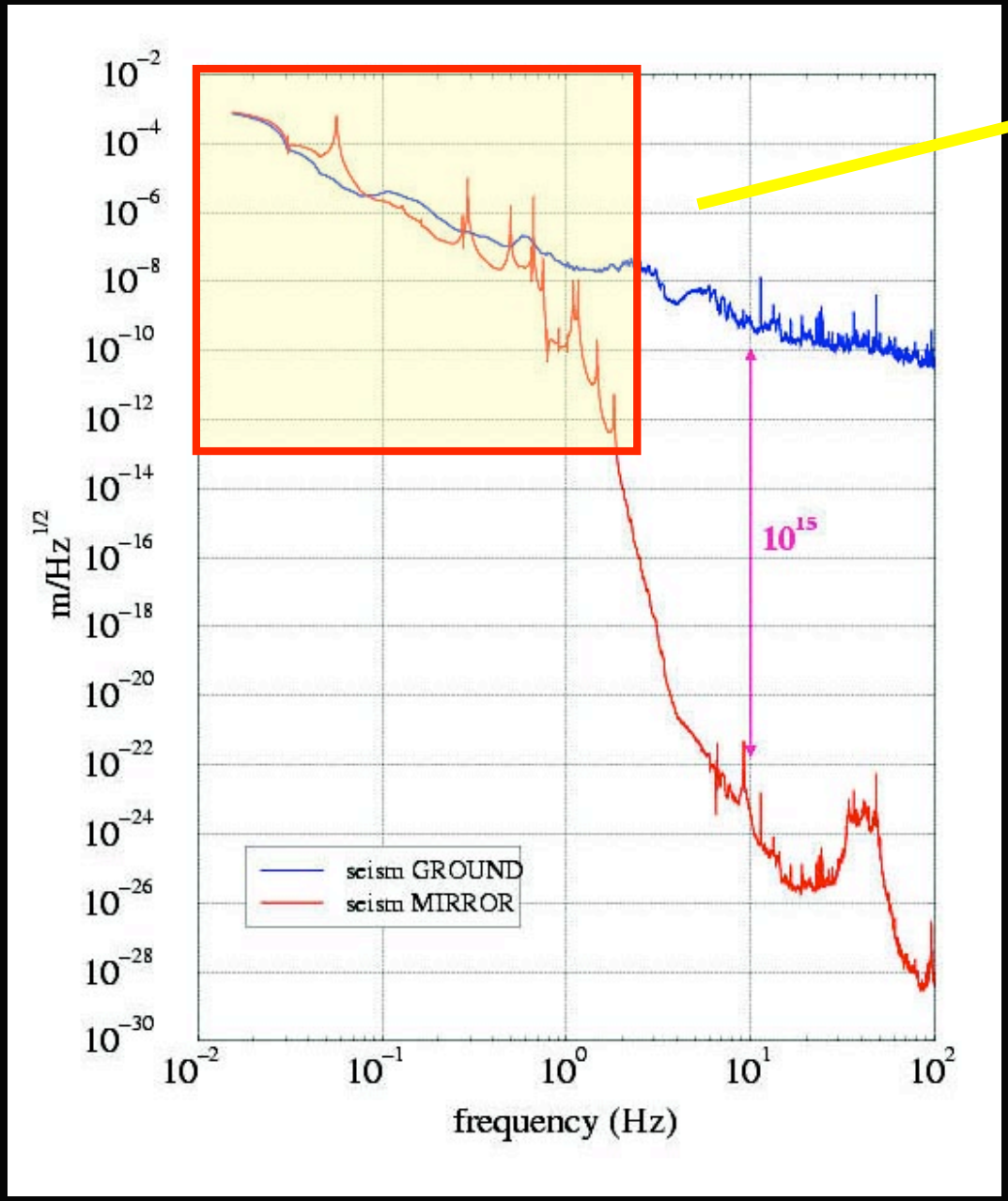
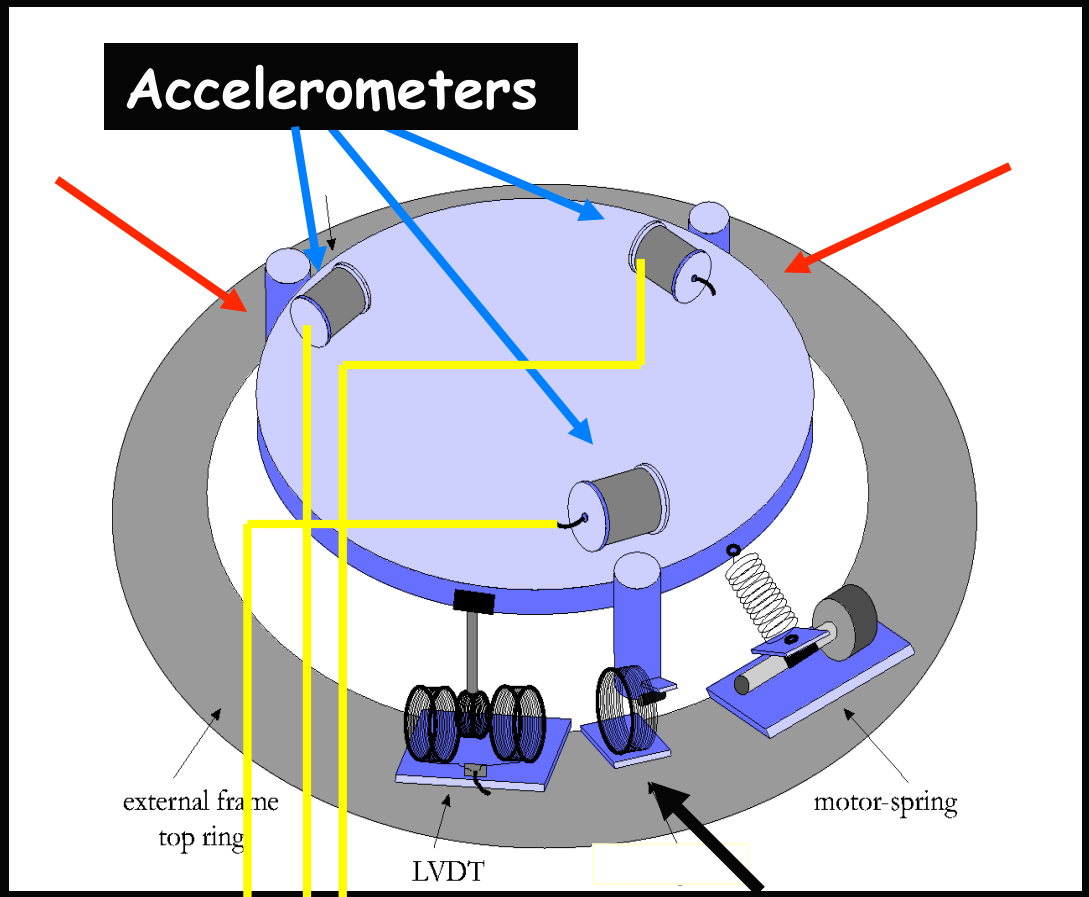
Control issues for ET

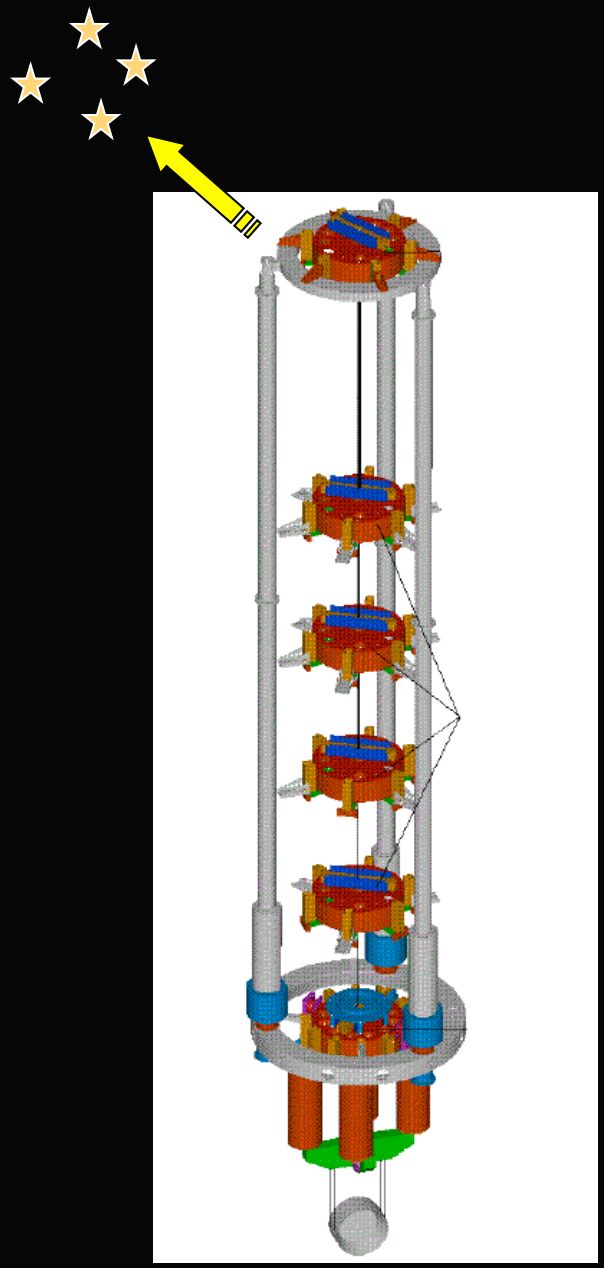
E. Majorana for WG2 group

Focus on Virgo (ground)



several microns swing



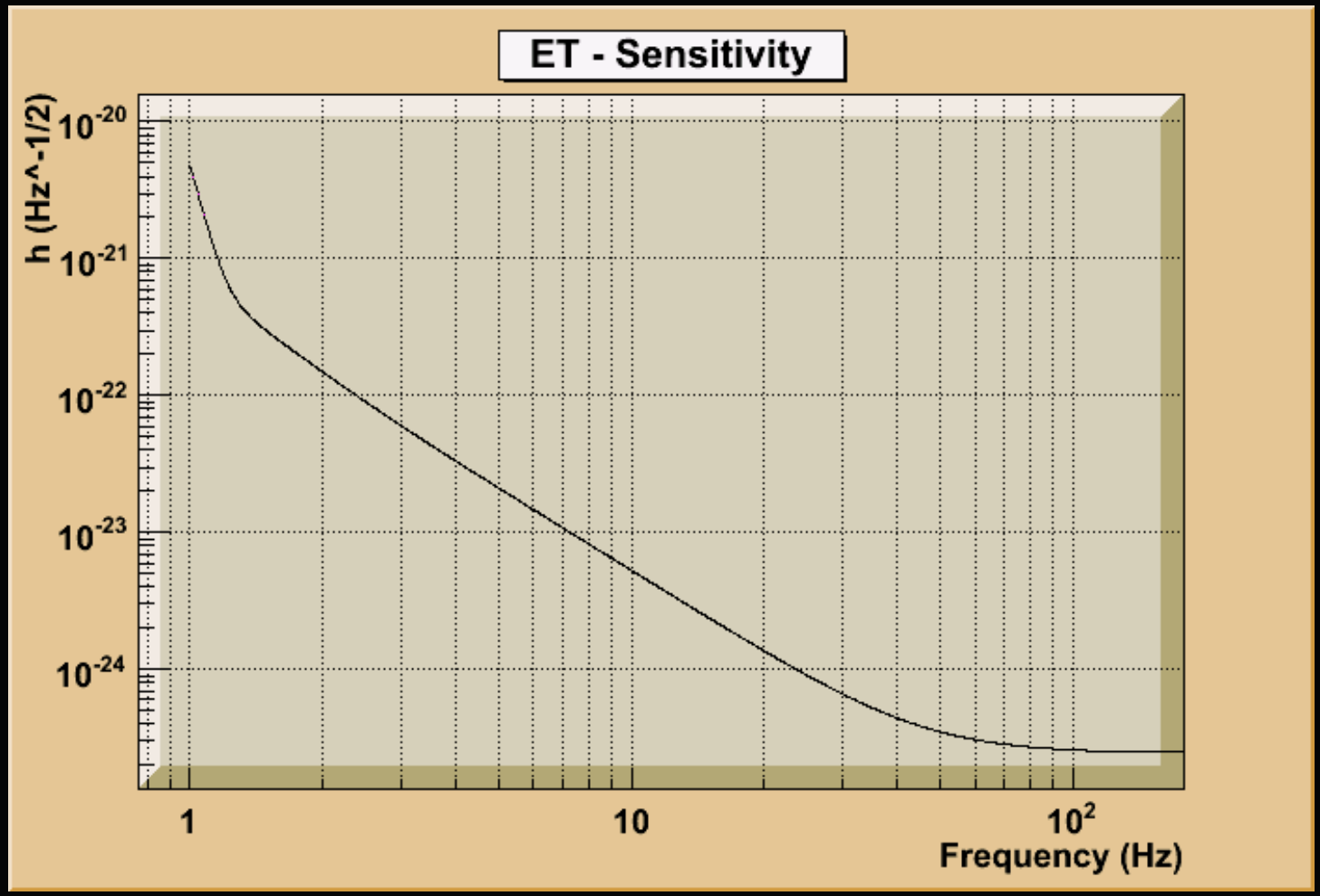


Actuators

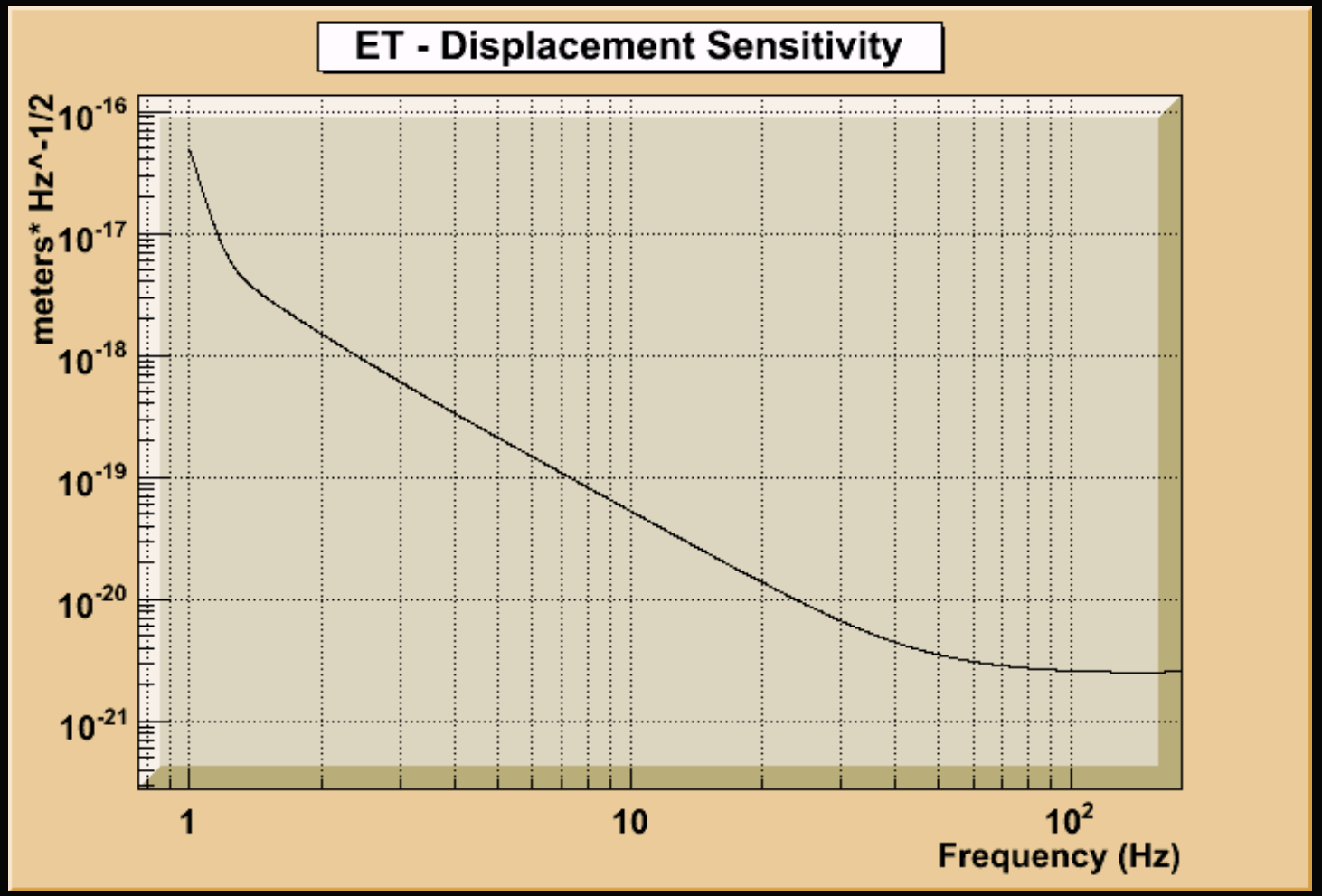
ADC → DSP → DAC

Focus on pure mechanics

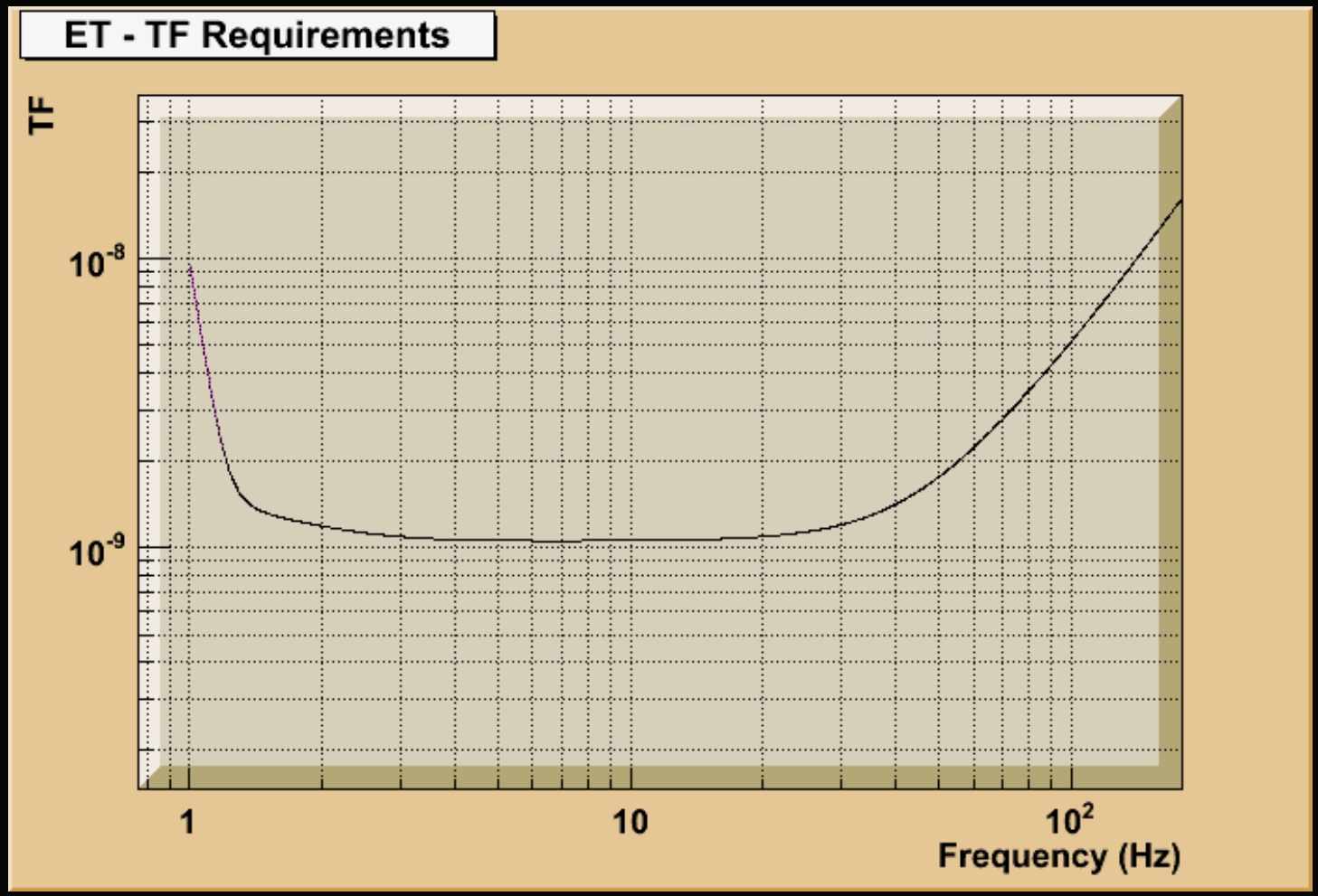
Sensitivity Curve (h(f))



$$\Delta L(f) = h(f) \times 10000$$

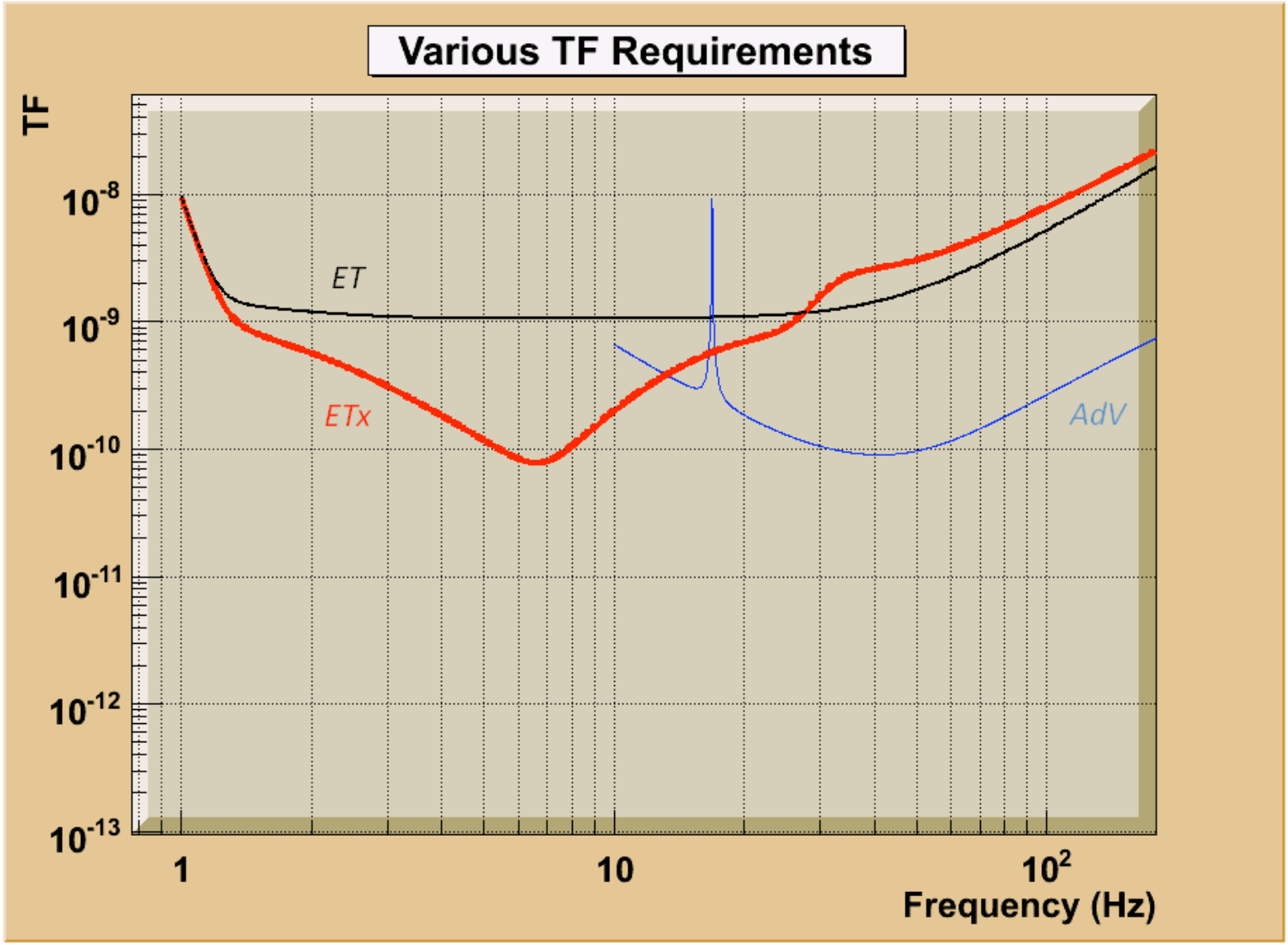


$TF_{max} = \Delta L(f) / (\text{LSD Under-Ground Seismic Noise})$



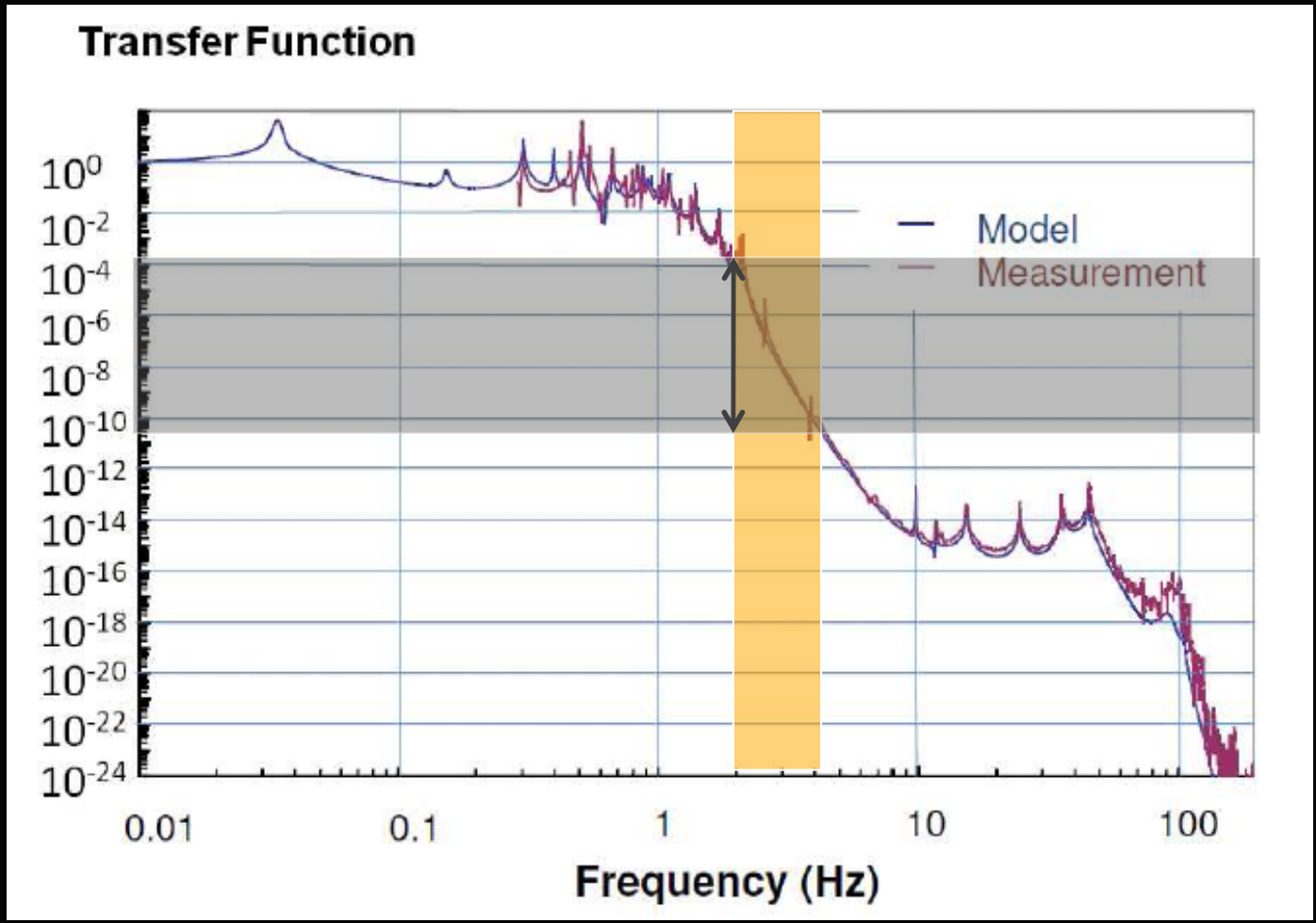
Ground Seismic Noise (Kamioka) - $5 \times 10^{-9} / f^2$ (conservative)

CONCLUSION ON REQUIREMENTS



Valid both for horizontal and vertical seismic noise

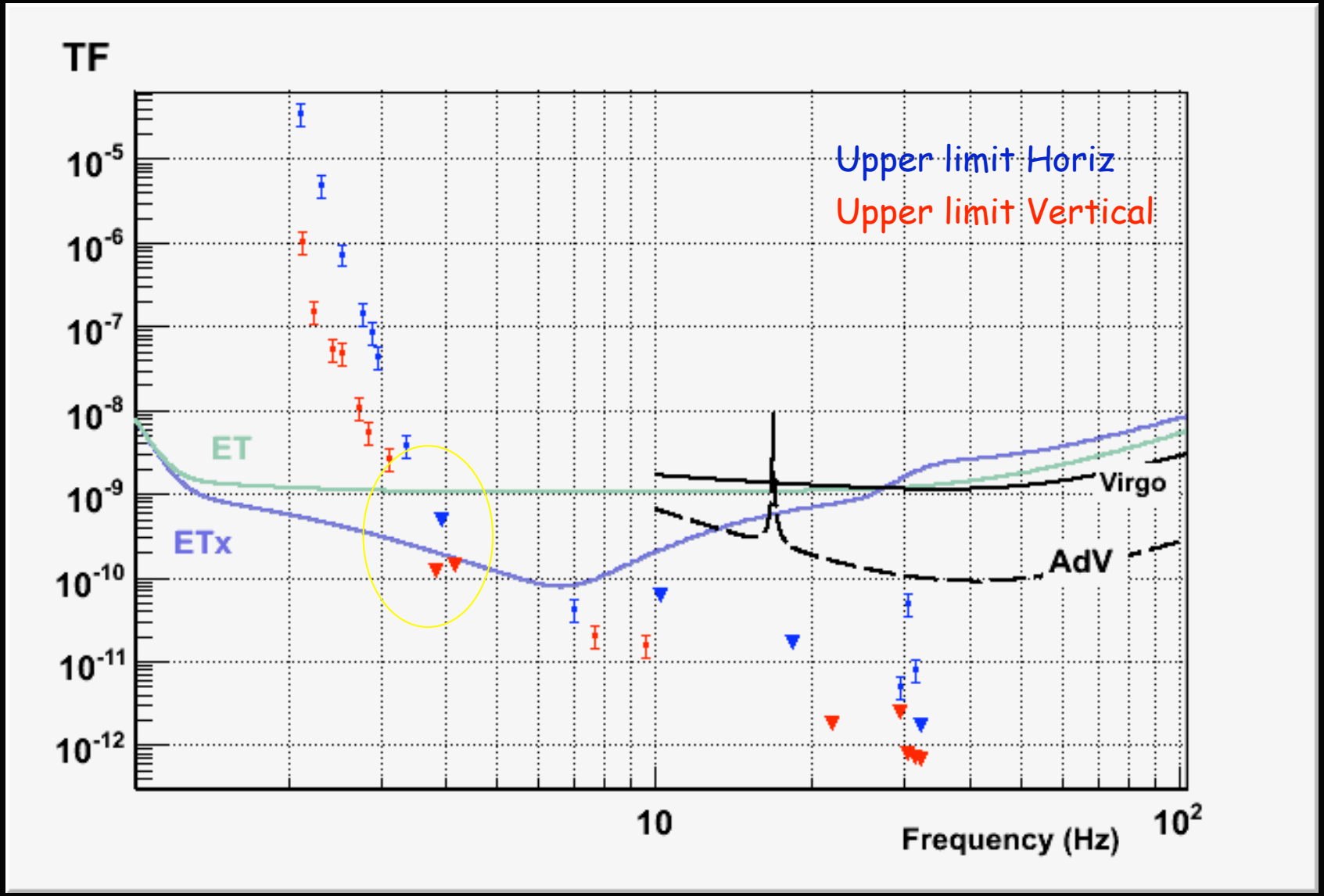
Stage by Stage TF



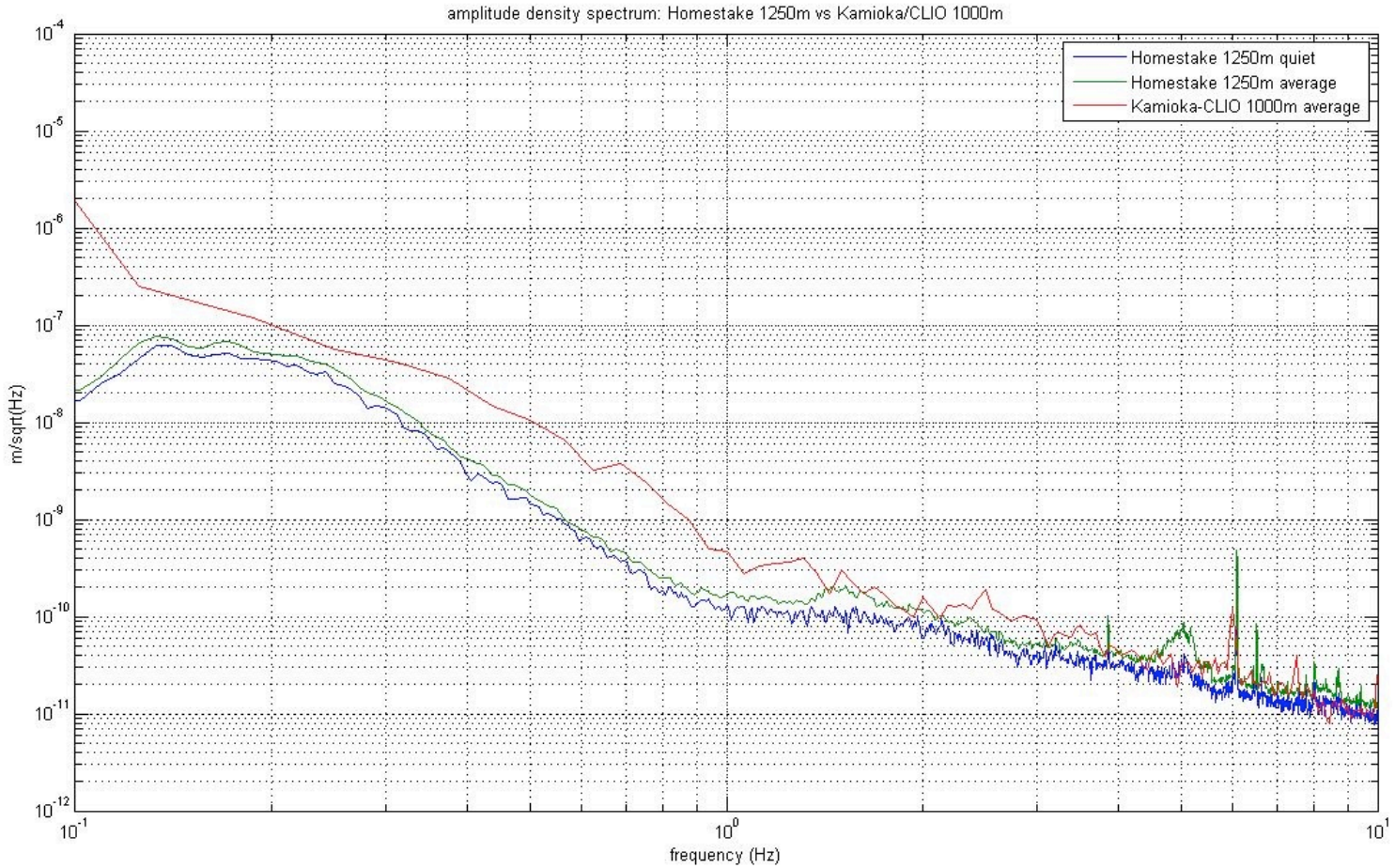
S. Braccini

Crossing expected @ 2.5-3 Hz

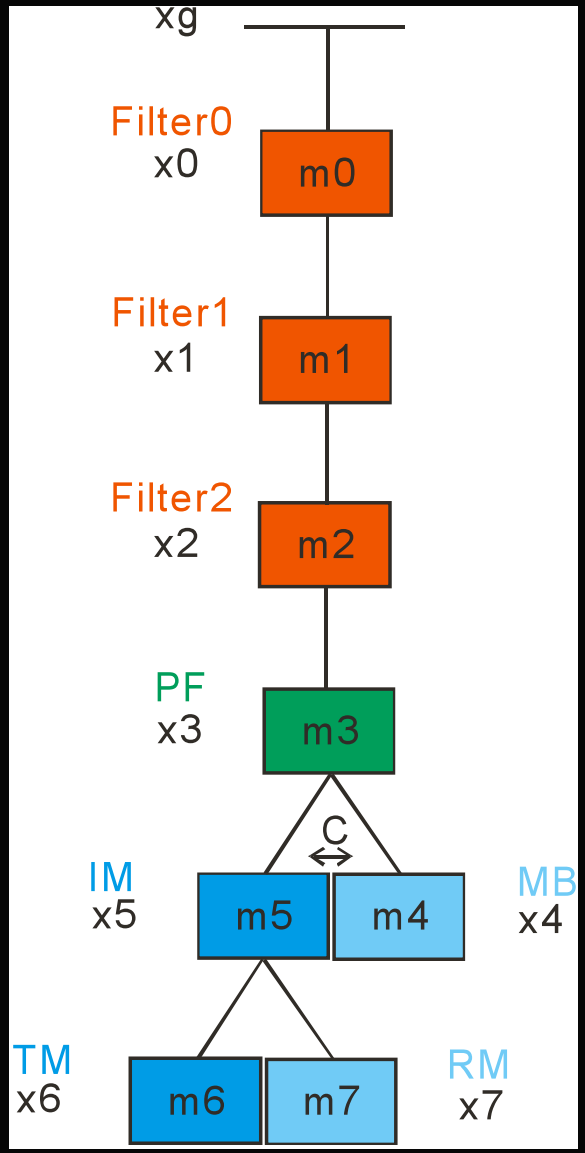
CONCLUSION ON PRESENT ATTENUATION



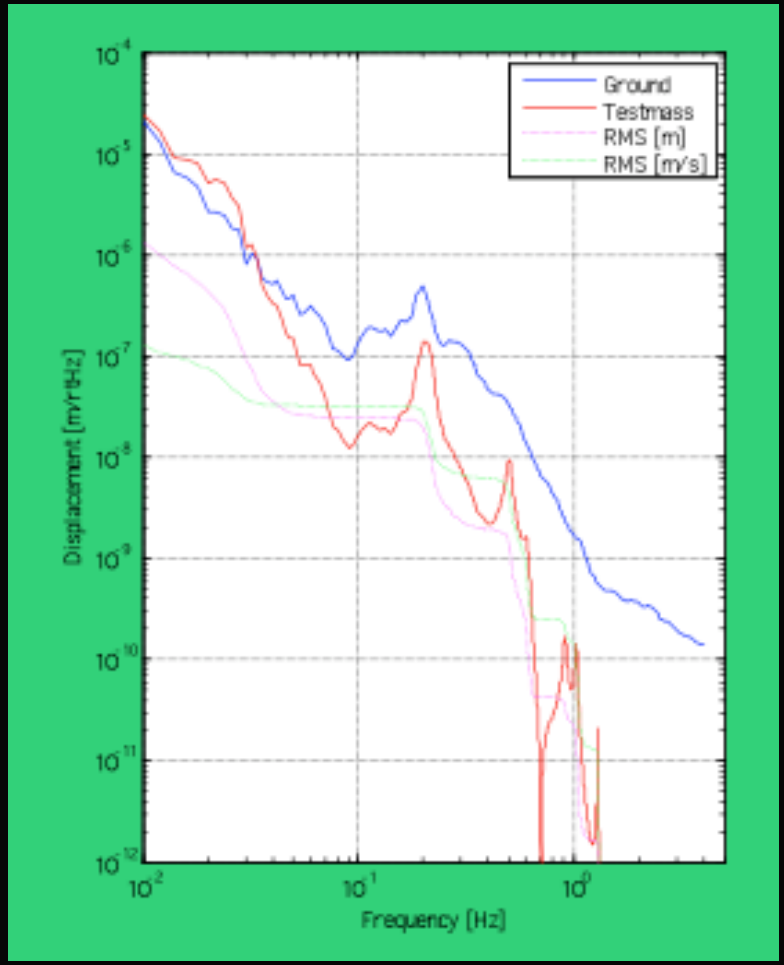
Noise level comparison Homestake/Kamioka



Preliminary LCGT (Kamioka) simple susp lumped model



Ryutaro Takahashi



Micro-seismic: normal
Inertial damping: on
Eddy-current damping: futile

	Disp. [μm]	Vel. [μm/s]	
	1.3	0.13	(0.01-4Hz)
	0.025	0.032	(0.1-4Hz)

Design Study Phases (INFN-Pisa,EGO)

1) Present Seismic Isolation
   - 1.a) ET requirements
   - 1.b) Measure present attenuation
   - 1.c) Measure present cross-over

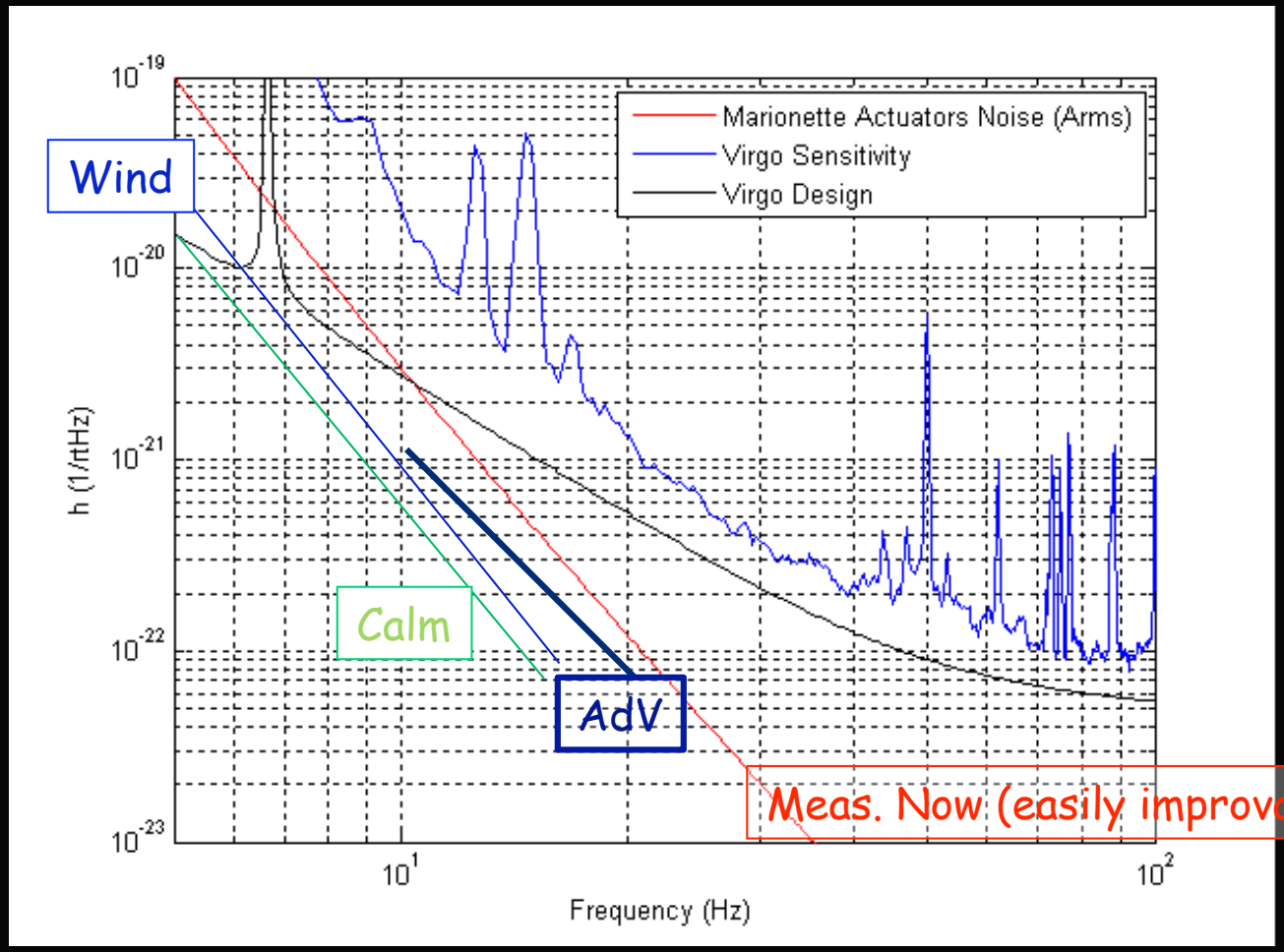
2) Cross-over reduction studies
   - 2.a) Keeping present length
   - 2.b) Varying present length
   - 2.c) Vertical Filtering

Concluded

↓

PROPOSAL: **Present SA (6 filters) extended** from 9 to 17 m
(1.8 Hz conservative cross-over)

Focus on actuation noise



OK for AdV but far from ET

Design Study Phases (INFN-Pisa,EGO)

1) Present Seismic Isolation
   - 1.a) ET requirements
   - 1.b) Measure present attenuation
   - 1.c) Measure present cross-over

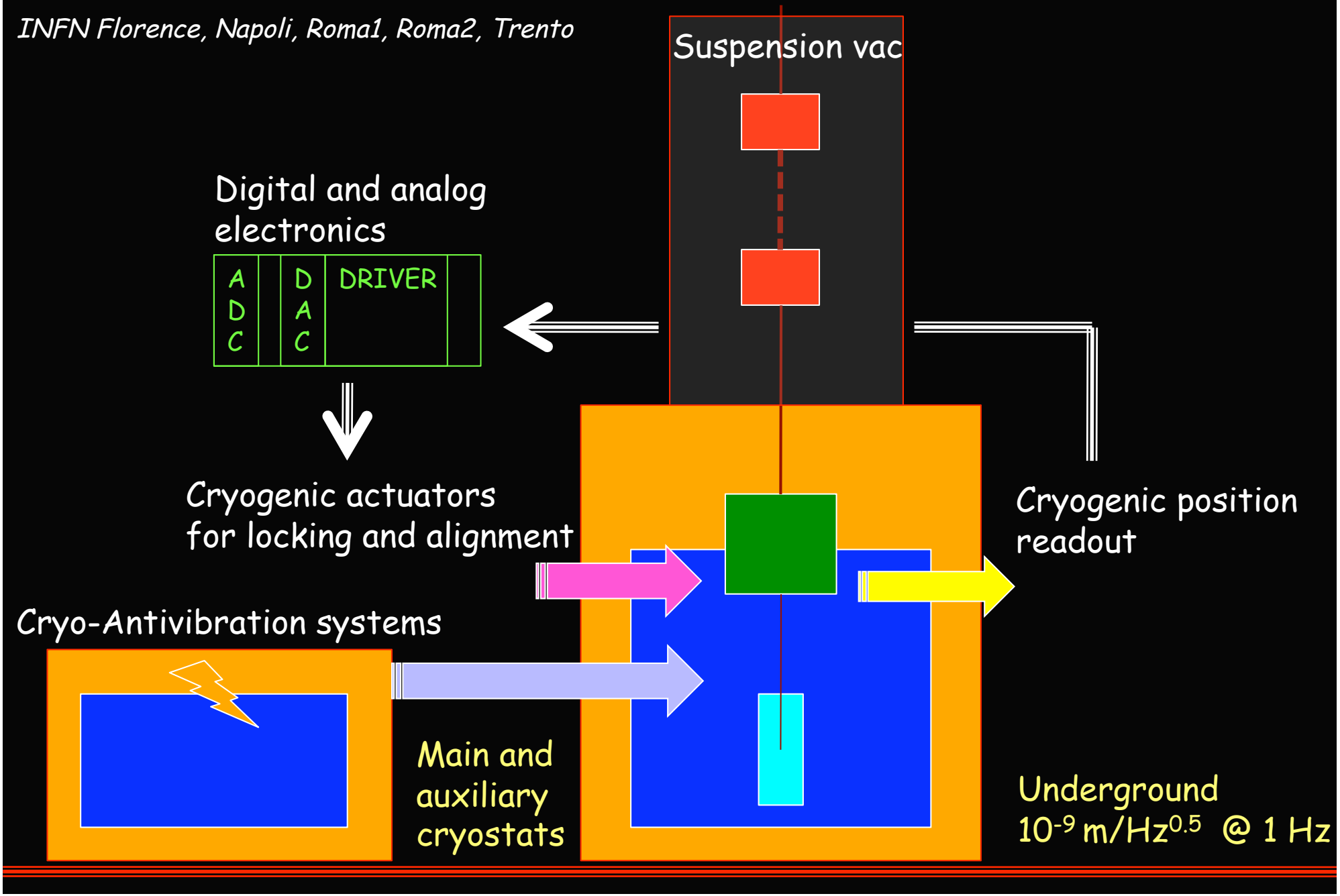
2) Cross-over reduction studies
   - 2.a) Keeping present length
   - 2.b) Varying present length
   - 2.c) Vertical Filtering

In progress

3) Other Requirements
   - 3.a) Micro-glitcheness
   - 3.b) SA upgrades
   - 3.c) Cryo-Compatibility
   - 3.d) Control
   - 3.e) Newtonian Noise Interface

Open issues for last stage suspension control

INFN Florence, Napoli, Roma1, Roma2, Trento



Mirror control issues

Digital and analog electronics (prosecution of AdvDet develoment).

Cryogenic actuators for locking and alignment

- Electrostatic actuation VS cryogenics
- Coil-magnet actuation line VS cryogenics

Cryogenic position readout

- mirror imaging needed ?
- fiber optic solutions
- short optical levers and fiber bundles

Local control impact on cryostats

Cryo-Antivibration systems

- Compliance with payload and integration model
- Active VS passive solutions
- Sensors (e.g. fiber/accel.)

Mirror control issues

Digital and analog electronics (prosecution of AdvDet develoment).

Cryogenic actuators for locking and alignment "score"
- Electrostatic actuation VS cryogenics ↗
- Coil-magnet actuation line VS cryogenics ↗

Cryogenic position readout
- mirror imaging needed ? ↘
- fiber optic solutions →
- short optical levers and fiber bundles →

Local control impact on cryostats ↘

Cryo-Antivibration systems
- Compliance with payload and integration model ↗
- Active VS passive solutions ↗
- Sensors (e.g. fiber/accel.) ↗

Overall status of design study

- Several R&D programs have been carried out but with limited resources: a bigger effort should be done on position sensing studies.
- Solution selection requires intensive experimental activity.
- Coordination efforts are significantly effective only if continuous activity in the labs is sustained.
- Dedicated manpower is needed.

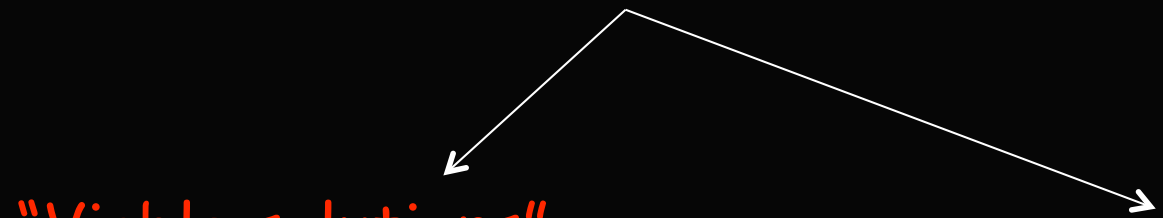
ET target by summer 2011 in blocks

- In absence of extensive and selective experiments, we must prepare a set of alternative (even if non exhaustive) scenarios

I) On-the-paper noise re-injection VS devices.

II) Impact of position sensors on cryostat design.

III) Impact of actuator type on cryostat design.



"Viable solutions"

"Validation lines for each of them"

Preparing the ET "future"

- The development of the activity would significantly benefit of coordinated collaboration with LCGT.

LCGT embeds ET mini-targets

LCGT-I
UNDERGROUND
NO-CRYO,
FS mirrors,
4 LF suspensions

Development of sensors for LF SAS to exploit underground operation.

Funded

Expected

UNDERGROUND
CRYO,
SA mirrors,
6 LF suspensions

LCGT "Small" cryostat experience: actuation and sensing devices.

ET R&D +
coordination effort +
dedicated manpower +
LCGT experience

?

Experimental selection of viable scenarios for larger scale underground ITFs