

Environmental research and sensors at EGO

Dr. Irene Fiori

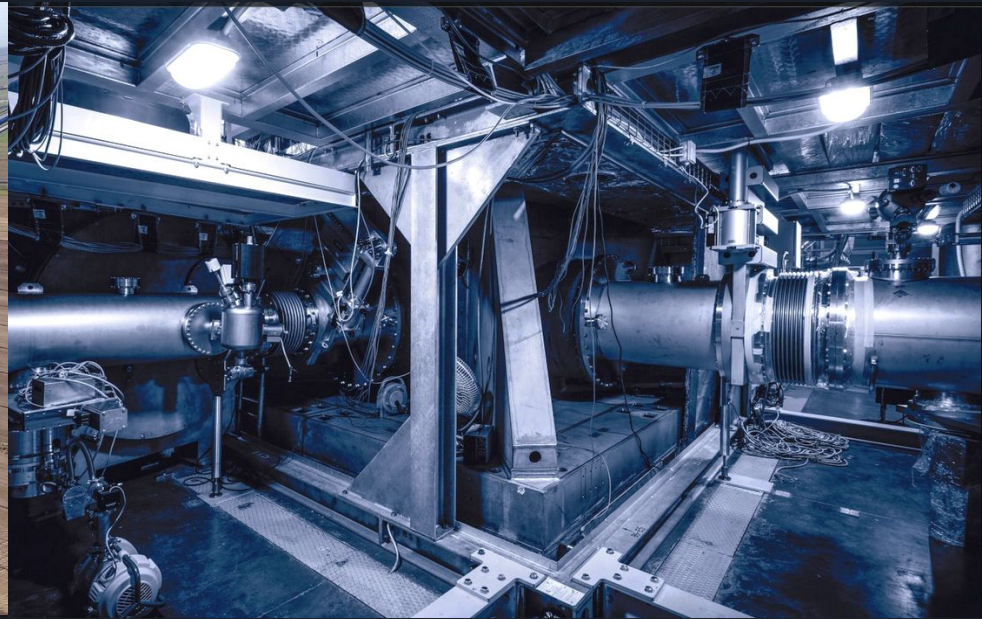
on behalf of EGO-environmental team

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EGO environmental noise team

our mission:

study environmental noises and their impact
on the Virgo interferometer



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Sounds

Vibrations



Electromagnetic

Measure and
monitoring

Identify and model
noise sources and
noise paths

Mitigation
solutions

in tight collaboration with other EGO teams and Virgo community

Sources

Natural

sea, wind,
earthquakes,
lightnings, cosmic
rays, Earth magnetic
fields



Human activity

traffic, wind-turbines,
airplanes, shooting,
tractors, trains, HV
ducts, ...



EGO and Virgo infrastructure

air conditioning systems, vacuum
devices, electricity, Virgo
experimental equipment (e.g. laser
chillers, electronic modules,
cameras, power supply...)



Measure and monitoring

FOCUS is on **low frequency** (≤ 100 Hz) and **low noise** ($< \text{nm}/\sqrt{\text{Hz}}$, $< \text{nT}/\sqrt{\text{Hz}}$)

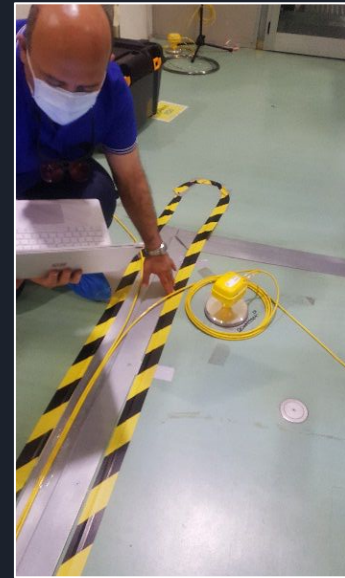
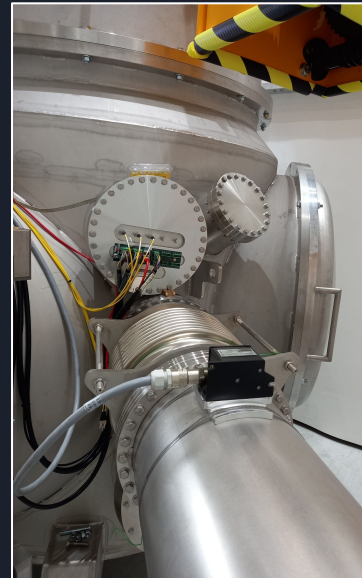
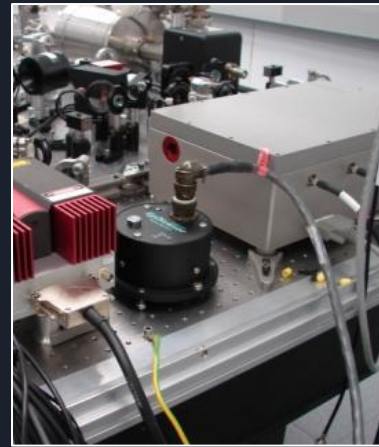
What we have:

Distributed network of sensors inside experimental buildings, in critical locations, continuously and synchronously acquired (~10-year records):

- Temperature, pressure, humidity, dust (~100 per building)
- Seismometers, microphones, magnetometers, RF, voltage and current monitors (~50 per building)

Our interests:

- 2D imaging: acoustic, vibration, magnetic
- Distributed sensing, like DAS systems:
 - we performed test deployment of distributed optical fiber sensors (SILIXA) for infrastructure noise monitoring
- Predictive monitoring of site infrastructure devices

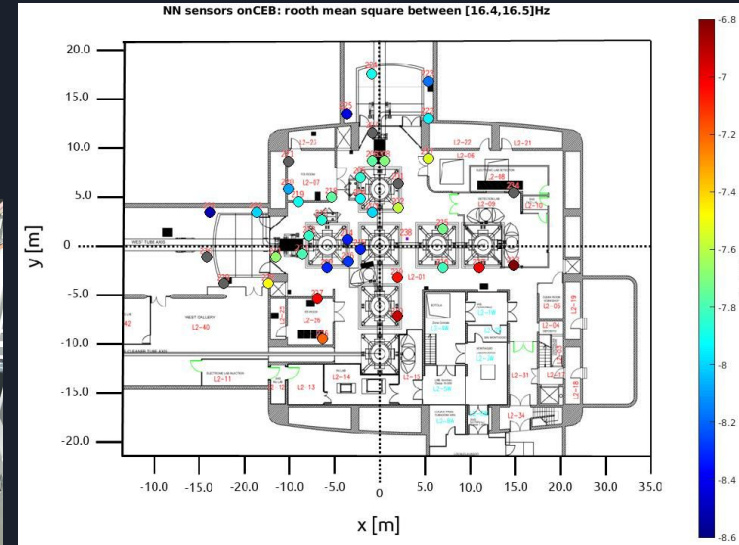
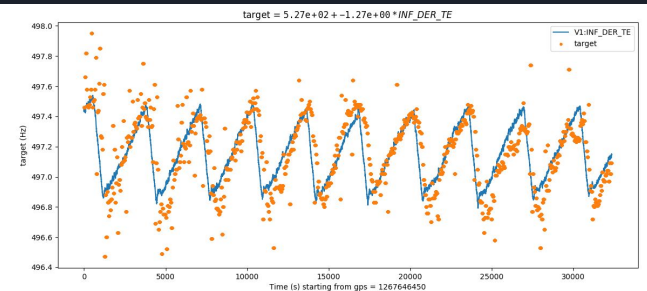


Identification and modelling of sources and noise paths

Measure coupling of environmental noise to Virgo interferometer by means of “noise injections”.

Sources localization by noise maps and “sniffing” with portable sensors.

Study correlations of sensors with ~10.000 Virgo signals.



Mitigation solutions

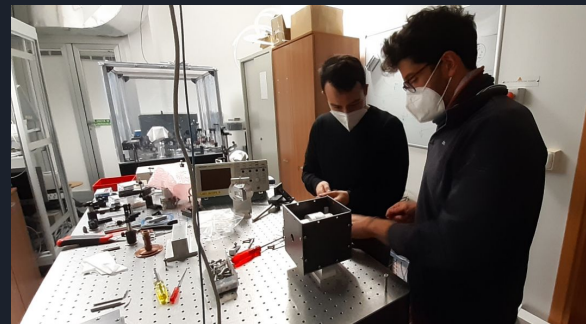
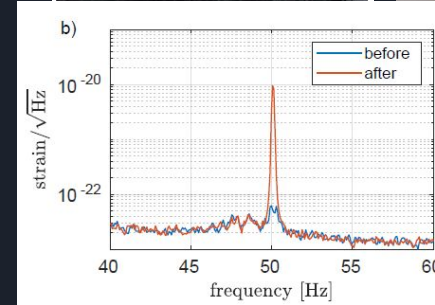
FOCUS is on low frequency noise (<100Hz)

Main targets:

- HVAC system (sound and vibrations)
- VACUUM system (e.g. vibration noise from pumps)
- Virgo detector electronics equipment (e.g. cooling fans, RF interferences, stray magnetic fields)

Mitigation typologies:

- Seismic isolation and damping
- Acoustic isolation and soundproofing
- Magnetic shields
- Active noise cancellation



Robotized sensors



AHEAD 2020
HIGH ENERGY ASTROPHYSICS



Funded by the Horizon 2020
Framework Programme
of the European Union
Grant Agreement No. 871158

Implementation:

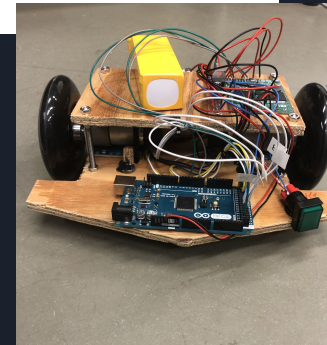
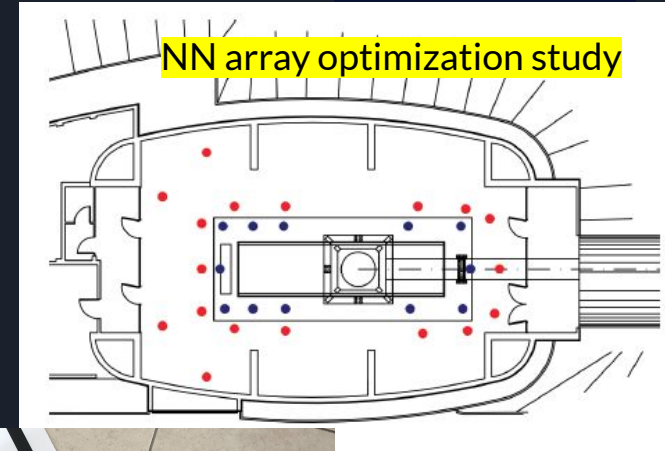
- Array of N robotized platforms carrying a seismic sensor, and eventually multiple sensors (acoustic, magnetic, ...) which move to assigned locations inside Virgo experimental buildings, record and transfer data wirelessly and synchronously to Virgo DAQ and to the position optimization software.

Scientific tasks:

- Cancellation of the gravity gradient noise
[M.C.Tringali https://arxiv.org/abs/1912.08619](https://arxiv.org/abs/1912.08619)
[F.Badaracco https://arxiv.org/abs/1903.07936](https://arxiv.org/abs/1903.07936)
- 2D mapping of large areas, localization of sources

Looking for collaborators:

- Job position - [Robotics and Electronics Technician](#)
- Internship - [robotized seismic array](#)



Thank you for your attention !



The EGO-environmental team

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