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Strategies for Mitigating Magnetic Noise in Future Gravitational Wave Detectors

The sensitivity of future Gravitational Wave (GW) detectors, such as the Einstein Telescope (ET), will be significantly limited by various noise sources, particularly magnetic noise, especially at low frequencies (from a few Hz to around 100 Hz). Magnetic noise arises from the interaction between environmental magnetic fields and magnetized elements, such as magnet-coil actuators. These environmental fields include natural background noise, such as Schumann Resonances, as well as "self-inflicted" noise. The latter stems from any device carrying an electric current, including power grid cables, motors, pumps, and conductive materials that are part of the detector infrastructure. Ambient magnetic fields exert forces on permanent magnets or ferromagnetic materials, generating field gradients and induced currents in sensitive electronics and conductive components, thereby amplifying the field gradients. Drawing on experience from Virgo and KAGRA interferometers, efforts have been made to identify the sources of magnetic noise, with the goal of optimizing future ET infrastructure. This talk will provide an overview of the nature of magnetic noise and propose potential mitigation strategies for ET.

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