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Optimal operation of cryogenic calorimeter through deep reinforcement learning

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Cryogenic phonon detectors with superconducting thermometers achieve the strongest sensitivity to light dark matter recoils in current direct detection dark matter searches. In such devices, the temperature of the thermometer and the bias current in its readout circuit need careful optimization to achieve optimal operation conditions. This task is not trivial and has to be done manually by an expert, which makes the simultaneous operation of many detectors challenging. We simulated the detector response as an OpenAI Gym reinforcement learning environment and finetuned it to resemble the behavior of three CRESST-III detectors currently operated in run 36 of the experiment. In the simulation, we test the capability of a Soft Actor-Critic agent to perform the optimization task. Furthermore, we report on a measurement interval in February 2023, during which we tested our method live on the identical detectors running in the CRESST underground setup at LNGS. Finally, we discuss large pre-trained models that can perform the optimization task without the necessity for training on individual detectors. Our method can improve the scalability of multi-detector setups.

Submitted on behalf of a Collaboration?

Yes

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