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Development of SuperCDMS Silicon HVeV Detectors for Low Mass Dark Matter Searches and Studies of Low Energy Excess

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The SuperCDMS-HVeV program has previously demonstrated competitive sensitivities to electron-recoil [1] and nuclear-recoil [2] dark matter in the sub-GeV mass range using voltage biased silicon crystals equipped with TES calorimeters. HVeV detectors have achieved excellent energy resolution through the application of an electric field to the crystal that enables amplification via the Neganov-Trofimov-Luke effect, allowing for eV-scale thresholds and enabling low mass dark matter searches. However, recent direct-detection searches for low mass dark matter including those from SuperCDMS [3], DAMIC [4], SENSEI [5], CRESST [6], and EDELWEISS [7] have encountered an excess of events at low-energy with unknown origin. As such, understanding the origin of these events is crucial to the study dark matter. HVeV detectors are well-suited for studies of this excess due to their excellent resolutions. New developments on the original HVeV design seek to test hypotheses regarding the origin of low energy events. In this poster, I will show two new iterations of HVeV detectors each designed to test a different hypothesis. In the first new iteration of HVeV detectors, an insulating layer is deposited between the crystal bulk and the phonon sensors to reduce signal from the diffusion of charge carriers through the crystal-sensor interface. The second iteration focuses on improving the position resolution of the HVeV detector in order to isolate stress-induced events near the edge of the detector caused by mechanical clamping during operation.

References

[1] R. Agnese et al. “First Dark Matter Constraints from a SuperCDMS Single-Charge Sensitive Detector”. In: Physical Review Letters 121.5 (Aug. 2018).

[2] M. F. Albakry et al. “Investigating the sources of low-energy events in a SuperCDMS-HVeV detector”. In: Physical Review D 105.11 (June 2022).

[3] R. Agnese et al. “Low-mass dark matter search with CDMSlite”. In: Physical Review D 97.2 (Jan. 2018).

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[4] I. Arnquist et al. “First Constraints from DAMIC-M on Sub-GeV Dark-Matter Particles Interacting with Electrons”. In: Physical Review Letters 130.17 (Apr. 2023).

[5] Orr Abramoff et al. “SENSEI: Direct-Detection Constraints on Sub-GeV Dark Matter from a Shallow Underground Run Using a Prototype Skipper CCD”. In: Physical Review Letters 122.16 (Apr. 2019).

[6] A. H. Abdelhameed et al. “First results from the CRESST-III low-mass dark matter program”. In: Physical Review D 100.10 (Nov. 2019).

[7] E. Armengaud et al. “Searching for low-mass dark matter particles with a massive Ge bolometer operated above ground”. In: Physical Review D 99.8 (Apr. 2019).

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