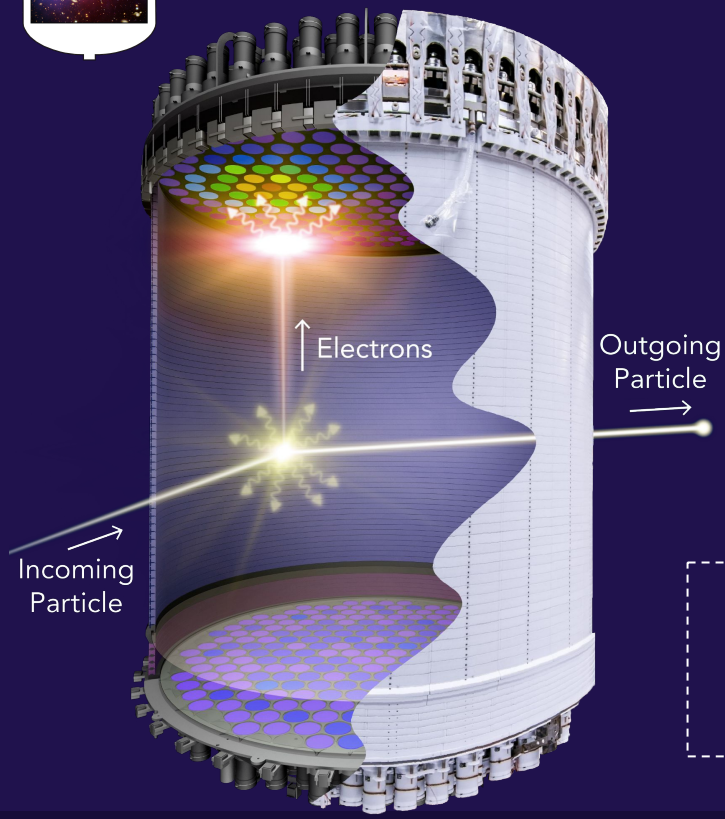
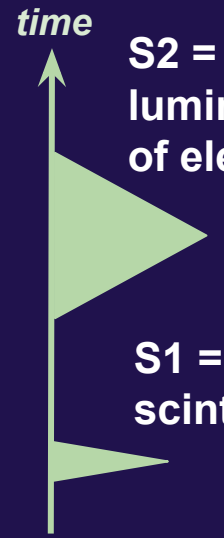
Status of the LZ Experiment

PANIC 2021 Conference

Alissa Monte
UCSB

Dual phase xenon detectors



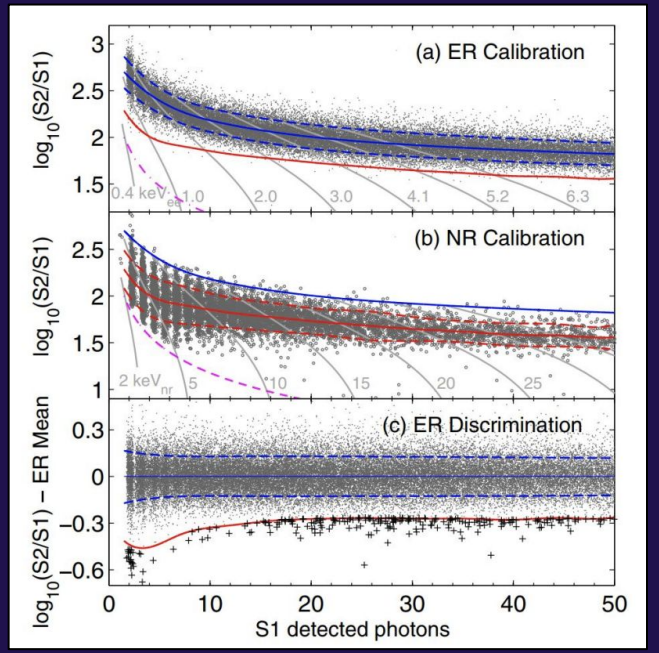


S2 = electro-luminescence of electrons

S1 = primary scintillation

Drift time indicates depth (Z), XY location from S2 distribution

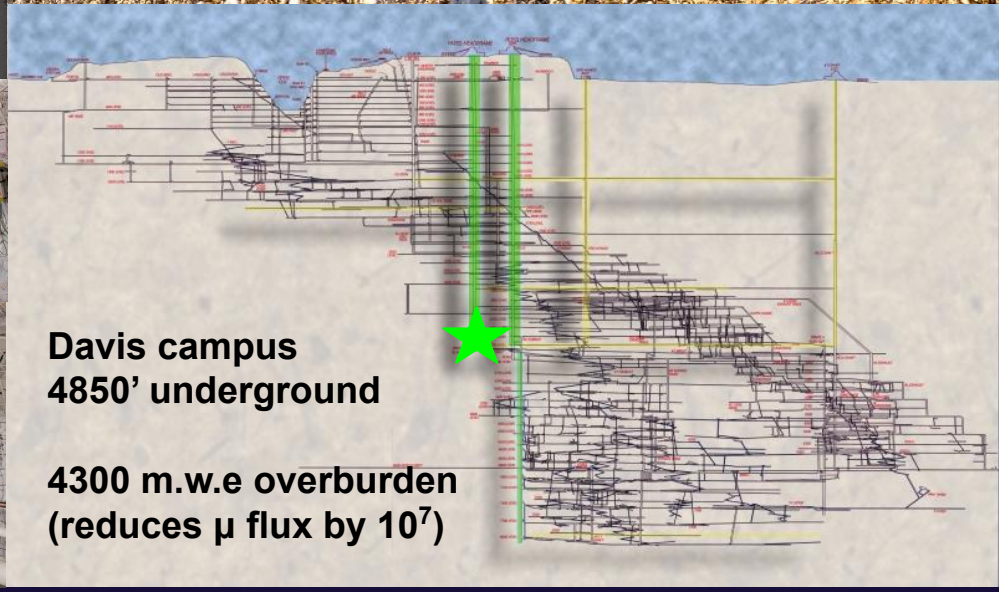
Discrimination from S2/S1



Phys. Rev. D 97, 102008 (2018)

Location, location, location

Sanford Underground Research Facility in Lead, South Dakota



Davis campus
4850' underground

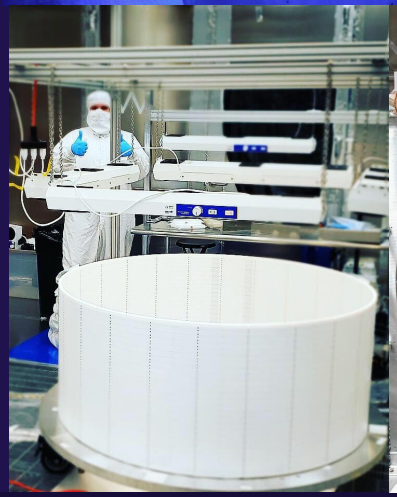
4300 m.w.e overburden
(reduces μ flux by 10^7)

Cleanliness

EPJC, Vol 80: 1044 (2020)

ALL components of LZ were screened for radioactivity

- ~2000 assays with 13 HPGe detectors, ICPMS, neutron activation analysis
- All major parts underwent radon emanation before installation
- TPC assembled in radon-reduced clean room
- Dust < 500 ng/cm^2 on all LXe-facing surfaces
- Plateout on walls < 0.5 mBq/m^2



Purification

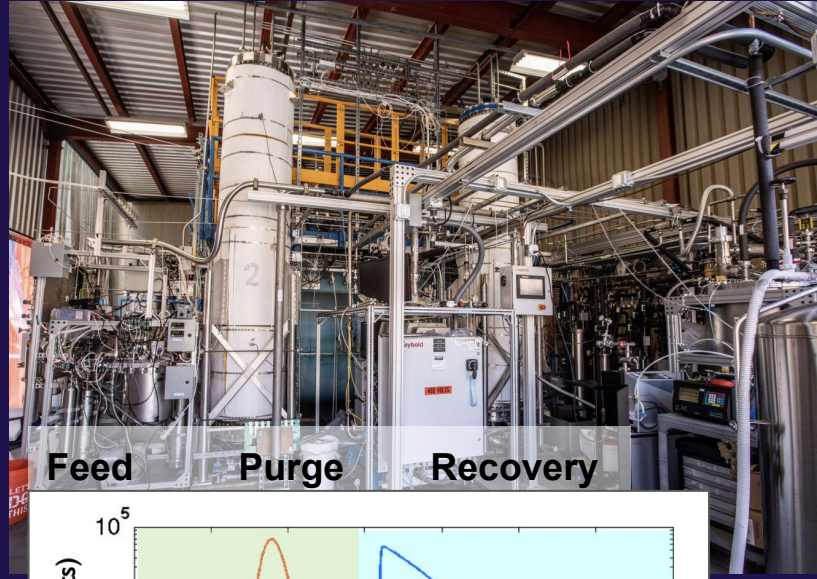
NIM A 163047 (2019)

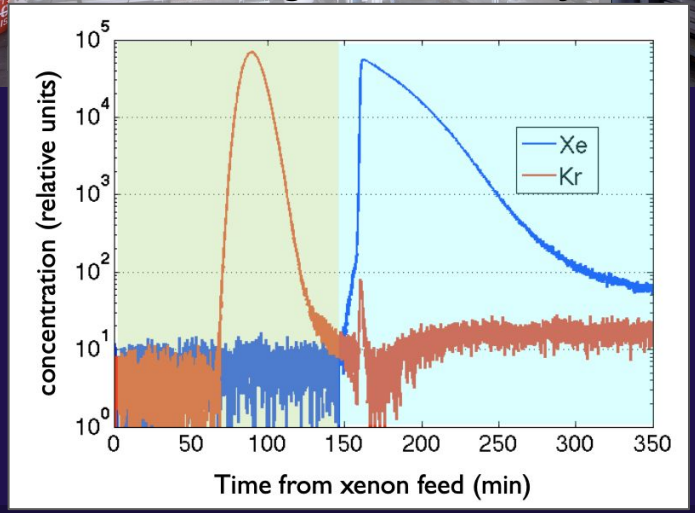
Kr removal system at SLAC

- Gas chromatography
- Demonstration of 0.06 ppt in R&D

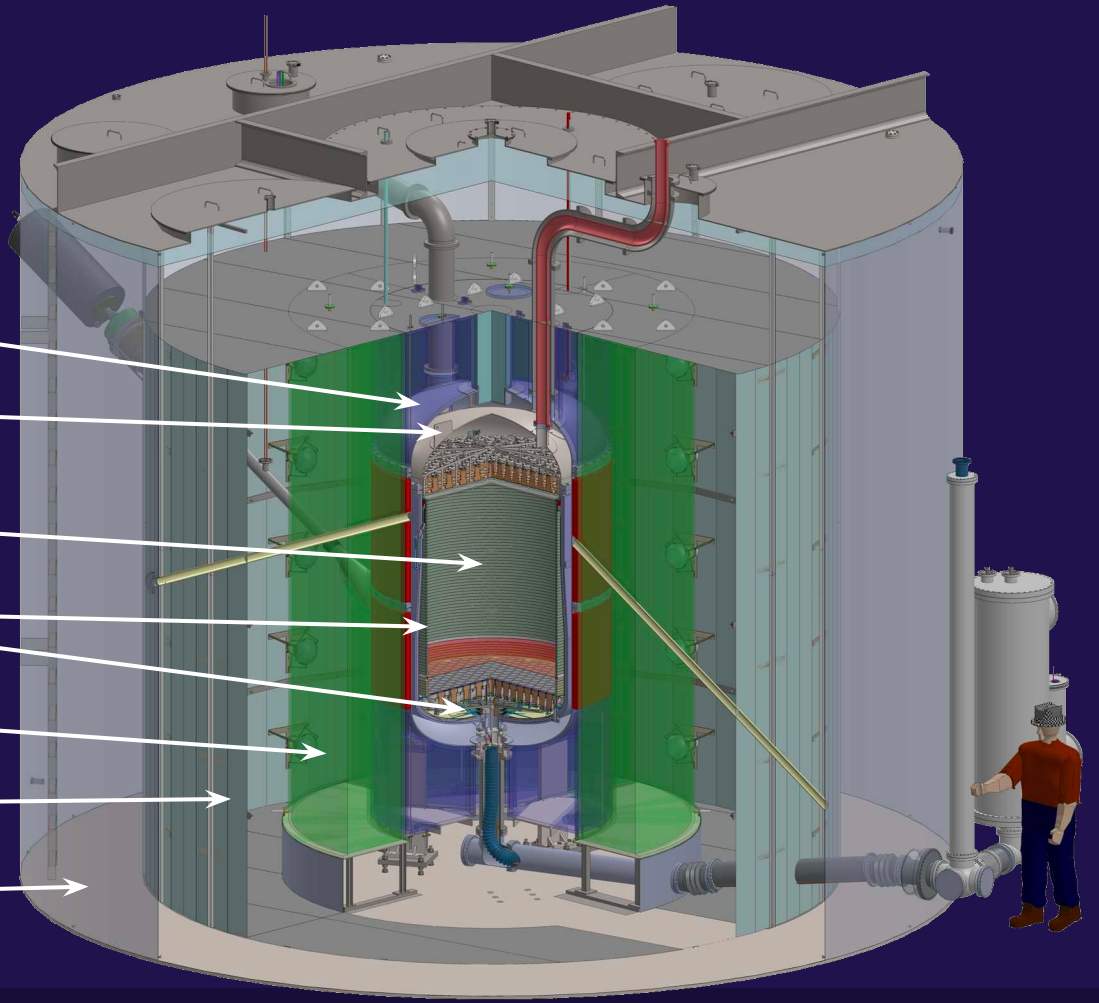
Gas purification

- Turn over full volume in ~2.5 days
- Have demonstrated 500-600 slpm





Nested Detectors



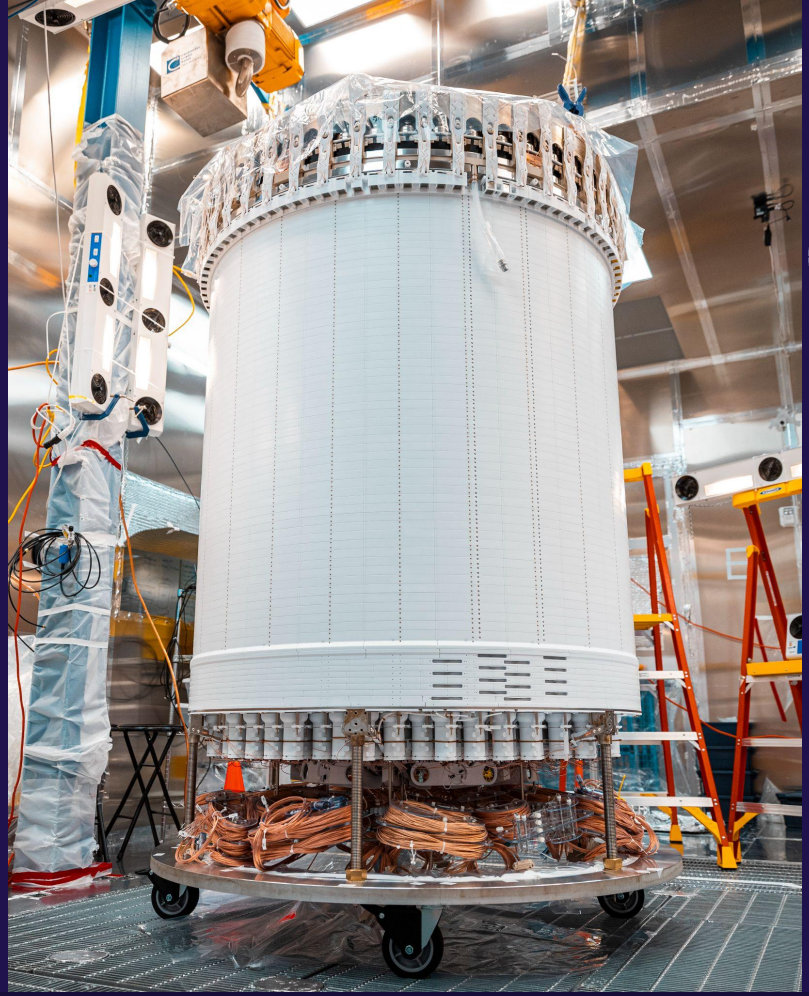
LXe TPC

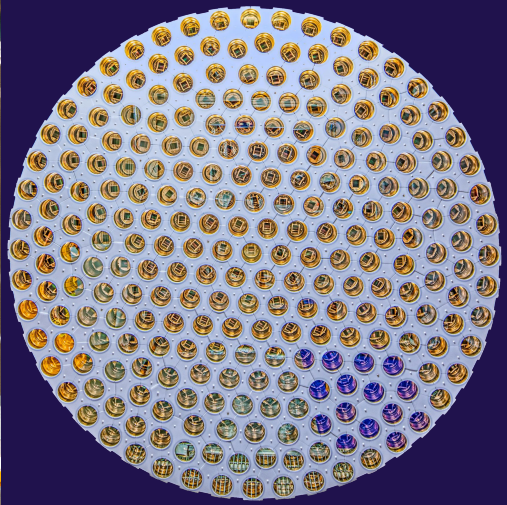
(7T active, 5.6T fid)

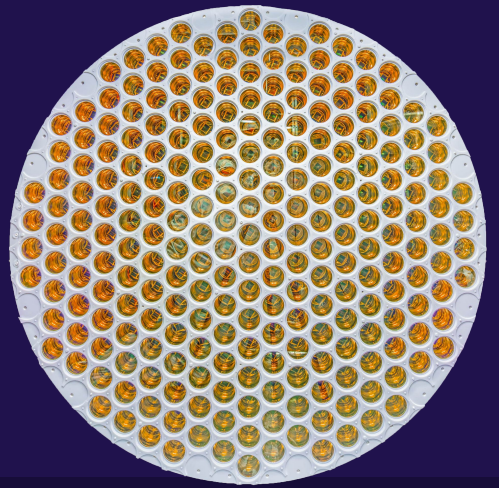
494 3” R11410-20 PMTs

Anode, gate, cathode, and bottom HV grids woven at SLAC

Cathode HV -50 kV

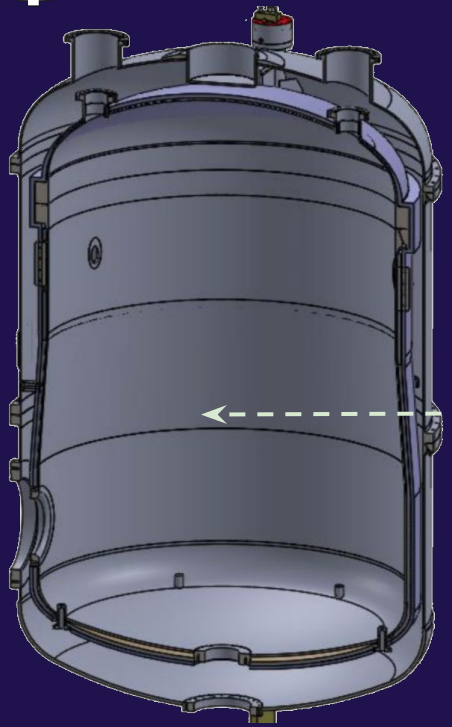




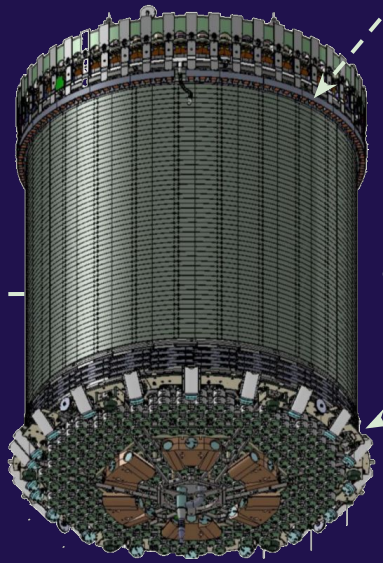


Liquid xenon skin

Actively instrumented with 131 PMTs



93 1” R8520 PMTs in “ice cube trays”

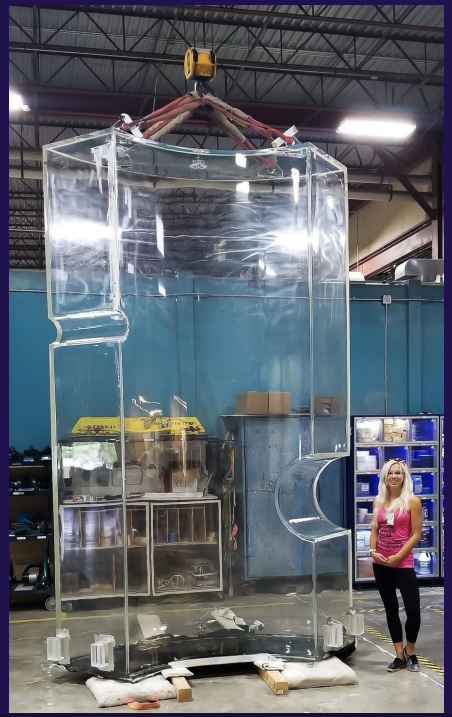


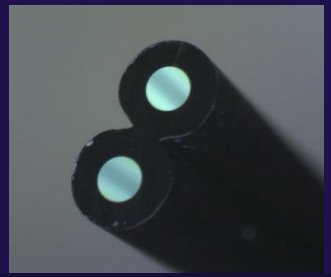
20 bottom side and 18 dome 2” R11410 PMTs

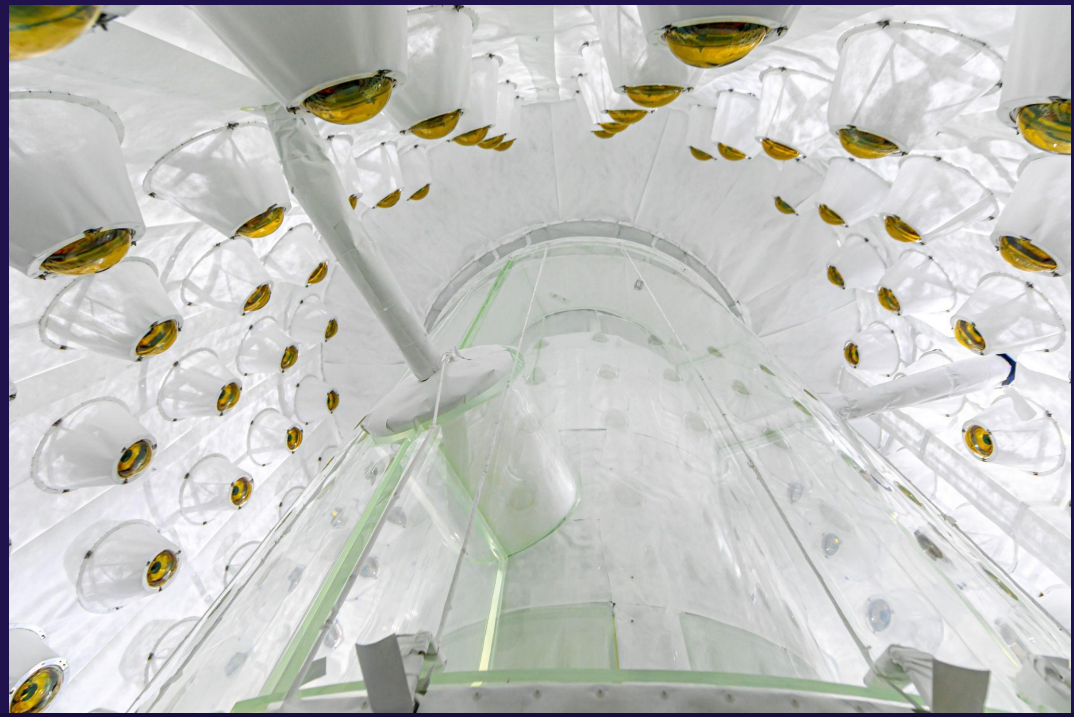
Outer detector

NIM A 937 (2019), NIM A 1010 (2021)

10 acrylic tanks filled with
Gadolinium-loaded liquid scintillator
Observed by 120 8” R5912 PMTs
40 optical fiber injection points for calibration



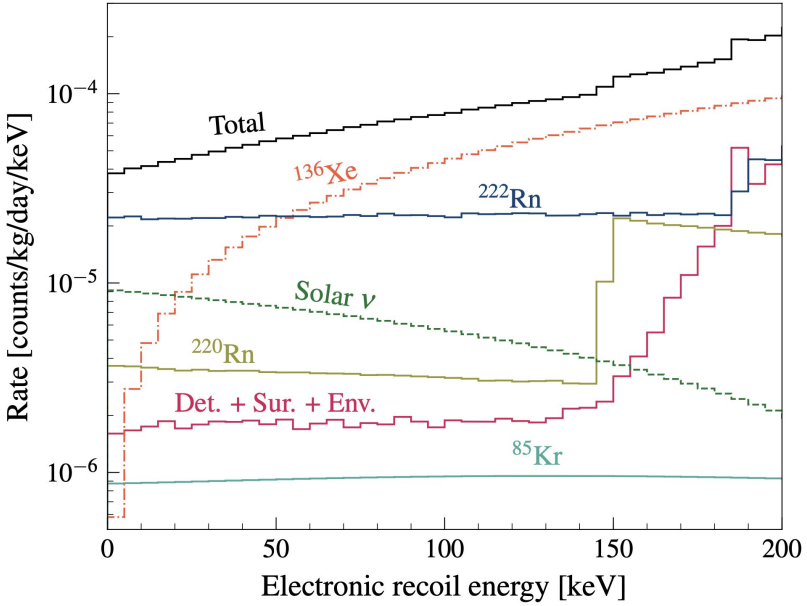




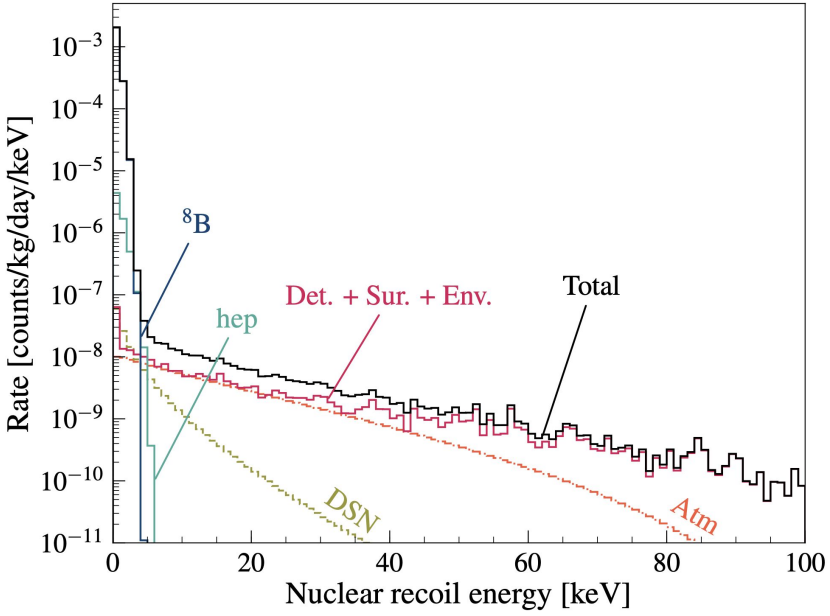
Expected backgrounds

Backgrounds in 1000 live-d	ER [counts]	NR [counts]
Total counts	1588	0.97
99.5% ER disc, 50% NR eff	7.94	0.48

Electron recoil backgrounds



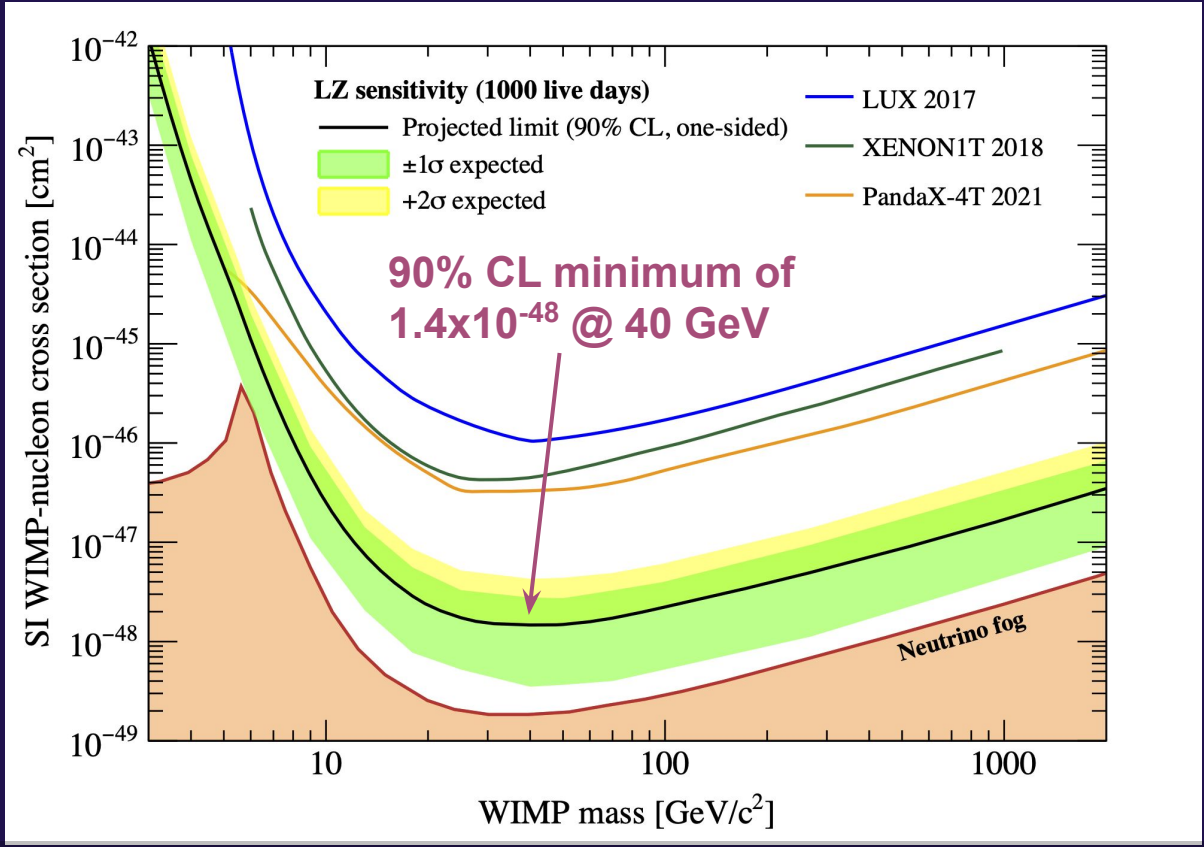
Nuclear recoil backgrounds



Expected sensitivity

Phys. Rev. D 101, 052002 (2020)

See “LZ Backgrounds and Sensitivity” poster from Alex Lindote!

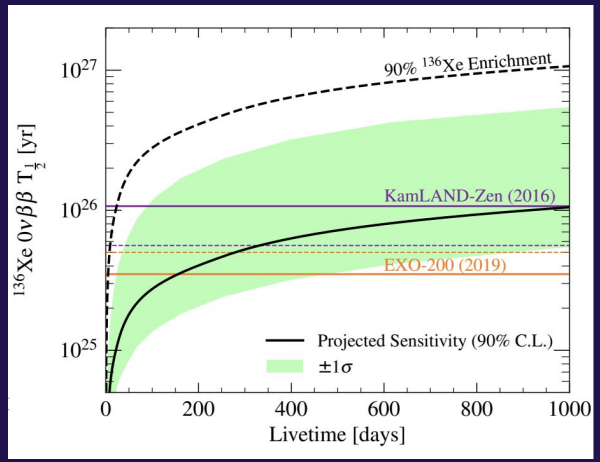


Other searches

See "Sensitivity of the LUX-Zeplin experiment to rare xenon decays" talk from Paolo Bras!

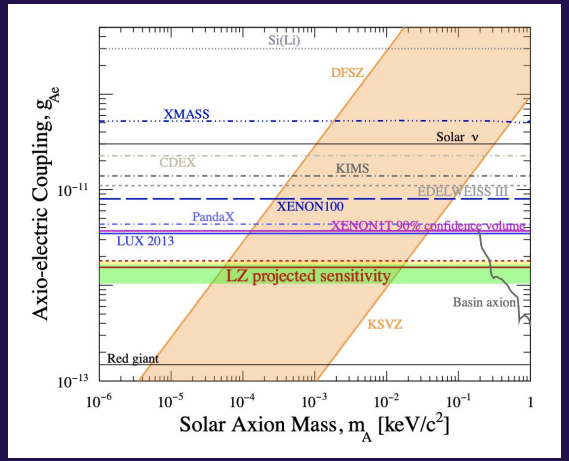
0vbb:

Phys. Rev. C 102: 014602 (2020)



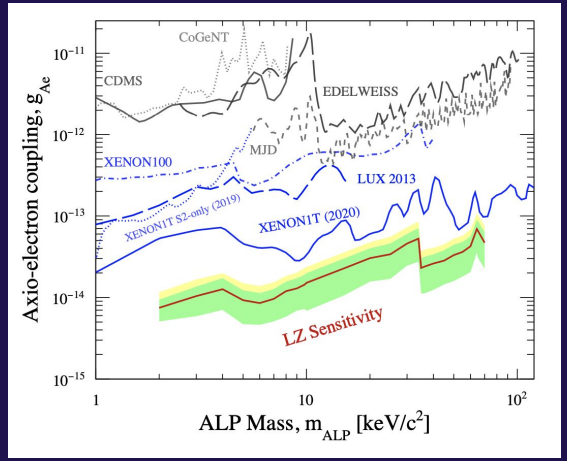
ER searches:

arxiv:2102.11740



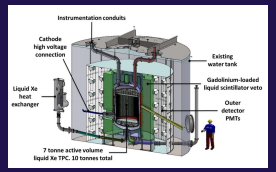
Axion searches:

arxiv:2102.11740

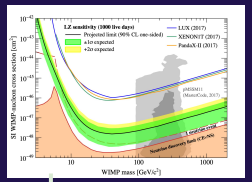


Timeline

TDR
Mar 2017



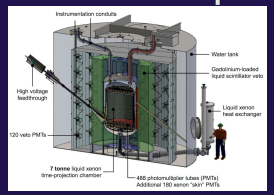
WIMP sensitivity paper
Feb 2018



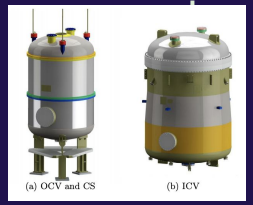
COVID-19
Experiment in safe configuration

Throughout 2021: commissioning, first science run

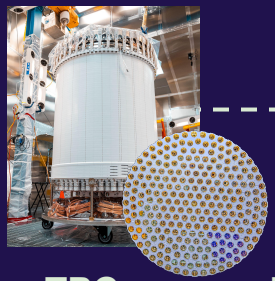
2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021



CDR
Sept 2015

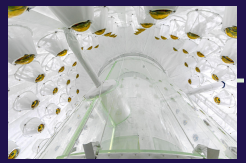


Ti paper
Feb 2017

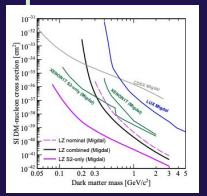


TPC assembled

TPC moved underground

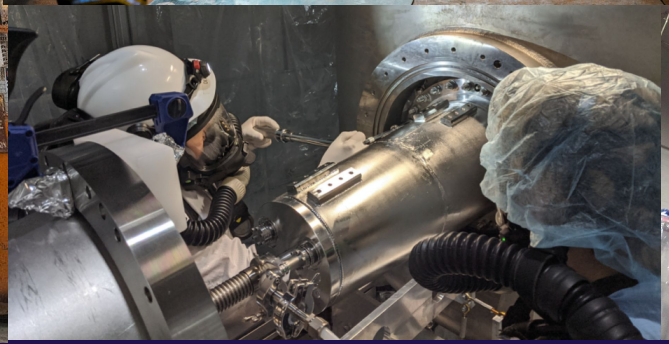


OD assembled



Low E ER, DPE & S2-only, 134Xe 0vbb sens papers

TPC installed underground

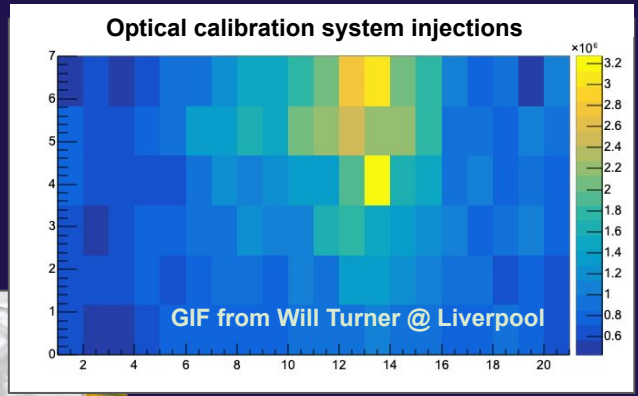


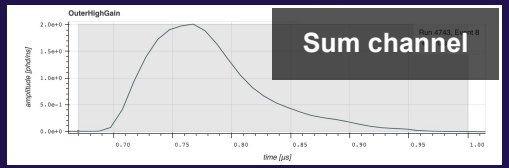
HV installed, ICV sealed and under vacuum before COVID shutdown in early 2020

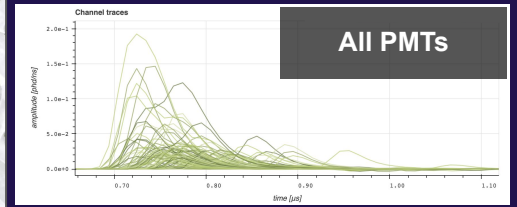
OD installation

Acrylic tanks underground early 2019

PMT & Tyvek installation completed





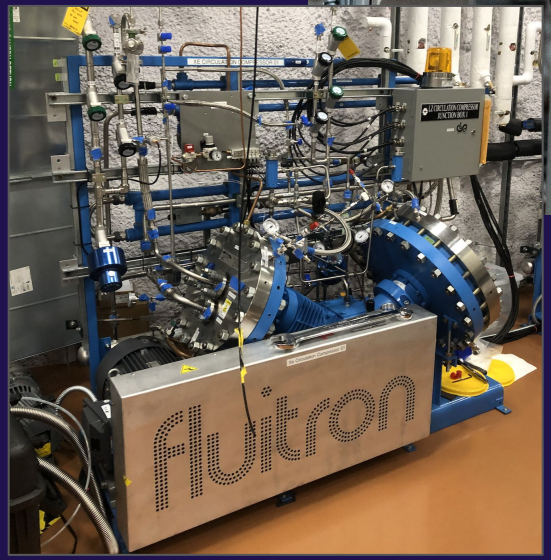


OD Optical Calibration System fully tested

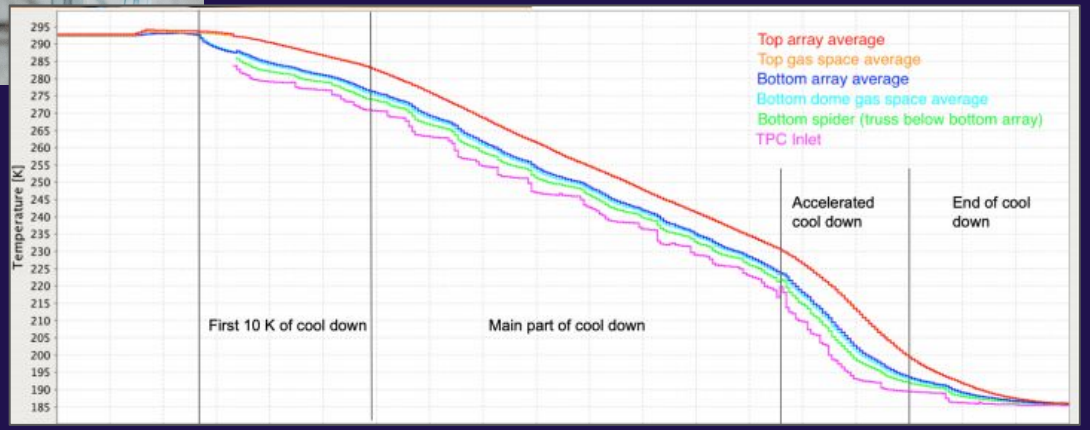
Arxiv:2102.06281

All PMTs see LED light

Cooldown and Commissioning



- Circulation test completed last year with test cryostat underground
- Demonstrated designed gas circulation rate of 500 slpm
- TPC cooled down to ~185 K



Outlook

- LZ assembly and integration almost complete!
- First science data expected this year
- 40x improvement in sensitivity on current limits, also sensitive to non-WIMP physics
- Get excited!

Thank you for your attention!

And thanks to our sponsors and participating institutions!

- 34 institutions from USA, UK, Portugal, and Korea
- ~250 scientists, engineers, and technical staff

@lzdarkmatter
https://lz.lbl.gov/