

He-II filled marionette suspension for the cryogenic payload of the ET-LF interferometer

Abstract. The low-frequency interferometer in the Einstein Telescope (ET-LF) shall be operated at test mass temperatures of 10 K to 20 K. Motivated by the potential of using superfluid helium (He-II) for cooling the test masses due to its exceptional heat transport properties and presumably low dissipative behaviour, we present the concept of integrating a double-walled He-II filled marionette suspension in the payload design. During the cool-down process, supercritical helium (He-I) at adjustable temperature flows in counter-flow through the double-walled suspension in order to cool the marionette. In steady-state operation, the suspension is filled with liquid He-II at rest, providing ultra-low noise cooling at 2 K via steady-state heat conduction. Considering the crucial role of the payload suspensions on the ET-LF sensitivity, we present the results of a thermal and mechanical feasibility analysis with particular focus on suspension thermal noise.

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