The future of xenon-based searches for neutrinoless double beta decay

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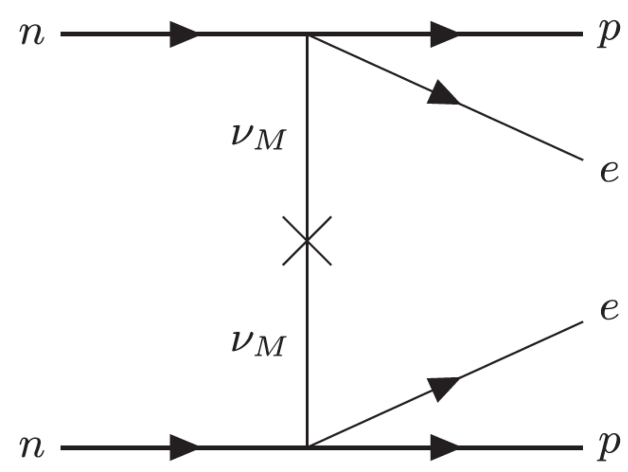
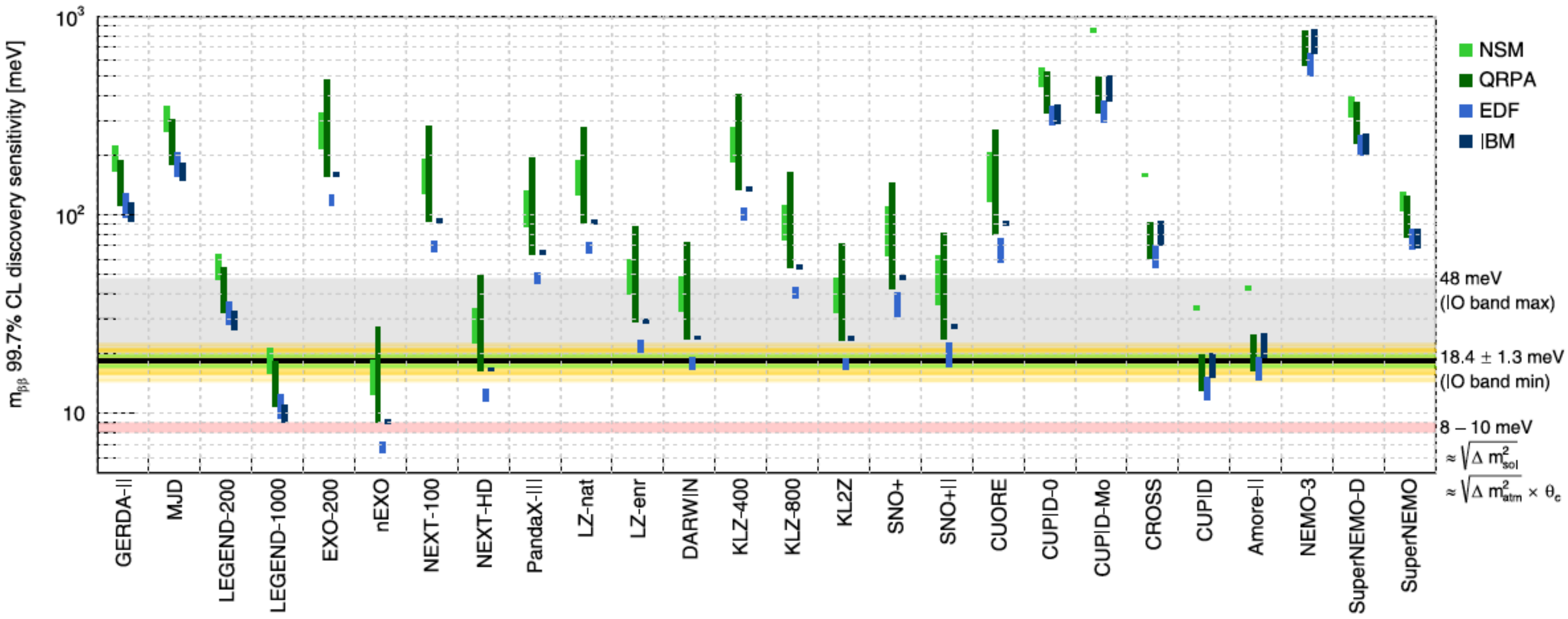
Neutrinoless double beta decay experimental program

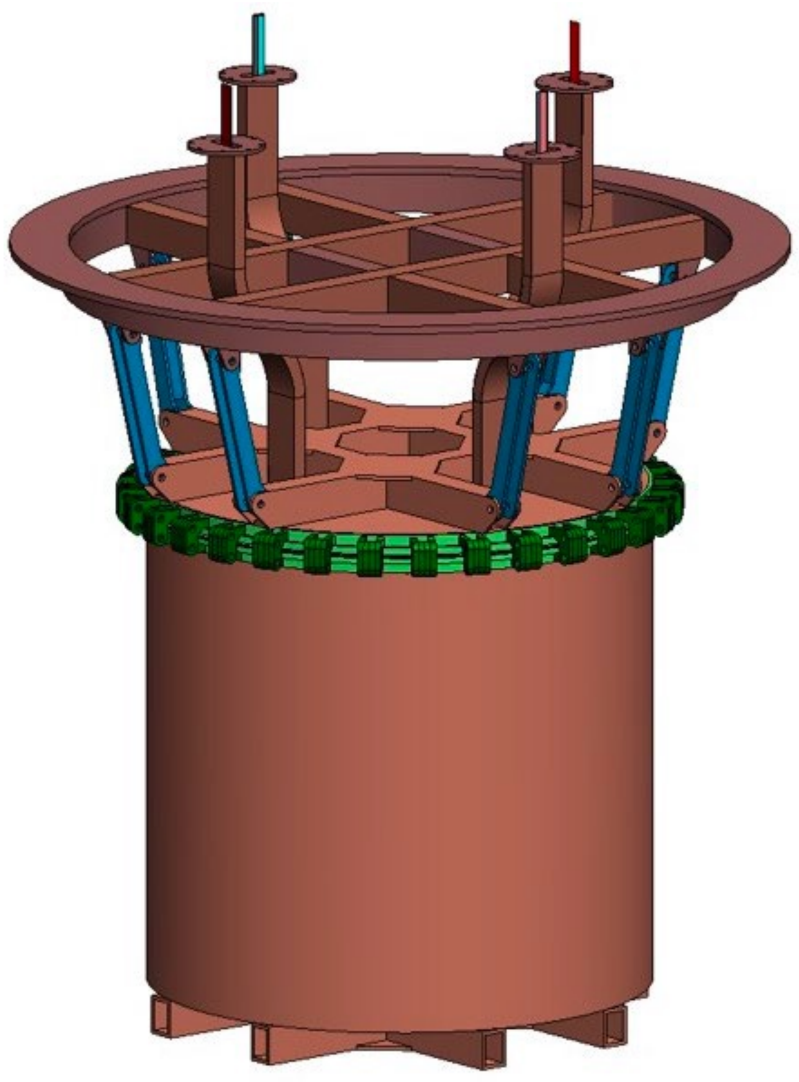


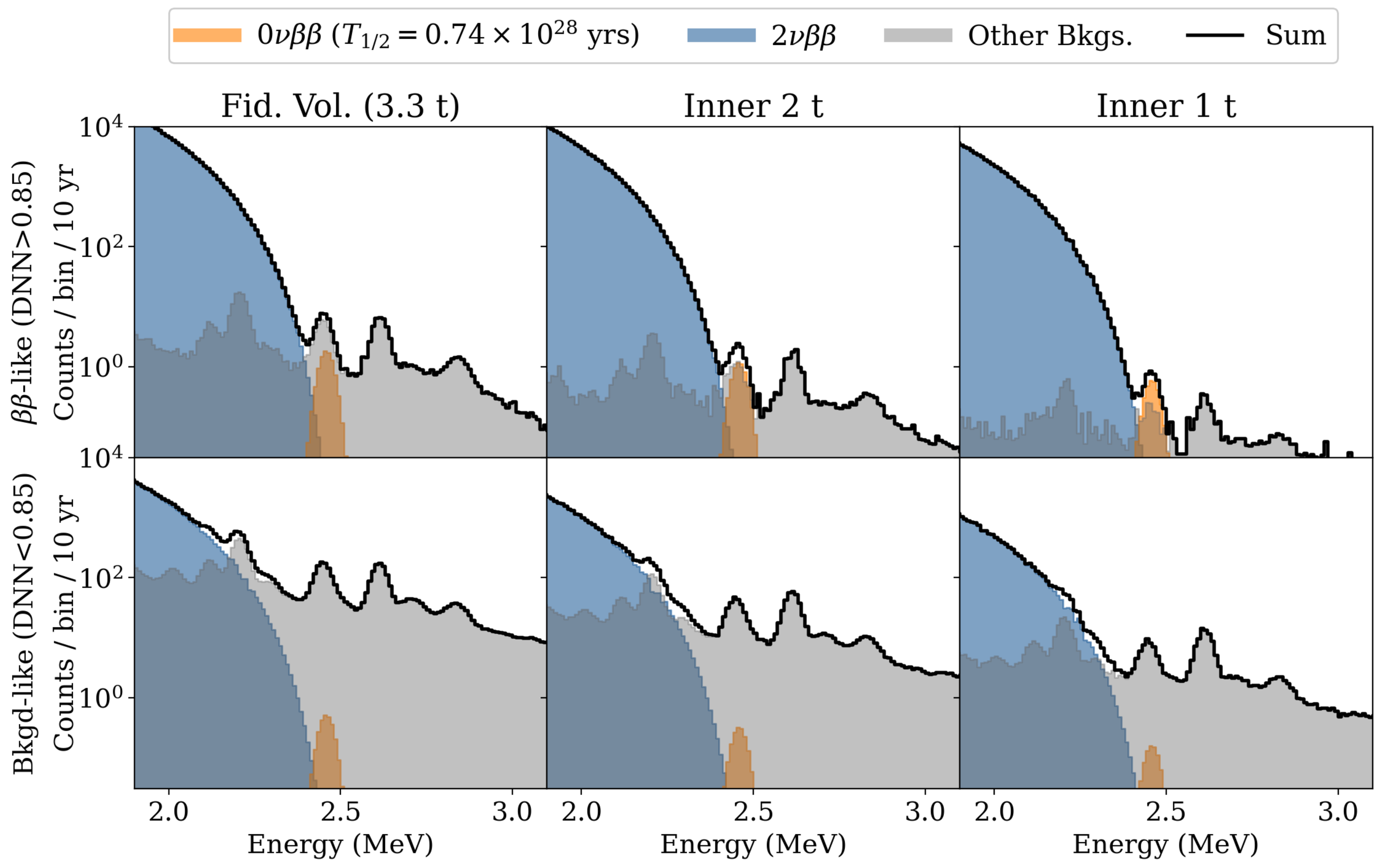
The search for neutrinoless double beta decay ($0\nu\beta\beta$) presents one of the most compelling experimental pathways for the discovery of lepton number violation and new physics beyond the Standard Model. Figures from [1] show the sensitivity of a selection of completed, current, and proposed experiments to the $0\nu\beta\beta$ mass parameter $m_{\beta\beta}$ (below), assuming the light Majorana neutrino exchange mechanism (right). Future detectors will be at the tonne scale with sensitivities of ~10^{28} years.

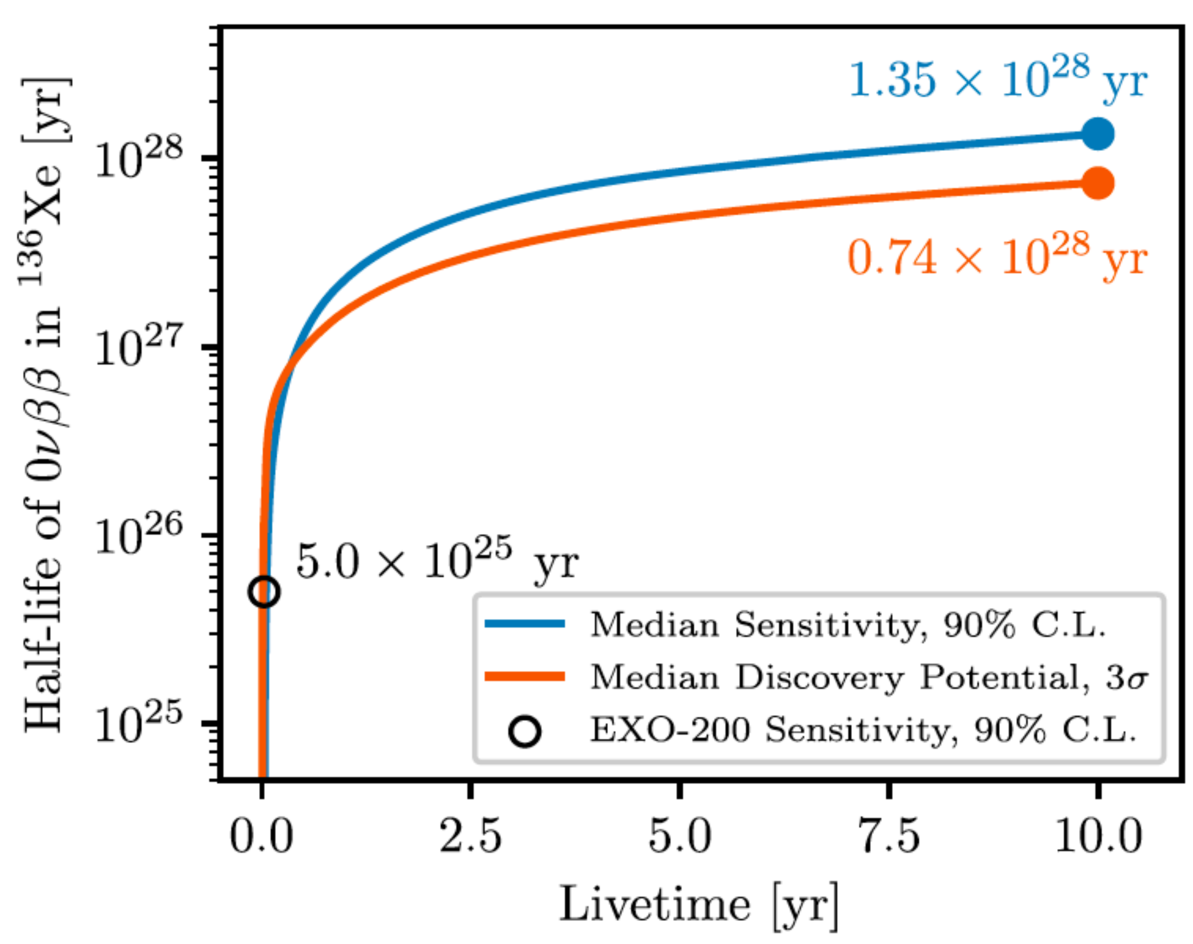


Power of xenon-based detectors: nEXO as an example

Xe-136, with its relatively high isotopic abundance, ease of enrichment, and favorable Q-value, is one of the strongest candidates for the discovery of $0\nu\beta\beta$. The power of Xe-based detectors to discern signal from background improves with the size of detectors, in contrast to solid-state detectors. The sensitivity of the proposed nEXO experiment [2], a 5 tonne enriched liquid Xe time projection chamber sited at SNOLAB, presents a compelling example. The combination of low background construction, monolithic active volume, and event topology provide excellent background knowledge and discrimination.







Neutrinoless double beta decay search in Xe – next-generation experiment workshop

With the future of the international double beta decay program uncertain, there is an opportunity for the xenon-based detector community to come together and plan the next generation search for Xe-136 $0\nu\beta\beta$. An upcoming workshop is being organized with this purpose in mind. The workshop is designed to be broad and inclusive, with the goal of bringing the community together to develop a common strategy.

The workshop will be held November 12-14, 2025 in Montreal, Quebec, Canada.

Scan the QR code or visit https://nyx.physics.mcgill.ca/e/XeDBD for more information and to register.

References and acknowledgments

[1] M. Agostini *et al.* *Rev. Mod. Phys.* **95**, 025002 (2023). https://doi.org/10.1103/RevModPhys.95.025002
[2] G Adhikari *et al.* *J. Phys. G: Nucl. Part. Phys.* **49**, 015104 (2022). https://doi.org/10.1088/1361-6471/ac3631

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