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Status of cryostat design for cryogenic payload suspension studies for the Einstein Telescope

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The Einstein Telescope (ET) is a third generation gravitational wave detector planned in Europe, combining a low-frequency (LF) and a high-frequency (HF) laser interferometer. Cryogenic operation of ET-LF in the temperature range of 10 K to 20 K is essential to suppress the suspension thermal noise, which dominates the detection sensitivity at
frequencies below 10 Hz. This requires suspension materials with high thermal conductivity and low mechanical dissipation at cryogenic temperatures. The baseline design currently considers two suspension concepts, using monocrystalline suspension fibers made of silicon or sapphire, and/or a thin-wall titanium suspension tube filled with static He-II. The mechanical Q-factor provides physical insight into dissipative mechanisms of material samples and their applicability as cryogenic suspensions in gravitational wave detectors. It is measured by the ring-down method, exciting the suspensions to resonant vibrations and analyzing the decay time. For this purpose, a test facility is being designed that enables full-size studies with various suspension materials and geometries. This includes also the integration of a noise-free He-II supply for investigating dissipation mechanisms in the static He-II column inside suspension tubes, which is a new field of research. We present the design progress,including specific design conditions imposed by the experimental campaigns.

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