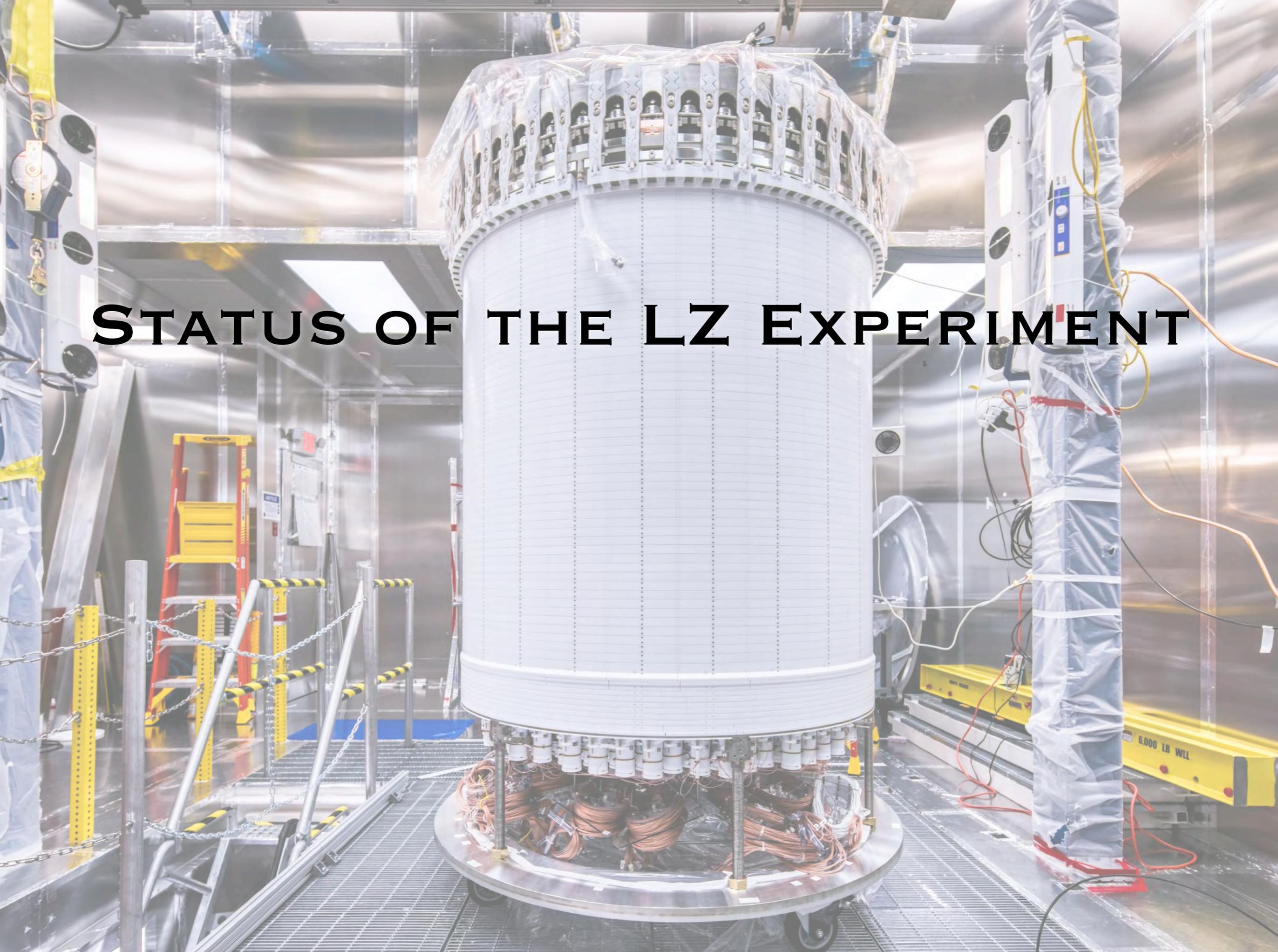
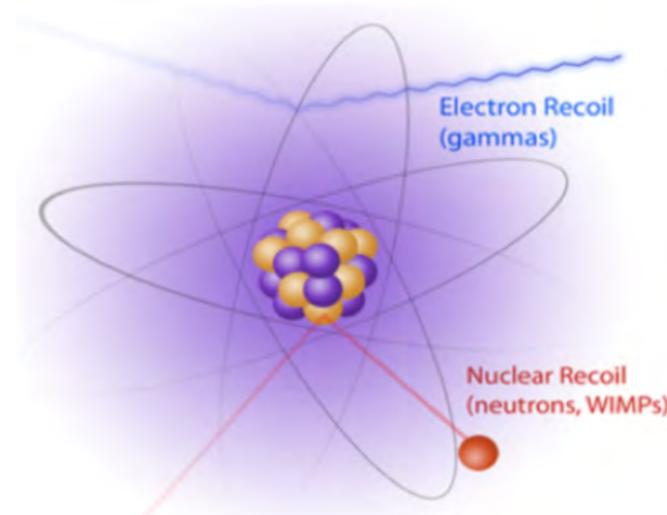
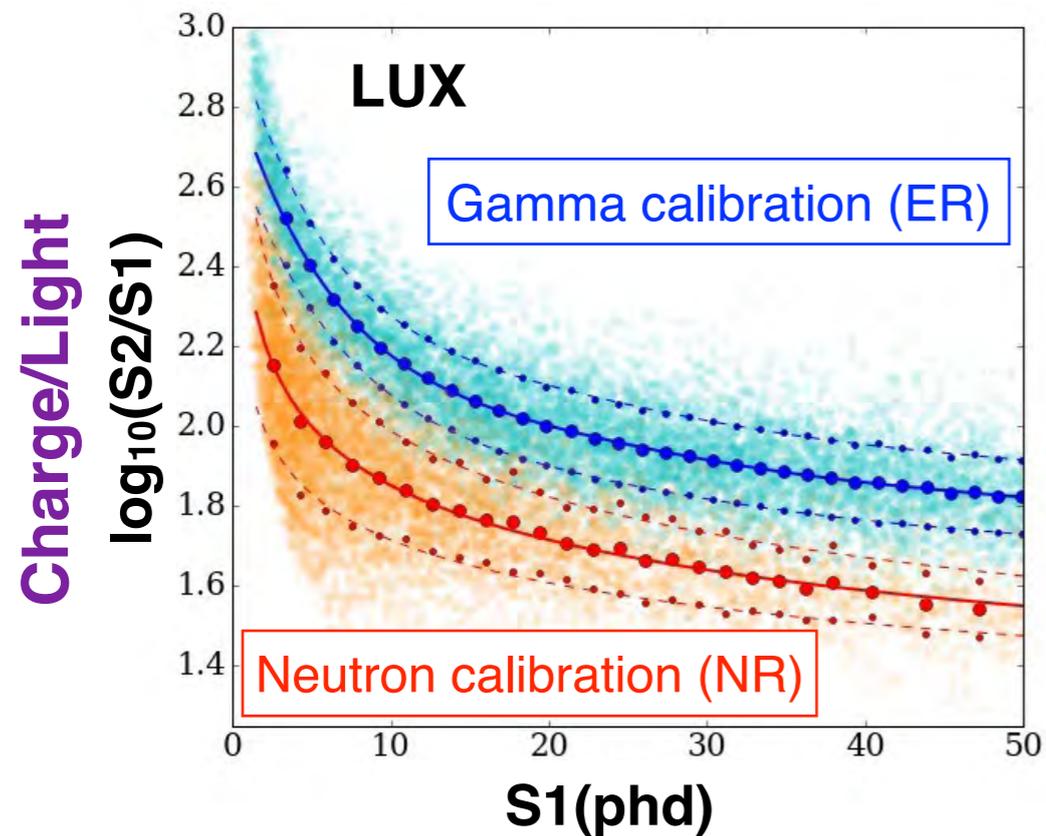
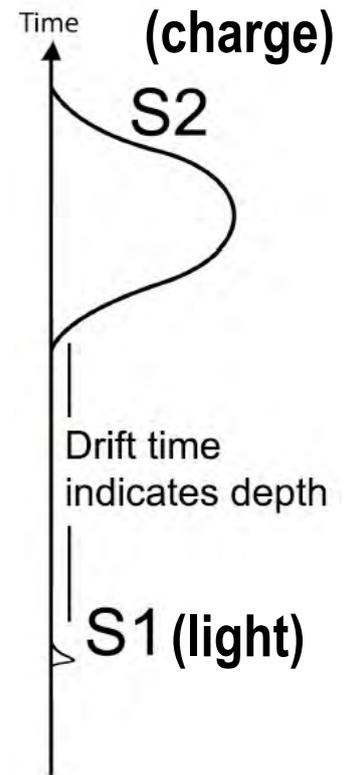
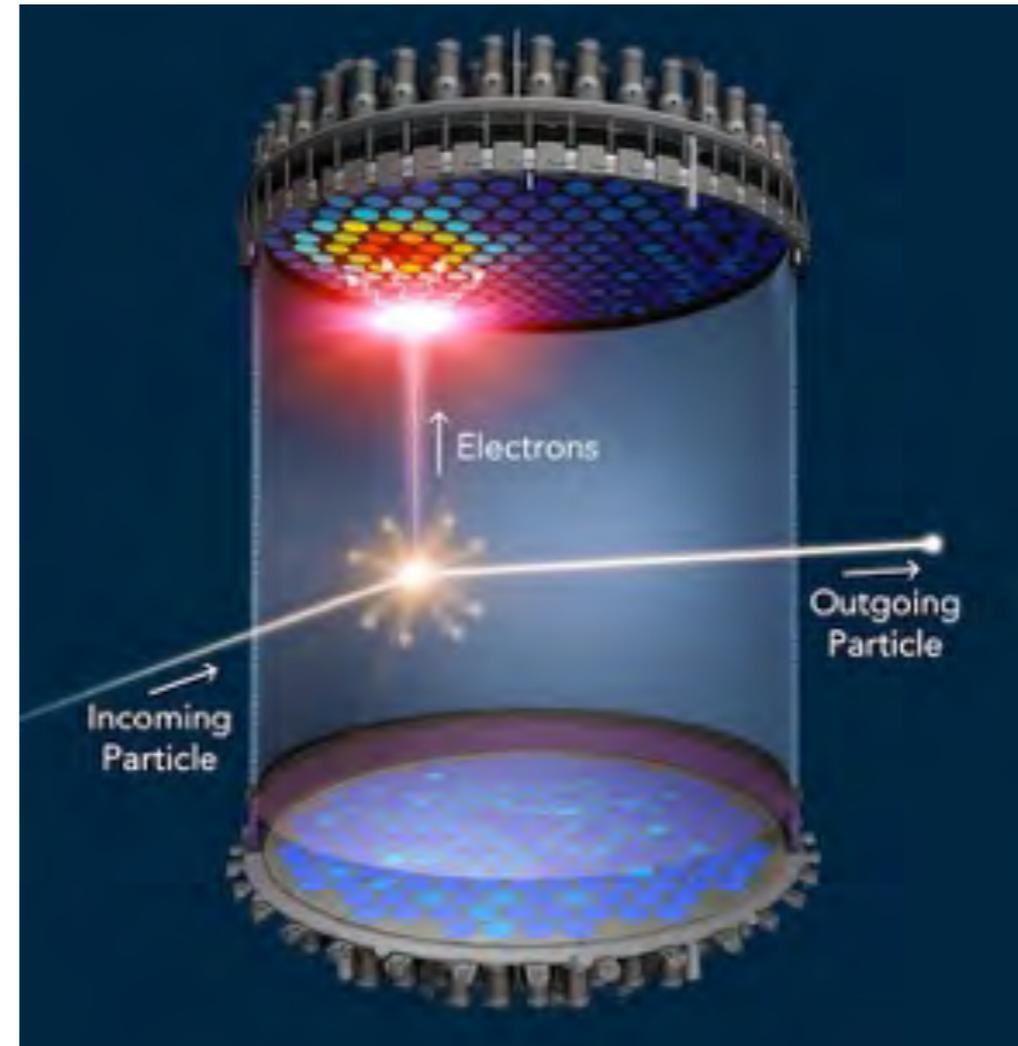


STATUS OF THE LZ EXPERIMENT



Dual Phase Noble Liquid TPC

- Excellent 3D imaging capability
 - ◆ Z position from S1 - S2 timing
 - ◆ XY positions from S2 light pattern
- charge / light ratio
=> Signal vs Background discrimination



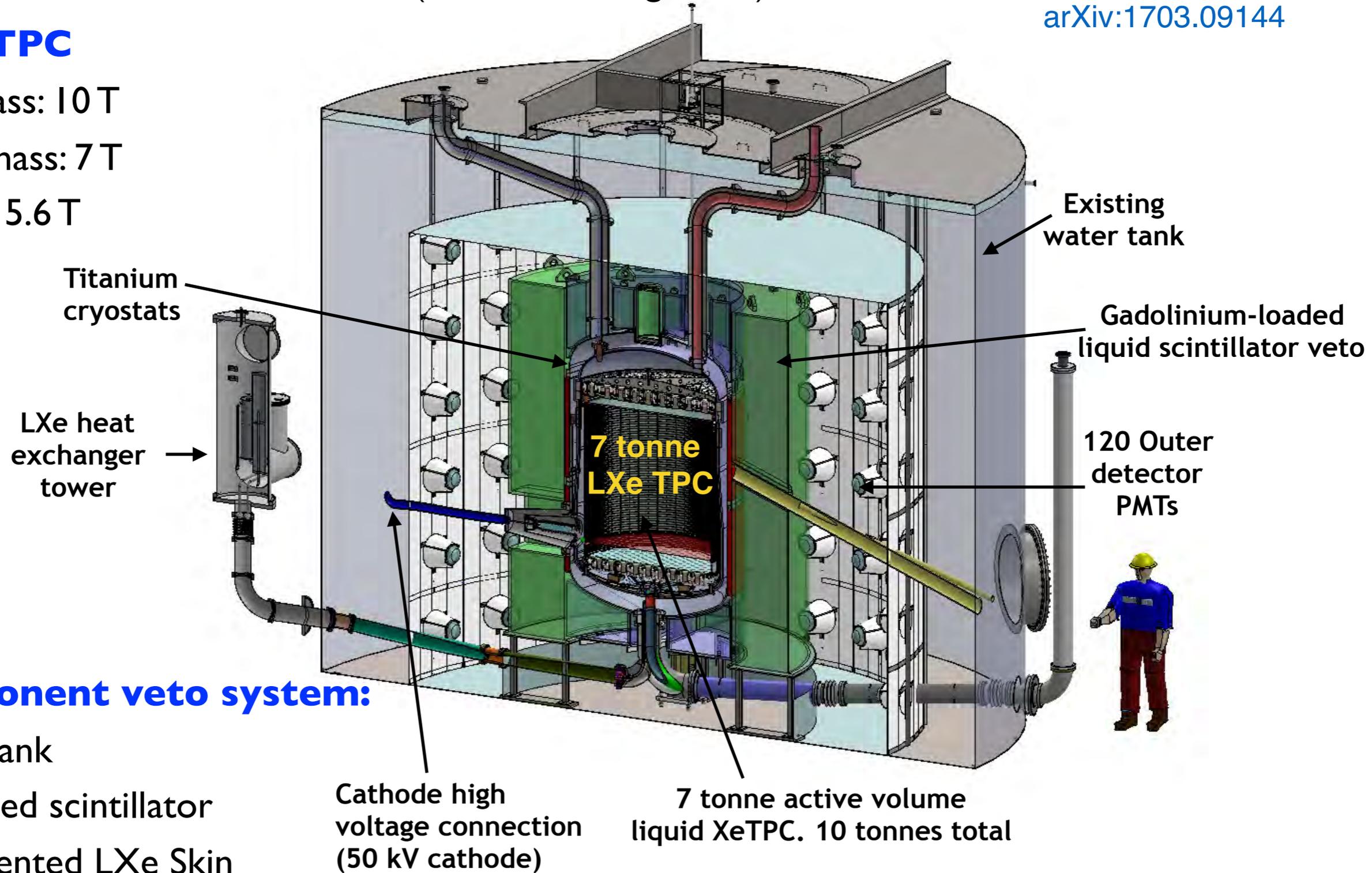
LZ Detector Overview

Technical Design Report:
arXiv:1703.09144

- LZ experiment at SURF, in Lead SD (~1 mile underground)

• Xenon TPC

- ◆ Total mass: 10 T
- ◆ Active mass: 7 T
- ◆ Fiducial: 5.6 T

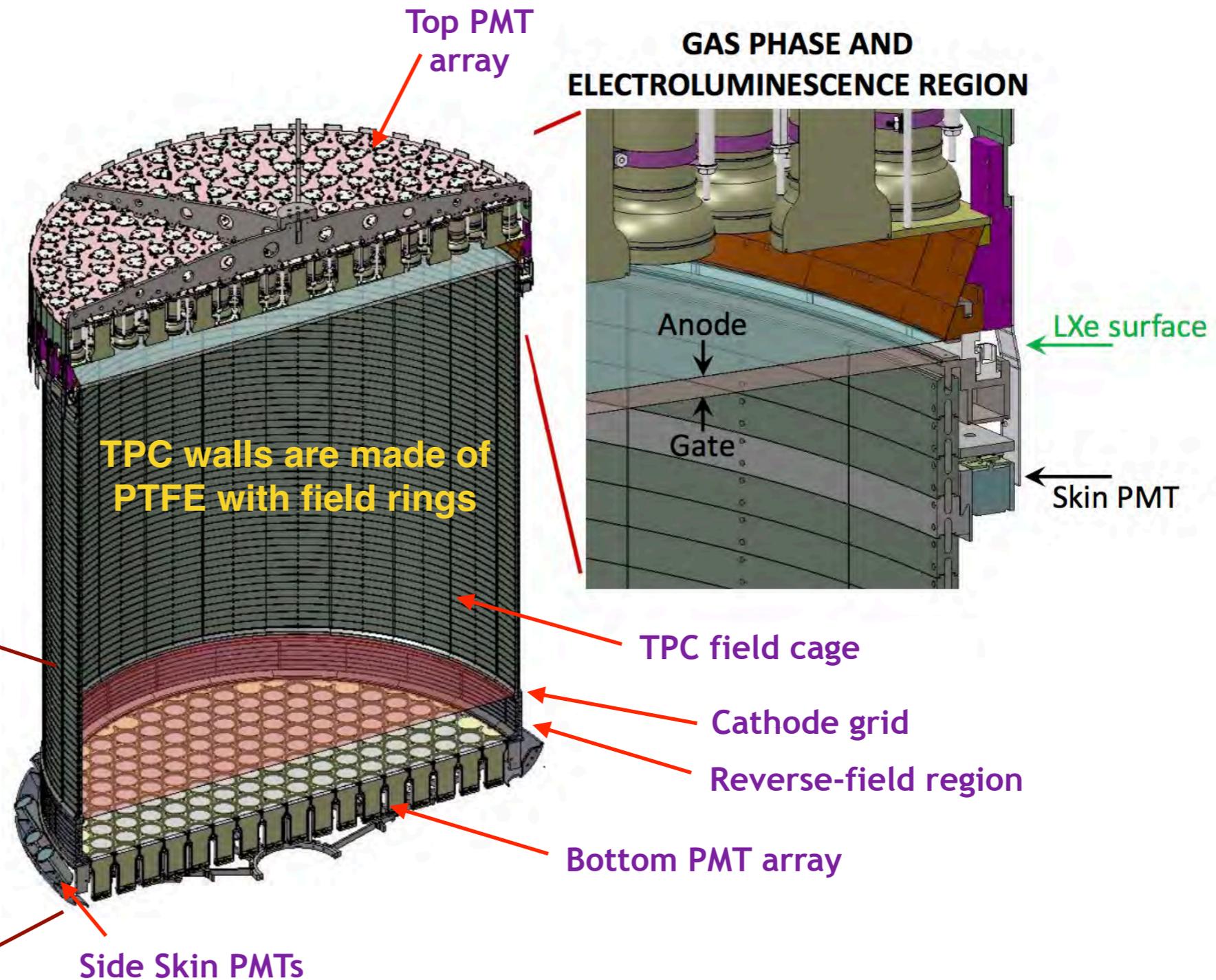
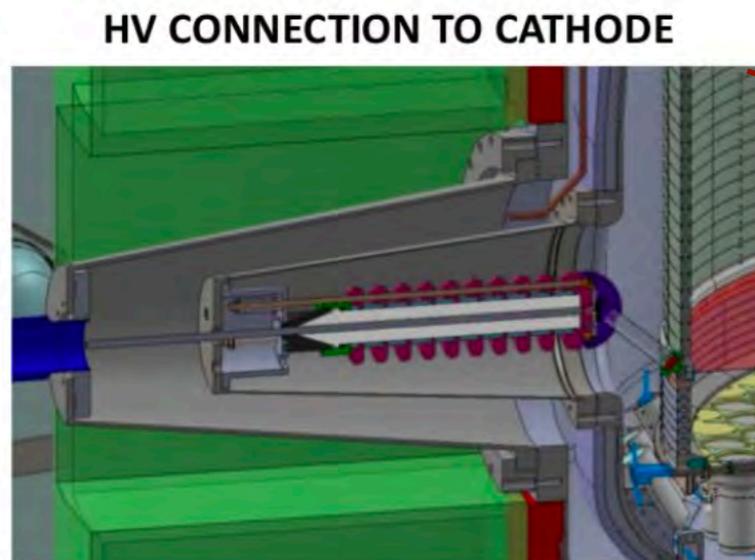


• 3-component veto system:

- ◆ Water tank
- ◆ Gd-loaded scintillator
- ◆ Instrumented LXe Skin

Xenon TPC

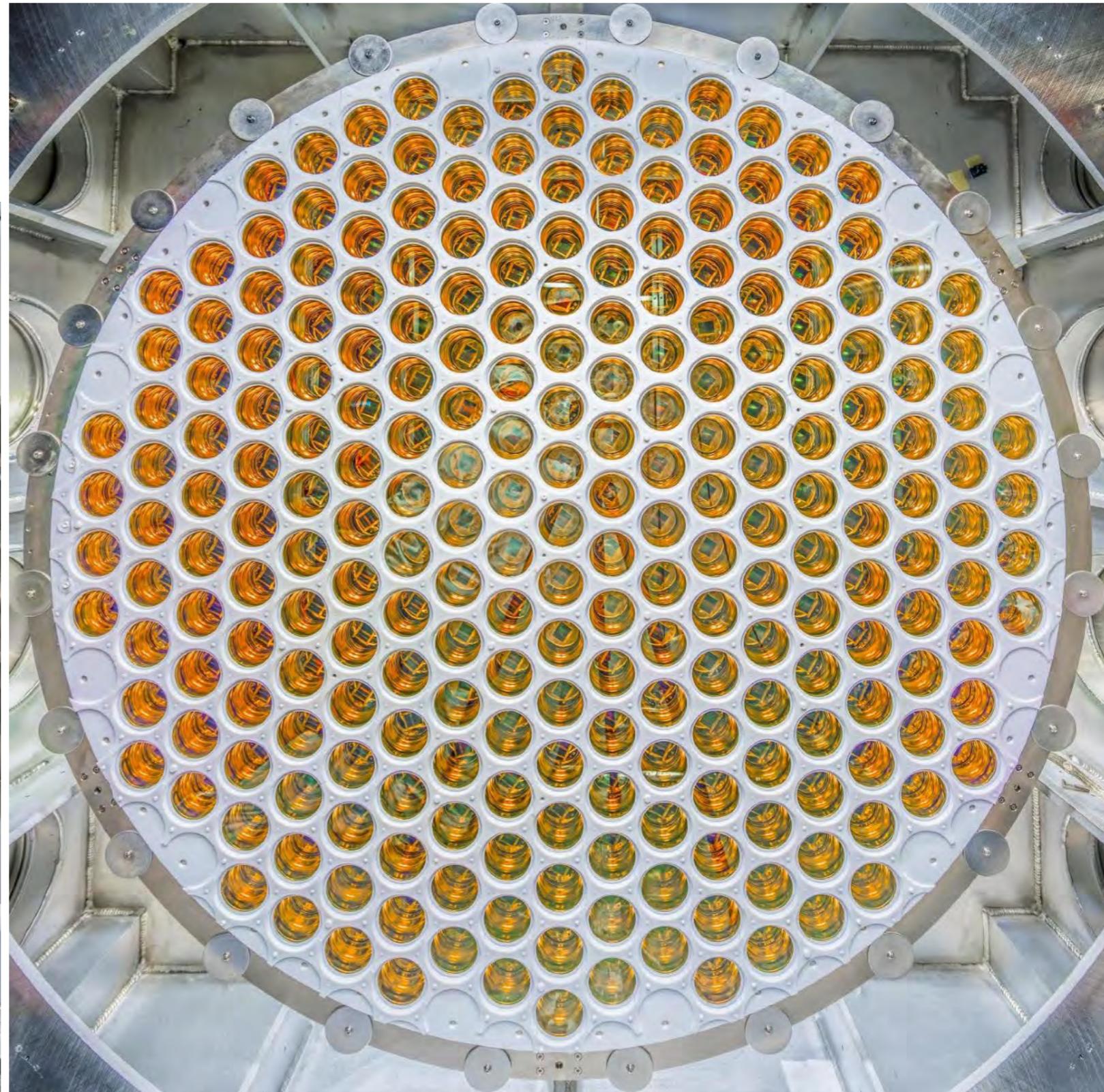
- 1.5 m diameter x 1.5 m height
- 7T active LXe (5.6T fiducial)
- 50 kV cathode HV
 - See talk by J. Watson!
(April 19, H14, at 11:21am)
- 494x 3" PMTs
- Gas circulation @ 500 slpm
(turnover full mass in 2.5 days)
- Instrumented Xe skin region,
outside the field cage



PMT arrays

Hamamatsu R11410 (3")

- Top array: 252 PMTs
- Bottom array: 241 PMTs



Assembled TPC



Full TPC - August 2019



Insertion into inner cryostat vessel



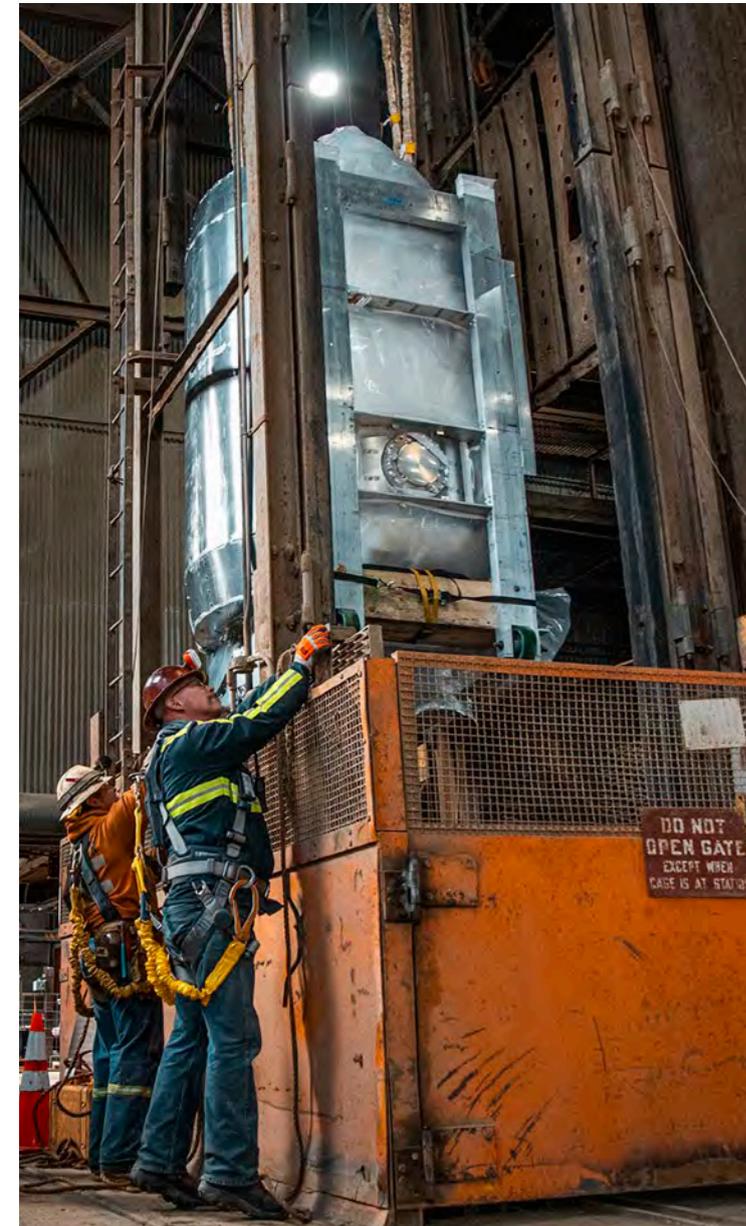
APS April 2020



October 2019

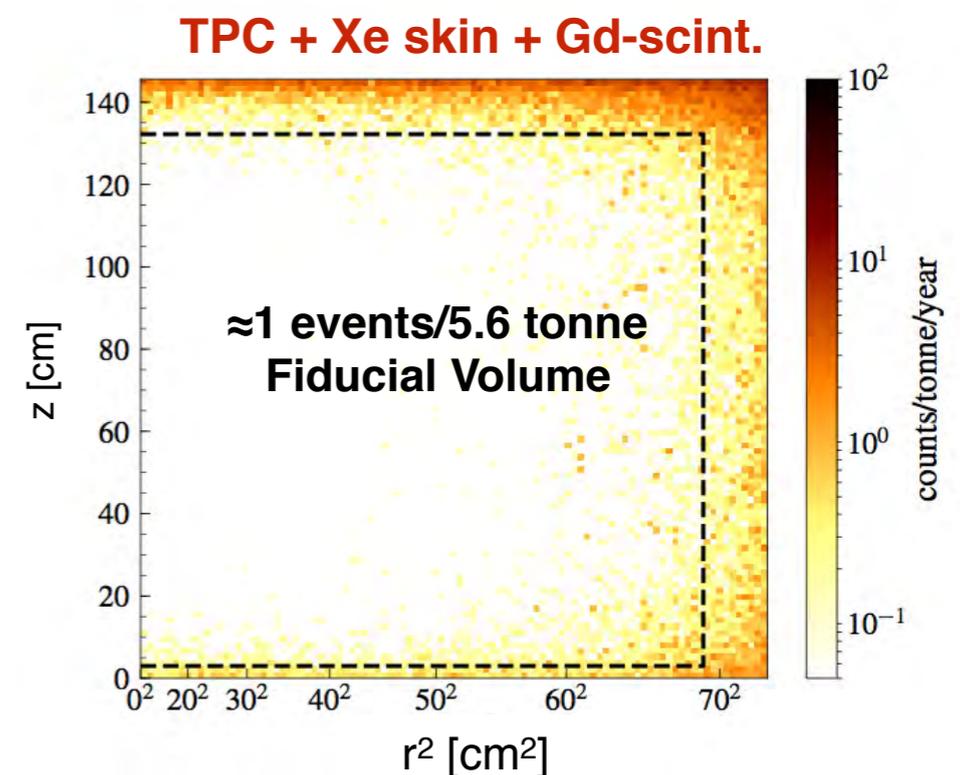
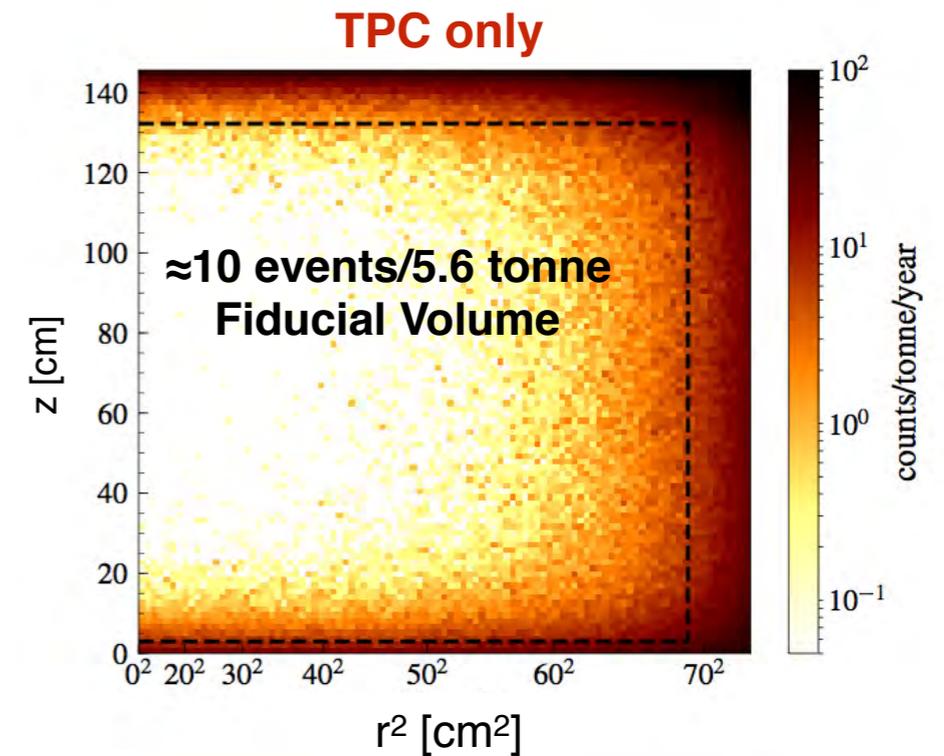
Transport of TPC Underground

October 2019



Expected backgrounds for 5.6 T fiducial - 1000 days

Background Source	ER (cts)	NR (cts)
Detector Components	9	0.07
Surface Contamination	40	0.39
Laboratory and Cosmogenics	5	0.06
Xenon Contaminants	819	0
Radon is the dominant background!		
222Rn	681	0
220Rn	111	0
natKr (0.015 ppt g/g/)	24.5	0
natAr (0.45 pub g/g)	2.5	0
Physics	258	0.51
136Xe 2vββ	67	0
Solar neutrinos (pp+7Be+13N)	191	0*
Diffuse supernova neutrinos	0	0.05
Atmospheric neutrinos	0	0.46
Total	1131	1.03
with 99.5% ER discrim., 50% NR eff.	5.66	0.52

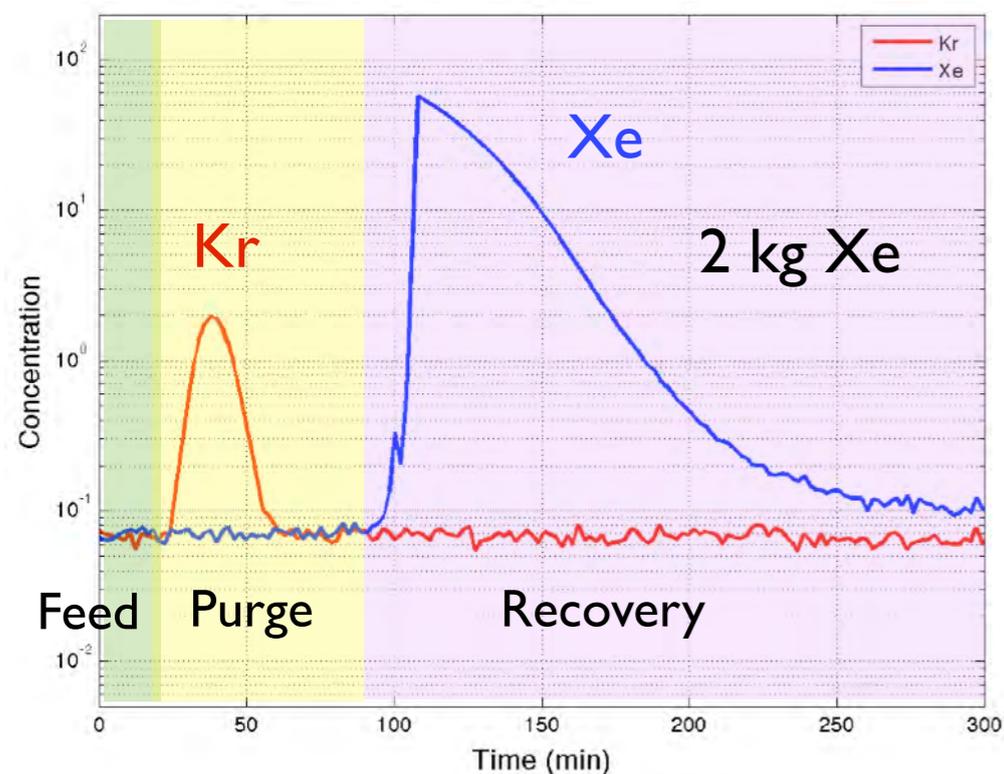


* 6 keV NR threshold used

D.S. Akerib et al (LZ collaboration) Phys. Rev. D 101, 052002 (2020)

Xe Procurement and Kr Removal

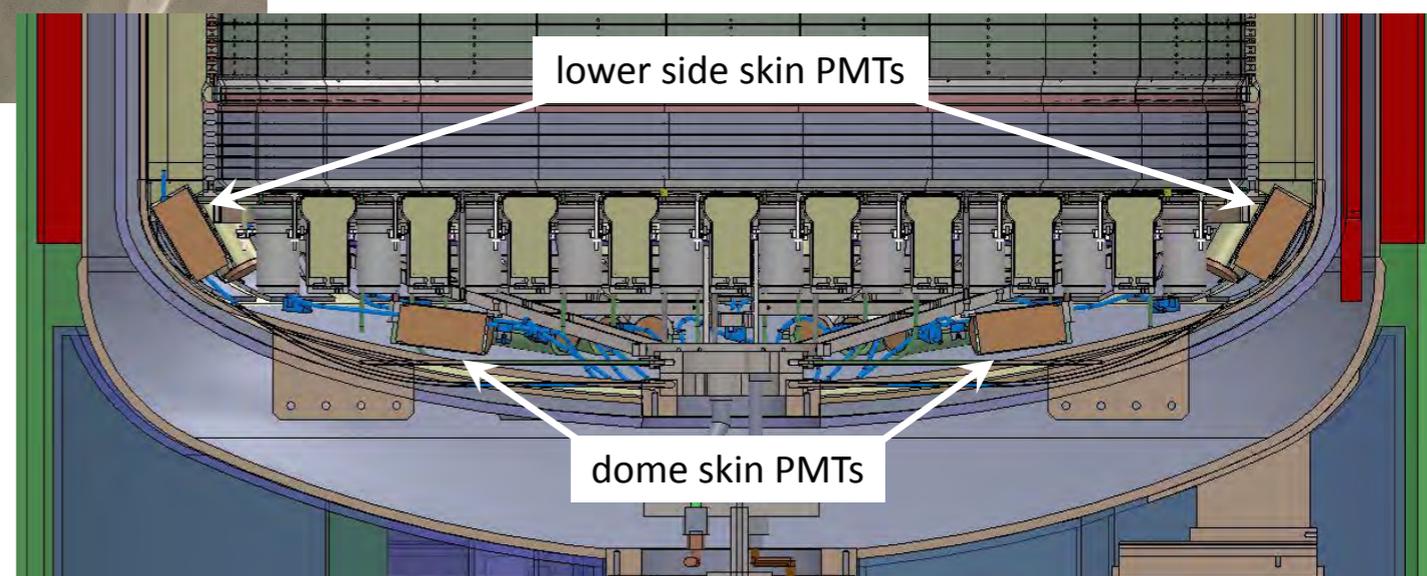
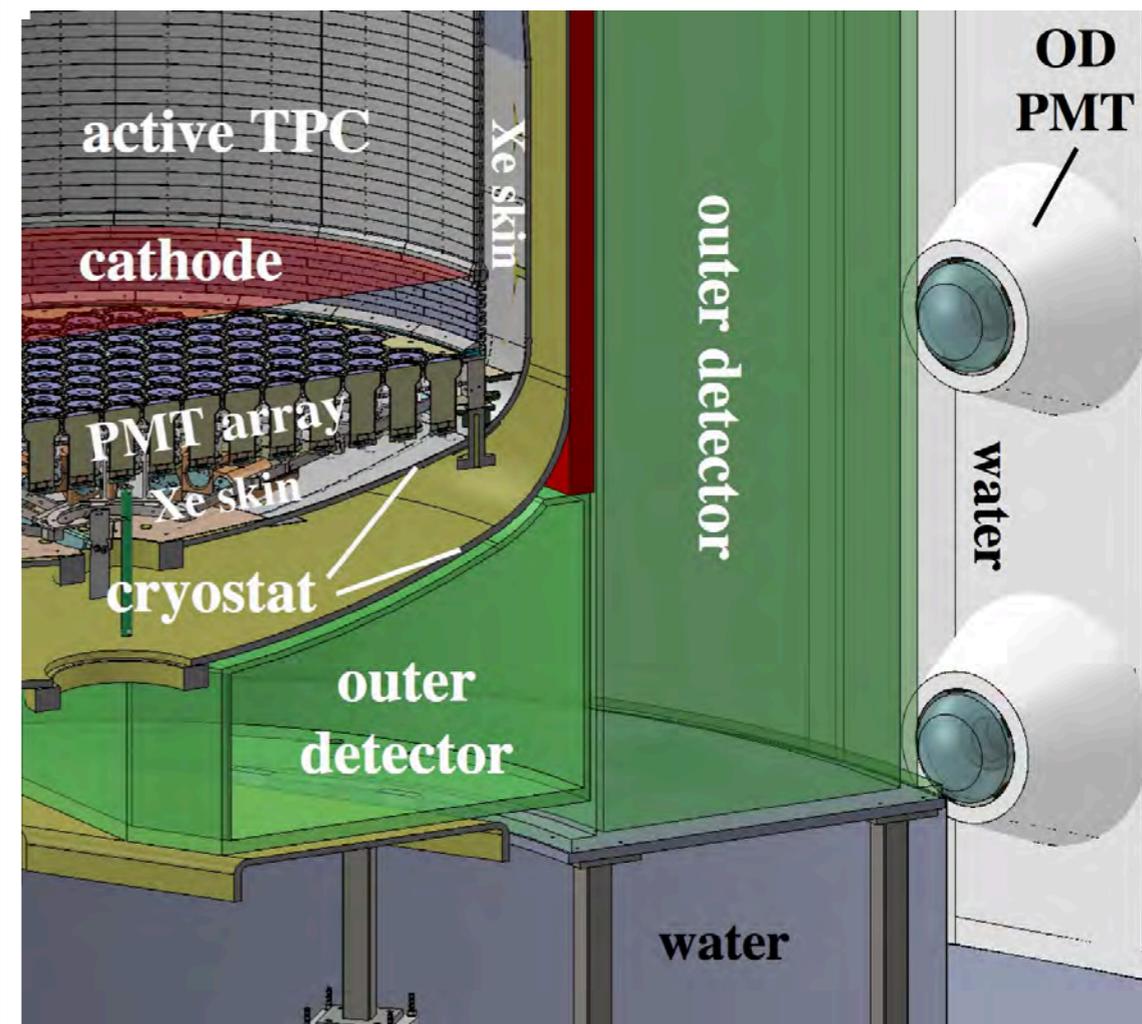
- 10 tonnes of Xe in hand
- Chromatography to separate Kr from Xe.
 - ✦ Demonstration of 0.06 ppt (g/g) in R&D at SLAC
 - ✦ Designed for 0.015 ppt (g/g)
- Production in progress
 - See talk from A.Ames!
(April 20, R13, at 2:54pm)



Kr removal system at SLAC

Xenon "Skin" veto

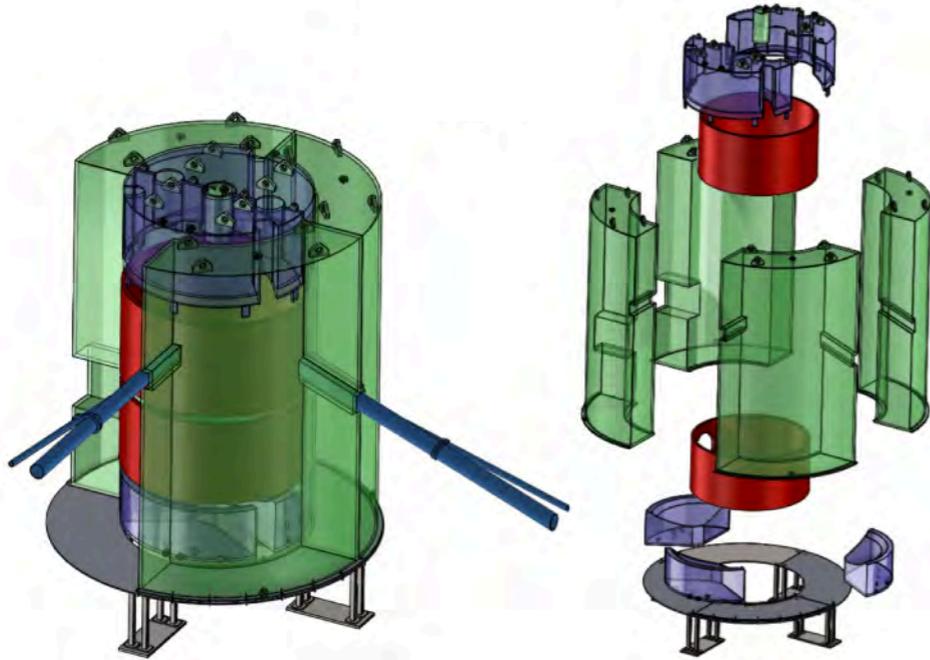
Bottom side skin assembly & PTFE tiling in ICV



- Detection of scattered gamma rays
- Optically segregated from TPC
- TPC top skin: 93 1" PMTs
- TPC bottom skin and lower dome: 38 2" PMTs

Outer Detector

- Suppression of neutron-induced nuclear recoil rate \Rightarrow maximize fiducial volume.

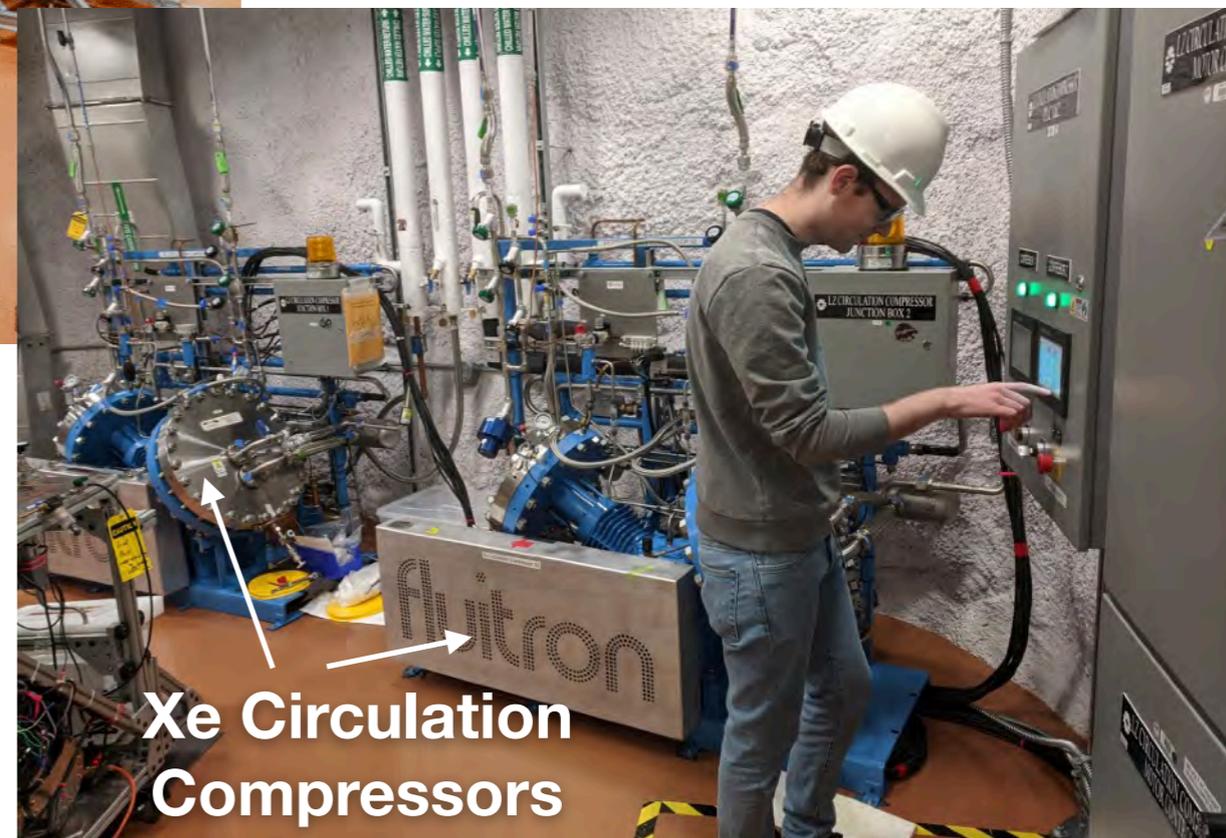
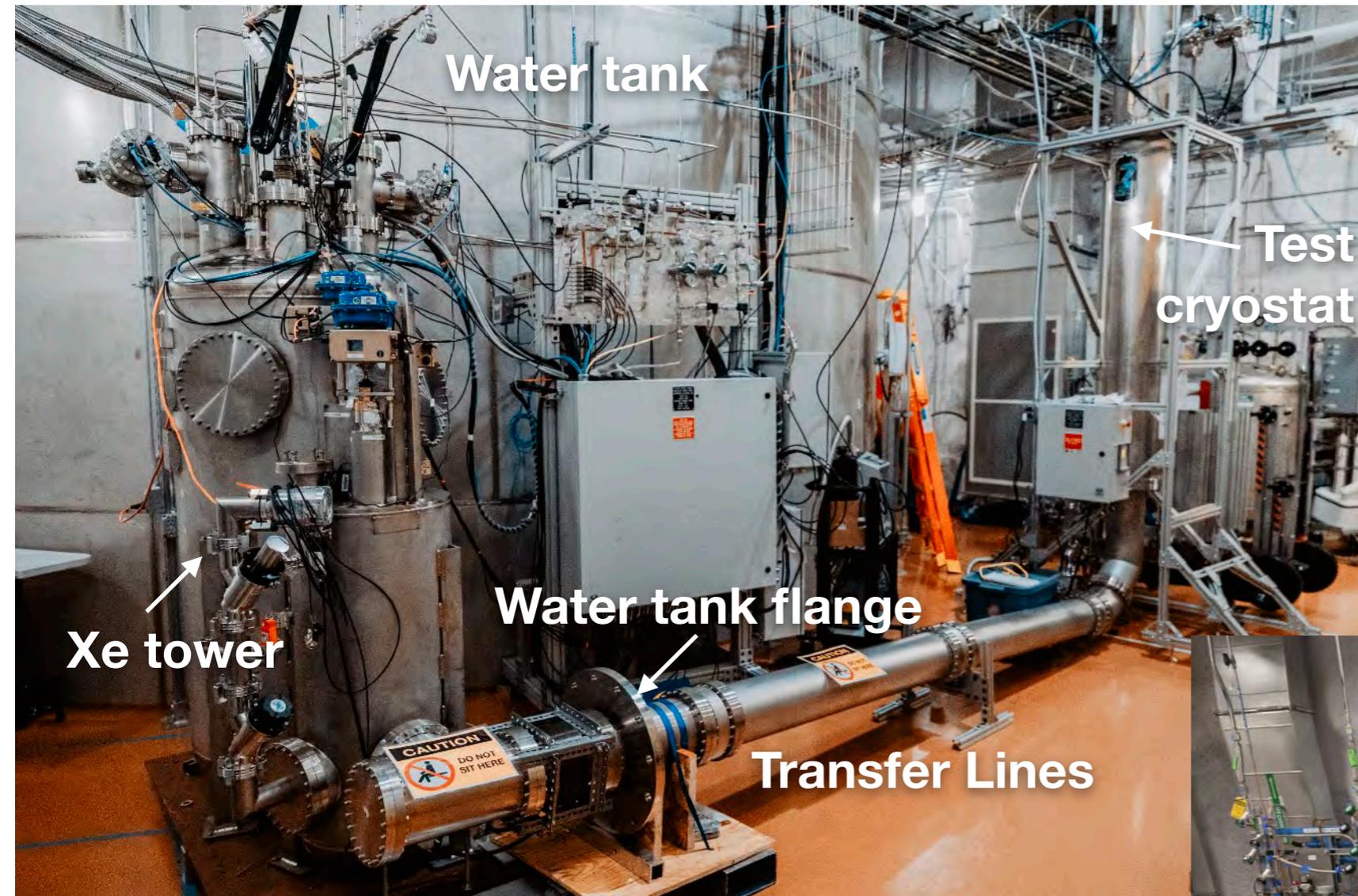


- Segmented acrylic tanks
- 120 8" PMTs
- Liquid scintillator: Gd-loaded (0.1%) LAB (linear alkyl benzene)
- Total LAB mass: \sim 17 tonnes

See talk by B. Penning! (April 20, R13, at 3:06 pm)

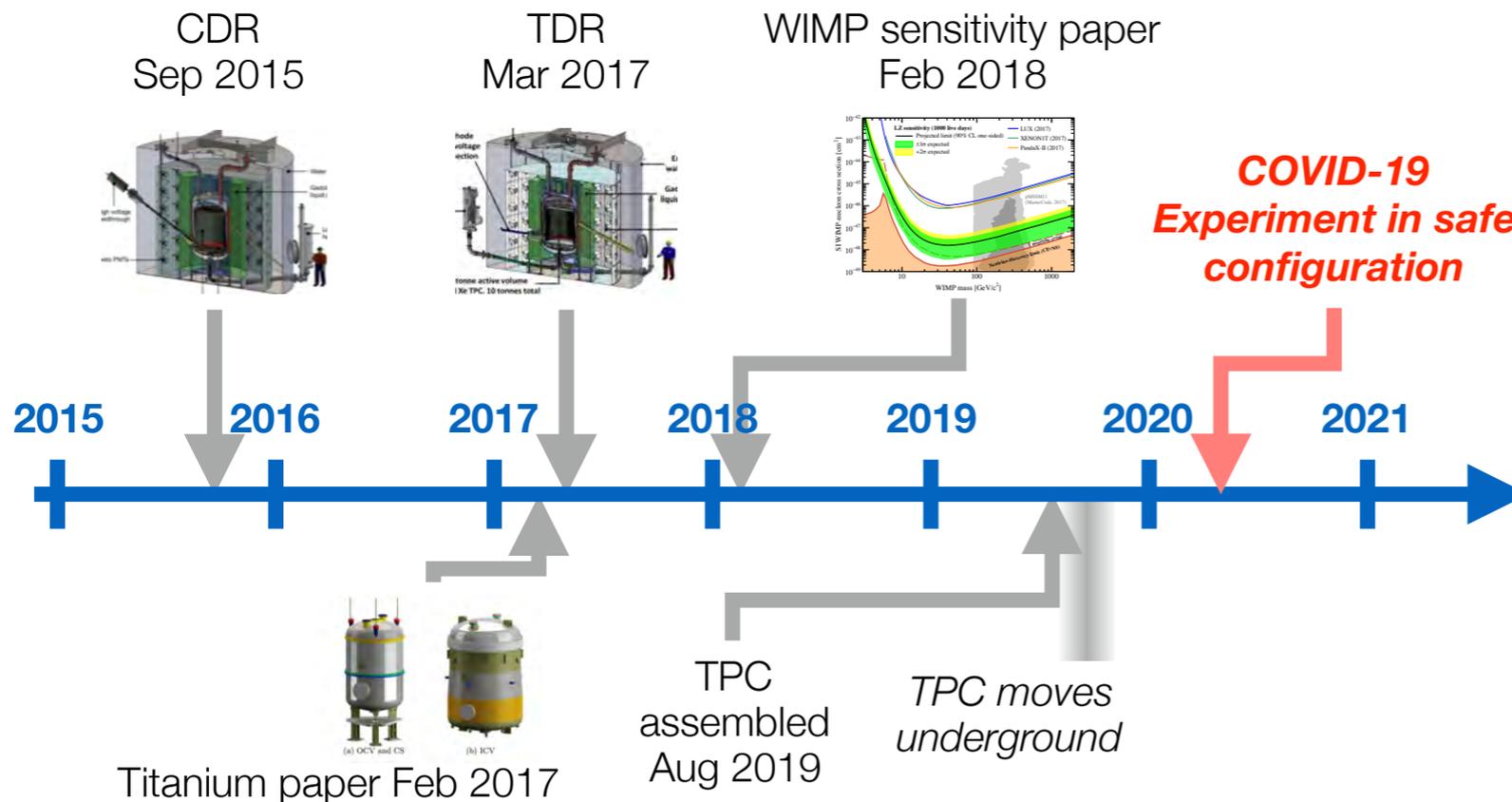


Xe Circulation System & Cryogenics



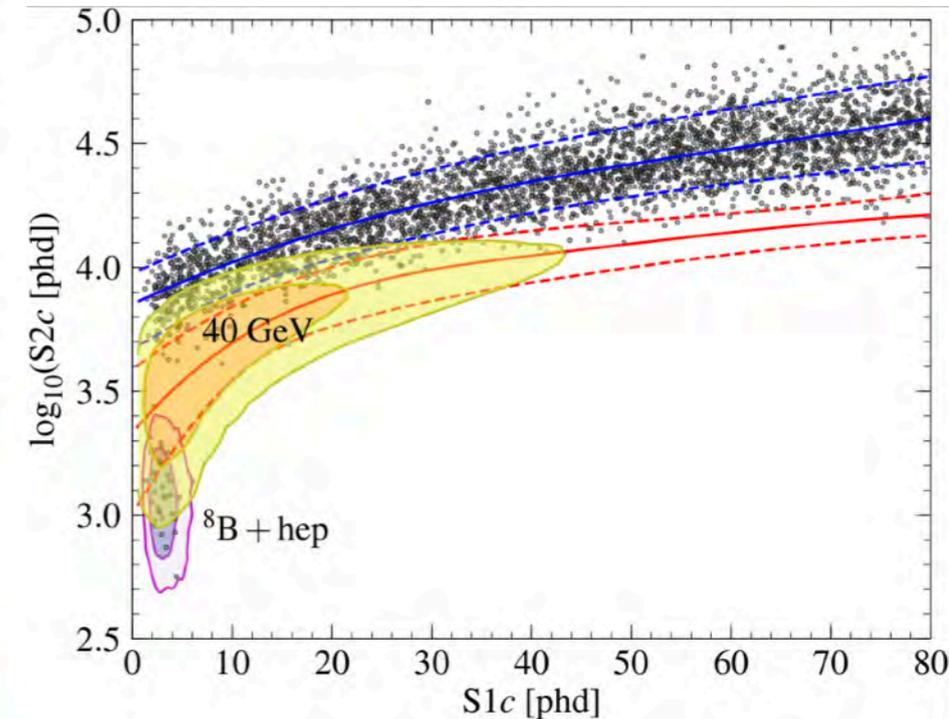
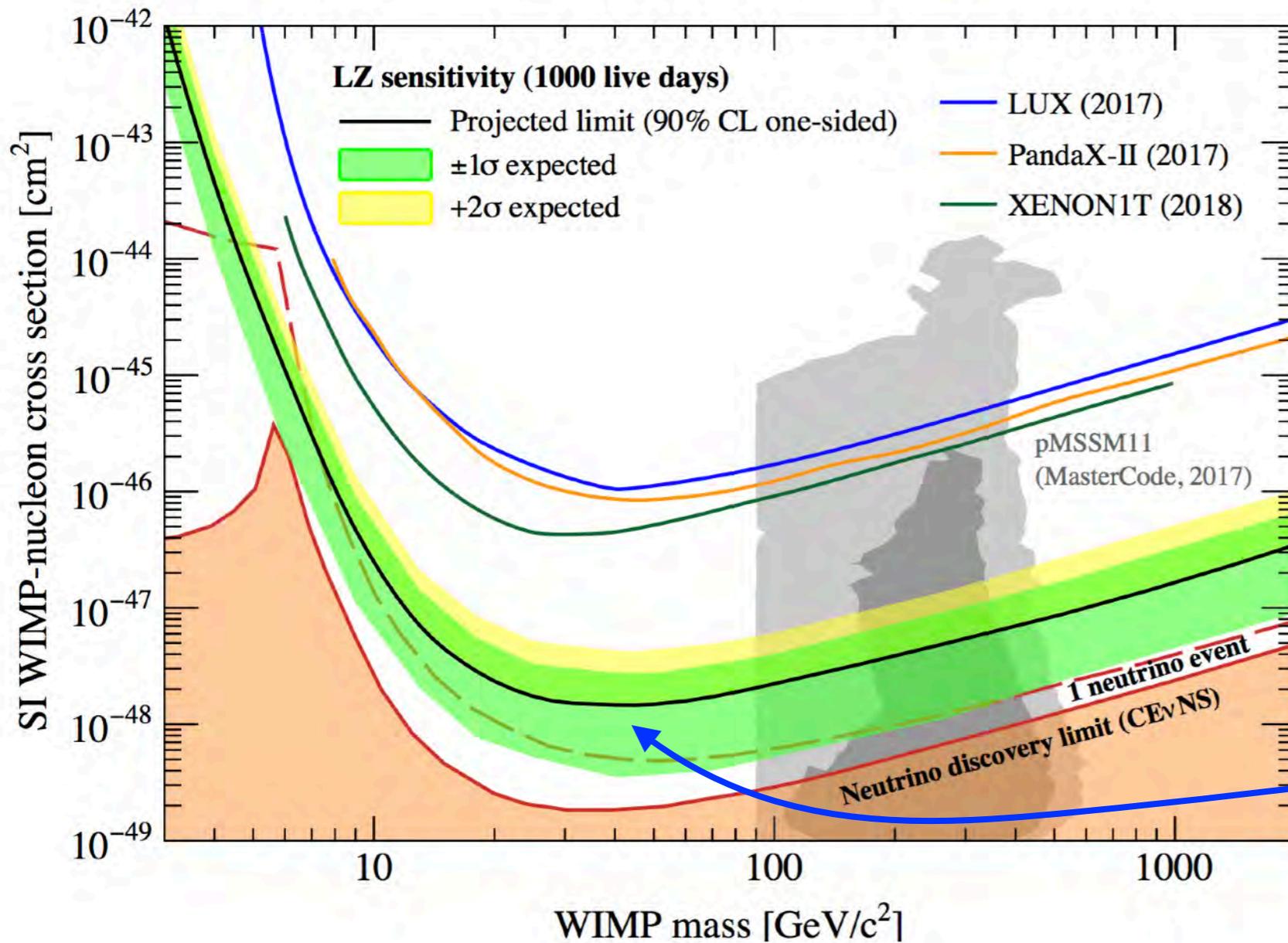
Current Status

- We have made significant progress in the assembly of the TPC and associated systems.
 - ✦ TPC complete, moved underground and currently at vacuum
 - ✦ HV cathode connection installed
- Out of concern for the health of our scientists and staff members and to slow the spread of the SARS-CoV-2 virus:
 - ✦ We are following DOE, Berkeley Lab, and Sanford Lab protocols and guidelines in response to this situation
 - ✦ We have secured the experiment in a safe and stable configuration
 - ✦ We await the reduction of risks associated with the virus and updated guidance from the DOE and the Laboratories to complete our assembly and advance to commissioning.



Projected Sensitivity (5.6 T exposure, 1000 live days)

Approaches coherent neutrino scattering background!



90% CL minimum of $1.6 \times 10^{-48} \text{ cm}^2$ at 40 GeV/c^2

D.S.Akerib et al. (LZ collaboration) Phys. Rev. D 101, 052002 (2020)

Thank You!

LZ Collaboration: 36 Institutions: 250 scientists, engineers, and technical staff

- Black Hills State University
- Brandeis University
- Brookhaven National Laboratory
- Brown University
- Center for Underground Physics, Korea
- Fermi National Accelerator Laboratory
- Imperial College London
- LIP Coimbra, Portugal
- Lawrence Berkley National Laboratory
- Lawrence Livermore National Laboratory
- Northwestern University
- Pennsylvania State University
- Royal Holloway, University of London
- SLAC National Accelerator Laboratory
- South Dakota School of Mines and Technology
- South Dakota Science and Technology Authority
- STFC Rutherford Appleton Laboratory
- Texas A&M University
- University at Albany, SUNY
- University College London
- University of Alabama
- University of Bristol



- University of California, Berkeley
- University of California, Davis
- University of California, Santa Barbara
- University of Edinburgh
- University of Liverpool
- University of Maryland
- University of Massachusetts, Amherst
- University of Michigan
- University of Oxford
- University of Rochester
- University of Sheffield
- University of South Dakota
- University of Wisconsin – Madison
- Yale University