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Title: Avalanche hypothesis: Investigating sources of excess noise with Superconducting Nanowire Single-Photon Detectors.

Abstract.

Properties of background observed in dark matter particle detectors and experiments aimed to detect low energy neutrino coherent scattering led us to the conclusion that universal noise / background generation mechanism should be present in low energy threshold detectors. Namely, energy accumulation in materials and non-steady releases of this energy in avalanche-like relaxation events should lead to excess athermal noise in the systems with energy flow. This resembles the scenario of Self-Organized Criticality, and we will discuss few examples of SOC-like dynamics in particle detectors.
Superconducting Nanowire Single-Photon Detectors (SNSPDs) demonstrate low energy detection thresholds, low dark counts, and high time resolution at an operating temperature higher than other types of superconducting photon detectors. We hypothesize that SOC-like dynamic is suppressed here, as energy dissipation by readout system in SNSPD is practically absent in the “waiting for the photon” state.
We will discuss how the sensitivity threshold of SNSPD technology could be pushed to lower energies, toward mid-IR and microwave photons, and, possibly, hot phonons in materials, and possible experiments to check for SOC-like dynamics and to better understand processes in these devices.