

# Test of the ETpathfinder coldfinger isolation

Luise Kranzhoff

ETpathfinder workshop

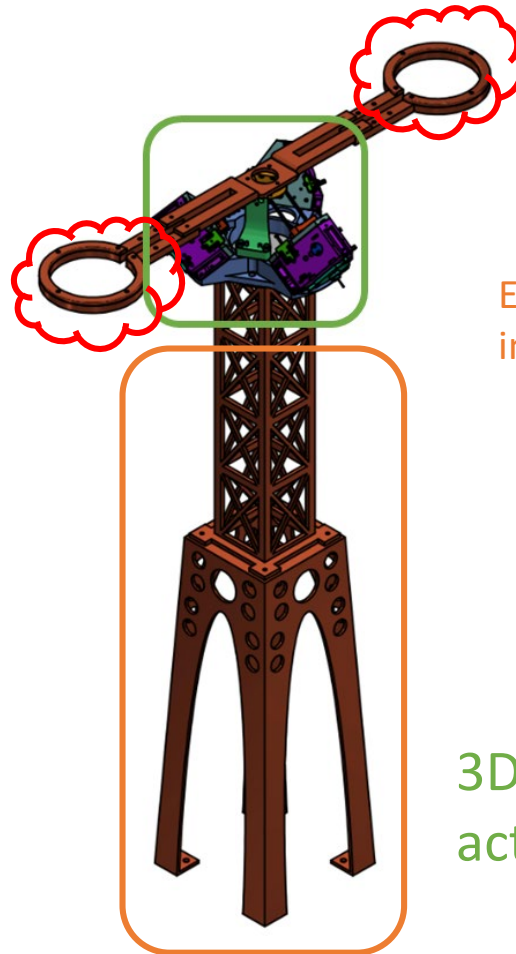
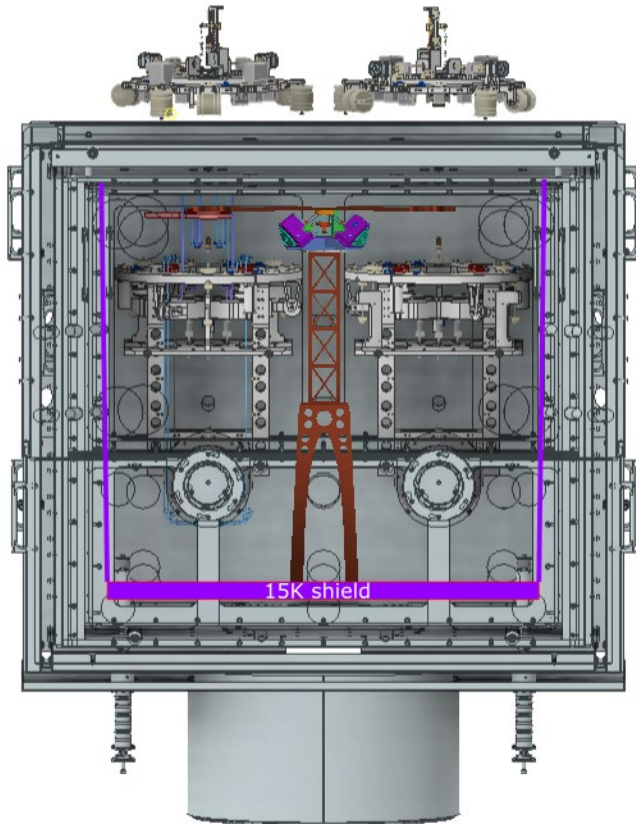
01.02.2024



# Previously...

**Objective:** create vibration damping support, prevent unwanted motion from reaching the mirror via the coldfinger (part of ET Technologies project, WP1)

**Starting point:** transfer functions coldfinger – payload, coldfinger support needs to be at least as quiet as the ground (A. Utina)



Coldfinger design will change

Eiffel tower design needs to be adjusted to design of innermost cryoshield and whatever goes in there



New focus for me

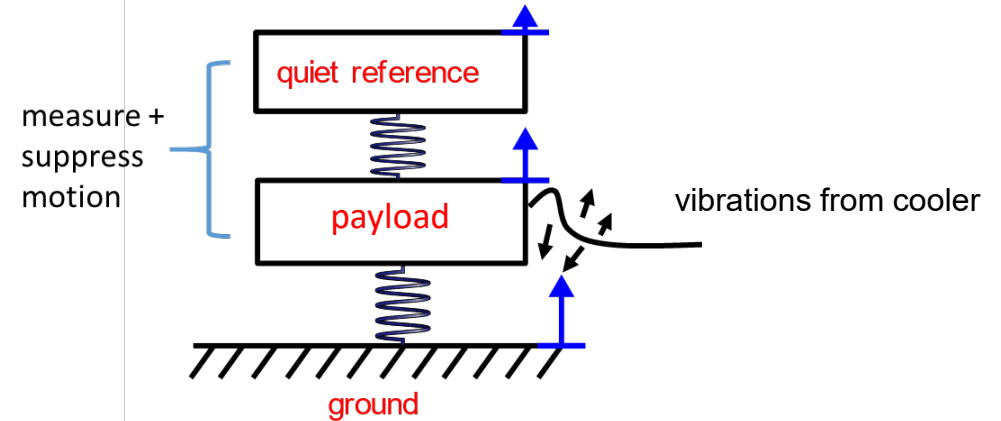
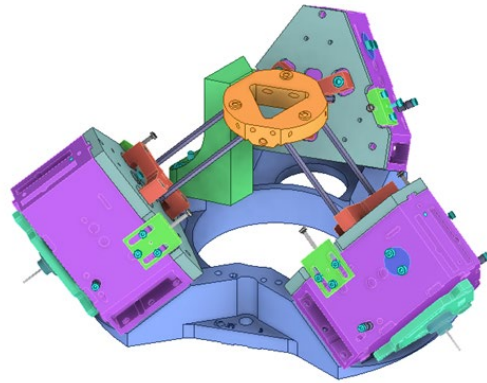
3D CAVI performance and its suitability as active stabilizer for the coldfingers

# 3D Cryogenic Active Vibration Isolator (CAVI)

~ 264mm diameter, 111mm height, mass 2.3kg  
3x 1DoF units tilted by 36.24deg, gravity compensation



Was finally delivered in  
**mid December 2023**



Attocube sensor heads

**Sensing**

Displacement Measuring Interferometer



optical fibres



digital and analog  
signal outputs

**Actuating**

JPE Cryo Voice Coil Actuator

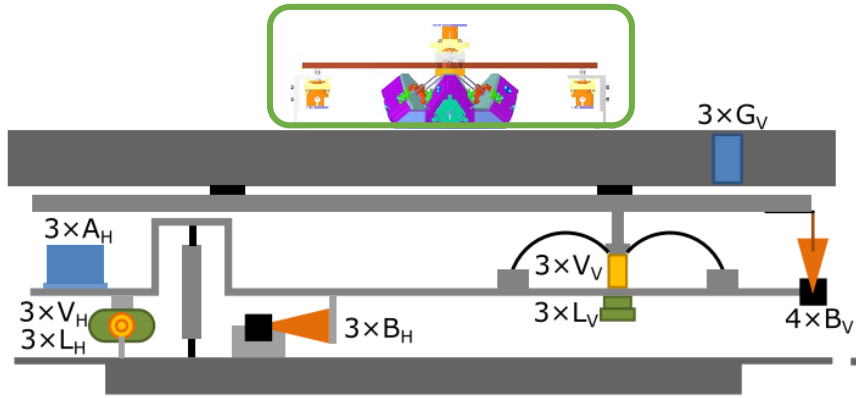


**Maastricht  
University**

Luise Kranzhoff  
01-02-2024

**Nikhef**

# The idea: Performance test on AEI-SAS

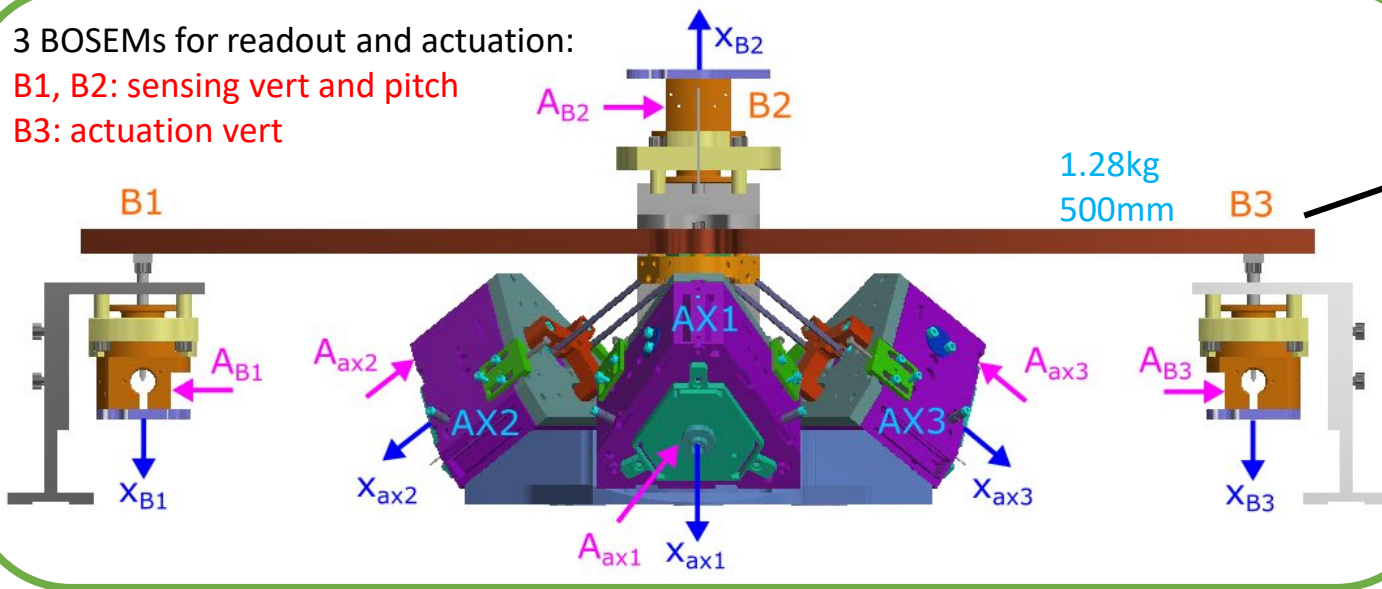


## Measurement in a clean and quiet environment:

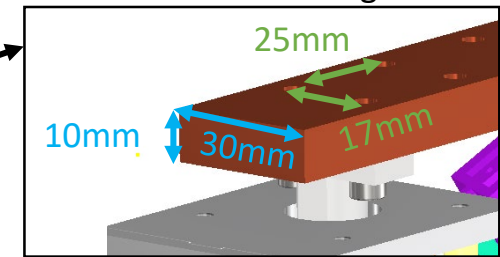
- integration into DAQ
- mechanical fine-tuning of the device
- transfer functions ground (table) – payload
- transfer function BOSEM actuation – payload
- noise characterization

3 BOSEMs for readout and actuation:

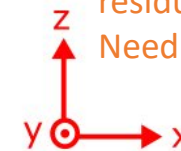
B1, B2: sensing vert and pitch  
B3: actuation vert



M4 through-holes

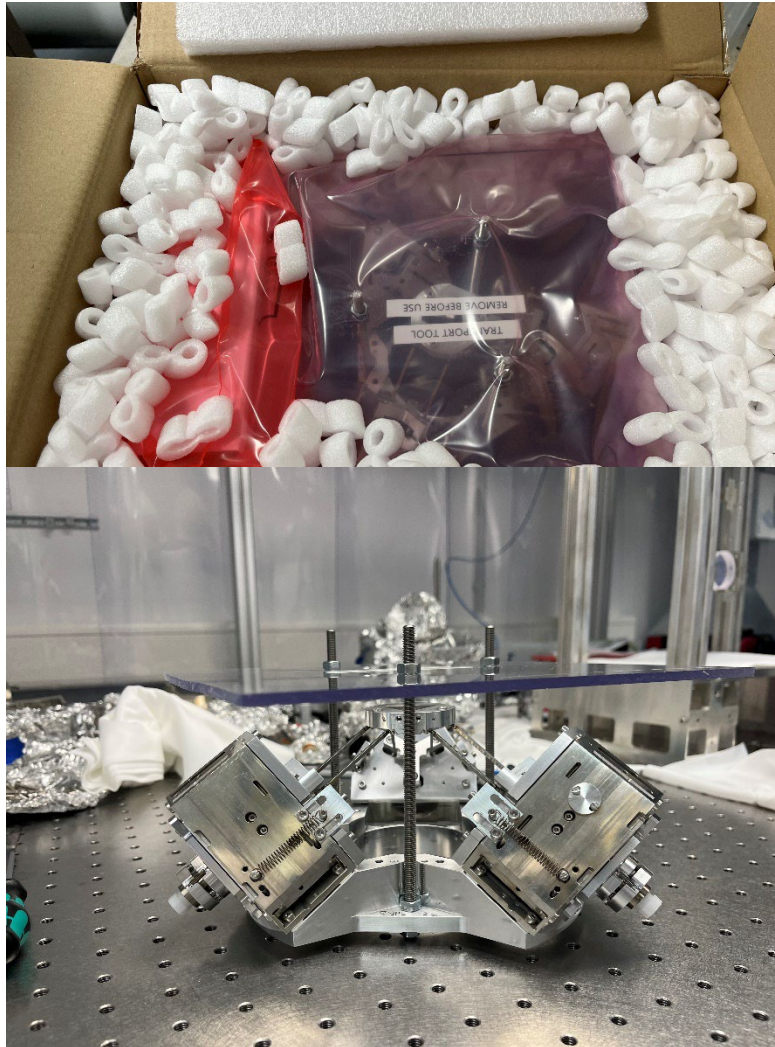


Possible test: connect cooler to payload and measure residual motion with open loop and closed loop. Need to see how timelines align...

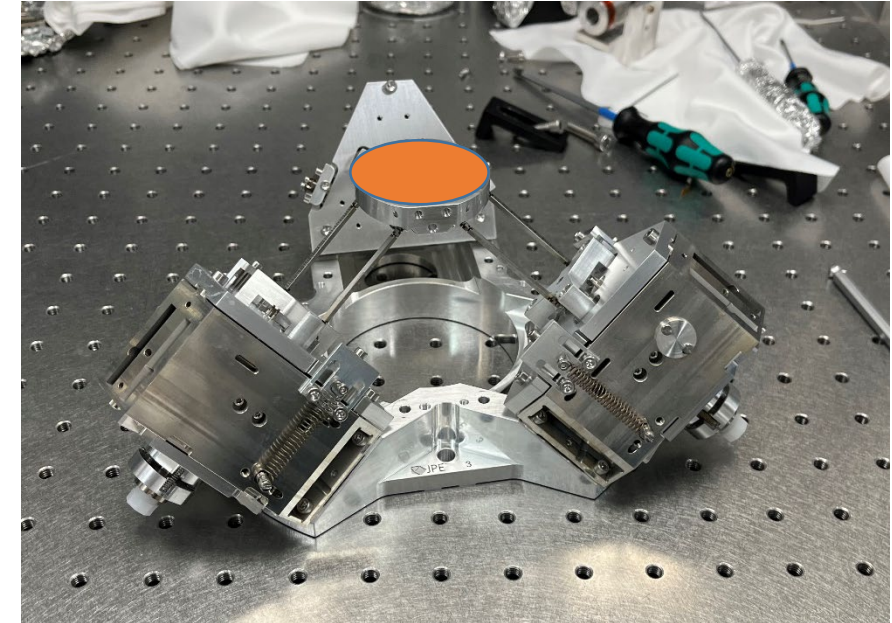




Mid December in Hannover...



# Finally the CAVI arrived!

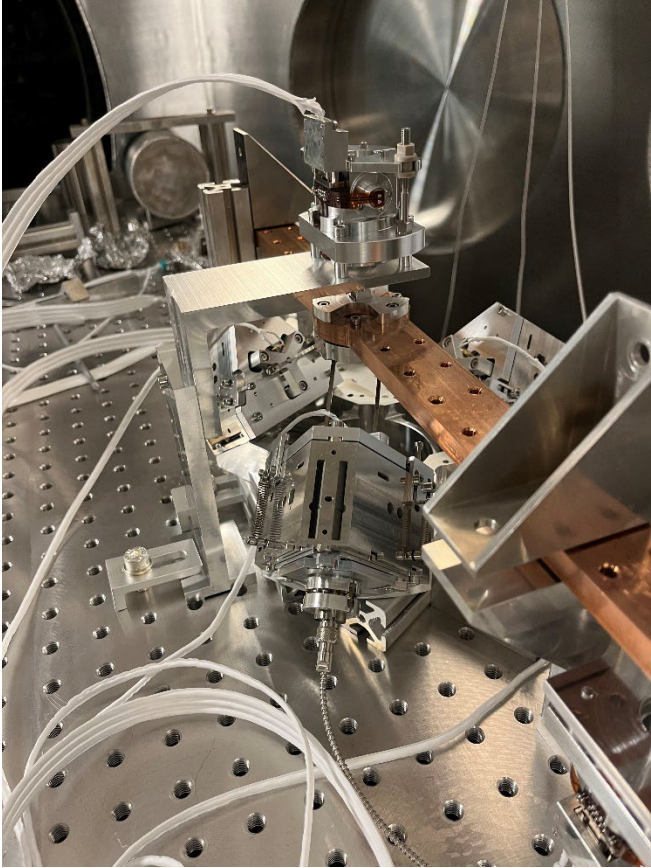
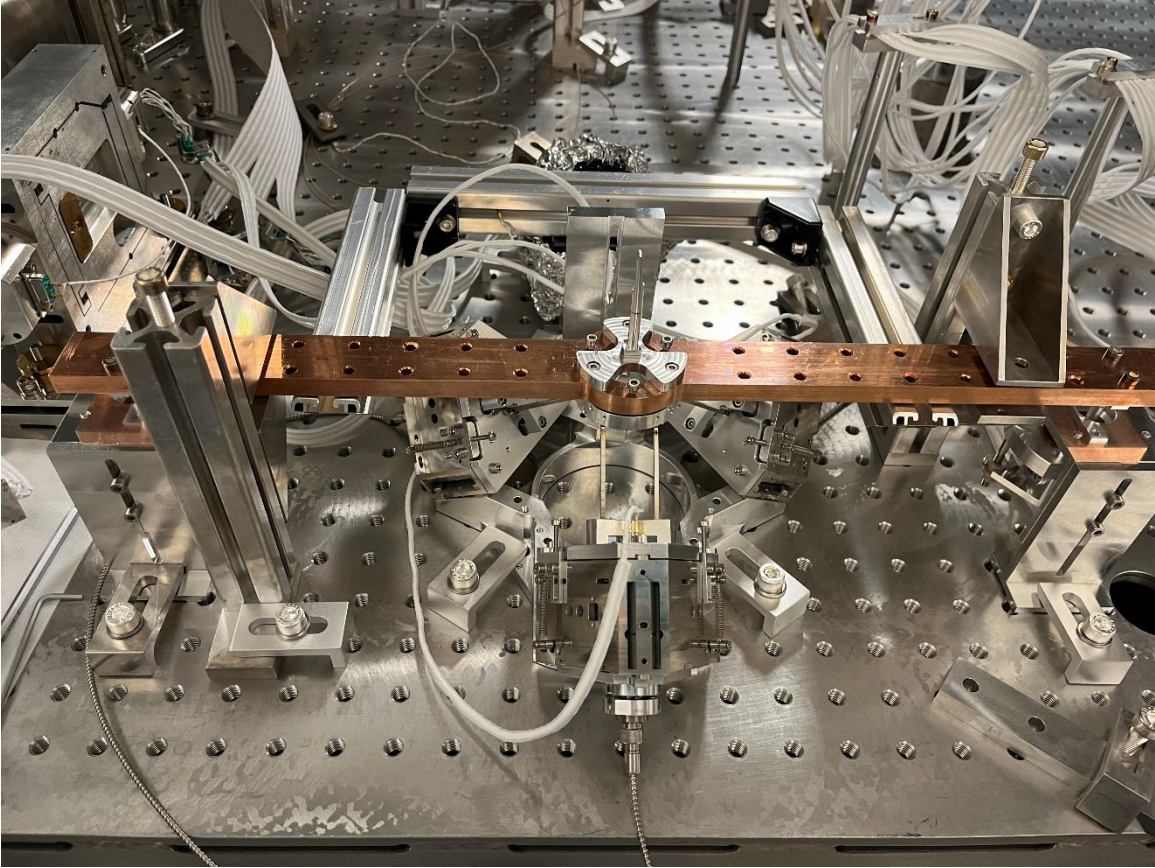


- detailed unpacking manual provided by JPE
- 3D CAVI survived unpacking and transport to vacuum system
- multiple warnings to avoid torques larger than 5Nmm
- came up with strategy how to load the platform





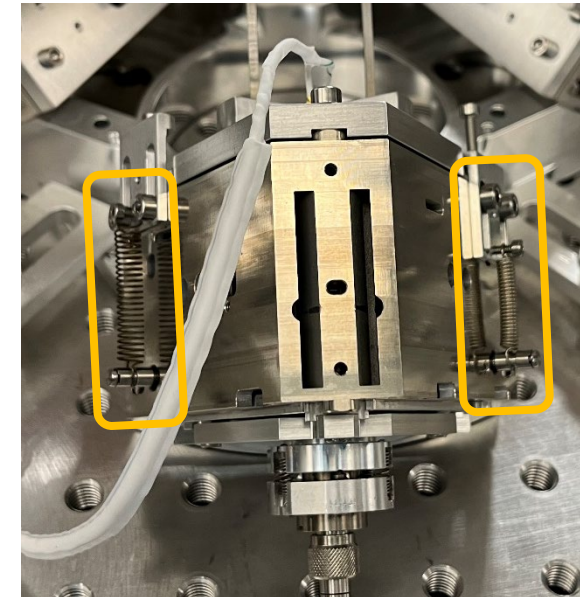
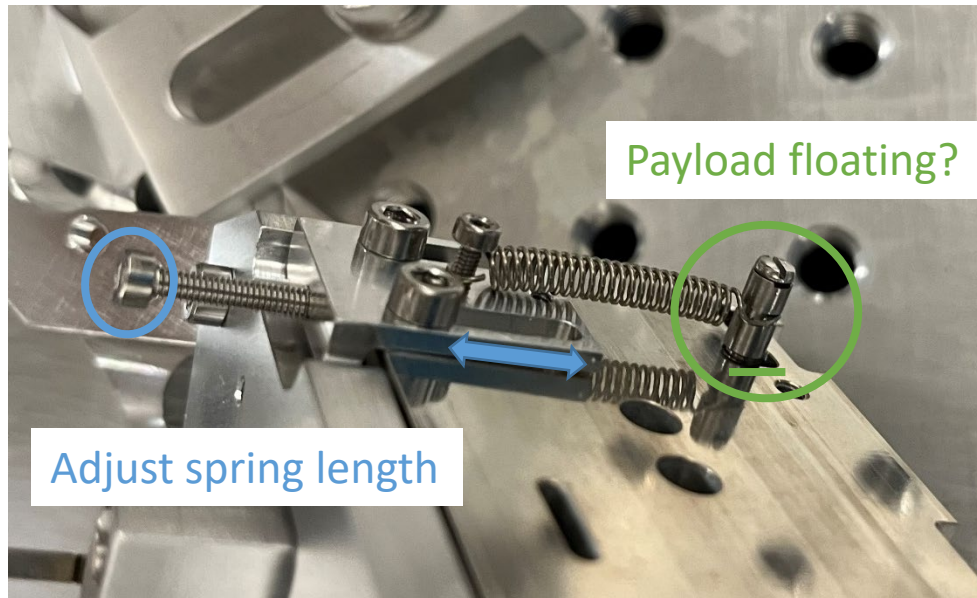
# Loading the 3D CAVI platform



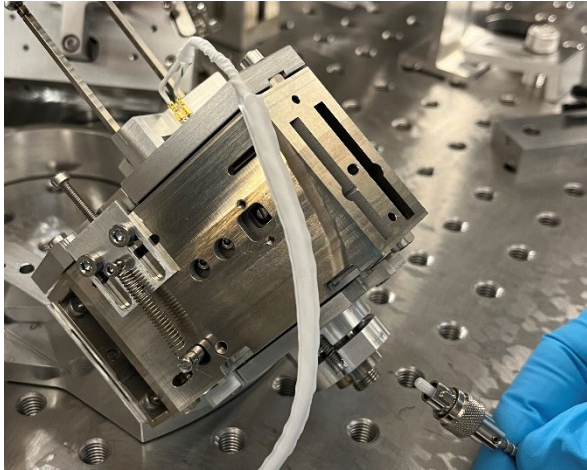


# Tensile springs for countering payload mass

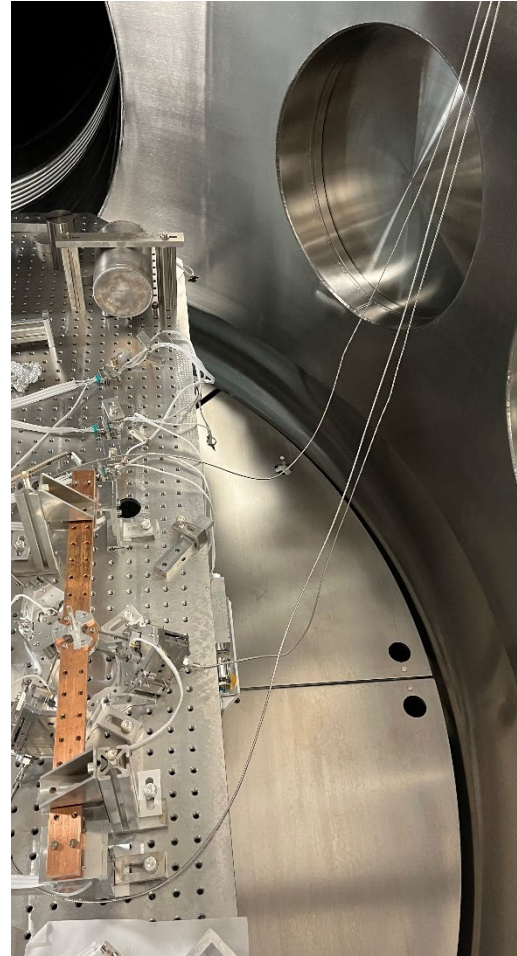
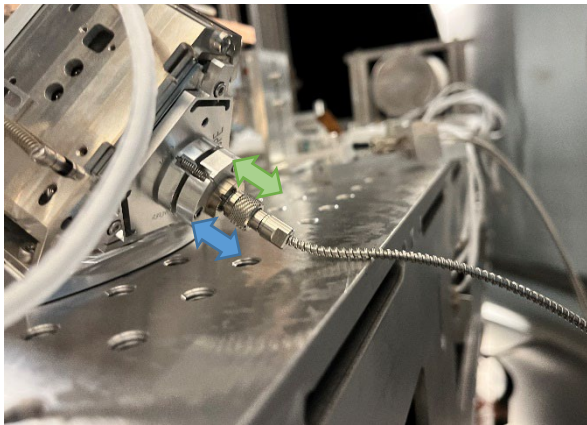
- copper bar  $\sim 1.3\text{kg}$ , CAVI needs to compensate additional load
- device arrived with compensation ability of  $\sim 0.5\text{kg}$   $\rightarrow$  too weak
- JPE sent replacement springs for  $\sim 1.5\text{-}2.0\text{kg}$   $\rightarrow$  too strong
- they accidentally also send intermediate springs (also too weak)
- multiple spring exchange procedures: found combination that worked
- **A good thing: JPE designed CAVI with flexibility for the payload**



# Sensing: Attocube interferometer alignment

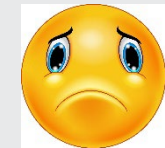


Tilt mount with 3 alignment screws



## Optics Alignment

Stop



Axis 1 contrast	10%	Warning: No sensor head or fiber is connected ⓘ
Axis 2 contrast	56%	Warning: Bad signal quality ⓘ
Axis 3 contrast	9%	Warning: No sensor head or fiber is connected ⓘ

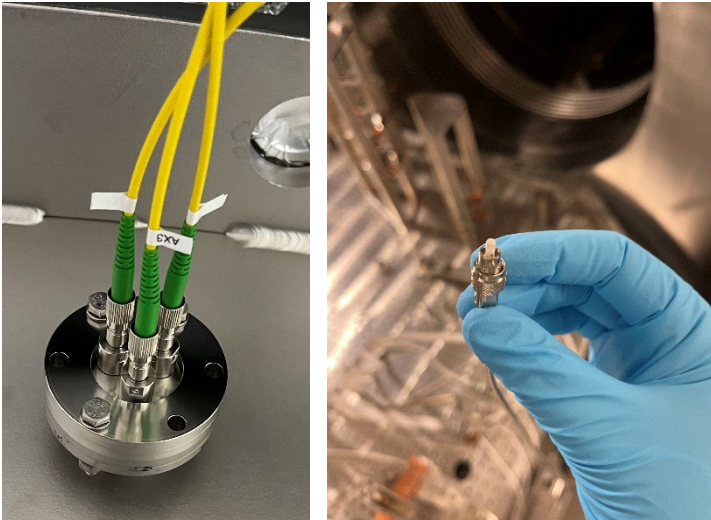
Spent quite some hours on unsuccessfully trying to align the interferometer...





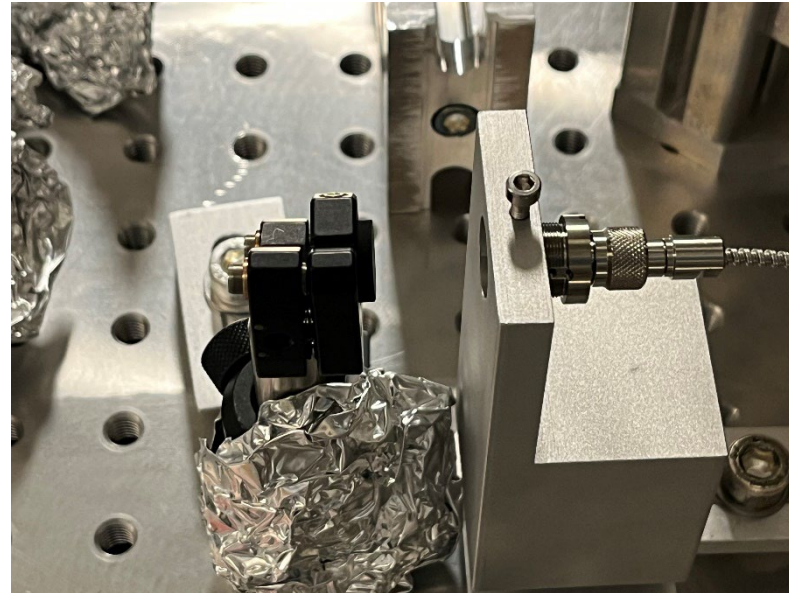
# Debugging the attocube system

'Basically a fibre-coupling task'

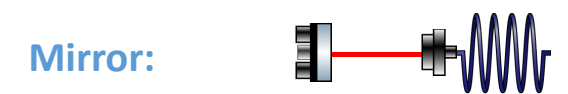
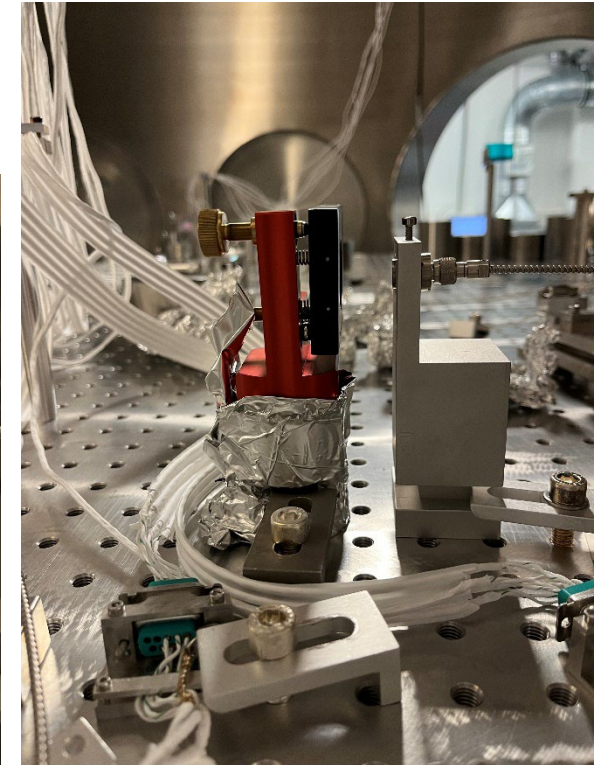


- swap, inspect and clean fibres
- characterise output beam (collimated?)
- inject 1064nm laser light and try to couple it back

Testing independent of CAVI mechanics:



sensitive to **lateral** alignment

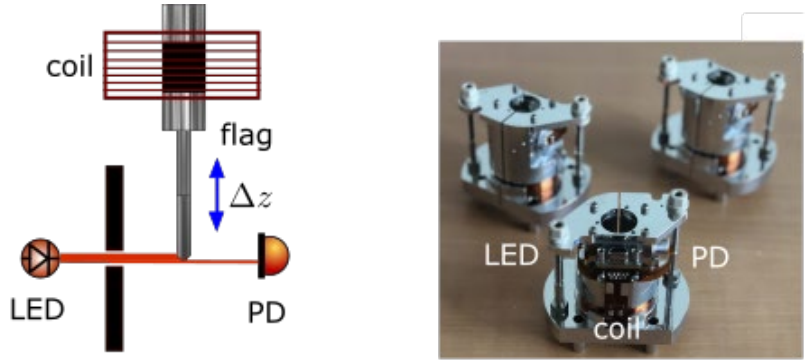


sensitive to **angular** alignment

Eventually contacted attocube, they suspect laser failure and asked me to send the readout system in for inspection (done last week).

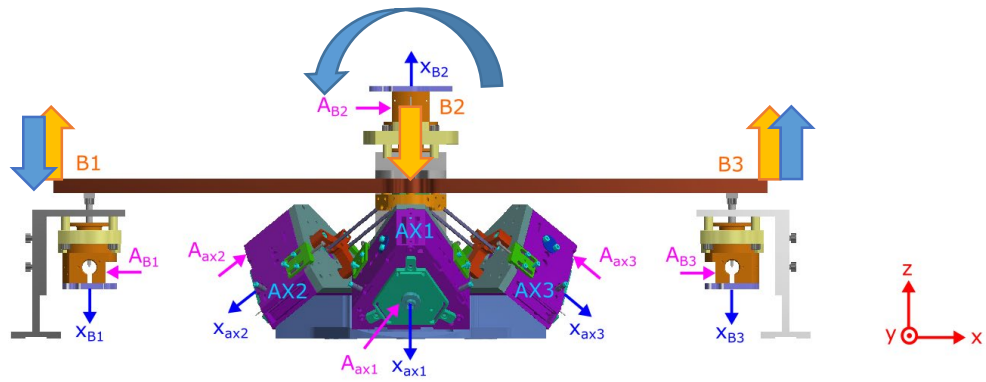


# CAVI resonances from BOSEM measurement

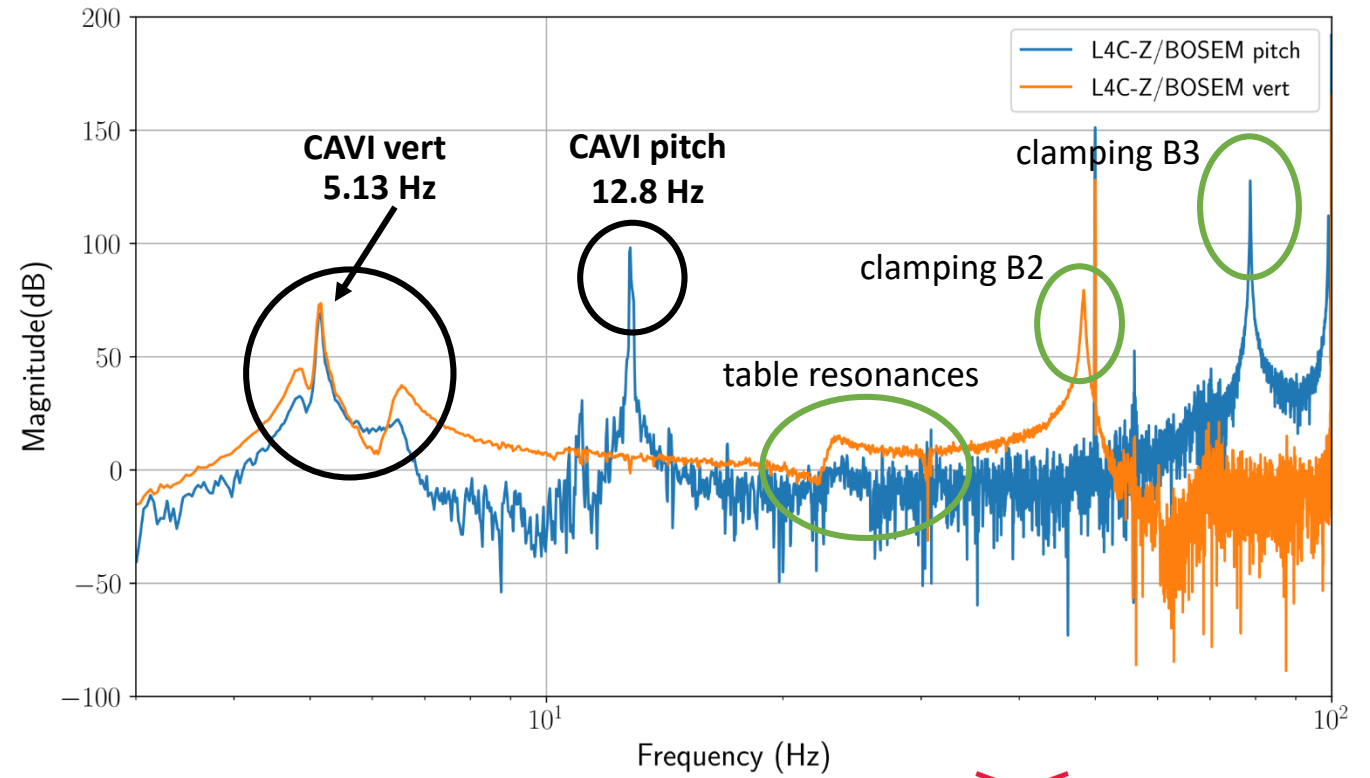


(a) sensing and actuation (b) assembled BOSEMs

Three BOSEMs (B1, B2, B3) measuring vert(z) and pitch (ry) of the copper payload

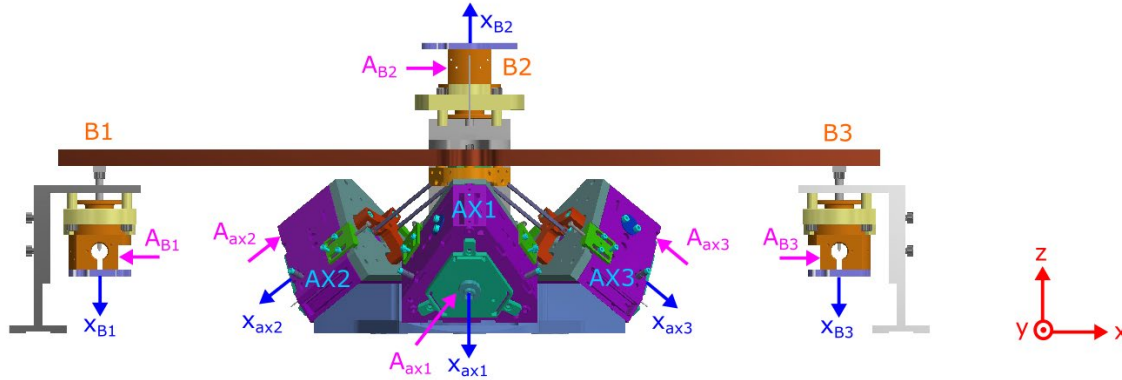


- free table, controlled in low-gain mode, Z actuation
- measure transfer function table (L4C) – payload (BOSEMs)
- identify (some) resonances of CAVI mechanics





# Summary and plans for 2024



## Goals remain

### In clean and quiet environment:

- integration into DAQ
- mechanical fine-tuning
- transfer functions
- noise characterization

- Some obstacles on the way:
  - delivery delay for CAVI
  - wrong tensile springs
  - **interferometer readout**
- Achievements:
  - integration into CDS
  - further understanding of CAVI
  - vertical and pitch resonances
- Status:
  - Attocube system being inspected
  - CAVI still in Hannover
- Ideas for 2024:
  - Readout problem needs to be solved!  
(1) attocube, (2) borrow JPE's system,  
(3) different readout system?
  - Continue tests in Hannover versus test in ETpathfinder on suspended bench

