



PandaX-20T: the next generation xenon detector for dark matter and neutrino searches

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on behalf of PandaX Collaboration

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@ IDM2026, Zaragoza

PandaX pathway

- Increasing sensitive target volume
- Lowering radioactive background

PandaX initiated



2009

PandaX-I
120 kg



2010-2014

PandaX-II
580 kg



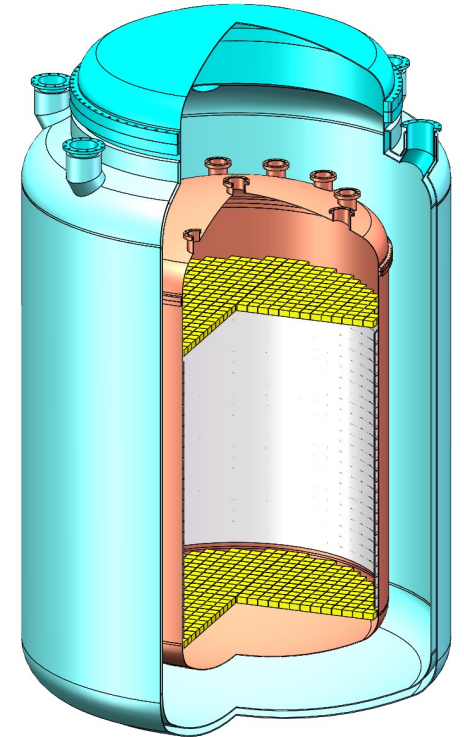
2015-2019

PandaX-4T
3.7 tonne



2020-2026

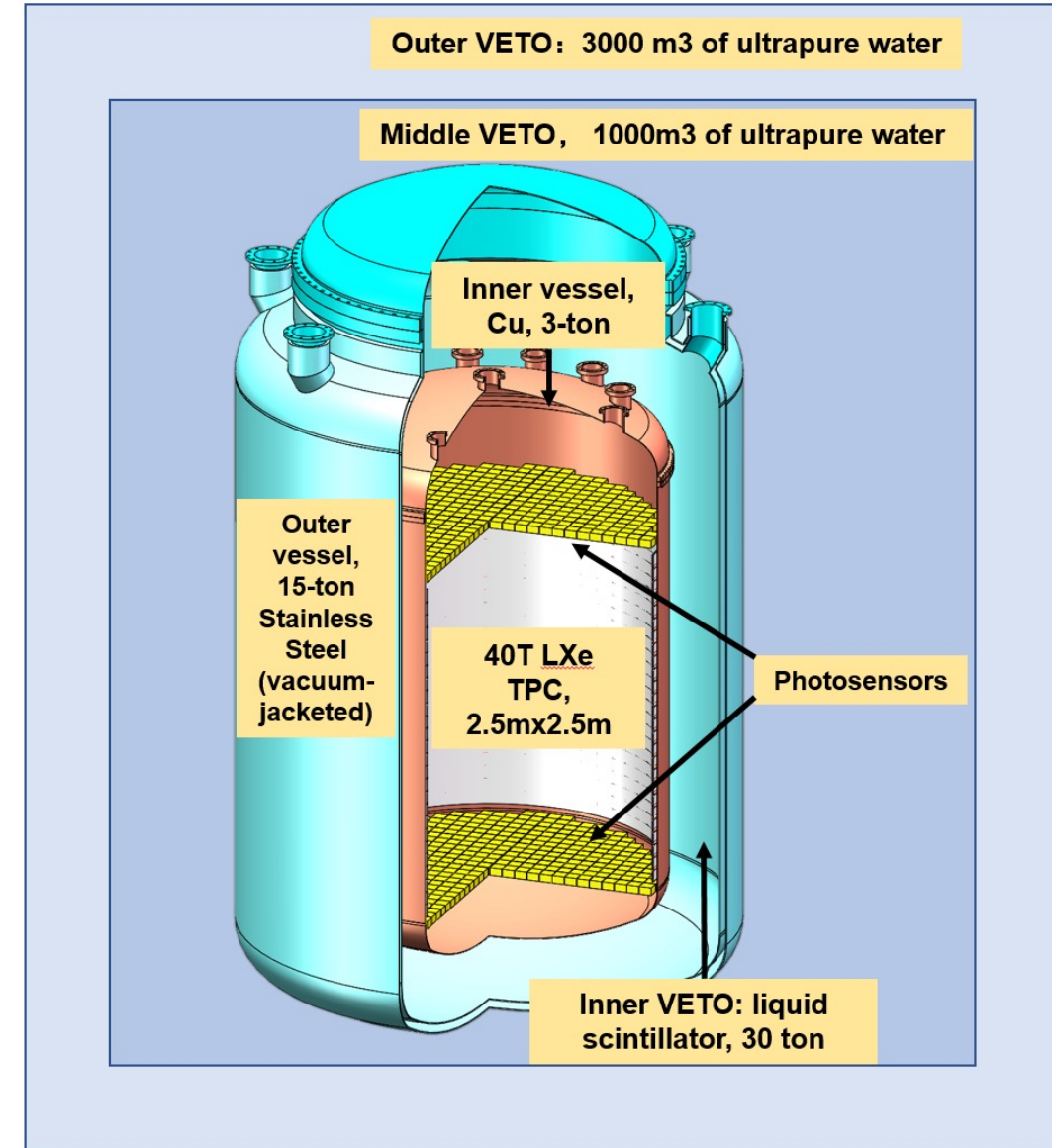
PandaX-xT
20 tonne → 47 tonne



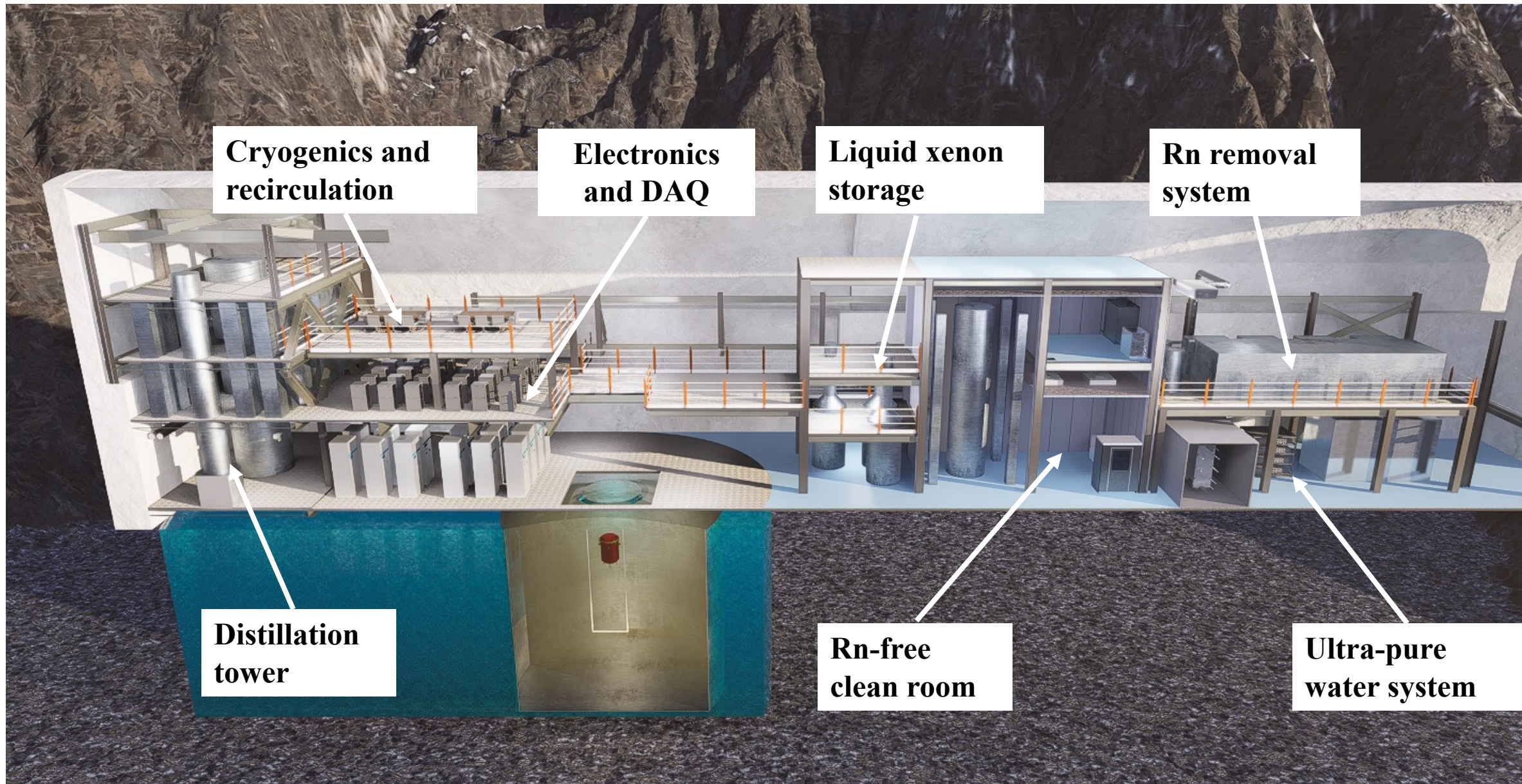
2027-

- Staged plan, eventually 47-tonne Xe with 40-tonne sensitive volume
 - TPC: 2.5 m in diameter and height
 - Cold LS veto right outside Cu vessel
 - Ultrapure water as veto and shielding
 - Dual-phase or single-phase options
- First stage PandaX-20T “fully” funded (by many patrons)

arXiv:2402.03596, SCPMA 68, 221011 (2025)



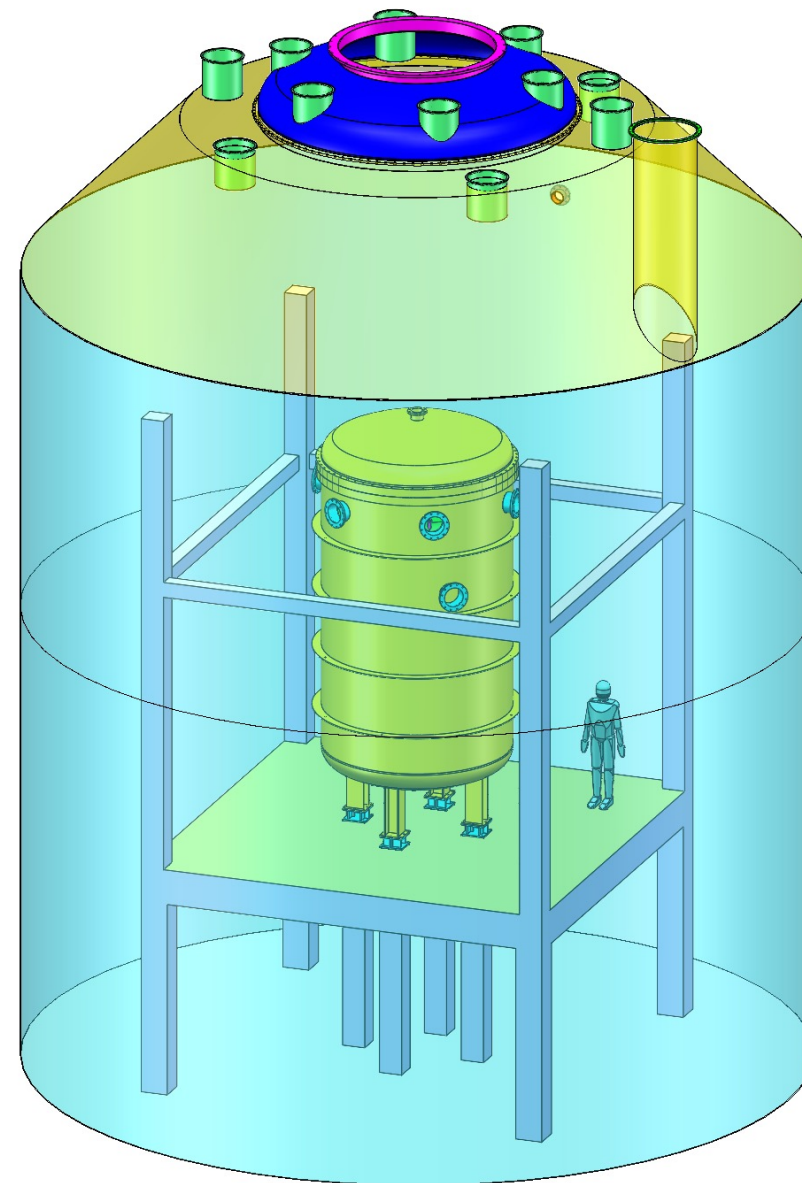
Layout of infrastructure renovation at CJPL



PandaX-20T overall design

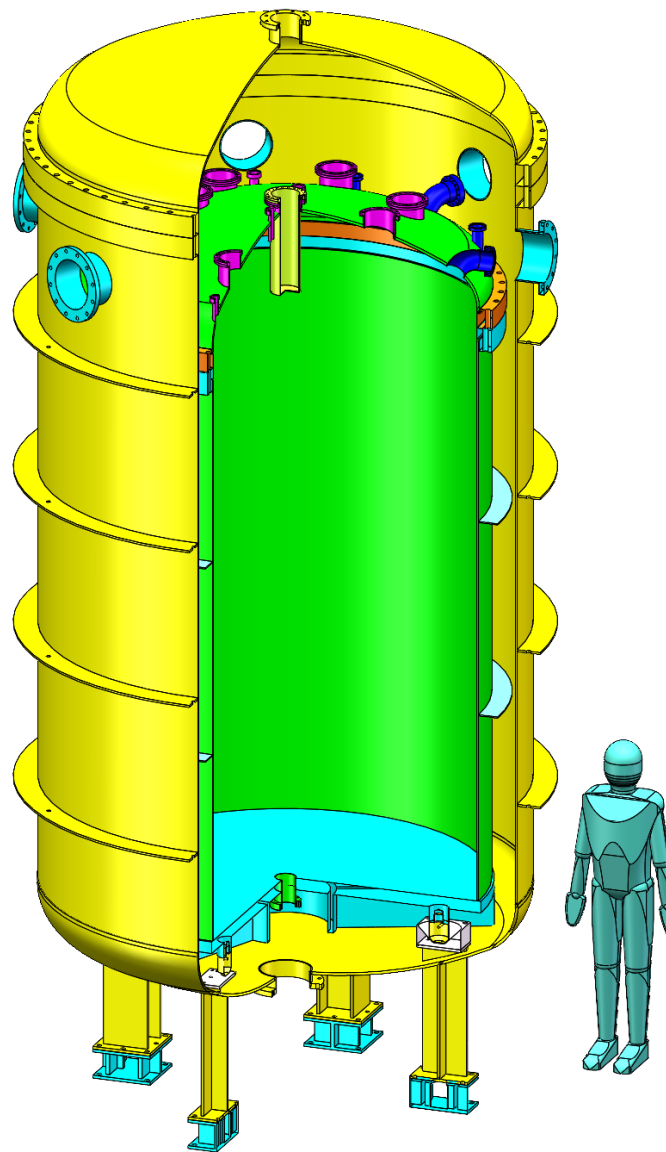
- Dual-phase TPC
- 2-inch PMT on top and 3-inch PMT on bottom
- Titanium cryostat
- Room-temperature LS veto outside Titanium cryostat
- Ultrapure water veto and shielding
- Cryogenics, LXe storage, Kr & Rn distillation tower, etc. for the final-stage 47-tonne detector

More details about **veto system** in **Yuehuan Wei's** talk on Thursday

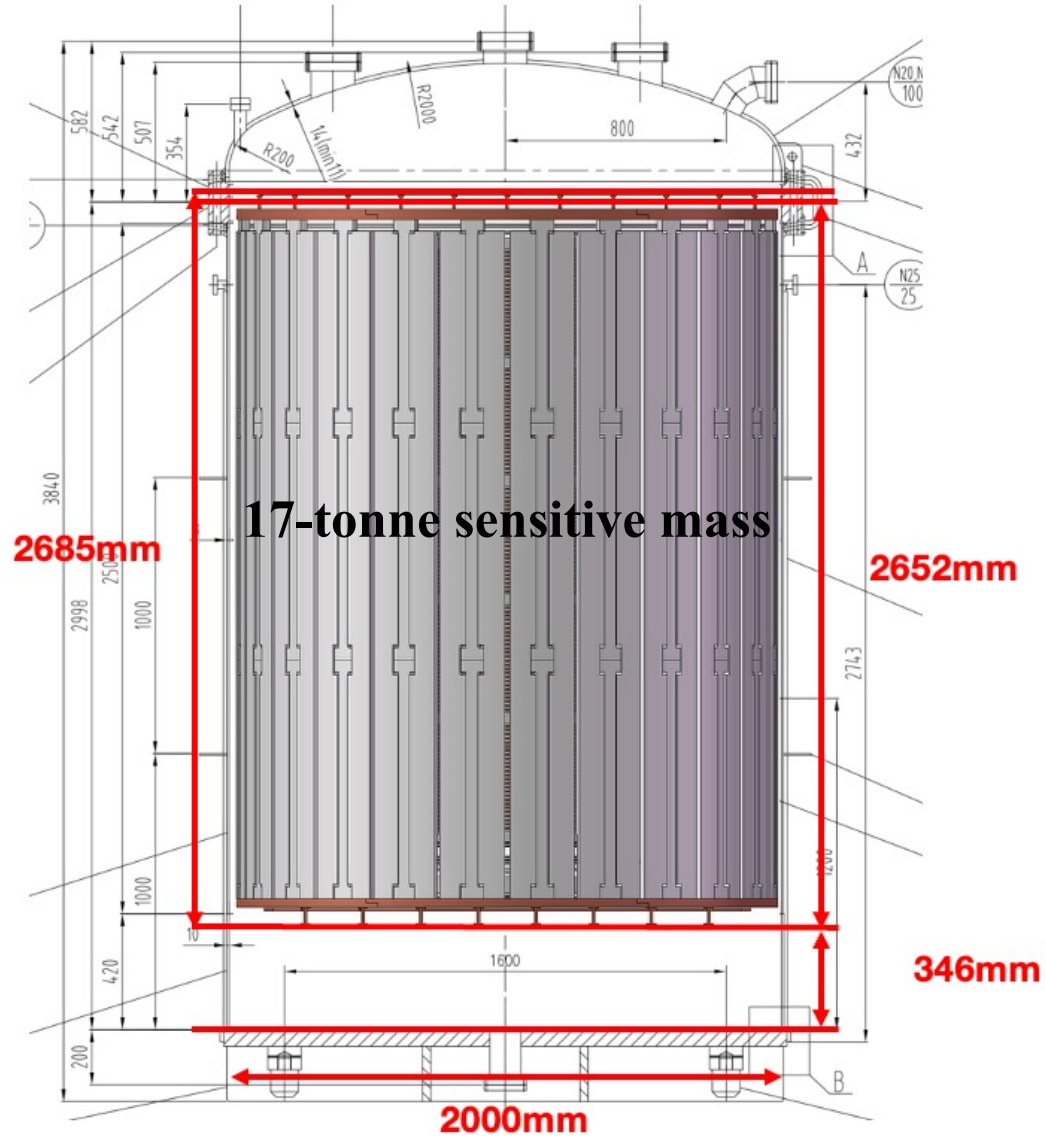


Titanium cryostat

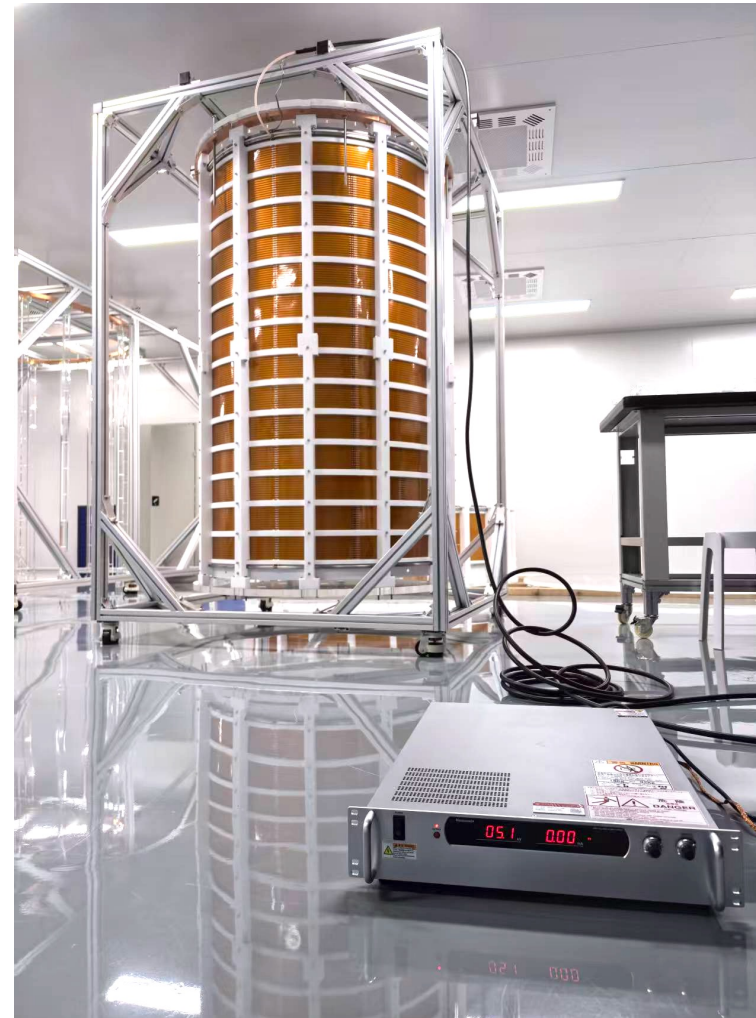
- Inner vessel
 - ID 2000 mm, height 3000 mm
 - Barrel thickness 8 mm
 - Design pressure: -0.1~0.45 MPa
- Outer vessel
 - ID 2400 mm
 - Barrel thickness 10 mm
- HPGe and ICP-MS for radioactivity assay
- In fabrication



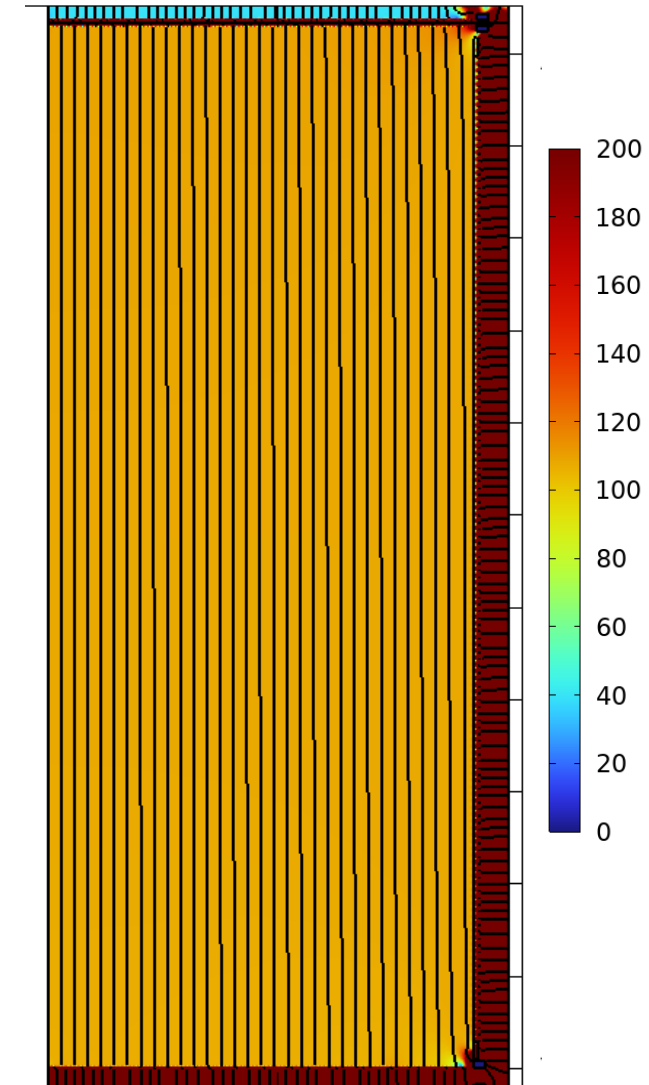
TPC: field cage



Flexible PCB shaping ring

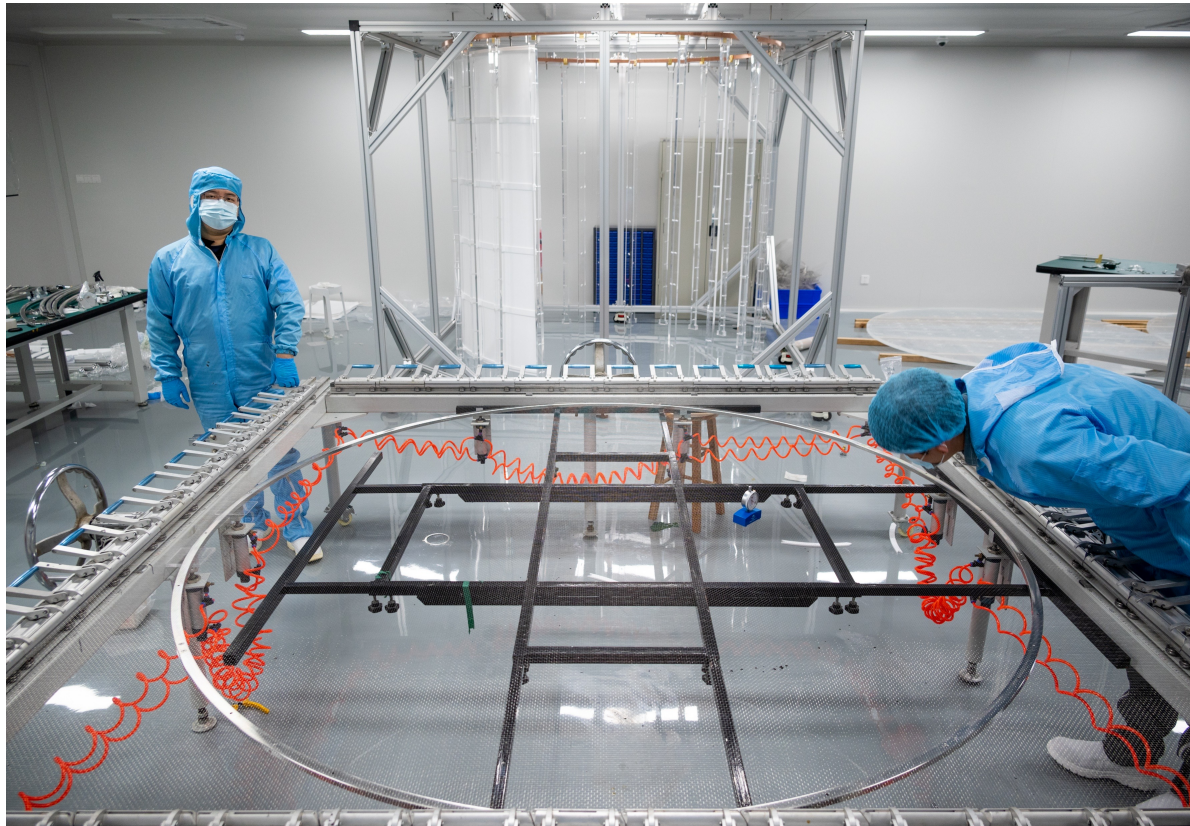


E-field simulation



Mesh grid

- 2.5 m in diameter
- 200 μm wire, 5 mm pitch



Wire grid

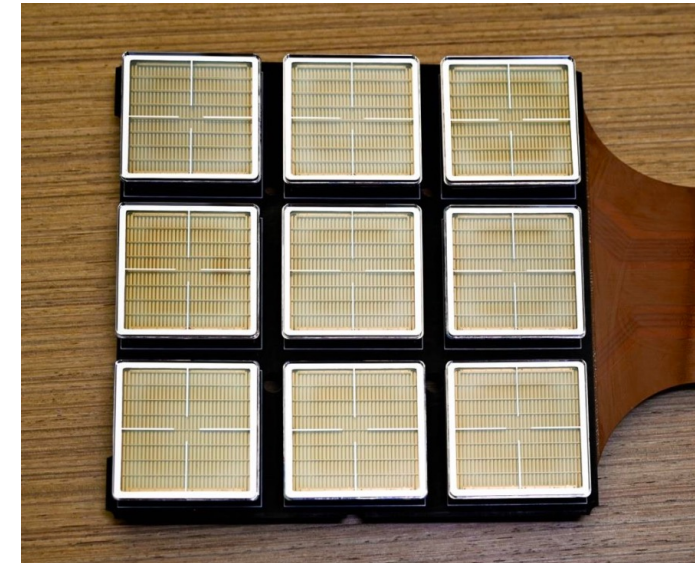
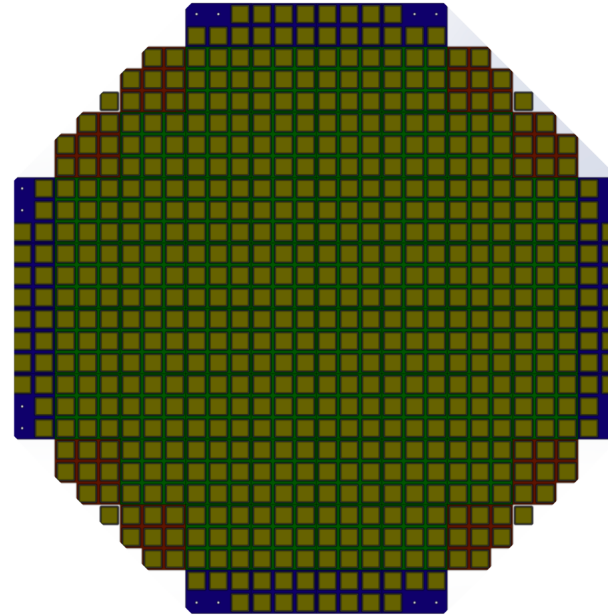
- 2 m in diameter
- Different wire pitch for different electrode



PMT array

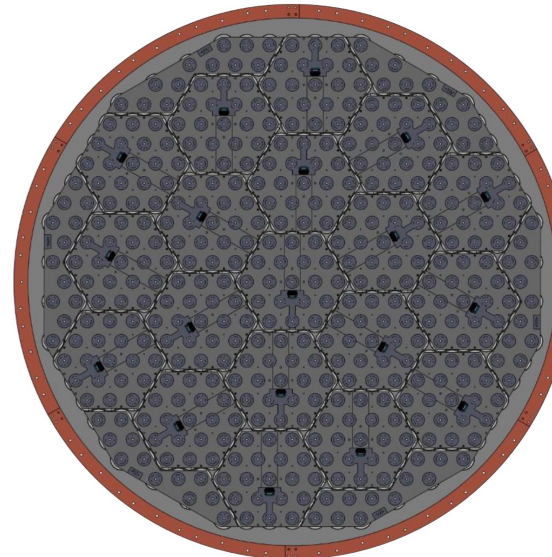
➤ Top PMT array:

- 616 2-inch multi-anode PMTs (R12699)
- Co-development with Hamamatsu for low-radioactivity version (*NIMA 1073 (2025) 170290*)
- Mainly 3×3 PMT tiles
- Flexible-Rigid PCB (FRP) boards for integrated HV/signal readout lines with base

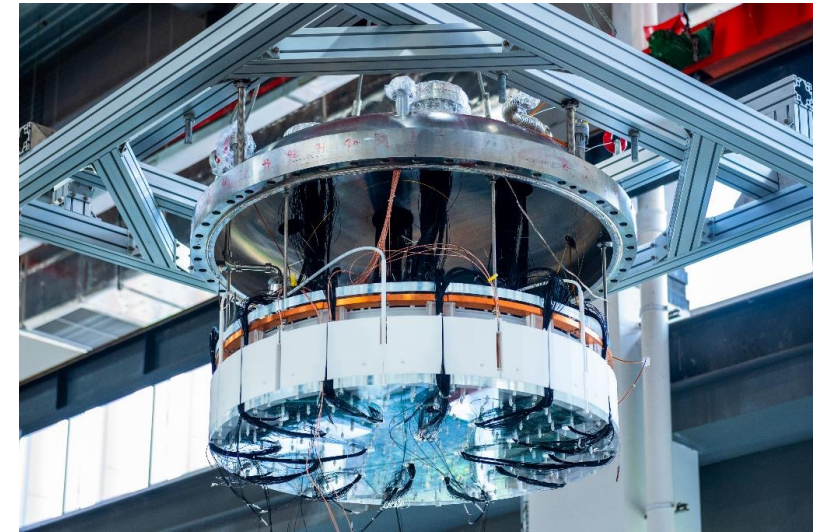
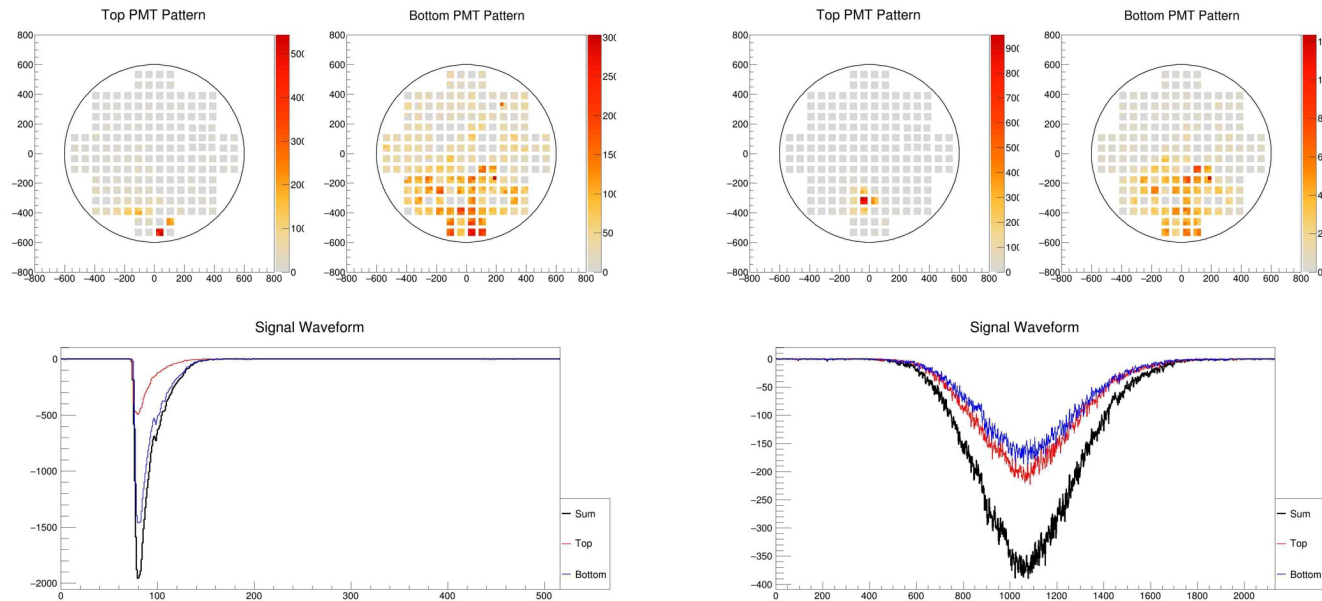
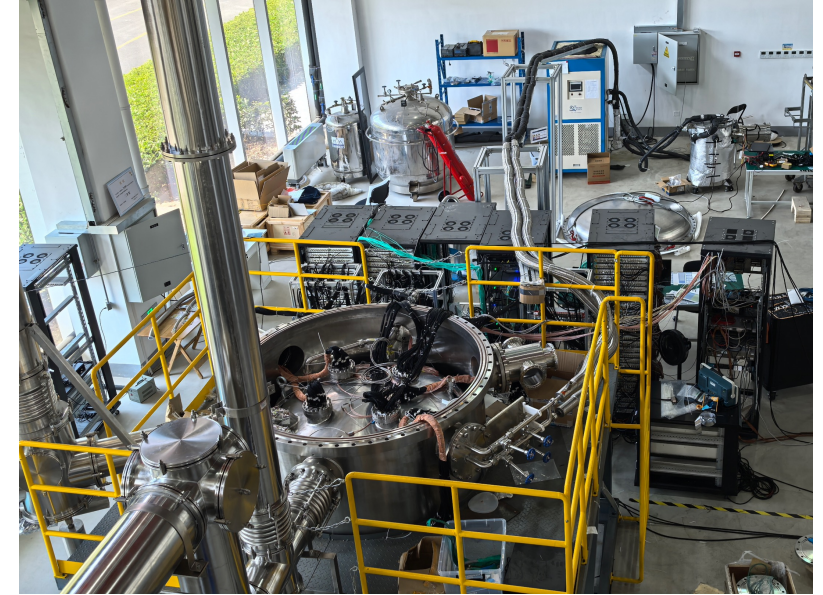


➤ Bottom PMT array:

- 433 3-inch PMTs (R11410)
- Mainly 19 PMT tiles
- Flexible PCB bases

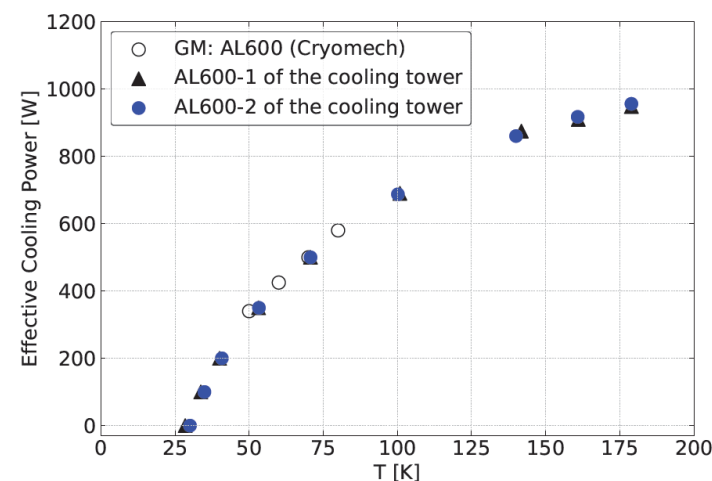
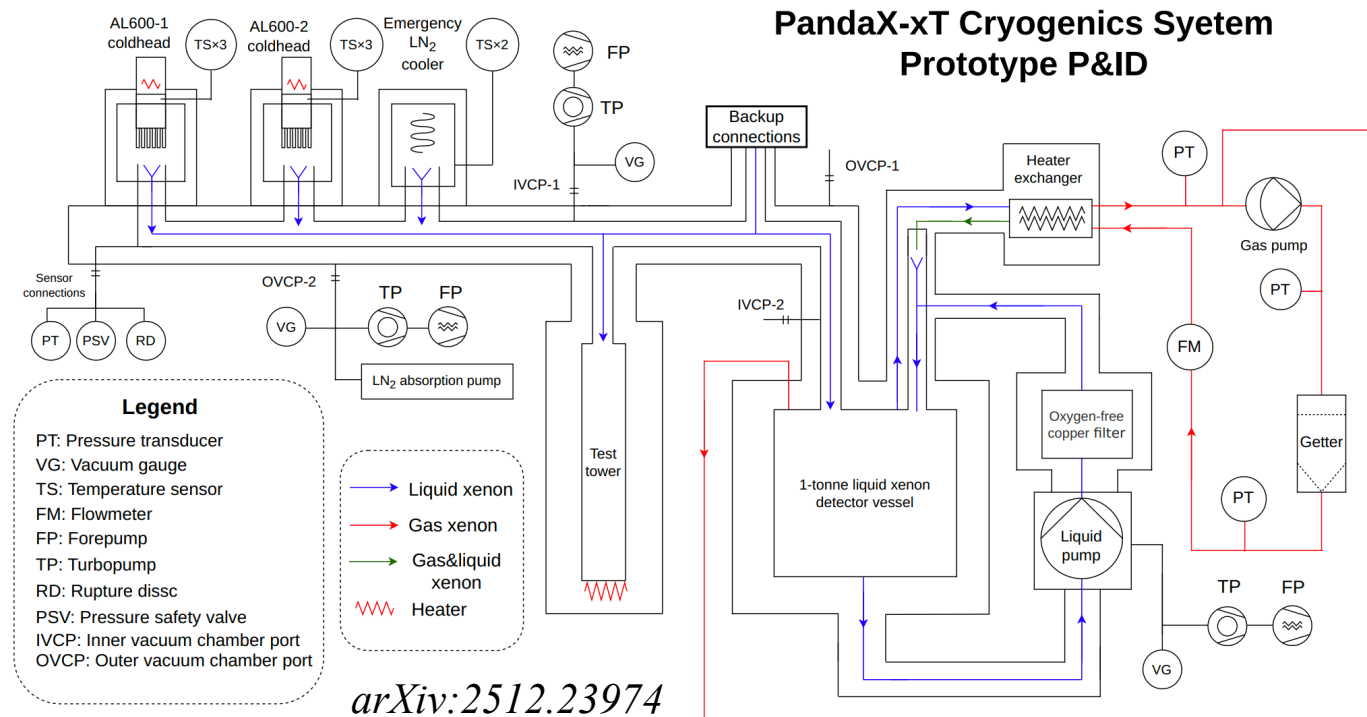


Prototype at TDLI



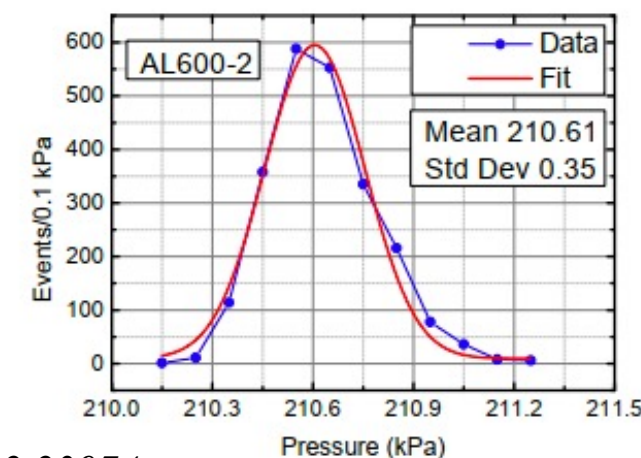
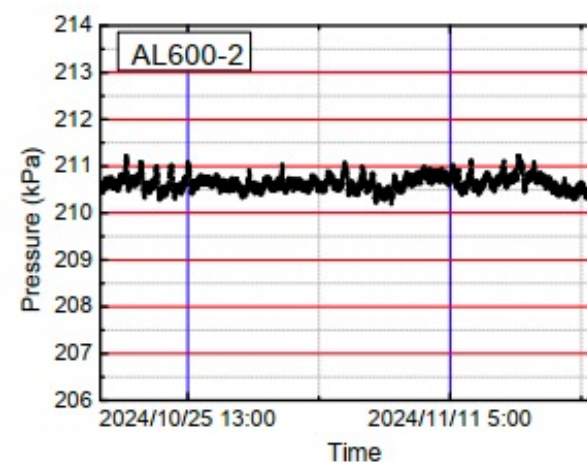
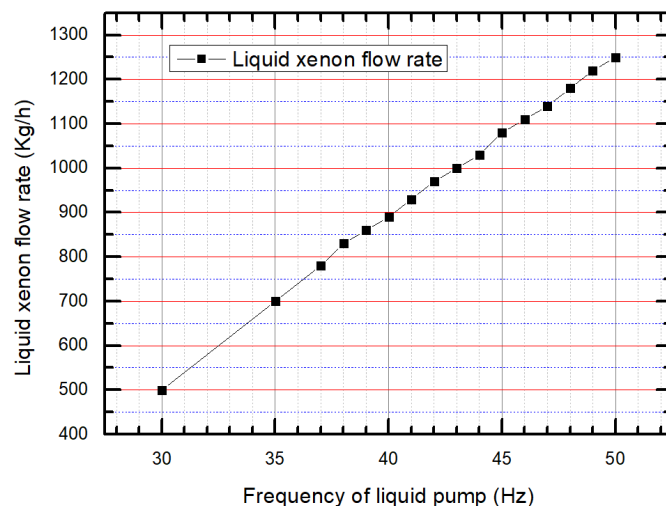
Cryogenics: cooling

- Inherited from PandaX-4T architecture and designed for 47-tonne LXe detector
 - Two AL600 GM cryocoolers (capable of adding more) and one LN₂ emergency cooling
 - Four gas recirculation loops with hot getters (in parallel)
 - One liquid recirculation loop with copper-based cold getter
- System built and being tested at TDLI
 - Cooling power: 1900W @178K with two cryocoolers (1500 W desired)
 - LN₂ emergency cooling power >1500 W @178K



Cryogenics: recirculation & purification

- System built and being tested at TDLI
 - Gas recirculation & purification speed: 360 SLPM with 2 loops (500 SLPM desired with 4 loops)
 - Liquid recirculation & purification speed: 4 LPM (2 LPM desired)
 - Xenon pressure fluctuation < 1 kPa over one month for 1-tonne prototype detector



arXiv:2512.23974

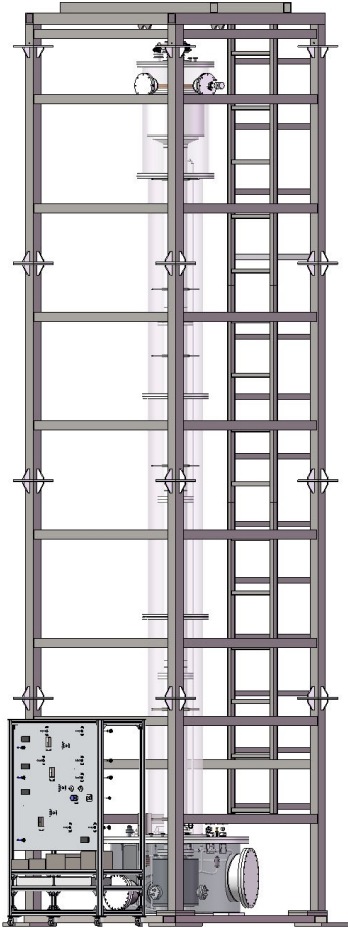
Liquid xenon storage and handling



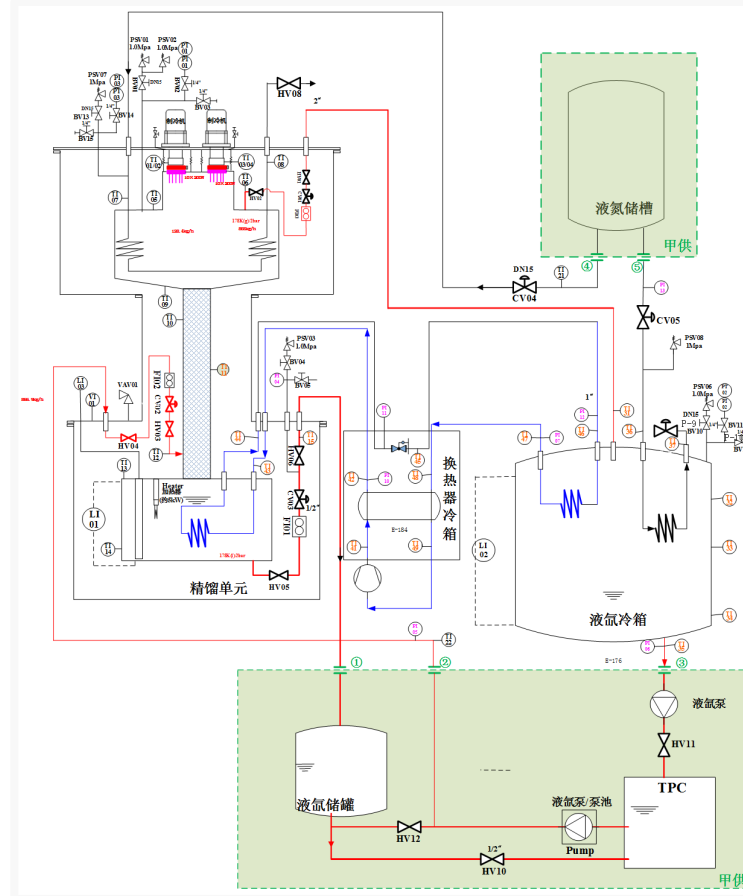
- Each storage tank: 6 m³ (maximum 18 tonne) of LXe
- Cryogenic pump: filling/emptying detector @ 1.5 ton/hour

arXiv:2301.06044

Kr & Rn distillation tower



- Kr distillation tower: 30 kg/hour
- **Target Kr concentration in Xe: 0.1 ppt**



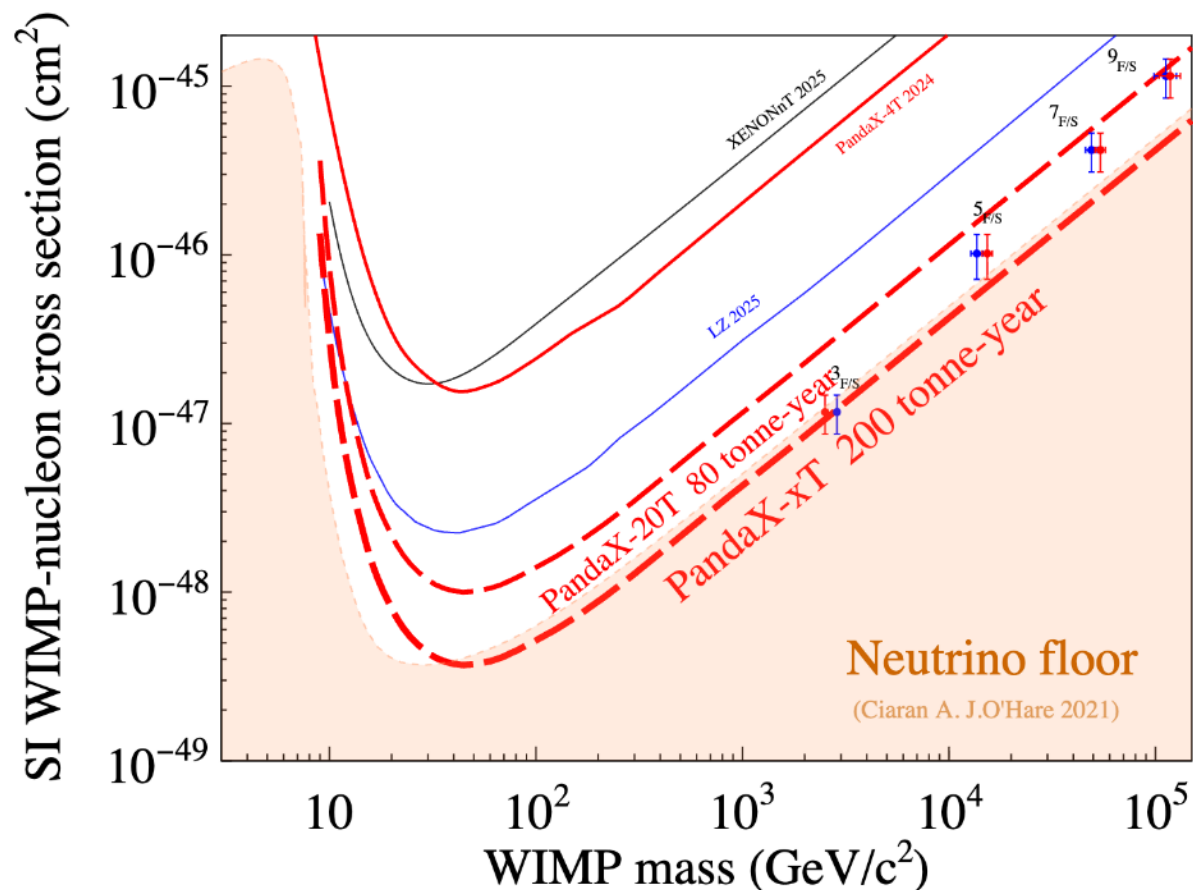
- Rn distillation tower: 850 kg/hour
- High-power cooling recovery system under R&D, aiming 20 kW cooling power for 850 kg/h xenon flow rate
- **Target Rn level: 0.5 $\mu\text{Bq/kg}$**

arXiv:2512.20947

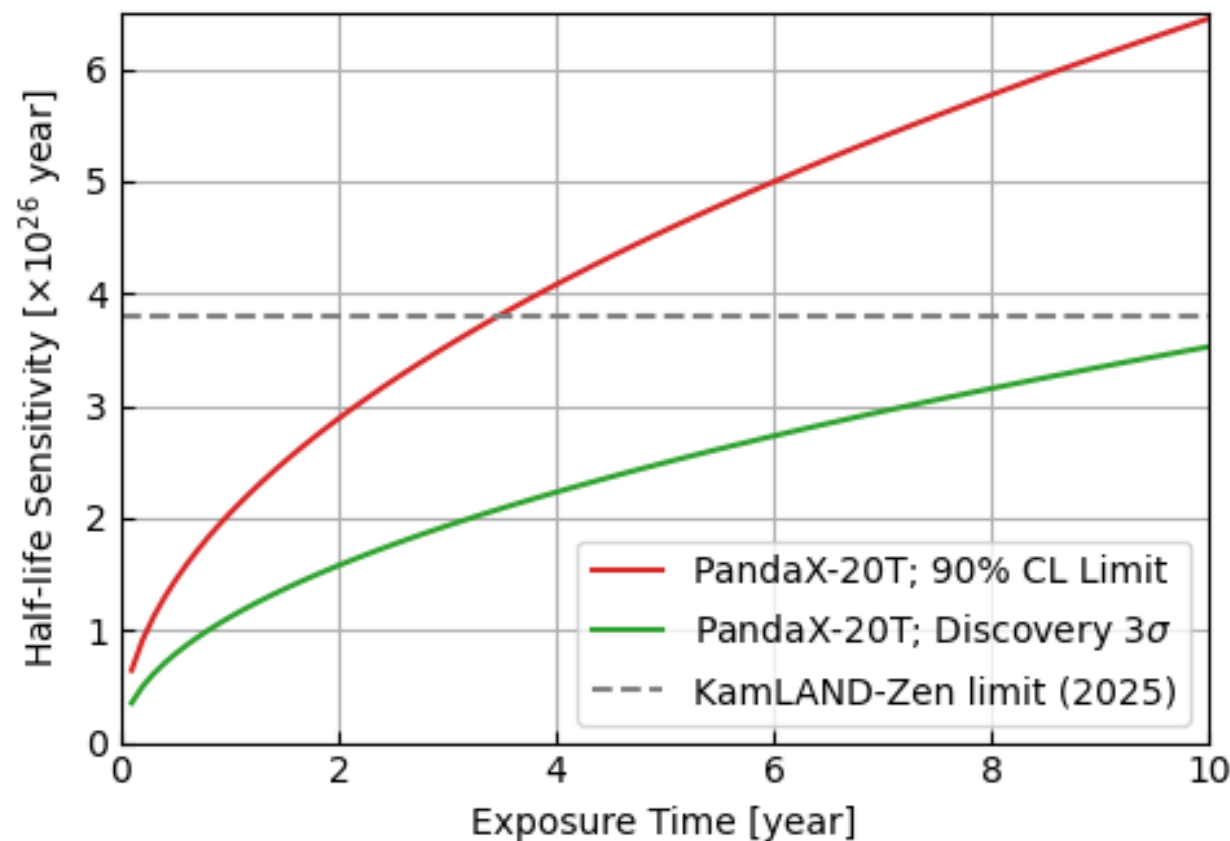
Component		Background assumption
1	Photosensors	$U / Th / K = 0.002 / 0.003 / 1.4 \text{ mBq/cm}^2$ Hamamatsu R12699 v2
2	Titanium cryostat	$U_{\text{early}} / U_{\text{late}} / Th = 1200 / 22 / 200 \text{ ppt (g/g)}$
3	Kr	0.1 ppt (mol/mol)
4	Rn-222	0.5 $\mu\text{Bq/kg}$

Sensitivity projection

FV 13 tonne, ROI 1-10 keVee, 99.7% ER rejection

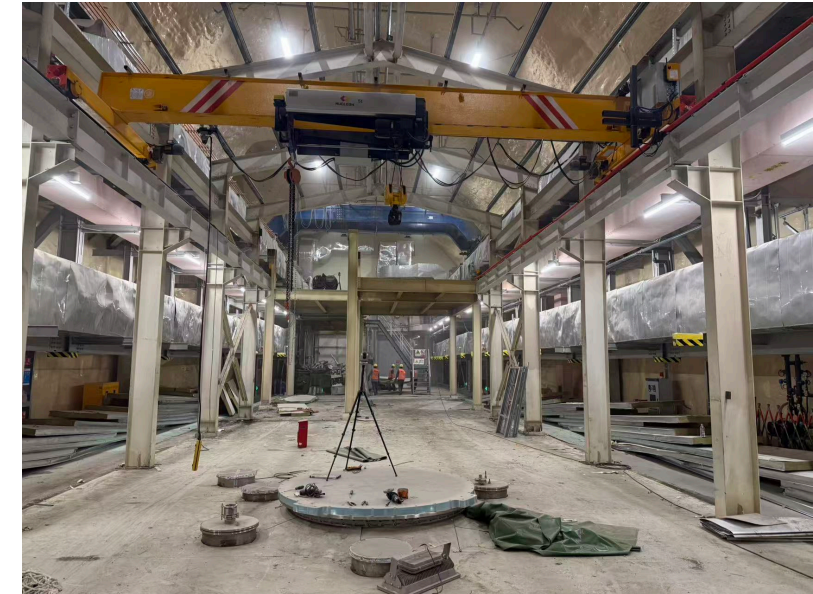


FV 2.4 tonne natural Xe, 1% resolution @Q-value



Schedule

- 2026.4-6: PandaX-4T decommissioning
- 2026.6-12: PandaX-20T infrastructure construction
- 2027.1-6: PandaX-20T installation
- 2027.7-12: PandaX-20T commissioning
- 2028.1: PandaX-20T physics operation



PandaX-xT open meetings

First open meeting at Shanghai
(Apr. 10-11, 2025)



Second open meeting at Huangshan
(Apr. 10-12, 2026)



- **PandaX will be continuously upgraded, with developing technologies tested in full-size experiments**
- **Collaboration is highly welcome!**