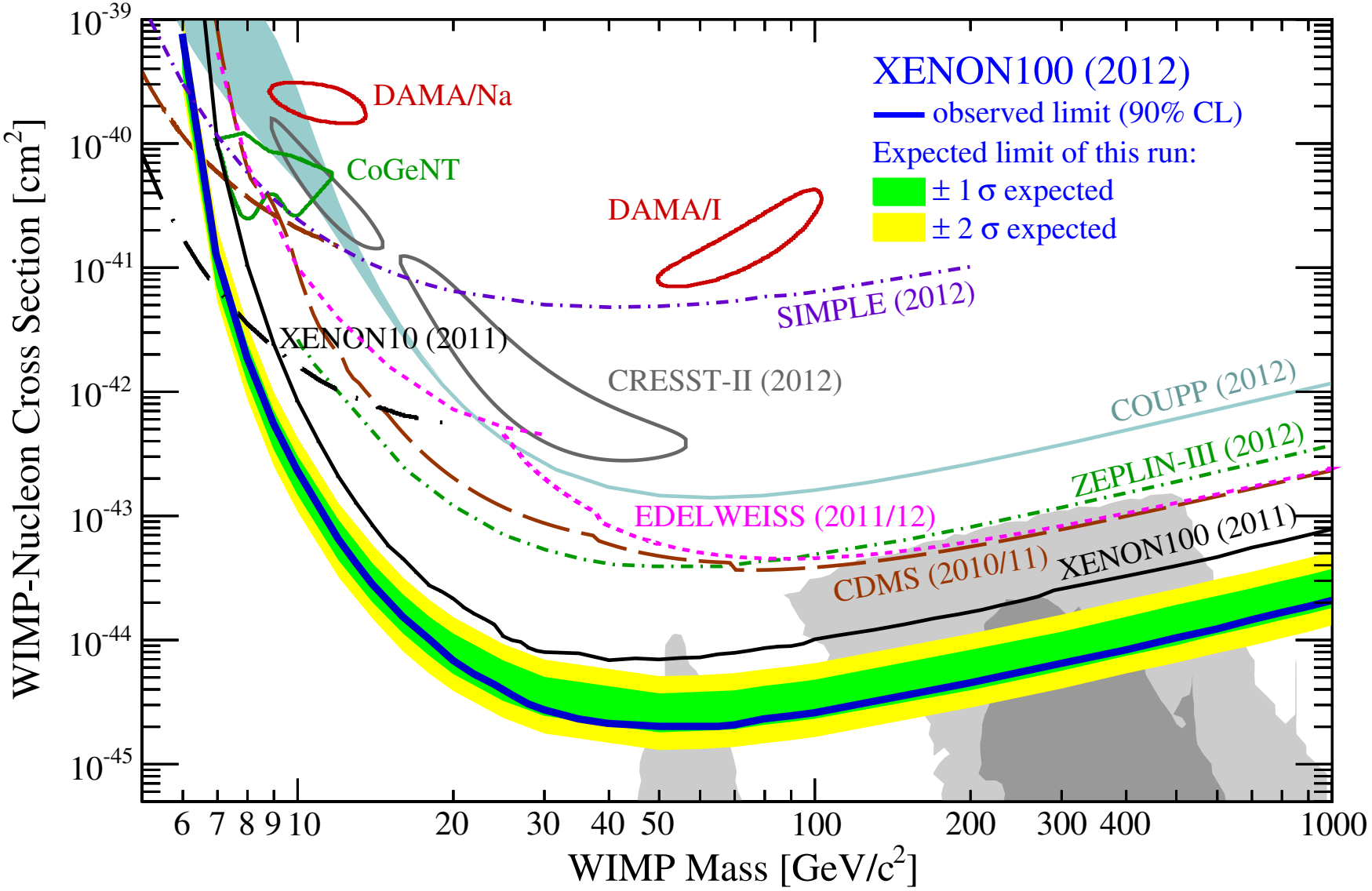
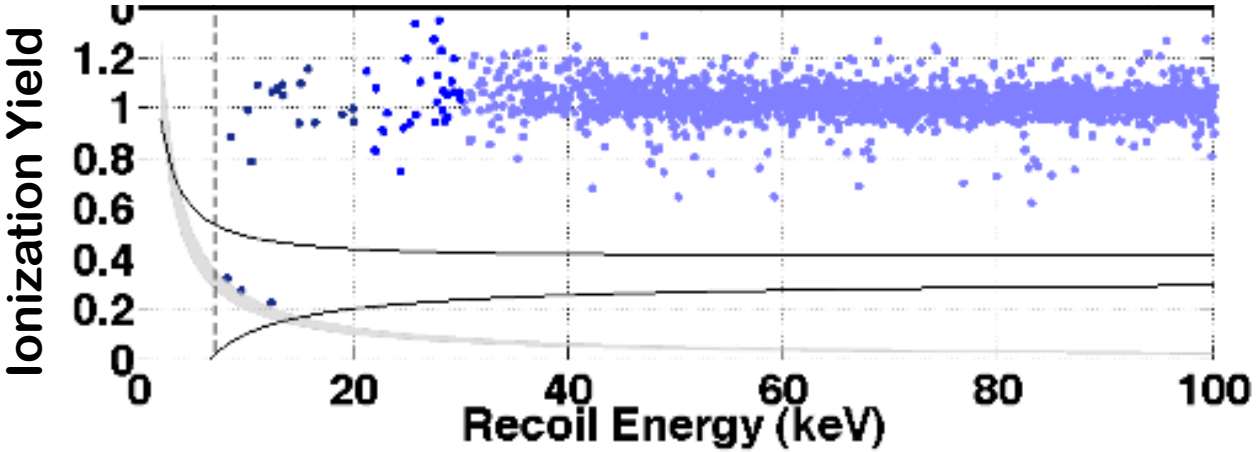
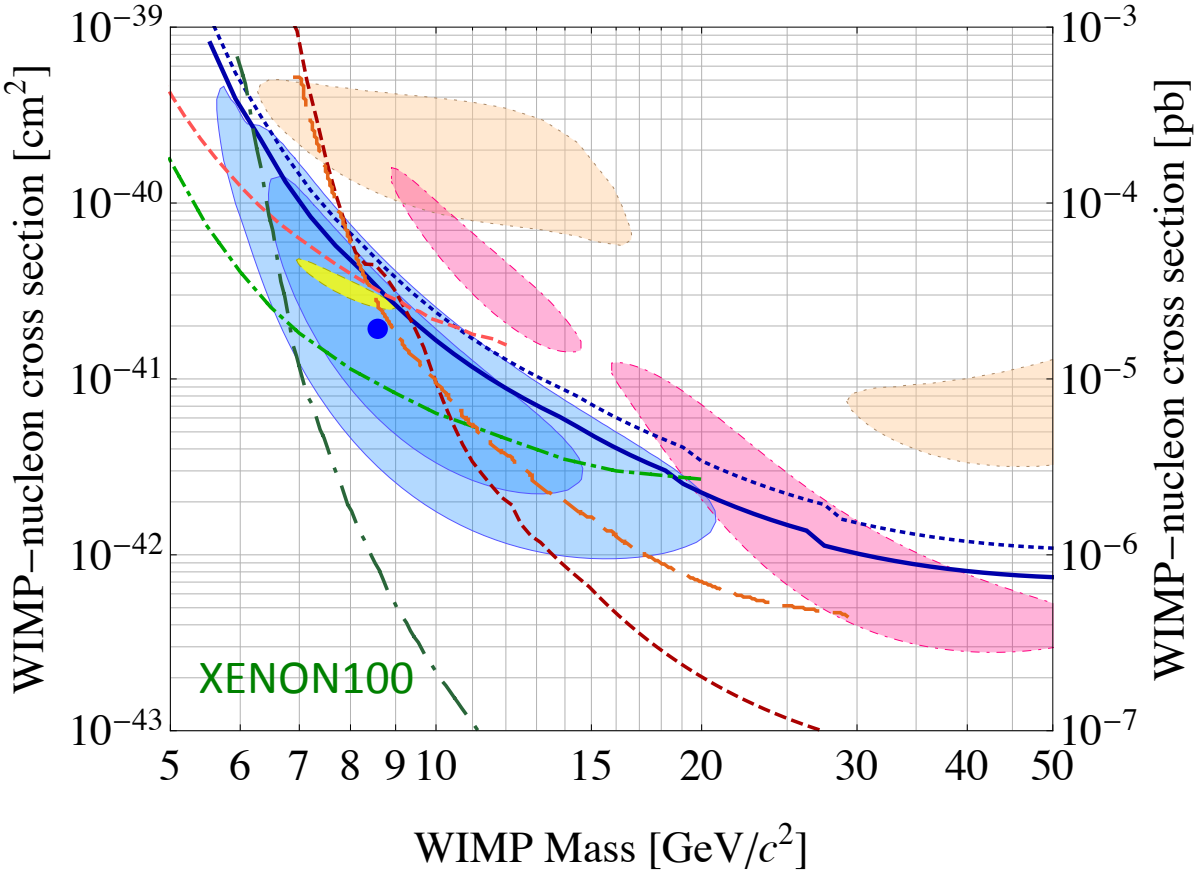
Status of the PandaX Dark Matter Experiment

Kaixuan Ni
(on behalf of PandaX collaboration)
Shanghai Jiao Tong University


XENON100 (2012)
observed limit (90% CL)
Expected limit of this run:
± 1 σ expected
± 2 σ expected
DAMA/Na
CoGeNT
DAMA/I
SIMPLE (2012)
XENON10 (2011)
CRESST-II (2012)
COUPP (2012)
ZEPLIN-III (2012)
EDELWEISS (2011/12)
CDMS (2010/11)
XENON100 (2011)
WIMP-Nucleon Cross Section [cm^2]
WIMP Mass [GeV/c^2]
10^{-39}
10^{-40}
10^{-41}
10^{-42}
10^{-43}
10^{-44}
10^{-45}
6 7 8 9 10 20 30 40 50 100 200 300 400 1000



CDMS-Si
1304.4279



PandaX: **P**article **AND** **A**strophysical **X**enon experiment

The goal is to build a large-mass two-phase xenon detector with ultra-low background for dark matter and neutrino-less double beta decay searches.

The initial experiment is optimized for light detection to enhance the sensitivity to light WIMPs, while has the capacity to upgrade to a ton-scale experiment.

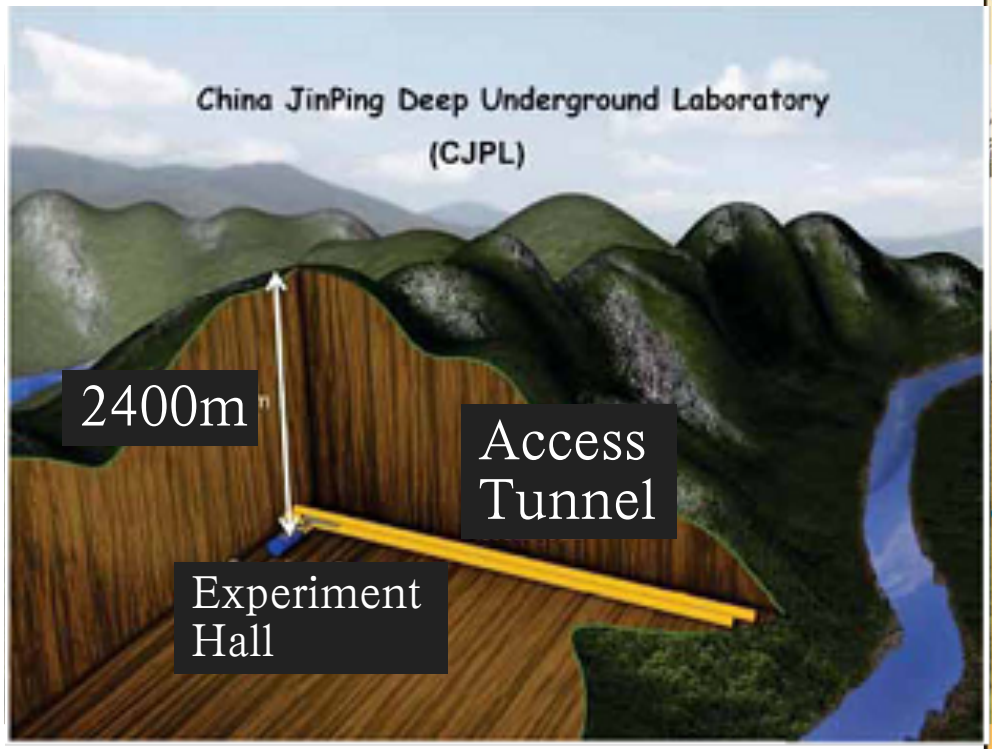
PANDA X at CJPL

Shanghai Jiao Tong University
Shanghai Institute of Applied Physics
Shandong University
Peking University
Yalong River Hydropower Development Company

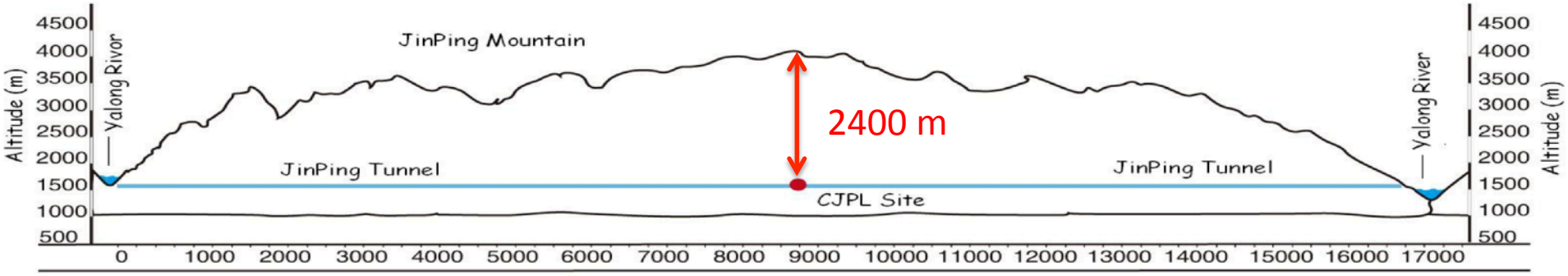
University of Michigan
University of Maryland

http://pandax.org

CJPL site


China JinPing Deep Underground Laboratory
(CJPL)
2400m
Access Tunnel
Experiment Hall


CHINA
Sichuan Province
YaLongRiver
Jinsha River
Jinping tunnels
YaLong River
Jinsha River
Jinsha River
N
Yunnan Province

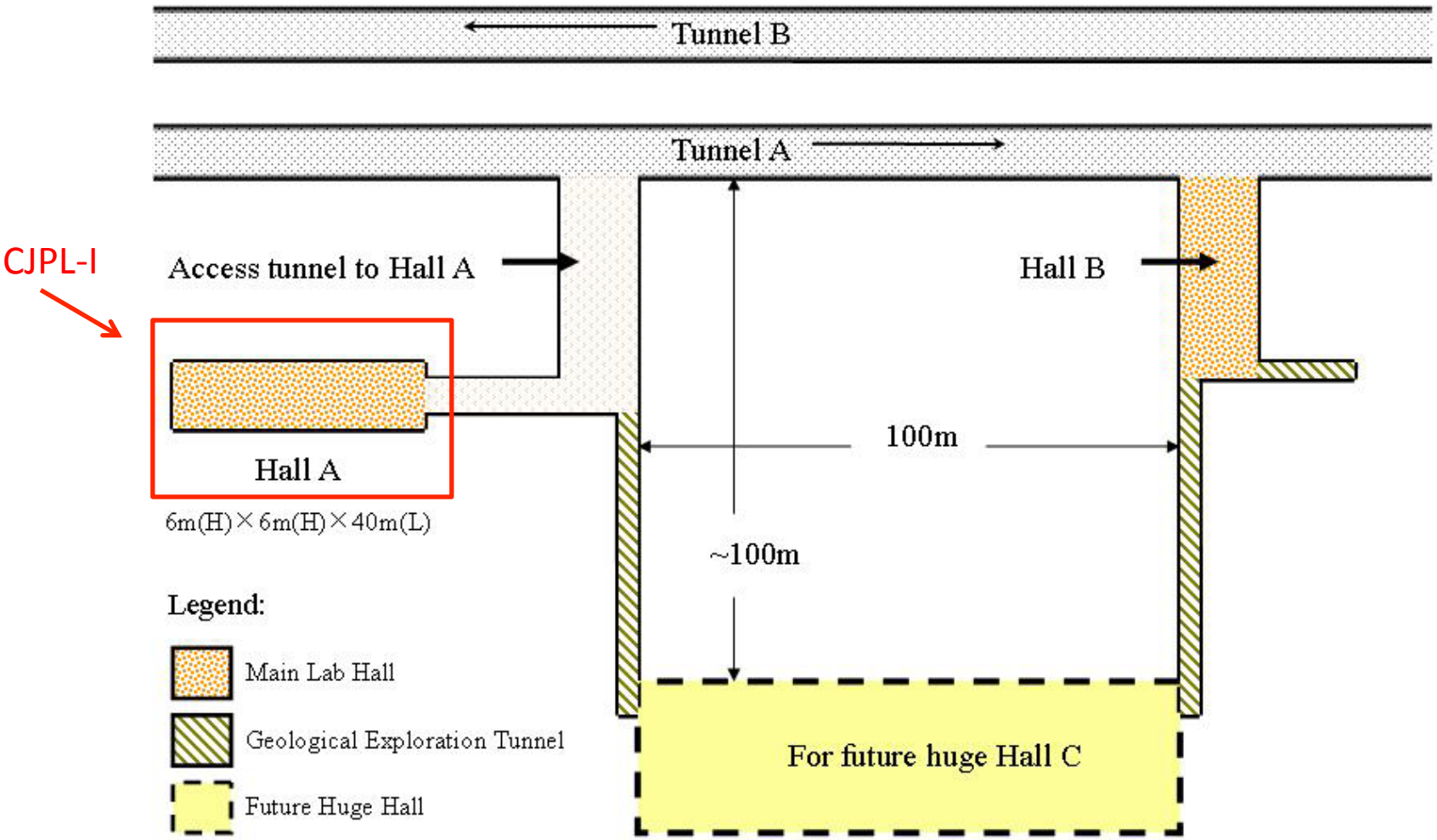

Altitude (m)
4500
4000
3500
3000
2500
2000
1500
1000
500
Yalong River
JinPing Mountain
2400 m
JinPing Tunnel
JinPing Tunnel
CJPL Site
Yalong River
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000

Lab excavation was started in 2010 and renovation was done in 2011.

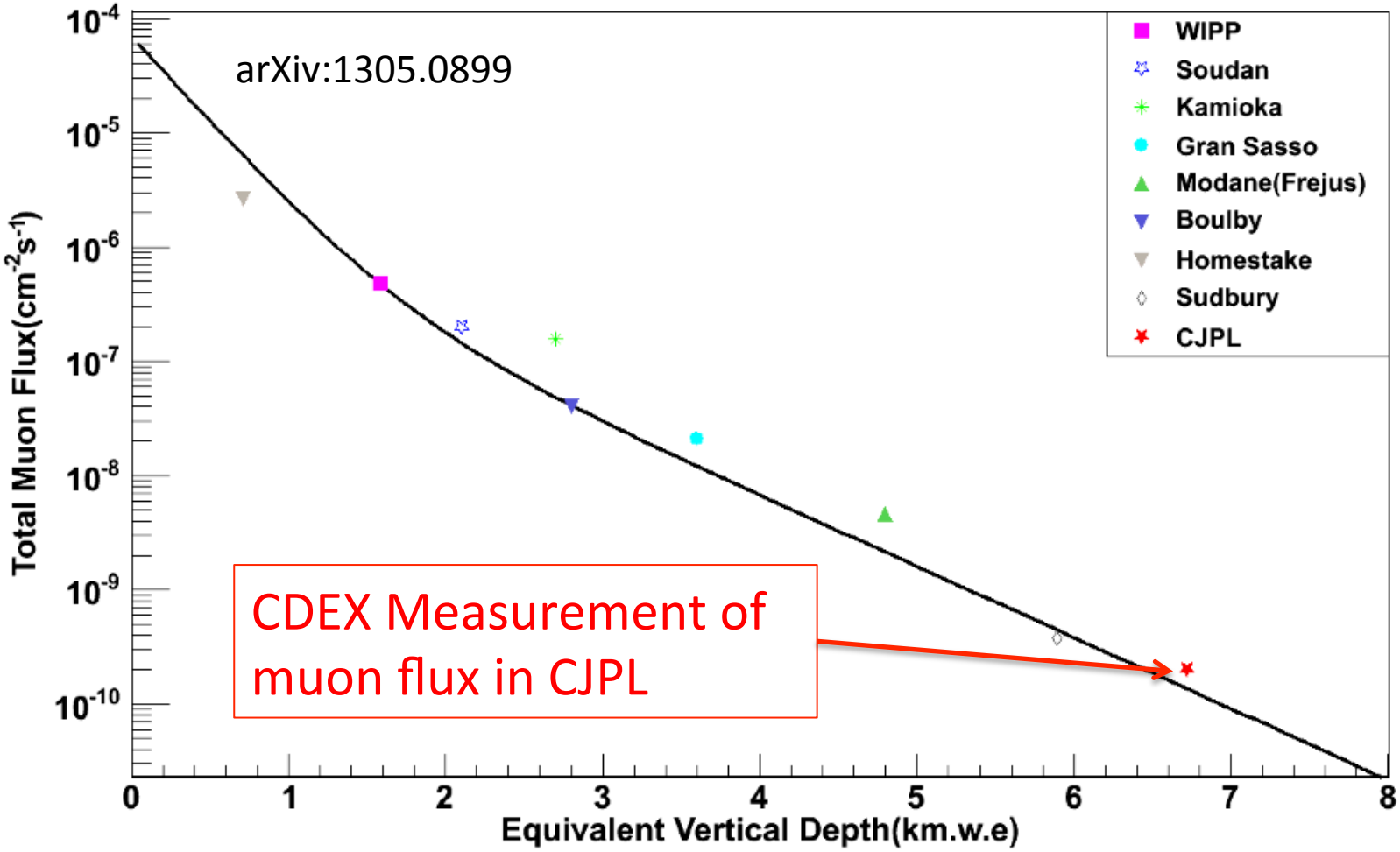
CDEX

PandaX

Future plans CJPL

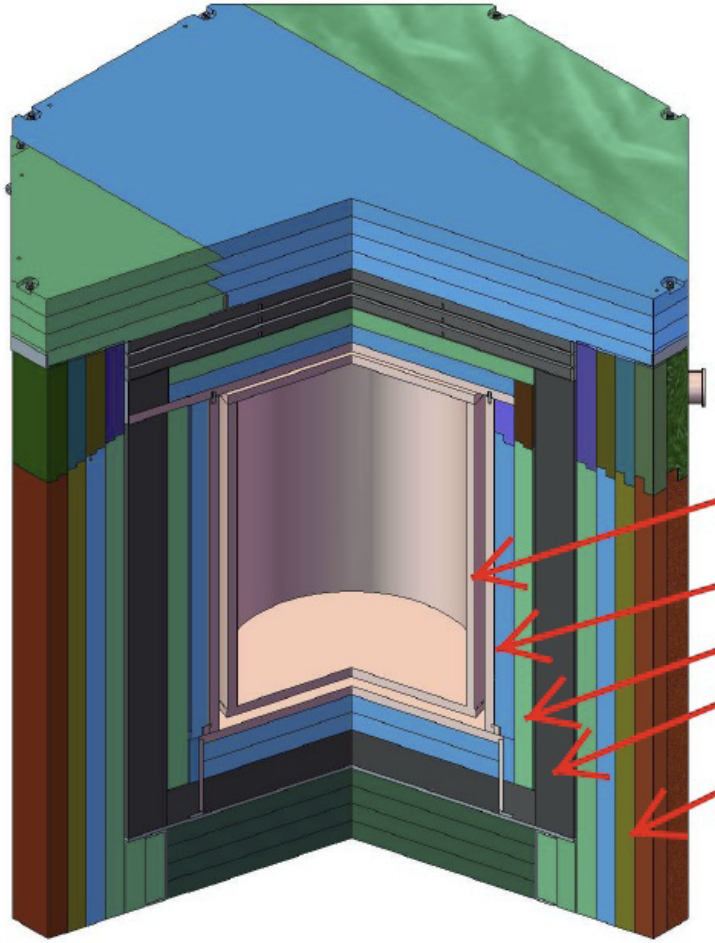


- CJPL-I: plans shown in 2010 for future development (shape & location flexible)
- CJPL-II: finalize plans to build (2013-2014)



- *CJPL muon flux: 2.0 x 10^{-10} cm^{-2} s^{-1} (~60 m^{-2} yr^{-1})*
- *A factor of 100 lower compared to the muon flux at Gran Sasso*

Passive shield, which can accommodate a ton-scale detector, is built for PandaX.



Vacuum Vessel

inner diameter 1240mm

inner height 1750mm

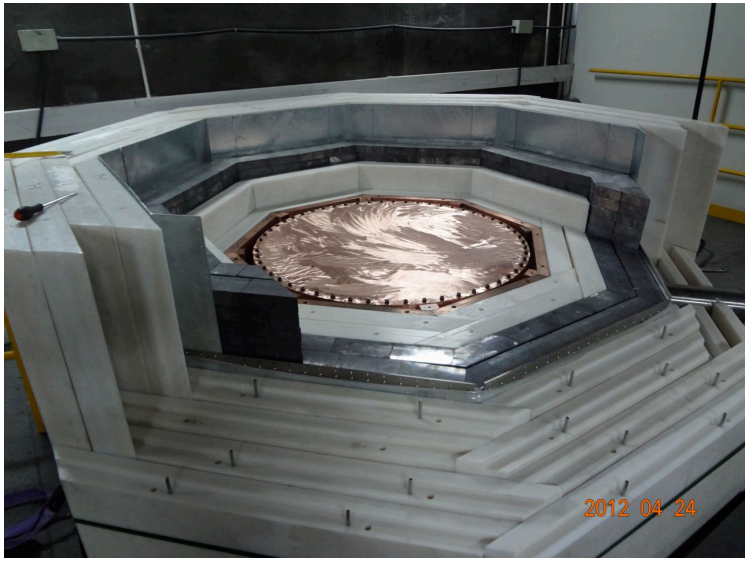
50mm Cu Vessel

50mm Cu

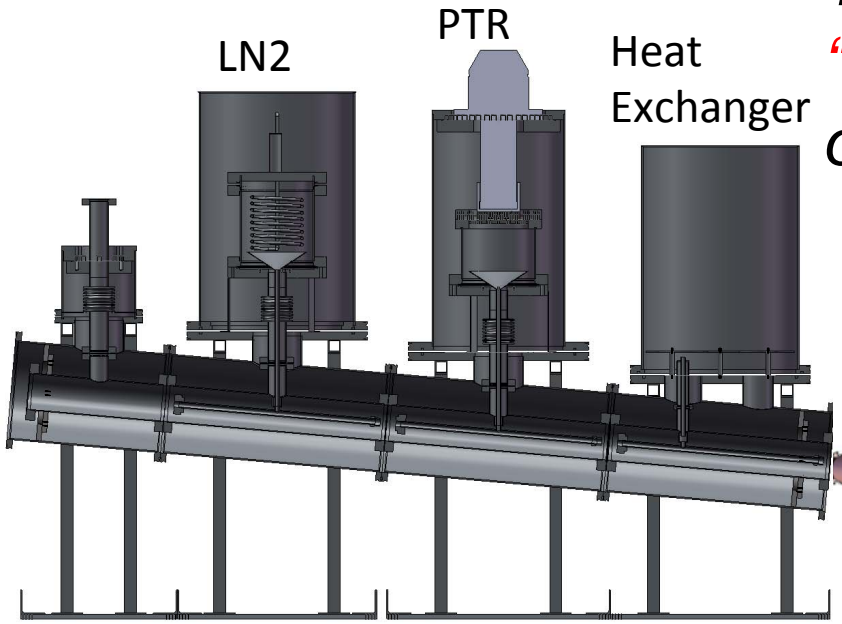
200mm inner PE

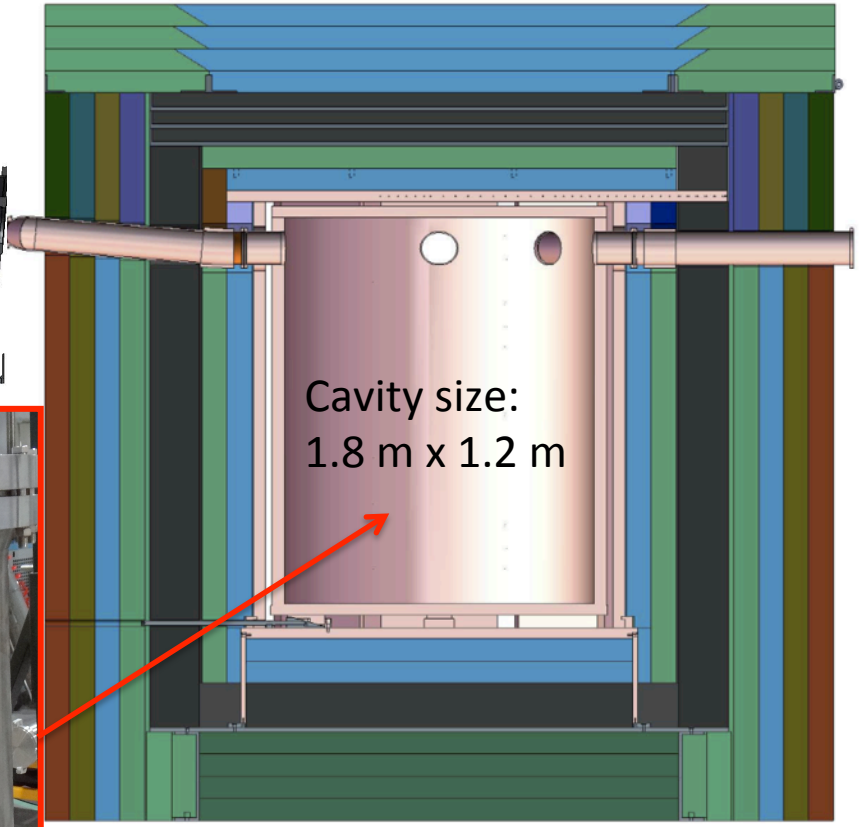
200mm Pb

400mm outer PE



The cryogenic system "cooling bus" is located at outside of the shield .

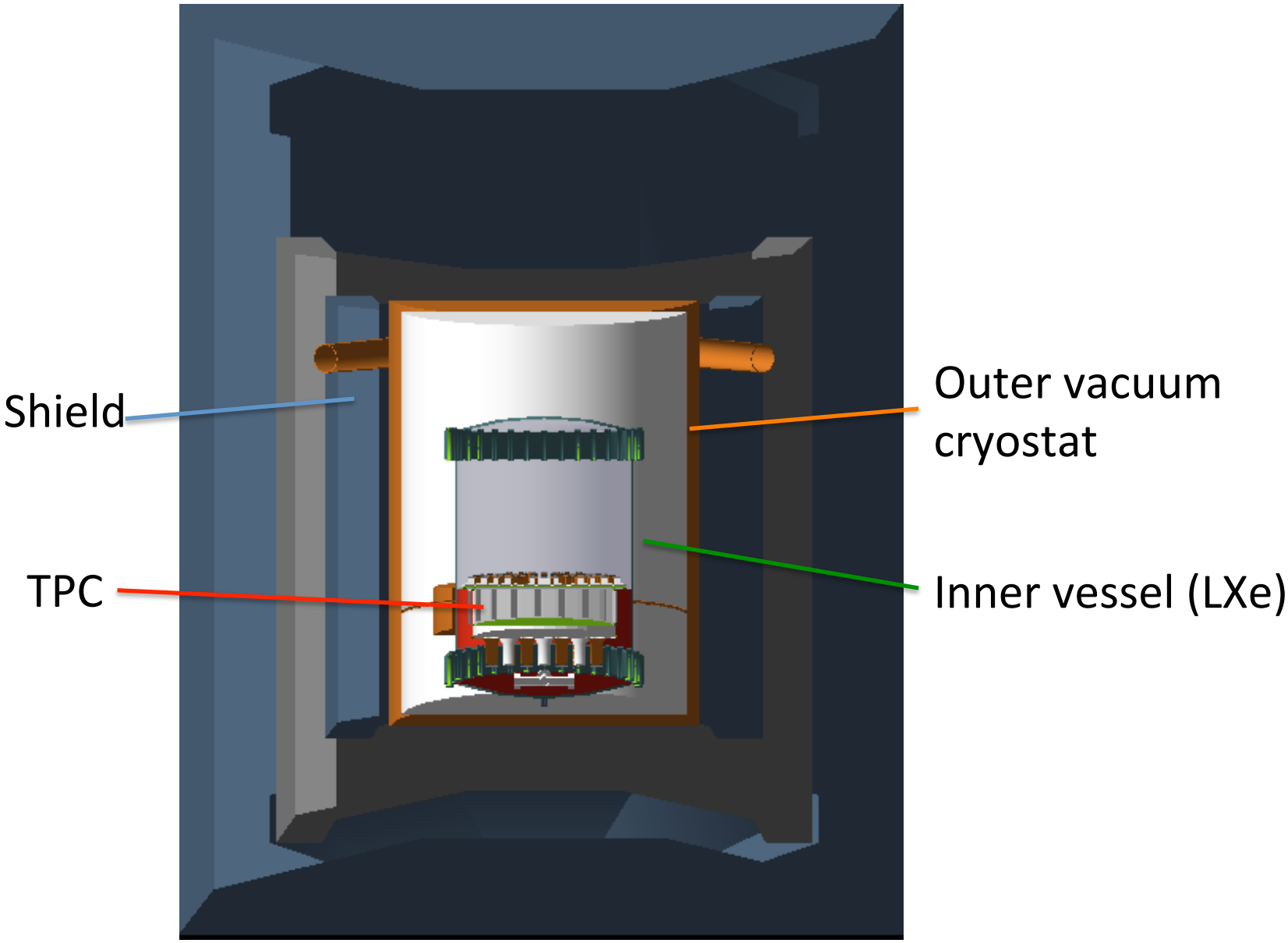




An inner liquid xenon vessel with a "weir" structure to control the liquid level.

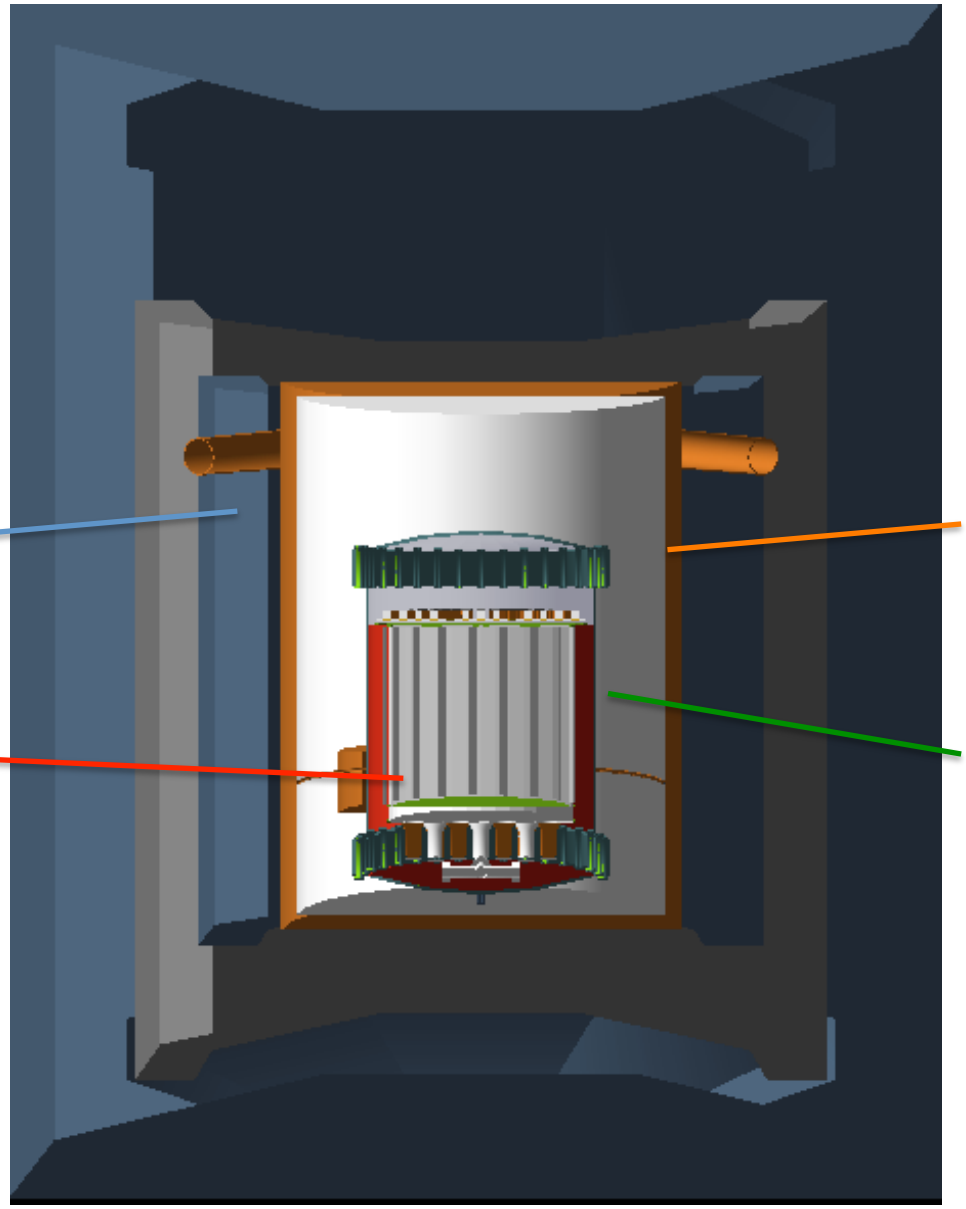

Vacuum Pump
Heat Exchanger
PTR
LN2
Purification Getter

PandaX will progress through three stages.



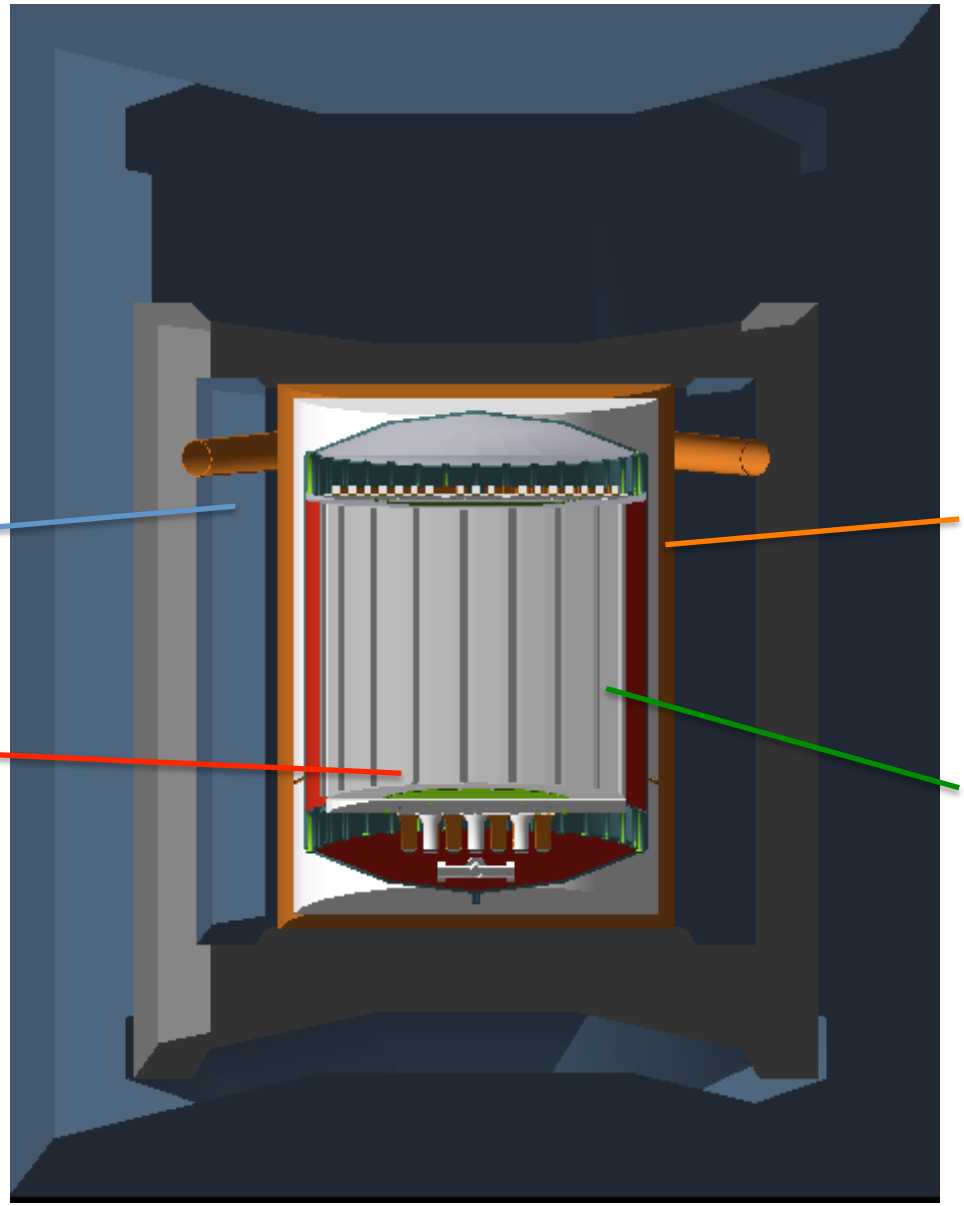
Stage-1a (125 kg target / 25 kg fiducial)

PandaX will progress through three stages.



Stage-1b (500 kg target / 300 kg fiducial)

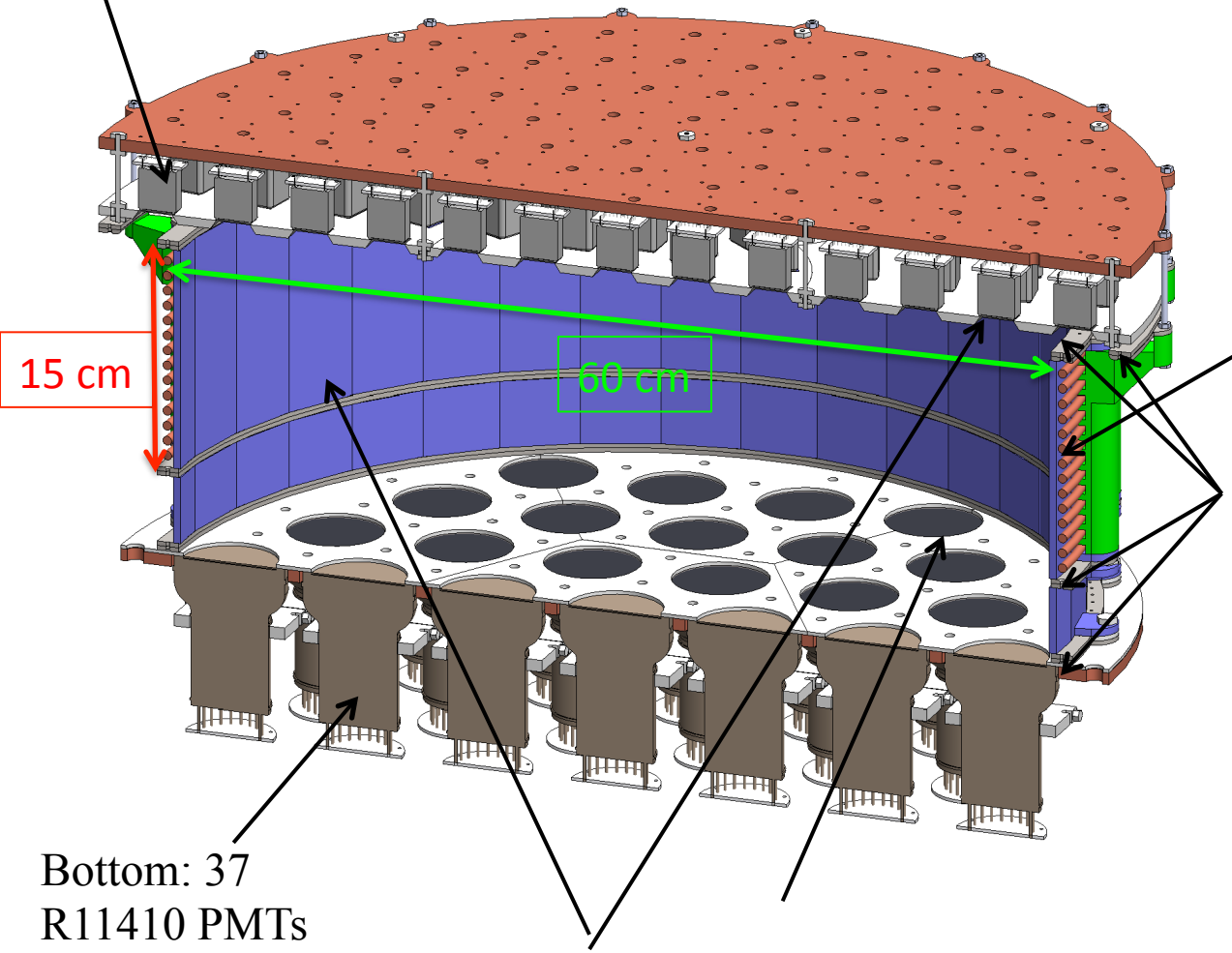
PandaX will progress through three stages.



Stage-2 (2.5 ton target / 1.0 ton fiducial)

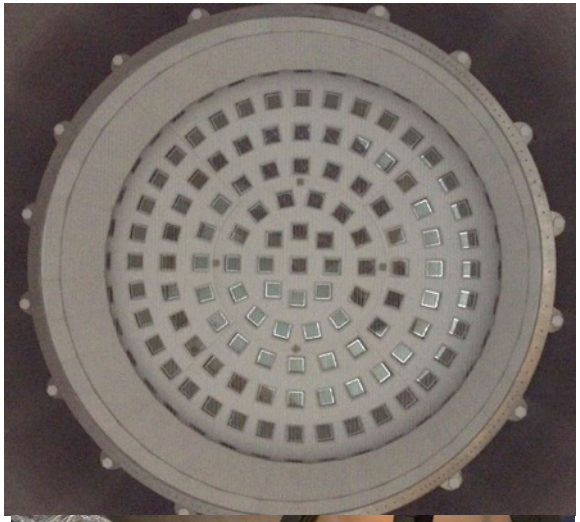
Stage-1a "pancake" TPC

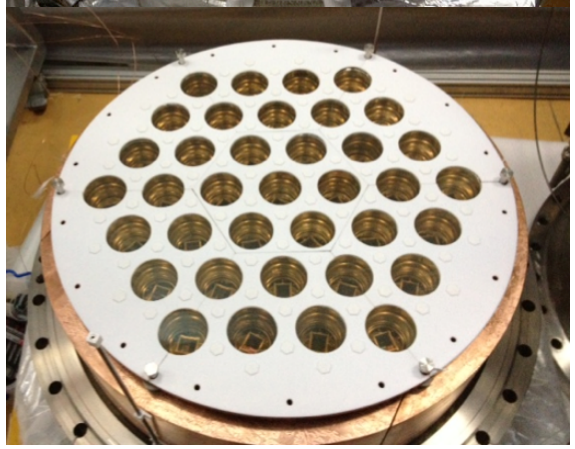
Top: 143
R8520 PMTs



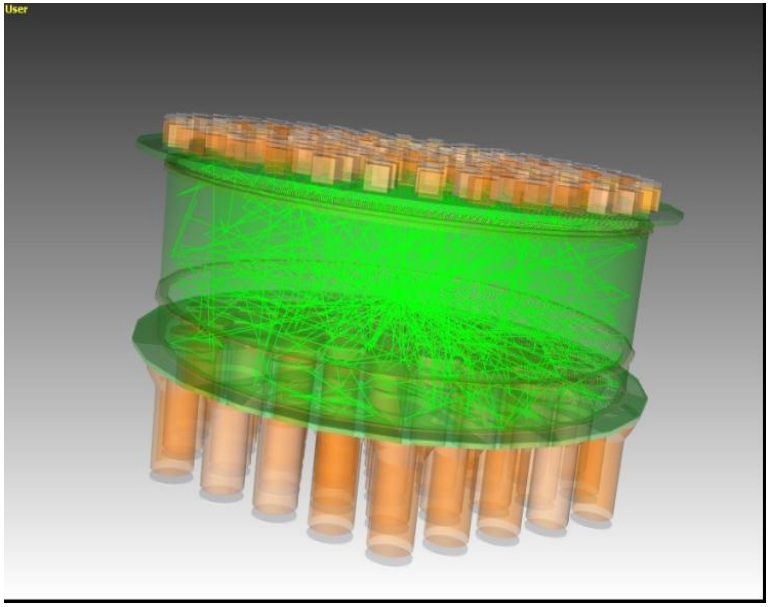
Bottom: 37
R11410 PMTs

Teflon reflector

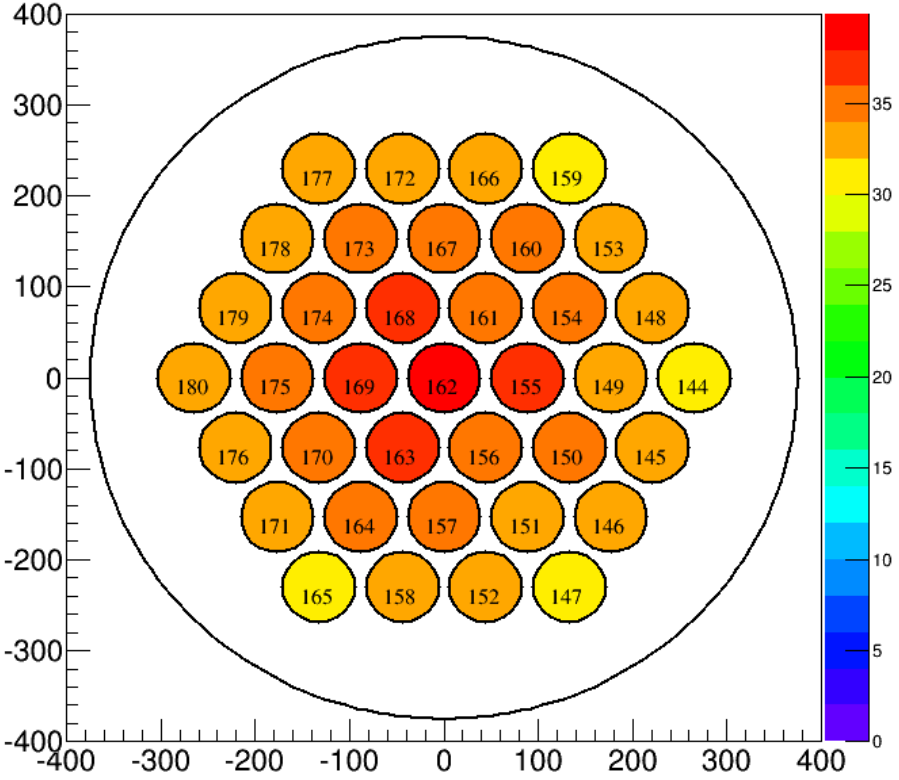




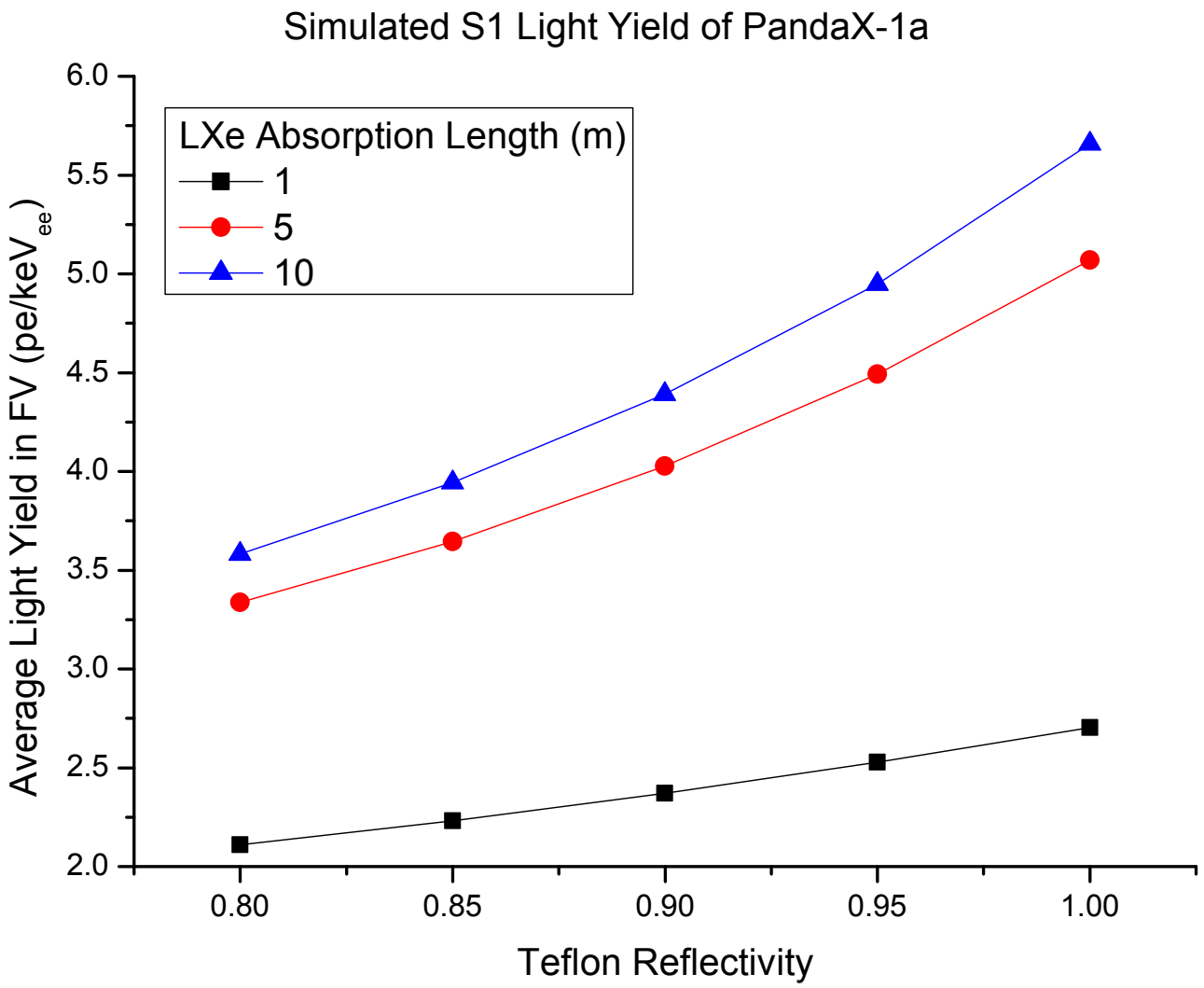
Light yield is simulated by taking into account PMT QEs, light absorption/scattering lengths and teflon reflectivity.



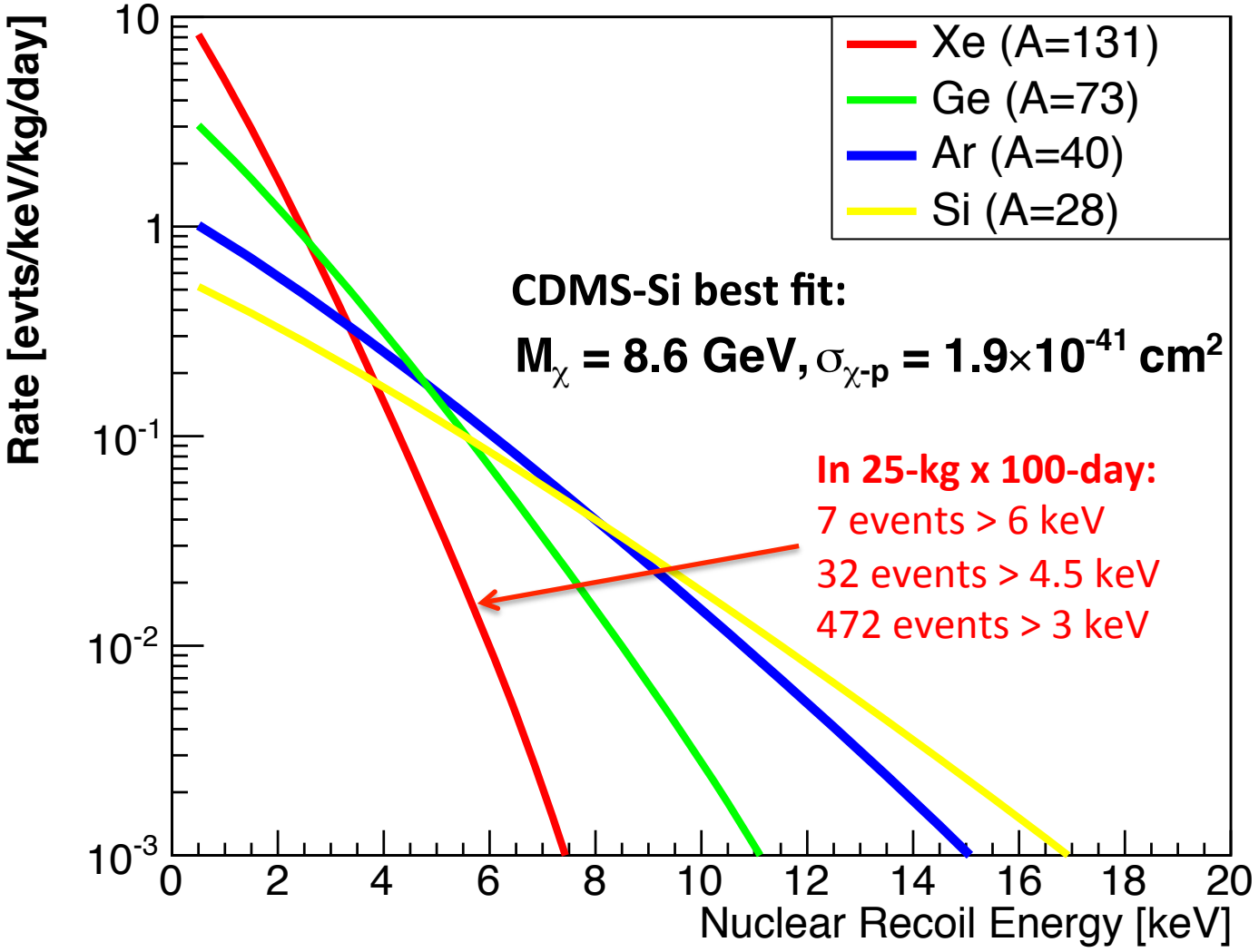
Bottom PMTs average QE ~34%
high QE PMTs in center



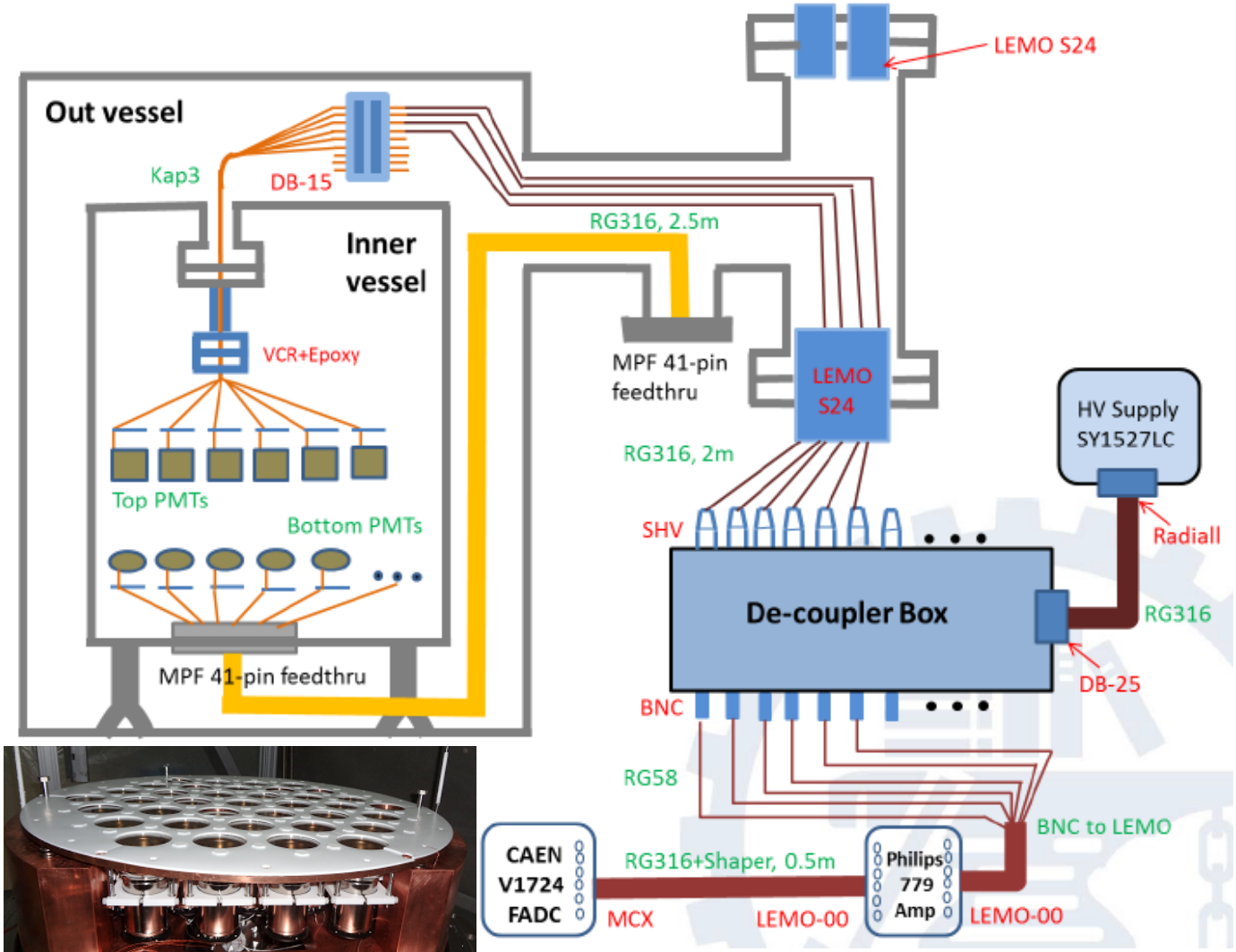
We expect to get 3.3~5.7 pe/keVee for 122 keV gammas at 1 kV/cm with at least 5 m of absorption length.

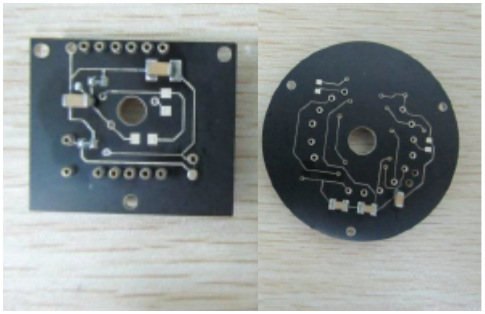


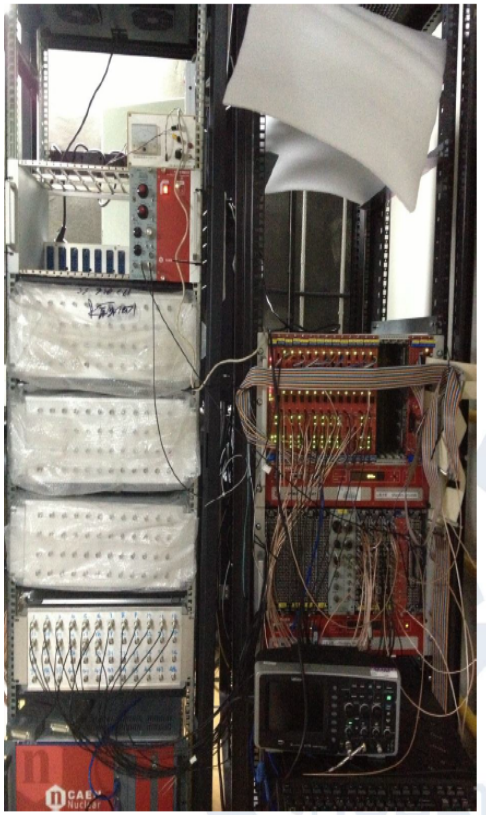
Expected event rate for "light WIMPs".



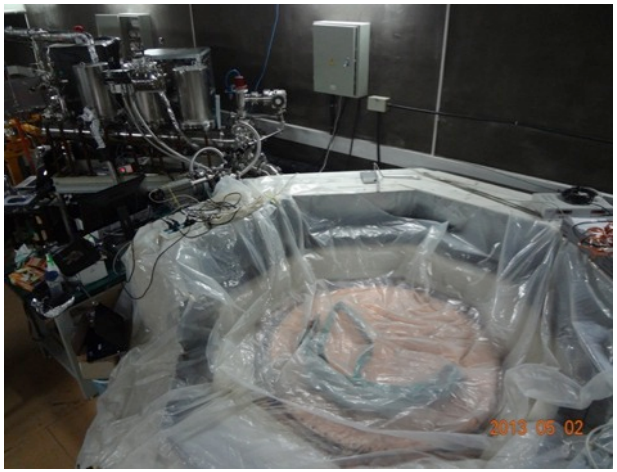
Positive voltage PMT bases and special cabling design to reduce the total length of signal cables, for less outgassing and radioactivity.

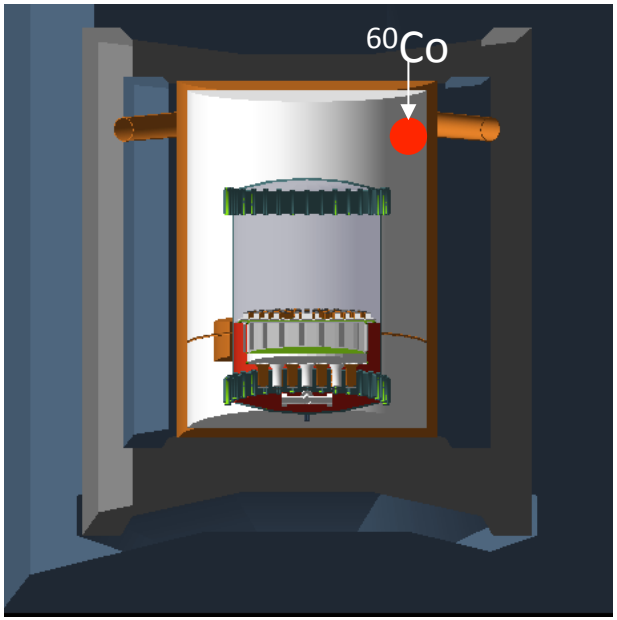




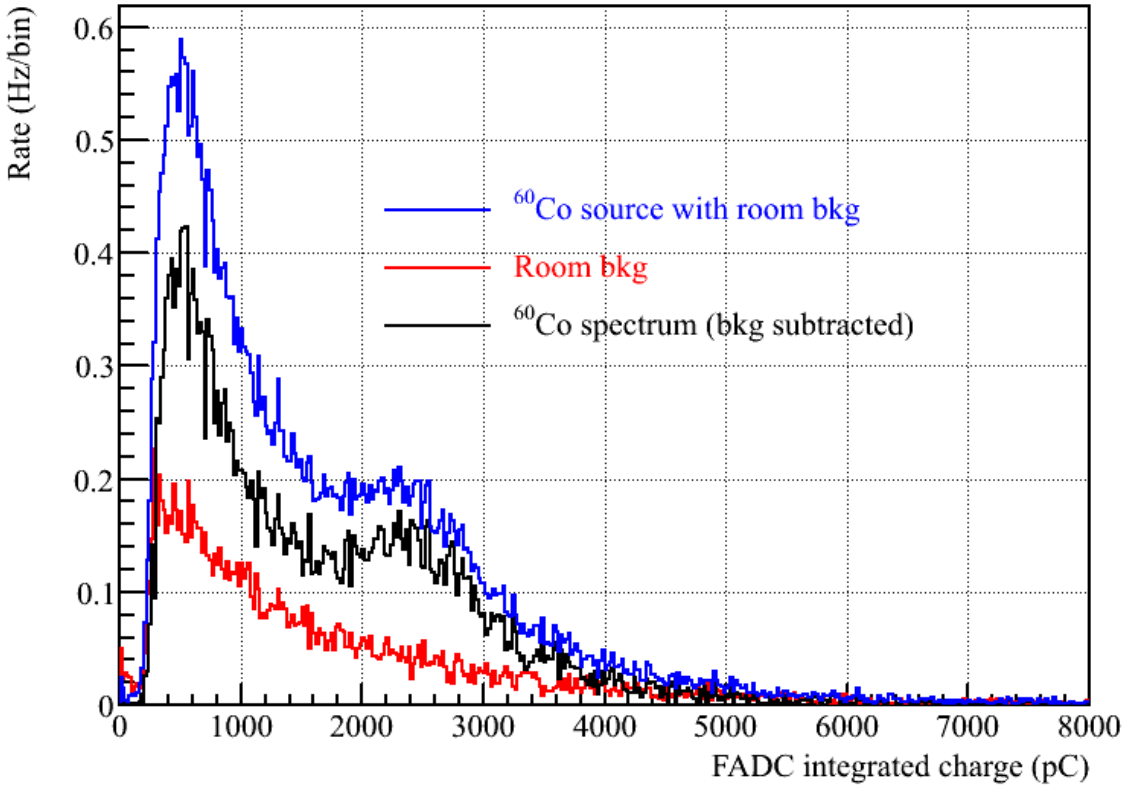


First liquid xenon test run at CJPL (Apr-May, 2013)

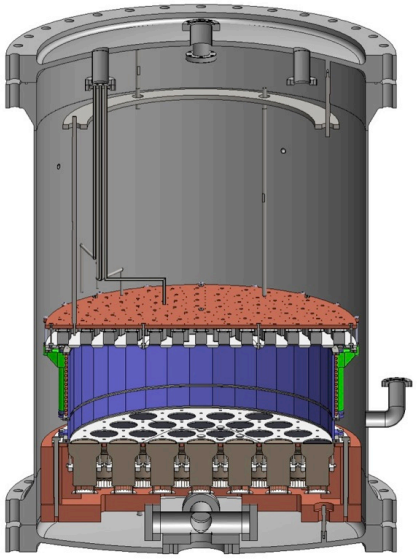




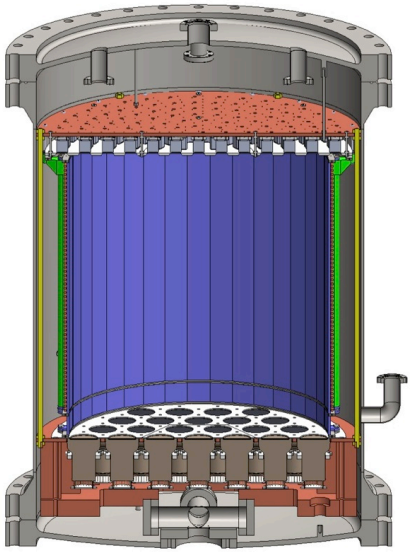
- *>400 kg liquid xenon was filled into the detector and maintained stably during the test run.*
- *Achieved 35 SLPM circulation speed through the purification getter.*
- *Bottom PMT array operational to observe the first light in liquid xenon from background and source.*



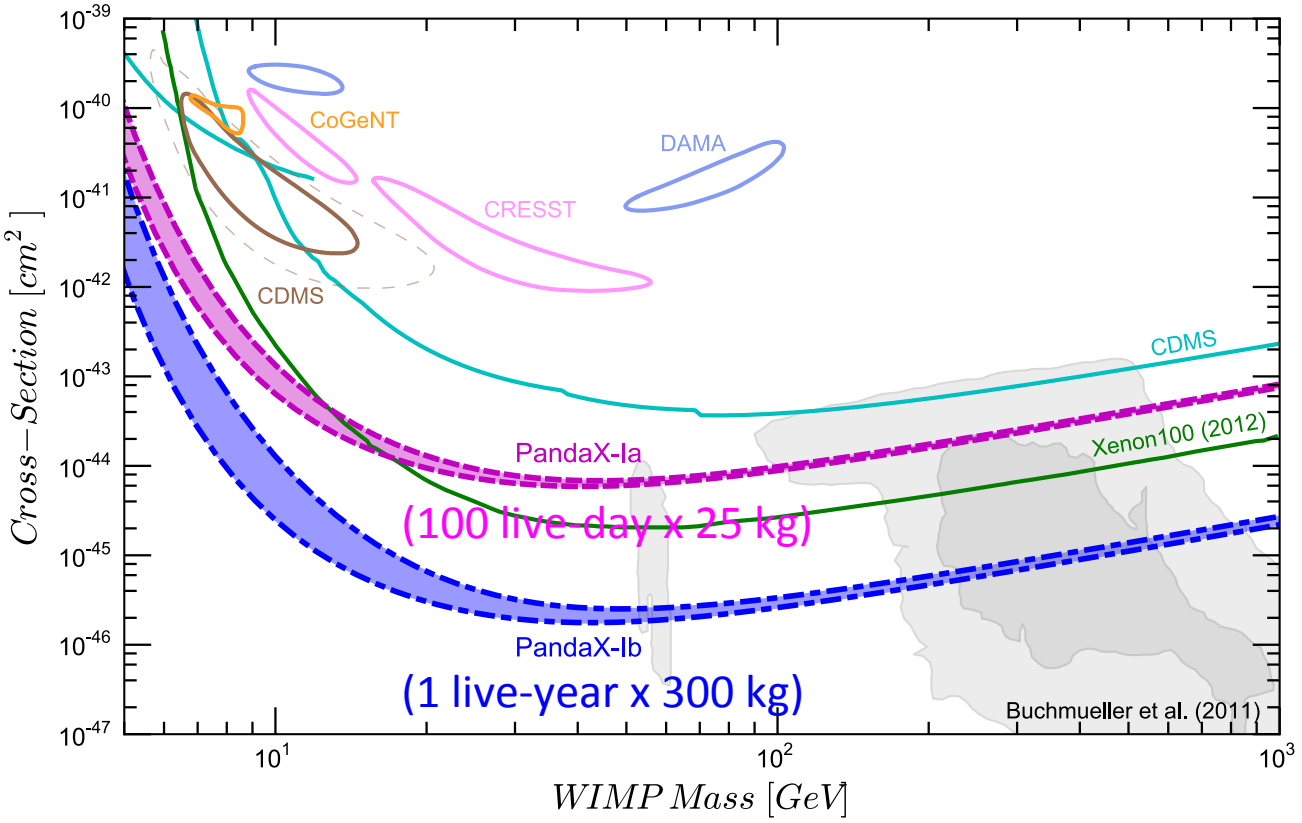
Projected sensitivity for PandaX-1a and PandaX-1b detectors.



PandaX-1a



PandaX-1b



Summary

PandaX is a two-phase xenon dark matter detector operated at the CJPL, the deepest underground lab in the world.

The current stage with optimized light yield is for light WIMPs, and an upgrade with better sensitivity for higher mass WIMPs is on the way.