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Building the Quietest Underground Platforms: GEMINI for the Einstein Telescope and Beyond

GEMINI is an underground research and development facility dedicated to advancing seismic isolation and control technologies for future gravitational-wave observatories. Its primary mission is to support the Einstein Telescope (ET) by providing a testbed for inter-platform control strategies, essential for stabilizing auxiliary interferometer degrees of freedom. The facility consists of actively isolated platforms designed to suppress motion from 10 mHz to 10 Hz, with the goal of achieving the quietest seismic environment of its kind. Detailed noise budgets, performance predictions, and residual motion evaluations are presented.

Beyond ET, GEMINI also provides a unique environment for testing cryogenic payloads and ultra-sensitive inertial sensors, including those envisioned for the Lunar Gravitational-Wave Antenna (LGWA). By integrating advanced cryogenic systems, precision inertial sensors, and state-of-the-art vibration isolation, GEMINI serves as a versatile testbed for both terrestrial and lunar gravitational-wave science.

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