

Episodic reinforcement learning for $0\nu\beta\beta$ signal discrimination

Friday 30 August 2024 14:20 (20 minutes)

$0\nu\beta\beta$ decay is a Beyond the Standard Model process that, if discovered, could prove the Majorana nature of neutrinos—that they are their own antiparticles. The Majorana Demonstrator (MJD) is one experiment searching for $0\nu\beta\beta$ decay using semiconductor detectors, however the nature of the waveform data produced by the detectors is such that they are unlabelled, and producing ground-truth labels is an involved process if using traditional methods. Fortunately, machine learning methods like reinforcement learning (RL) are able to perform tasks on unlabelled data. I present an episodic RL algorithm implementing Randomized Return Decomposition for binary classification of detector events from the Majorana Demonstrator Data Release for AI/ML Applications. Under stringent masking of the MJD detector data, the RL-trained classifier slightly outperforms a standard supervised learning model trained under the same conditions, showing potential for further development and even future deployment as a first-stop classifier on other $0\nu\beta\beta$ decay experiments like LEGEND.

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