Advancements in the Einstein Telescope project

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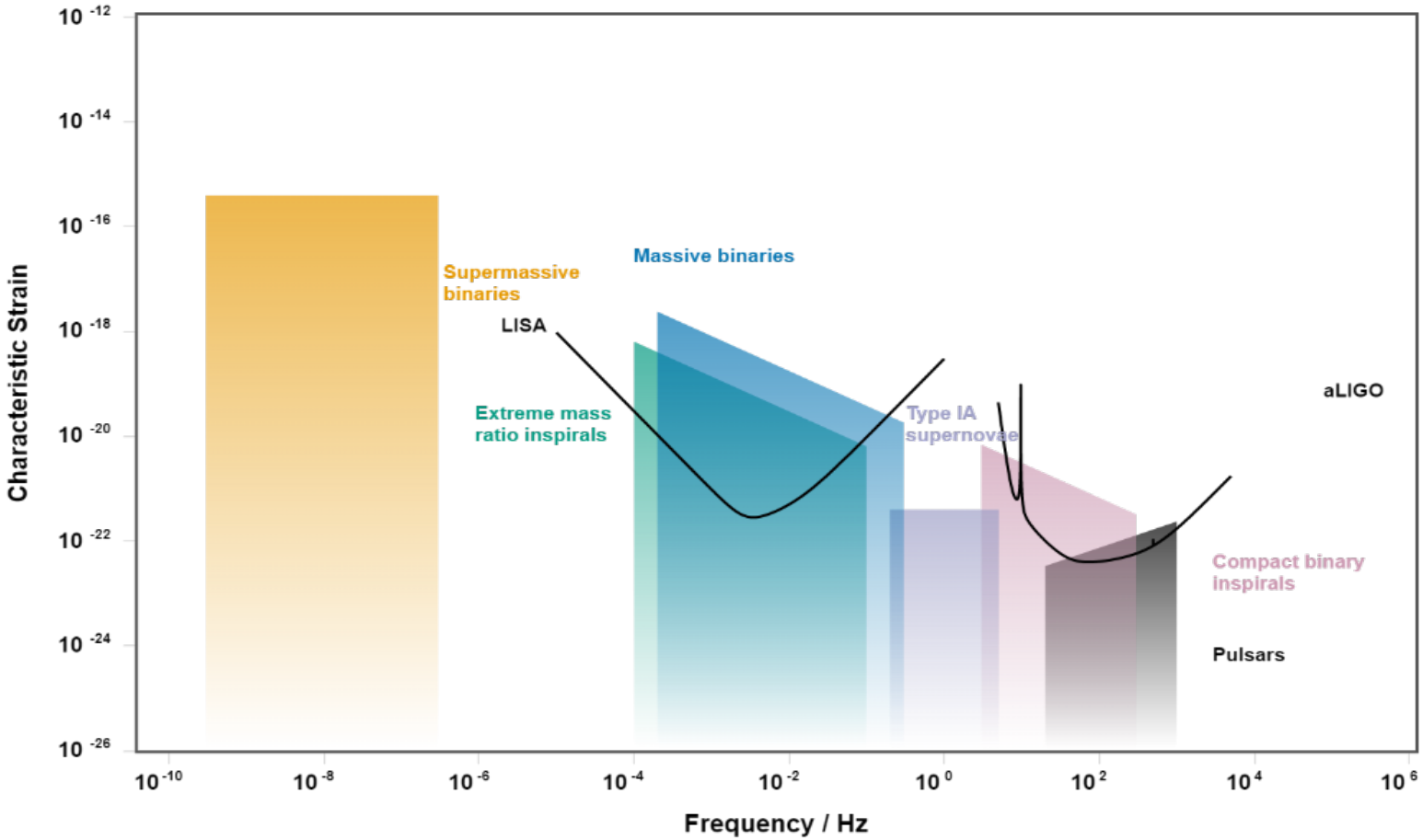
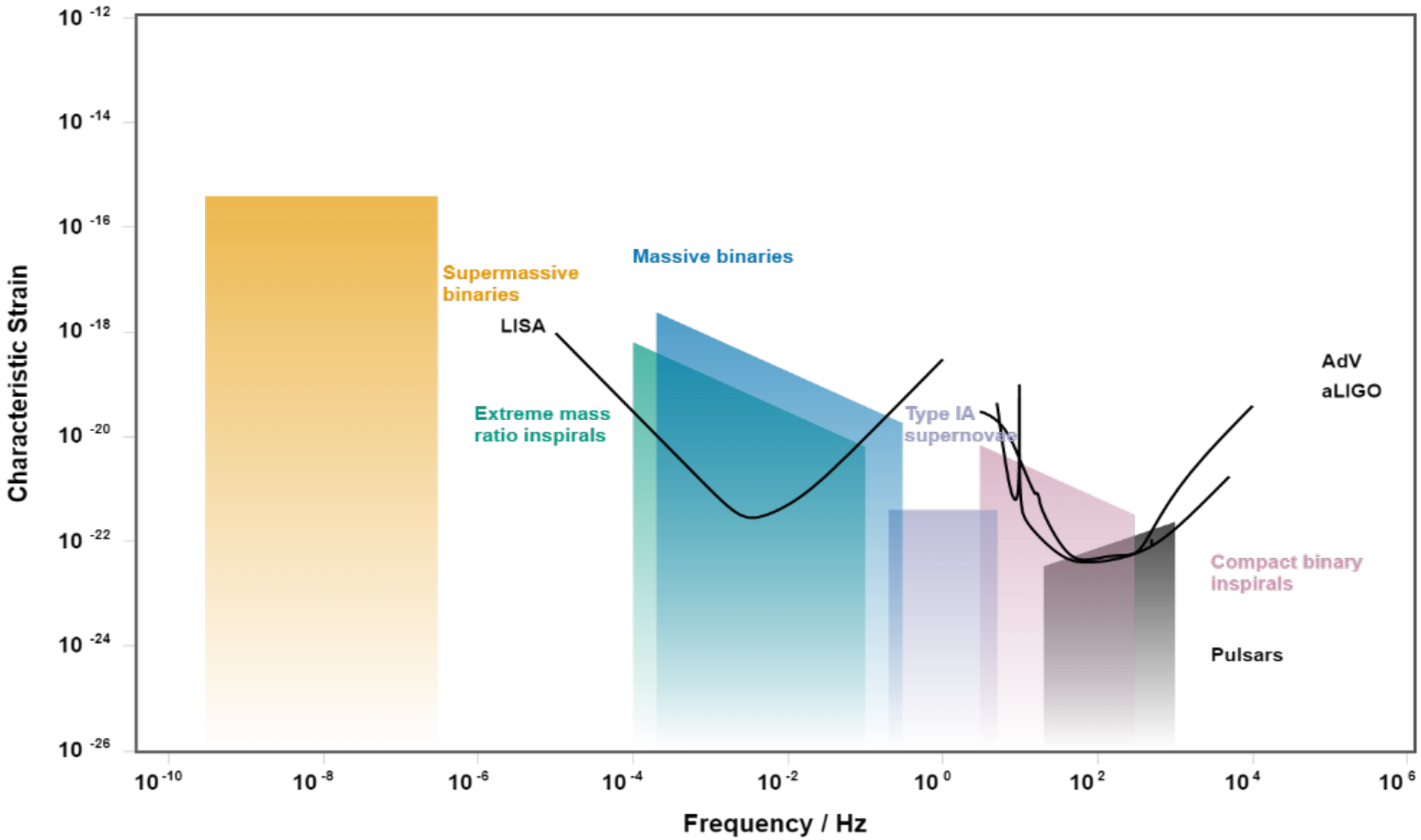
LIGO

Hanford and Livingston, USA, 4 km long arms.



VIRGO

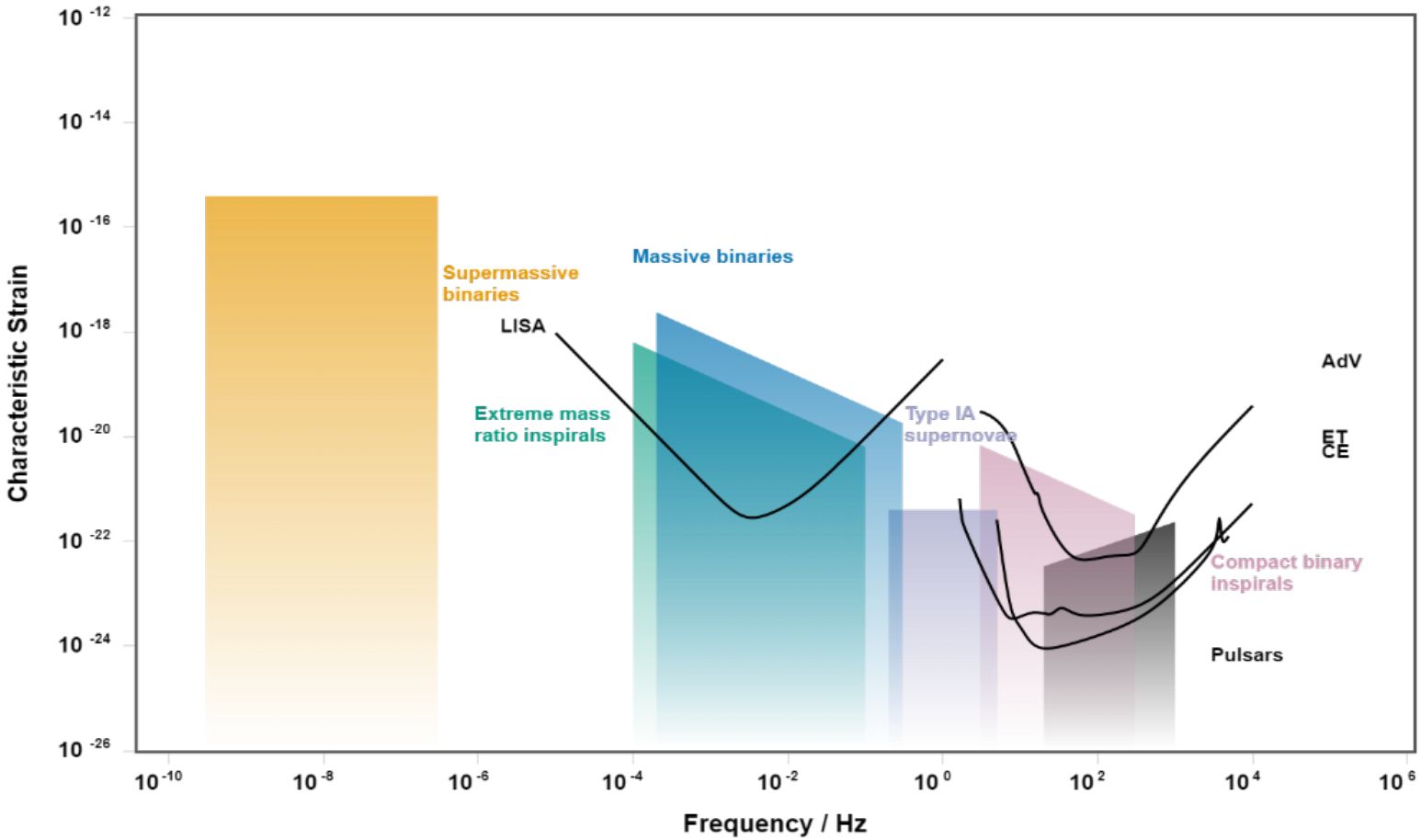
Santo Stefano (near Pisa), Italy, 3 km long arms.



... and many others exist or planned (space or ground-based).

Aims: wider frequency range + higher sensitivity.

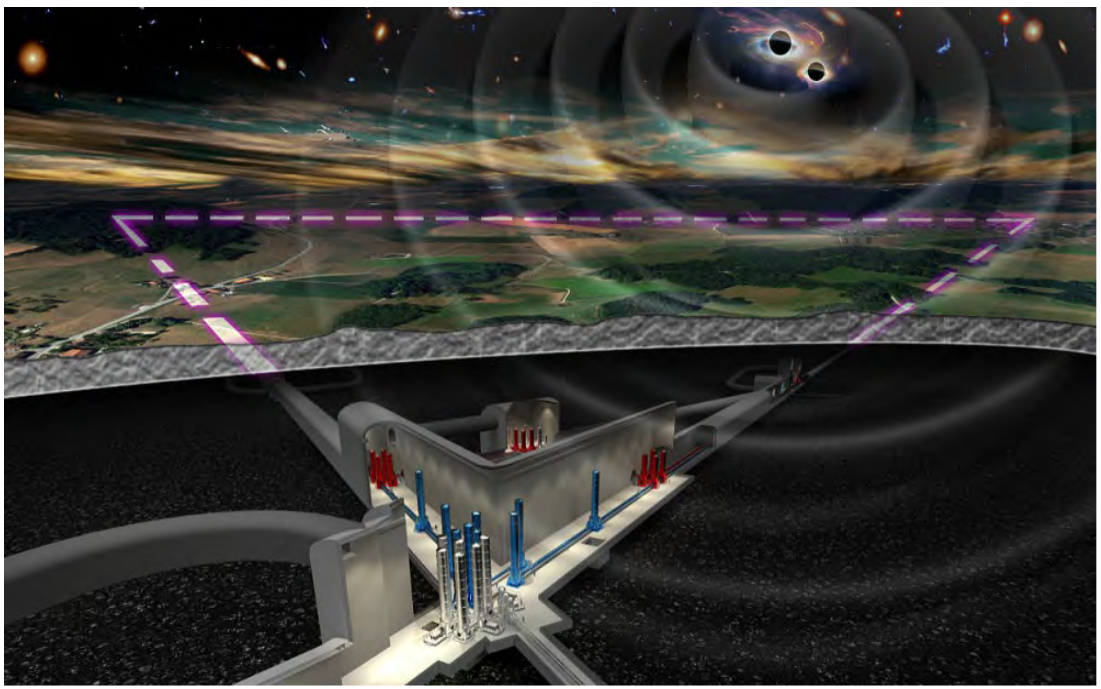
Detectors are designed for specific frequency intervals.
Einstein Telescope (ET): $\sim 1 - 10^4$ Hz.

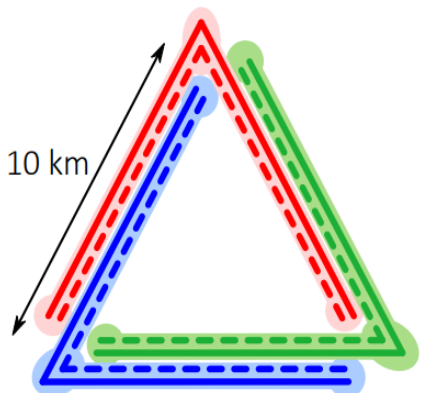


Competitor from USA: Cosmic Explorer (CE), 40 km arm length.

ET design

Underground facility. LF and HF instrumentation for each arm.
Overall: 6 detectors. Cryogenic.





KAGRA (Japanese): underground water difficulties.

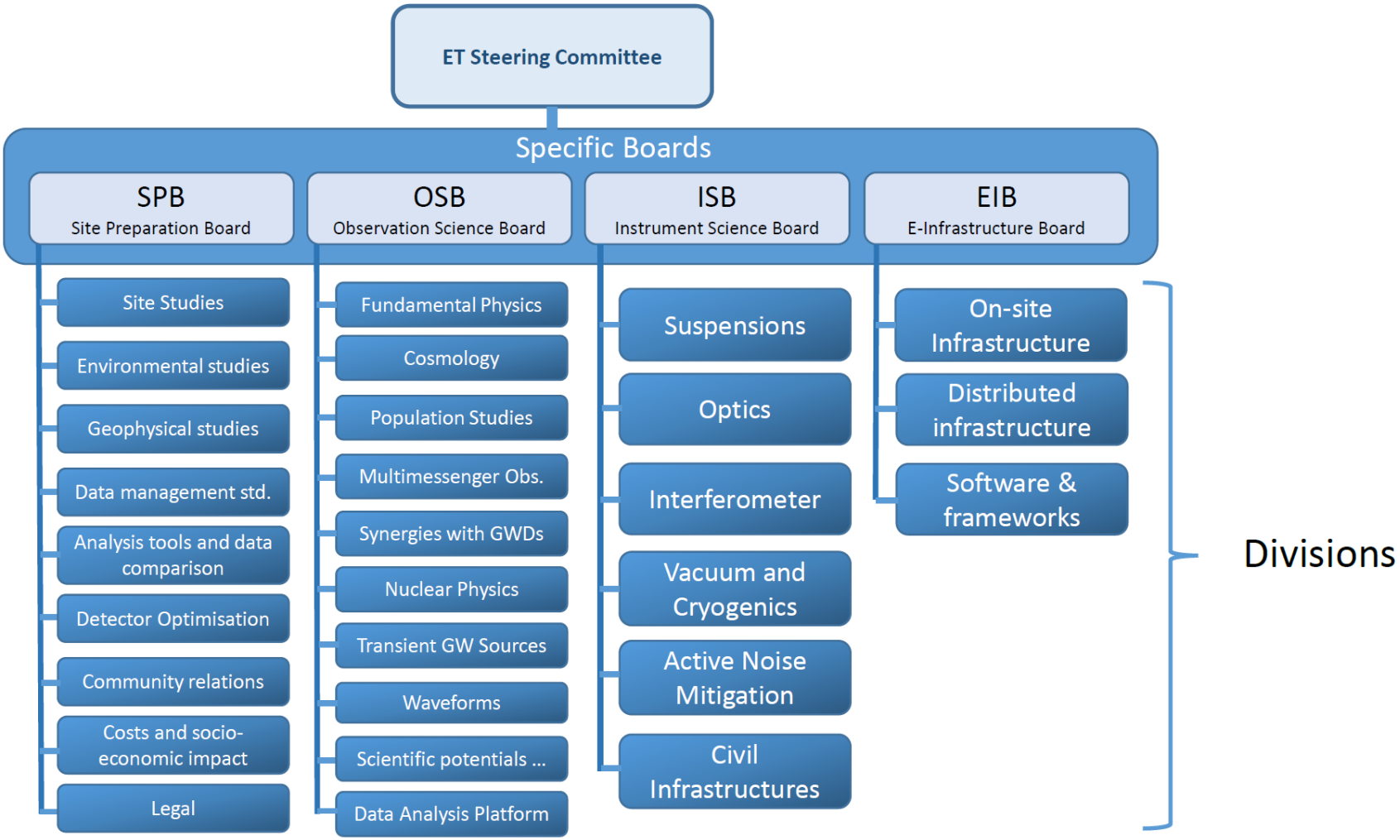
Organization

ET collaboration is forming: $\sim$ 700 collaborators.

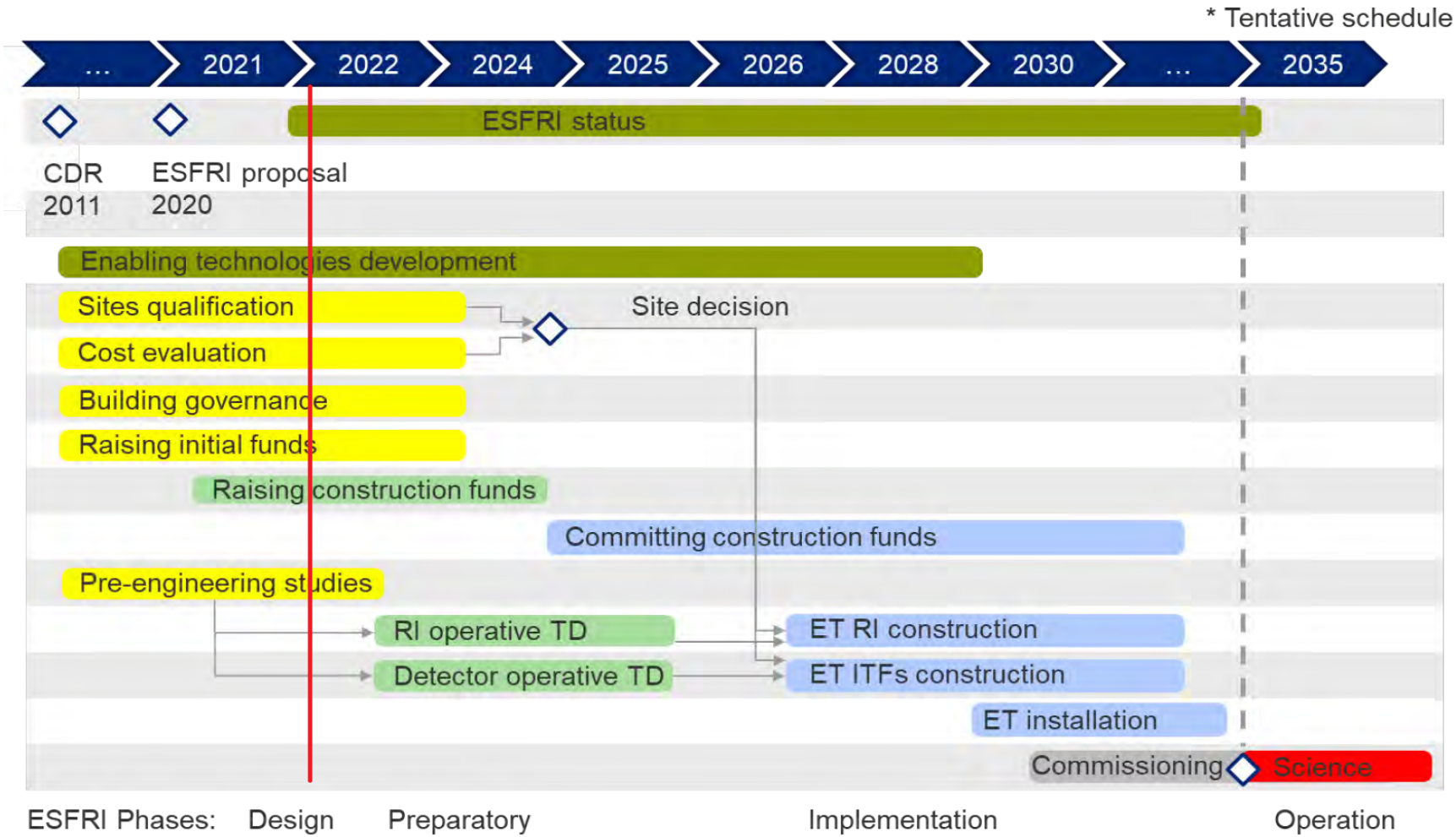
CERN recognized experiment?

Kick-off events for specific boards.

Joining to the boards is continous.
Hungary: Wigner RCP, BME, ATOMKI,...



+ advisory and ethics committees.

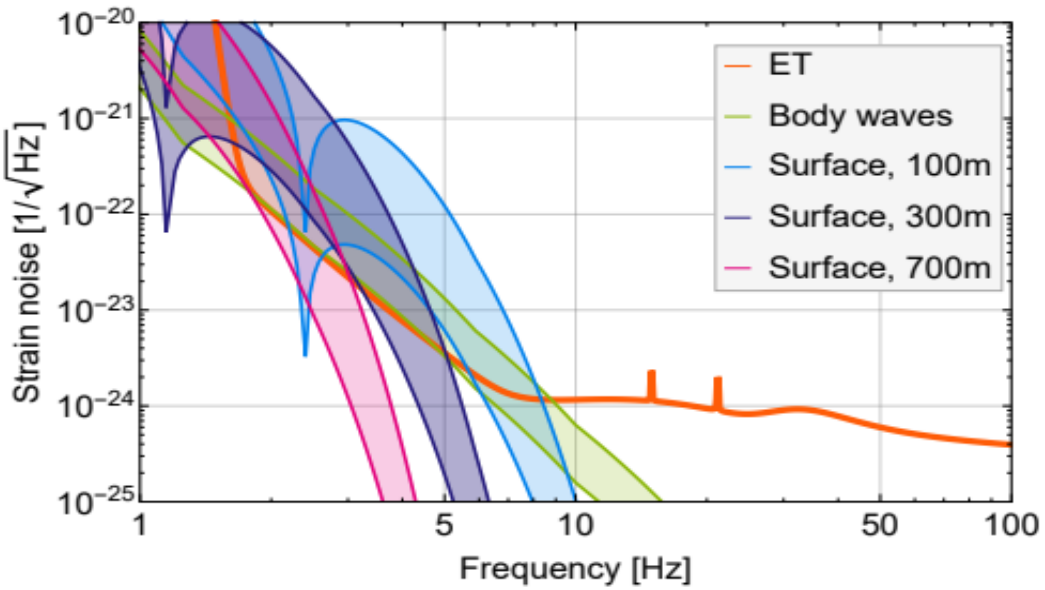


Horizon proposals are under preparation.

Newtonian noise?

Crucial for high sensitivity.

Pressure variation in the atmoshphere and rocks.
NN contribution of shear and body waves in rocks:
T. Andrić, J. Harms



Filtering?

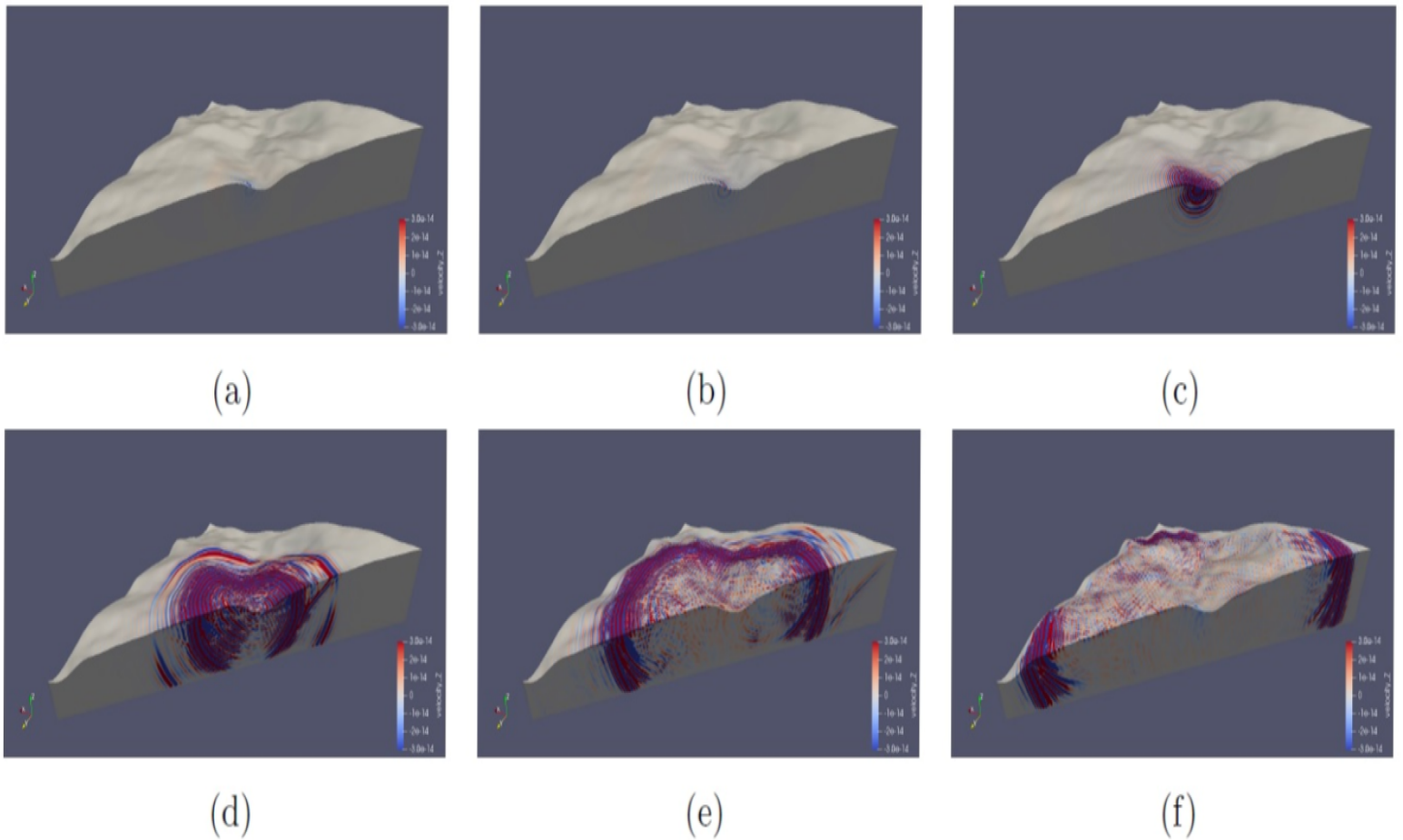
First attempts of VIRGO

T. Andrić, J. Harms:
Providing priors to Bayesian array optimization,
ET – Site studies and characterization, 08.-11. 11. 2021.

Geology+topography $\rightarrow$ numerical simulations $\rightarrow$
seismic correlations in 3D.

Seismometer measurements $\rightarrow$ filters.

T. Andrić, J. Harms:
Using SPECFEM3D: only Hookean (elastic) model.



Does not really work as intended...what is missing?

Rheology

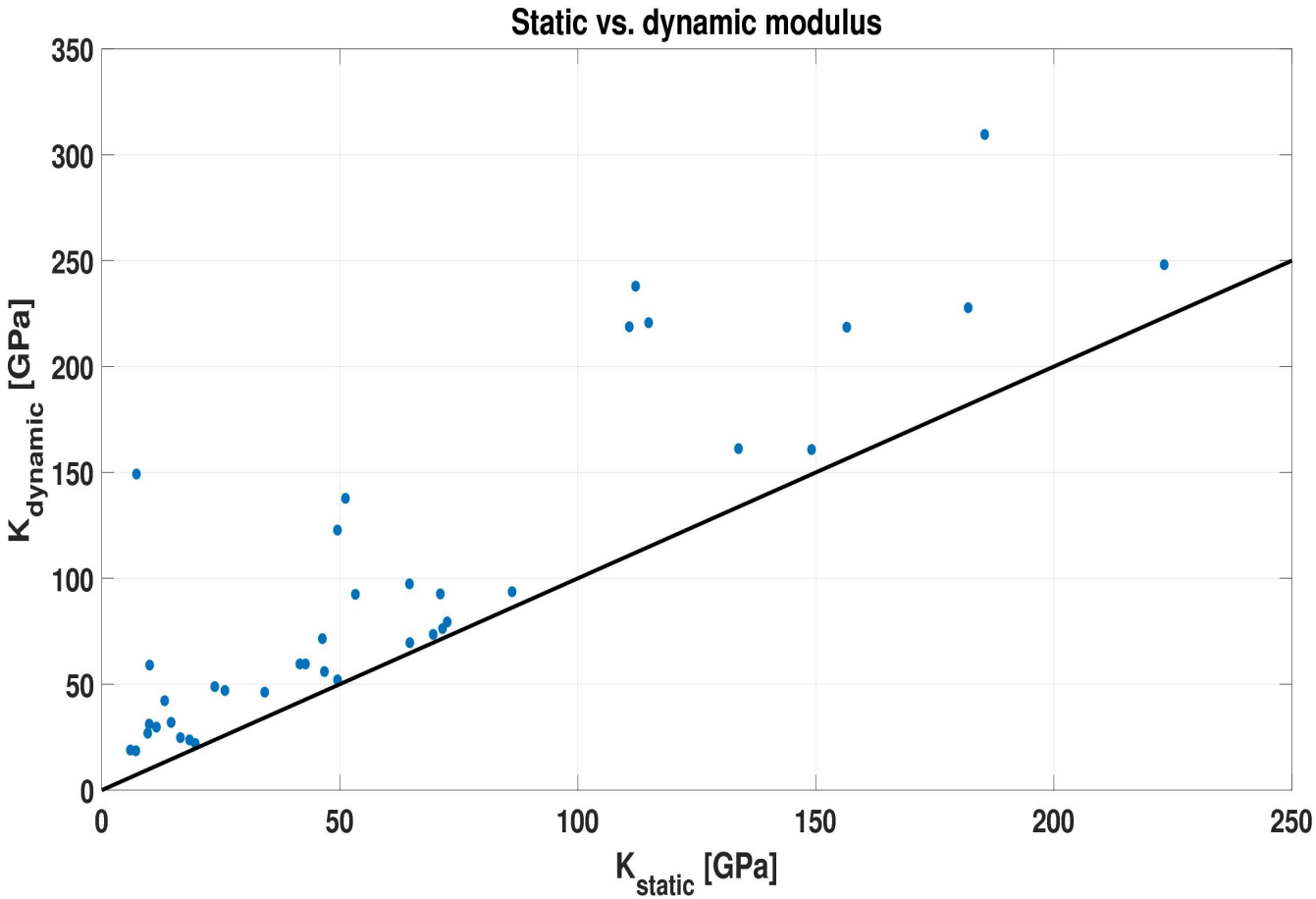
Collaboration with T. Fülöp, P. Ván and ROCKSTUDY Ltd. (HU)

Hookean case: $\sigma = E\varepsilon$. Elastic model, no dissipation.

Poynting-Thomson-Zener case: $\tau\dot{\sigma} + \sigma = E\varepsilon + \hat{E}\dot{\varepsilon}$.

Complex dissipative behaviour, damping, thermal effects.
$\rightarrow$ Thermal expansion.

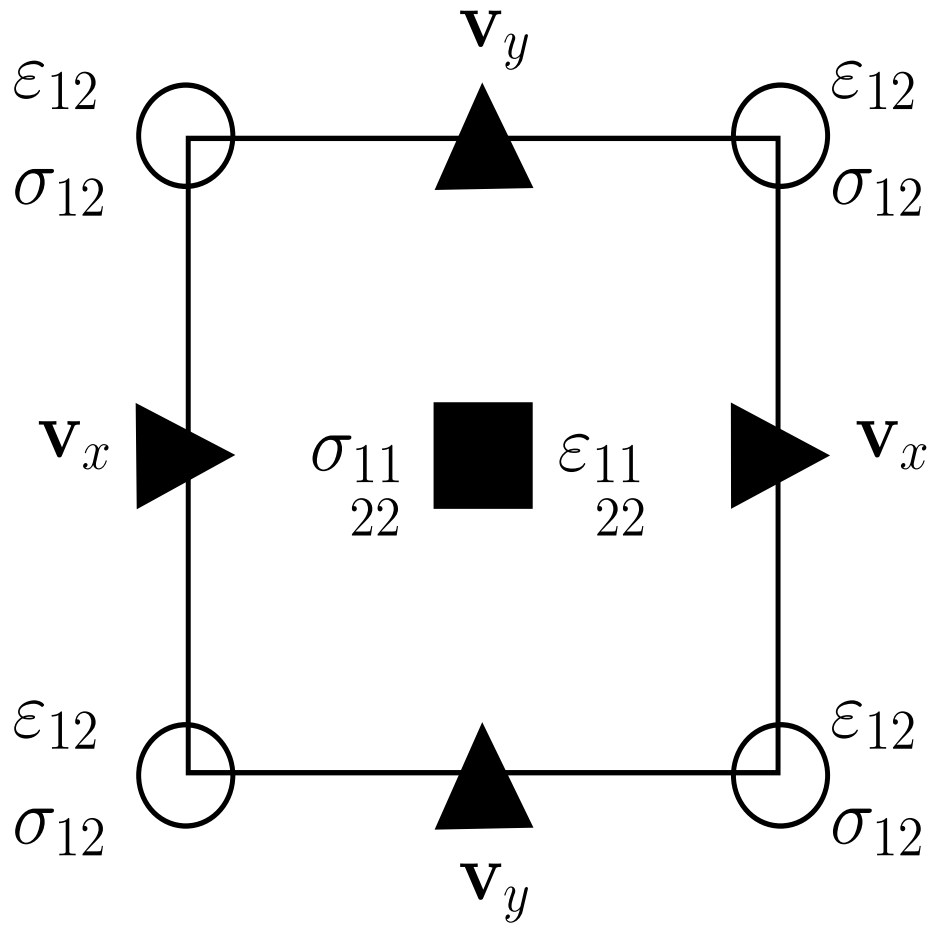
$+$ extra time scales (numerical methods $+$ measurements), dynamic vs. static


Static vs. dynamic modulus
K dynamic [GPa]
K static [GPa]
0
50
100
150
200
250
300
350

Challenges for numerical solutions:

conserving energy: symplectic schemes

free from numerical dissipation and dispersion



Videos:

1. Cylindrical object, elastic vs. rheological behaviour.

2. Temperature evolutions.

$\Rightarrow$ More realistic and accurate estimation for wave propagation.

$\Rightarrow$ More precise NN prediction.

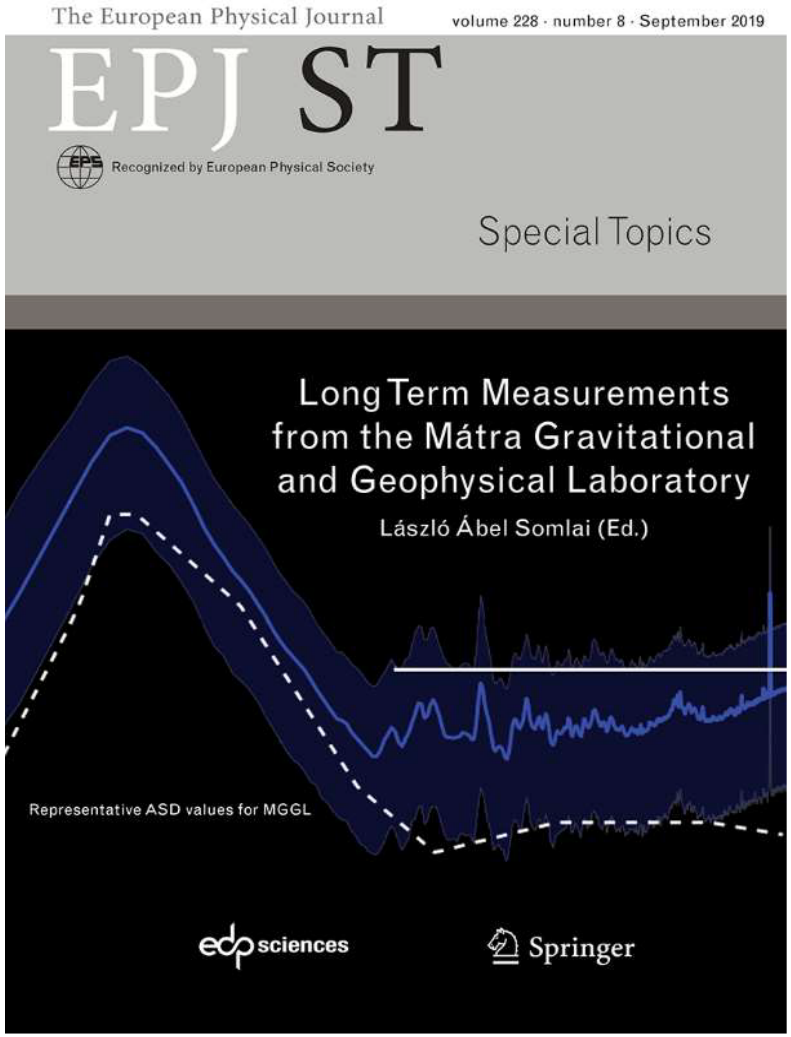
Gravitation in Hungary I.

P. Ván et al.: repeating the Eötvös experiment.

Jánossy Laboratory (Wigner)

Gravitation in Hungary II.

- MGGL underground lab.
- Mátra as former candidate for ET site.
- Seismometers.
- Infrasound detector.
- Magnetometer.
- Muon detector.
- Long-term seismic results.



Thank you for your kind attention!