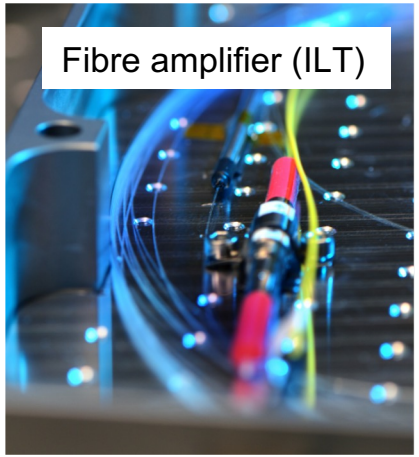
WP6: Optics

- 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
- simulations on locking scheme, mode matching etc. ongoing

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

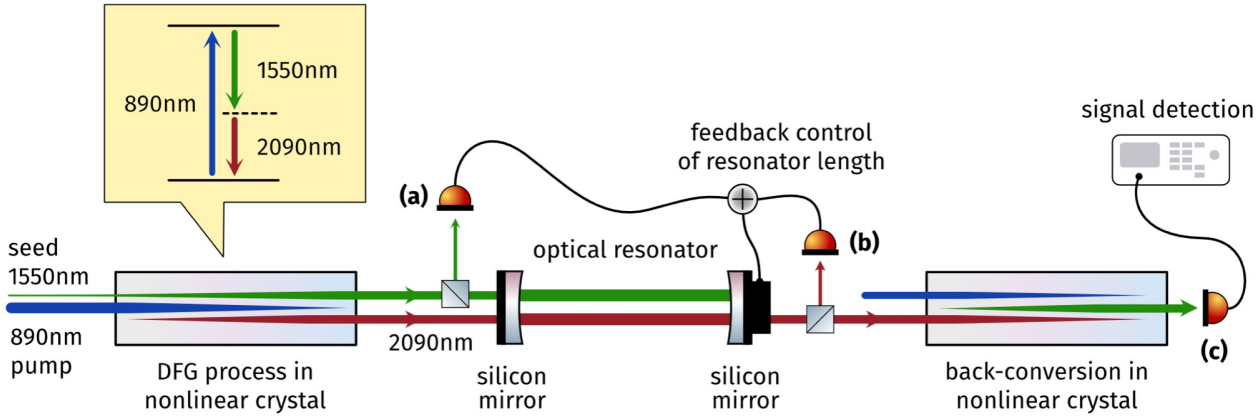




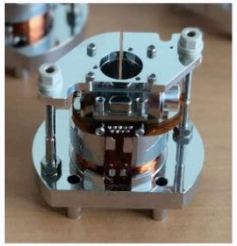
Related VIDI project

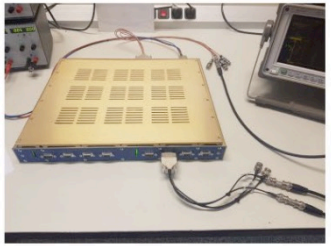
Project just started:

- Convert stable 1550nm fibre laser to 2090nm via DFG in a nonlinear cavity
- Use 1550nm + 2090nm for ALS-style control of resonators with silicon mirrors
- Reverse process can be used to convert 2090nm signals to 1550nm, where high-QE PDs already exist

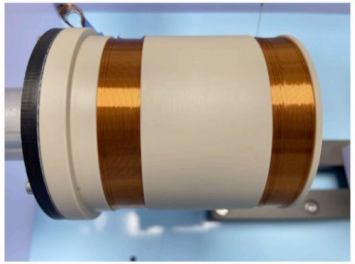


WP7: Controls





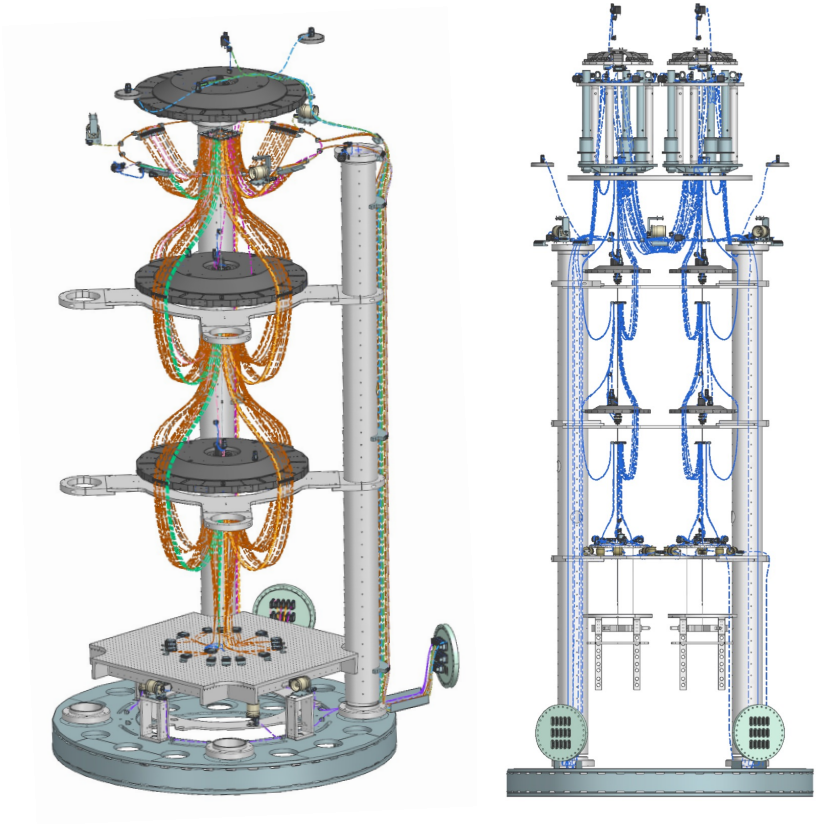
- suspension electronics
  - 12x Trillium120 seismometer
  - BOSEMs produced by Birmingham, delivered
  - readout electronics finished by VU Amsterdam
  - stepper motors received, driver design (Nikhef)
  - LVDTs and electronics produced by Antwerp
  - LVDT coil-winding machine in Maastricht



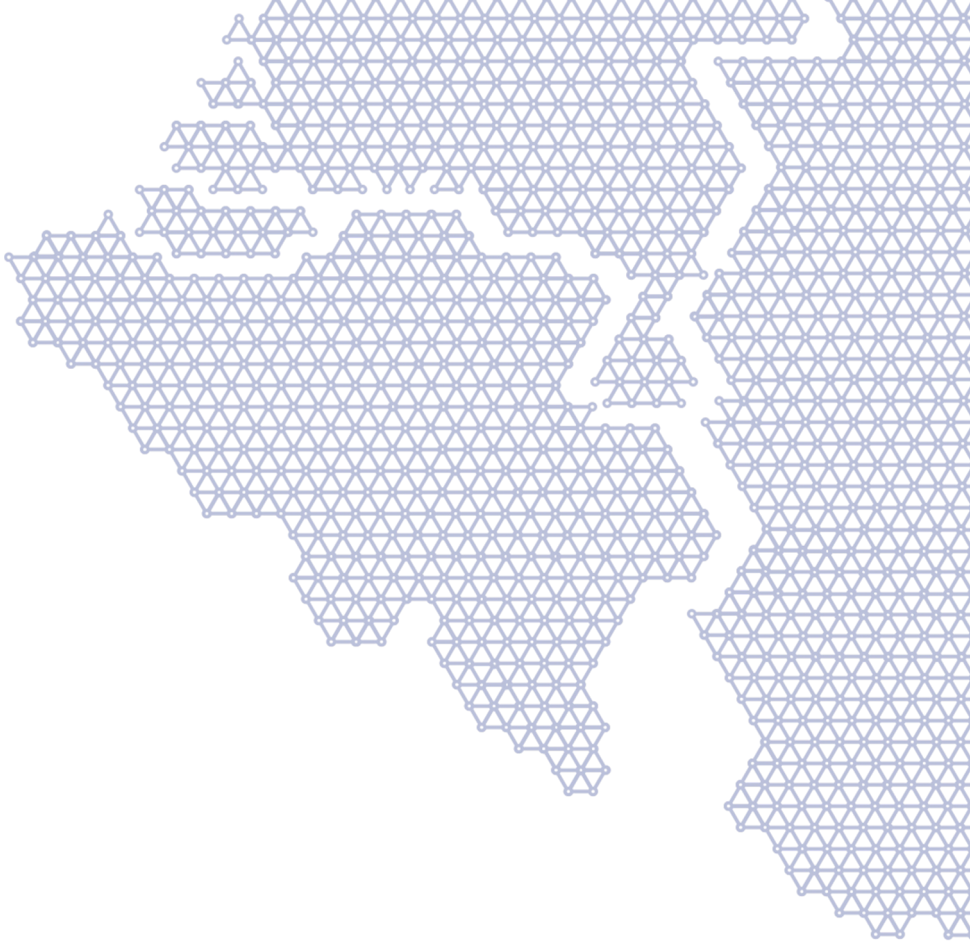
- setting up general computing and network
- data acquisition: based on Adv Virgo+ DAQ, not yet running
  - received ADCs, DACs, DAQboxes (LAPP), 14 RTPCs
  - configured 3 standalone RTPC + DAQbox systems
- vacuum control system interface with Siemens PCS7 (KIT)
- several sensors for environmental monitoring acquired

WP7: Controls

- in-air cabling (DSub25): quality issues, strain reliefs
- ordered 15km of in-vacuum cable, connectors (Antwerp)
- Working hard on cabling plan for inside and out of vacuum
- now: priorities driven by commissioning of first suspension tower



ETpathfinder partners



Thanks for your attention!
Questions?