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Development of a Silicon Suspension System for the Einstein Telescope Pathfinder

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The Einstein Telescope Pathfinder (ETPF) is a cryogenic test facility in Maastricht, aimed at developing core technologies for the Einstein Telescope, a future third-generation gravitational wave observatory. One key component under investigation is a low-noise suspension system designed for cryogenic operation. Due to its low mechanical quality factor and high thermal expansion at cryogenic temperatures, the so far used material, silica, can not be used to reach the aimed sensitivity goals. Silicon, therefore, is a strong candidate for use in suspension elements due to its favourable properties at low temperatures, including a high mechanical quality factor, excellent thermal conductivity, and a low thermal expansion coefficient. These characteristics are critical for thermal noise reduction and system stability under cryogenic conditions. To address potential variations in the geometry of silicon suspension wires and further minimise thermal noise, the implementation of silicon blade springs is being explored. We currently use finite element simulations to study different blade designs with a focus on stress distribution, deformation, and eigenfrequencies. Additionally, we present prototypes of silicon–silicon connections.

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