

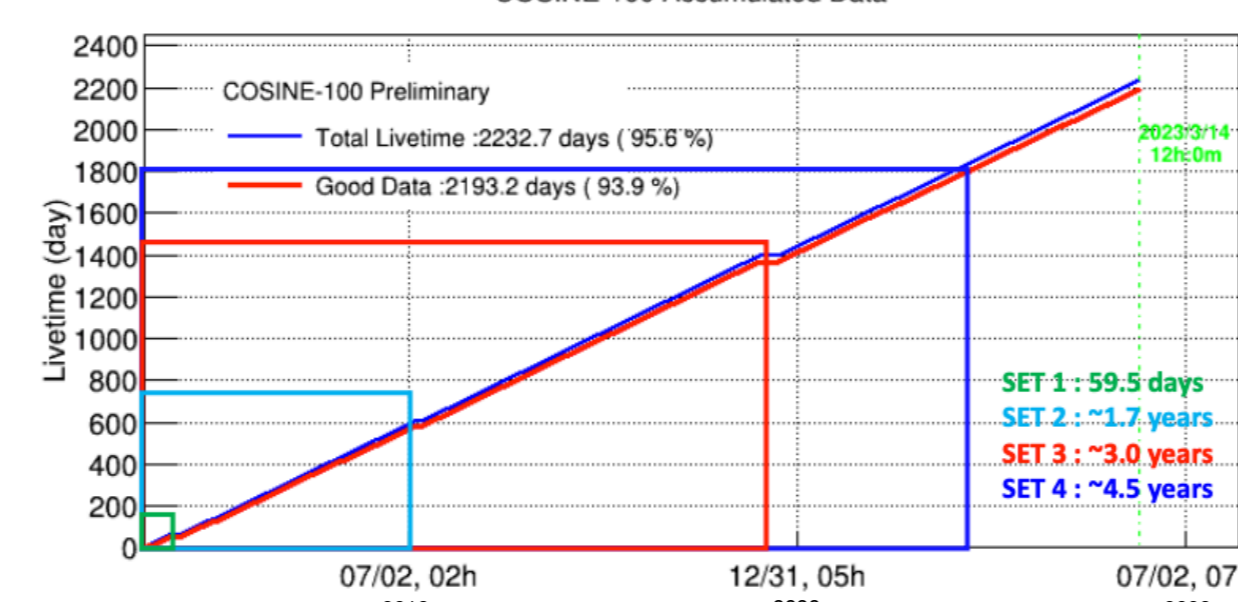
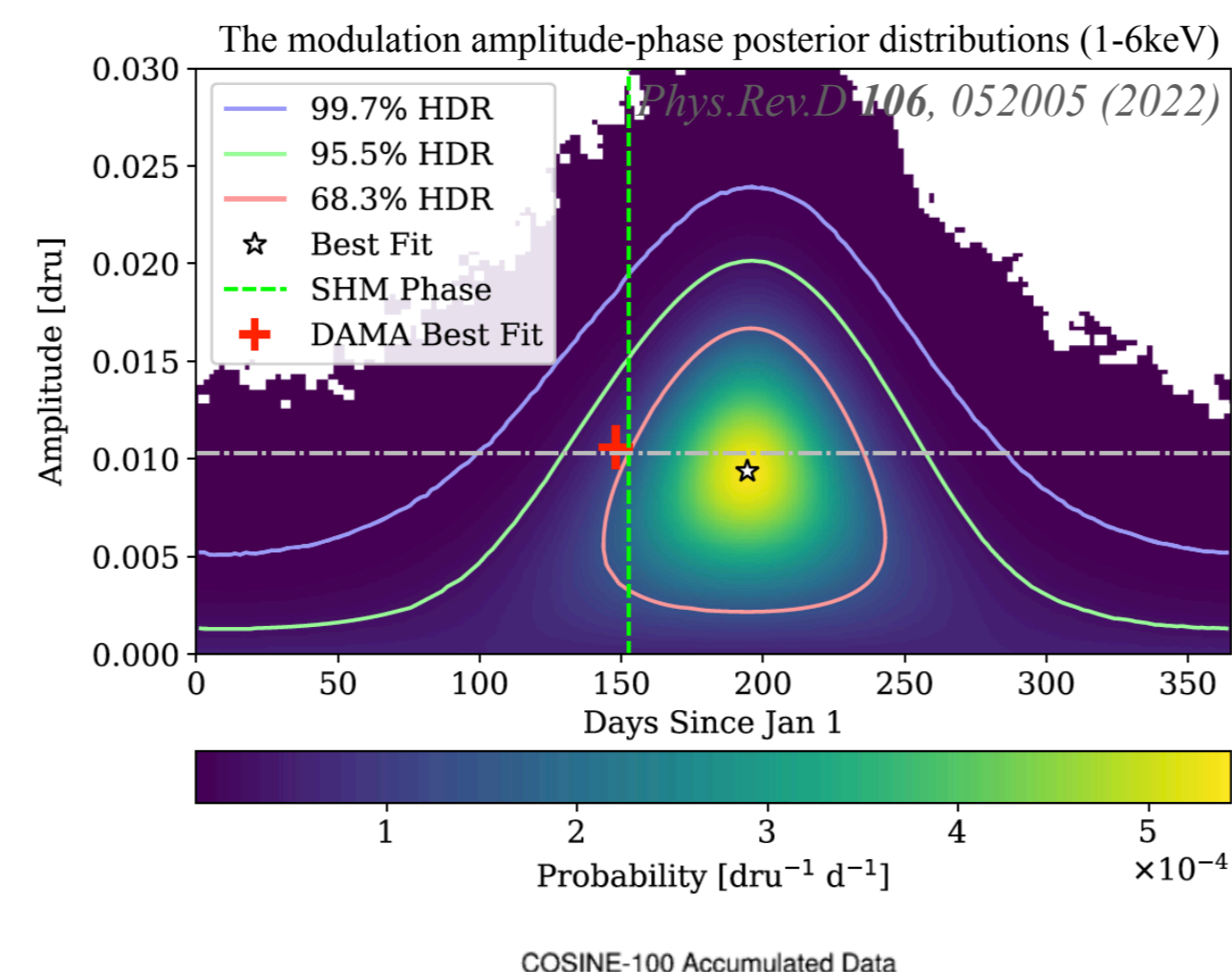
Status for COSINE-100 Upgrade and COSINE-200

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On behalf of the COSINE-100 Collaboration

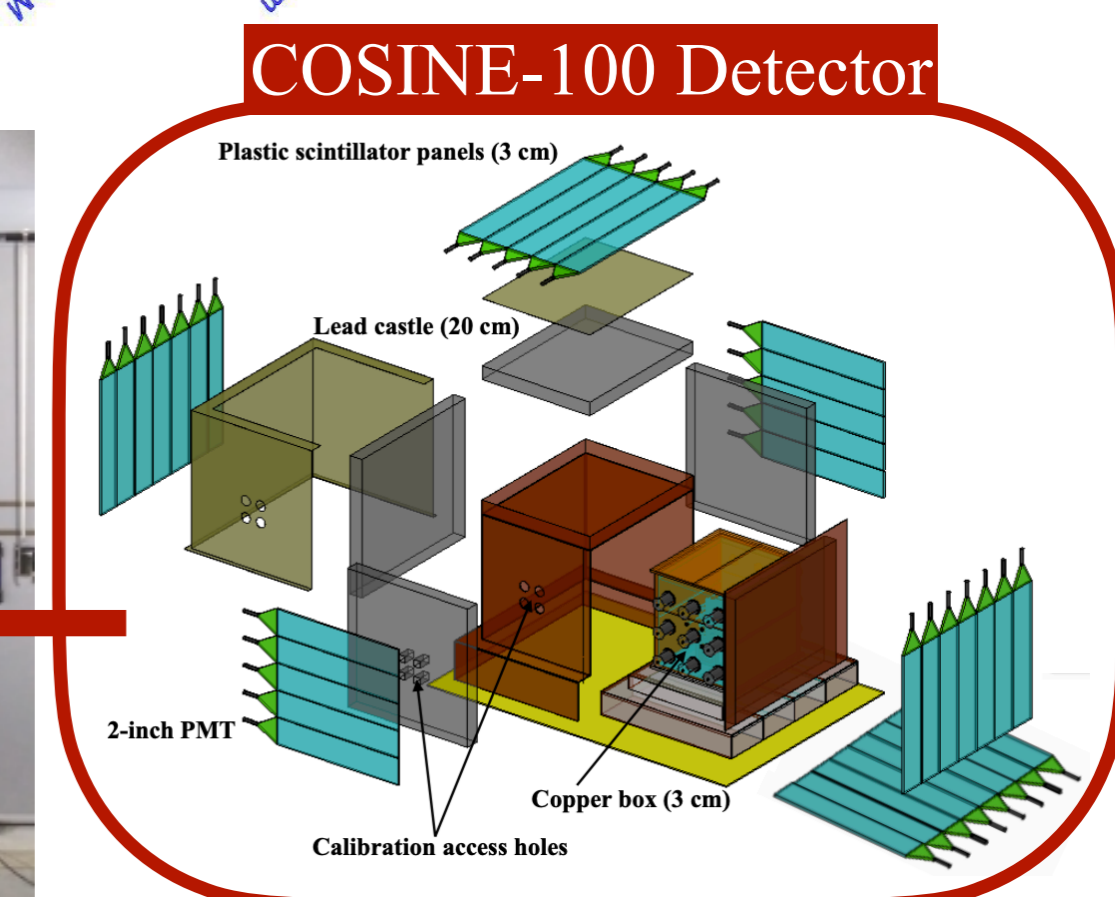
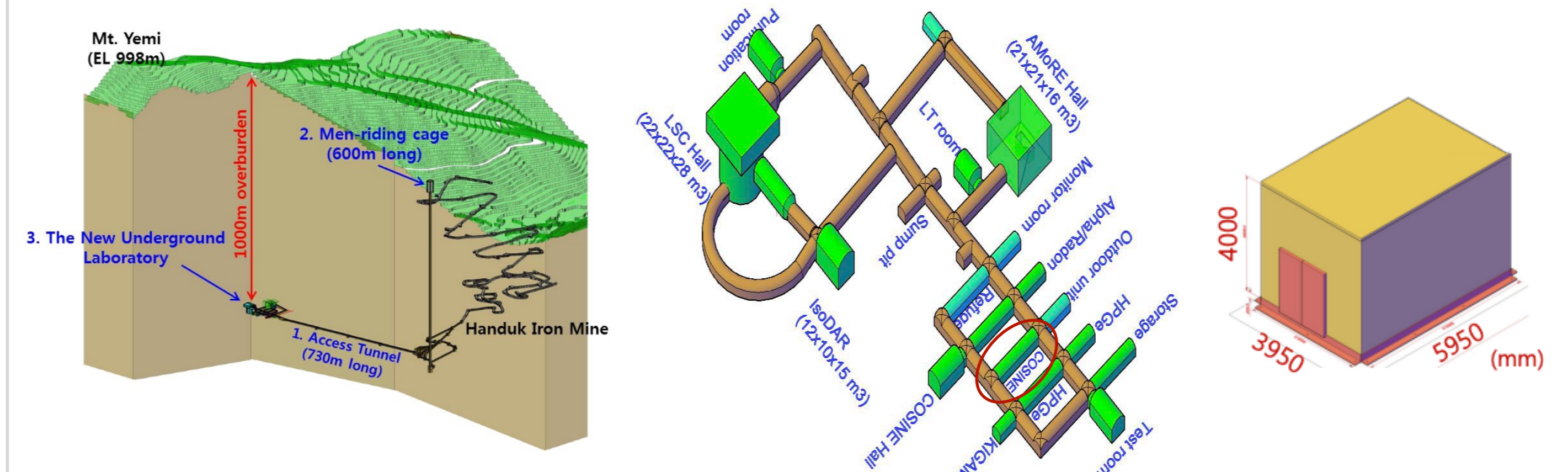
COSINE-100 decommissioned on March 14, 2023

- COSINE-100 is poised to DAMA's signal
- Stable operation from Sep. 2016 for about 6.5 years
 - DAQ efficiency : 95.6% (6.2 years)
 - good quality data : 93.9% (6.0 years)
- High light yields(LY) of 15 PEs/keV (5-10 PEs/keV for DAMA)
- Moderate background of 2.7 dru (1 dru for DAMA)
- Low effective detector mass
 - low LY for crystals 5 and 8 (~5 PEs/keV)
 - too many noise for crystal 1
- Shallow overburden (700m at Y2L)
- Model independent test results statistically limited



Moving to Yemilab for COSINE-100 Upgrade and COSINE-200

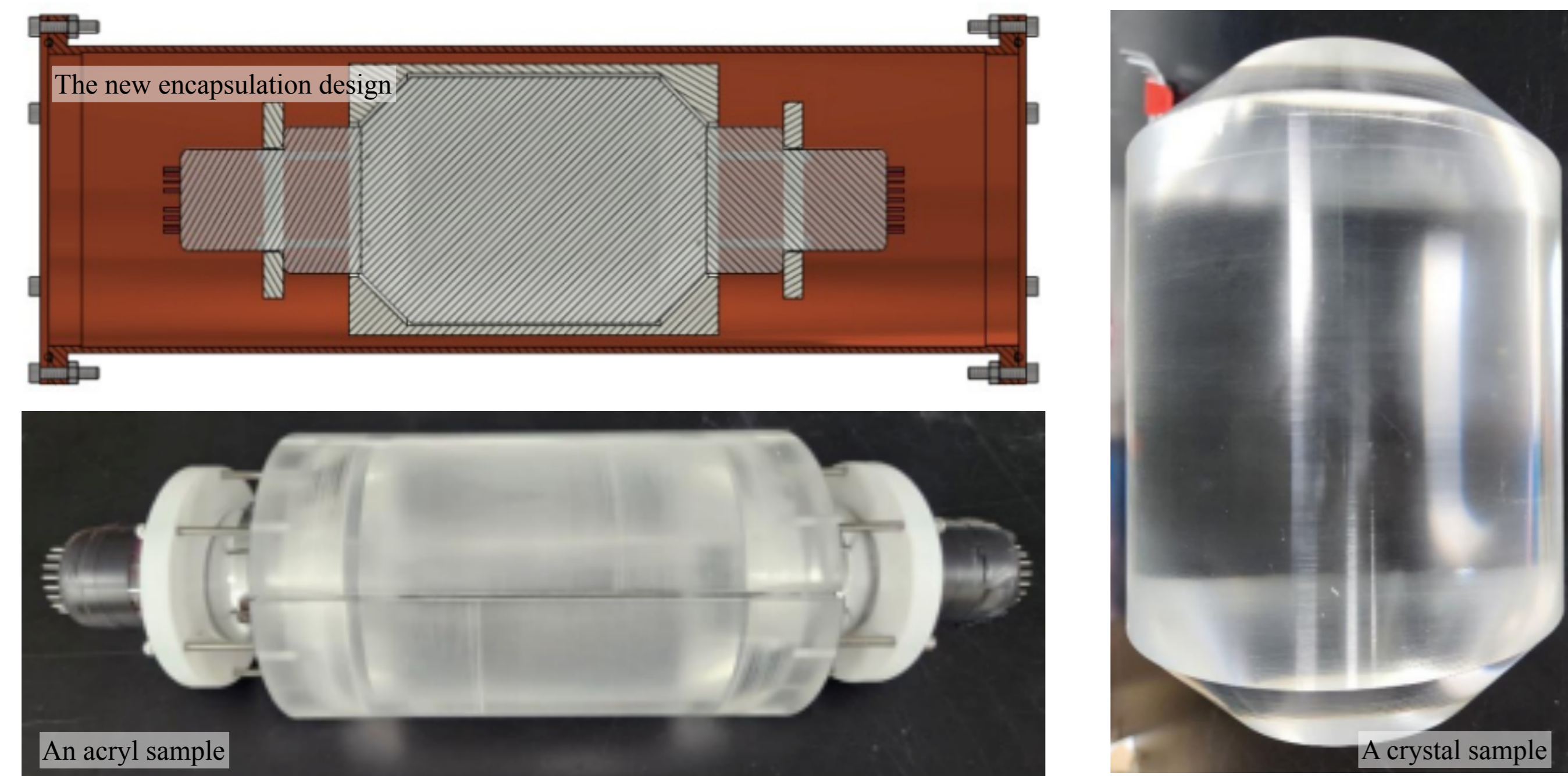
- Yemilab (1,000m depth) dark matter hall ready as of mid-2022
- Low temperature housing built in December 2022
- COSINE-100 shields will move to Yemilab by this summer
- Crystals will be refurbished and re-encapsulated



NaI(Tl) LY R&D for crystal encapsulations and at moderately low temperature

Crystal Re-encapsulation

- No quartz guide and matching diameter with PMT window : 50% LY increase
- R&D crystals and NEON sister crystals show LY > 20 PEs/keV (see B.C.Koh's poster)
- Cask-shape crystal and direct PMT coupling

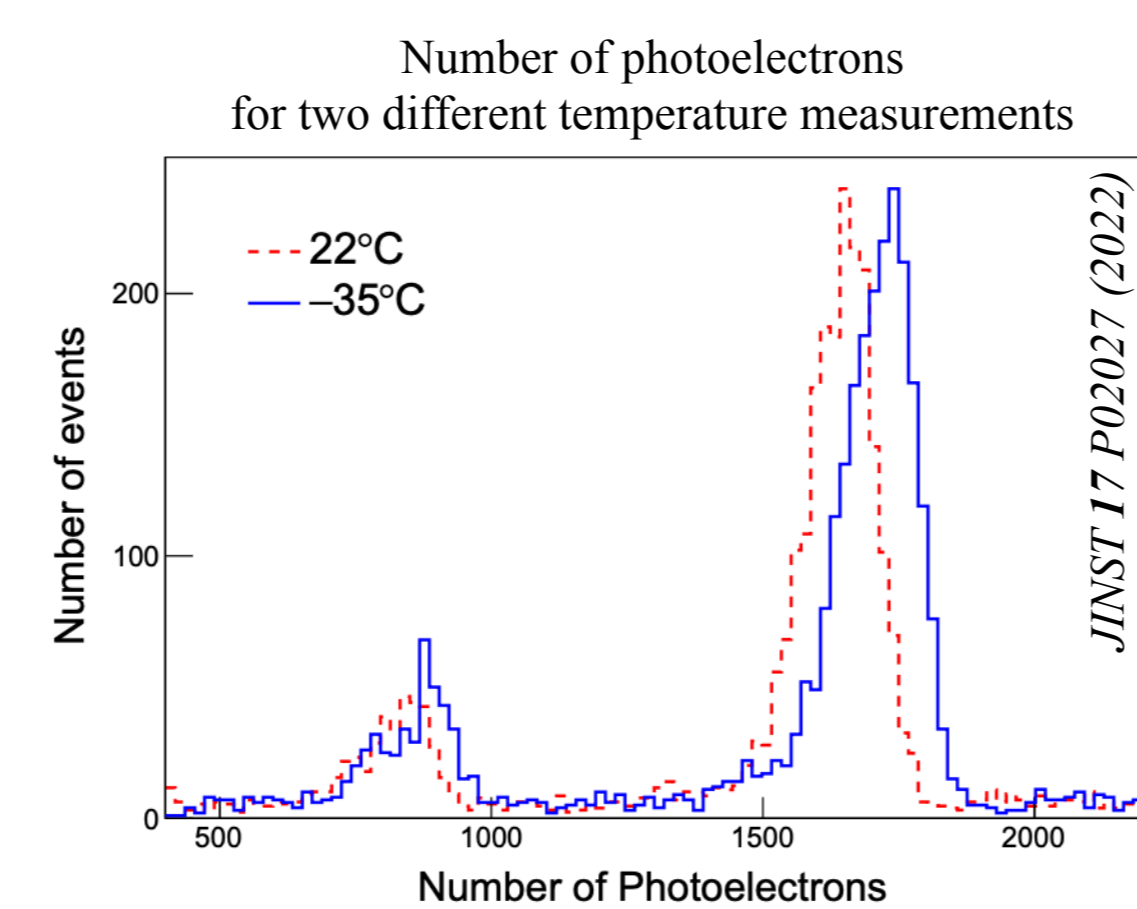


NaI(Tl) LY increase in low temperature

- Known to increase LY at -35 °C and -150 °C.
- 5% or more additional increase expected.

Measured light yields at two different temperatures.

Temp. (°C)	LY (PEs/keV)	σ/mean (%)
22	27.6 ± 0.3	3.8 ± 0.1
-35	28.9 ± 0.2	3.7 ± 0.1



Expected light yields for COSINE-100 Upgrade > 20 PEs/keV

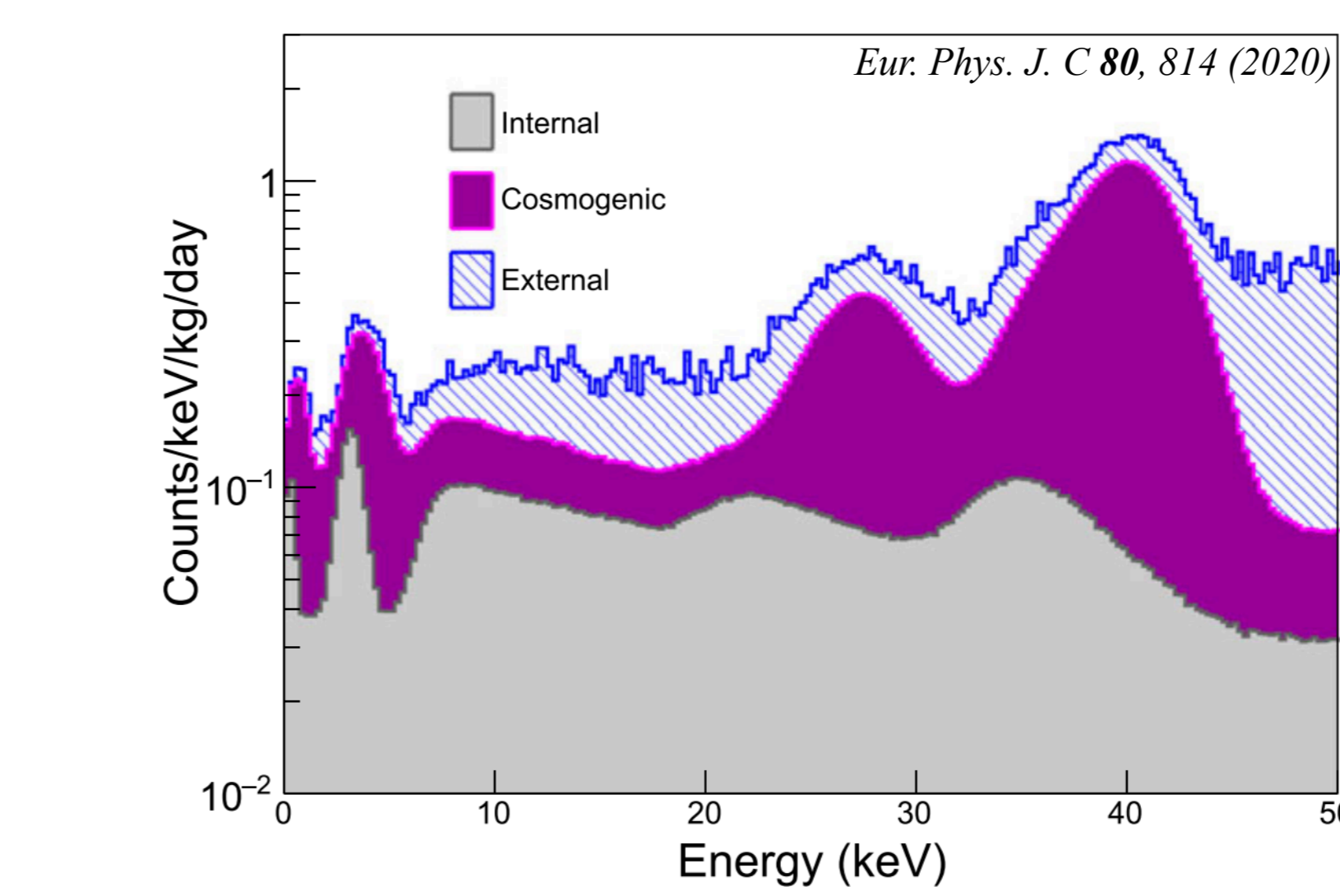
- COSINE-100 Upgrade : Refurbished & Re-encased crystals (100kg)
- COSINE-200 : New ultra-low background crystals (200kg)

R&D status of COSINE-200

J. Rad. Nucl. Chem. 317, 1329 (2018)
JINST 15, C07031 (2020)

- NaI-035 crystal was made by small test grower
- Background of NaI-035 after purification is less than 1 dru
- Now large crystals (~50kg) growing is under R&D processes

	Initial NaI	Purified NaI
K (ppb)	248	< 16
Pb (ppb)	19.0	0.4
U (ppb)	< 0.01	< 0.01
Th (ppb)	< 0.01	< 0.01



The expected background spectrum of a COSINE-200 crystal for low-energy single-hit events assuming the same internal and cosmogenic radioisotopes as NaI-035 but, installed in the COSINE-100 shield with an enlarged crystal size (12.5kg).



Expected sensitivities for COSINE-100 Upgrade and COSINE-200

Phys.Rev.D 105, 042006 (2022)

Assumptions

- COSINE-100 Upgrade : COSINE-100 backgrounds, 22 PEs/keV LY, 100 kg · 1 year exposure including crystals 5 and 8
- COSINE-200 : NaI-035 background (<1 dru), 22 PEs/keV LY, 200 kg · 1 year exposure
- COSINE-1T : NaI-035 background (<1 dru), 25 PEs/keV LY, 1 ton · 1 year exposure

