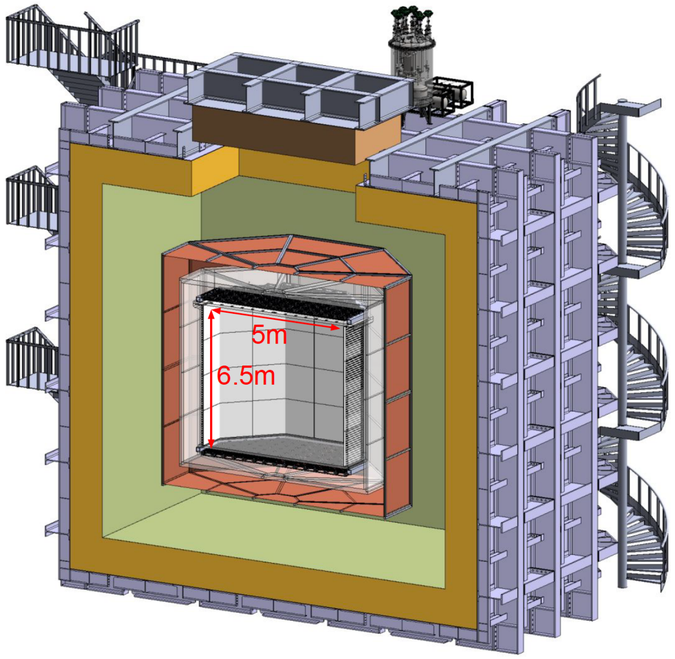
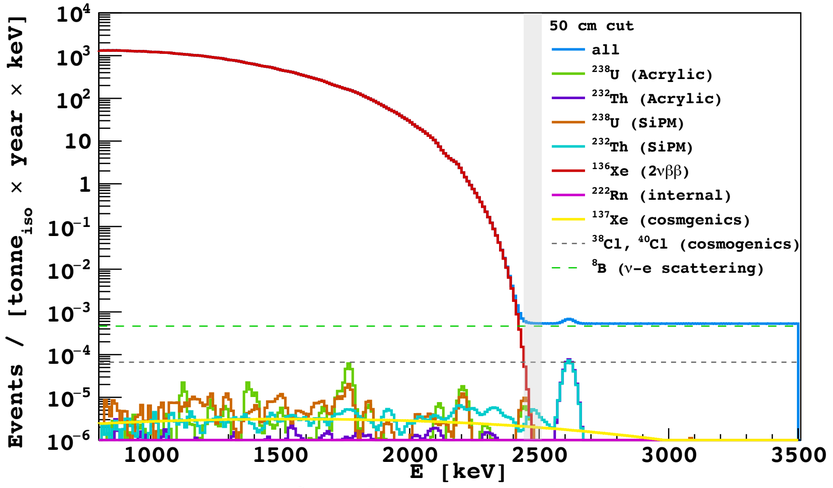
DarkNoon: ^{136}Xe target dissolved in LAr



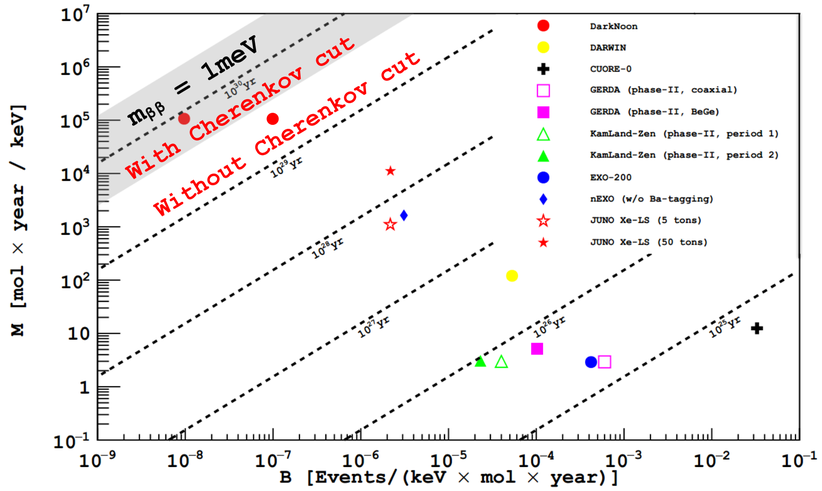
Technology

- 50t fiducial volume dual-phase TPC.
- 20% molar fraction mixture of enriched LXe in LAr.*
- Mature, scalable technology.
- 3D position reconstruction, target fiducialization, and novel background rejection via detection of Cherenkov light.



Backgrounds

- Background rate in the ROI lower than 5E-4 events/t/yr/keV, dominated by ^{8}B ν-e scattering and 2νββ events.
- Radiogenic backgrounds from detector components effectively suppressed by position-based cuts.
- RadonWithout Cherenkov cut sub-dominant thanks to low temperature of the Ar-Xe mixture
- Cherenkov-based cut significantly reduces surviving single-ionization-track events (not shown in the plot)



Physics reach

- Projections with 1000t·y exposure (20y).
- Assumed energy resolution: 0.7% at the ROI (EXO-200: 1.15±0.02%, nEXO: 1%)
- High exposure thanks to TPC scalability and stability over time.
- Strong background rejection in FV.
- Sensitivity up to $T_{1/2}$ ~10^{30} years
- Exclusion limits for the effective Majorana mass down to ~1meV (model dependent).

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Darknoon program: ideas and R&D

Idea	Motivation	R&D
• Target: 20% molar fraction mixture of LXe in LAr. Xe enriched to 90% in ^{136}Xe	Mixture temperature near LAr boiling point: • Abatement of Radon emanation/de-gassing. • SiPM dark count rate abatement.	• Develop a cryogenic system that ensures long-term mixture stability. • Cryogenic distillation technique developed for DS-20k to enrich Xe

• Cherenkov light as a mean of background rejection.	• Event classification (1 vs 2 ionization tracks) at a given energy via detection of Cherenkov light from ionizing particles.
	  • intensity proportional to track length.
	  • photons' directionality allows reconstruction of event topology
		• Develop a solid event classification algorithm based on Cherenkov light.

• Detection technology: high efficiency, sub-nanosecond time resolution Silicon Photo Multipliers (SiPMs)	SiPMs' performances • High photon detection efficiency results in a higher energy resolution • Sub-nanosecond time resolution needed for Cherenkov photons identification • Extreme radio-purity	• Develop cleaner cryogenic pre-amplification and read-out electronics. • Improve single photon time resolution.