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Installation of the Omnisens inertial isolation system.

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To achieve its ambitious scientific goals [1], the Low-Frequency Einstein Telescope observatory aims for orders-of-magnitude reduction in residual strain noise between 3-10 Hz compared to current detectors. Many noises affecting the 3-10 Hz band are driven by ground vibration and the resulting residual motion of the interferometer optics. These noises have been a challenge to deal with in second-generation GW detectors [2, 3], and threaten to severely impact the low-frequency sensitivity of ET-LF unless substantial improvements in the initial stages of the seismic isolation chain are developed.

The Omnisens experiment is a novel in-vacuum inertial isolation system based on six-dimensional interferometric sensing of a reference test-mass [4]. The three-armed test-mass is suspended from the inertial platform using a high-quality-factor fused-silica suspension system. Thanks to its large moment of inertia and to the overlap of its centre-of-mass with its centre-of-rotation, the test-mass has a tilt resonance frequency lower than 10 mHz.
The relative position of the test-mass with respect to the inertial platform is sensed using six compact Homodyne Quadrature Interferometers (HoQI) [5].
A high-gain control system actuates on the inertial platform to make it follow the suspended test mass. Low-noise is achieved in all six degrees of freedom, suppressing the effect of cross-couplings thus allowing to distinguish rotation from translation.

The presentation will discuss the status of the Omnisens experiment currently being assembled in Amsterdam and its future commissioning and characterisation.
Most recent updates include the suspension of the test-mass from the fused-silica fibre, the assembly and on-going installation of the active inertial platform and the measurement of the performance achieved by the matured-design Omnisens HoQI detectors.
The presentation will also treat well known problems such as long-term drifts of the suspended test-mass orientation and thermal gradients, which will be addressed by the installation of thermal shields, centre-of-mass tuners, and low-noise electrostatic drive actuators acting on the suspended test-mass.

[1] Einstein Telescope Steering Committee, "Design report update 2020: for the einstein telescope,"Einstein Telescope Collaboration, Tech. Rep. ET-0007B-20, 11 2020. https://apps.et-gw.eu/tds/ql/?c=15418

[2] Martynov D V et al 2016, Sensitivity of the advanced ligo detectors at the beginning of gravitational wave astronomy Phys. Rev. D 93 112004. https://doi.org/10.1103/PhysRevD.93.112004

[3] Acernese, F., T. Adams, K. Agatsuma, L. Aiello, A. Allocca, A. Amato, S. Antier, et al. "Advanced Virgo Status."Journal of Physics: Conference Series 1342, no. 1 (January 1, 2020): 012010. https://doi.org/10.1088/1742-6596/1342/1/012010.

[4] Mow-Lowry, C M, and D Martynov. "A 6D Interferometric Inertial Isolation System."Classical and Quantum Gravity 36, no. 24 (November 14, 2019): 245006. https://doi.org/10.1088/1361-6382/ab4e01.

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