

Strategy for a Canadian search for neutrinoless double beta decay in xenon-136 at the SNOLAB Cryopit

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for the nEXO Collaboration

SEF Meeting
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nEXO 2.0: a Once-in-a-Generation Opportunity

$0\nu\beta\beta$
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- Understanding the origin of matter in the Universe via $0\nu\beta\beta$ will be the biggest subatomic physics discovery of a generation; we know how to do it!
- The physics community has determined that searches in multiple isotopes are required for a definitive discovery.
- nEXO 2.0 is the DOE nEXO project under Canadian leadership, realizing opportunities for improvement:
 - A next-generation $0\nu\beta\beta$ experiments that reaches 10^{28} yrs on a competitive timescale.
 - Well reviewed and vetted plan. Ready to start construction within a year of receiving funding.
 - We are looking for national and international partners to realize the experiment under shared governance.
- Time is of the essence to make a discovery. This search is highly competitive.

Close out slides from 3rd $0\nu\beta\beta$ Summit

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Statement from first JOG meeting (1)

The international funding agencies and laboratory directors who attended the 3rd International Summit on Double Beta Decay (the stakeholders) re-affirmed that the science of neutrino-less double-beta decay remains one of the most compelling and important in contemporary physics. The summit meeting summarised the state of the field, including recent developments in different technologies. The stakeholders congratulate the double-beta community for the substantial progress made since the last summit meeting, in a resource restricted environment.

The stakeholders recognise that the best chance for an unambiguous discovery is an international campaign with multiple isotopes and more than one large tonne-scale experiment implemented in the next decade. Following the 2nd International Summit, a Working Group was struck and charged with exploring possible governance structures to support this objective. The Working Group reported back at this meeting, with a recommendation for a 'hybrid' governance structure to retain flexibility, agility and a forum for maximising impact of available funding.

- **Canadian Agencies participating at summit in person:**
 - ISED
 - CFI
 - NSERC
- Jodi Cooley & Nigel Smith represented SNOLAB & TRIUMF.
- nEXO was one of five experiments invited to the summit.
- Nigel Smith interim chair of "Joint Oversight Group (JOG)"



<https://indico.ph.tum.de/event/7802/>

Statement from first JOG meeting (2)

The stakeholders endorse the recommendation of the Working Group, whilst recognising the change in funding environment since the previous summit. It was agreed that the intention is to phase the development of the hybrid governance model. Phase-I is the formation of an initial Joint Oversight Group comprised of interested funding agency representatives and facility directors to ensure a forum for communication and discussion, and, if applicable, coordination by the funding agencies, for deployment of tonne-scale detectors in North America and Europe.

The 3rd Summit meeting closed session on Day 2 was viewed as the initial JOG kick-off meeting where the funding agencies and laboratory directors met under the umbrella of the JOG to discuss the terms of reference and operational mode.

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

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

12-14 November 2025
Montreal
America/Toronto timezone

<https://nyx.physics.mcgill.ca/e/XeDBD>

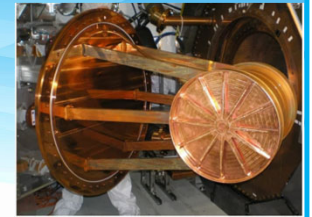


Xe-focused $0\nu\beta\beta$ workshop planned in Montreal on November 12-14, 2025!

nEXO 2.0 proposal

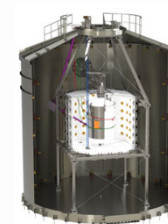
- Leveraging advanced design, nEXO 2.0 can be ready to start construction in the next ~year:
 - Coalesce a new collaboration with a sensitivity goal of greater than 10^{28} years in 10 years.
 - Take the well-reviewed nEXO design as basis.
 - Invite collaborators to take on responsibilities for subsystems and contribute their expertise.
 - Refine technology decisions in terms of cost, risk, performance, and schedule.
- **Liquid noble TPC – a demonstrated technology at the tonne scale.**
- **$0\nu\beta\beta$ in Xe-136 at SNOLAB should be ranked at the highest priority in the LRP, pursued ideally with nEXO2.0 or, as an alternative, with XLZD, depending on their schedule.**

EXO-200 (175 kg)

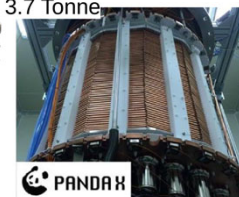


Past

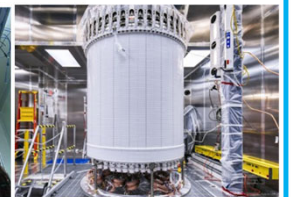
XENONnT (6 Tonne)



3.7 Tonne

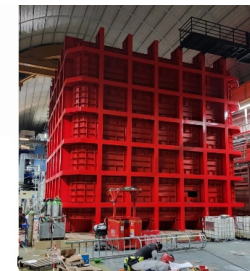


LZ (7 Tonne)

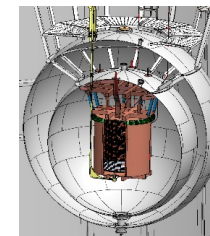


Current Generation

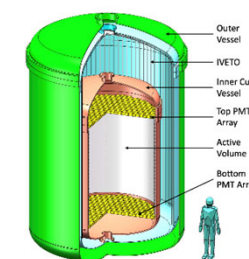
DarkSide-20k (70 Tonne underground Ar)



SBND (112 Tonne Ar)



nEXO (5 Tonne)



PandaX-xT (43 Tonne)



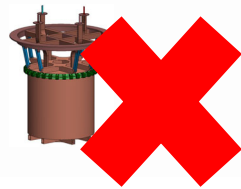
XLZD (60 Tonne)

Next Generation Concepts

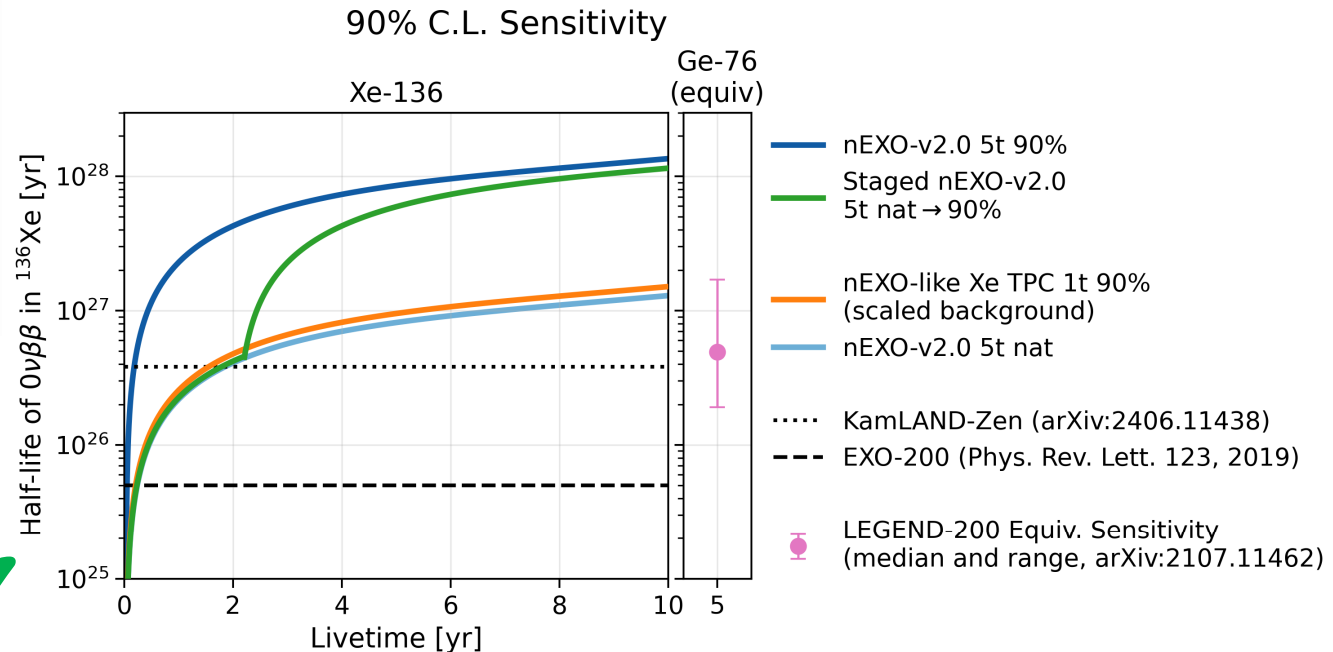
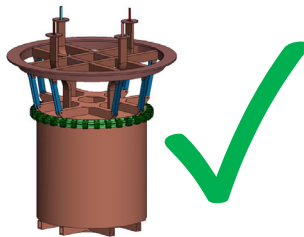
Sensitivity Comparison of Alternatives

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- **Alternative 1**
 - 1 t single-phase liquid Xe TPC @90% enrichment



- **Alternative 2**
 - 5 t single-phase liquid Xe TPC









- **Mass matters** → **Alternative 2 is the preferred option.**
- Starting with a 5T detector with natural Xe
→ load with 90% enriched Xe after ~2 years of running.

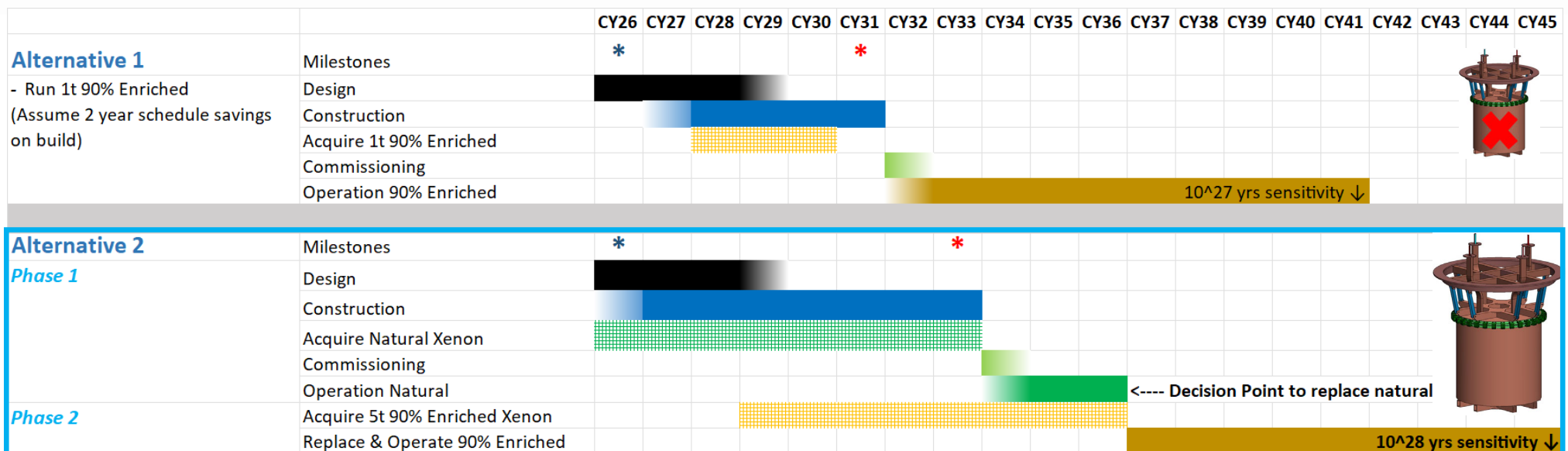
Xenon Program Schedule

0vββ
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Next steps:

- Need imminent release of R&D infrastructure support from CFI IF 2020 and IF2023 to keep momentum, advance technical readiness, and demonstrate Canadian interest to lead Xe-136 program at SNOLAB.
- Collaboration building for the next ~1 year → attract international partners.
- Start construction of outer detector in late 2026 with IF 2023 release.

Legend:	
	Xenon Natural
	Xenon 90% Enriched operation run
	Natural xenon acquisition
	Enriched xenon acquisition
	Operations Review
	Need IF2023 Released



Summary

- Understanding the origin of matter in the Universe via $0\nu\beta\beta$ will be the biggest subatomic physics discovery of a generation!
- The nEXO design is optimized for a sensitivity of 10^{28} yrs, has been extensively vetted by peer-reviews and the technology is well proven.
- **We are looking for additional collaborators to move forward a $0\nu\beta\beta$ experiment with Xe at SNOLAB.**

