



LCGT - SAS development status

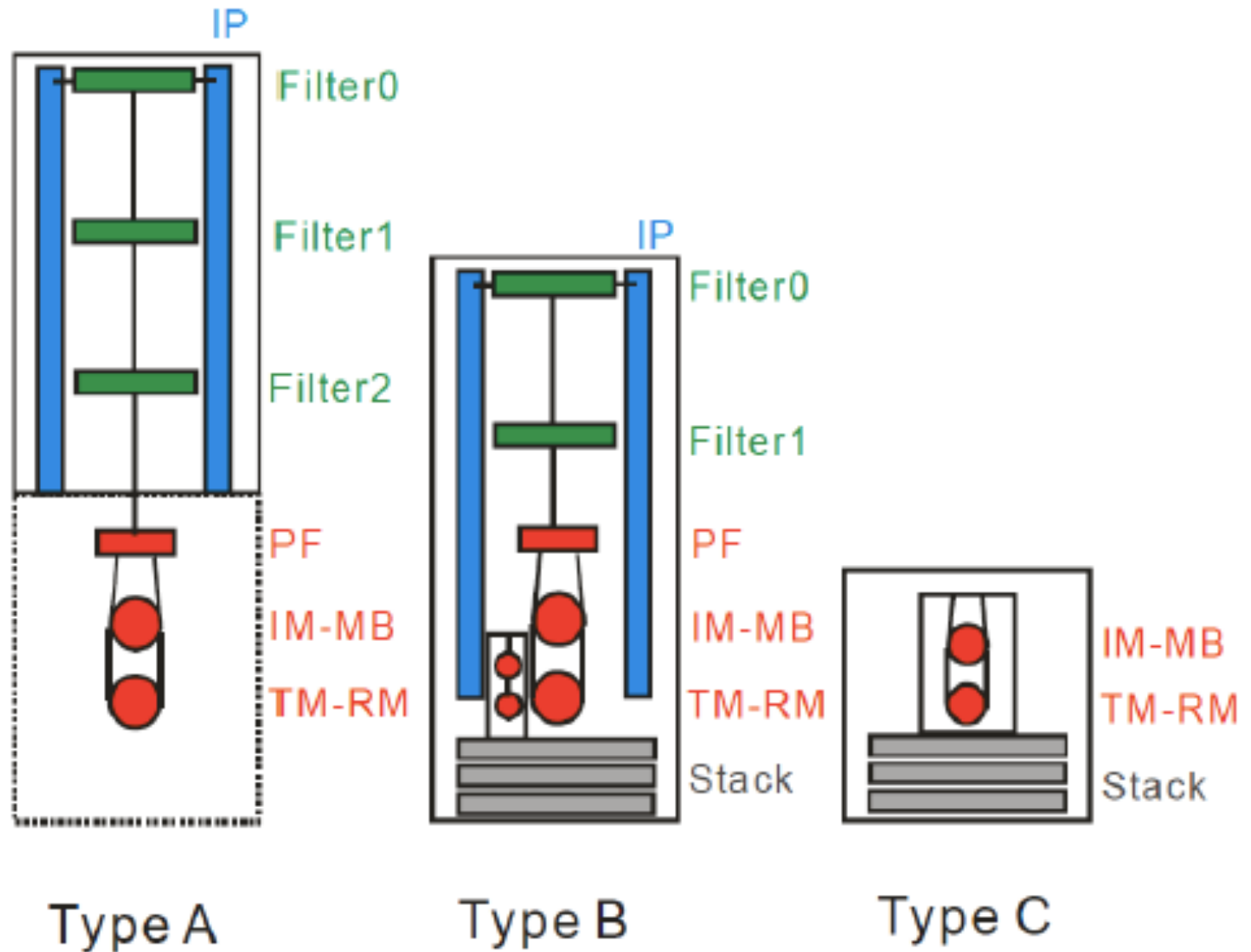
H. Ishizaki, E. Majorana, T. Sekiguchi, R. Takahashi,
A. Takamori, T. Uchiyama, R. DeSalvo

The structure and functions of
LCGT SAS

JGW-G1100385



Attenuator types





LCGT SAS general design

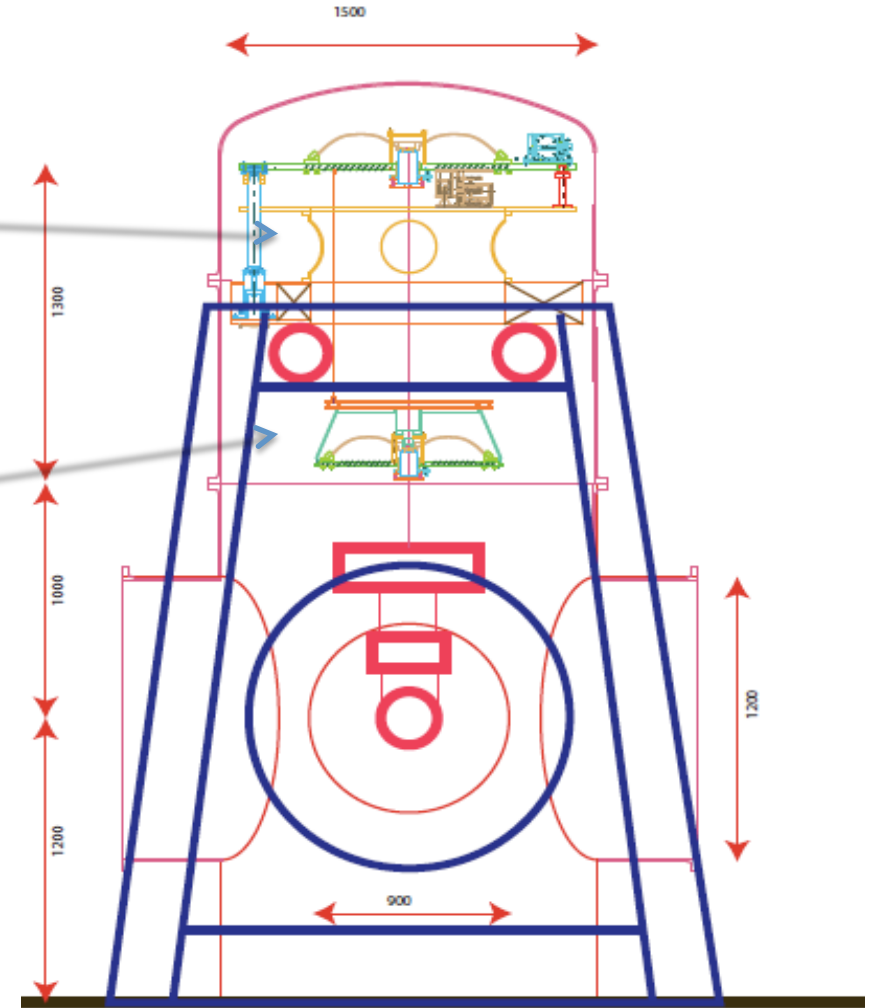
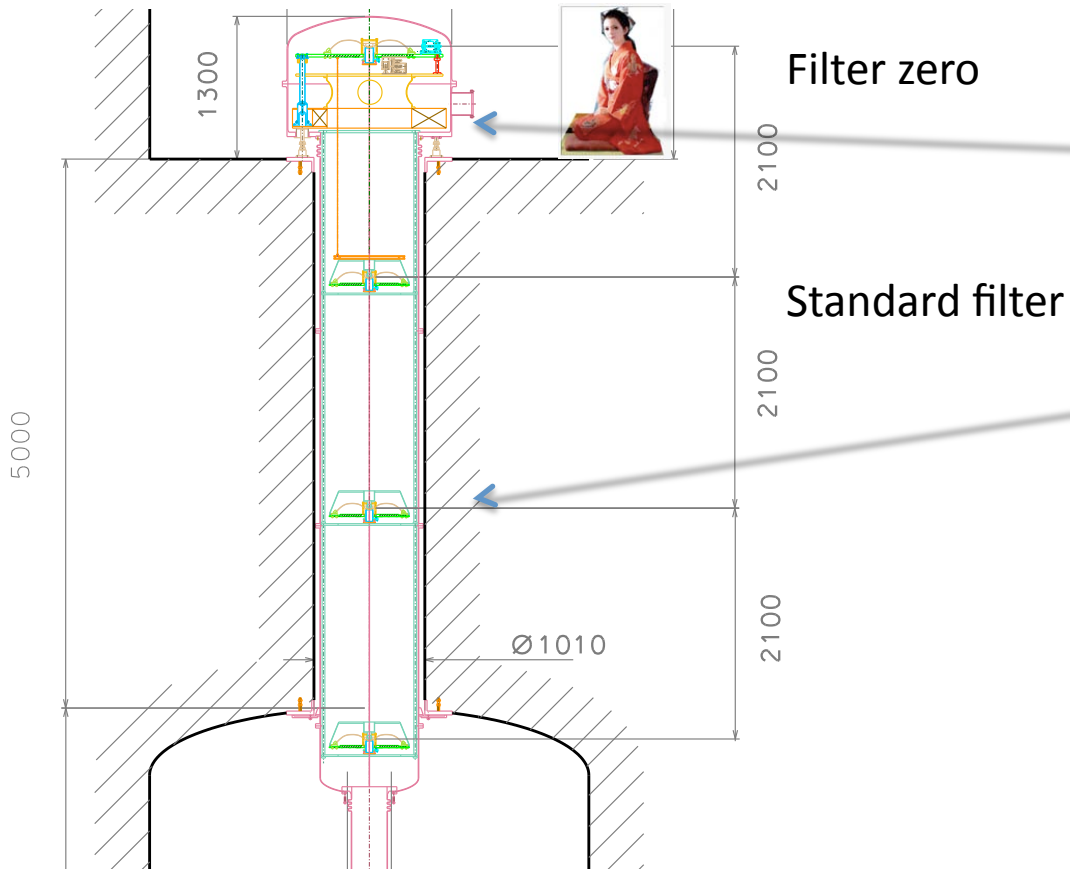
- Passive seismic attenuation
- Based on Geometric Anti Springs (GAS)
- Pendula
- and inverted pendula (IP) on the first stage



Modular design

Type A

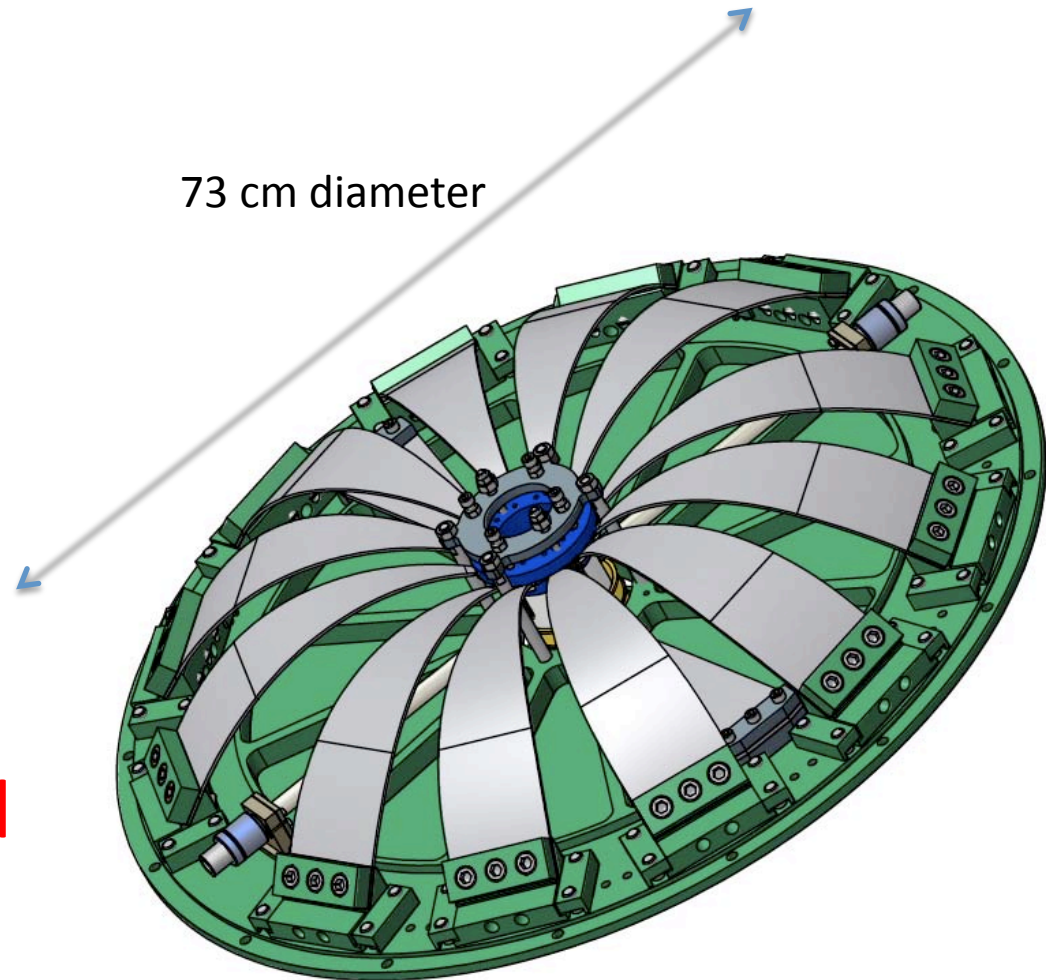
Type B





Standard modular filter

- Up to twelve blades
- <100 to 600 kg load
- Change number and size of blades to match required load



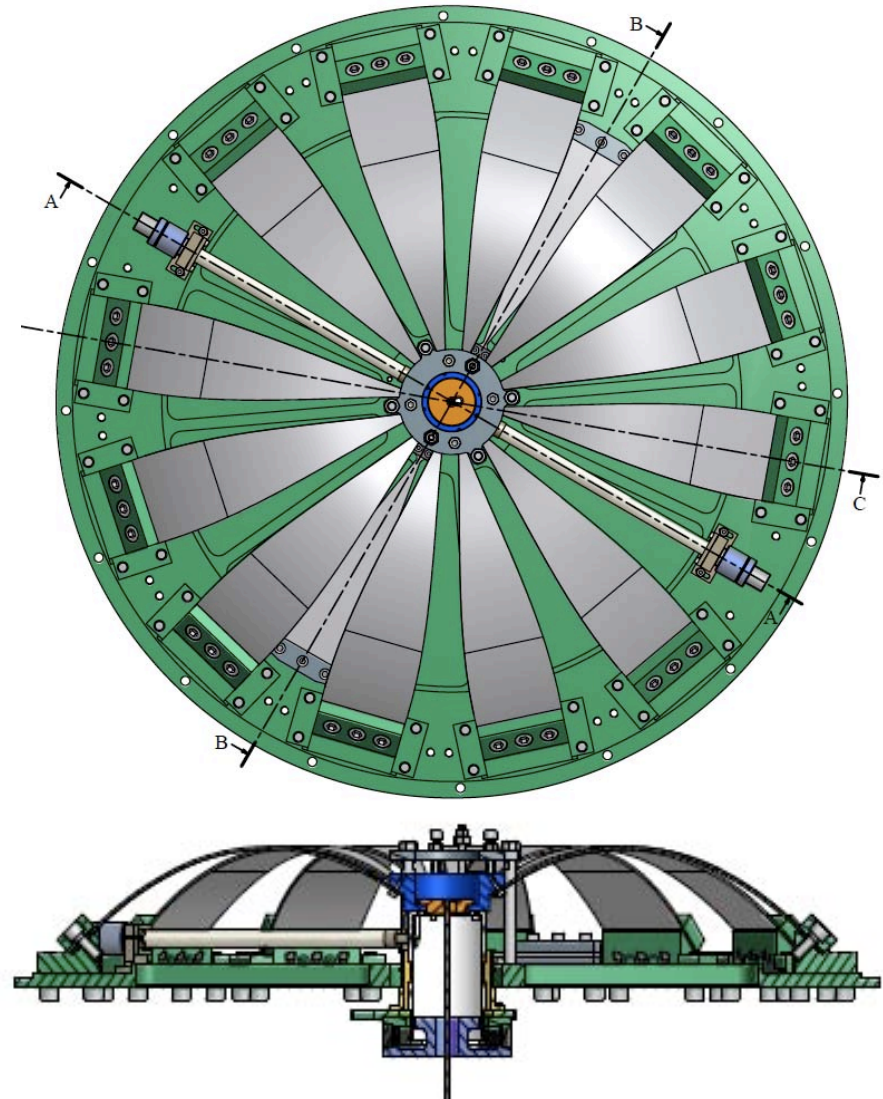
73 cm diameter

85 kg mass



Standard filter performance

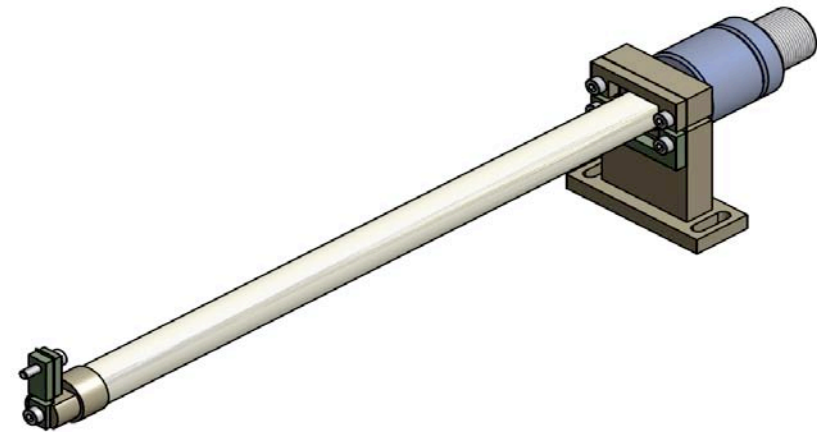
- Passive frequency tuning by changing radial compression
- LVDT/Actuator for testing, ringdown, thermal compensation, frequency tuning, . . .





Magic wands

- Compensate center of percussion limitations
 - Peak attenuation 90 dB



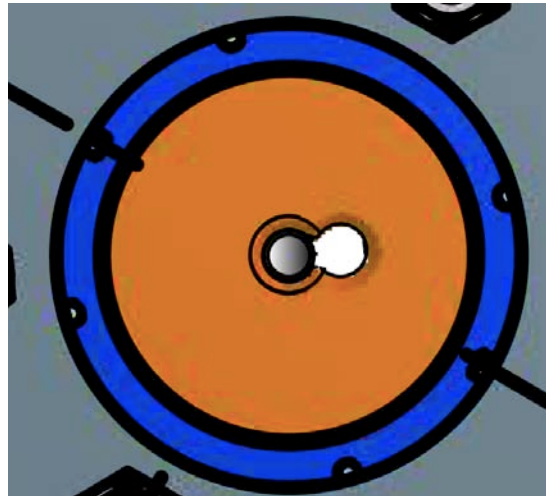
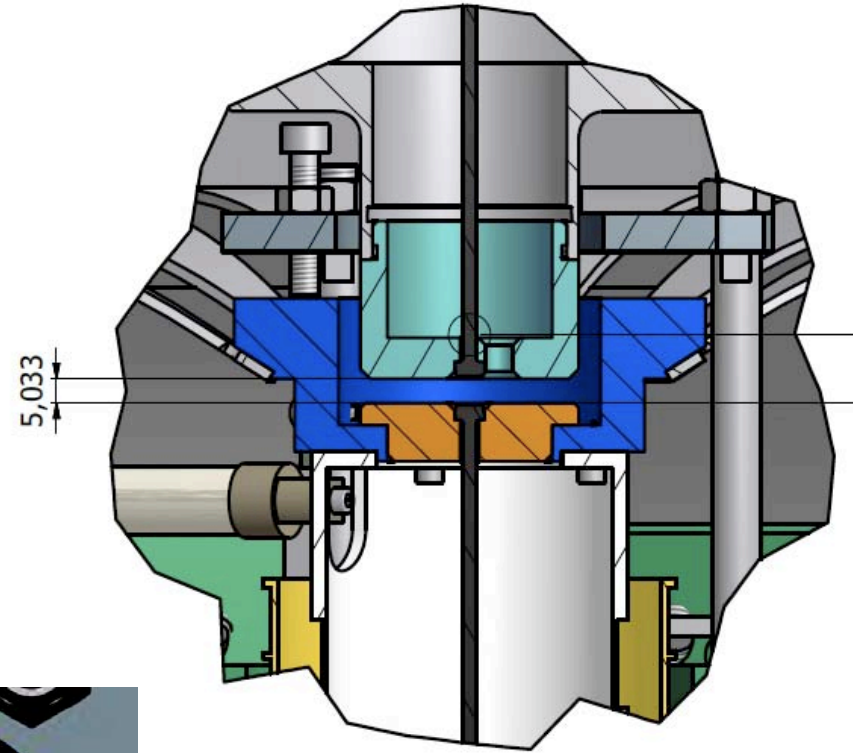
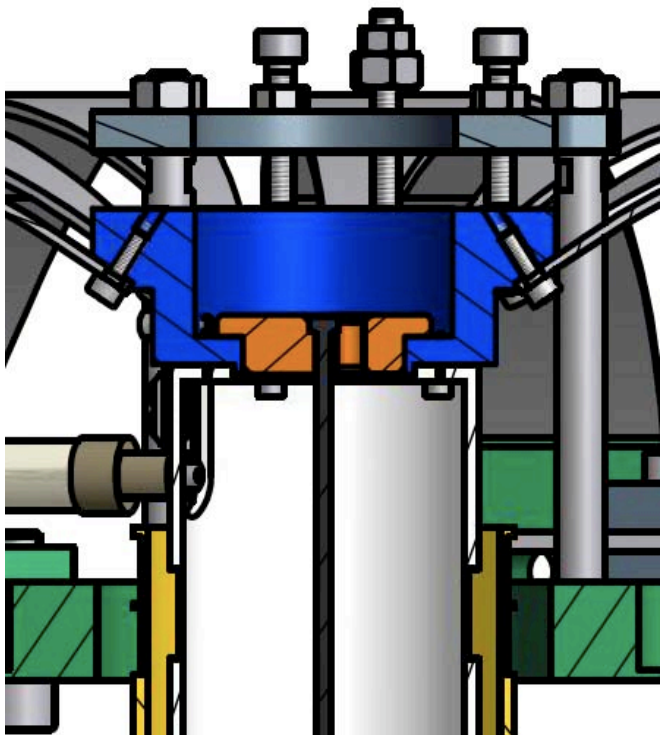


LVDT actuator unit





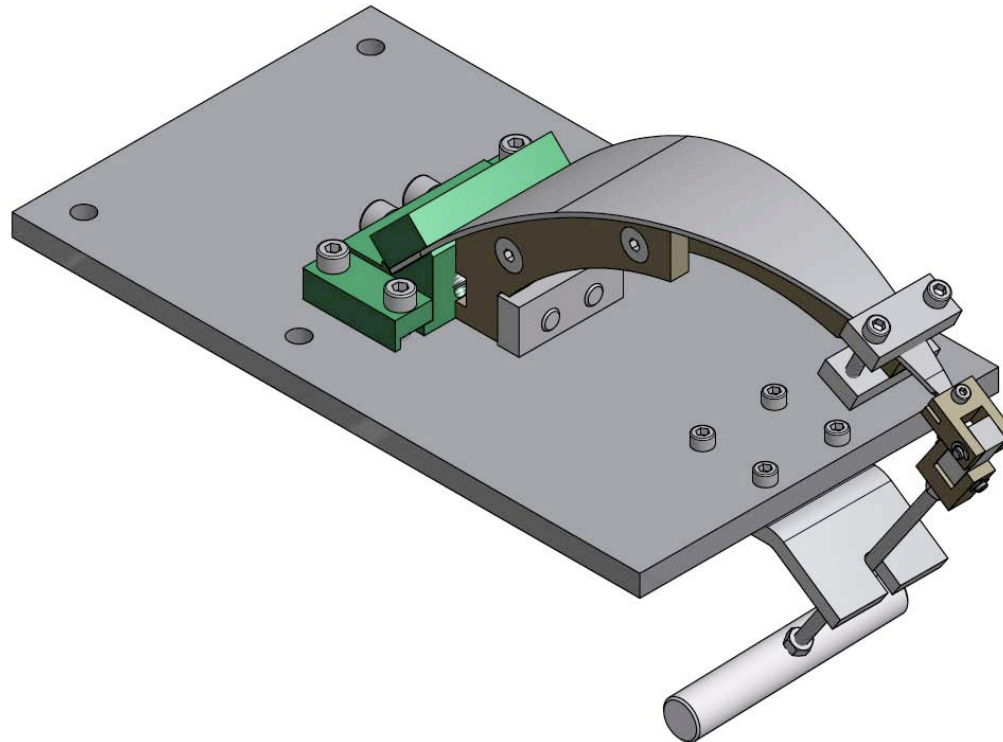
Rapid suspension wire hooking





Modular-rapid blade assembly

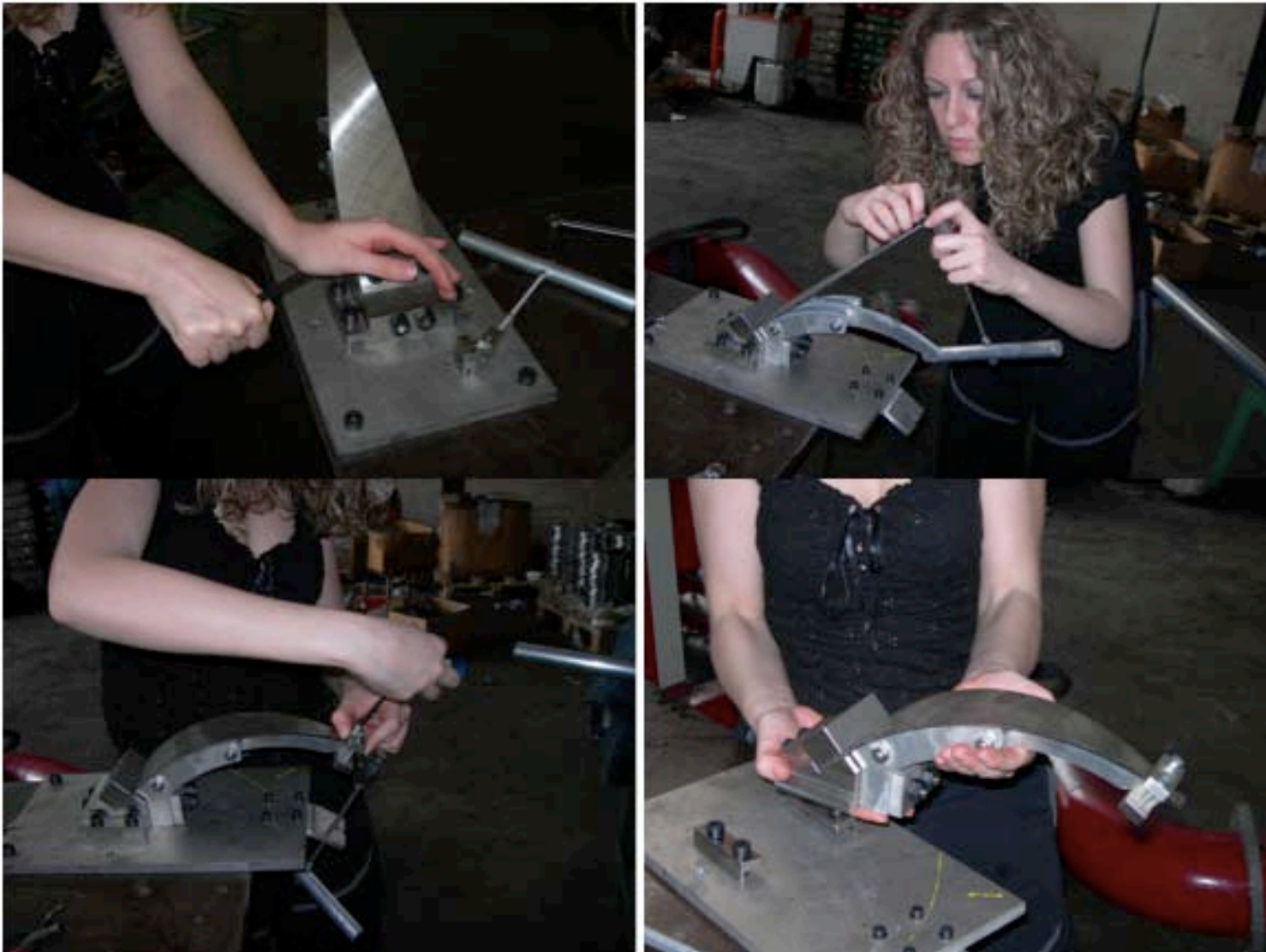
- Specialized tooling



JGW-G1100385



Easy to assemble





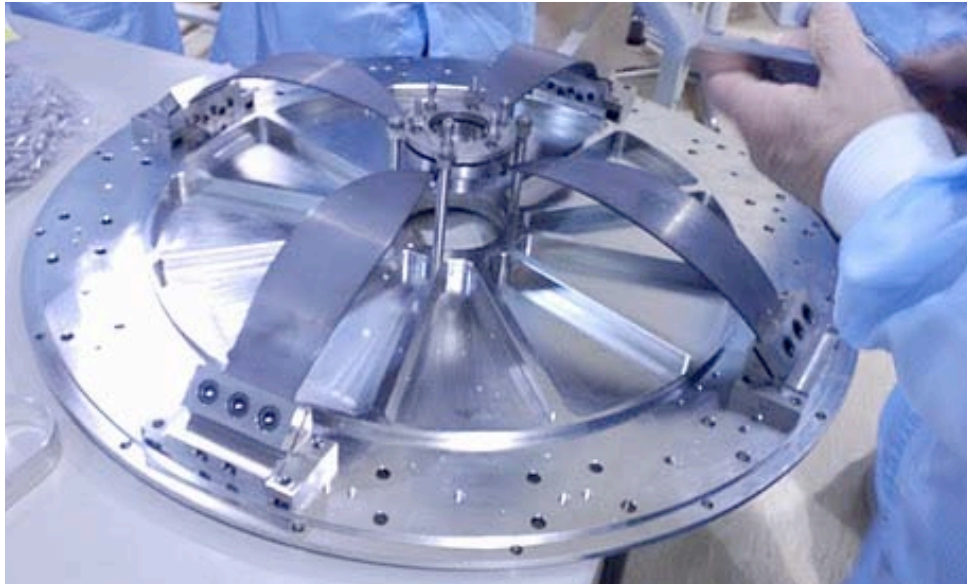
Standard filter machining





Standard filter

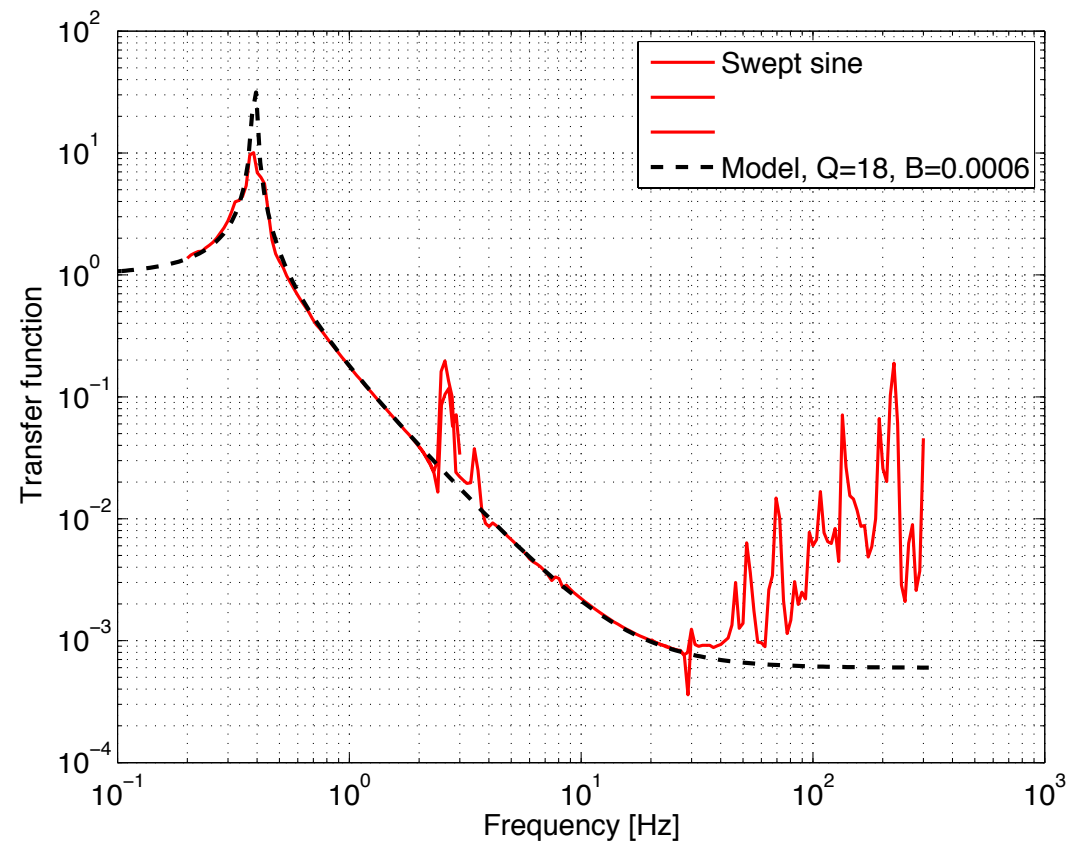
- The first prototype of standard filter was built assembled and delivered





Standard filter

- It was tested it in NIKHEF, Netherlands
- Performance as expected





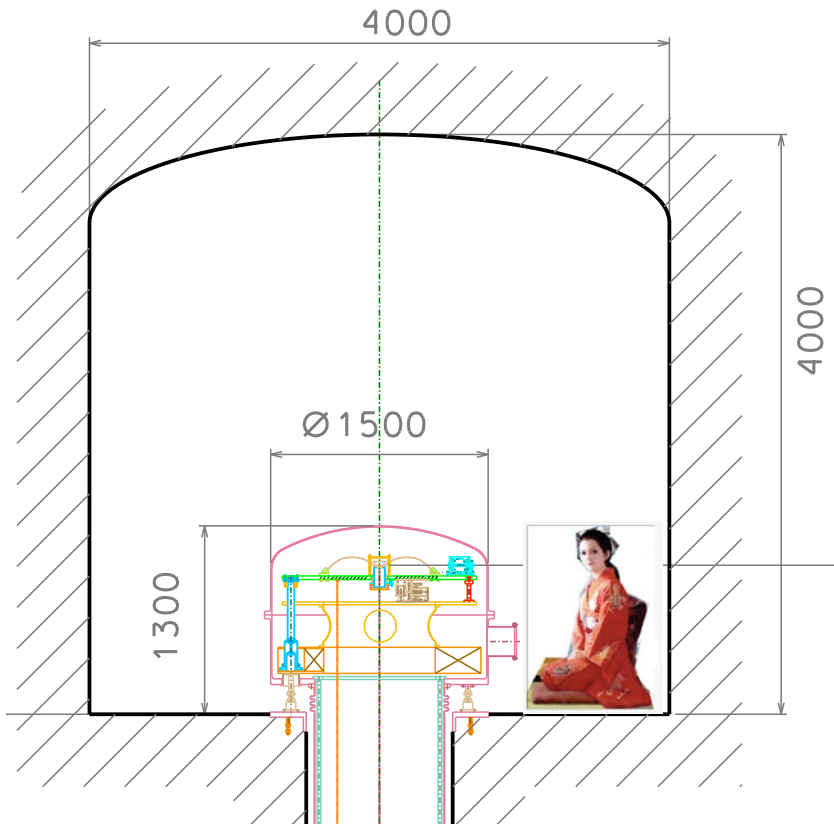
Optimized blades

- A surprise
- The better is the enemy of the good
- Previous blades are good enough
- 90 dB when not cabled





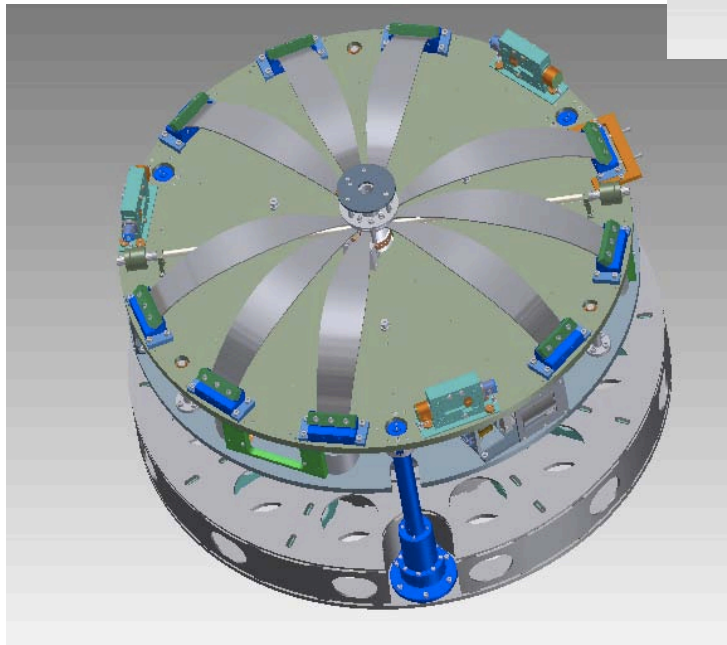
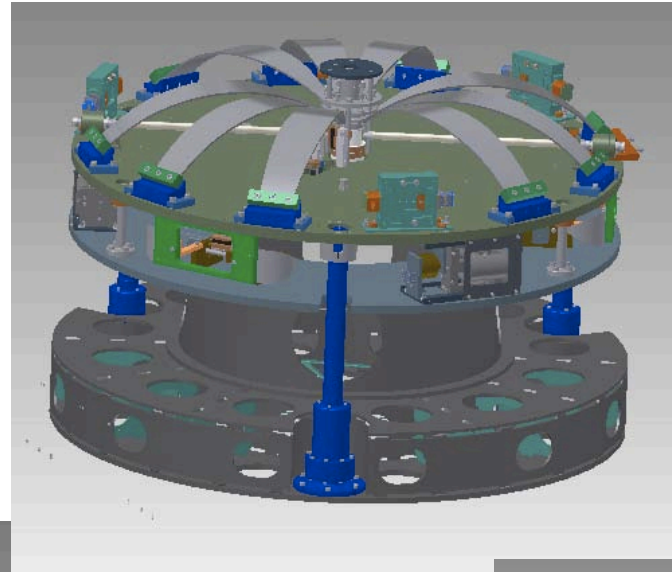
The top filter and IP table



- footed on solid rock
- Inverted Pendulum table with short legs
- Large GAS filter
- Easily accessible

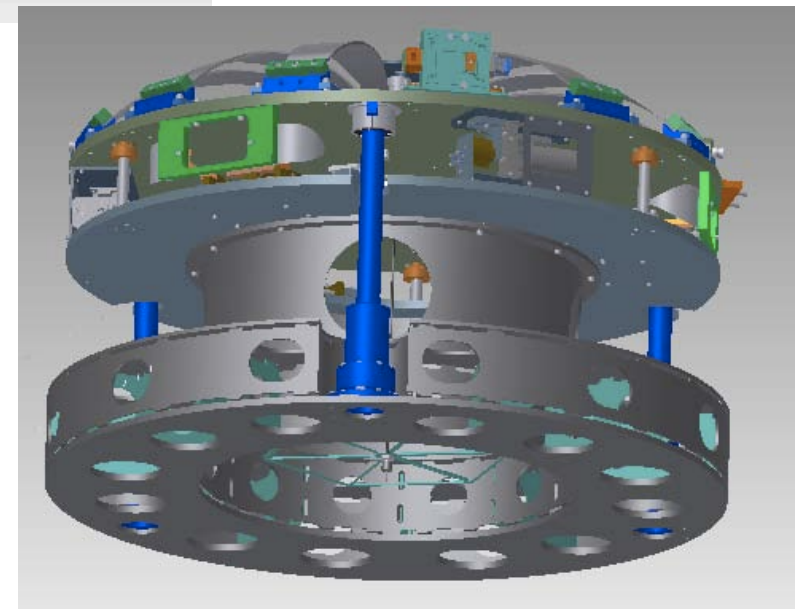


Top Filter / Inverted Pendulum



Please consult
T1100306-v1
Top filter
description

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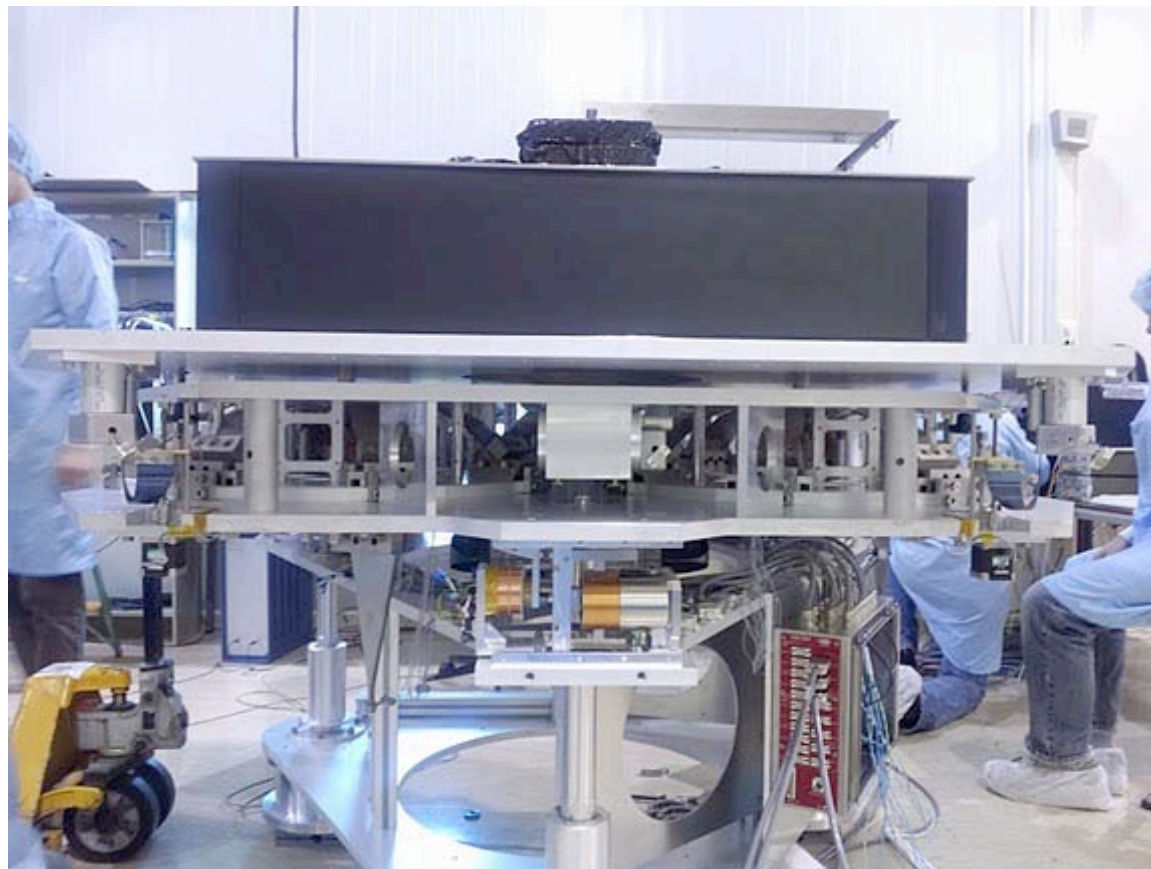


Top filter pedigree

- Same as HAM SAS, AEI SAS and NIKHEF-Virgo SAS

Please read LCGT-T1000253:

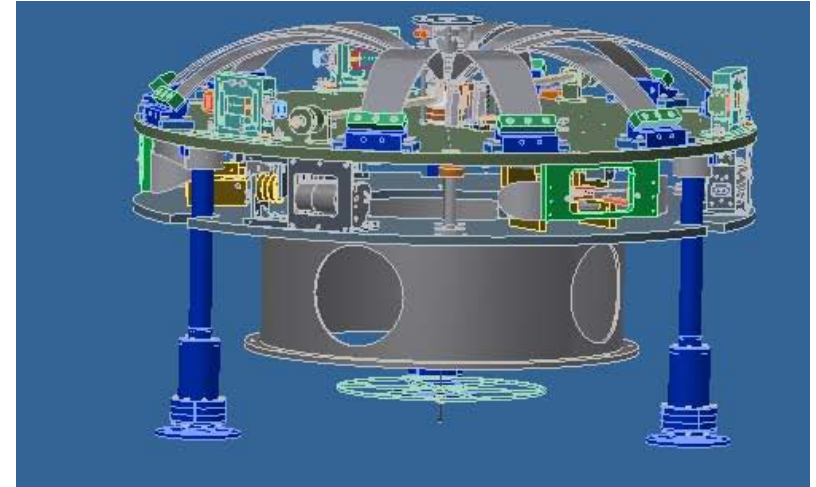
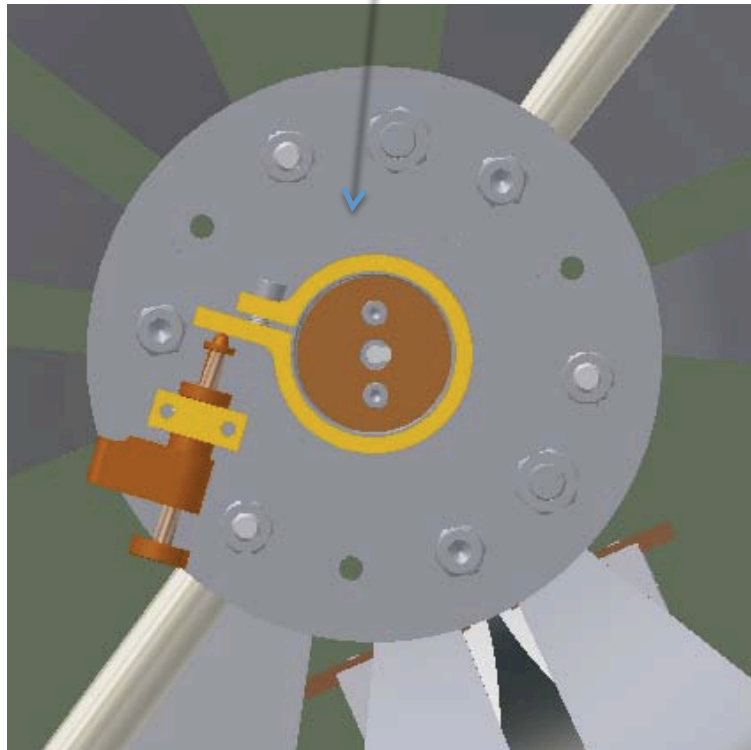
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Top Filter functionalities

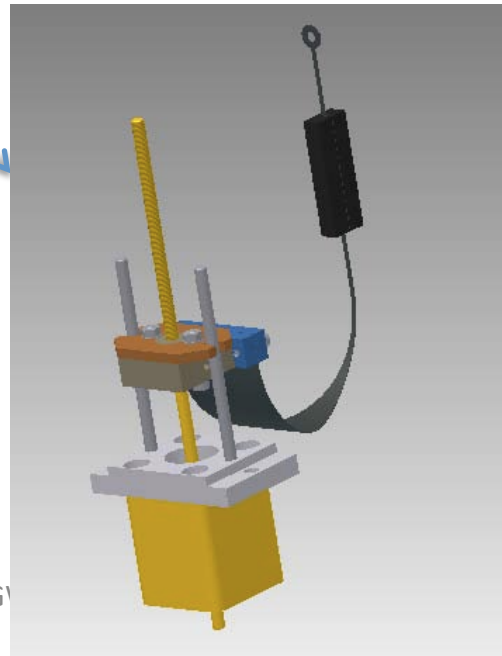
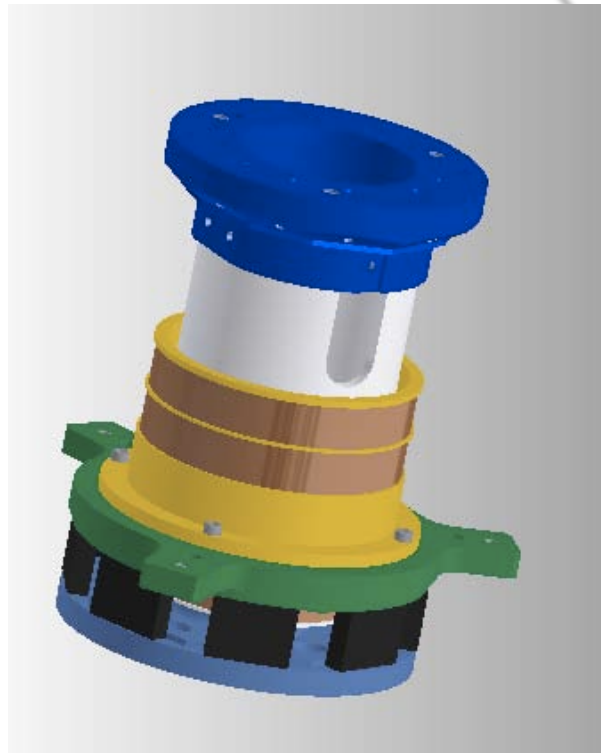
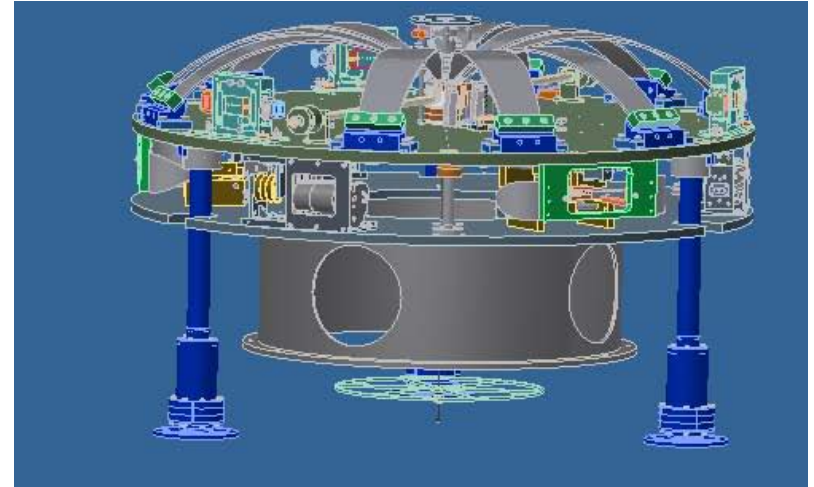
Tunable load
Rotatable suspension wire





Top Filter functionalities

Vertical Dynamic and static positioning

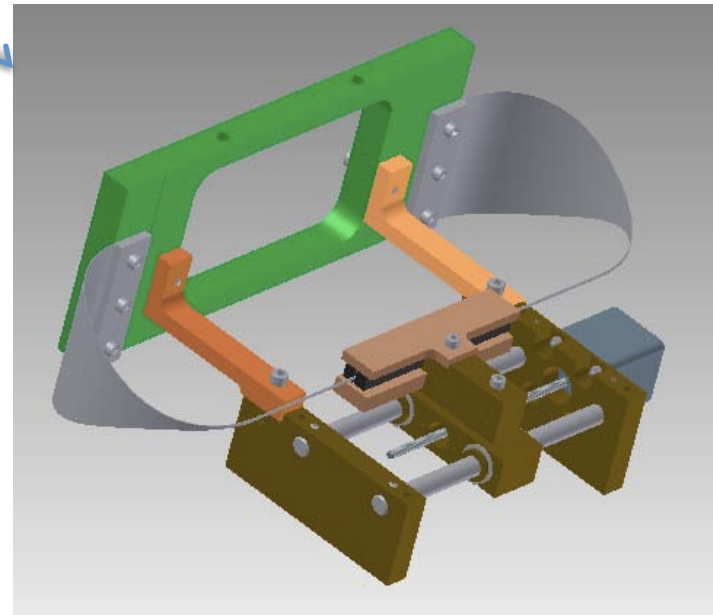
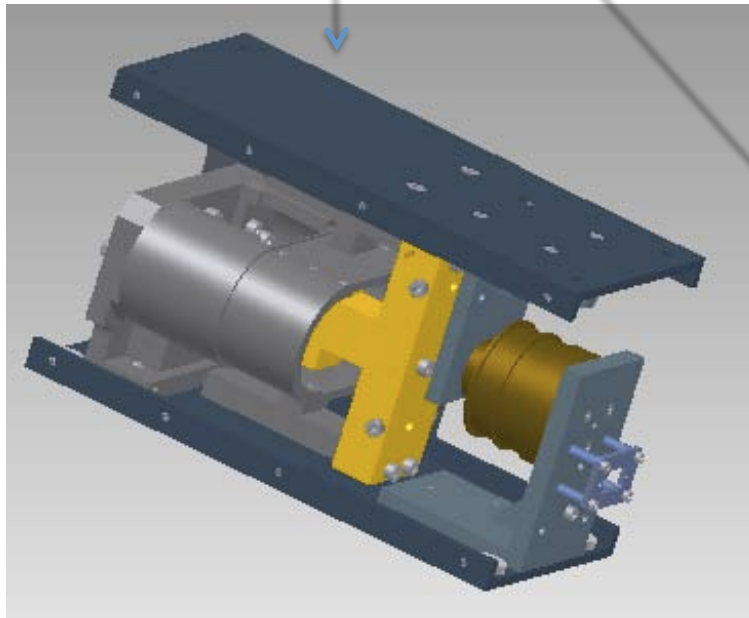


JGV



Top Filter functionalities

Horizontal Dynamic and static positioning





Top Filter functionalities

Inertial controls

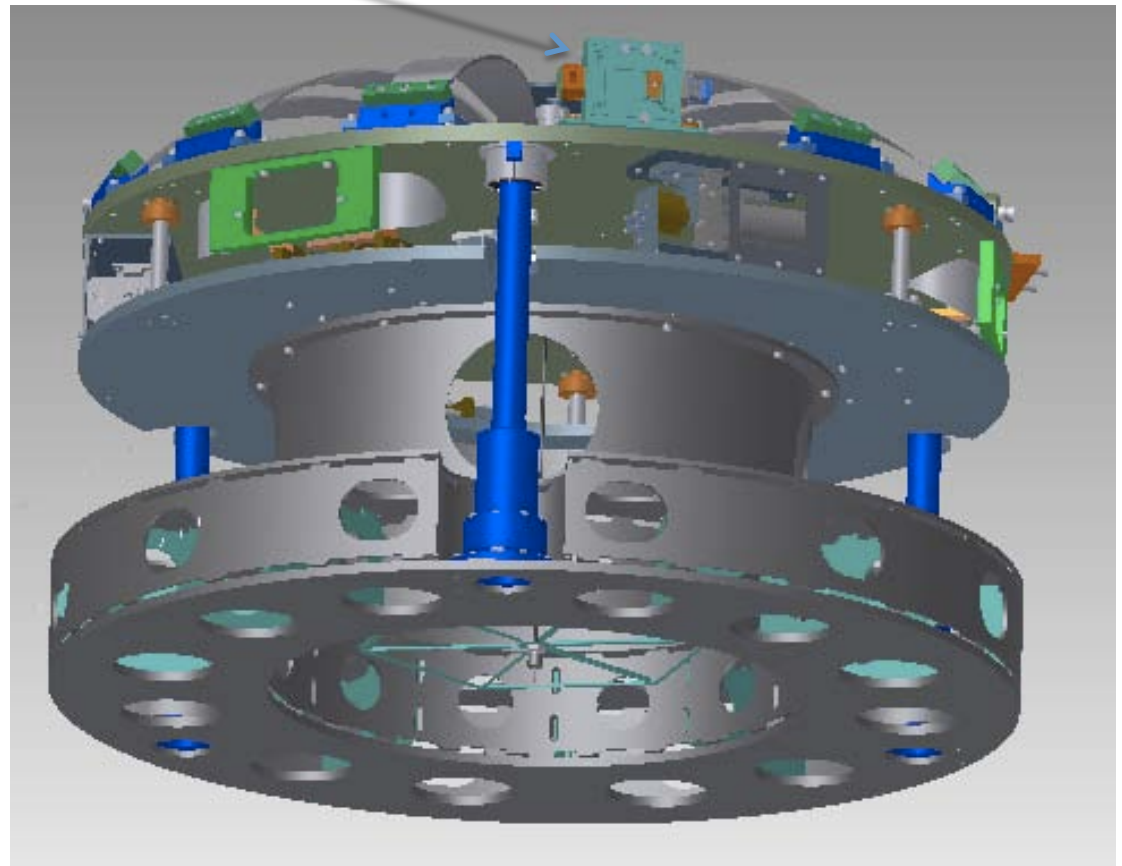
The key point:

Horizontal accelerometers
Mounted on soft X-Y table
rigid in tilt

Avoid internal tilt problem

Can use an external
tiltmeter for tilt correction

Will implement
accelerometer in second
stage, when money
available, if necessary





Top filter / Inverted Pendulum Controls

- Sufficient performance tested by HAM SAS at LASTI
- Designed as platform for active controls
 - Separated degrees of freedom
 - Very soft flexures
 - Tilt problem mitigated by tilt rigidity
- Under development at AEI and NIKHEF
- We will simply copy all controls from Virgo and AEI
- Copy electronics and data acquisition



Top filter – Inverted Pendulum

- Design of the top filter nearing completion
- Prototyping will follow immediately

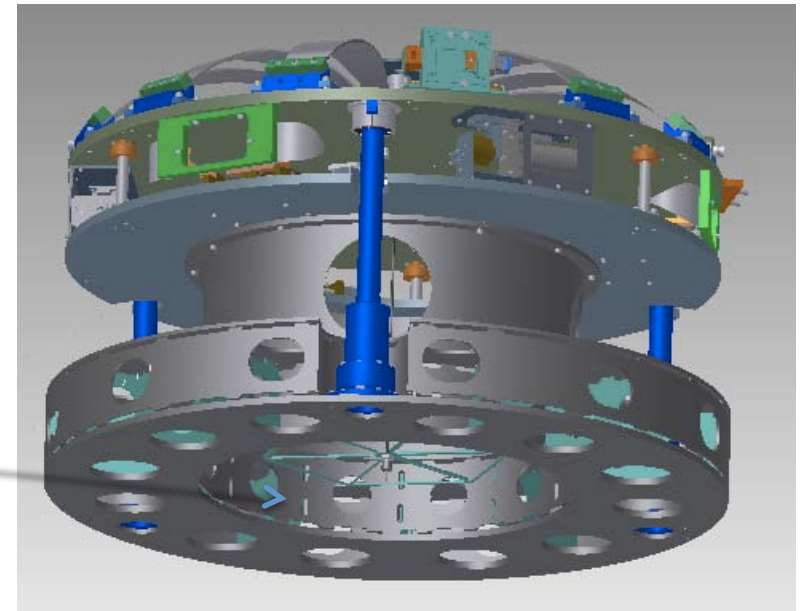
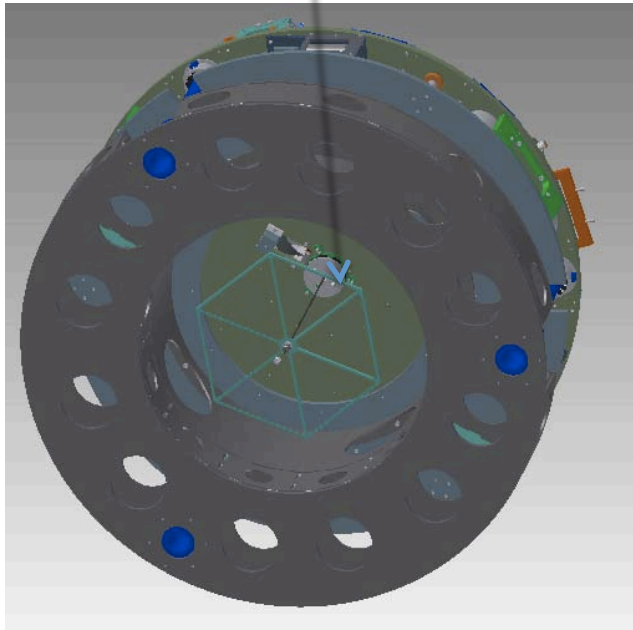
Filter zero and
Standard Filter
Drawing set
As of today
D1100307-v2



Wiring

Kapton bound ribbon wires

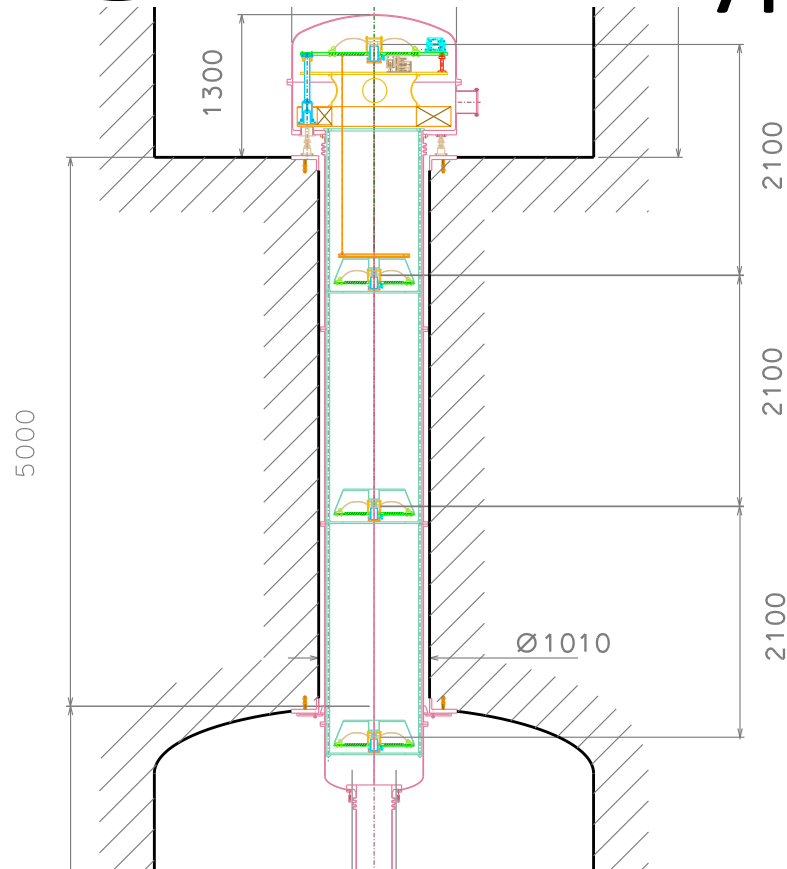
Spider for cabling



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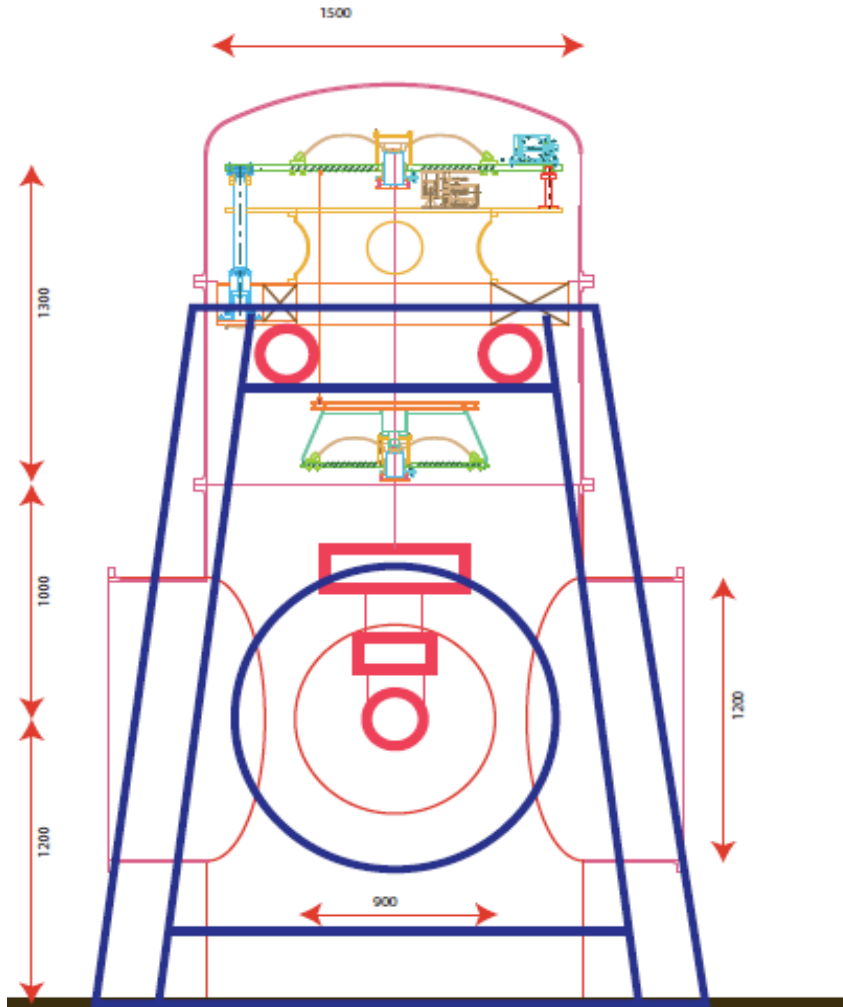
Type A chain



- Intended for the four test masses
- Virgo measured sufficient attenuation from 4 Hz
- This is an advanced version of Virgo's Superattenuators
- Expected to do equally well



Type B chain

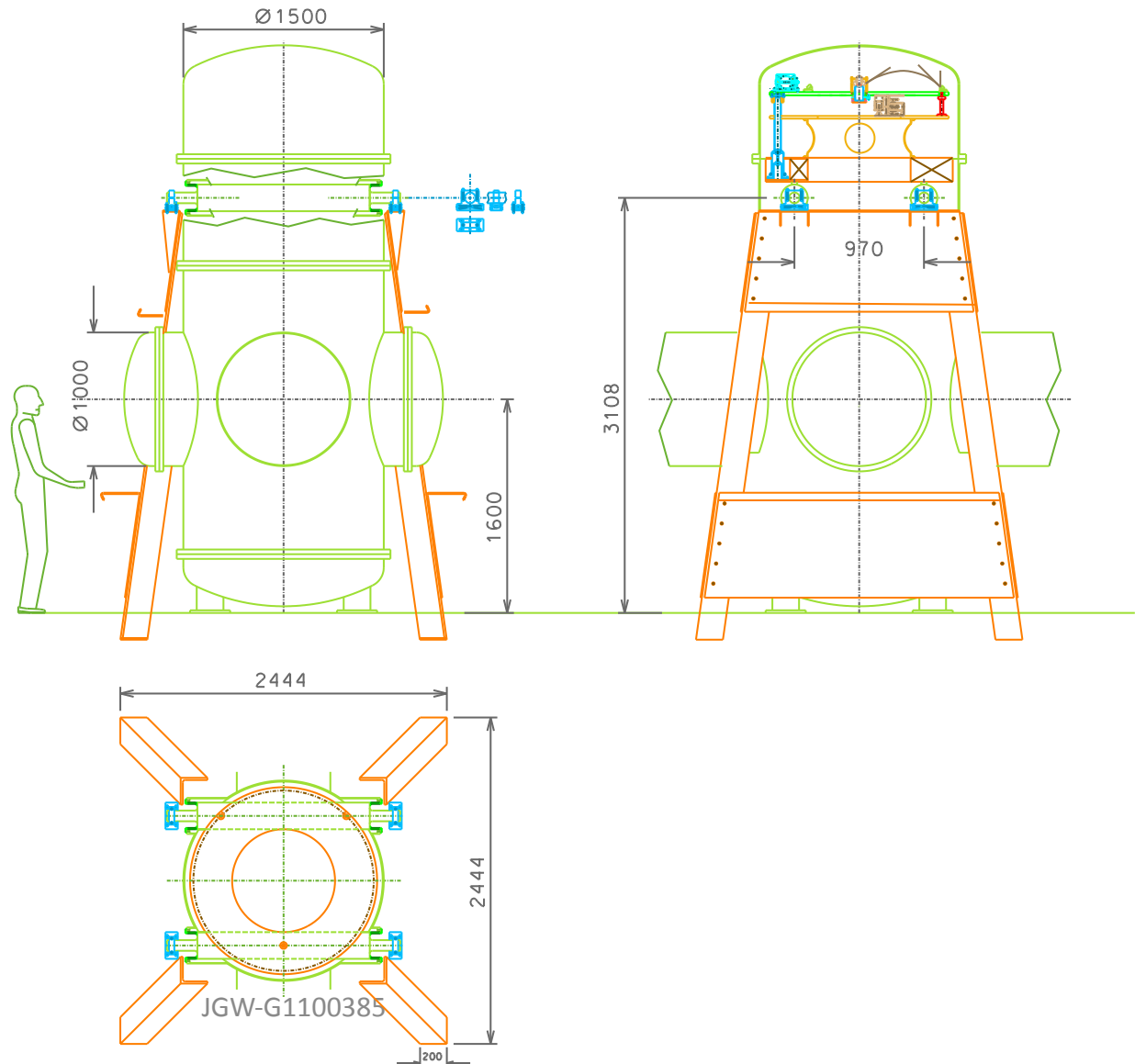


- Intended for beam splitter and recycling mirrors
- Single standard filter
- Mirror suspensions



Type B

- Rigid external structure to support IP





Type C table

- Intended for input-output optics
- Simplify and miniaturize HAM SAS
- Will use the same modular components reduced in size as needed
- Otherwise copy all lesson learned
- If not sufficient money available, will use stacks



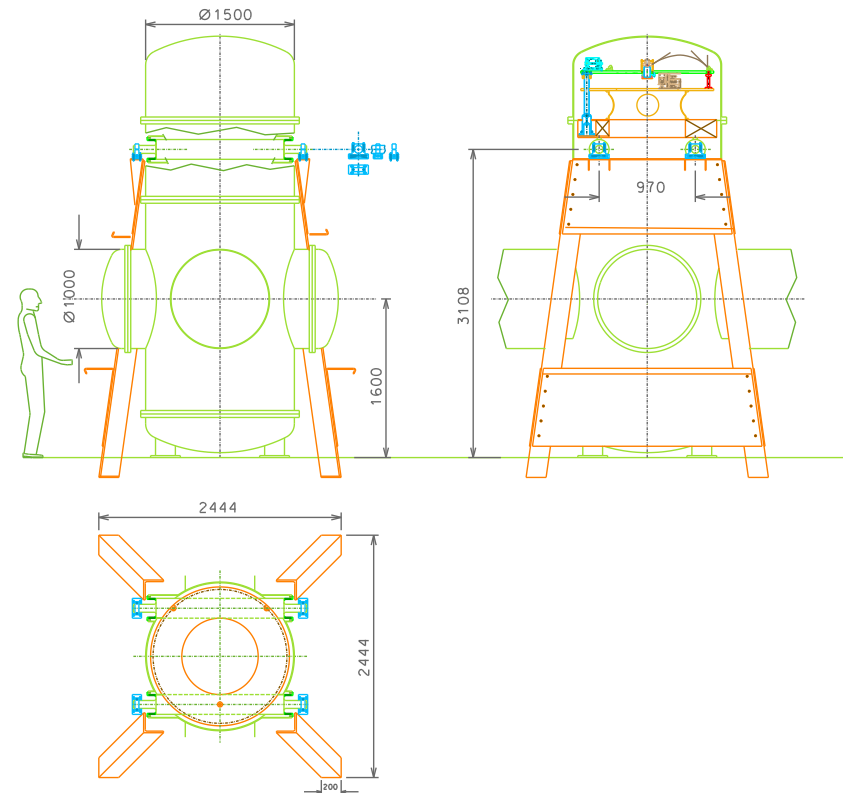
SAS Pre-commissioning scenario

- After prototype test of both filters,
- We are considering pre-commissioning at the TAMA facility
- Reduced payload?
- At Kamioka we will implement very heavy recoil and intermediate masses to make space for future payloads without disassembly



Type B pre-commissioning

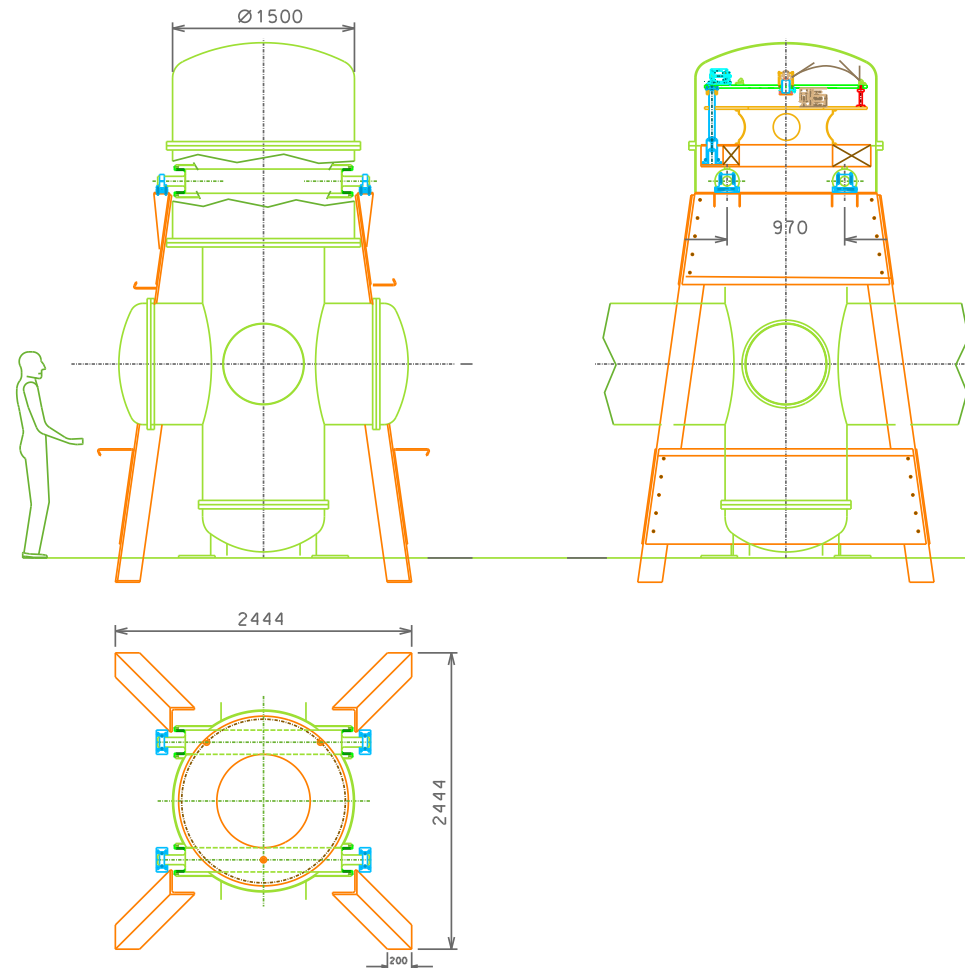
- TAMA tanks 1 m diameter
- Type B 1.5 m diameter
- Solution?





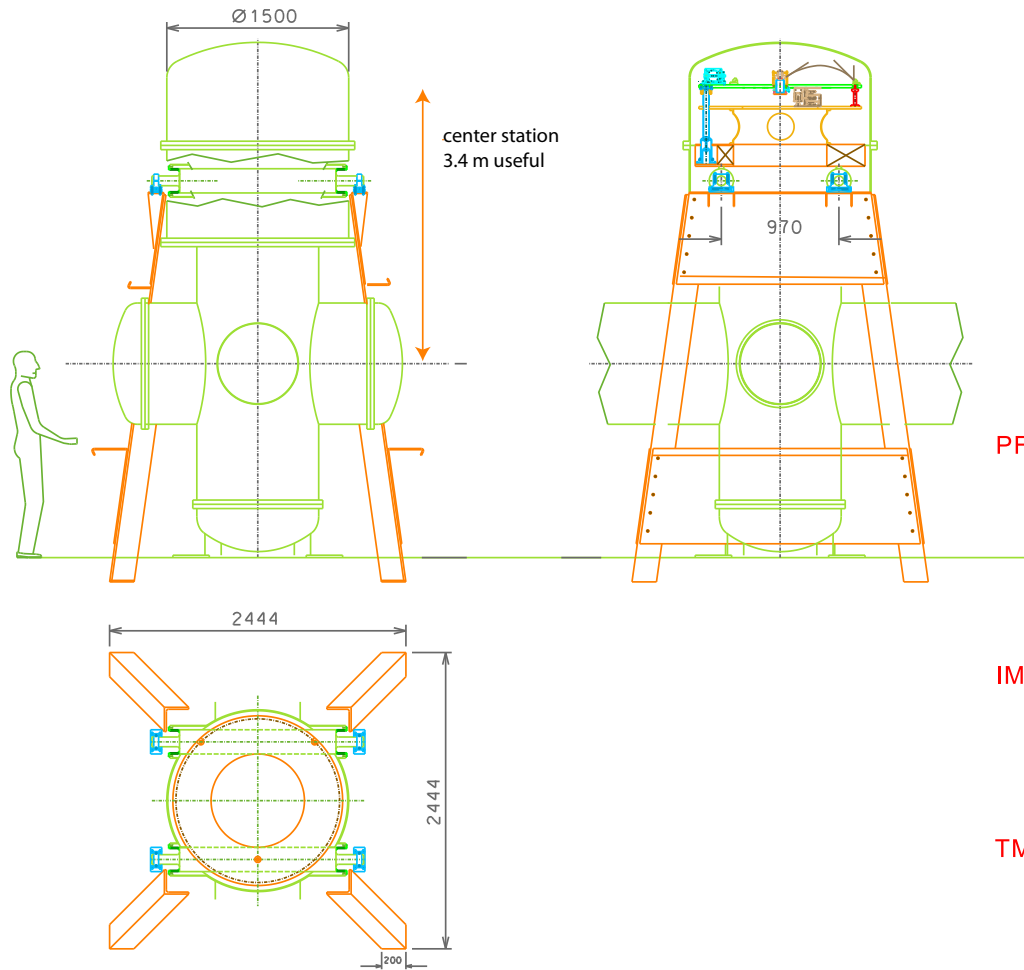
Type B pre-commissioning

- Solution:
- Weight watchers
- Hat supported by external structure at the central station





Type B pre-commissioning

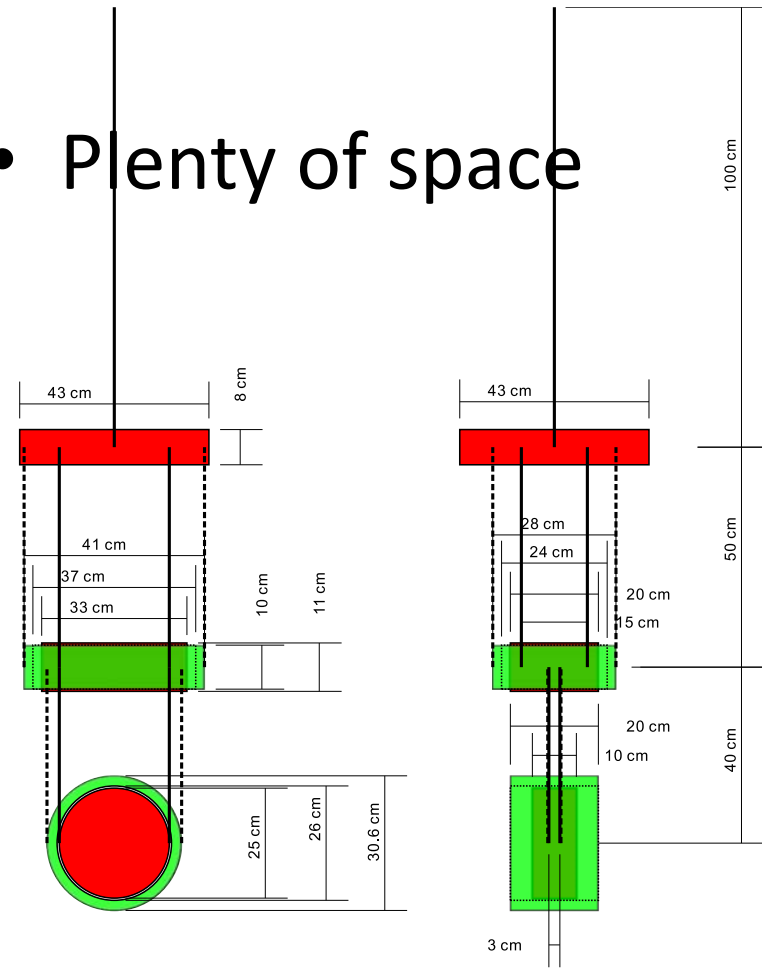


- Plenty of space

PF

IM-MB

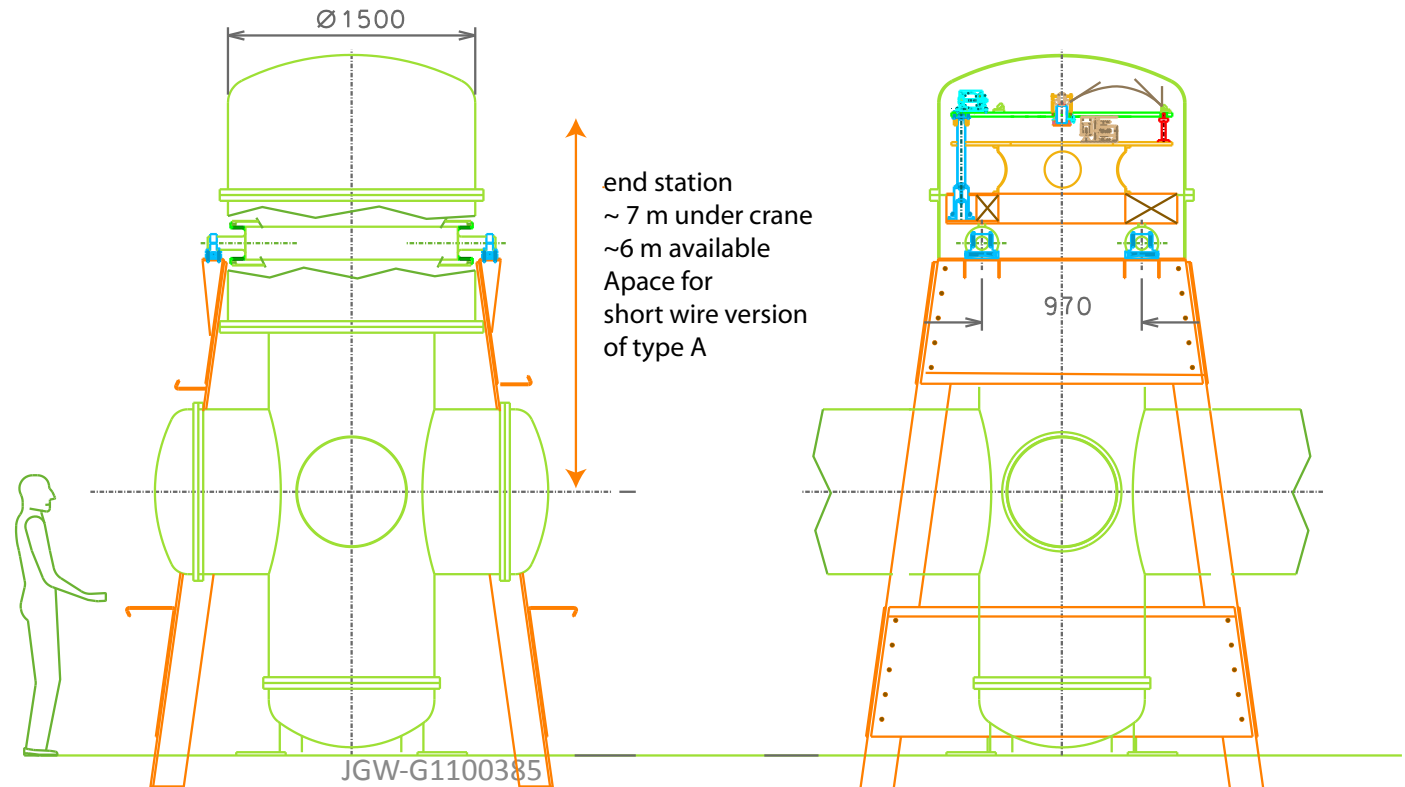
TM-RM





Type A pre-commissioning

- In the end stations there is vertical space, but
- May need a more massive external structure
- Feasible in principle with shorter wires





Pre-commissioning tentative schedule

- Filter production will start in 2011
- Extra filters for pre-commissioning facility can be readied by end of fiscal year 2011
- Electronics and control logic from AEI-NIKHEF
- Conceivably can have one year of pre-commissioning for at least type B,
- possibly even for type A as well before the installation in tunnels



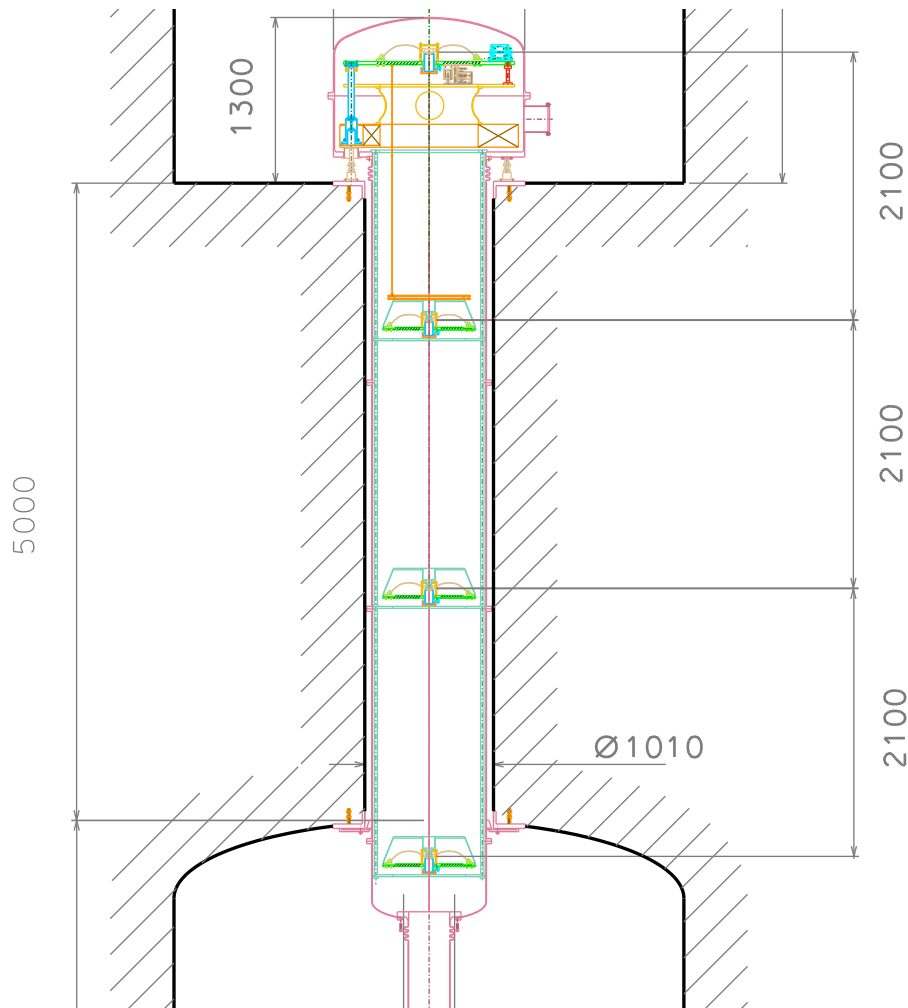
Pre-commissioning problems or show stoppers

- Funding
- Manpower
- Limited time scale

- Still it may give a great payback and is worth a big effort



Cryogenics pre-commissioning



- Heat links sufficiently soft to filter out cooling noise above 10 Hz
- Heat links are very rigid for controls (\sim mHz)
- A separated specialized underground facility and thorough tests may be necessary before implementation on LCGT