Lunar Gravitational Wave Antenna

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2023-04-13

Rilevare le onde gravitazionali: le prime idee

Weber 1960:

> *"Experimental work [...] has begun recently. [...] Excitation of resonant acoustic vibrations in a block of metal [...] is being considered. [...] Search at frequencies* $\sim 10^3$ *cycles per second is planned. "*

Weber 1967:

> *"The use of the Earth's normal modes an those of the Moon offers the possibility of observations in the range from about one cycle per hour upwards in frequency [...]."*

Apollo 17: Lunar Surface Gravimeter

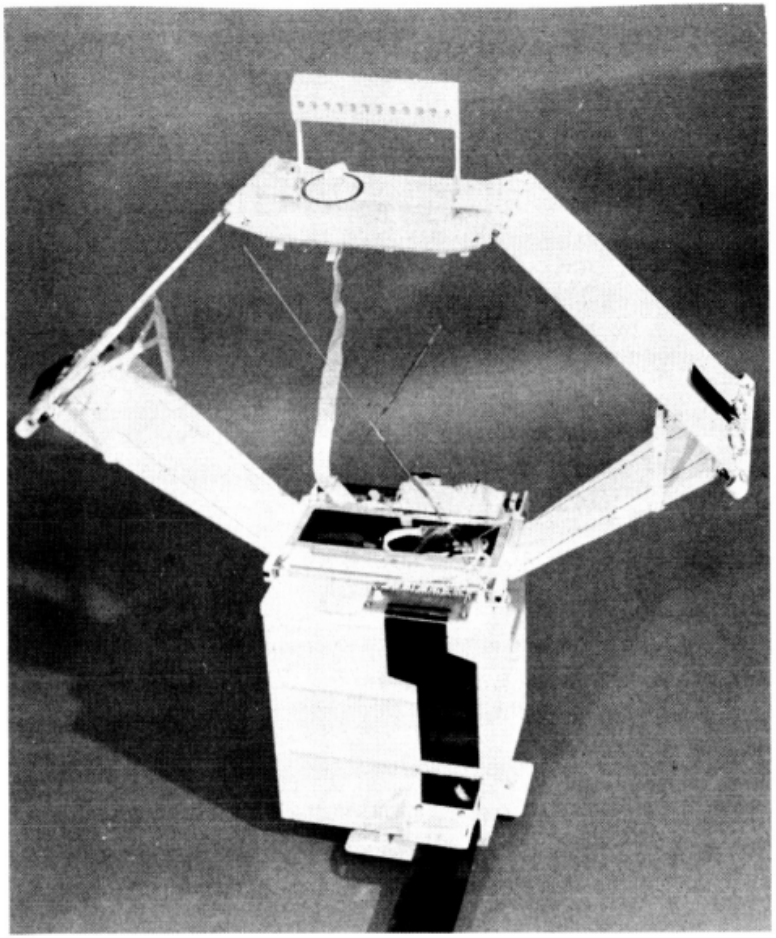
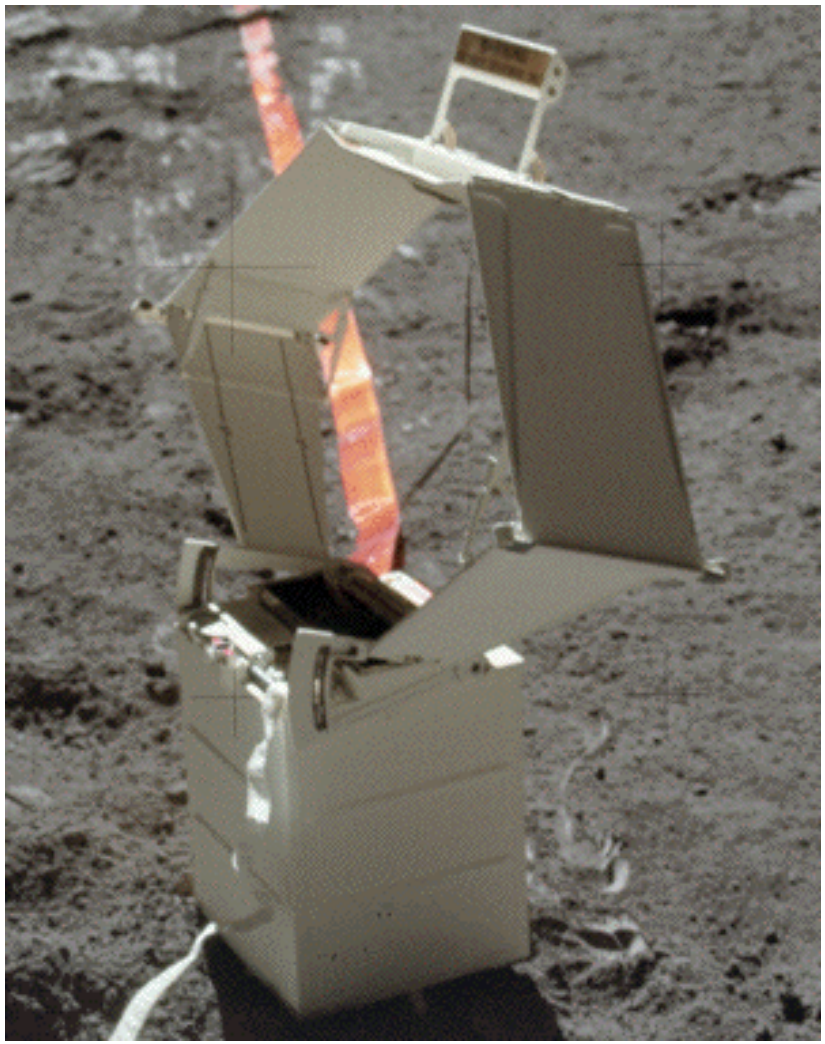


FIGURE 12-1.–Lunar surface gravimeter.



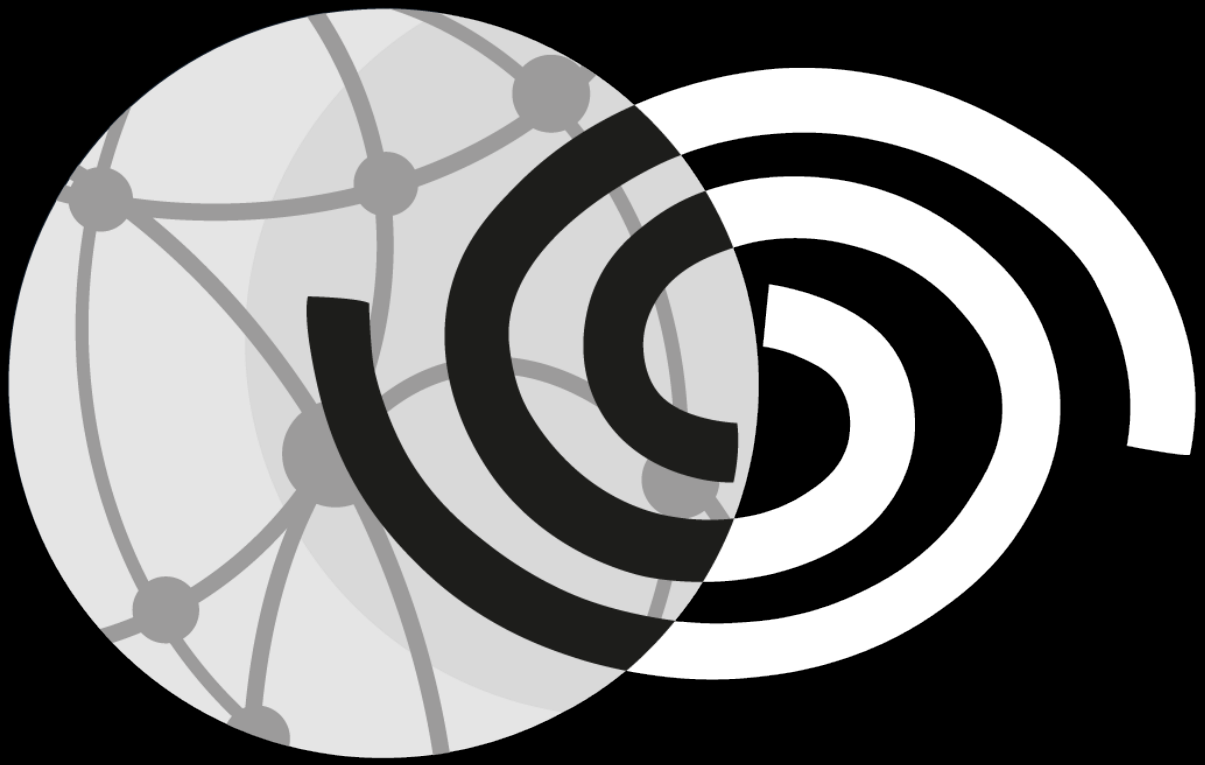
Risultati del Lunar Surface Gravimeter

LUNAR SURFACE GRAVIMETER EXPERIMENT

By Joseph Weber

Approximately 1 year of data are recorded on magnetic tape for lunar surface vertical acceleration. The sensitivity is estimated to be a few angstroms (10^{-10} m) displacement in the vicinity of a narrow spectral band (Q = 25) in the vicinity of 1.5 hertz. The passband of the instrument is from dc to approximately 20 hertz.

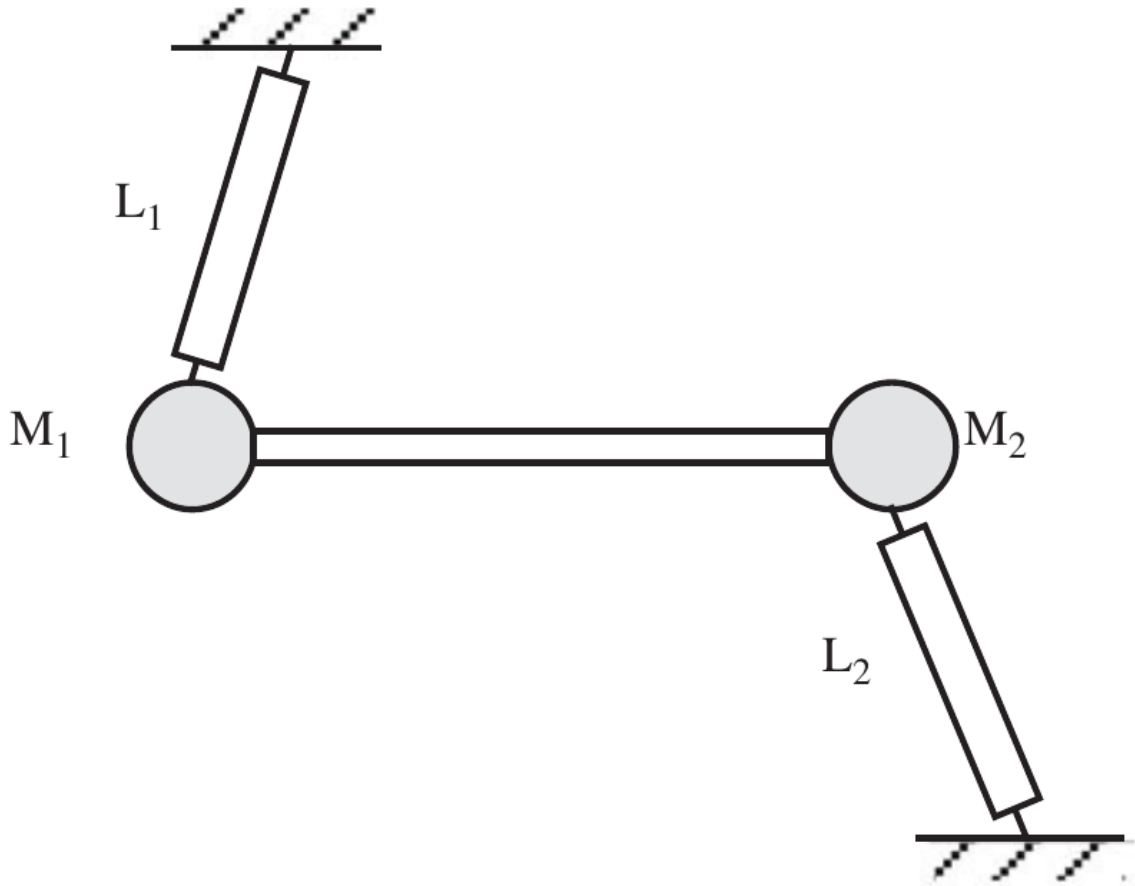
Partial analysis of data has found no resonances corresponding to the lunar free modes of oscillation, and no evidence was found of correlation of lunar surface acceleration with coincidence events observed using the gravitational radiation detectors at the University of Maryland and at the Argonne National Laboratory. It should be noted that only extremely wideband phenomena would have been observed in such a correlation analysis. The Argonne-Maryland detectors have a very narrow passband in the vicinity of 1660 hertz, which is far from the lunar-surface-gravimeter passband near 1 hertz.



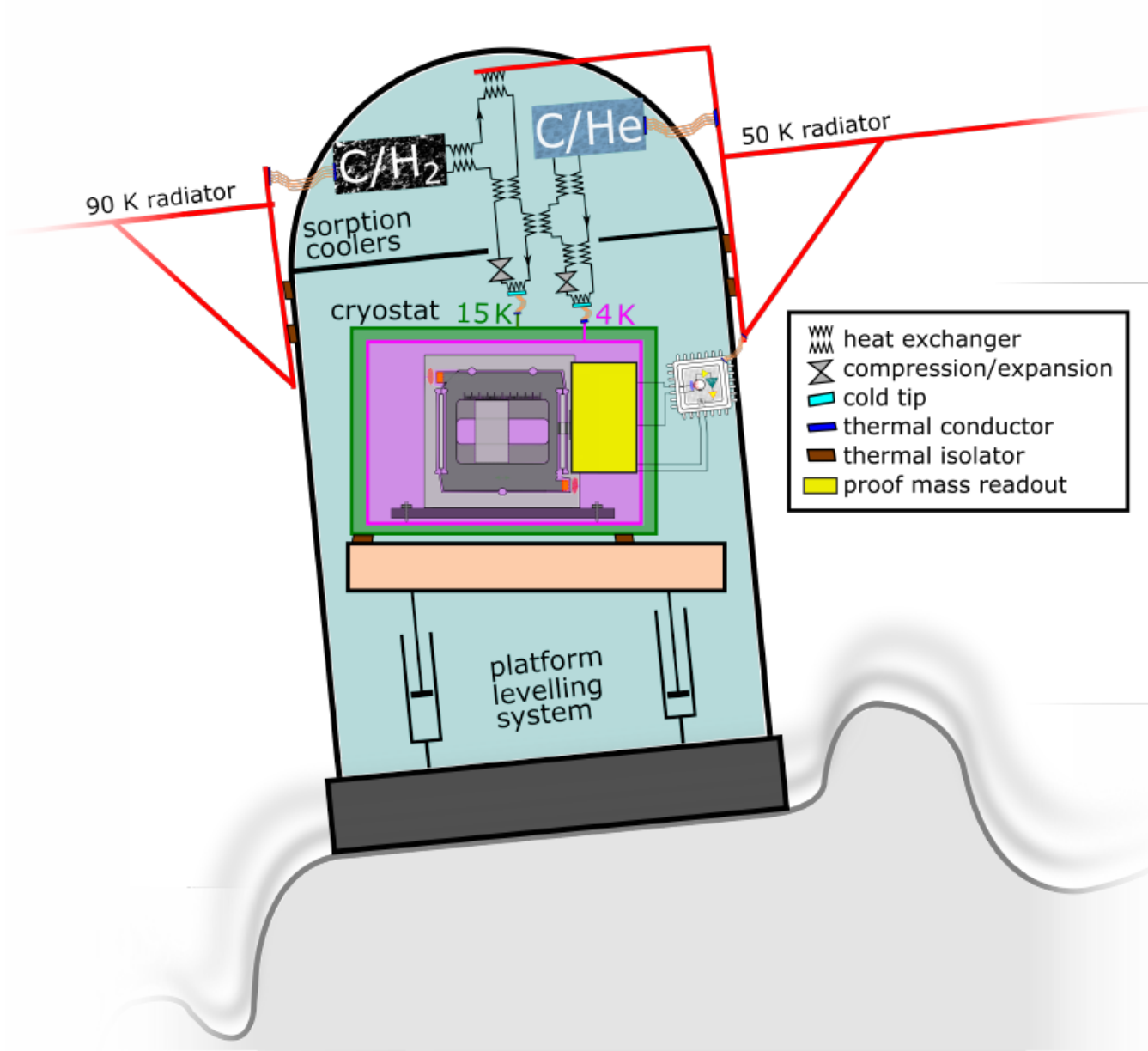
LGWA

Misura di spostamento inerziale: collegamento di Watt

$$F = -\left(\frac{M_1}{L_1} - \frac{M_2}{L_2}\right) gx$$

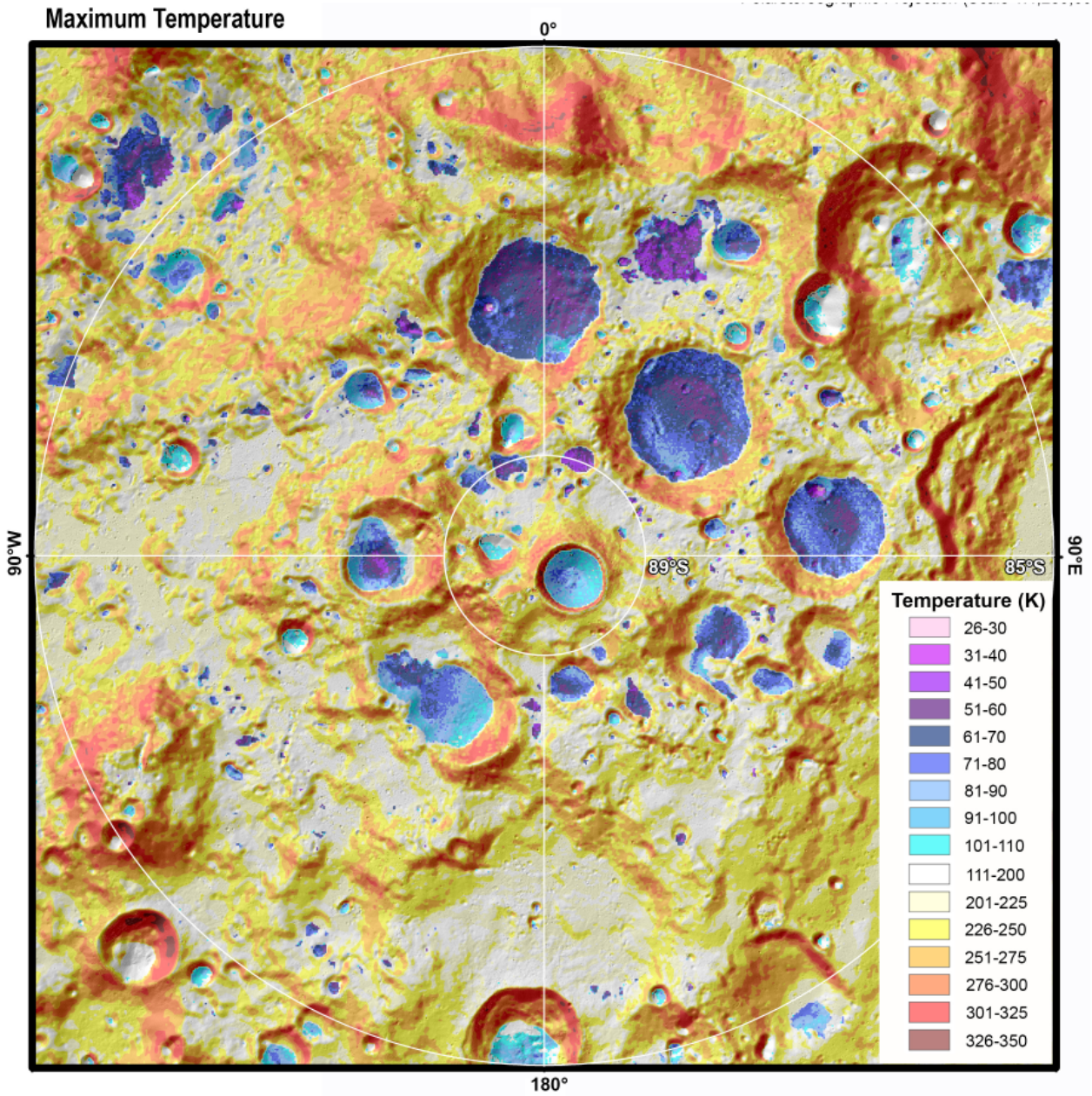


Struttura di un sismometro di LGWA

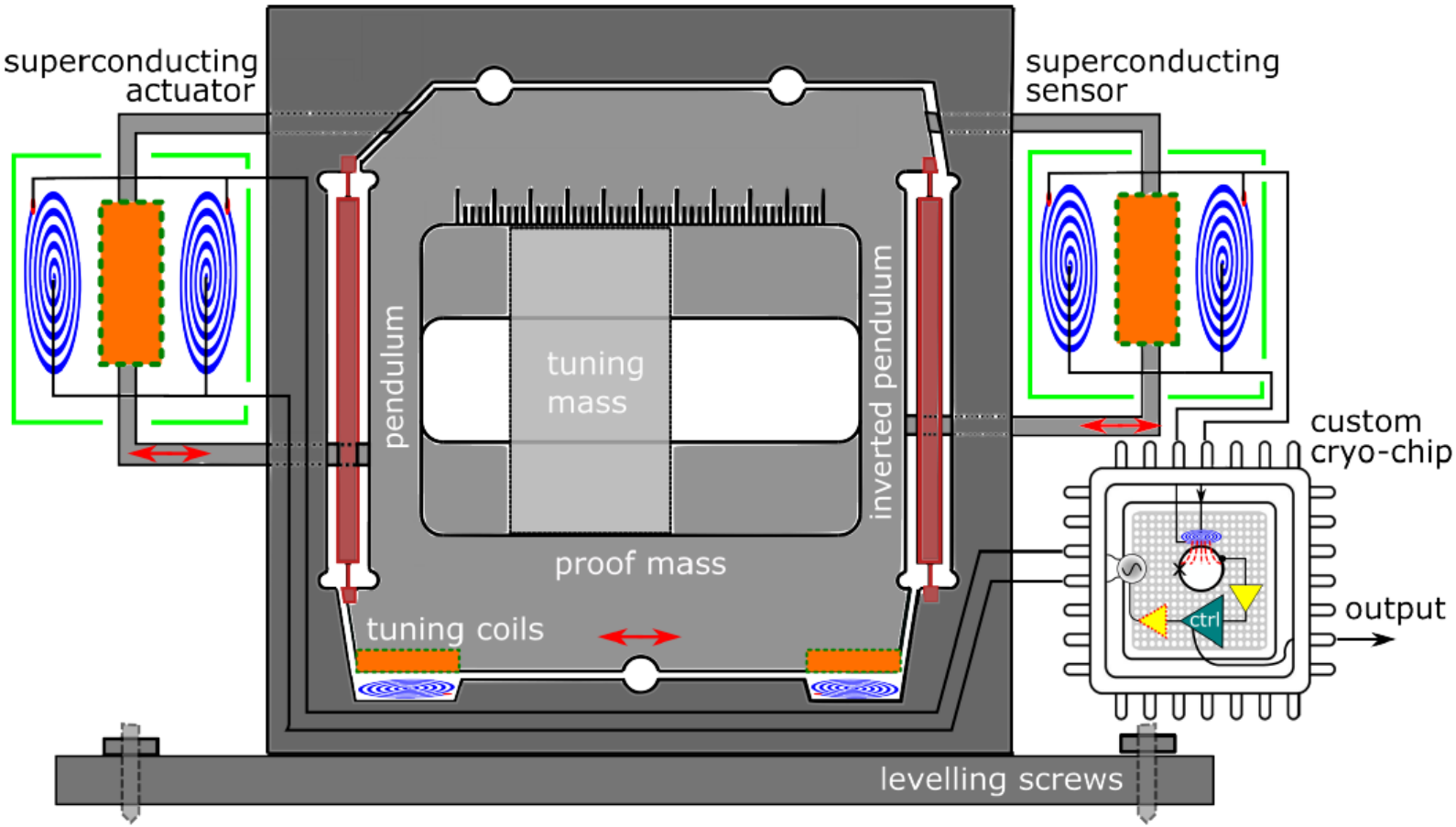


Posizionamento di LGWA

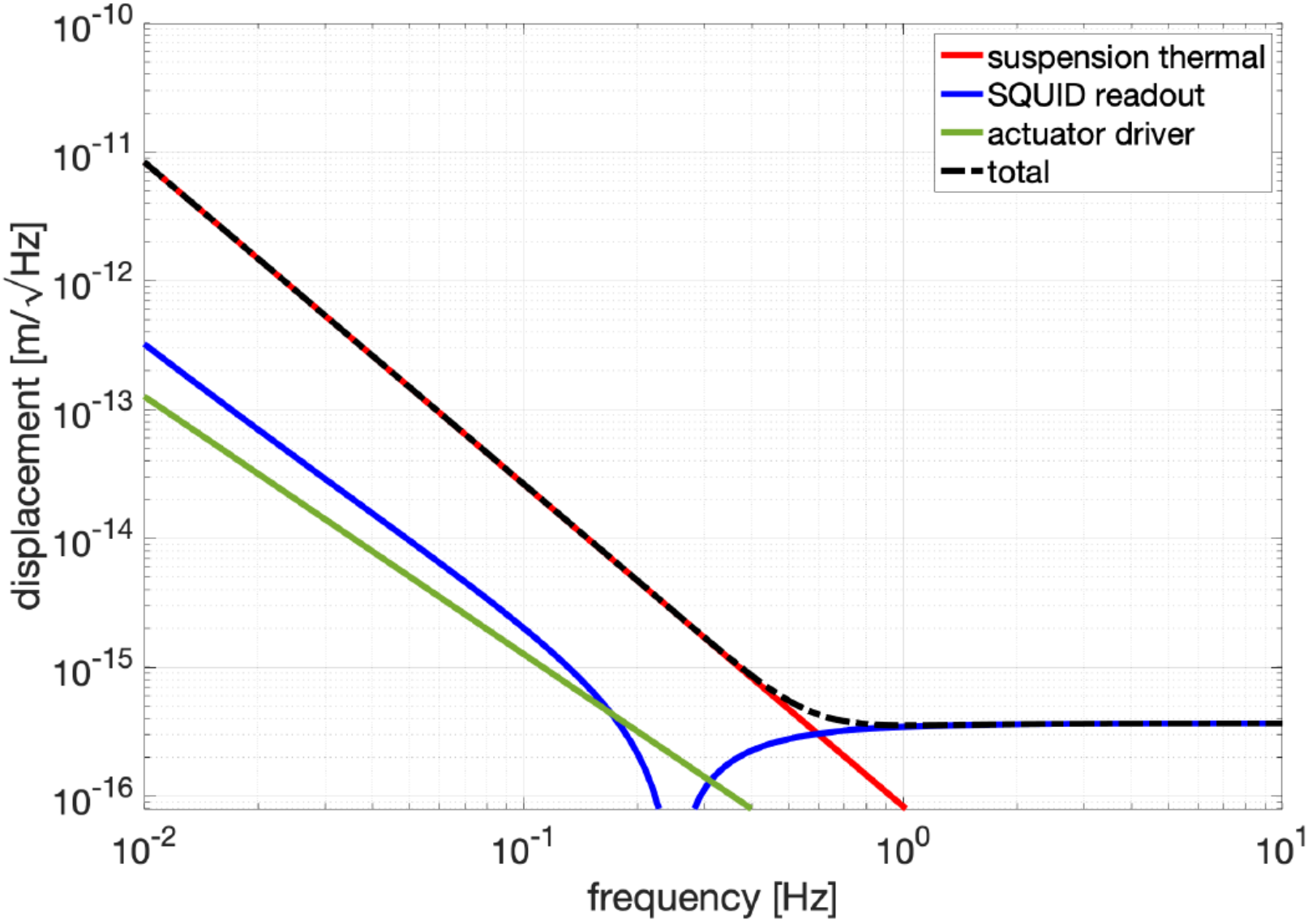
Crateri permanentemente in ombra



Misura di spostamento inerziale con SQUID

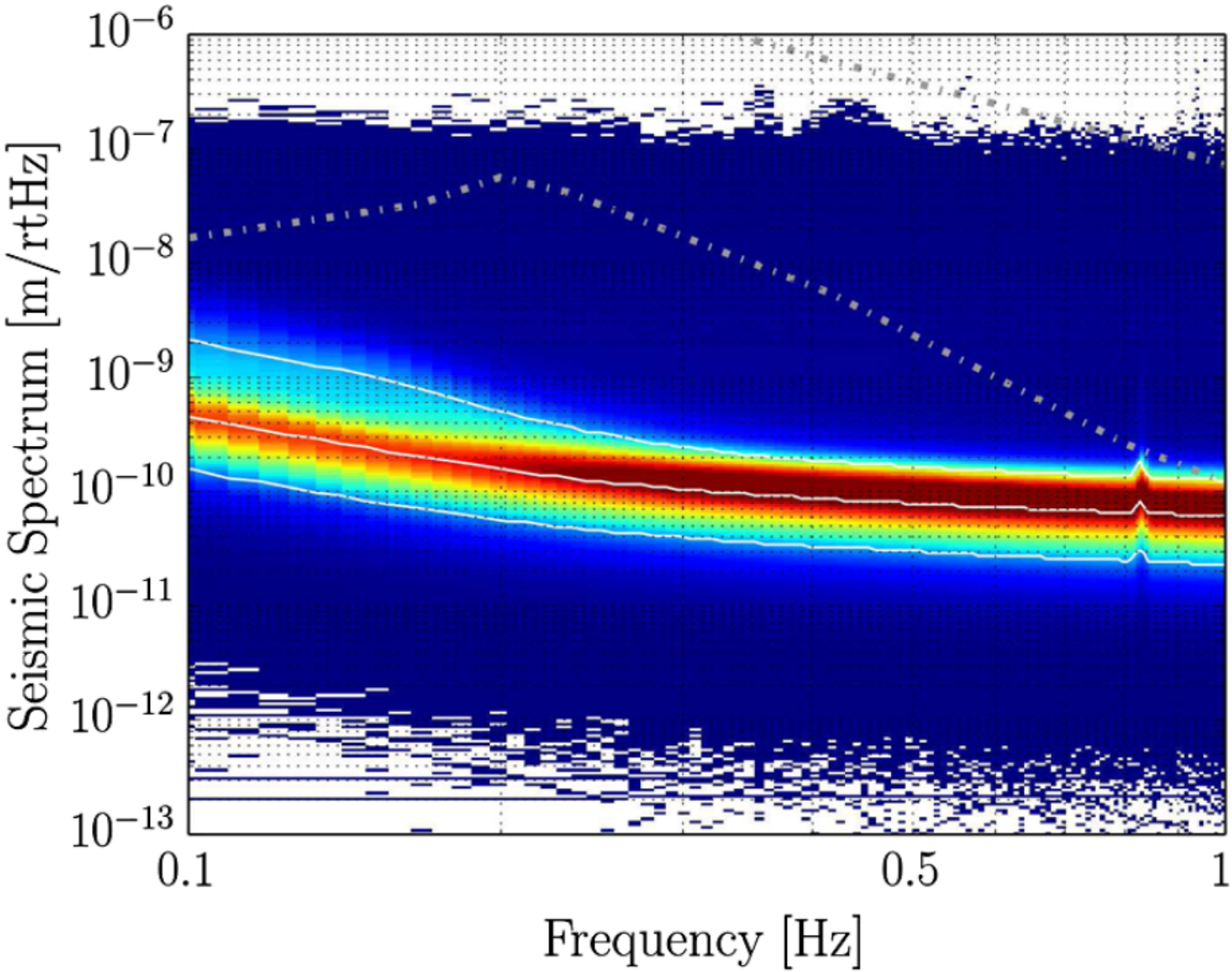


Il rumore termico domina a bassa frequenza

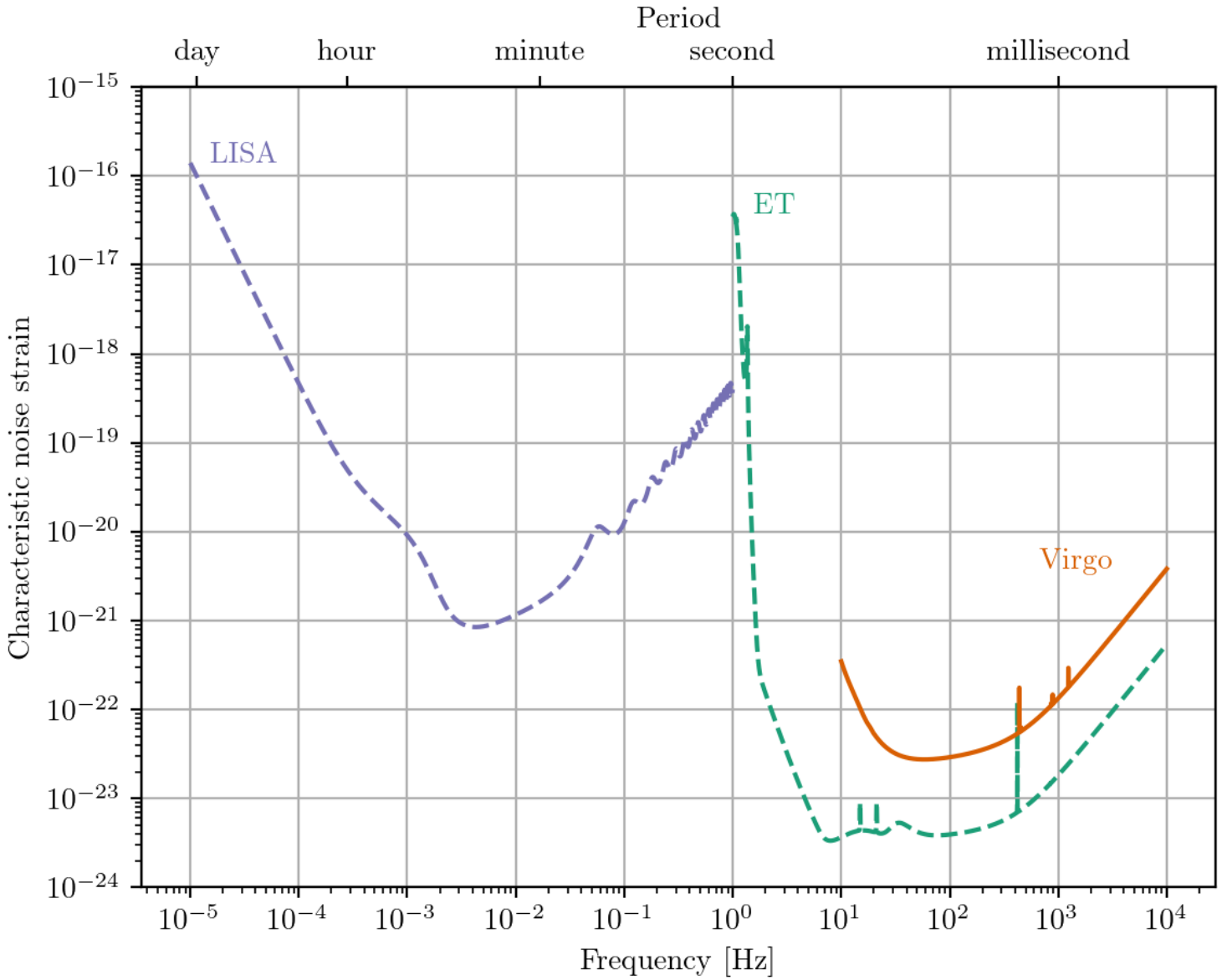


(b)

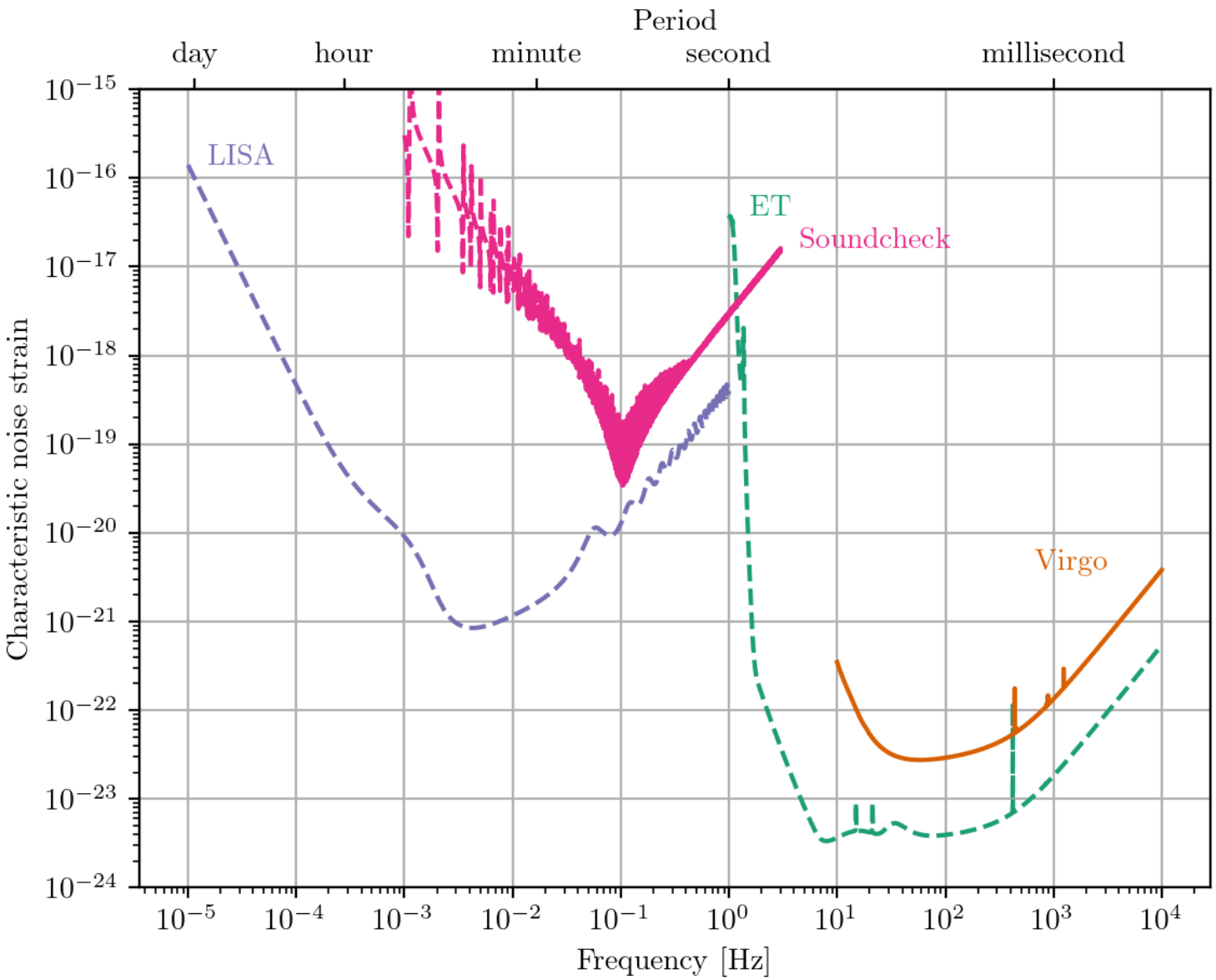
Limiti di Apollo 14 sullo spettro sismico



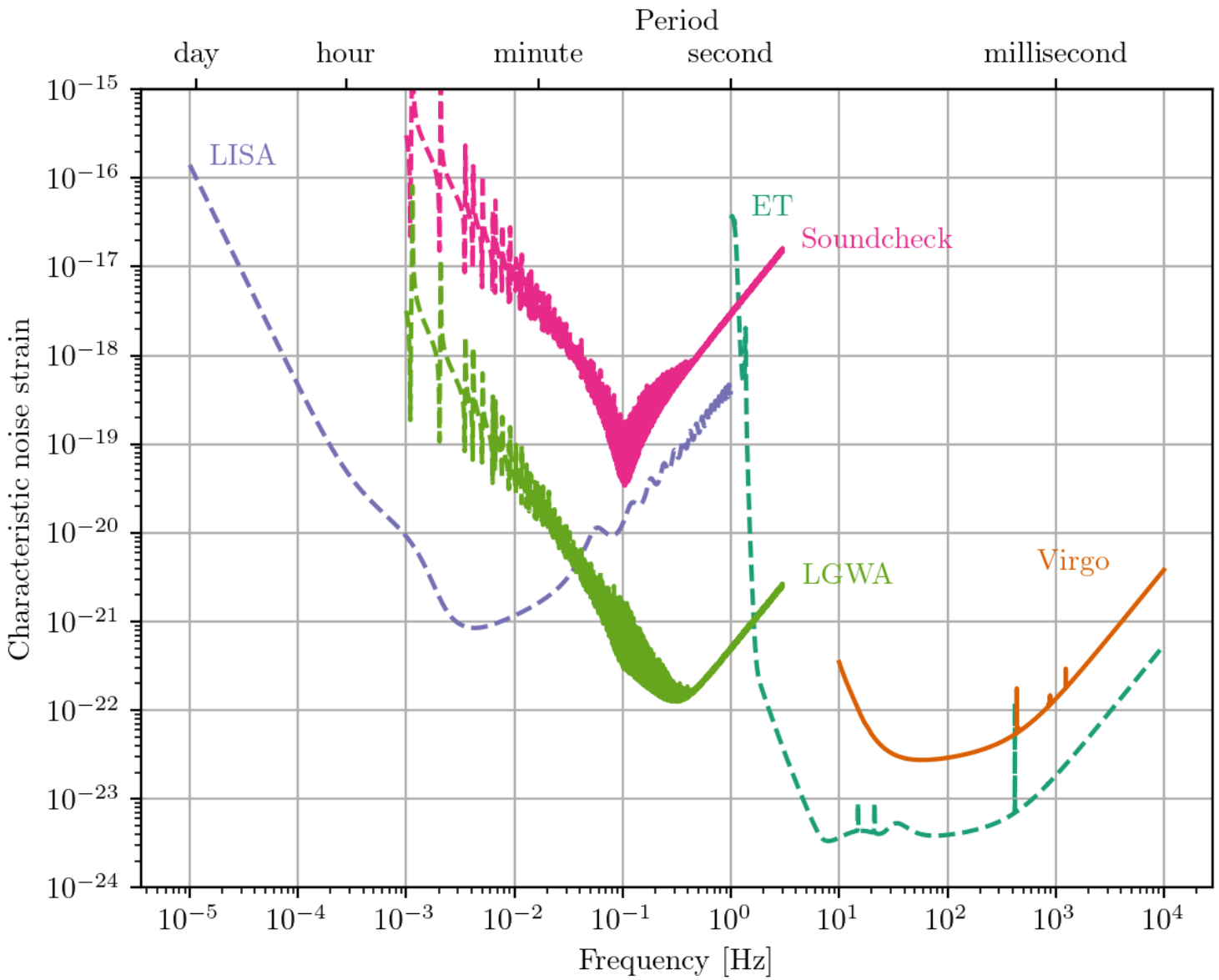
Sensibilità dei rilevatori negli anni 2030



Soundcheck


Period
day
hour
minute
second
millisecond
LISA
ET
Soundcheck
Virgo
Characteristic noise strain
Frequency [Hz]
10^{-15}
10^{-16}
10^{-17}
10^{-18}
10^{-19}
10^{-20}
10^{-21}
10^{-22}
10^{-23}
10^{-24}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}

LGWA


Period
day
hour
minute
second
millisecond
LISA
ET
Soundcheck
LGWA
Virgo
Characteristic noise strain
Frequency [Hz]
10^{-15}
10^{-16}
10^{-17}
10^{-18}
10^{-19}
10^{-20}
10^{-21}
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10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}

Bibliografia minimale

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- Bertolini et al, 2006, *Mechanical design of a single-axis monolithic accelerometer for advanced seismic attenuation systems*.