

李政道研究所

Tsung-Dao Lee
INSTITUTE

Status and Prospect of PandaX

Pengwei Xie

On behalf of PandaX
collaboration

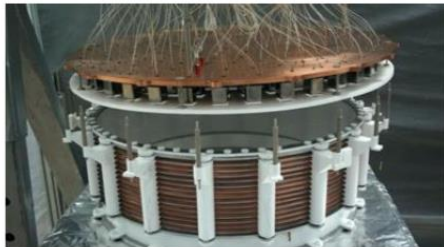


上海交通大學

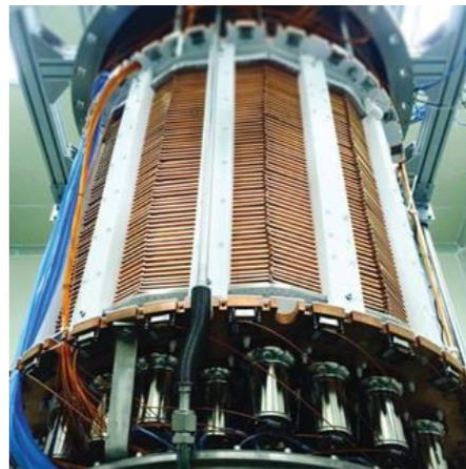
SHANGHAI JIAO TONG UNIVERSITY

PandaX roadmap

- series of experiments base on xenon, searching for dark matter with dual-phase time project chamber (TPC)



PandaX-I
120kg Liquid xenon
(2009-2015)

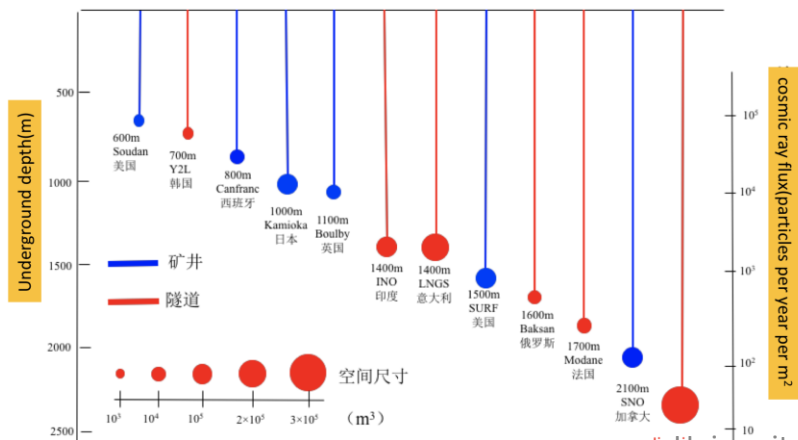
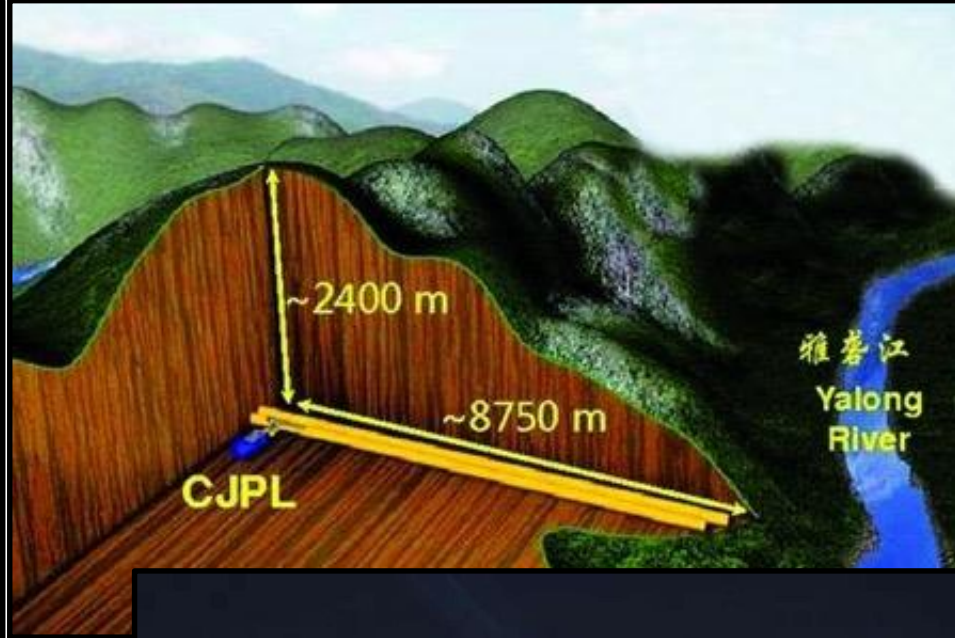


PandaX-II:
580kg Liquid xenon
(2015-2019.7)



PandaX-4T:
4ton Liquid xenon
(coming)

China Jin-Ping Underground Lab(CJPL)



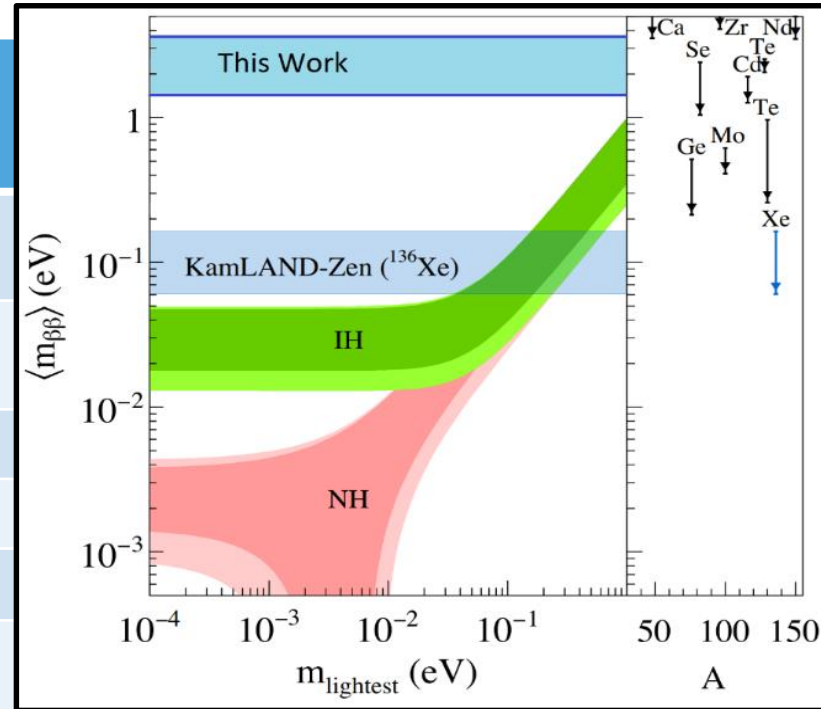
- China Jin-Ping Underground Lab(CJPL)
- 2400 m, deepest, 1 muon/week/m²
- Tunnel, horizontal access, 4000 m³



Recent results from PandaX-II

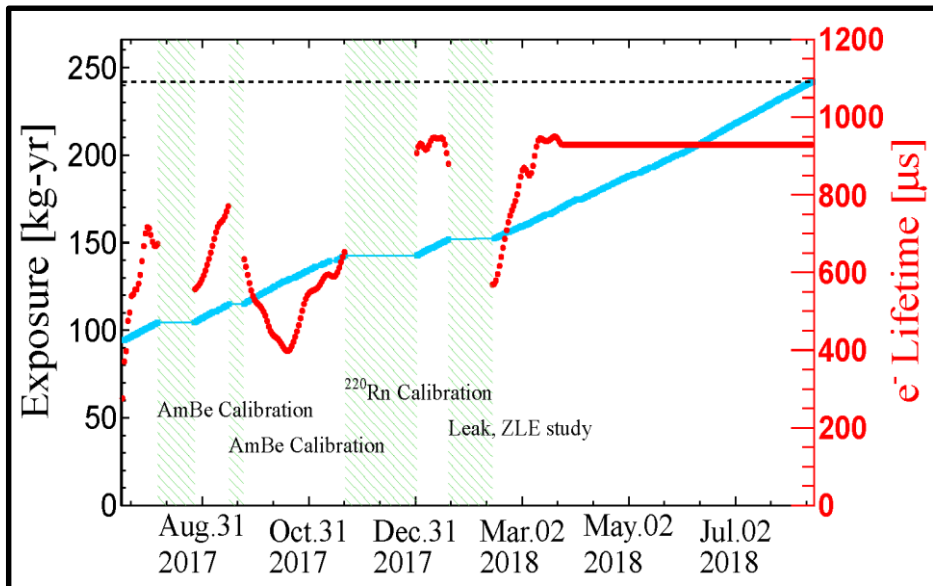
Dark matter models	Exposure (Ton-day)	Publications
WIMP-nucleon Spin-Independent	33	PRL 117, 121303 (2016)
WIMP-nucleon Spin-dependent	33	PRL 118, 071301 (2017)
Inelastic scattering	27	PRD 96, 102007 (2017)
Axion and ALP	27	PRL 119, 181806 (2017)
WIMP-nucleon SI	54	PRL 119, 181302 (2017)
light mediator, self-interacting DM (*)	54	PRL 121, 021304 (2018)
EFT models and SD (*)	54	PLB 792, 193–198 (2019)
On2b decay search	8.1 (^{136}Xe)	CPC, 2019, Vol.43, 11: 113001

(*) collaborating with theorists: Hai-bo Yu (UCI) and Wick C. Haxton (UCB&LBNL)



- No evidence of NLDBD
- Half-life(90% C.L.): 2.1×10^{23} yr
- $M_{\beta\beta}$: (1.4 – 3.7) eV
- **First NLDBD result from dual-phase liquid xenon detector**
- Demonstrate multi-physics reach of xenon dark-matter detector

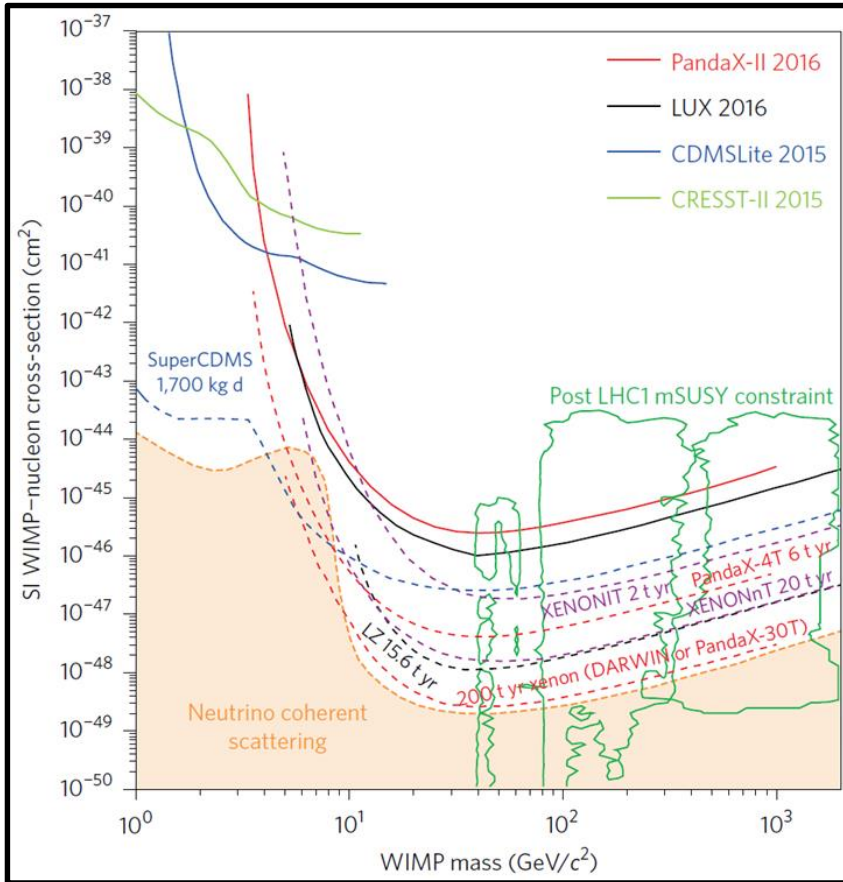
Analysis of PandaX-II full exposure ongoing



- Data
 - More DM search data
 - Complete calibration data
- Improved reconstruction
 - PMT Gain correction
 - Energy reconstruction
 - Position reconstruction
- Improved background estimation
 - Neutron
 - ^{222}Rn
 - Accidental

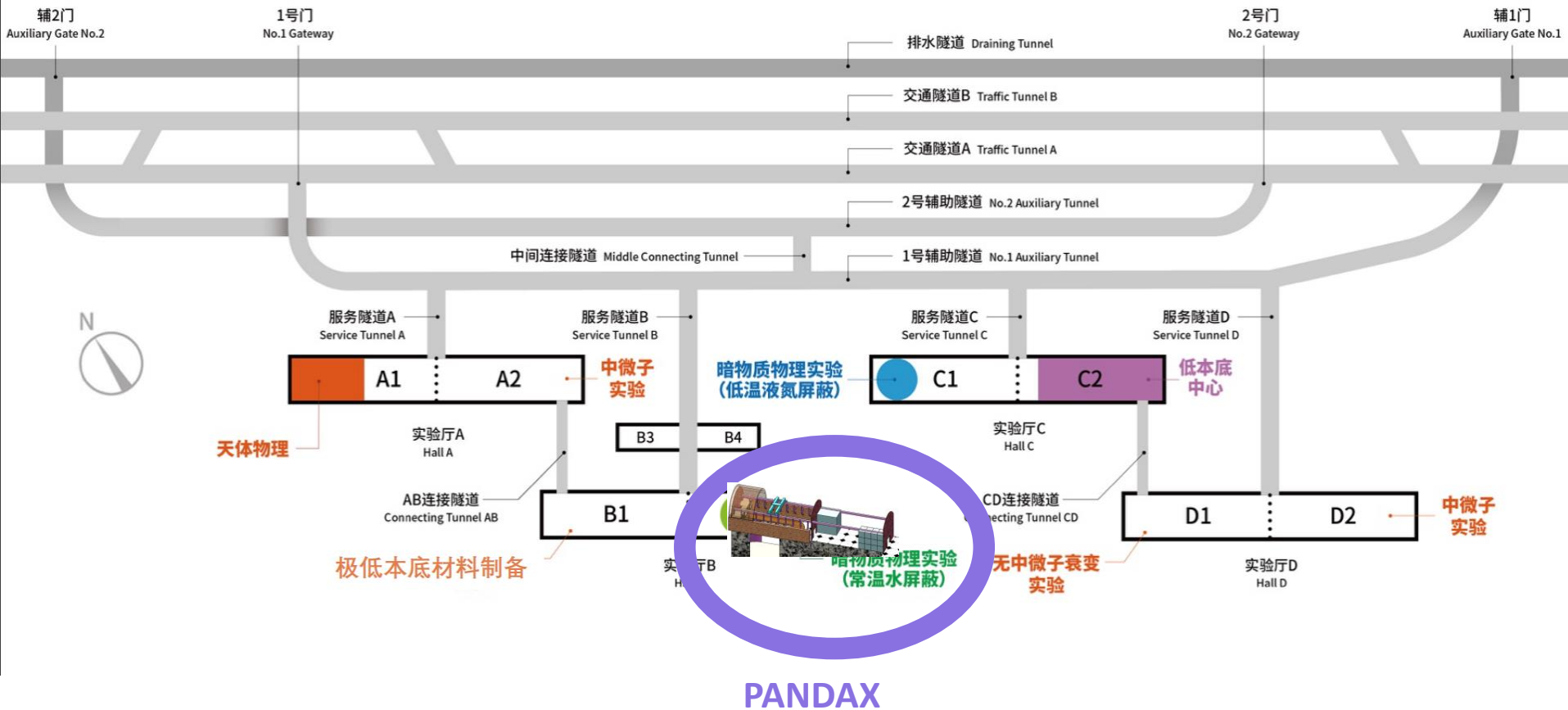
Result will come out soon!

PandaX-4T Sensitivity



- A multi-ton upgradable liquid xenon experiment with an eventual goal of the neutrino floor
- Intermediate next stage:
 - PandaX-4T (4-ton target) with SI sensitivity $\sim 10^{-47} \text{ cm}^2$
 - x10 more sensitive than PandaX-II

Nature Physics 13, 212-216 (2017)



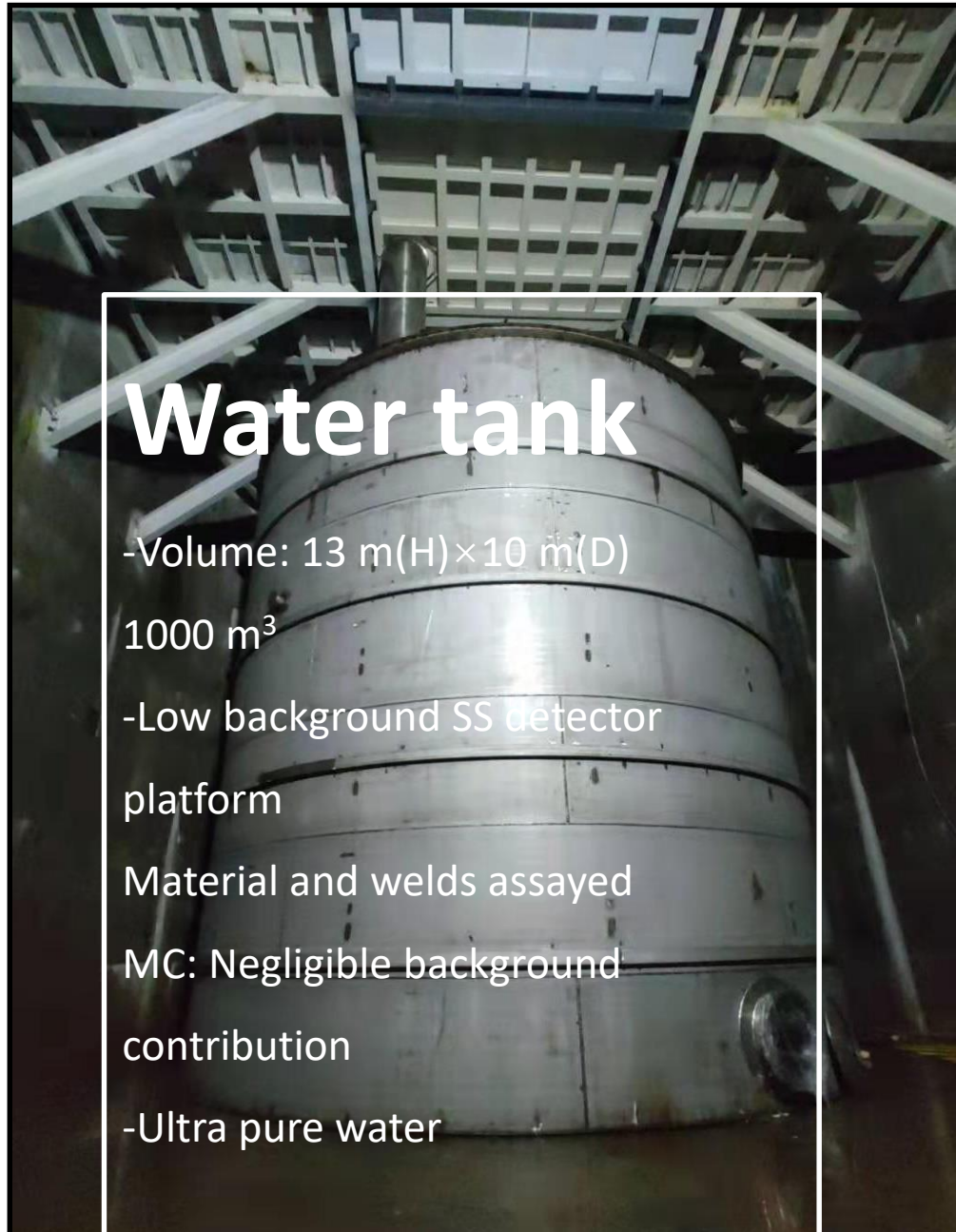
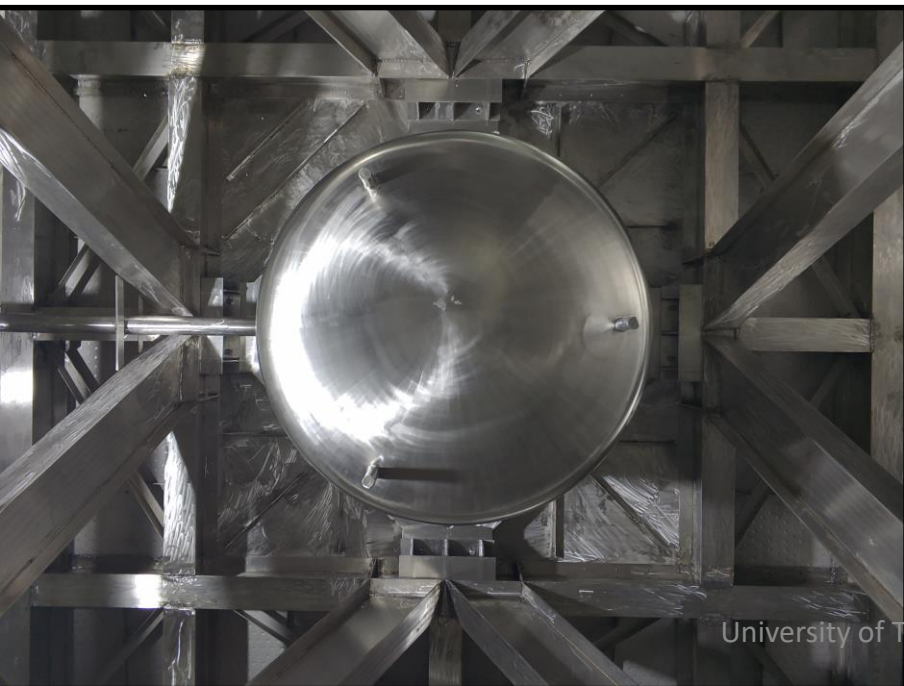
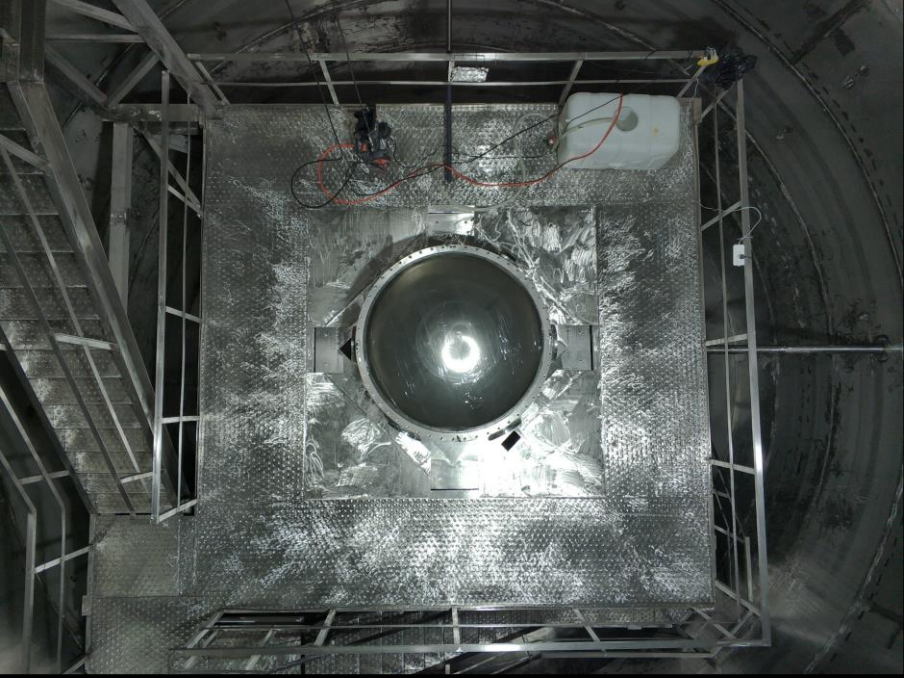
CJPL-II

-8 experimental halls

-B2 PandaX



University of Tokyo, Kashiwa Campus



Water tank

-Volume: 13 m(H)×10 m(D)

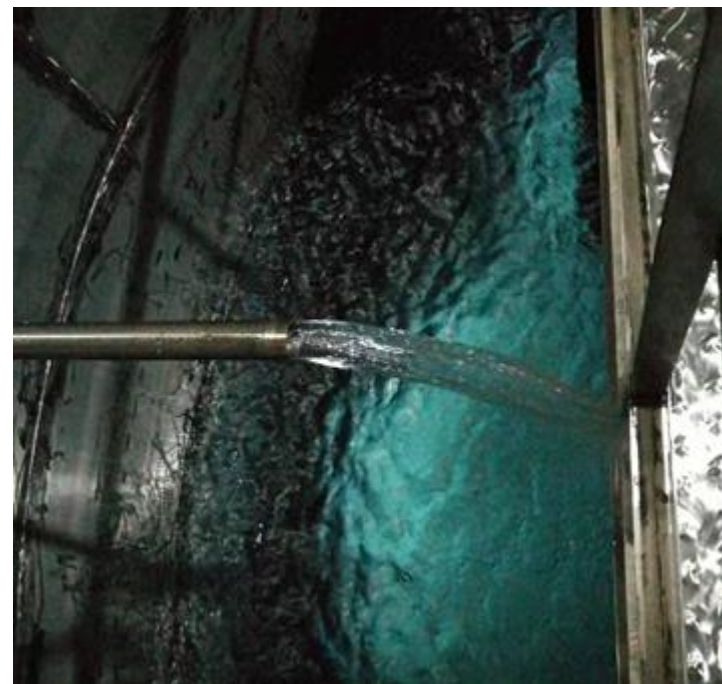
1000 m³

-Low background SS detector
platform

Material and welds assayed

MC: Negligible background
contribution

-Ultra pure water



Water purification system

- Underground water inlet: 22 m³/h
- Ultra pure water production: 10 m³/h
- U238: 0.03 ppt Th232:0.06 ppt
- Rn requirements: 0.2 Bq/m³ for dark matter, 2 mBq/m³ for 0vDBD (R&D)

Radon removal system: Rn level $< 0.4 \text{ Bq/m}^3$



Clean rooms



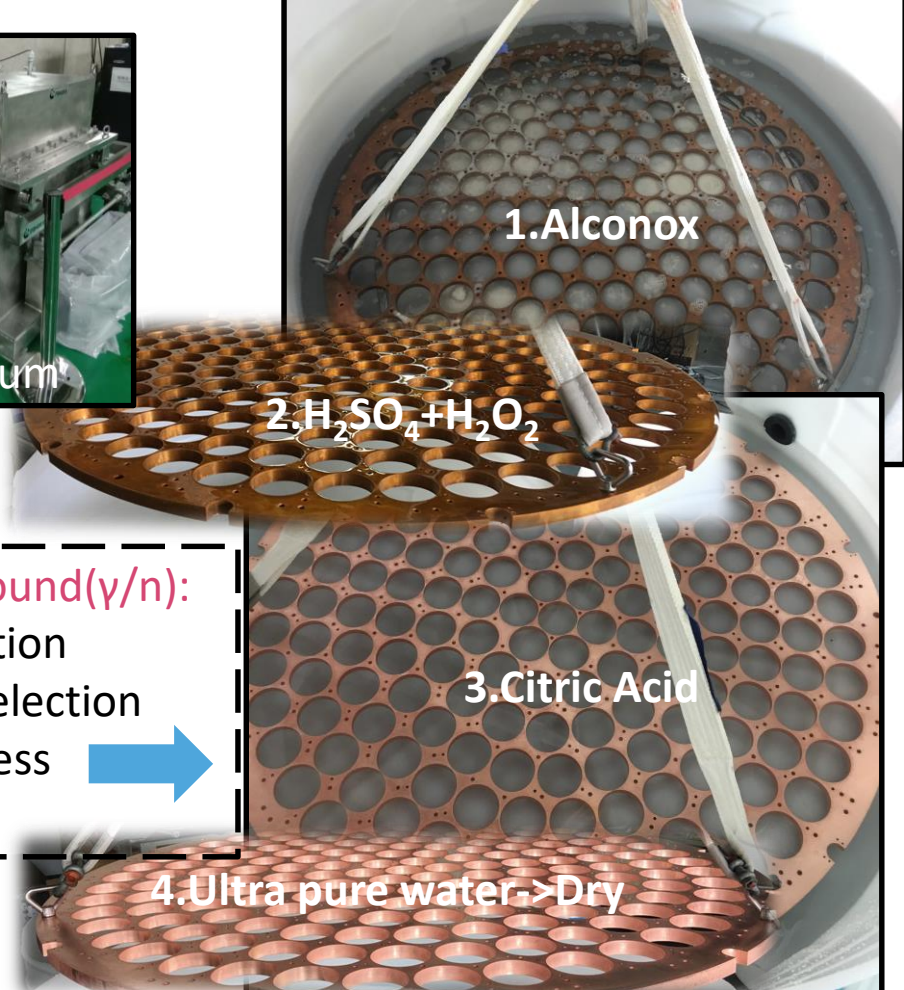
Class 10000
Install cryogenic system
Cleanliness



Class 1000 Radon free
Weaving electrodes
Storing cleaned PTFE/PMTs

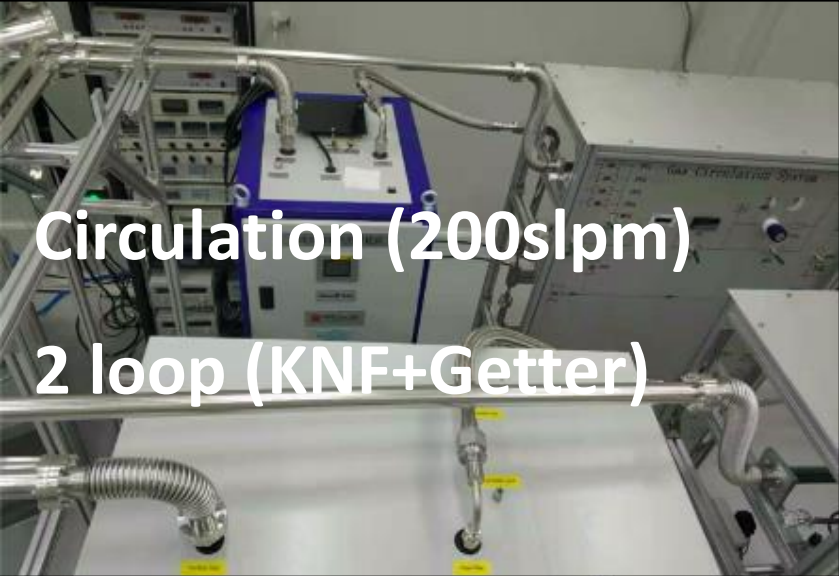
Background control

Internal background:
Kr&Rn removed by Distillation tower (two modes).
Kr(0.1ppt), Rn(1 μ Bq/kg)



External background(γ/n):
Ge/ICPMS selection
Rn emanation selection
Surface cleanliness \rightarrow
eg: Copper





Circulation (200slpm)
2 loop (KNF+Getter)



Xenon Storage
6t xenon

Cryogenics、Purification、Storage



Heat exchanger
under water



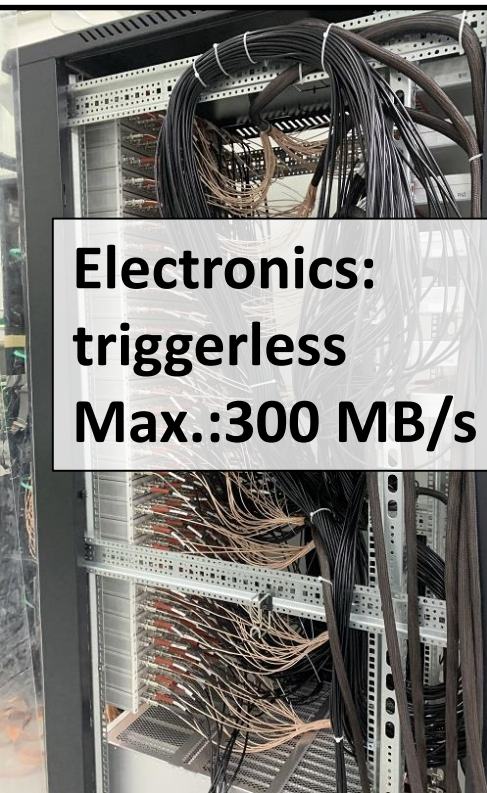
Cooling bus
600W power(three heads)



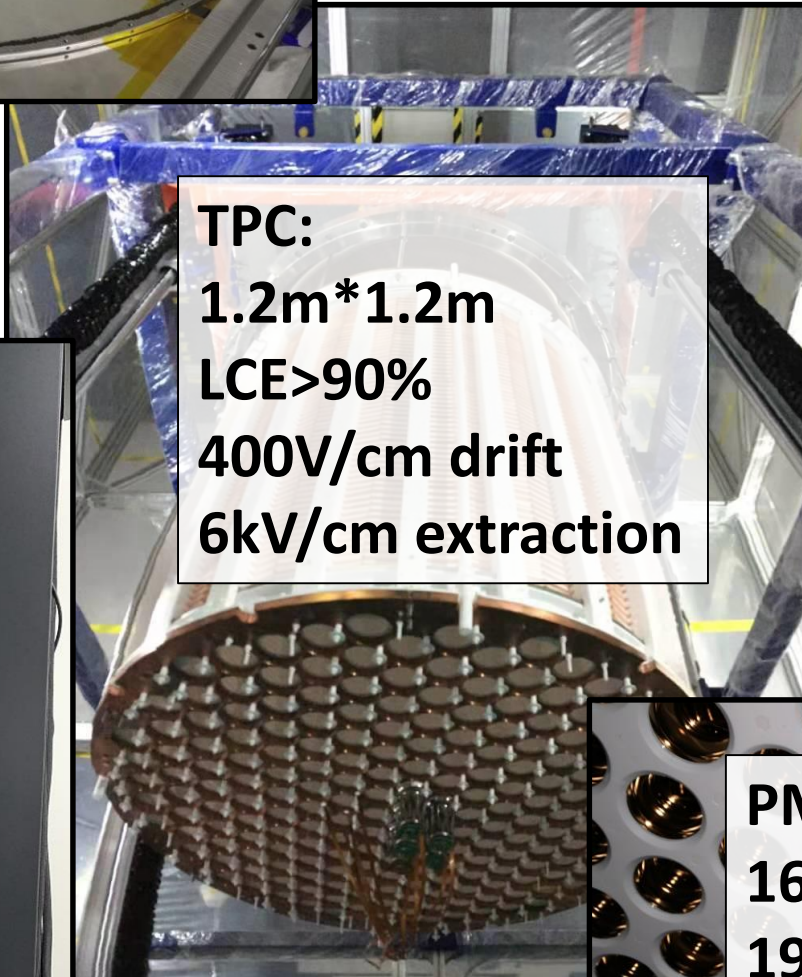
4 Electrodes



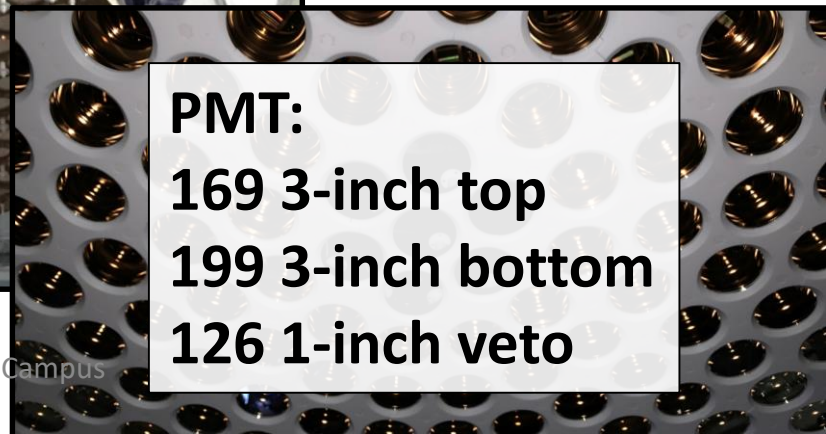
External Cal. Tub



**Electronics:
triggerless
Max.:300 MB/s**



**TPC:
1.2m*1.2m
LCE>90%
400V/cm drift
6kV/cm extraction**



**PMT:
169 3-inch top
199 3-inch bottom
126 1-inch veto**

PandaX-4T Collaboration



2019.7.6 PandaX Collaboration meeting
@ Nankai University
~50 people

- 🇨🇳 Shanghai Jiao Tong University
- 🇨🇳 Shandong University
- 🇨🇳 Peking University
- 🇨🇳 Shanghai Institute of Applied Physics, CAS
- 🇨🇳 University of Science & Technology of China
- 🇨🇳 Beihang University
- 🇨🇳 Fudan University
- 🇨🇳 Nankai University
- 🇨🇳 Sun Yat-Sen University
- 🇨🇳 Yalong Hydropower Company
- 🇺🇸 University of Maryland

Graduate students

• Boys

C Cheng, JJ Yang, YL Huang, GF Shen,
ZH Bo, XN Zeng, CX Li, K Liang, Z Huang,
Abdusalam, KX Ni, CD He, WB Ma, SJ Li,
YJ Fan, HD Sha, C Xie, H Lin

~18

• Girls

L Si, MT Fu, ZC Qian, MM Wu, D Huang,
ZQ Jiang, XY Ning, LH Gu, Y Yuan, YT
Guo, R Yan, XL Wang, J Liang, D Zhang,
XY Lu, HY Du, Rubia

~17



We almost reach a balance between boys and girls naturally!!!



Thank you!