

Vibration-free Mirror Coating Test Facility for the Einstein Telescope

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The Einstein Telescope is a proposed ground-based third-generation gravitational wave observatory. The extreme sensitivity with which current second-generation gravitational observatories have measured gravitational waves is to be improved even further. One of the ways in which this is achieved is by cooling down the mirrors of the interferometers. Brownian noise, mainly originating from the coating of the mirrors, scales with temperature and as such can be suppressed by operating at cryogenic temperatures. Development of the mirror coatings is an ongoing process and the performance of these coatings (in terms of noise) will need to be tested.

Characterisation of mirror coating noise requires a cryogenic setup of which the background noise contribution is limited to an absolute minimum. We achieve this by using an off-the-shelf cryocooler combined with a thermal storage unit (TSU). The cryocooler is switched off during mirror coating characterisation and the low operating temperature (typically 10 K) is maintained by the TSU, thus allowing for vibration-free experiments. The mirror is then stabilised at its operating temperature using a controllable heat switch to tune the heat flow from the mirror test platform to the TSU.

We will present the design of this system and simulations demonstrating the intended operation. Furthermore, the next steps in towards the realization of the system will be discussed.

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