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Control of cryogenic dark matter detectors through deep reinforcement learning

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Cryogenic phonon detectors are used by direct detection dark matter experiments to achieve sensitivity to light dark matter particle interactions. Such detectors consist of a target crystal equipped with a superconducting thermometer. The temperature of the thermometer and the bias current in its readout circuit need careful optimization to achieve optimal sensitivity of the detector. This task is not trivial and has to be done manually by an expert. In our work, we created a simulation of the detector response as an OpenAI Gym reinforcement learning environment. In the simulation, we test the capability of a soft actor critic agent to perform the task. We accomplish the optimization of a standard detector in the equivalent of 30 minutes of real measurement time, which is faster than most human experts. Our method can improve the scalability of multi-detector setups.

References

We did not publish our method before. Experiments, that could benefit from our method are e.g. CRESST (https://arxiv.org/abs/1904.00498) and COSINUS (https://link.springer.com/article/10.1007/s10909-020-02464-9).

Experiment context, if any

CRESST, COSINUS

Significance

Multiple dark matter experiments plan to scale up the number of detectors used, up to the simultaneous operation of 100 detectors. Our method is valuable for them to avoid the repetitive, manual task of detector optimization.

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