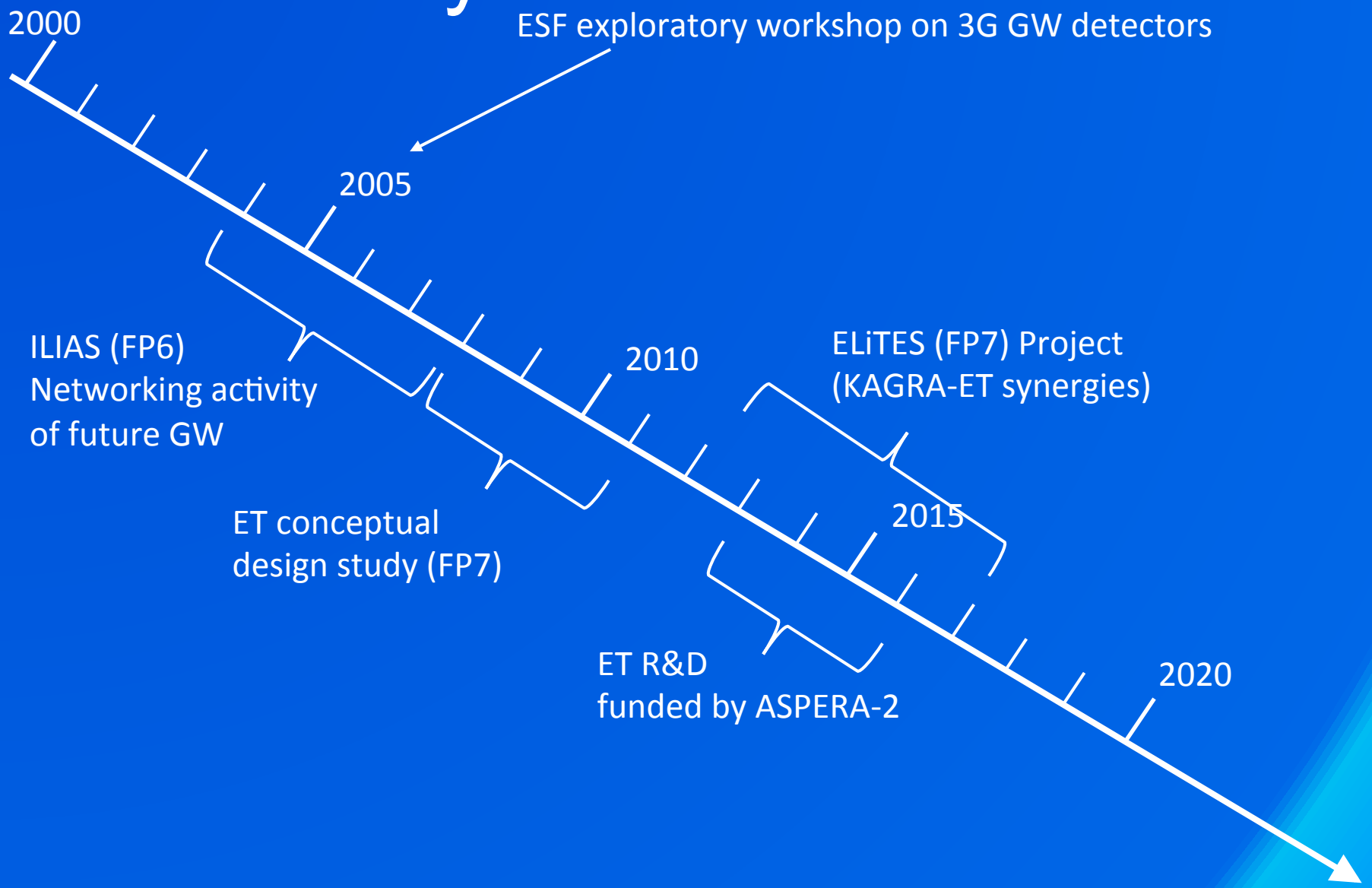
ET and the Advanced Detectors

- The Advanced Detectors (Virgo&LIGO) has reached the great success of GW discovery
- The ADV+ will reach in the next few years new better sensitivity but will approach the limits
- New infrastructure are needed for the next decades

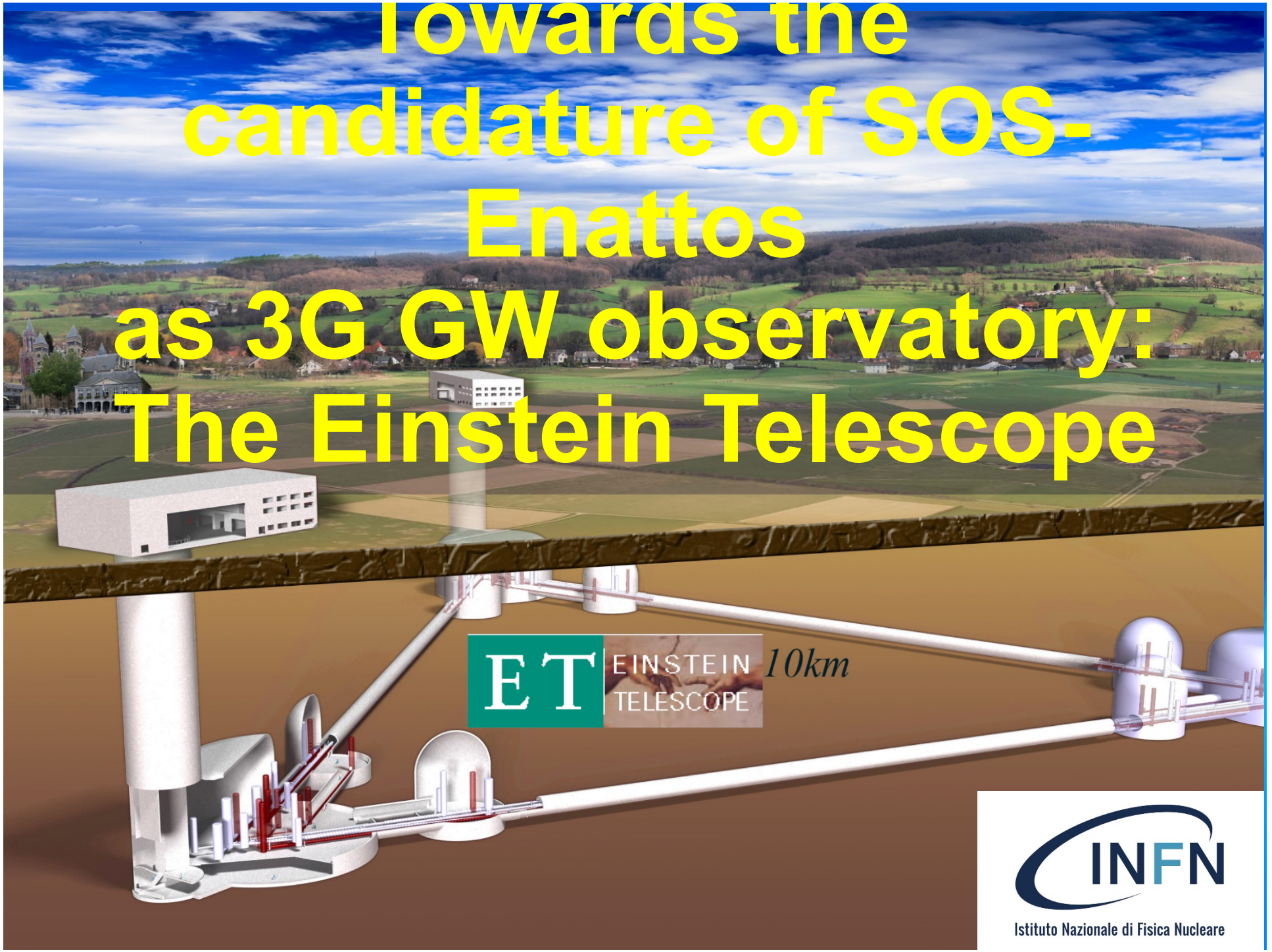
Virgo in 1997

LONGER ARMS & UNDERGROUND

ET history


2000
ESF exploratory workshop on 3G GW detectors
2005
ILIAS (FP6)
Networking activity
of future GW
2010
ELiTES (FP7) Project
(KAGRA-ET synergies)
ET conceptual
design study (FP7)
2015
ET R&D
funded by ASPERA-2
2020

Towards the candidature of SOS-Enattos as 3G GW observatory: The Einstein Telescope

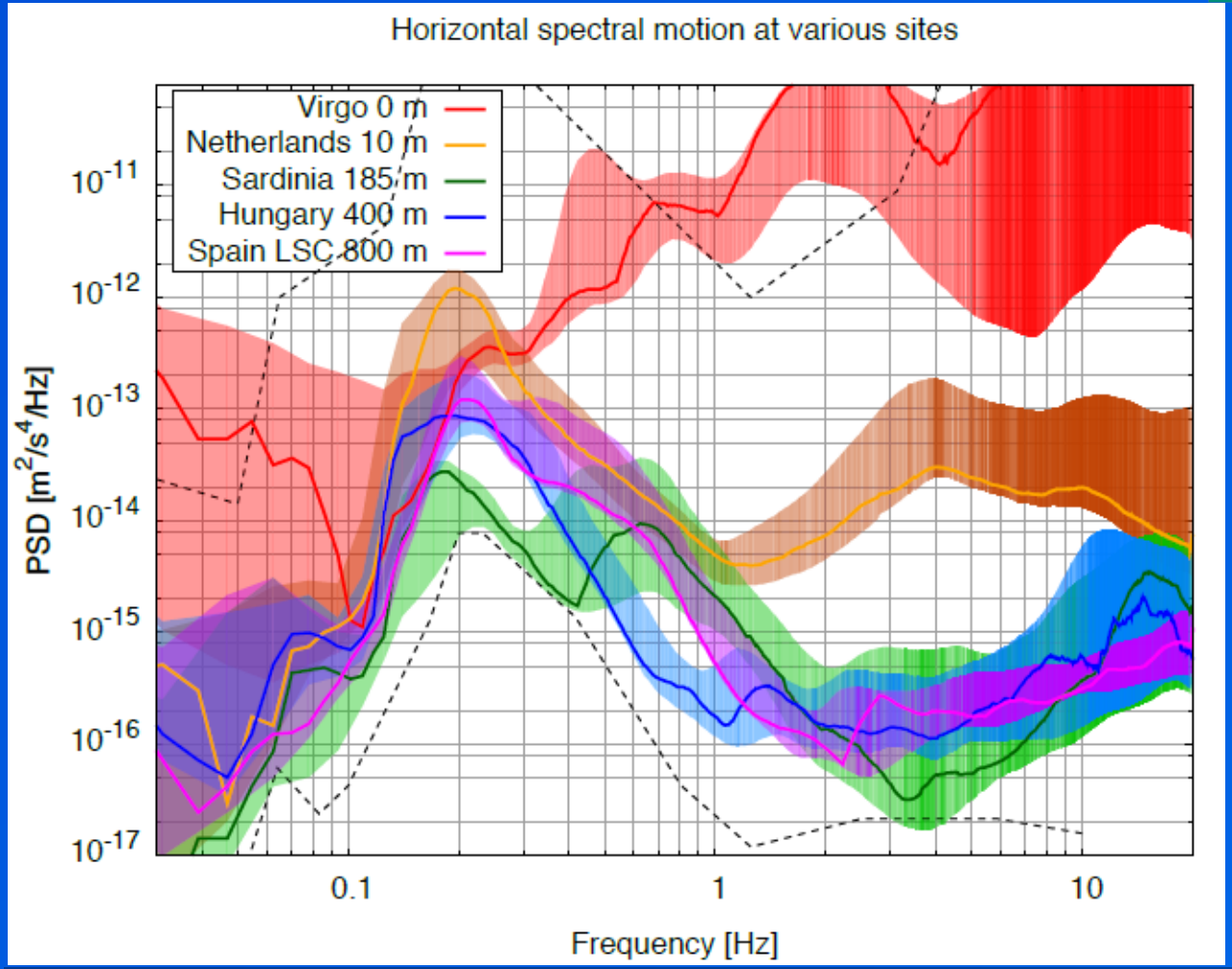


INFN
Istituto Nazionale di Fisica Nucleare

ET design study

- Involving 5 EU countries and a wider science team
- Delivered a conceptual design report describing:
  - New concept of a 3G observatory
    - Research Infrastructure vs detector
    - Wide band
    - Polarisations
    - Pointing capabilities
  - Science case for a single 3G observatory
  - Enabling technologies for a 3G GW detector
  - Rough cost estimation for the infrastructure
  - List of sites in Europe compatible with 3G requirements
- Formed an ET scientific community meeting every year (ET symposia) since 2008

Underground Seismic noise Measurement



Underground sites are the candidates for a very quiet site

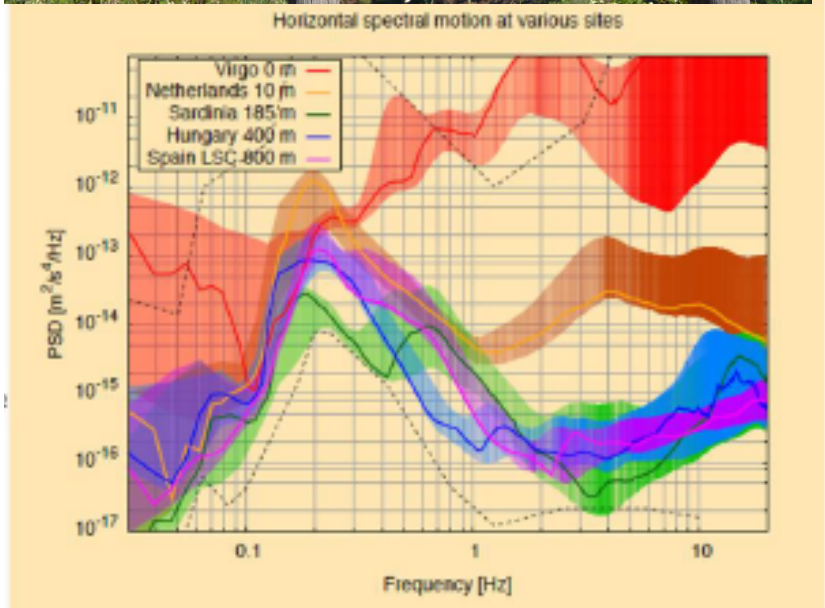
Credits: J.v.d. Brand

Site Location

Sindaco	Mario Calia (lista civica) dall'11-6-2012
Territorio	
Coordinate	40°28′N 9°29′E
Altitudine	521 m s.l.m.
Superficie	148,72 km²
Abitanti	1 407[1] (31-7-2016)
Densità	9,46 ab./km²
Comuni confinanti	Bitti, Dorgali, Galtellì, Irgoli, Loculi, Lodè, Onani, Orune, Siniscola

Low Seimic and anthropic noise

Disused mine SOS - ENATTOS presso Lula (Nu)



Seismic
Measurements
By Virgo and
ET collaborations

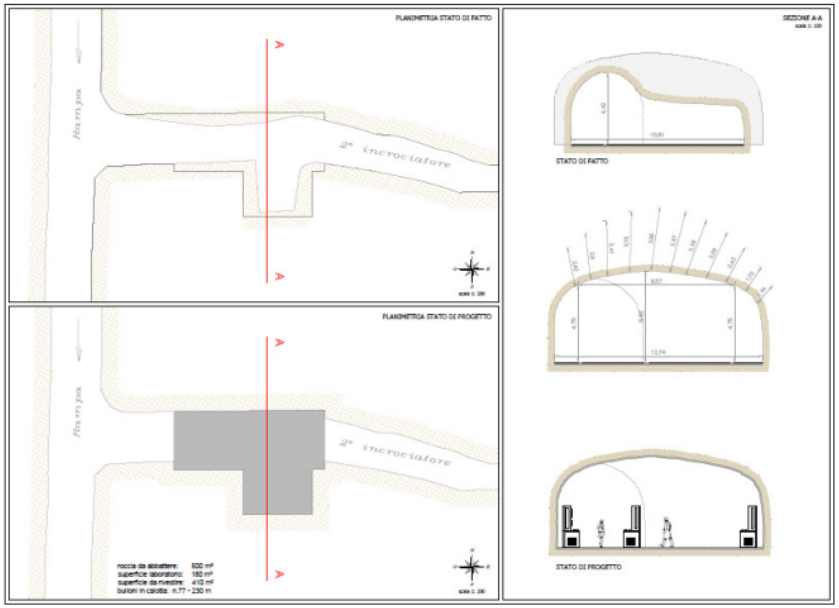
SOS ENATTOS green

The SAR-GRAV pilot laboratory

SAR-GRAV is born as collaboration of Regione Sardegna, IGEA SPA, Sassari University, INFN and INGV (National Institute of Physics and Vulcanology). It is open to the collaboration of any other research institute.

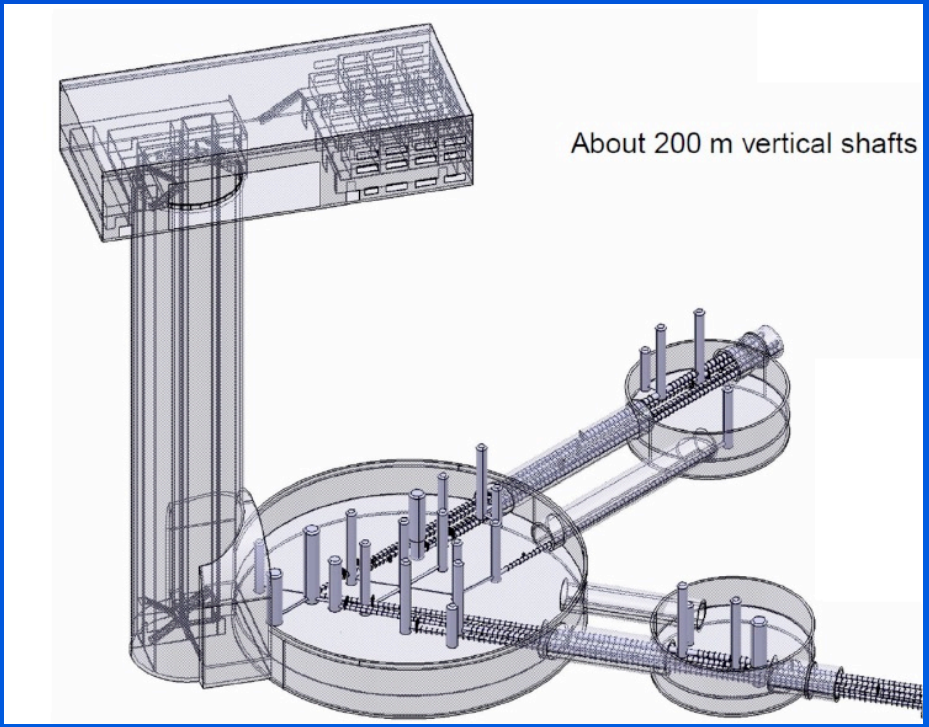
- The construction of an underground laboratory has been funded by Regione Sardegna
- It is expected to be completed within this year
- It is devoted to gravitational experiments that need a very quiet environment
- It will host Archimedes as first experiment
- It will be the base for a complete characyerization of the site

Present cave to be excavated



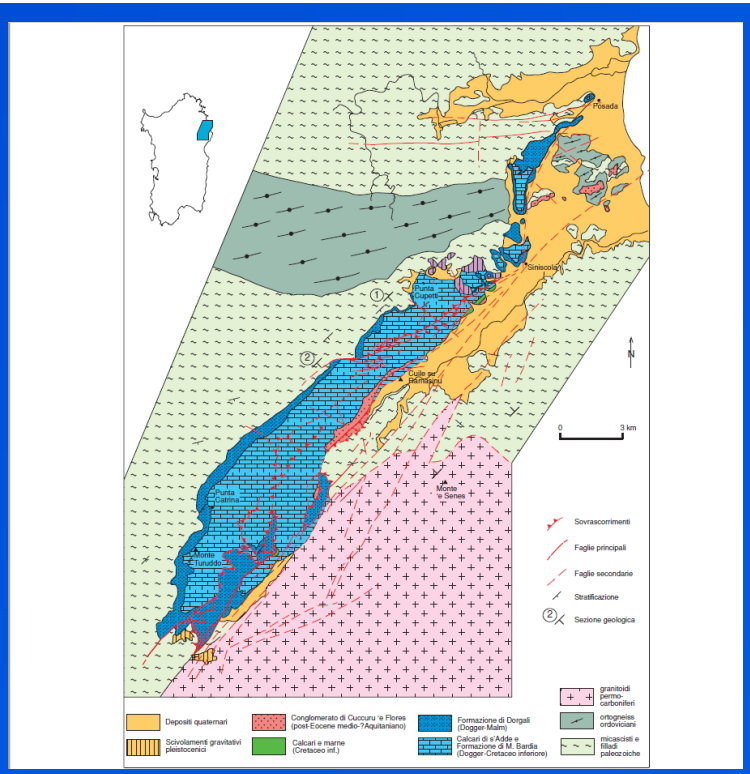
Underground location and excavation project

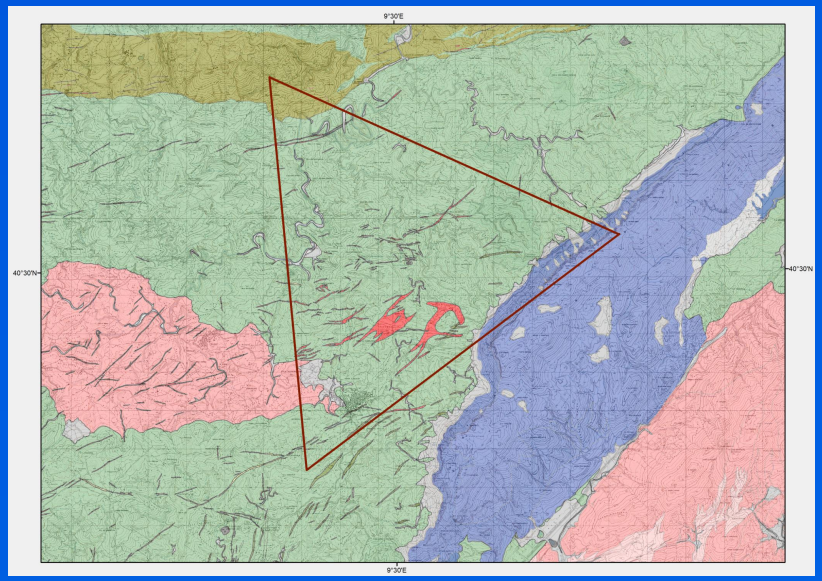
Characterization of the site
Geological studies



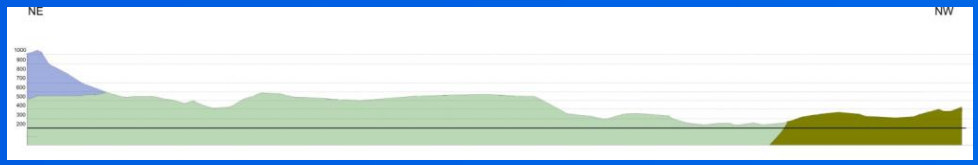
Extremely big caverns

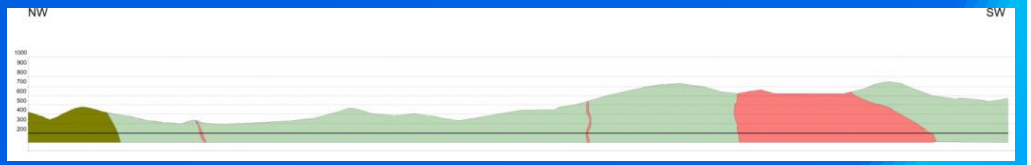
- Are they really needed?
- Is the rock sufficiently resistent?
- Can ET be optimally rotated?

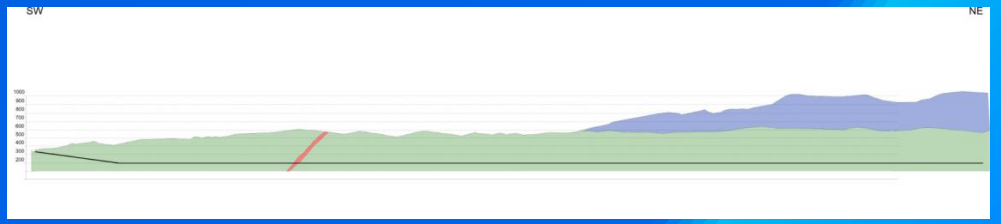




- Very different rocks are present in the region
- The region is ondulated
- Possibile to individuate entrances at low depths



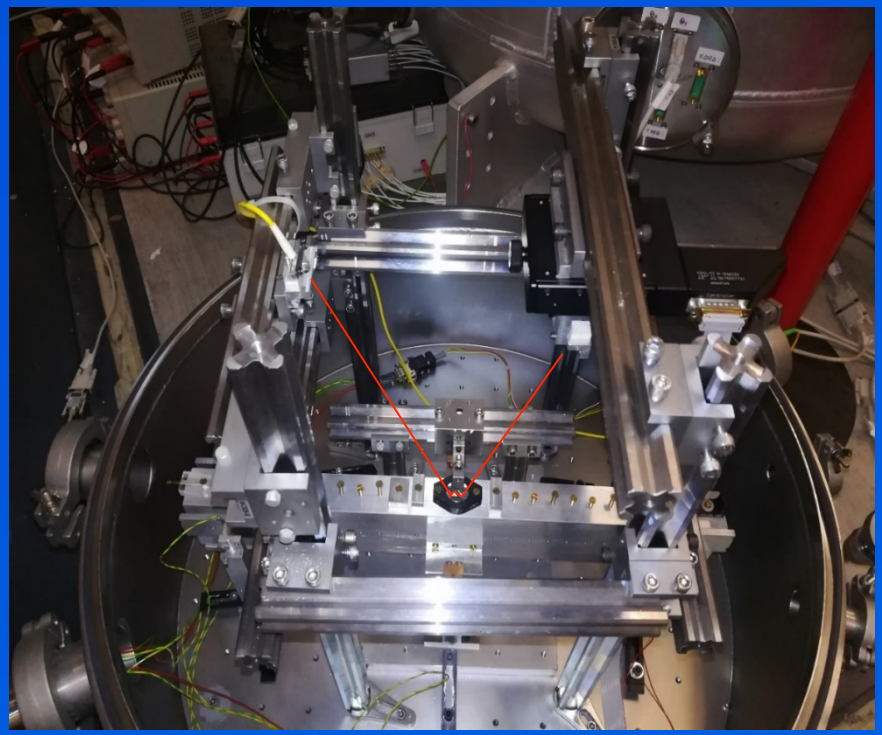


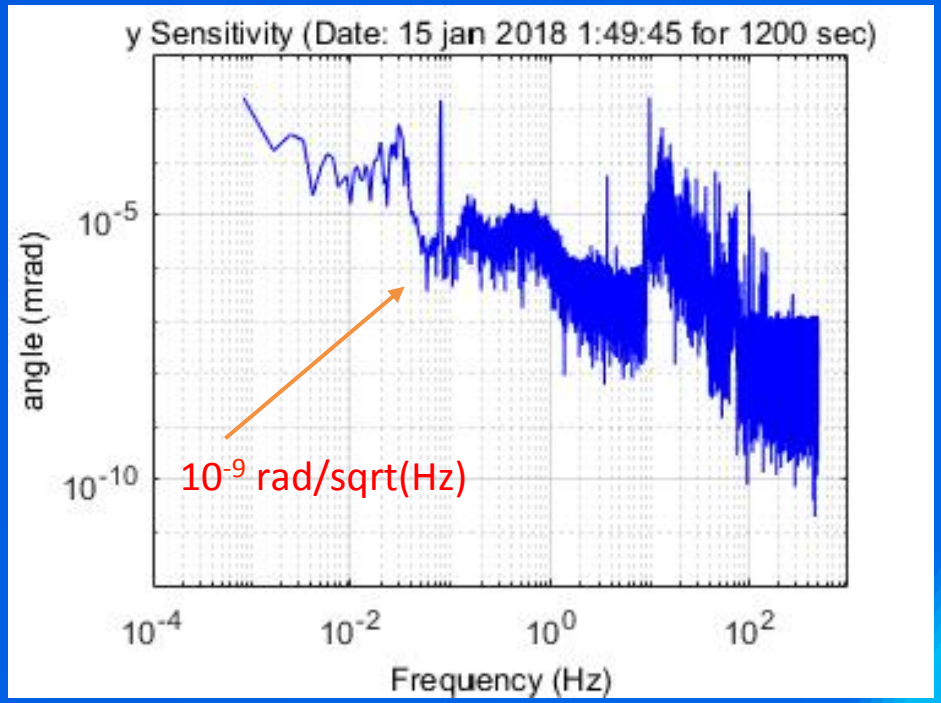


Seismic characterization and newtonian noise projection of SOS-Enattos site

- Seimic accelerometers (trillium 240) array km size all over the region and at different depths
- Measurement in the whole bandwidth
- Tiltmeter in low frequency in SAR-GRAV lab
- Environmental measurements

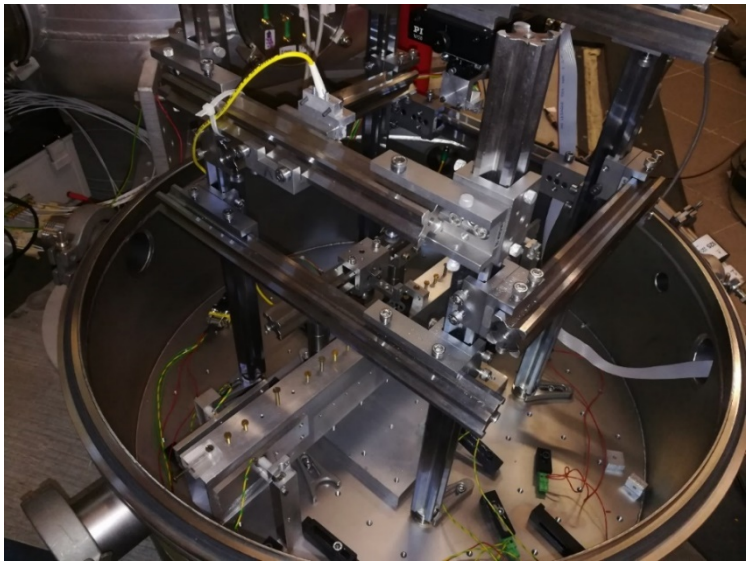
Tiltmeter

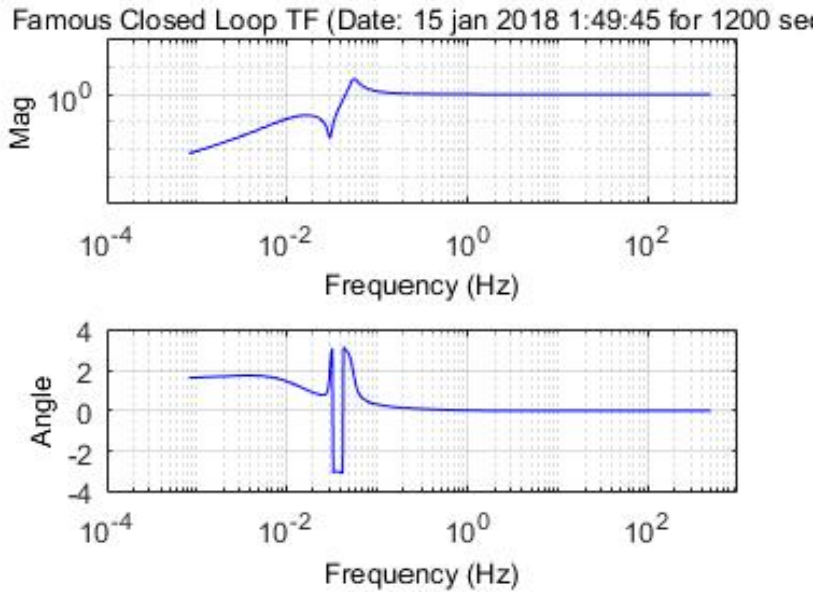



y Sensitivity (Date: 15 jan 2018 1:49:45 for 1200 sec)
angle (mrad)
10-5
10-10
10-9 rad/sqrt(Hz)
10-4
10-2
100
102
Frequency (Hz)

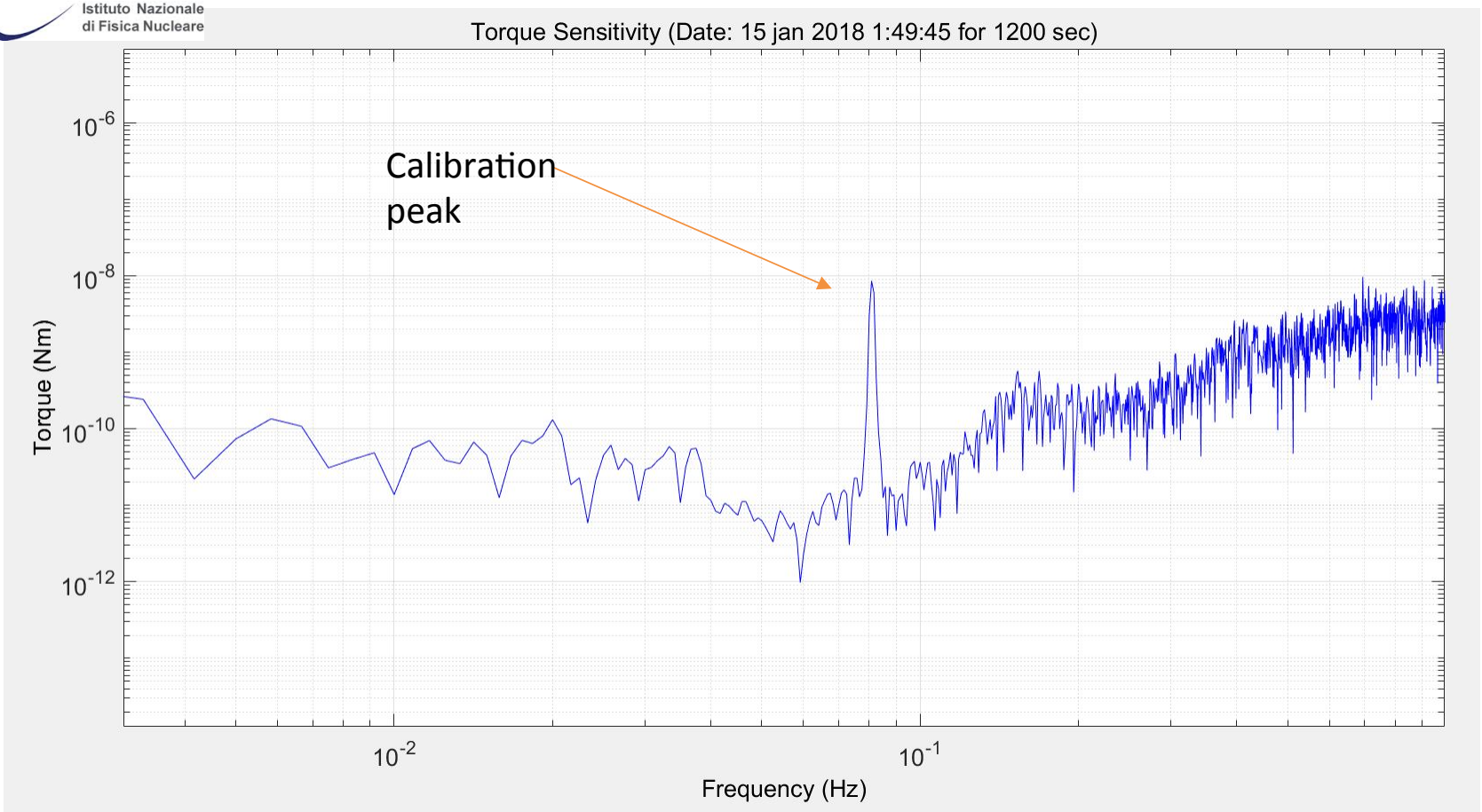
Characteristic of the present balance

- Read-out: Optical lever and quadrant photodiode – 3 reflections
- Balance works on closed loop
- Elettrostatic Acutators
- Photodiode follows the beam (repositioning every 1.5 hour)
- Small force power/supply/ Actuator to maintain low actuator noise
- Balance lying on a Plinto of about 6 m^3 of concrete.





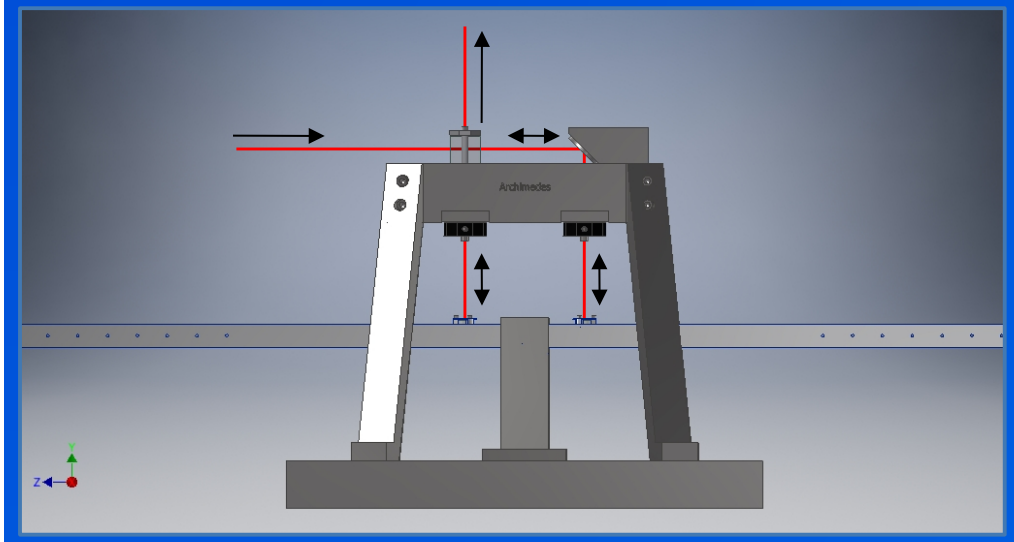
Present Torque Sensitivity



Lower than 10^{-11} in the region of interest.

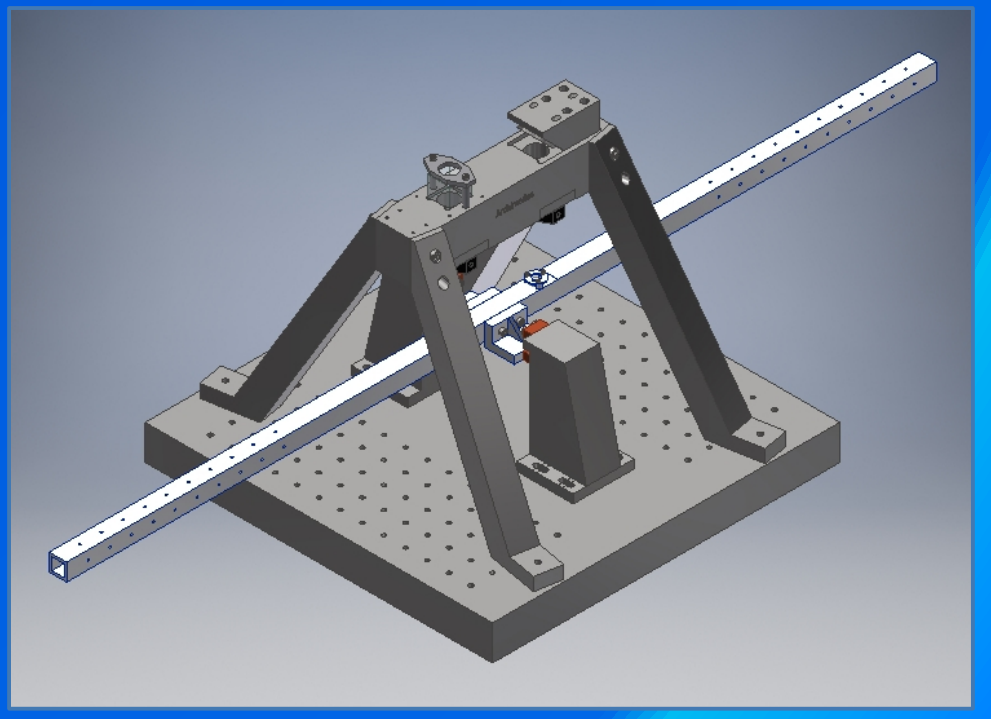
1) We are continuing in trying to improve → thermally threated joints, lower coupling with seism, suitable feed-back for lower resonance frequency

New Balance and Michelson mechanical design



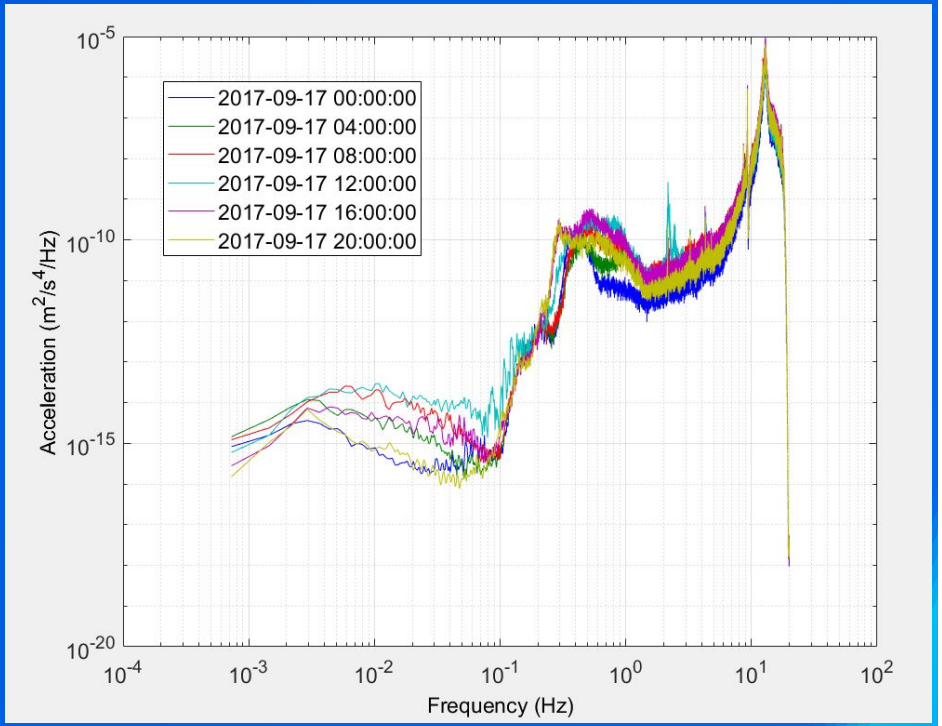
The interferometer is embedded in a monolithic steel structure

- **Total arm length:**
  1m
- **Base dimensions:**
  40 cm x 40 cm
- **Total height :**
  ~35 cm (~15 cm only the balance)



Km size km Array of accelerometers

- Minimum of 8 Accelerometers placed also at different depth to recover 3D mass displacemente
- Coherence study
- Newtonian projection on the ET test masses and study for Newtonian noise reduction
- Estimation of Newtonian Noise and projection on ET Sensitivity Curve



Trillium 240 measurement in an NOT quiet lab

CONCLUSION

- New phase for ET
- ET is now a prioritary project in the APPEC european consortium that will push ET in the ESFRI roadmap
- SOS-Enattos will be one the most studied candidates, the decision is expected most probably in 2021