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Superconducting Quantum Sensors for Fundamental Physics Searches

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Superconducting Transition Edge Sensors (TESs) are a promising technology for fundamental physics applications due to their low dark-count rates, good energy resolution, and high detection efficiency. On the DESY campus, we have been developing a program to characterize quantum sensors for fundamental physics applications, particularly focused on TESs. We currently have one fully equipped dilution refrigerator for TES characterization, and a second dilution refrigerator is being prepared. In this presentation, we will summarize the current status of our TES characterization, including recent calibration efforts and efficiency measurements, as well as simulations to better understand the TES behavior. Additionally, we will summarize physics applications we are already exploring or planning to explore. We will give the latest results on a direct dark matter search with our TES, where exploiting low-threshold electron scattering in superconducting materials allows us to search for MeV-scale dark matter. We are also working toward performing the first measurement of the even number photon distribution (beyond one pair) of a quantum-squeezed light source. Finally, if it proves to meet the requirements, our TES detector may be used as a second, independent detection system to search for an axion signal at the ALPS II experiment.

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