Status and prospects of CJPL and the CDEX experiment

- CDEX Collaboration
- Recent status of CDEX
- China Jinping Underground Laboratory(CJPL)
- Summary

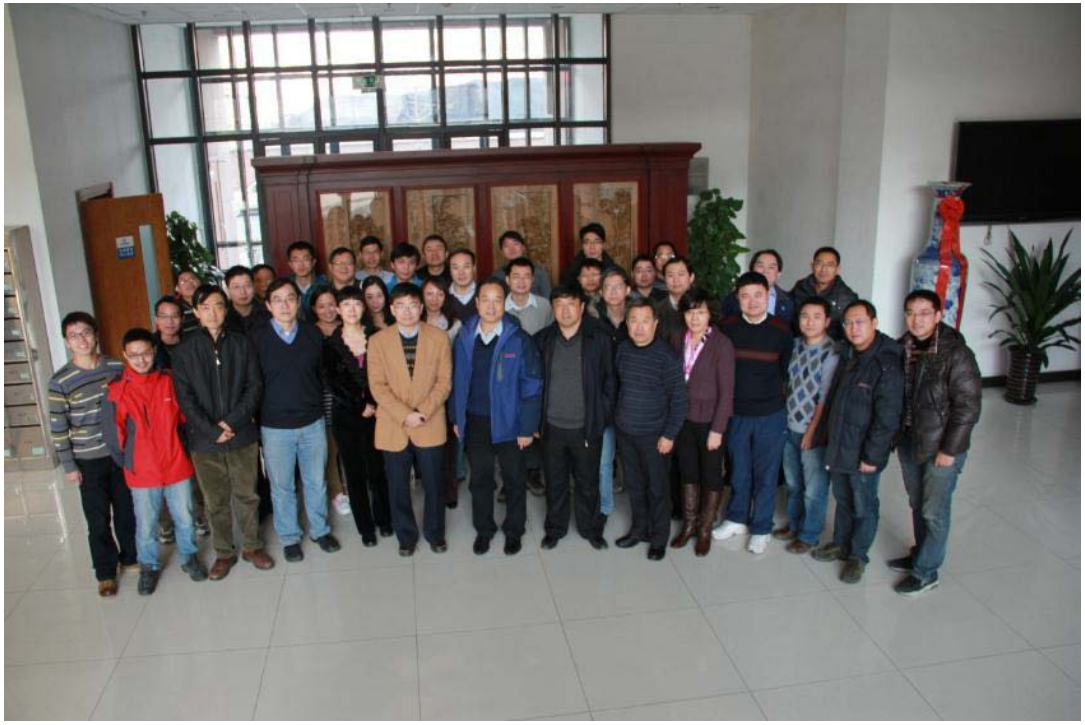
LIN,SHIN-TED / Academia Sinica, Taipei
On behalf of CDEX Collaboration
@TAUP-2013 CA, Sept. 12 , 2013
(Materials Provided by Prof. Qian Yue, Tsinghua University, China)

CJPL 中国锦屏地下实验室 China Jinping Underground Laboratory

China Dark matter EXperiment (CDEX)- EST in 2009

🏆 Direct detection of cold dark matter with *Ton-scale PCGe* array with ultra-low energy threshold (<300 eV).

- Tsinghua University, THU
- Sichuan University, SCU
- Nankai Univeristy, NKU
- China Institute of Atomic Energy, CIAE
- Yalong River company (former name: EHDC)
- Collaborate with *TEXONO* and *KIMS* group.



Before and after CDEX born

2015: Design of CDEX-1T (based on new CJPL space)

2014: CDEX-10 10kg Ge array + LAr shielding

2013: CDEX-1 preliminary result(without B/S and A.C.)

2011: CDEX-1 Detector test and data taking

2010: CJPL run; CDEX-1 20g Array +1kg PPCGe

2009: CJPL planed; CDEX was born

2005: 5g Ge det. run in Y2L, S. Korea

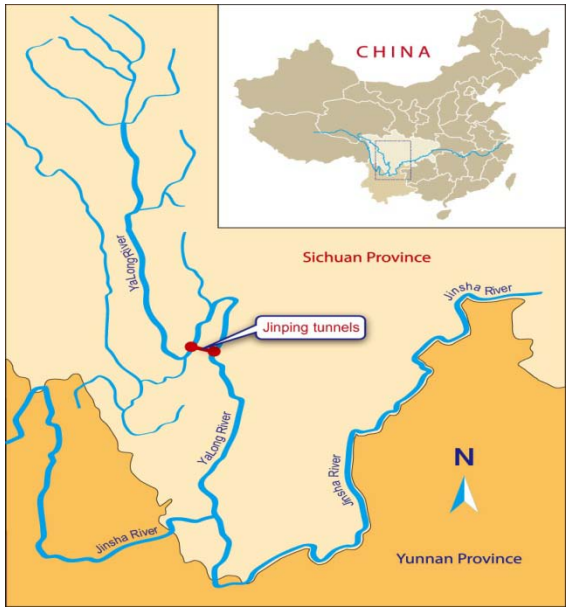
2003: A group led by THU, joined by members from TEXONO and KIMS

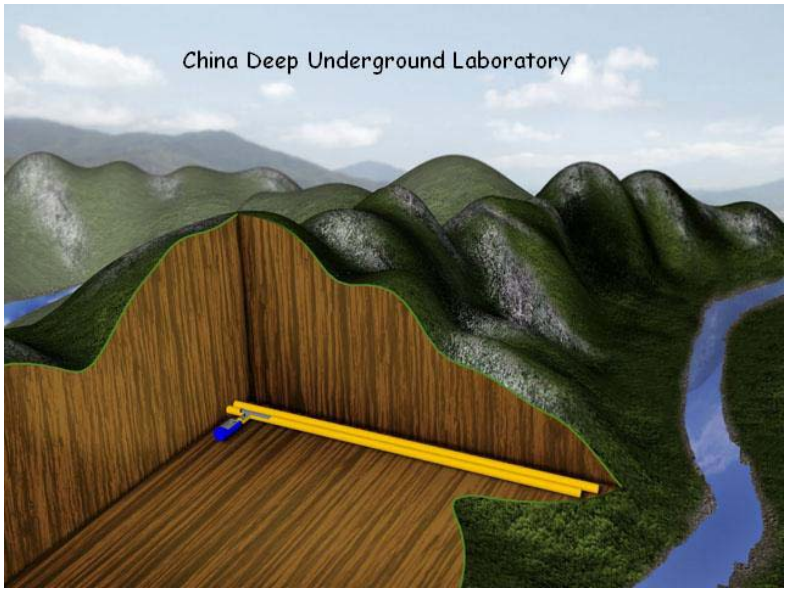
CJPL

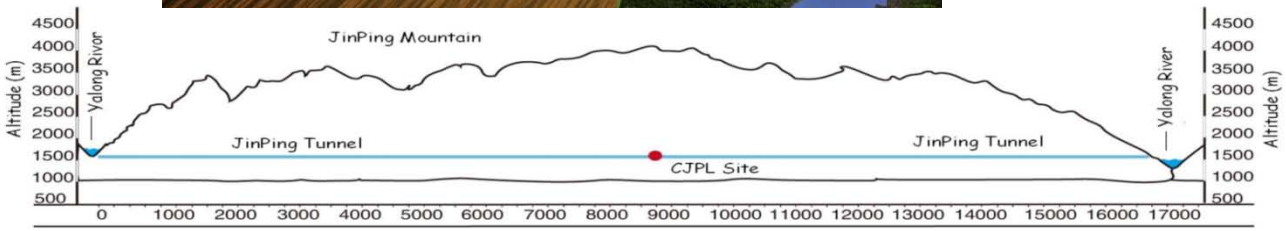
China JinPing underground Laboratory

- Tsinghua University, have collaborated with Yalong River company to construct and run CJPL (*6 m X 6 m X 40 m*).

- CDEX has done many measurement of its main. These parameters are very important for dark matter experiments



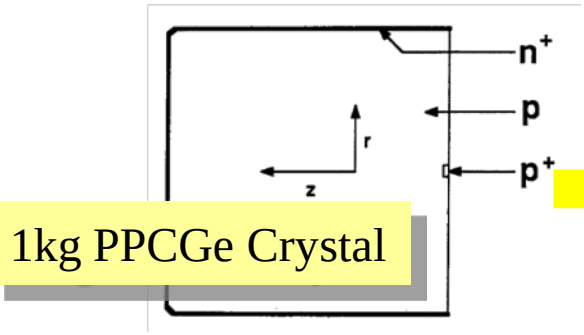




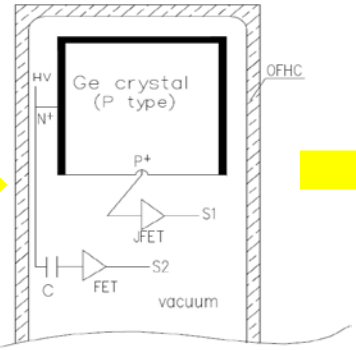
CJPL

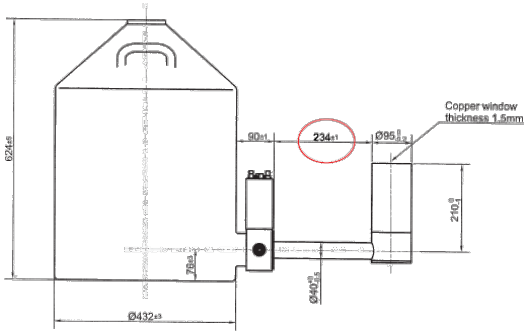
CDEX-1 kg @ CJPL

- ✓ Point-contact & ULE Ge detector with ultra-low energy threshold (~ 300 eV or less).
- ✓ Mass of Ge target : 20g, 1000g.

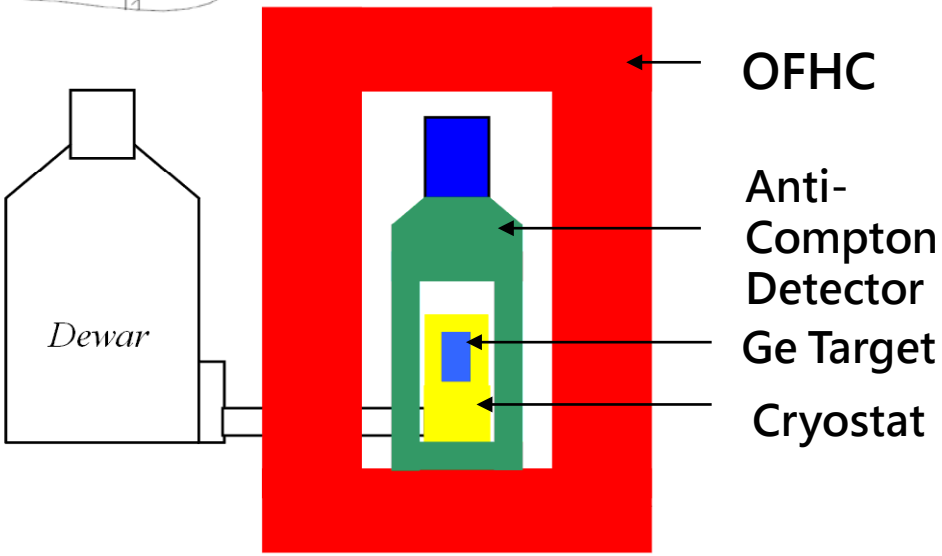


1kg PPCGe Crystal





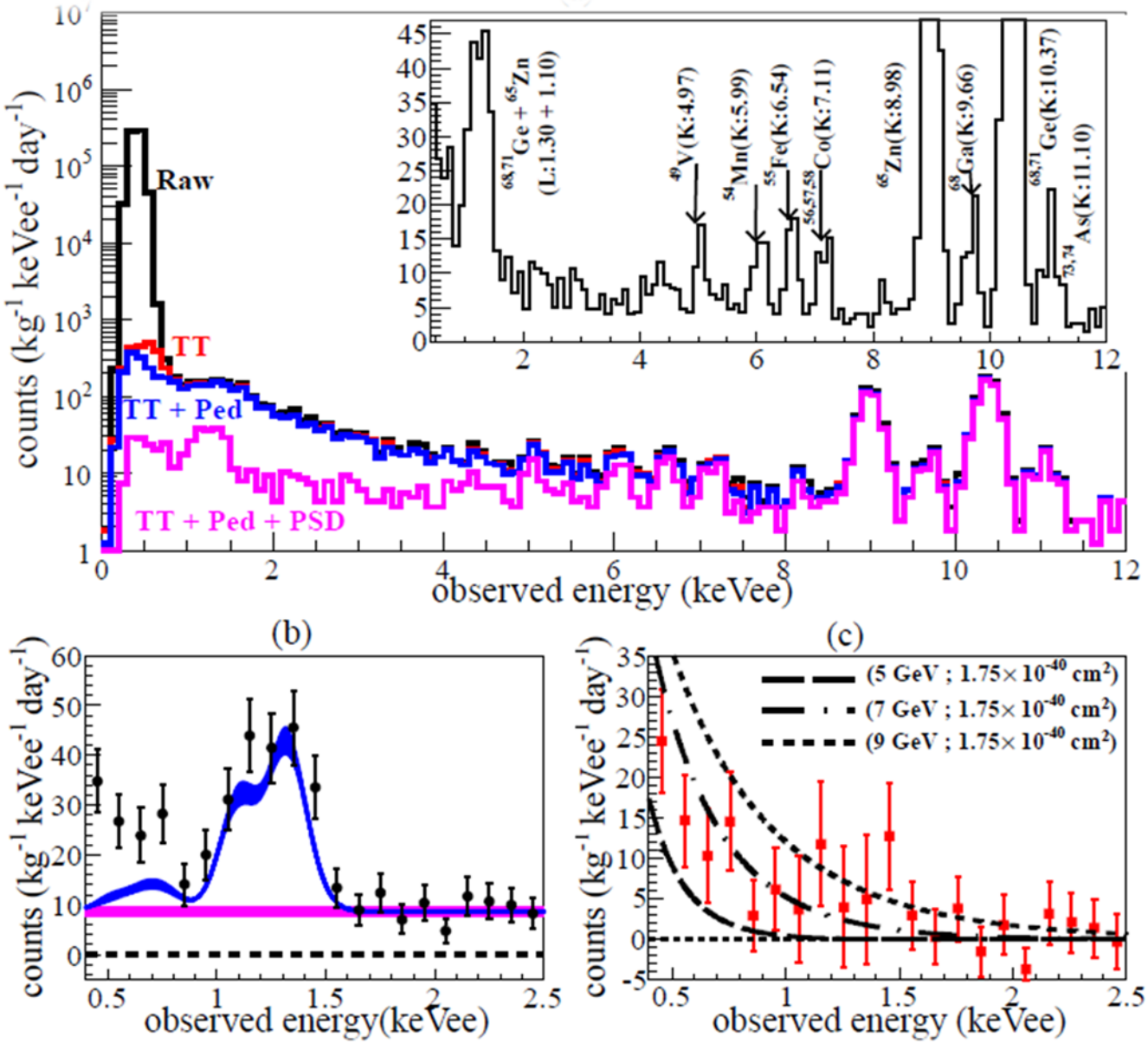
- ✓ Further ultra-pure crystal serve as active shielding and anti-compton detector.



CJPL

CDEX-1

CDEX-1 low energy spectra



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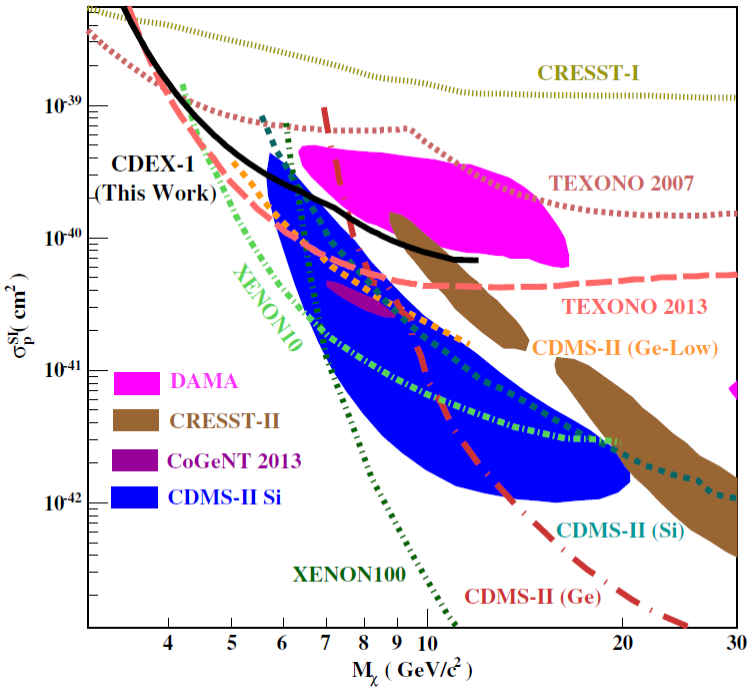
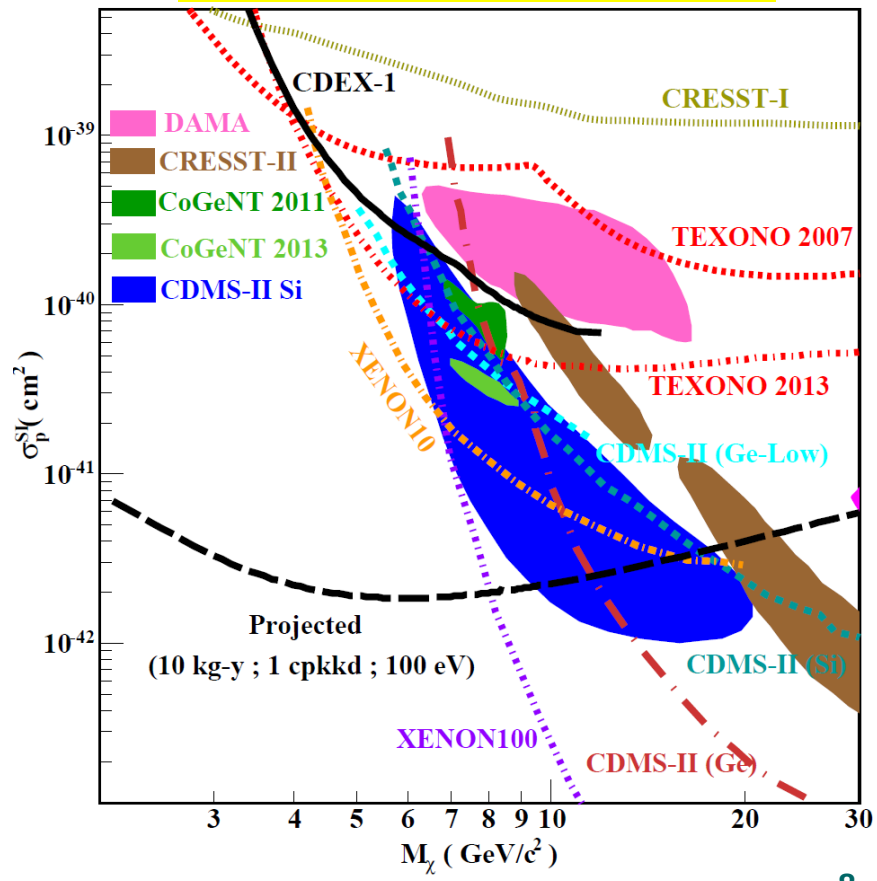
CDEX-1 physics result

- CDEX-1 PPC-Ge, Fiducial mass : 994 g ; 15 kg-day of data (prior to Anti-Compton & Bulk/Surface cut)



arXiv:1306.4135, *PRD 88 052004(2013)*

Projected sensitivity



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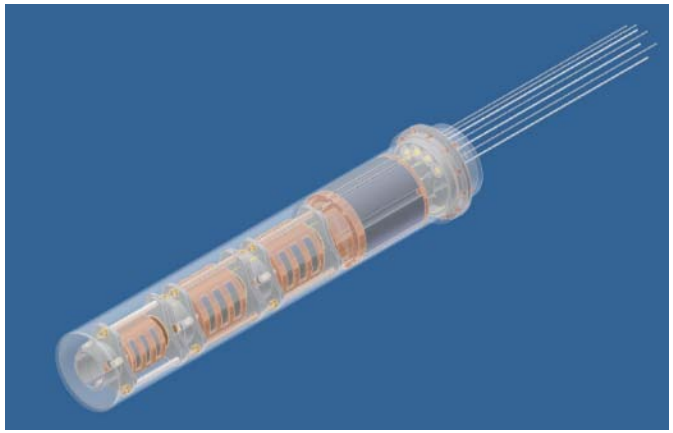
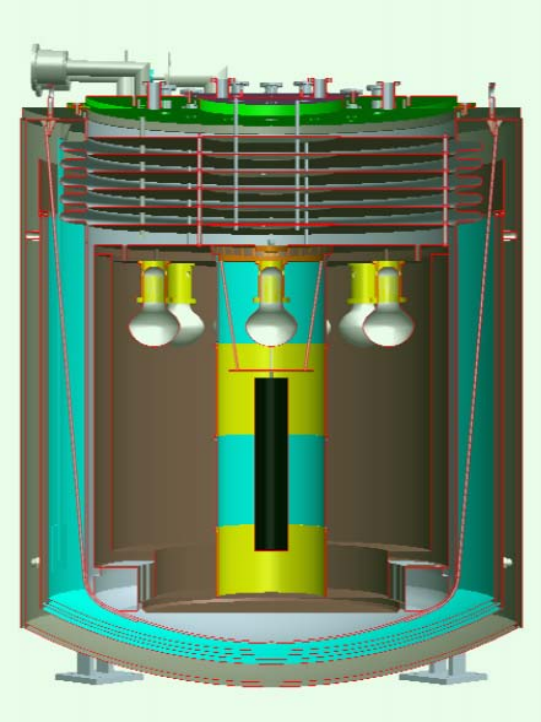
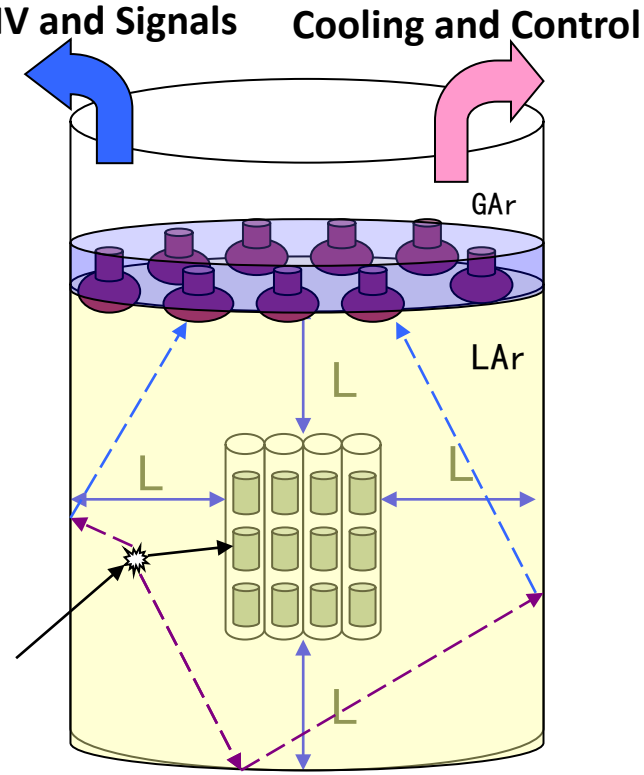
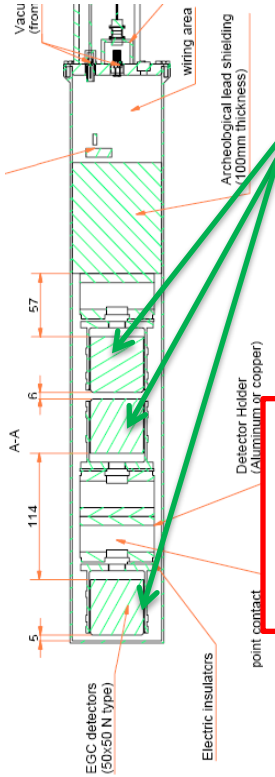
CDEX-10 kg Experiment

LAr: Passive shielding + Active shielding.
Ge: Encapsuled into copper vacuum tube.
WLS: Transfering 128nm light to~420nm light.









PCGe

Target

9 Kg of PCGe
⊕
1.5 Ton of LAr

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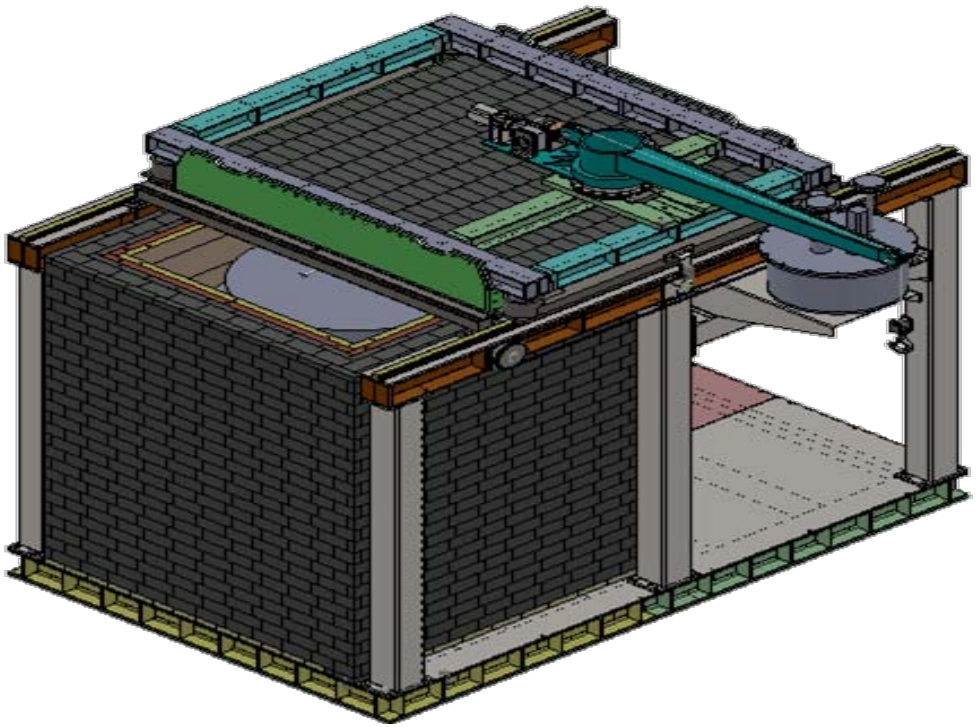
CDEX-10
Mechanical Support & Shielding system



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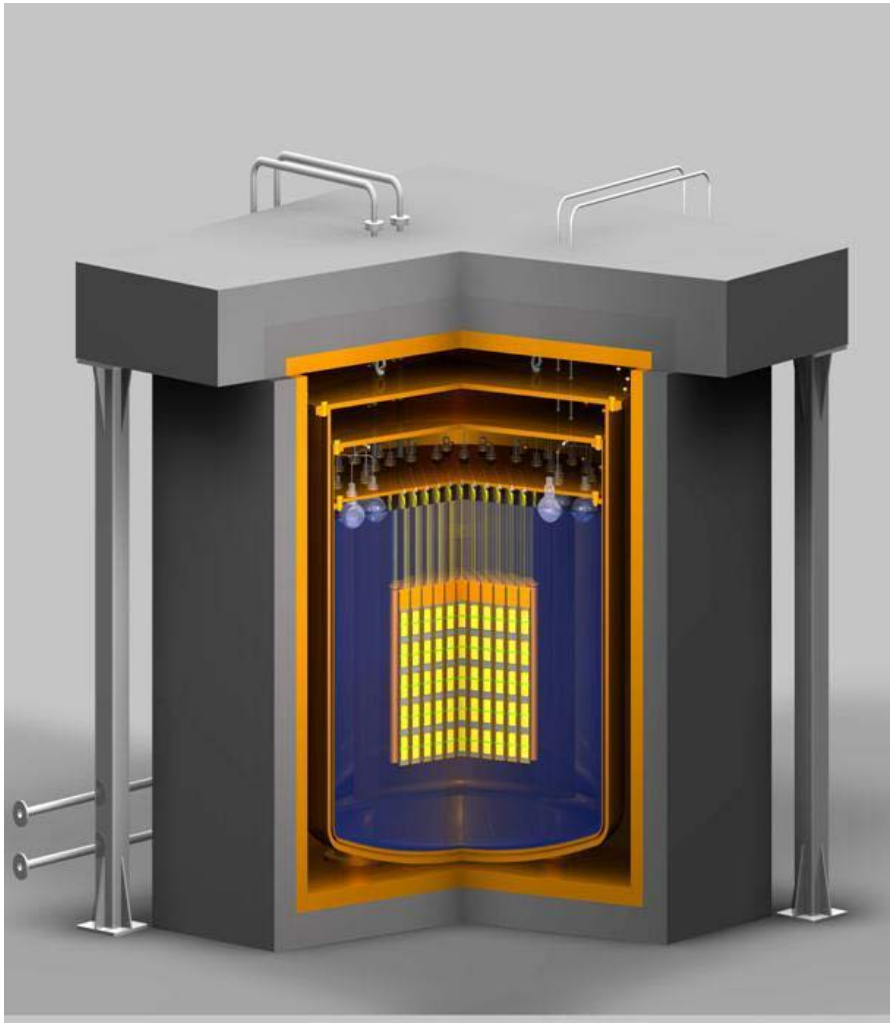
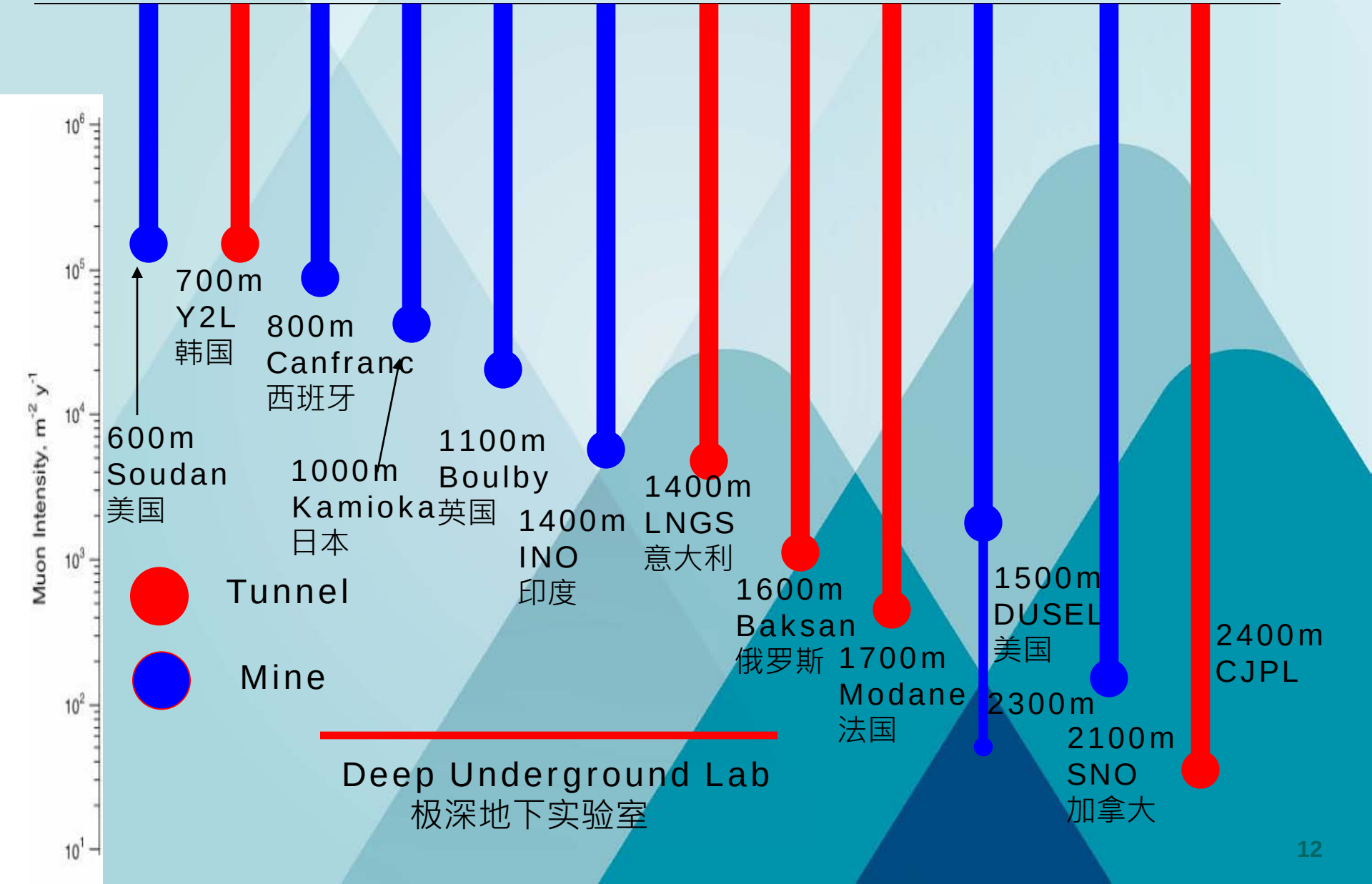
CDEX-1T plan

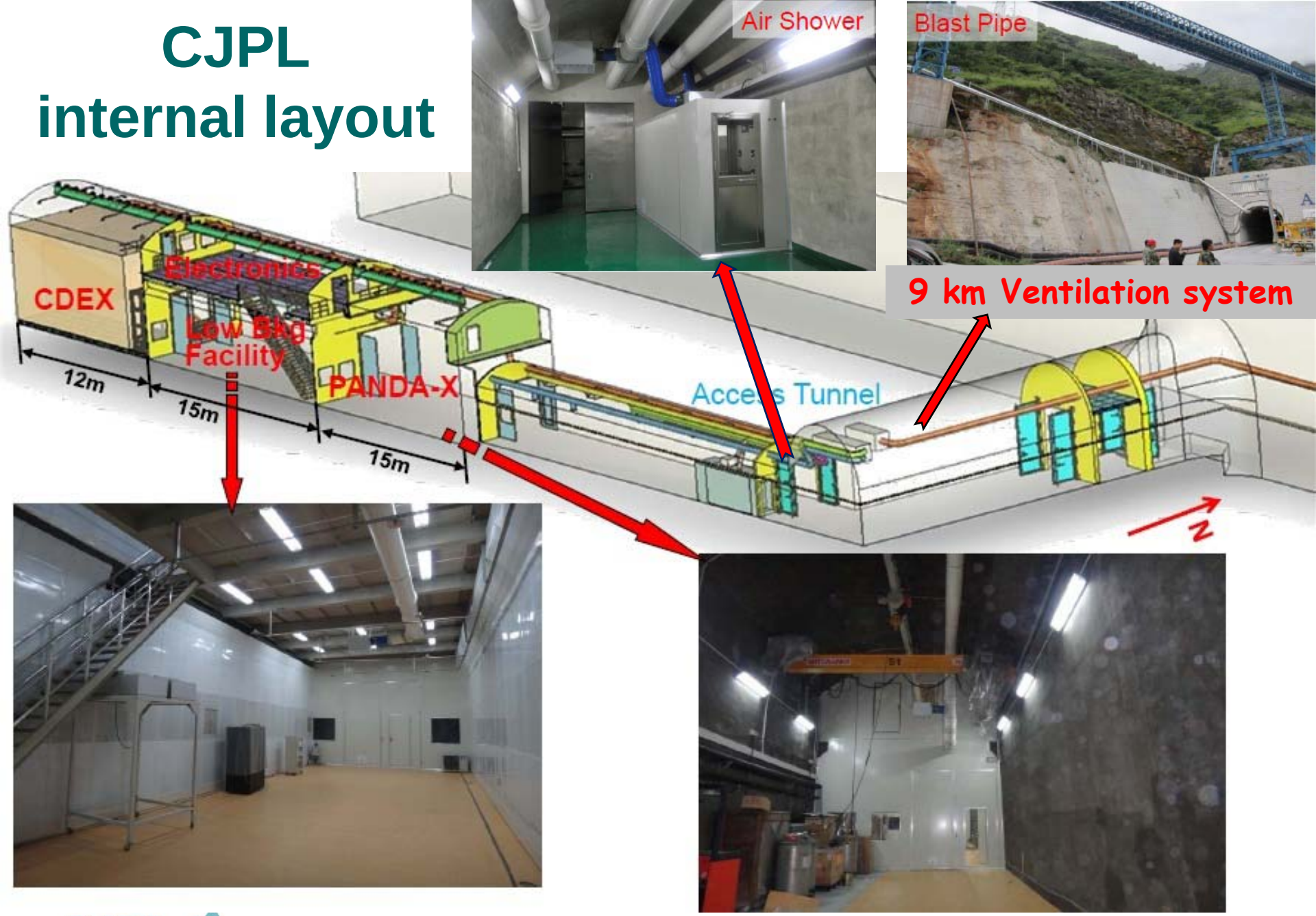


●Goals：Both Dark Matter & Double beta decay

UL in the world(rock overburden)



CJPL internal layout



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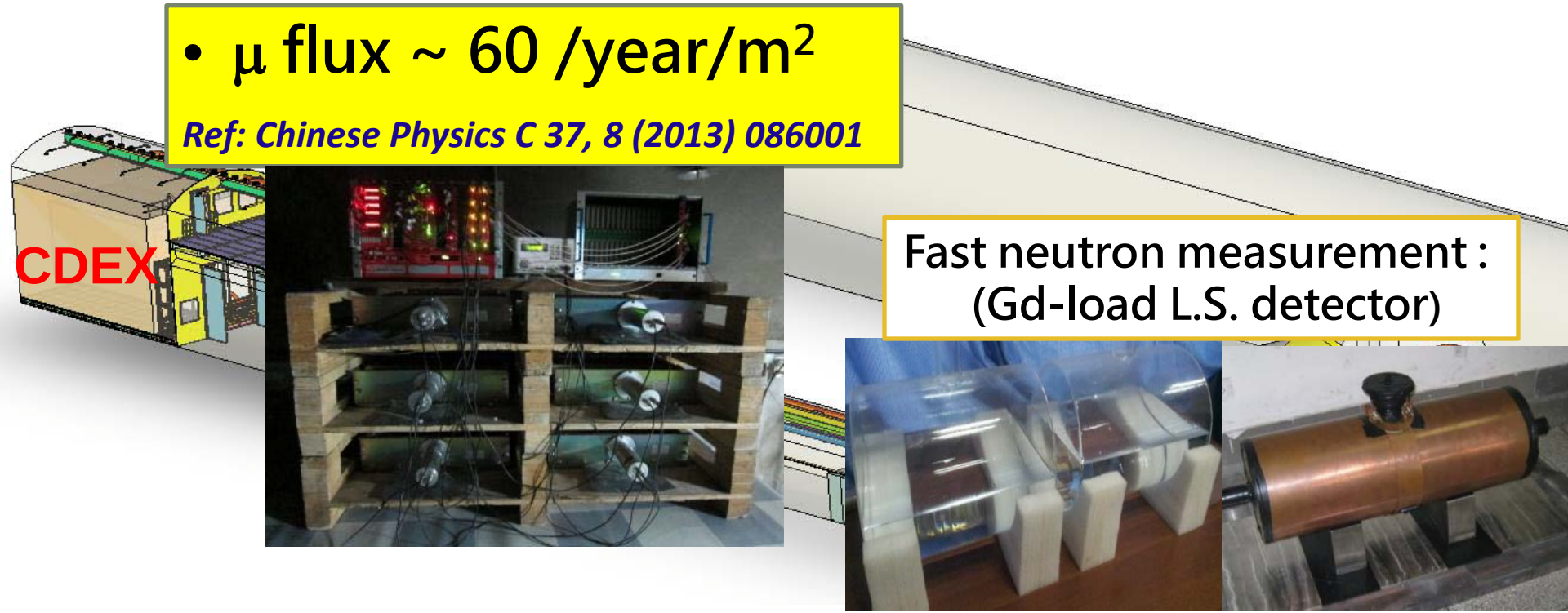
Background understanding

- μ flux ~ 60 /year/m^2

Ref: Chinese Physics C 37, 8 (2013) 086001



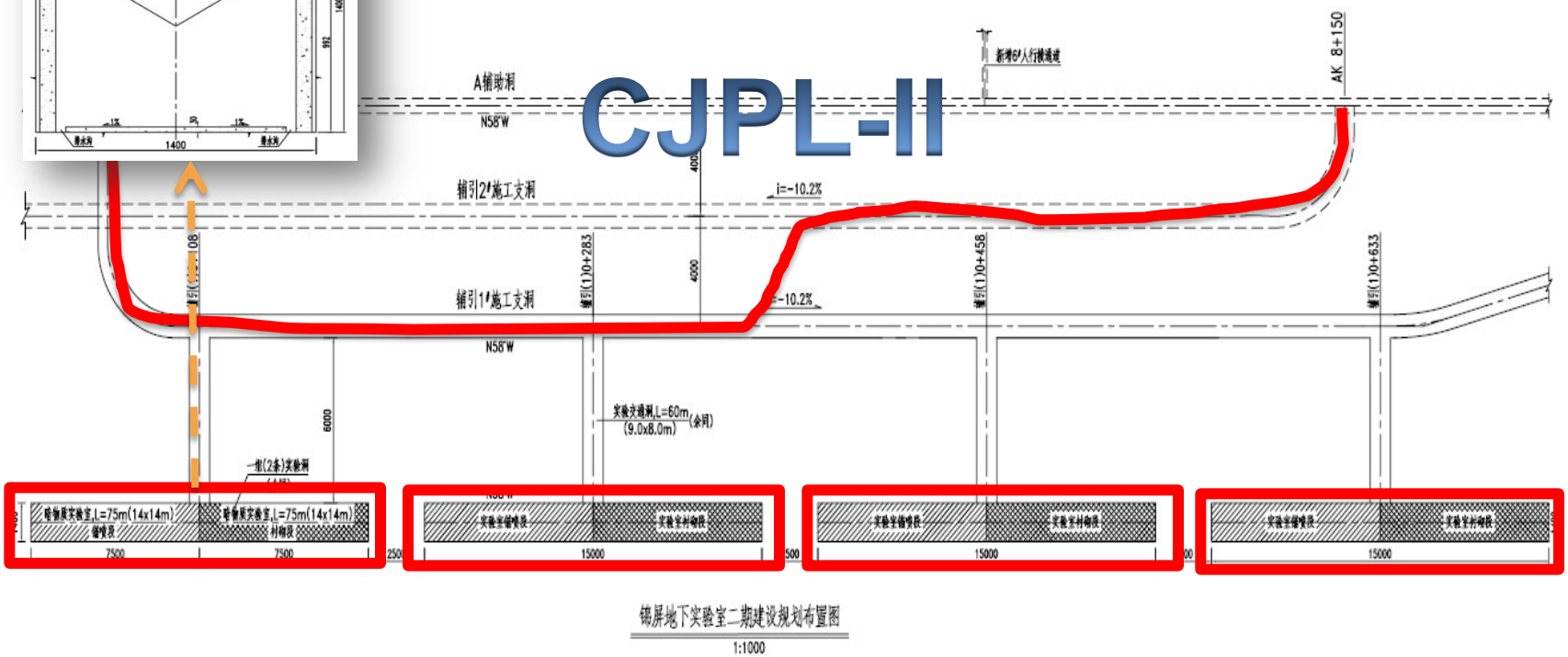
Fast neutron measurement :
(Gd-load L.S. detector)

Rock Background

(Unit : Bq/kg)	K-40	Ra-226 (609keV)	Th-232 (911keV)
Rock Sample	< 1.1	1.8±0.2	< 0.27
Ground Level (Beijing)	~600	~25	~50

CJPL Future Plan

- CJPL-II: space 20 * CJPL-I;
- Dimension: 12m*12m*50m*N;
- Plan to be finished in 2015. [see talks by Joseph Wang,Sep.12 & CJPL Town meeting]



- **Four 12m*12m*150m cave**

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Summary

- CDEX has started **CDEX-1** experiment, and first result on light WIMP in June 2013 (*PRD 2013*). Complete hardware and analysis chains soon.
- **CDEX-10** (PCGe⊕LAr A-C) will start ground testing at SCU from this May on and plan to ship to CJPL from 2014.
- **CDEX-1T** related technologies has been exploited by CDEX including background understand, detector fabrication, crystal growth, electronics and so on.
- The prototype PCGe and BEGe detectors will also scan the 76Ge **DBD** energy region to learn the background therein.
- **CJPL** with deepest rock overburden in the world run now. **CJPL-II** with **20** times space under design.

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Backup slides

Backup slides

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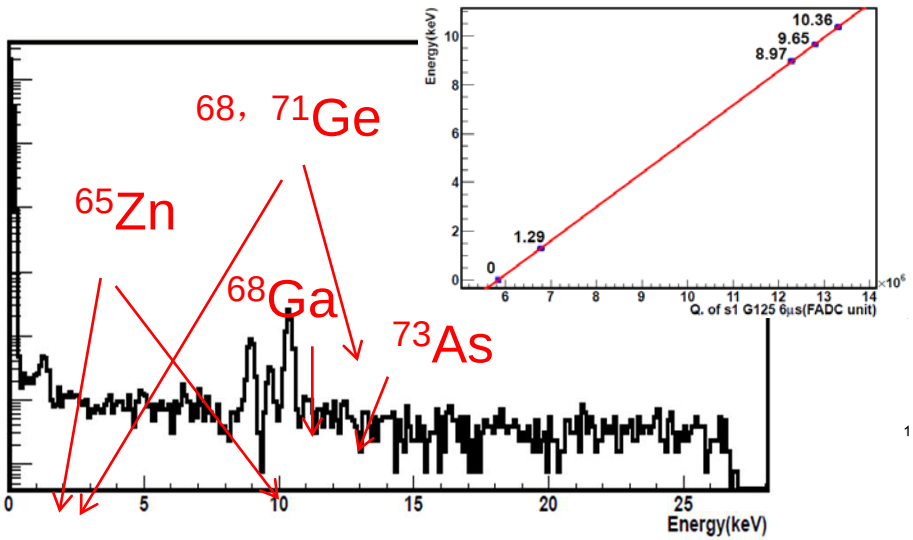
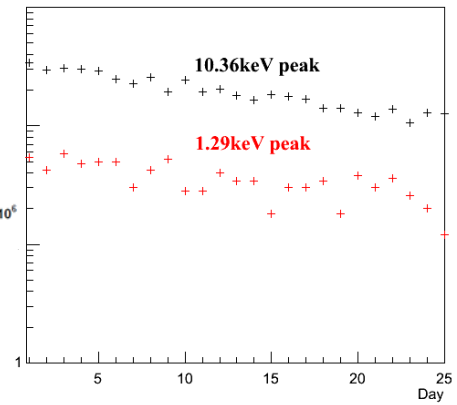
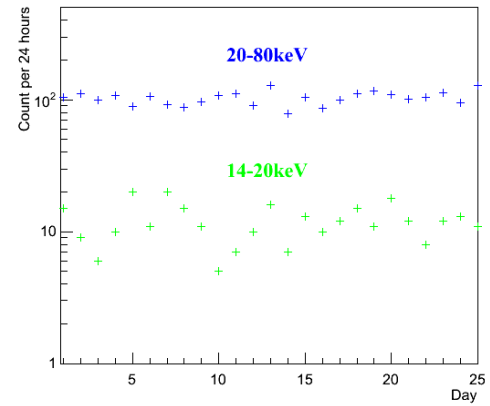
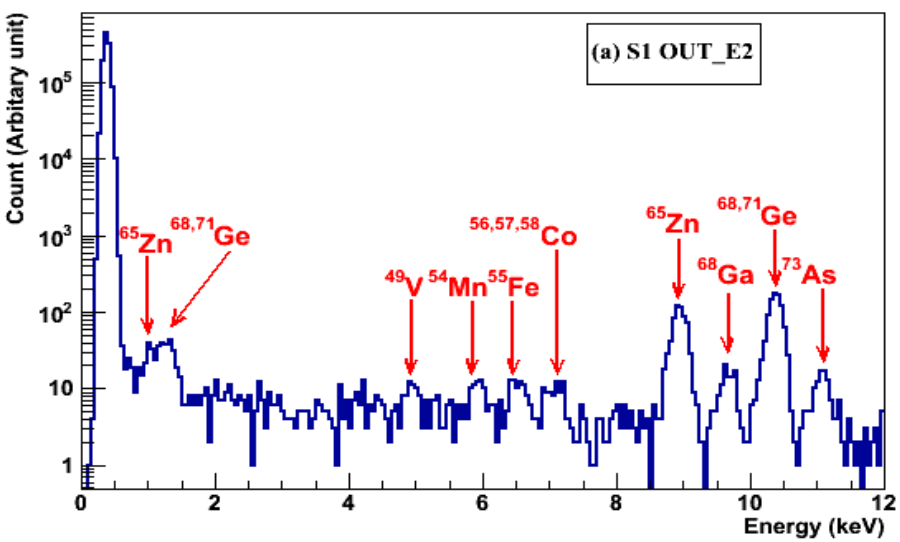
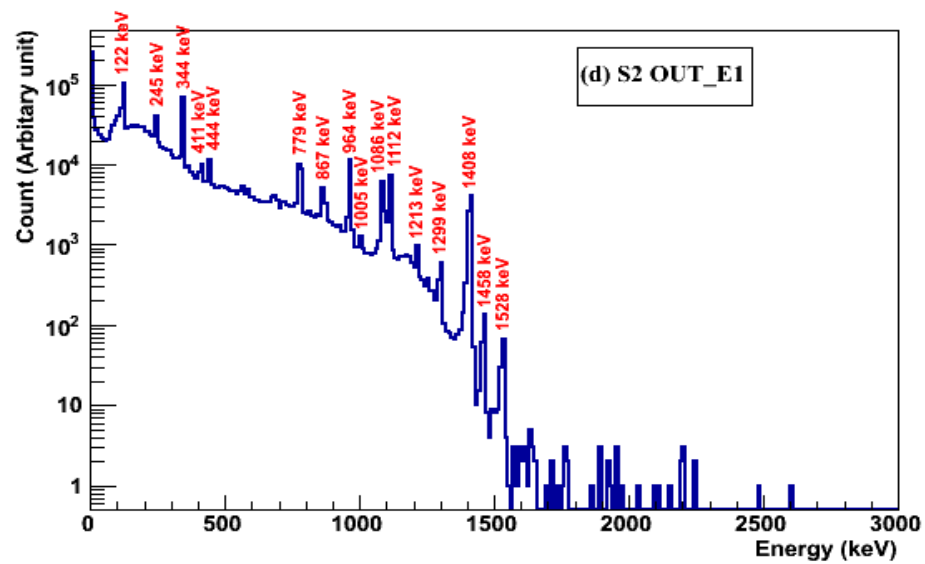
Recoil spectrum of P-PCGe detector











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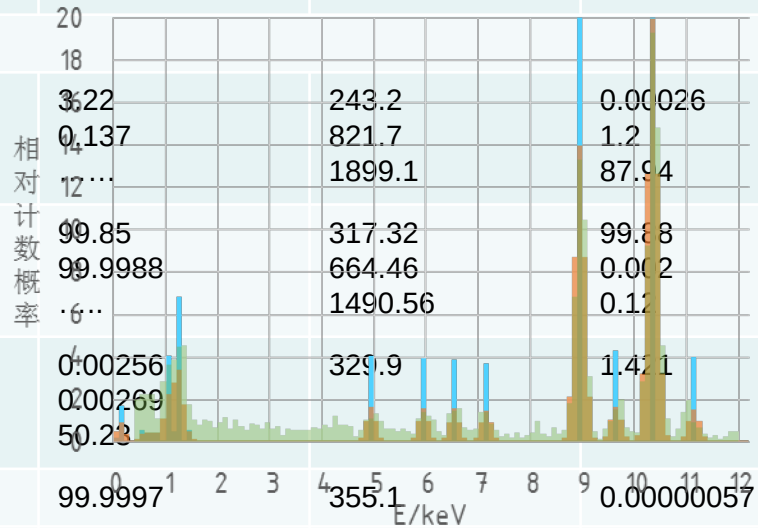
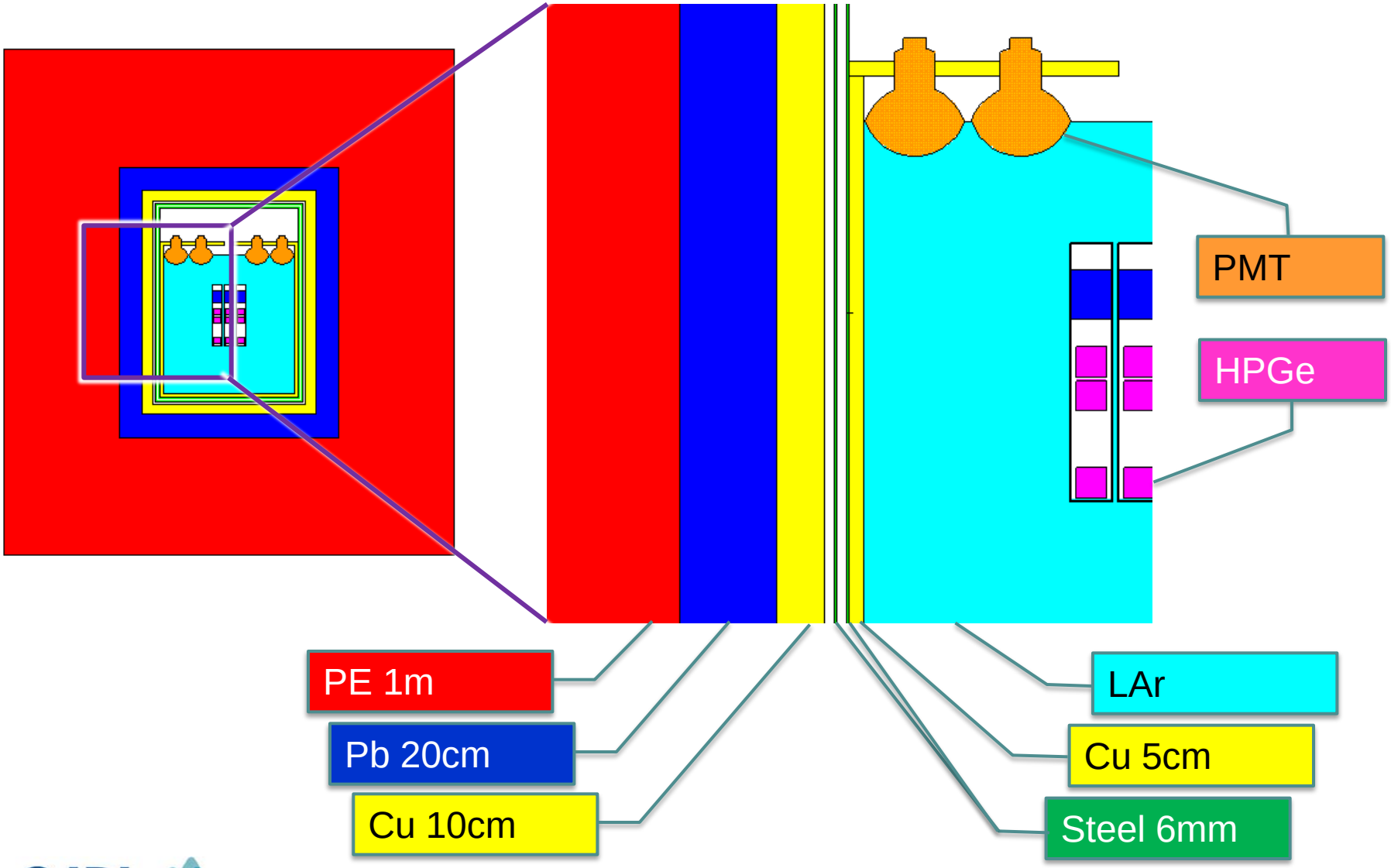
Study of simulation & background

Isotope	Half life	Decay mode	gamma		β	
			Peak(keV)	Prob.	E(keV)	Prob.
Ge68	270.95d	EC				
Ga68	1.1285h	EC, β+	1077.35 1883.19 ……	3.22 0.137 …	243.2 821.7 1899.1	0.00026 1.2 87.94
Co60	5.27a	β-	1173.24 1332.508 ……	99.85 99.9988 …	317.32 664.46 1490.56	99.88 0.002 0.12
Zn65	244.01d	EC, β+	344.95 770.64 1115.55	0.00256 0.00269 50.23	329.9	1.421
Mn54	312.13d	EC, ,β+	834.845	99.9997	355.1	0.00000057
Co57	271.8d	EC	14.41 122.06 136.47 230.27	87.69 87.53 12.3 0.0004		
Co58	70.83d	EC, β+	810.765 863.958 1674.75	99.48 0.69 0.52	474.6 1285.4	15 0.00082
Fe55	2.747a	EC	125.949	0.00000013		
Ni63	98.7a	β-			66.980	100
Co56	77.236d	EC, β+	846.77 1037.84 1771.36 2598.5 ……	99.97 14.03 15.45 16.969 …….	421.1 1458.9 2697.2 ….	1.04 18.29 0.25



CDEX-10 : Design of shielding system



CJPL