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A seismic isolation system for the test masses of the Einstein Telescope

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The Einstein Telescope (ET) gravitational wave interferometer will be the biggest research infrastructure built in Europe in the next decade and its design and construction will bring unprecedented technological challenges.
Third-generation gravitational wave detectors, such as ET, aim at reducing their noise to the lowest possible level for an Earth bound detector, broadening their detection band down to 2 Hz. This improved sensitivity, with respect to Virgo and LIGO, gives access to the early Universe by detecting high red-shift black hole mergers, to the extreme space-time curvature of high mass black holes. It makes possible to detect neutron star inspirals well before they merge, allowing a multimessenger observation of extreme states of matter.
The sensitivity increase in the low frequency region will put however challenging constraints on the suppression of seismic noise. On the basis of the experience accumulated in construction and running the Virgo interferometer for the last two decades, we are developing a suspension system that seismically isolates the test masses of ET at frequencies above 2 Hz with the same height - of about 10 m - of current Virgo Superattenuator. With respect to the baseline design for ET, this study aims at reducing the size of the isolation system, resulting in very significant cost savings in ET civil works. The project foresees an evaluation of possible solutions performing simulation with software tools validated by the previous experience, a detailed mechanical design of the first isolation stages, that are most critical, their construction and successive tests at the Sar-Grav laboratory located in the Sos Enattos mine in Sardinia, candidate as the site to host ET, due to its unique seismic characteristics.

Collaboration

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