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Two-stage Cryogenic Charge Amplifier for Semiconductor Dark Matter Detectors

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Effective searches for sub-GeV particle dark matter require sensitivity to recoil energies below ~1 eV. The SPLENDOR (Search for Particles of Light dark mattEr with Narrow-gap semiconDuctORs) collaboration aims to detect MeV-scale dark matter through the use of novel narrow-gap semiconductor materials coupled to extreme low noise charge amplifiers. In this talk, I describe the design and performance of a two-stage cryogenic charge amplifier built upon CryoHEMTs - commercial HEMTs (high electron mobility transistors) specifically designed for deep cryogenic charge readout. A base temperature source-follower stage is first used to buffer the charge signal, mitigating the effects of cabling/stray capacitance. The buffered signal is then amplified at T=4K and read out using standard room temperature electronics. The amplifier's expected charge resolution is a few electrons, resulting in sub-eV energy resolution when coupled to a suitable narrow gap material.

Early Career

Yes

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