Nikhef

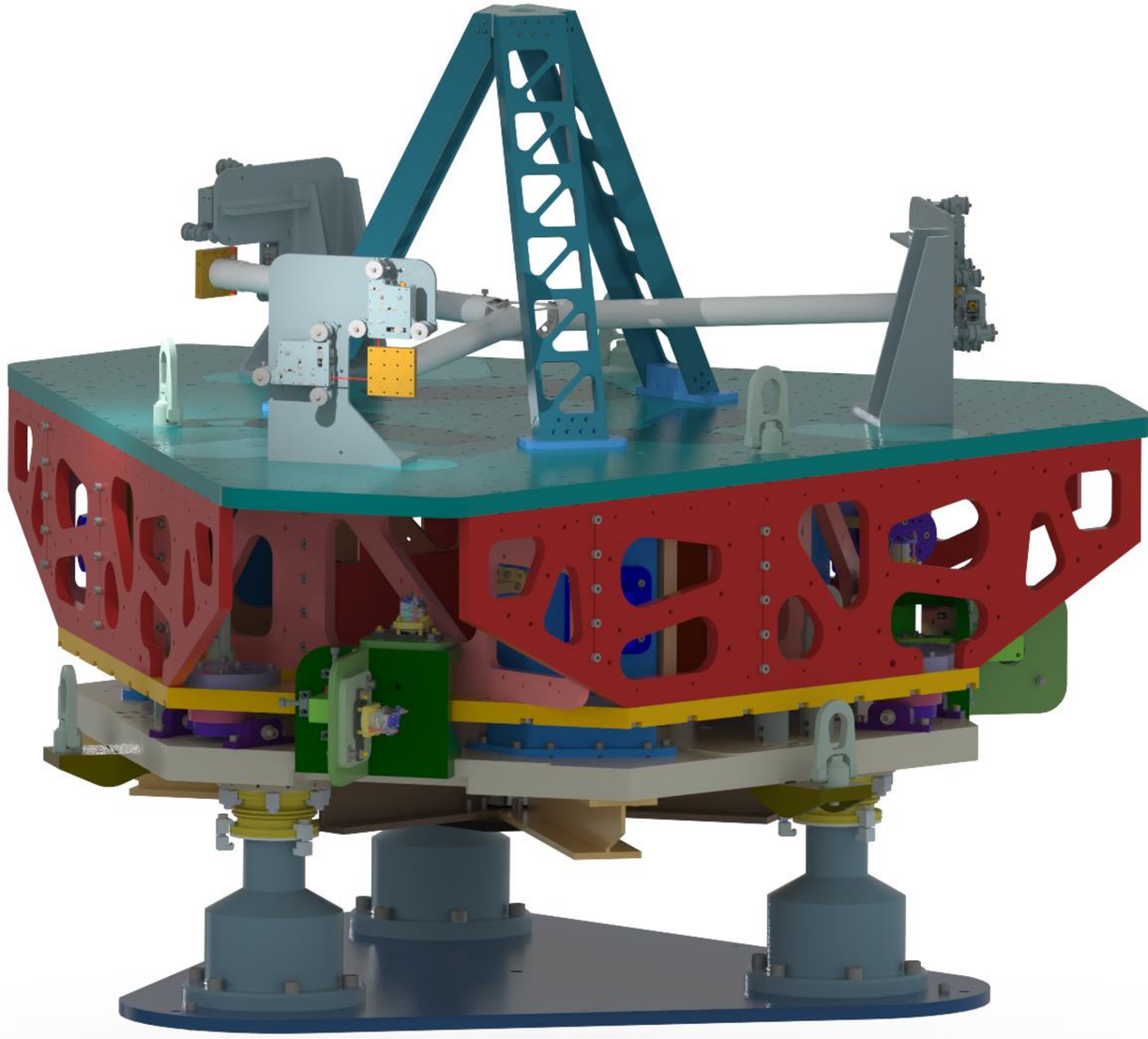
VU VRIJE UNIVERSITEIT AMSTERDAM

Jesse van dongen

On behalf of:

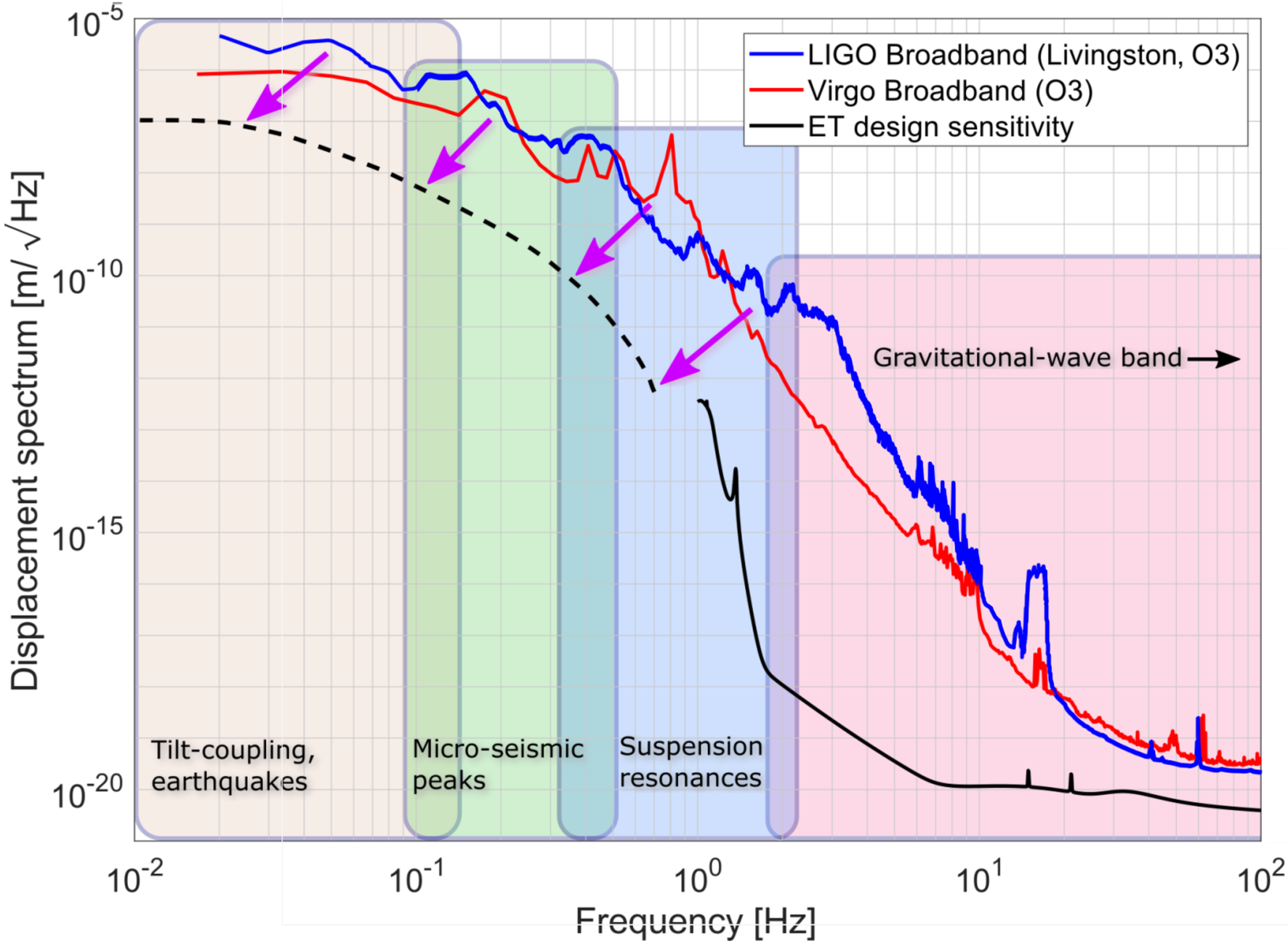
Nathan A. Holland, Alexandra L. Mitchell ,
Armin Numic, Pooya Saffarieh, Michele Valentini,
Conor M. Mow-Lowry and Others

UPDATES FROM THE OMNISENSE PROJECT



Credit: Conor Mow-Lowry

ET DESIRE: LOW FREQUENCY SENSITIVITY

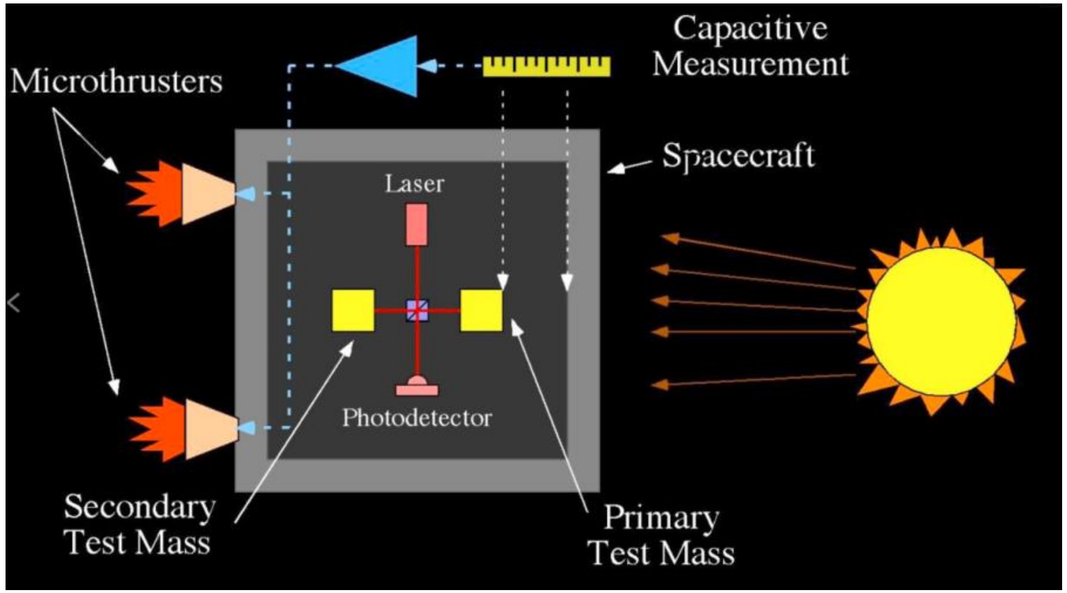


CREDIT: CONOR MOW-LOWRY

SEISMIC ISOLATION FOR EINSTEIN TELESCOPE

OMNISENS CONCEPT

…A SORT OF TERRESTRIAL DRAG-FREE CONTROL



DRS WORKING PRINCIPLE – IMAGE: NASA/JPL

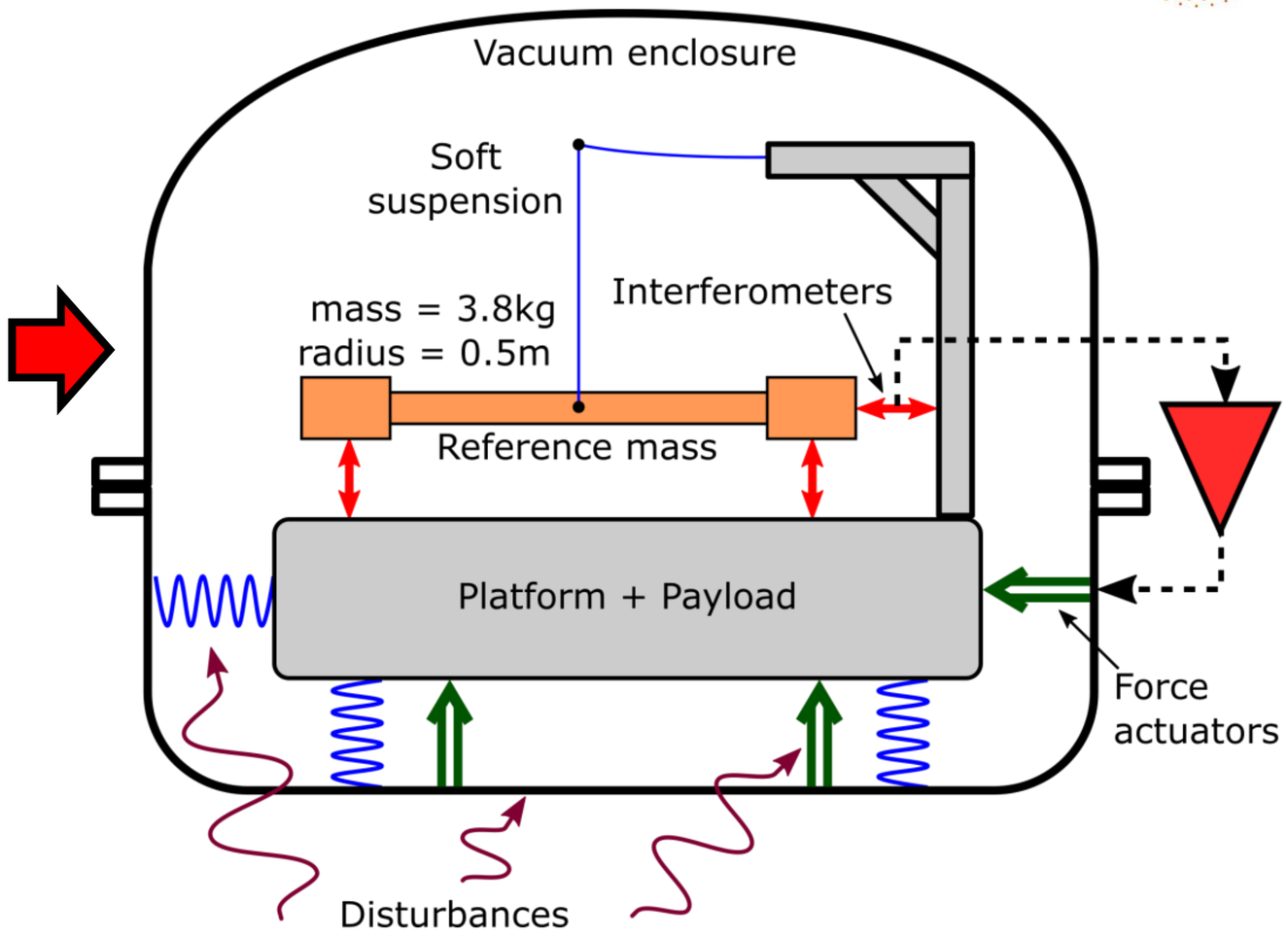
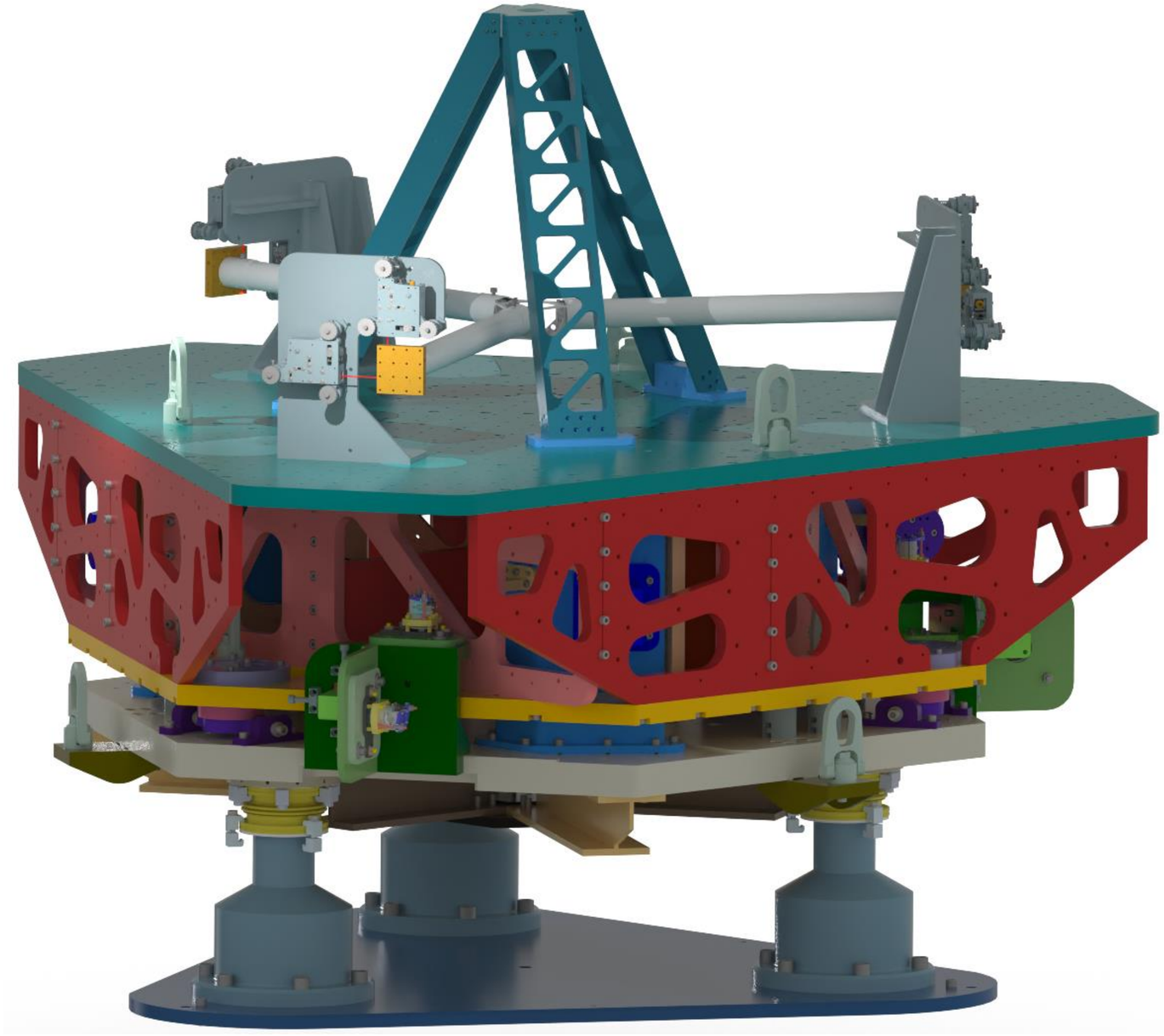
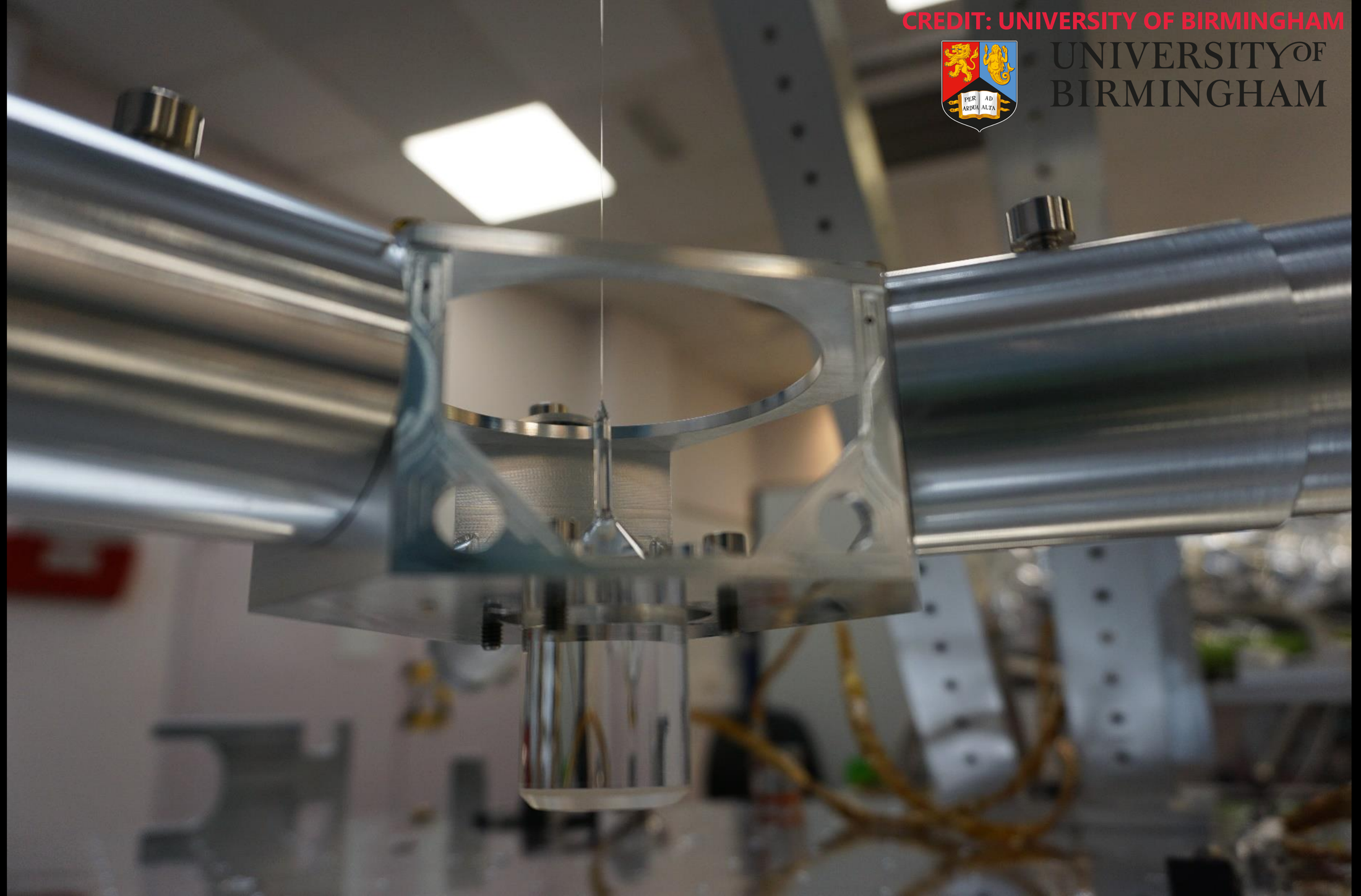


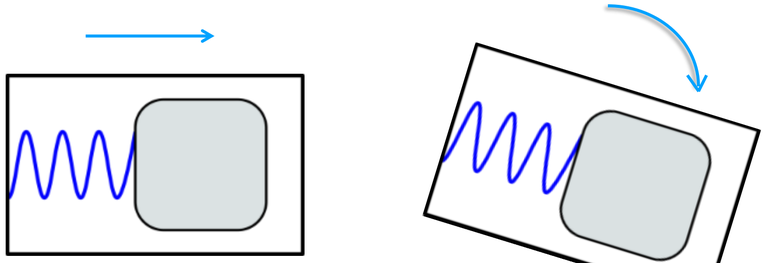
IMAGE CREDIT: ARMIN NUMIC




CREDIT: UNIVERSITY OF BIRMINGHAM
UNIVERSITY OF BIRMINGHAM
PER ARDUA
AD ALTA

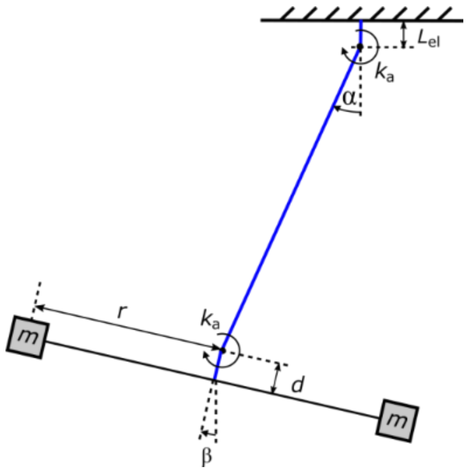
Credit: Conor Mow-Lowry

Tilt-to-Horizontal coupling

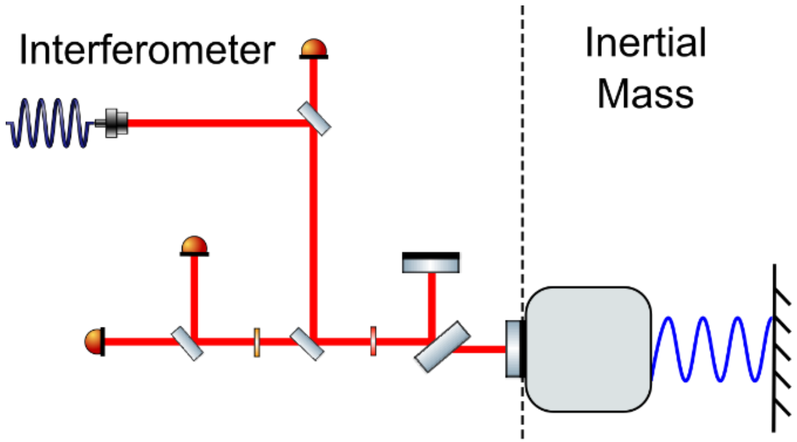


$\delta x \propto ax$ $\quad$ $\delta x \propto g\theta$

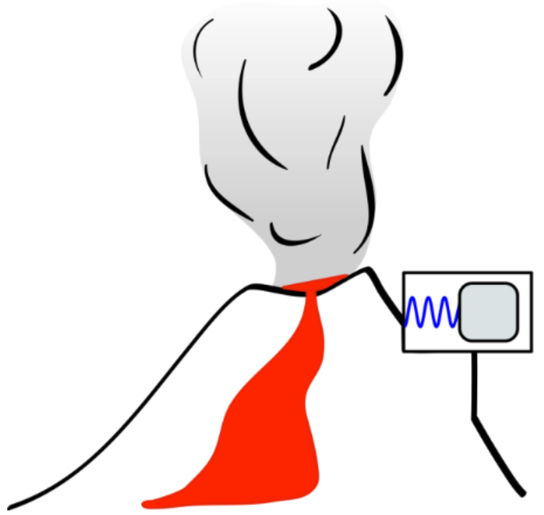
Mechanical cross-coupling



Sensor/actuator noise

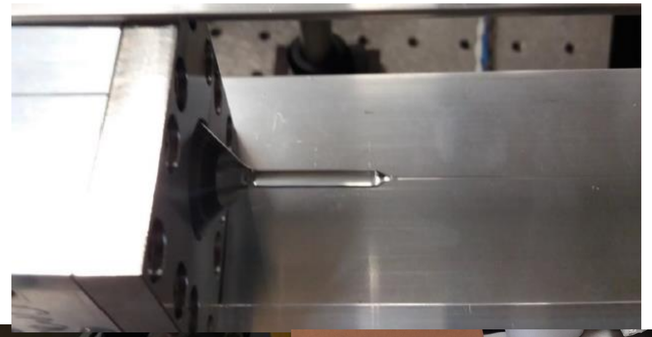


Dynamic range



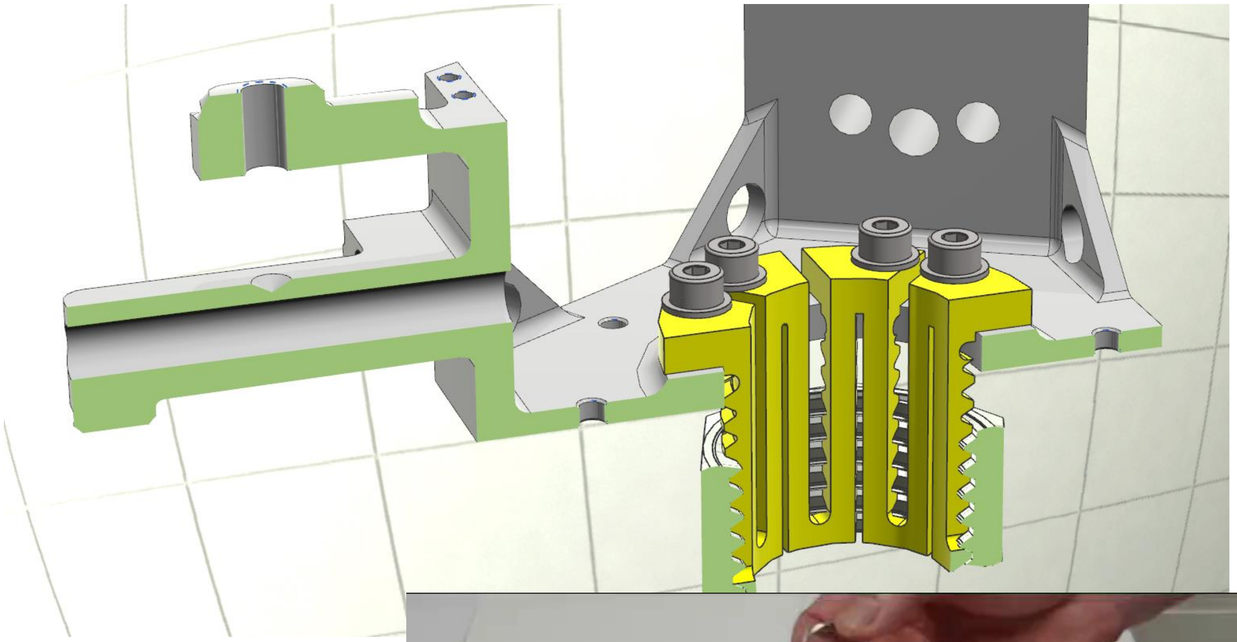
CREDIT: ALAN CUMMING

FIBERS PULLED @ GLASGOW



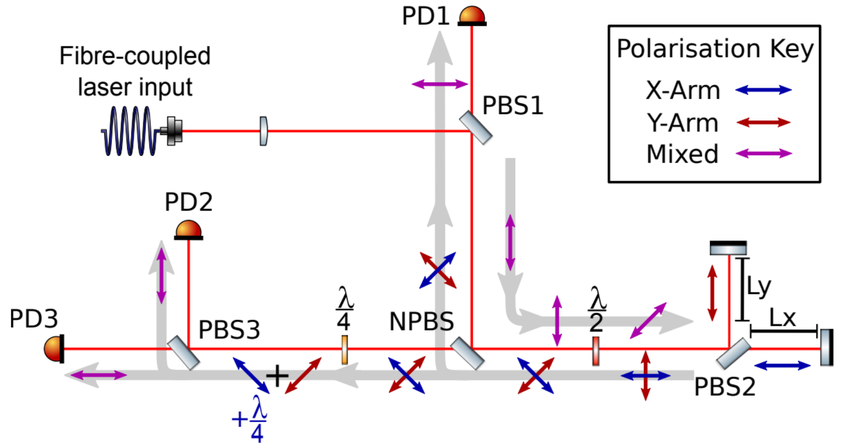
CREDIT: MARTIN ADAMS

GLASS METAL INTERFACE



HOQI FOR READOUT

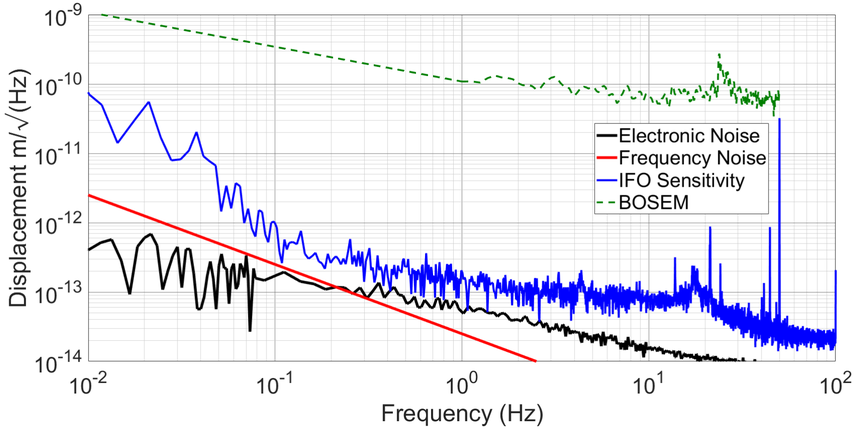
Homodyne Quadrature Interferometers noise hunting / optimizing the performance

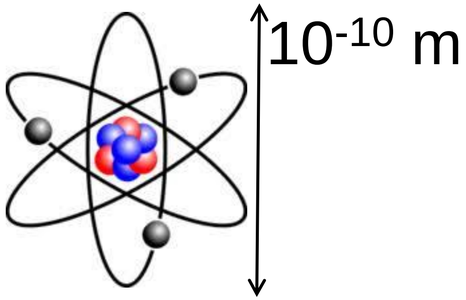


UNIVERSITY OF BIRMINGHAM

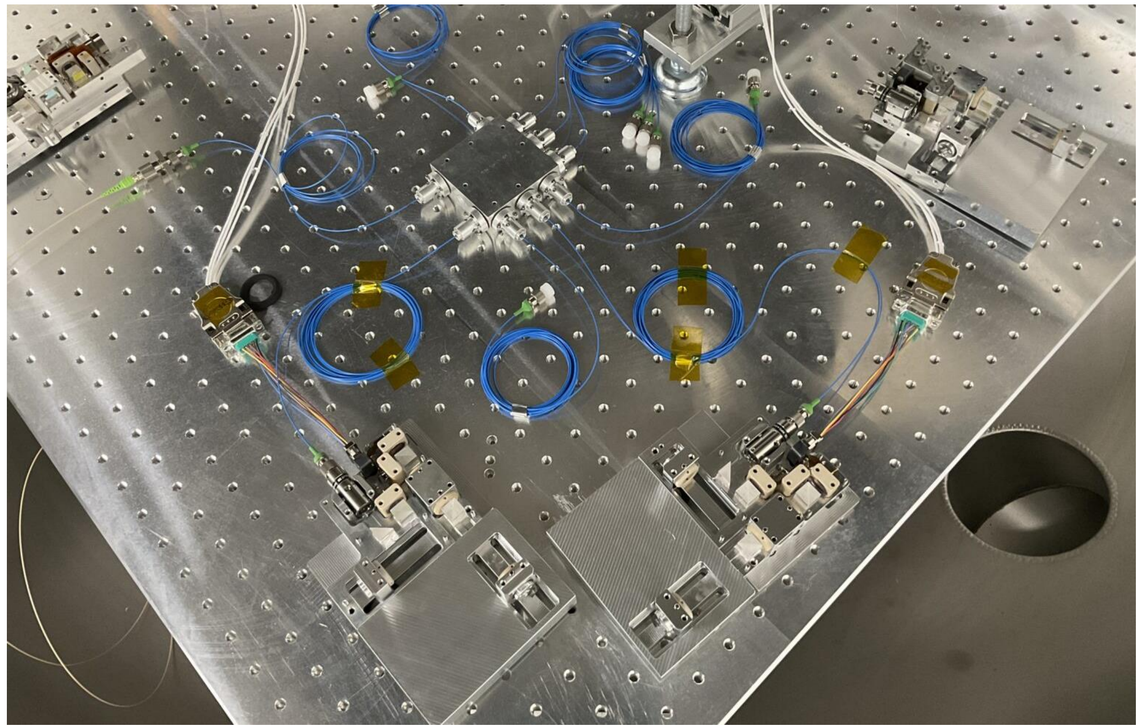
VU VRIJE UNIVERSITEIT AMSTERDAM

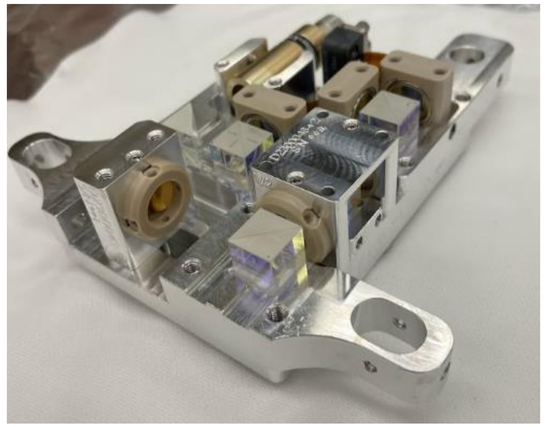
Nikhef

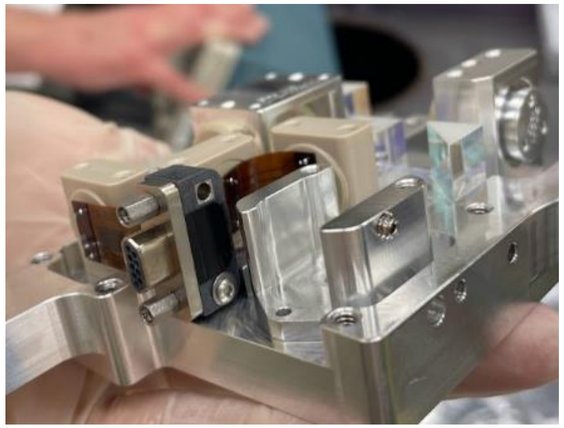




CREDIT PICTURES: ALEXANDRA MITCHELL



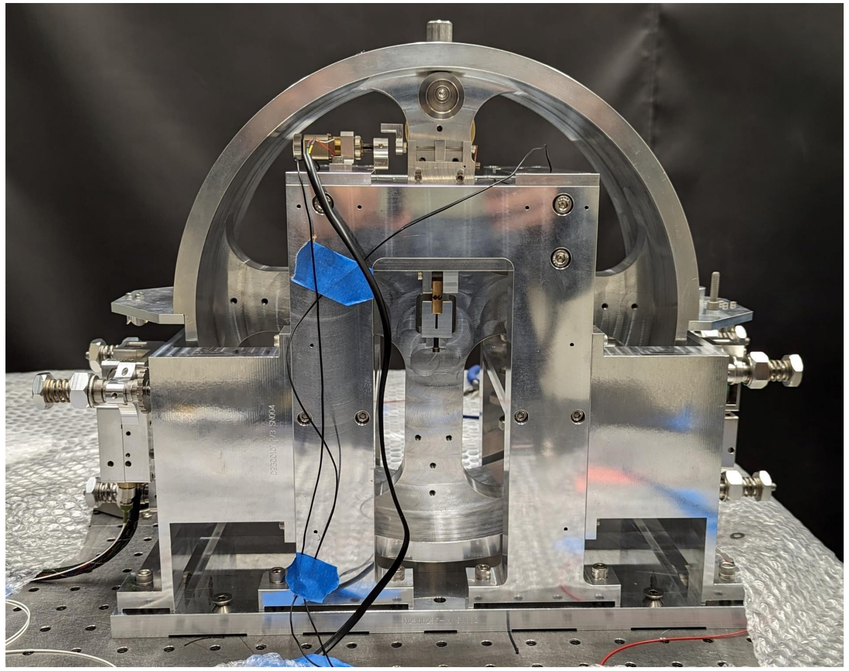




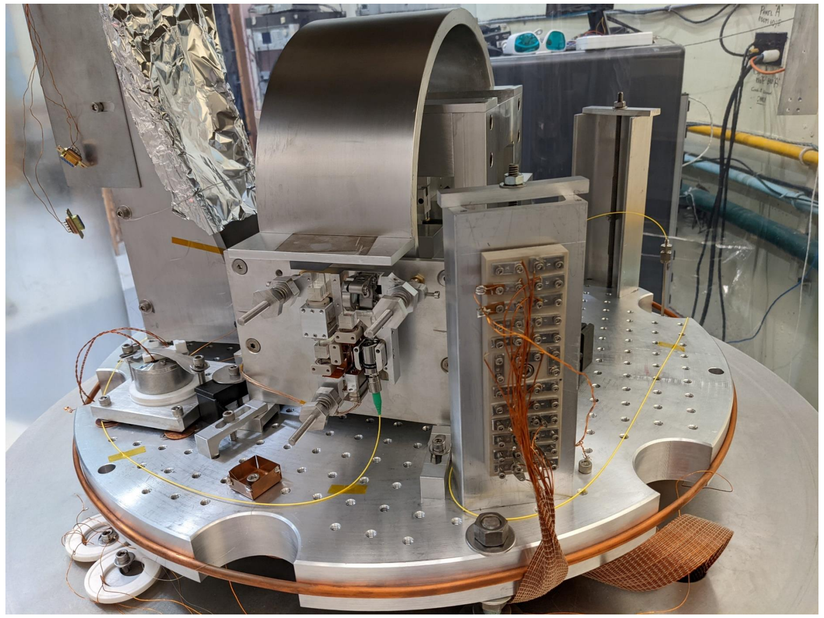
COOPER *ET AL.*, CQG 35 095007 (2018)
HTTP://IOPSCIENCE.IOP.ORG/ARTICLE/10.1088/1361-6382/AAB2E9/META

HoQIs around the world …

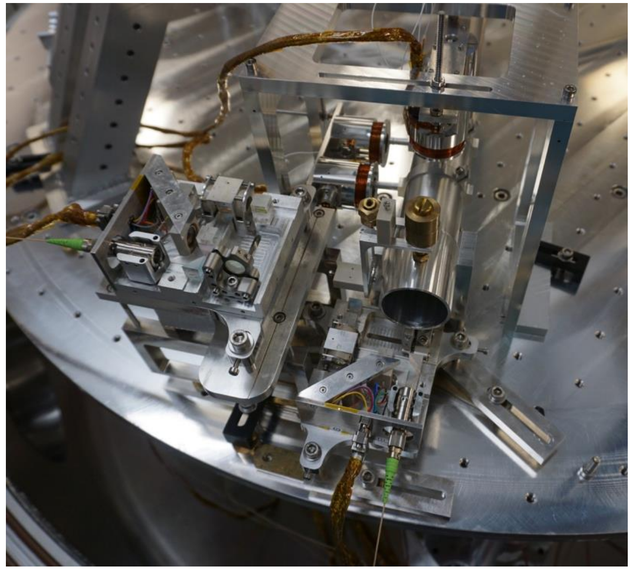
Credit: Alexandra Mitchell



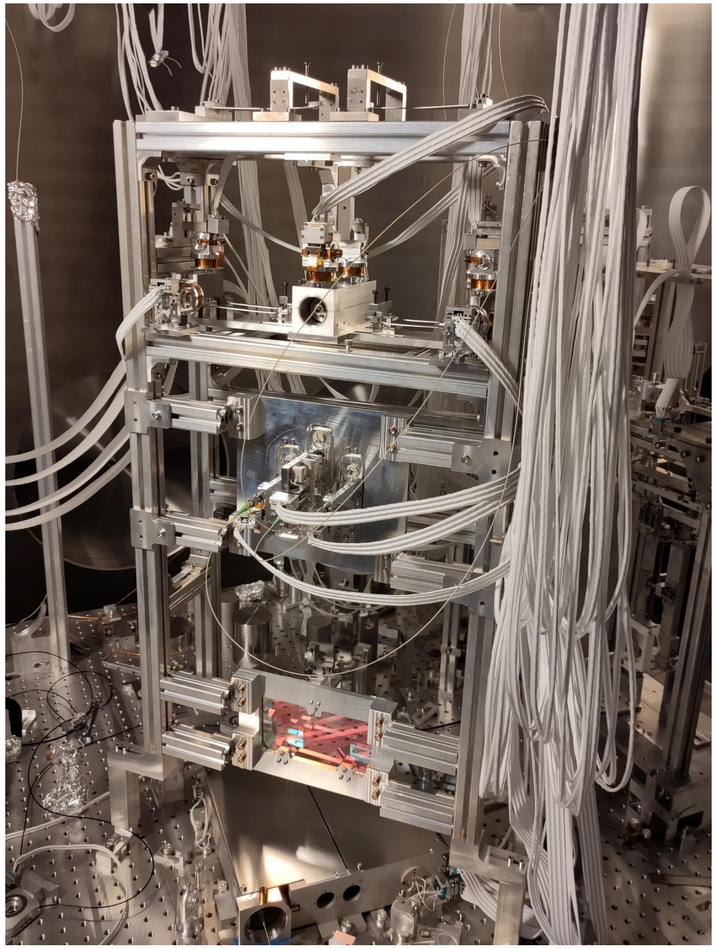
Cylindrical rotation sensor readout at CALtech



Cylindrical rotation sensor readout at UW



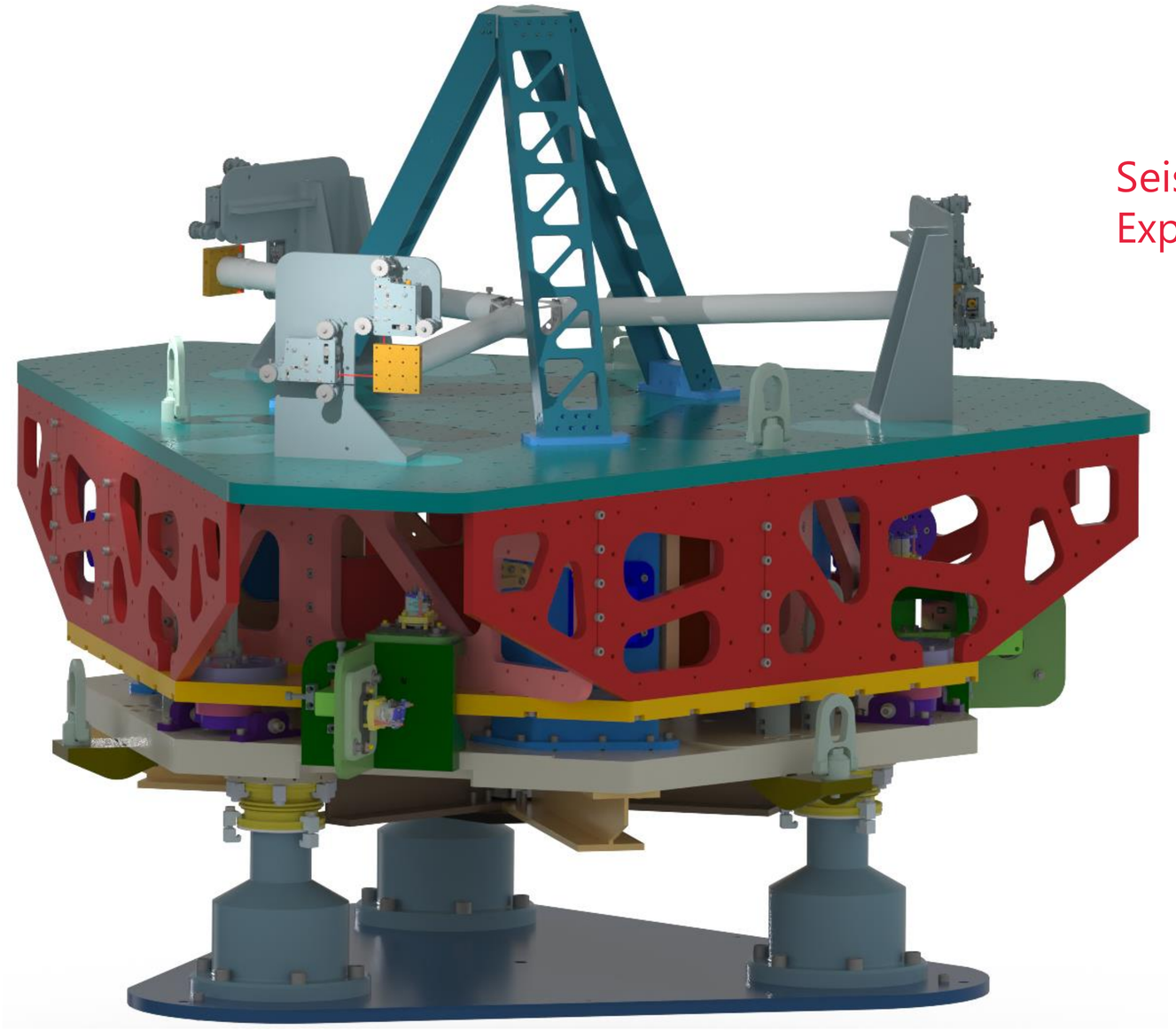
Readout of Birmingham 6D experiment
https://dcc.ligo.org/LIGO-G2300542



Measuring IM in AEI 10m prototype beamsplitter suspension

9

IMAGE CREDIT: ARMIN NUMIC



Seismic Isolation platform ordered,
Expecting first parts to arrive late january

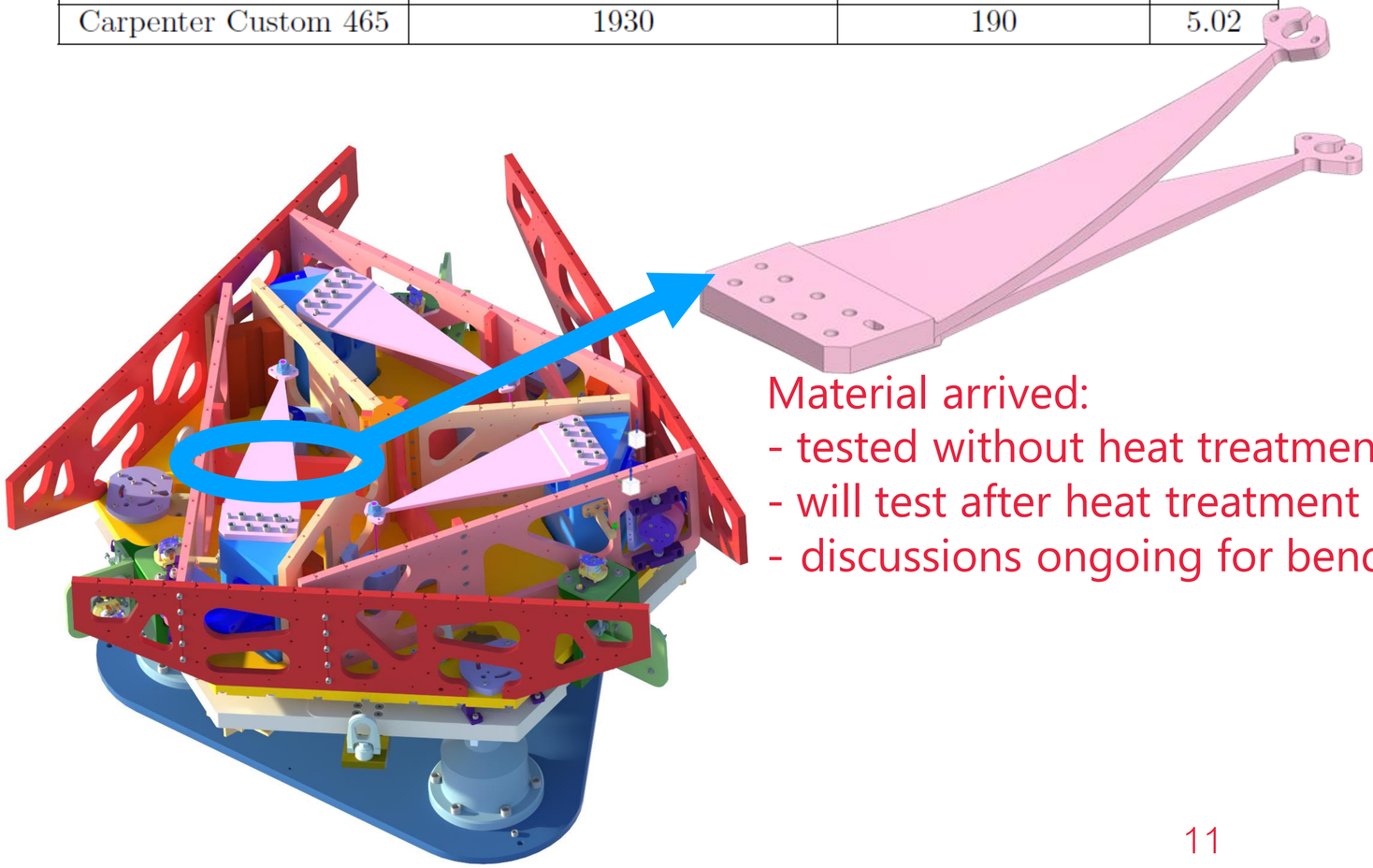
CREDIT: ARMIN NUMIC

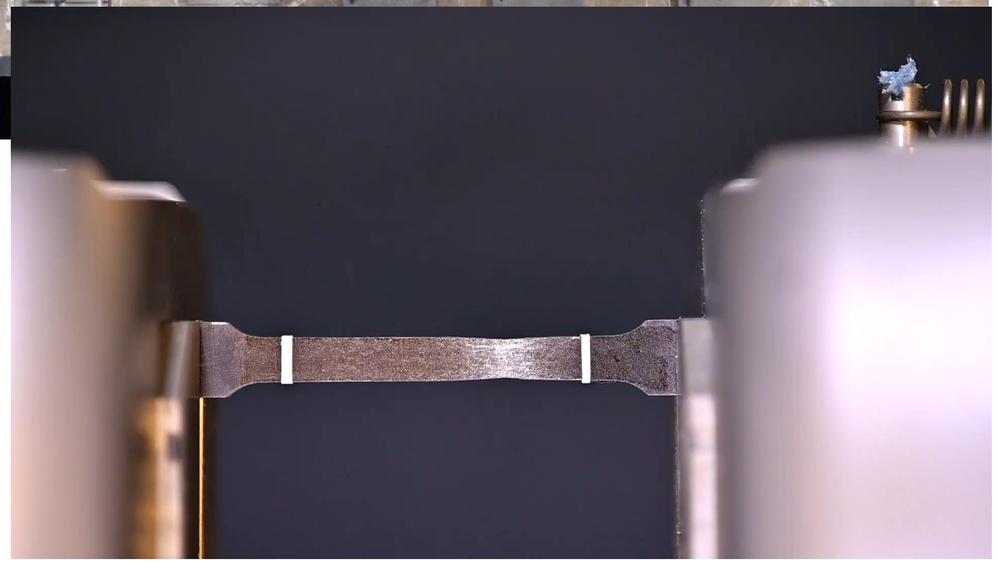
SEISMIC ISOLATION FOR EINSTEIN TELESCOPE

OMNISENS PROTOTYPE

Titanium grade 19 Beta-C

Material	Typical Ultimate Tensile Strength, σ [MPa]	Youngs Modulus, E [GPa]	E^2/σ^3 $\times 10^{-6}$
Maraging Steel	1800	190	6.19
Titanium Grade 19	1300	120	6.55
Carpenter Custom 465	1930	190	5.02

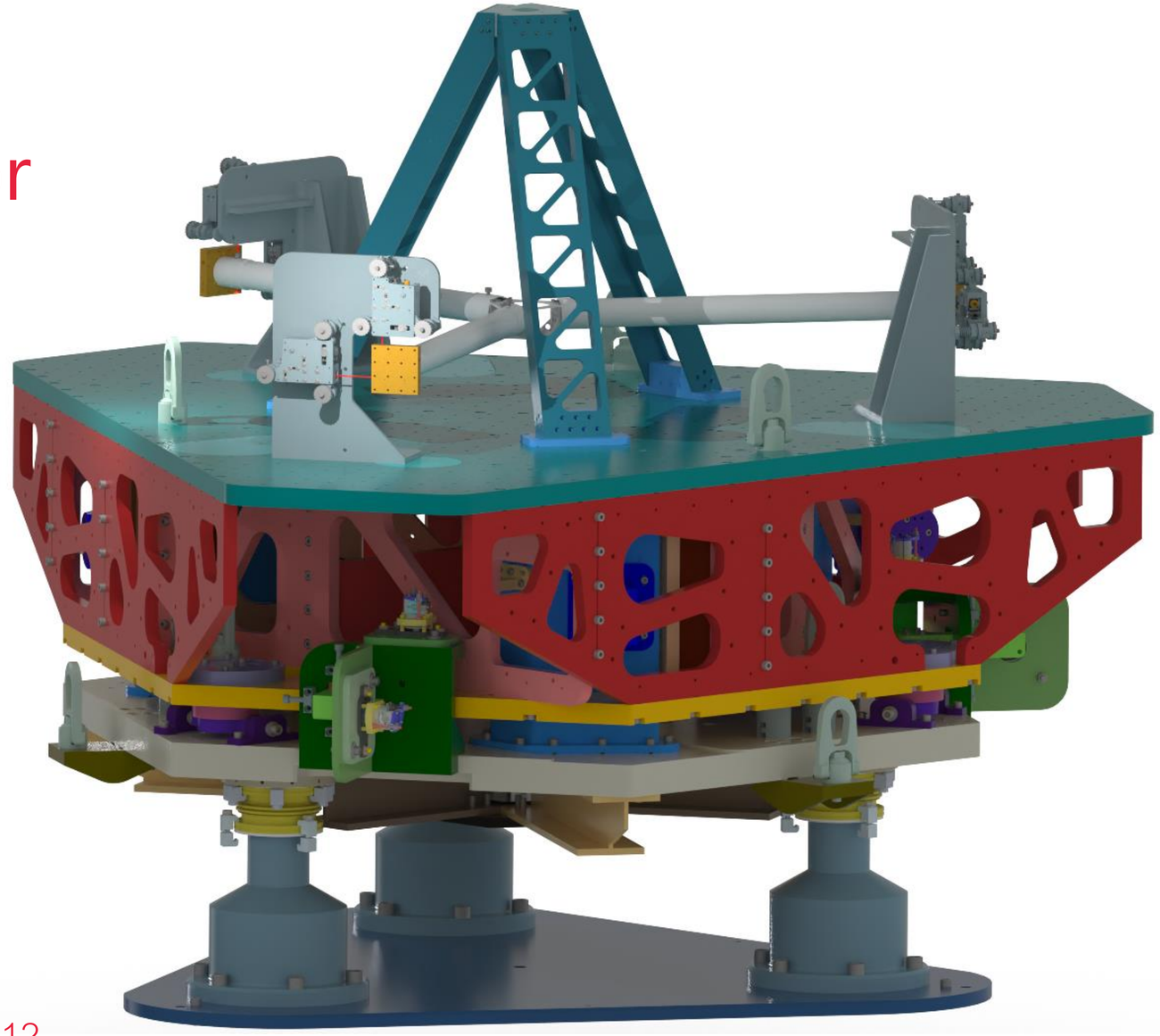




Material arrived:
- tested without heat treatment
- will test after heat treatment
- discussions ongoing for bending

IMAGE CREDIT: ARMIN NUMIC

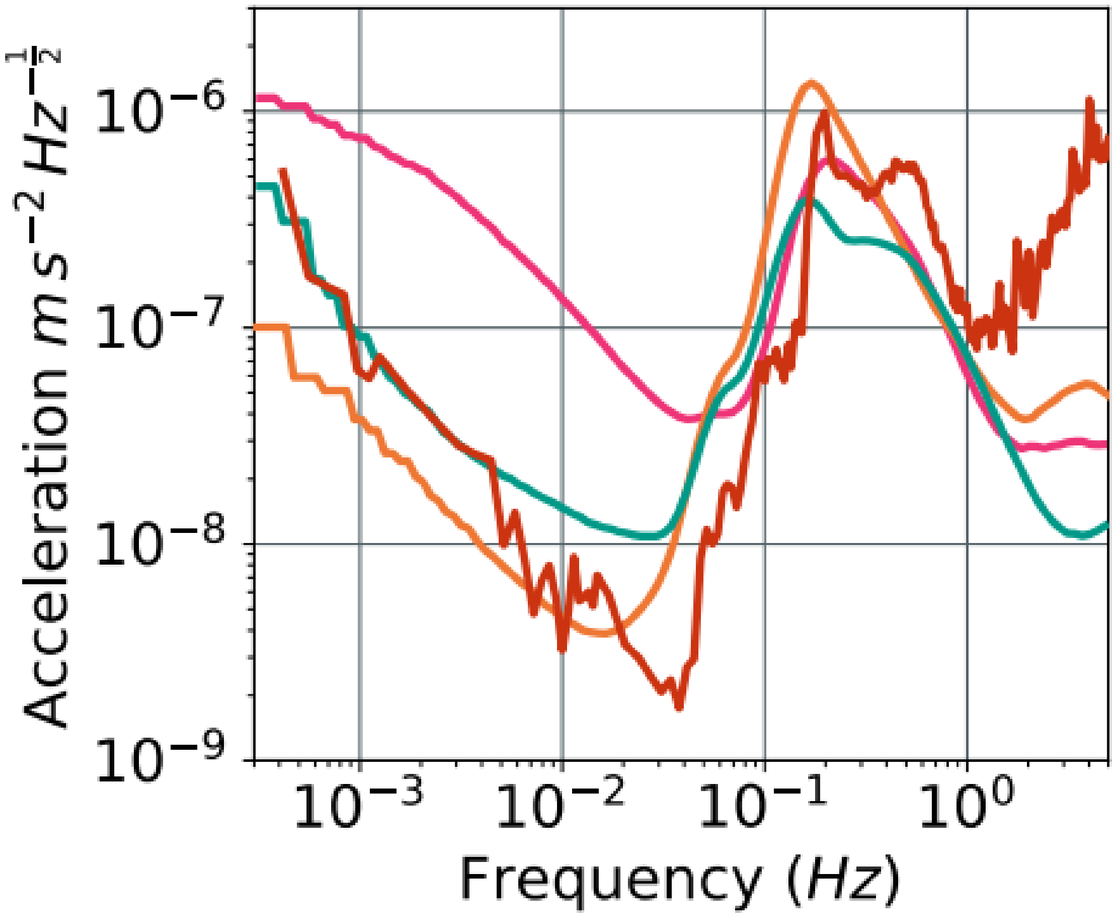
Do we need active isolation for The Einstein Telescope?



SEISMIC MOTION AT BOREHOLES

From; C. M. Mow-Lowry, et. al.,
13 ET Symposium, May 2023.

LNGS Terziet Sos Enattos Hanford (no wind)

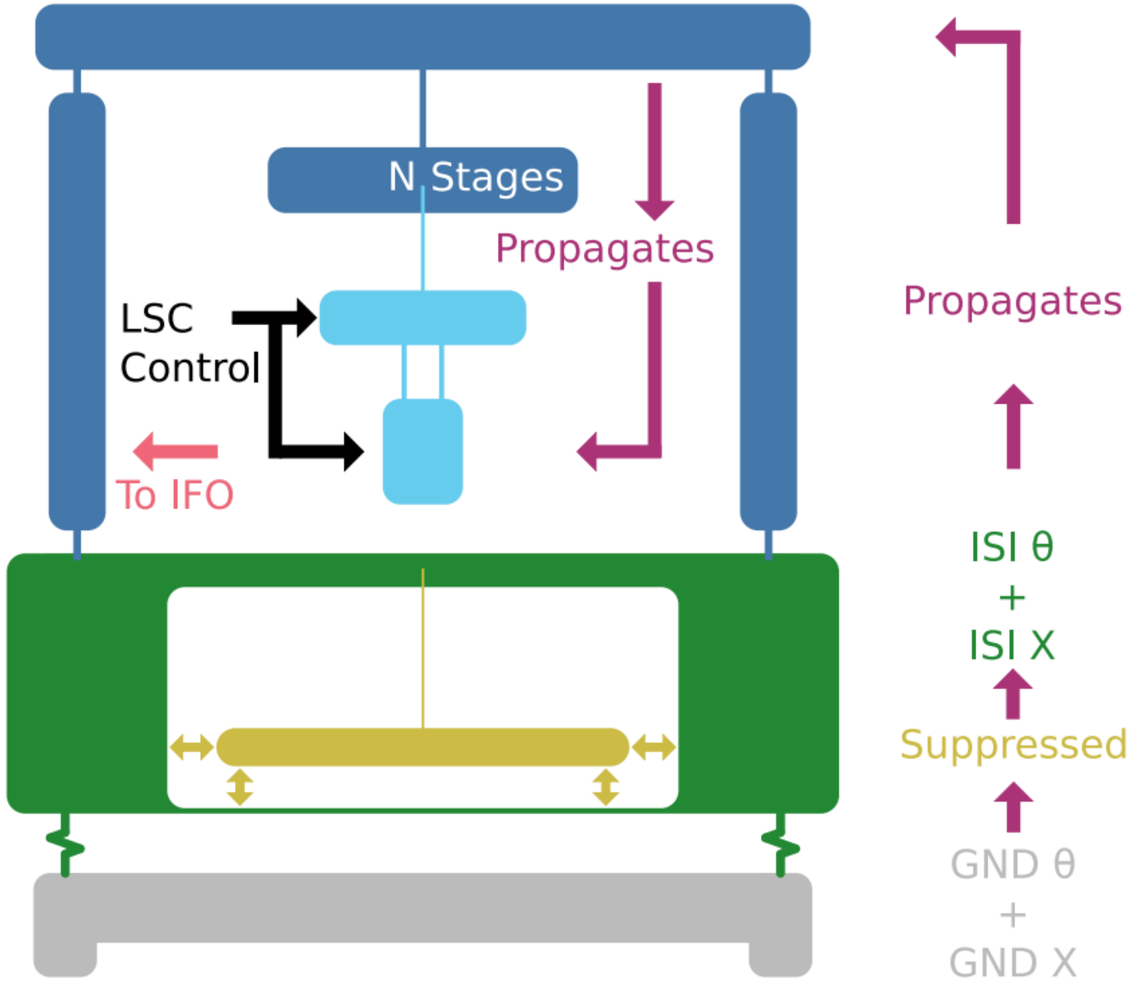


- Boreholes/seismic vaults are NOT representative of Seismic spectra for large ventilated caverns.
- For analysis worst case LNGS spectrum is used.

MODELLED SYSTEM

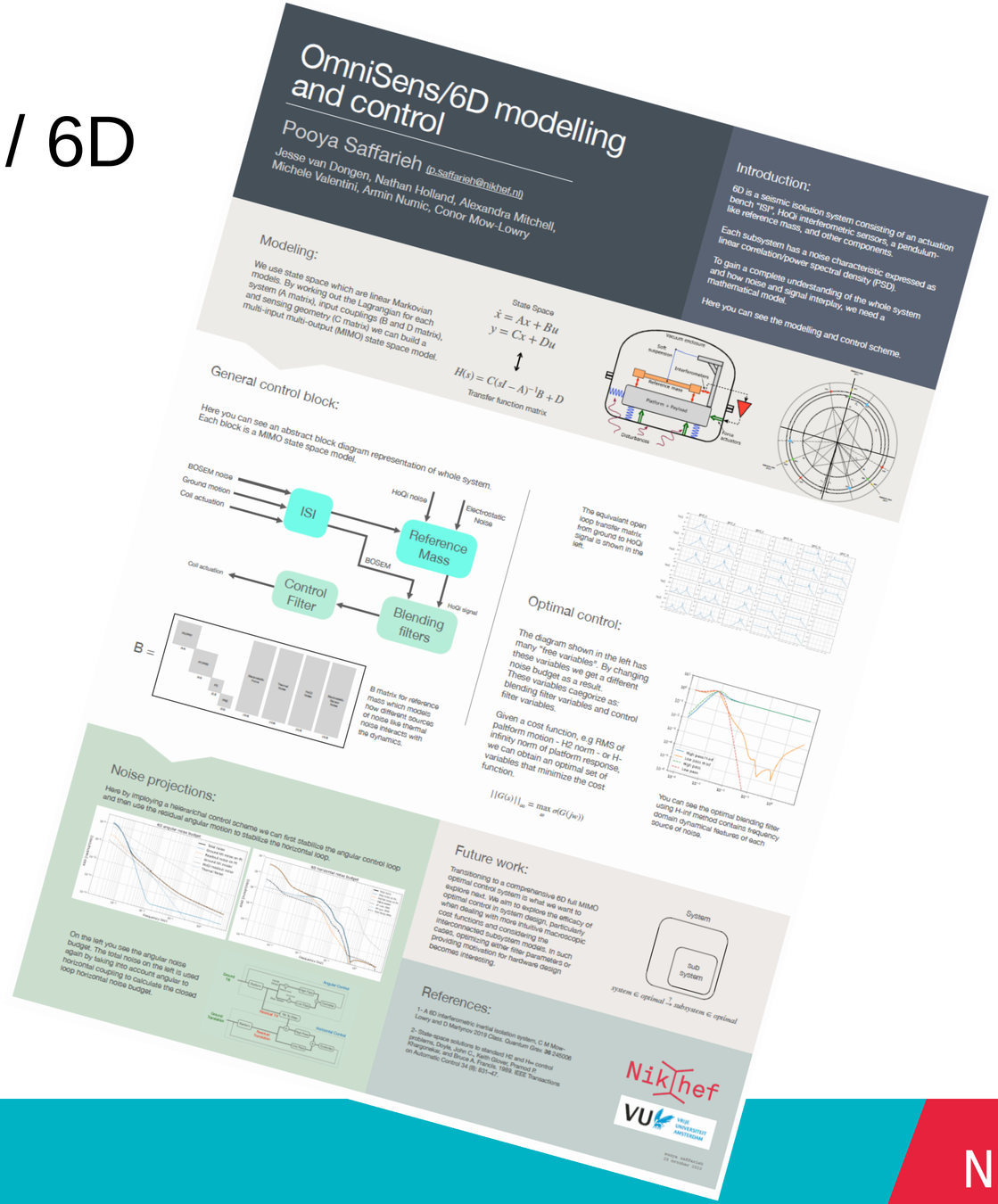
Credit: Nathan A. Holland
GWADW 2023

- LNGS ground spectra.
- 6D ISI pre-isolation.
- Suspension model used:
  - 9m Virgo.
  - 12m ET.
  - 17m ET-LF.



POSTER ON MODELLING & CONTROL OF OMNISENSE / 6D

By Pooya Saffarieh

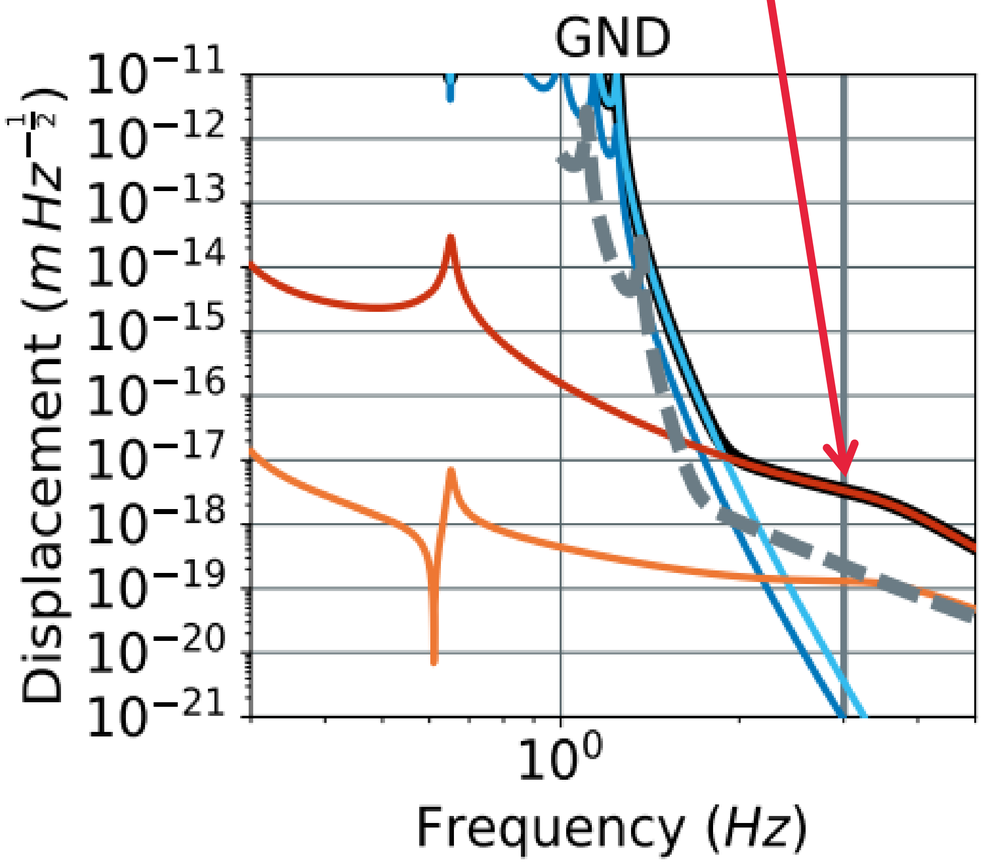


MODELLED RESULTS

Credit: Nathan A. Holland
GWADW 2023

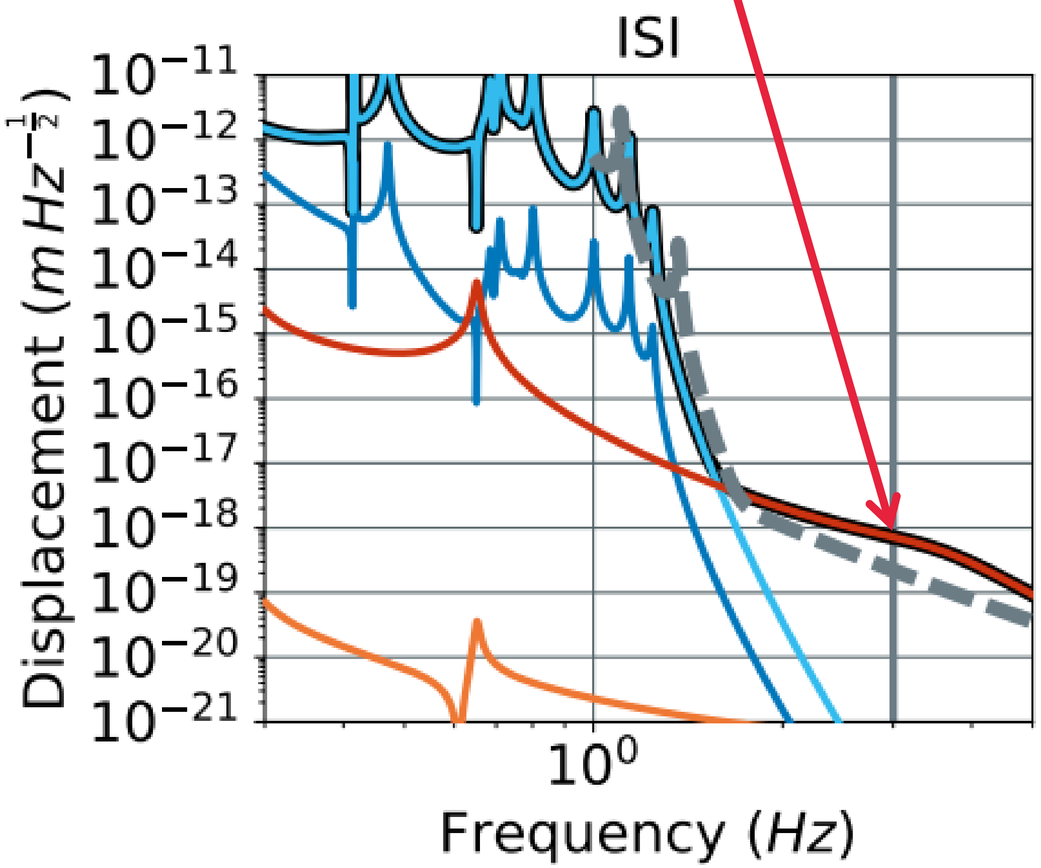
No Active Isolation

Noise 35x too high at 3 HZ



With Active Isolation

Noise 8x too high at 3 HZ



ET-LF
Total
x (SAT)
θ(SAT)
ACT (STG0)
ACT (STG1)

IMAGE CREDIT: ARMIN NUMIC

TAKE HOME MESSAGE

- The 6D experiment at Amsterdam is becoming reality soon.
- Initial extremely optimistic modelling of ET suspensions including actuation noise is not yet good enough.
- An active platform is probably needed for ET