Antwerpen GW group

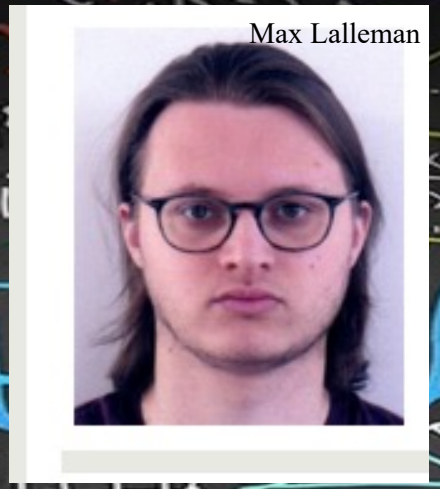
Nick van Remortel
Hans Van Haevermaet
University of Antwerp, Belgium

CosPa Meeting, ULB

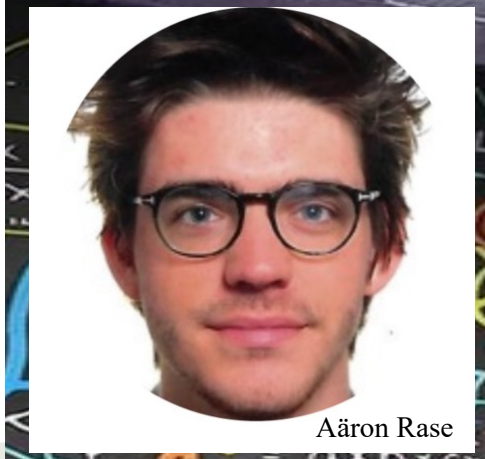
Oct 29, 2021

Group Composition

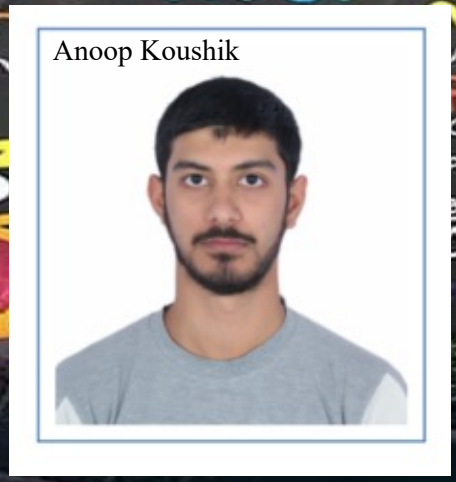
Joint with VUB



Joint with ARTEMIS Nice



Joint with UCL

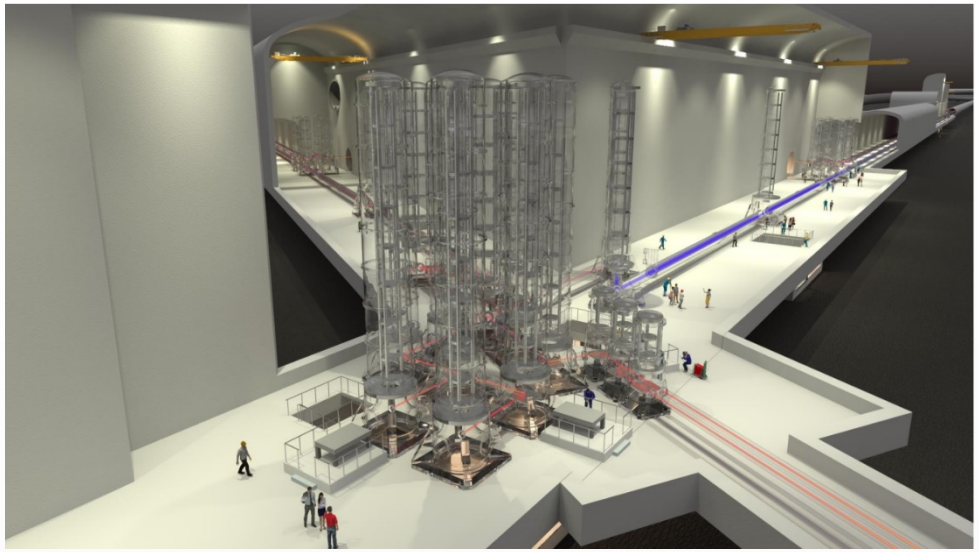


- 2 ZAP
- 1 Post-doc
- 6 PhD students
- 2 engineers

Engineering

Topics Covered

Einstein Telescope



Noise hunting

Stochastic analysis

Detector characterisation

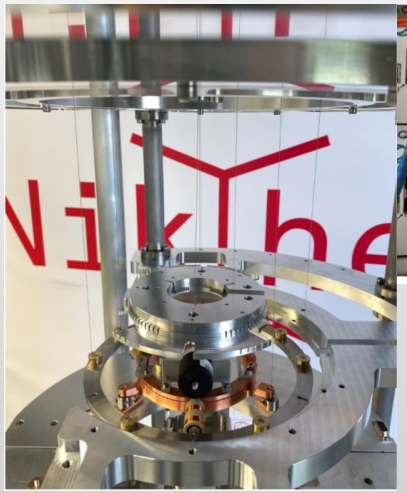
Instrumentation

R&D

Model building

LIGO - Virgo

ETpathfinder



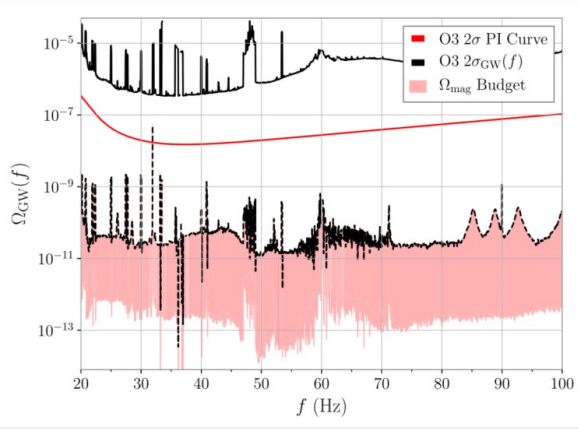
Milestones

- Joining ET consortium in 2017, planning ETpathfinder, main proponent
- Approval of Etpathfinder in April 2019: 14.,5 MEur infrastructure
- Joining VIRGO in Nov 2019: Nick vR & Kamiel Janssens (FWO PhD)
- Jan 2020: NvR becomes VIRGO chair of stochastic WG
- 2020: Wim Beaumont becomes co-chair of ETpathfinder sensor & controls group
- Summer 2020: Hans Van Haevermaet joins GW activity as 50% ZAP
- June 30 2021: Einstein Telescope on ESFRI roadmap
- Summer 2021: Nick vR co-chairs ET beampipe vacuum group

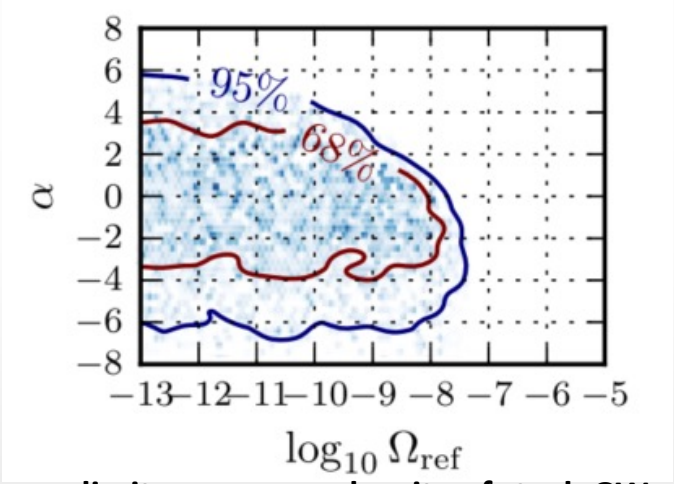
Check us out on: https://www.virgo-gw.be/people/

Stochastic Gravitational wave analysis

- Search for incoherent superposition of non resolvable astrophysical and cosmological sources of GW signals
- Participated in Isotropic (non-directional) search using LIGO-Virgo O3 data



Correlated magnetic noise budget below sensitivity of search



Upper limits on energy density of stoch GW and Spectral index of frequency spectrum

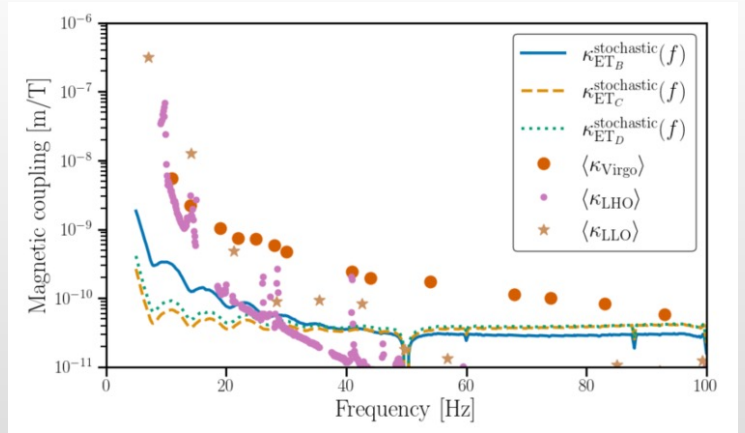
PHYSICAL REVIEW D **104,** 022004 (2021)

Upper limits on the isotropic gravitational-wave background from Advanced LIGO and Advanced Virgo's third observing run

KCL-PH-TH/2021-71

Impact of Schumann resonances on the Einstein Telescope and projections for the magnetic coupling function

Kamiel Janssens,[1,2] Katarina Martinovic,[3] Nelson Christensen,[2] Patrick M. Meyers,[4,5] and Mairi Sakellariadou[3]



Coupling of correlated magn fields across Detectors becomes problematic for ET

- Model building for Cosmological SGW signals

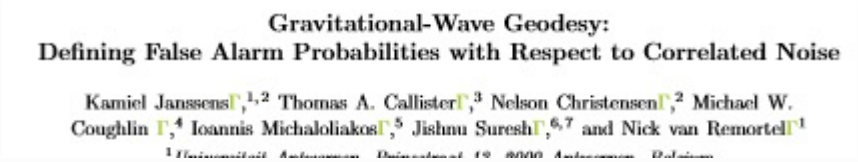
ULB-TH/21-09

Baryogenesis via relativistic bubble expansion

Iason Baldes,[1] Simone Blasi,[2] Alberto Mariotti,[2] Alexander Sevrin,[3] and Kevin Turbang[4,5]

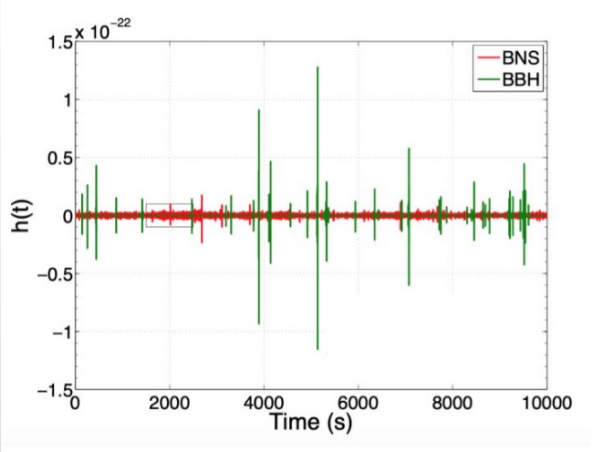
Stochastic Gravitational wave analysis

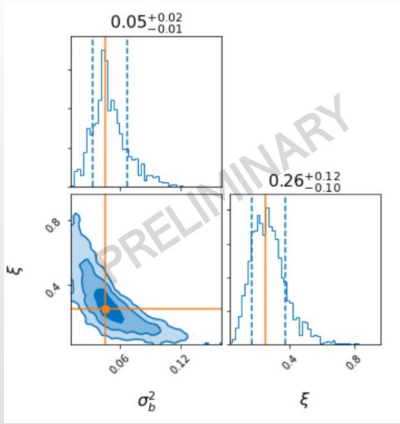
- Lots of new projects in pipeline
- GEODESY: method/tool to compute detection efficiency and false alarm rate in case of detection

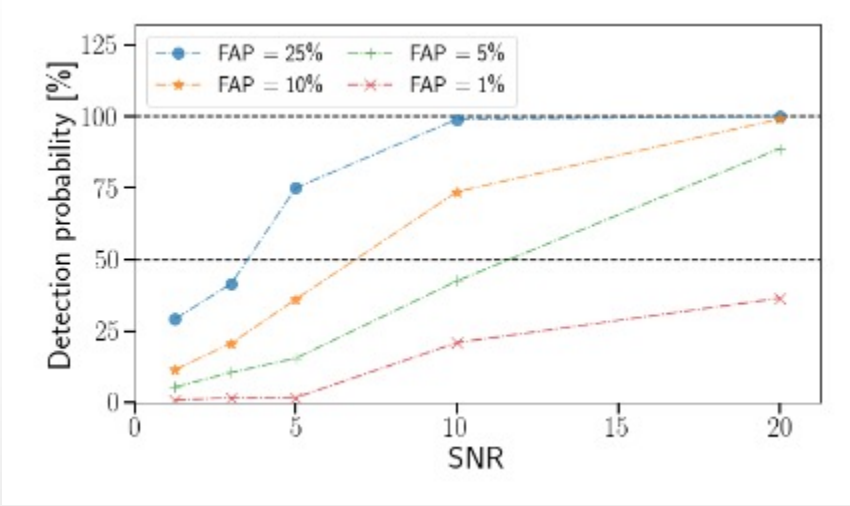

Gravitational-Wave Geodesy:
Defining False Alarm Probabilities with Respect to Correlated Noise

Kamiel Janssens[1,2] Thomas A. Callister[3] Nelson Christensen[2] Michael W. Coughlin[4] Ioannis Michaloliakos[5] Jishnu Suresh[6,7] and Nick van Remortel[1]

- SSI: Stochastic Signal Intermittant analysis







Detection probability at various S/N ratios for fixed false alarm probabilities

Intermittent time structure of BBH events dilutes Sensitivity of standard search if not properly taken into account

Succesful recovery of parameters of toy models with Increasing level of complexity

Other LIGO/Virgo and ET projects

- Development of Python based stochastic analysis pipeline: pyGWB
- Mock data challenges, software signal injections

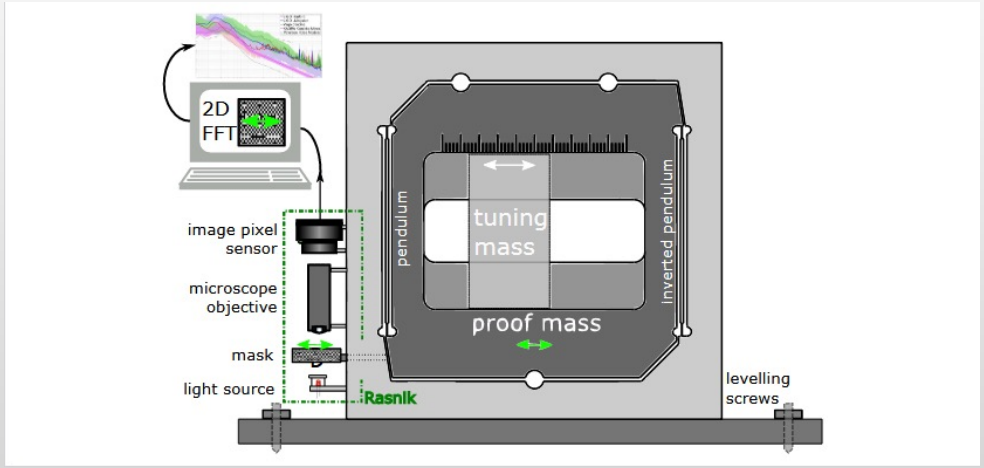
- Detector Characterisation and development of tools for coherent noise detection
- Injection of EM noise: measuring magnetic coupling to interferometers at Hanford, Livingston, Cascina
- Study of global, high frequency EM noise due to thunderstorms

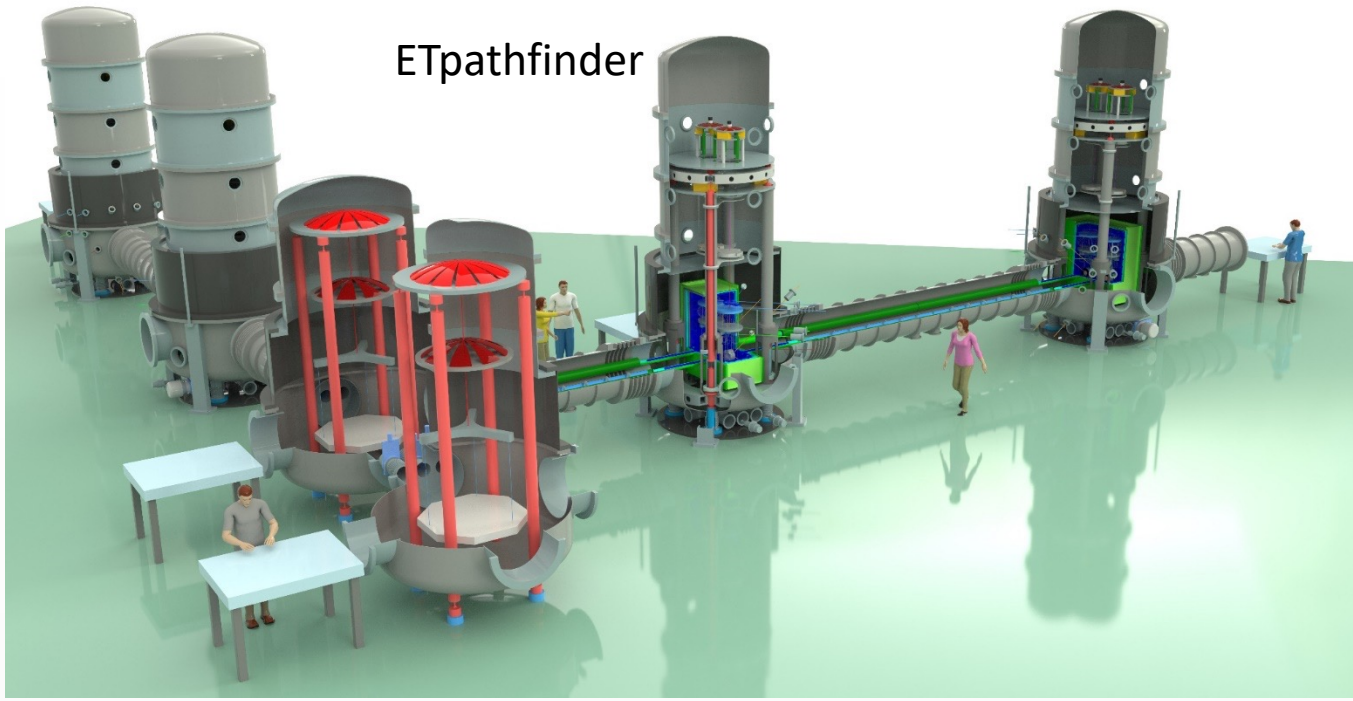
- ET: Stochastic GW detection potential study using a ‘null-channel’
  - Transposing a LISA based analysis strategy to Einstein Telescope

Hardware activities

ETpathfinder

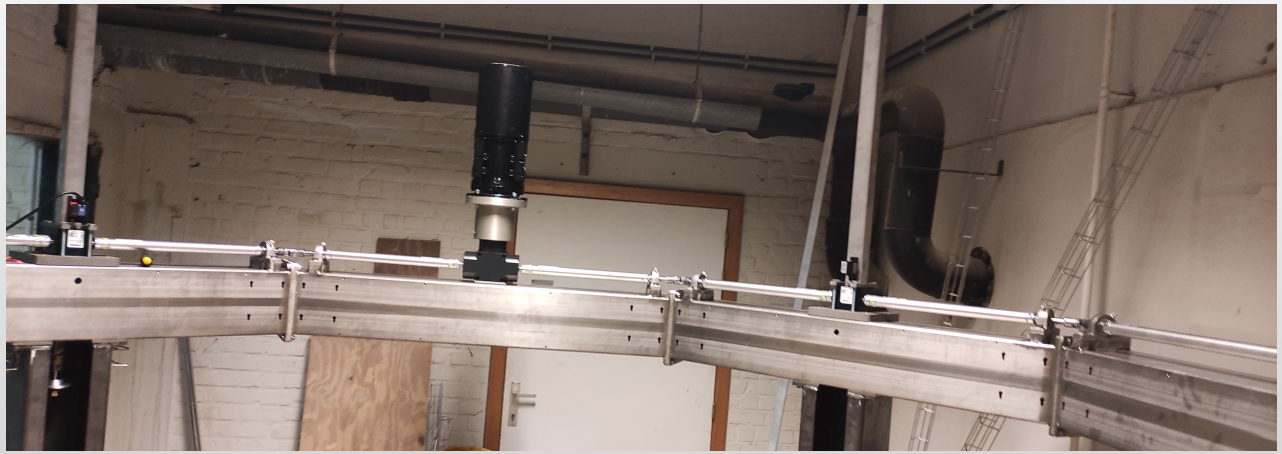
- Lifting system for vacuum towers
- Mass production of LVDTs + electronics
- Novel LVDT design R&D
- Adv Virgo and Etpathfinder DAQ system
- Cryogenic inertial sensor (Watts link) with matching electronics

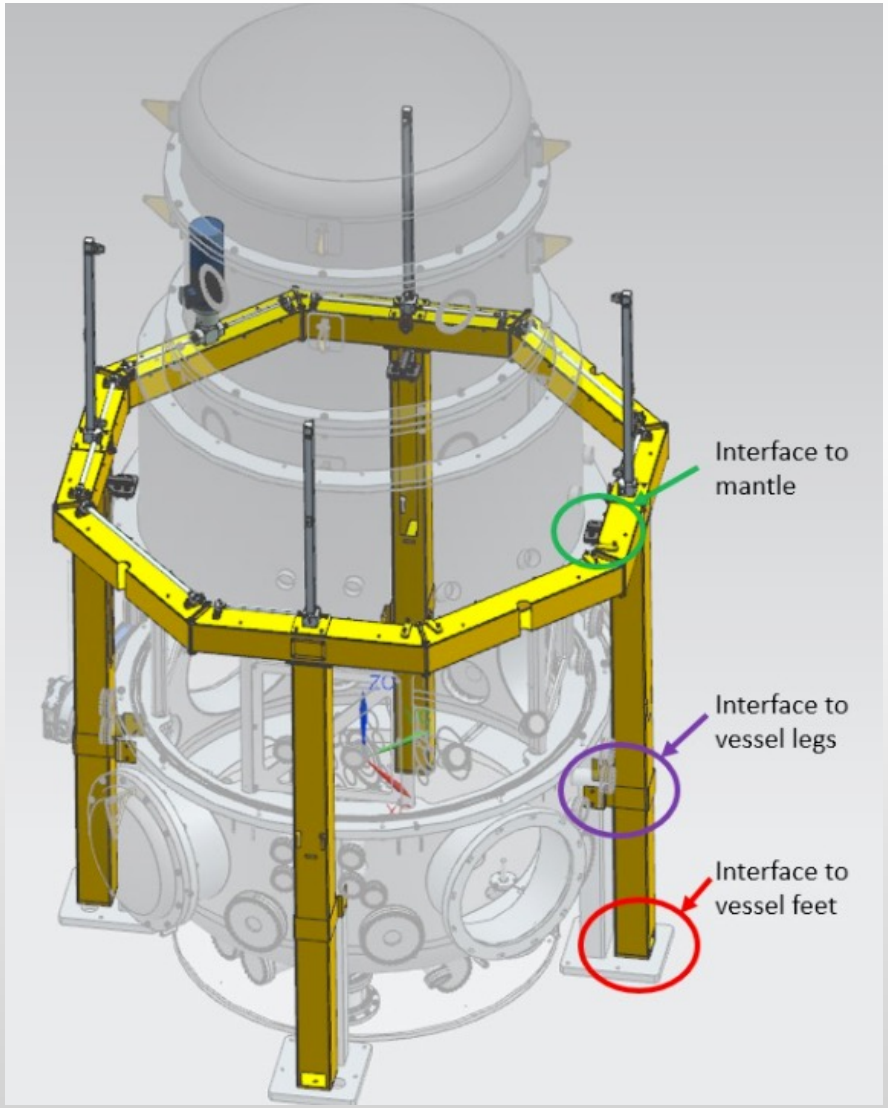




Lifting system for vacuum towers

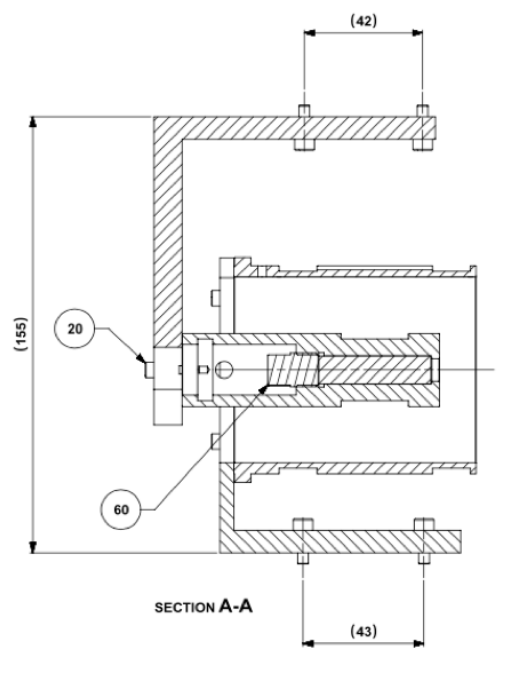
- Prototype currently under construction in Antwerp

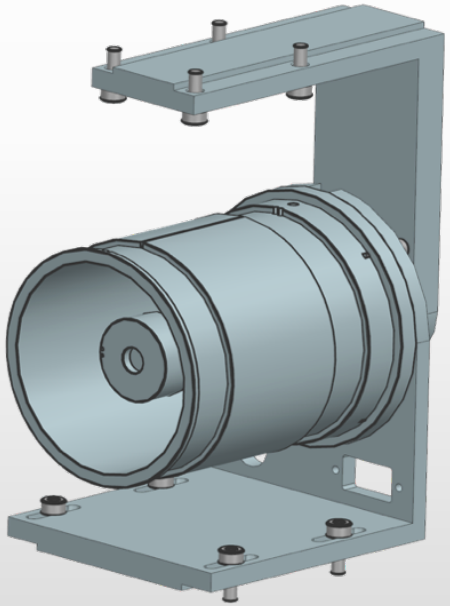




Production and development of LVDTs

- Production of LVDTs and electronics for ETpathfinder Phase I
- Support parts, coil winding, read-out boards, UHV cleaning, …





3 sets already made by UA workshop for IP prototype at Nikhef

Help with finetuning of design.

LVDTs used in several stages/filters Of the suspension systems

First sets to be installed ~june 2022

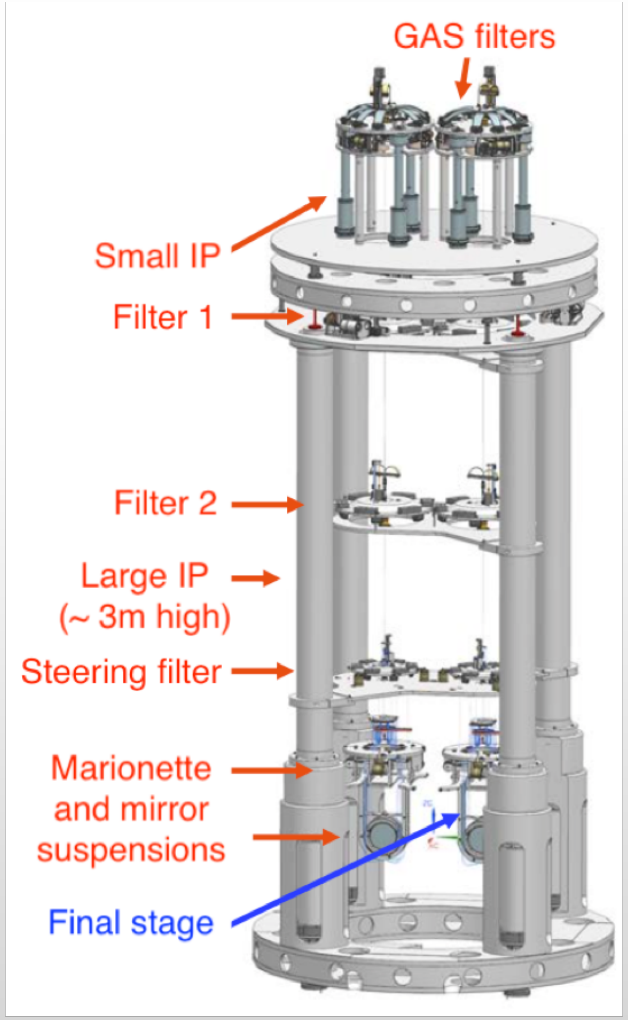
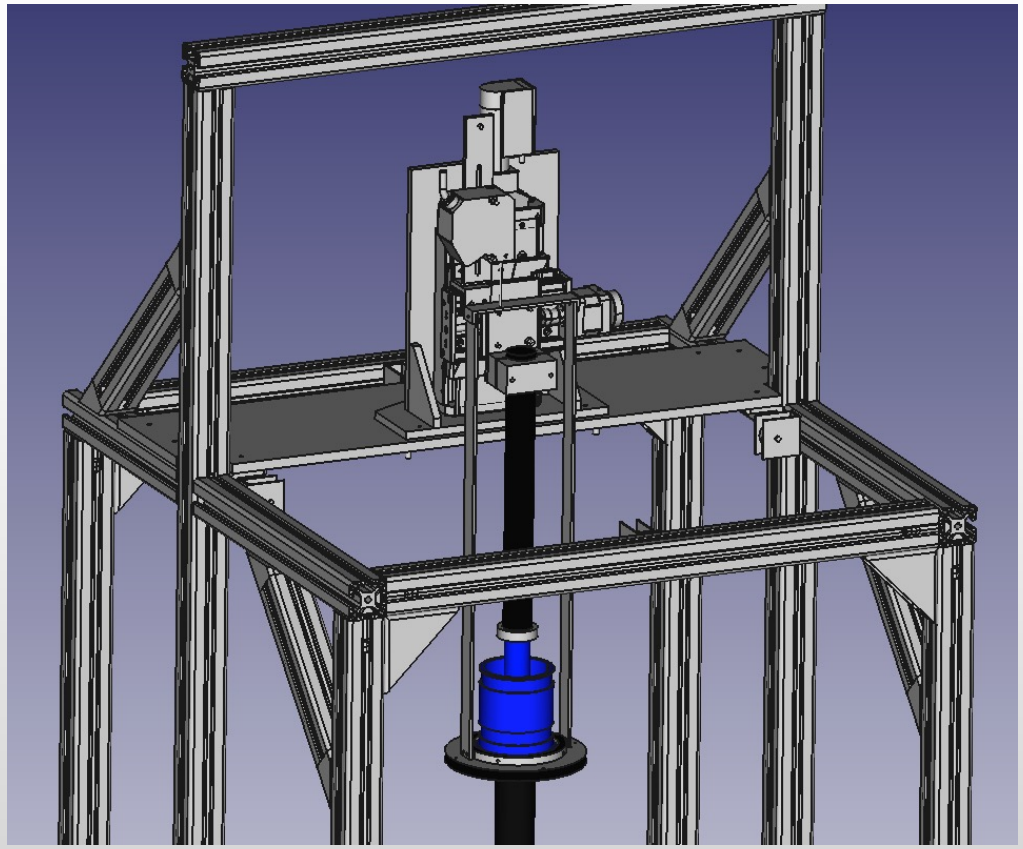
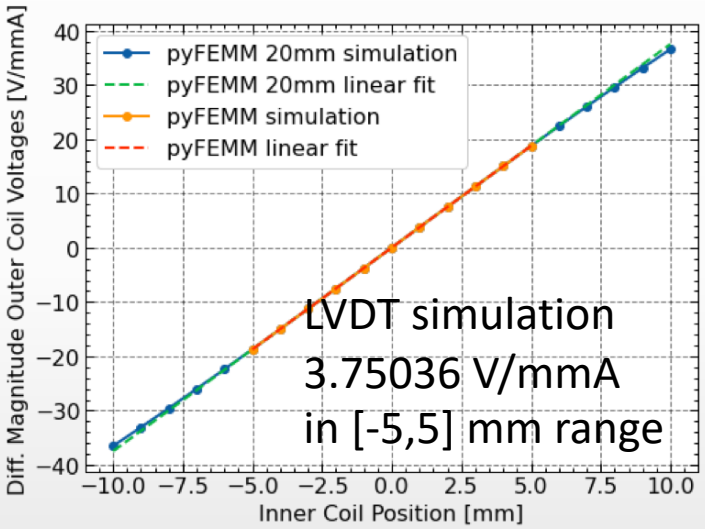


Fig. 2: Seismic attenuation system of ETpathfinder

Production and development of LVDTs

- Novel LVDT design R&D: Construct dedicated test-setup in Antwerp and explore new design ideas with simulation and prototype production





New ideas:
- reversed operation
- Less cables
- Magnetic shielding
- Improved read-out electronics