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Optimising the LUX-ZEPLIN Neutron Veto using MOO

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Located 1.5 km underground, the LUX-ZEPLIN experiment uses a 7t liquid xenon time projection chamber to search for weakly interacting dark matter (WIMPs) and other beyond-standard-model physics. Interactions between neutrons and xenon are not readily distinguishable from WIMPs. To be able to perform direct detection searches of dark matter, this background must be removed, for which LZ has a dedicated outer detector (OD) acting as a neutron veto. Optimising the neutron veto inherently involves a compromise between efficiently rejecting background neutron events while minimising the amount of deadtime incurred. Using concepts from multi-objective optimization (MOO), a custom algorithm has been implemented to efficiently calculate the so-called Pareto frontier - the set of optimal choices where improving one objective necessarily requires compromising another. This allows for quick selection of the best parameters (coincidence, pulse area threshold, time window), and helps with tuning the veto to maximize physics reach. The suite of tools introduced will be beneficial for a wider variety of analysis applications.

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