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A study of suspensions with flexures in compression for cryogenic mirrors

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The Einstein Telescope will operate with cryogenic mirrors at 10-20K. This temperature needs to be maintained by extracting heat coming from absorption in the substrate and coating and thermal radiation. We present a study of an alternative to tensile suspensions of the Einstein Telescope mirrors. The mirror suspensions presented here tackle the conflicting requirements of being good heat conductors while remaining soft to preserve low thermal noise vibration isolation. Additionally, using small diameter silicon flexures deals with the low tensile strength of crystalline silicon.
The design consists of large suspension beams, connected to marionette and mirror, by thin, small flexures. The architecture is organised such that the flexure sustains compressive load only. The bending strain due to mirror motion is concentrated in this flexible part, and therefore we expect a low suspension thermal noise. Here, we show the trade-offs induced by this suspension design, focussing on the flexure design, and how it affects the frequency and thermal response of the system.

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