Vibration and EMF Backgrounds at NEXUS
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Background

NEXUS (Northwestern EXperimental Underground Site) is a dark matter detector prototyping and calibration facility at Fermilab. It is part of the SuperCDMS collaboration, which is focused on exploring light-WIMP parameter space. The NEXUS cryostat, typically operated at temperatures of about 10 mK, is located 107 meters underground in the MINOS Near Detector Hall to reduce cosmic ray backgrounds. We characterized the vibrational and electro-magnetic frequency (EMF) backgrounds surrounding the cryostat and investigated how these backgrounds transfer into the detector itself.

Measurements

Vibration on and around the cryostat was measured using a piezoelectric transducer. Sets of measurements were taken with fridge equipment in different states, and with mechanical and acoustic excitation of different components. EMF around the cryostat and potential noise sources like computer equipment and lights was measured using a loop of copper wire.

Results and Next Steps

The frequency signatures of fridge components and local EMF sources were identified, along with the resonance frequencies of the cleanroom and cryostat.

Detector Operation

Collisions in the detector payload create electron-hole pairs whose energy is converted to quantized thermal vibrations known as phonons[2]. These phonons heat up the Transition-Edge Sensors (TES), which respond strongly to small changes in temperature.

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The current through the TES is measured by the magnetic field it creates through a Superconducting QUantum Interference Device (SQUID). The SQUID output is carried out of the fridge by a chain of temperature-specific wiring that was installed over the course of this investigation.

References