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# Effects of energy accumulation in materials: Self-Organized Criticality dynamics in low energy threshold ionization detectors for coherent neutrino scatter, dark matter searches and in superconducting sensors and qubits.

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Abstract.
In experiments aiming on low-interaction energies—exemplified within the low energy neutrinos coherent scatter and quest for low-mass dark matter particles—researchers must understand the underlying noise mechanisms in their detectors. We observed patterns among low-energy detector backgrounds, which invited questions about condensed matter effects in materials under energy flow. Residual radioactivity and cosmogenic radiation lead to slow energy accumulation in detector materials, so we hypothesize that when the relaxation of this energy occurs in a non-steady manner, the avalanche-like events mimic interactions with particles. Though production mechanisms for excitations, their interactions and destructions processes interplay differently across materials, the properties of this dynamic—called self-organized criticality—appear in sectors ranging from particle physics detectors to quantum sensors and qubits, two of which we discuss here. In some cases, these noise mechanisms may be suppressed and mitigated. In this sense, studying the condensed matter effect in particle detectors can provide useful feedback for designing qubits and quantum sensors, yielding an unexpected crosspollination between quantum information and high energy physics. Side-by side comparison of this on a first glance disparate fields allows to understand common problems and see how these fields are merging in studying space microwave background, serches for axions and coherent scatter of low energy neutrinos with low and ultra-low temperature sensors.
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