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The World's First Underground Facility for Interplatform Control and Seismic Isolation in Gravitational-Wave Detection

We present the design and performance requirements of GEMINI, the first underground R&D facility dedicated to active seismic isolation and interplatform control for next-generation gravitational-wave observatories. The GEMINI site is located 1.4 km deep at the National Laboratories of Gran Sasso (LNGS). The facility consists of two actively isolated platforms operating in a vacuum, designed to achieve a record-low residual motion in the 1 mHz to 1 Hz band. For the Einstein Telescope (ET), GEMINI will test interplatform control in an underground environment for the first time. It will be essential in assisting the ET length and alignment control of auxiliary degrees of freedom and hence in enabling ET performance. We are also addressing the tilt-to-horizontal coupling, essential for meeting the stringent noise requirements of ET's underground interferometers. Furthermore, GEMINI will provide platforms to test novel, high-precision accelerometers at cryogenic temperature as will be required for the Lunar Gravitational-wave Antenna.

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