

Latest results from the CDEX experiment at China Jinping Underground Laboratory

- **CDEX Collaboration**
- **Facility : CJPL (China Jinping Underground Laboratory)**
- **New Results of CDEX-1/0**
- **Status and plans**

LIN, SHIN-TED / Sichuan University, China

On behalf of CDEX Collaboration

A joint of TeVPA/IDM Conference

@ Amsterdam NL , June 23-28 , 2014

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 (~ 100 eVee).

□ CDEX

➤ THU ; SCU ;
NKU ; CIAE ;
Yalong River
company.



➤ Collaborate with **TEXONO** and **KIMS** group (DM searches since 2003)

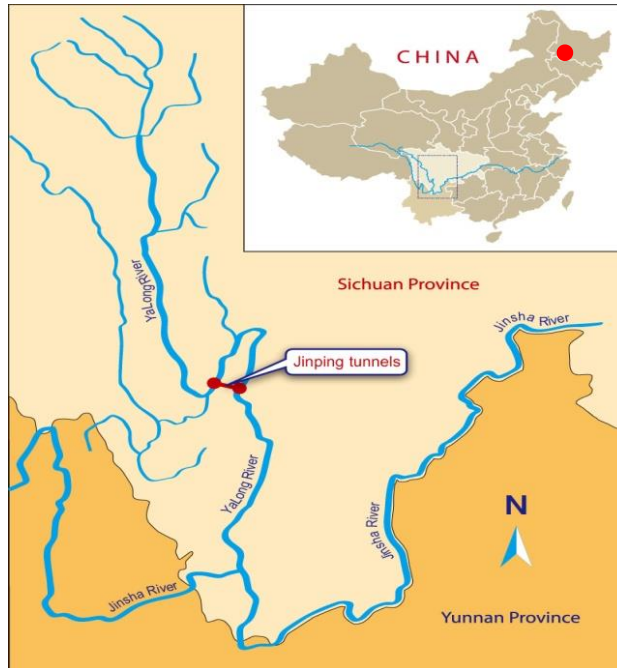
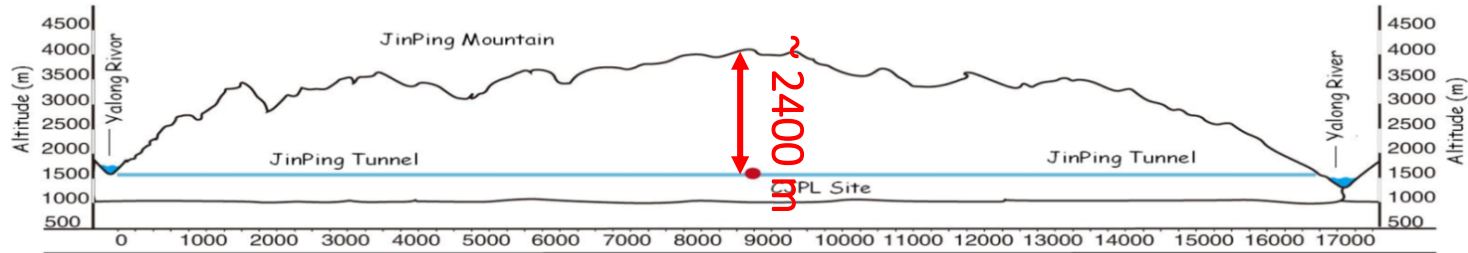


CDEX Experiment

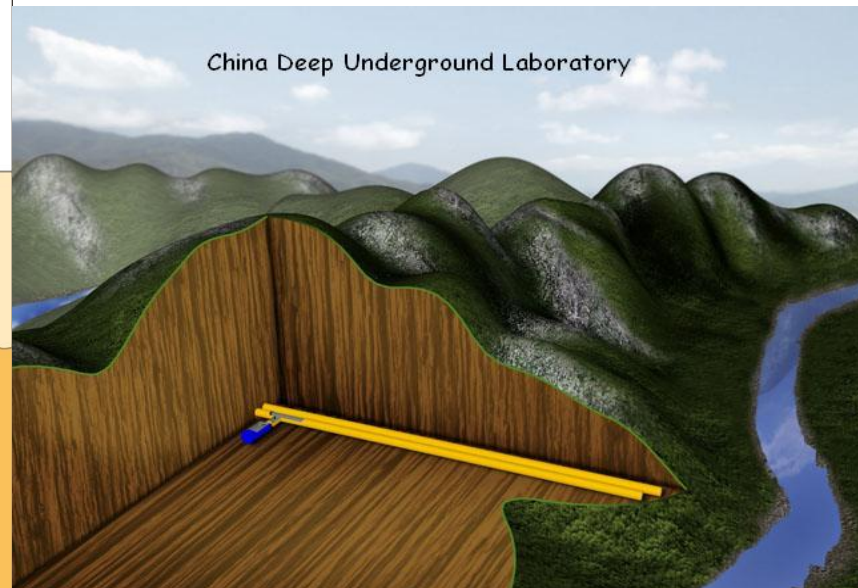
- **CDEX-1:** Searches on the **light WIMPs** based on O(1 kg) Ge detectors ; **Background understanding @ deepest underground site, CJPL ; Detector performance** of various types of Ge detectors.
- **CDEX-10:** Build the **Ge array detector** system with **LAr** detector served as AC detector and its shields.
- **CDEX-10X:** **Scale up** the detector mass based on the fabrication of Ge detector and Ge crystal growth by our own.
- **CDEX-1T:** Multi-purpose experiment for **Astro-particle physics** and **Neutrino physics**

China JinPing underground Laboratory

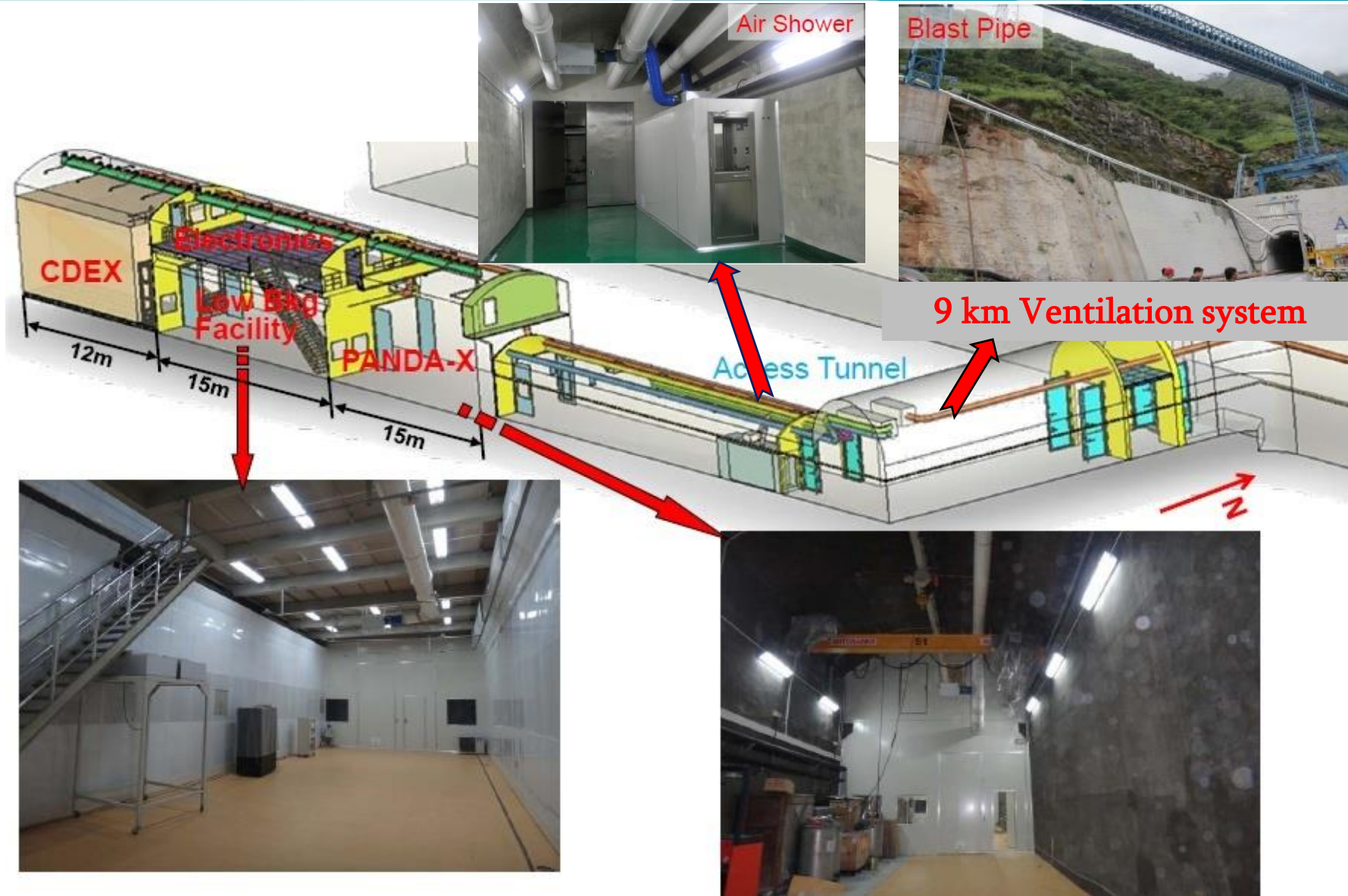
- Tsinghua University, have collaborated with Yalong River company to construct and run CJPL (6 m X 6 m X 40 m).



Deepest operational Underground Laboratory



CJPL - internal layout

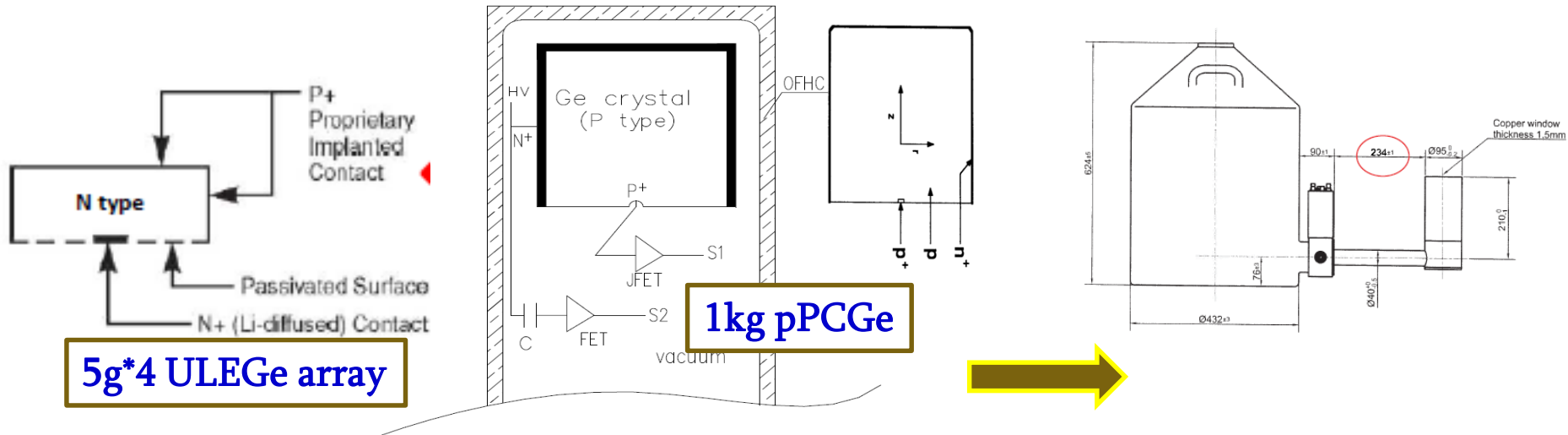


CJPL - internal layout

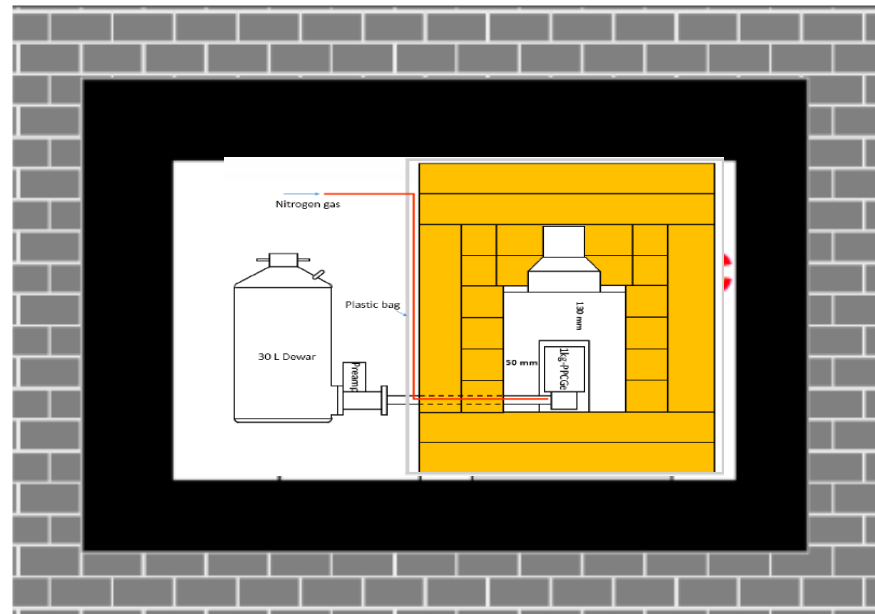


CDEX-1/0 Ge detectors @ CJPL

✓ Mass of Ge target : 20 g, **1000 g**.



✓ Further ultra-pure NaI crystal serve as active anti-Compton detector.



CDEX-1/0 : Experimental site

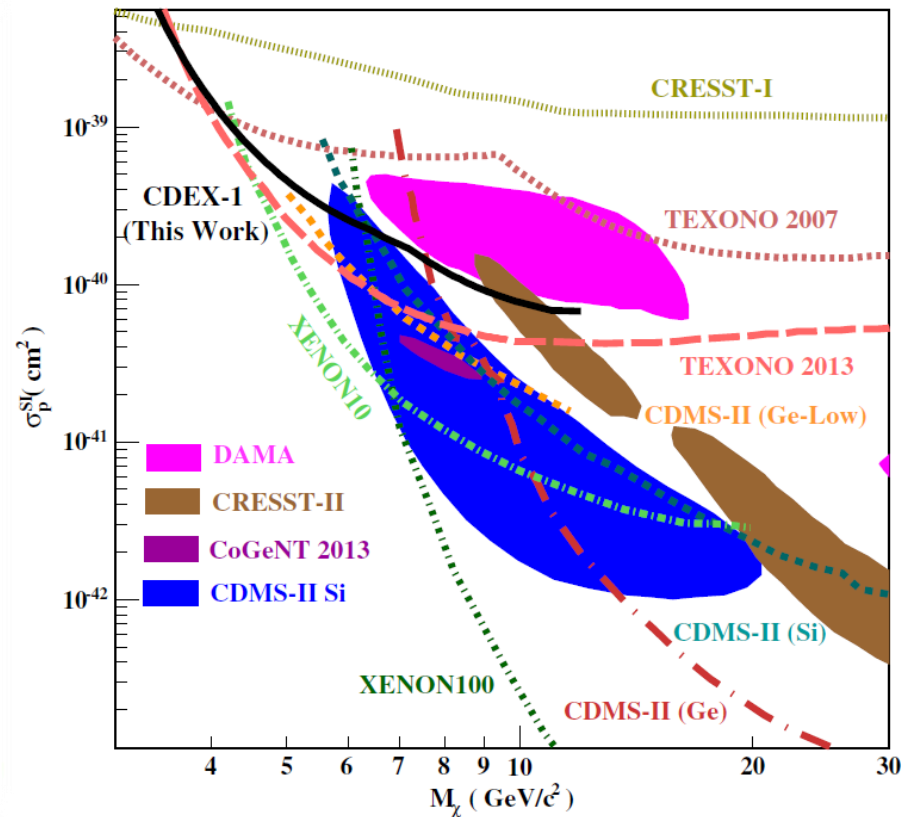
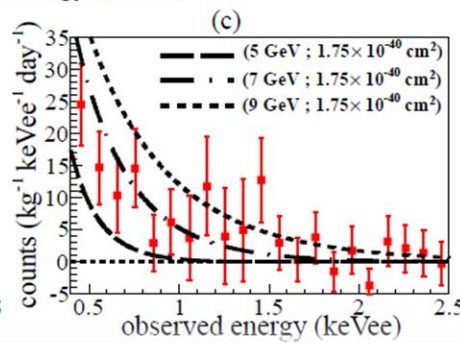
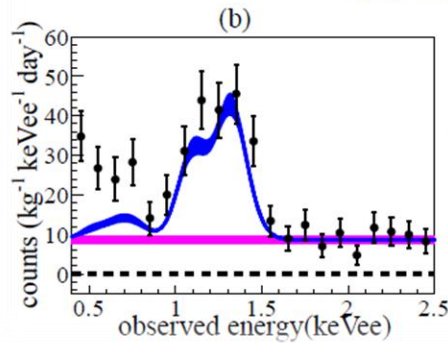
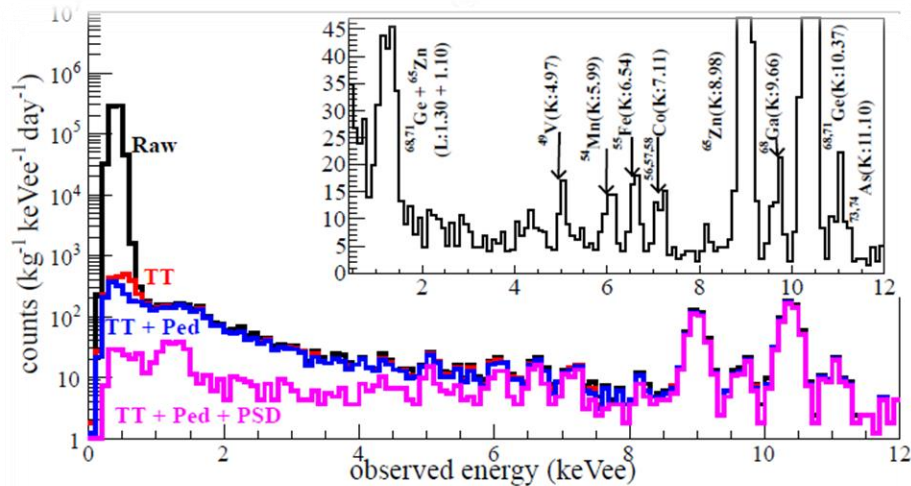


1kg PCGe

20g ULEGe

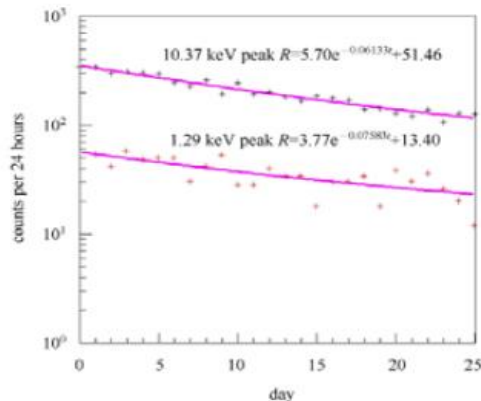
20cm OFHC Copper
+20cm Lead

Results on CDEX-1 2013

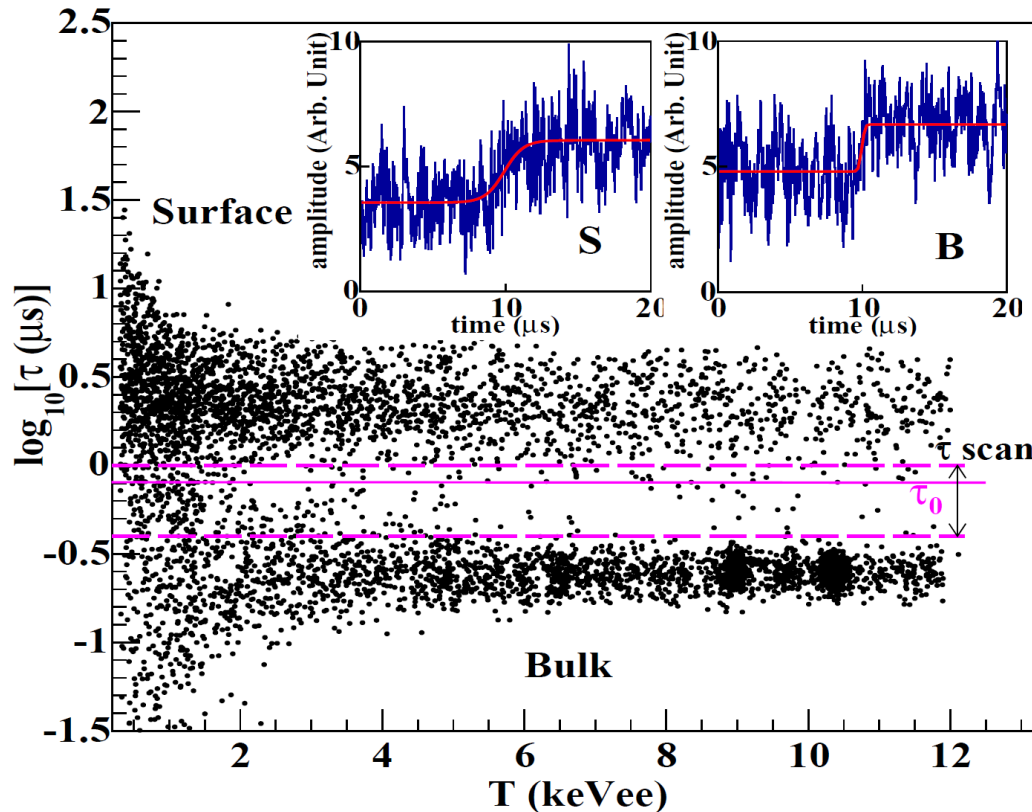


arXiv:1306.4135, *PRD* -2013

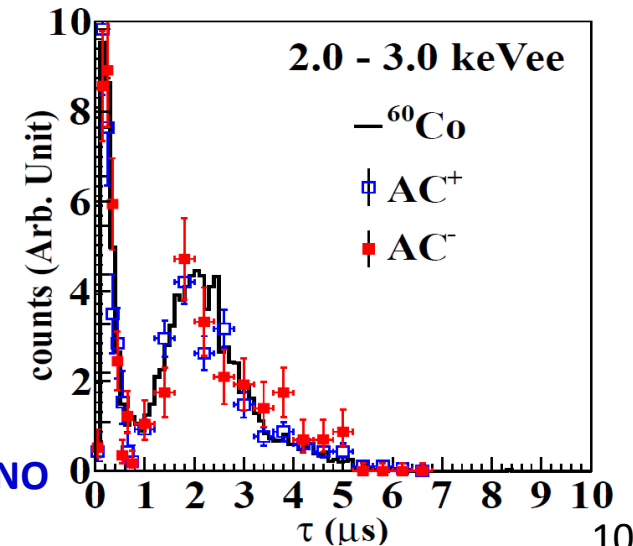
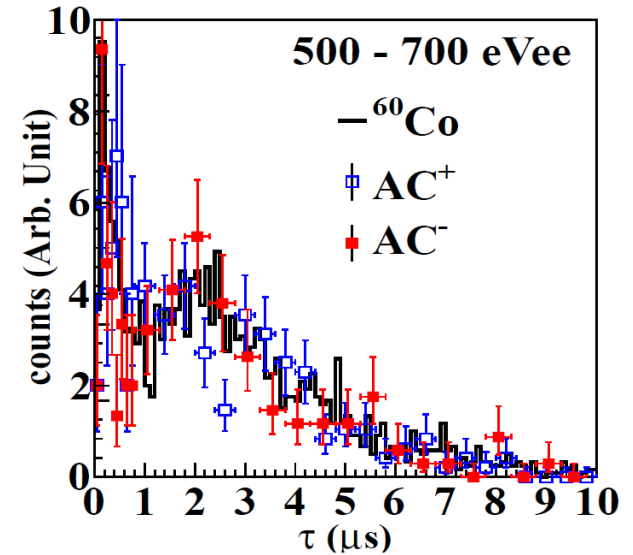
- CDEX-1 PPC-Ge, Fiducial mass : 994 g ; 15 kg-day of data
- Background understanding (prior to Anti-Compton & Bulk/Surface cut)



Bulk/surface Analysis @pPCGe 2014



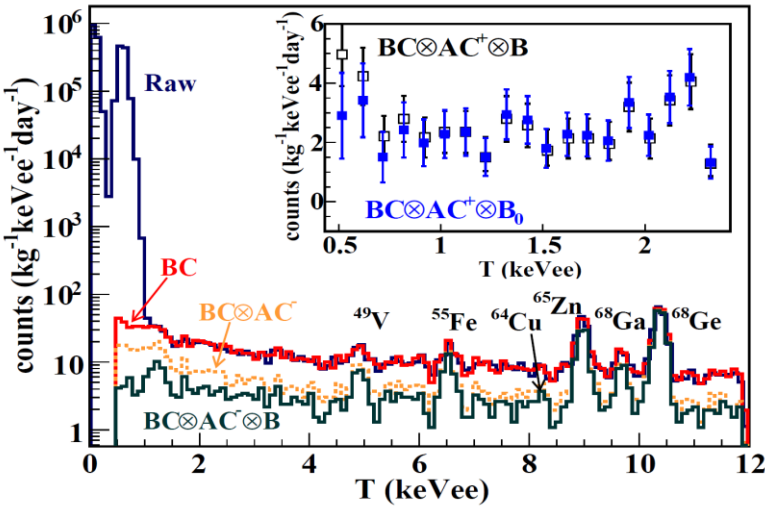
τ -distributions



Configurations:

- * 54 kg-days of data @ CJPL
- * NaI(Tl) as AC detector
- * Fiducial mass : 994 g
- * Analysis above 475 eV

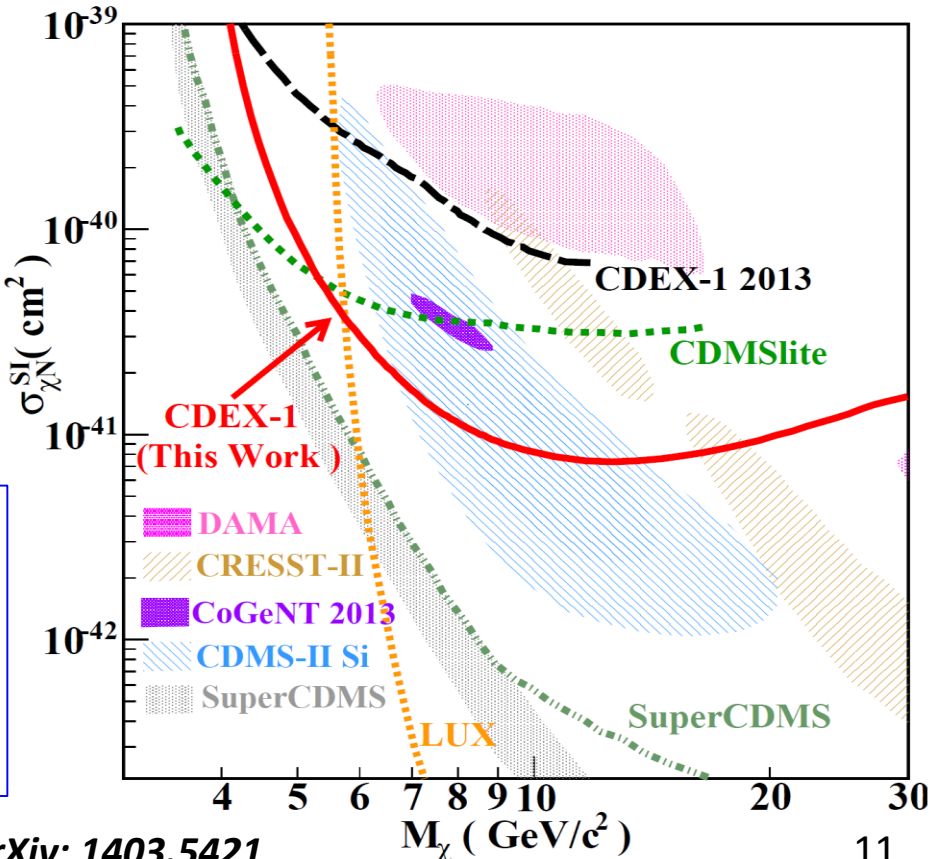
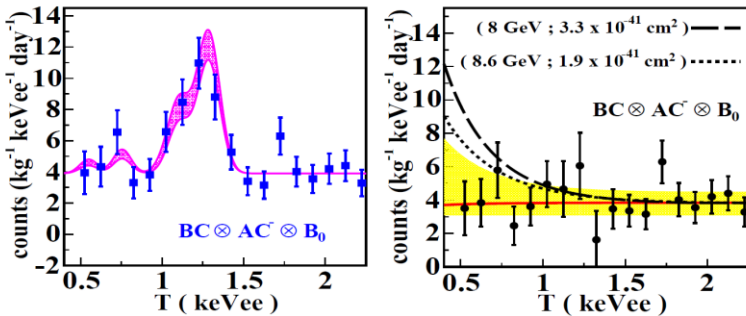
Results from CDEX-1/0 experiments



Selection Criteria:

- ✓ Physics Vs Electronics Noise – **Timing & PSD**
- ✓ Anti-Compton vetos (**AC⁻**) – NaI(Tl)
- ✓ Bulk Vs Surface Cut (**BS**) – pulse shape (fast) including **systematic errors**
- ✓ Q.F. adopted by **TRIM** with **10%** uncertainty

(b)



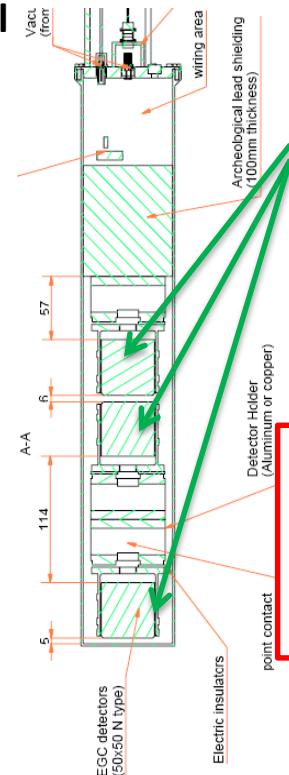
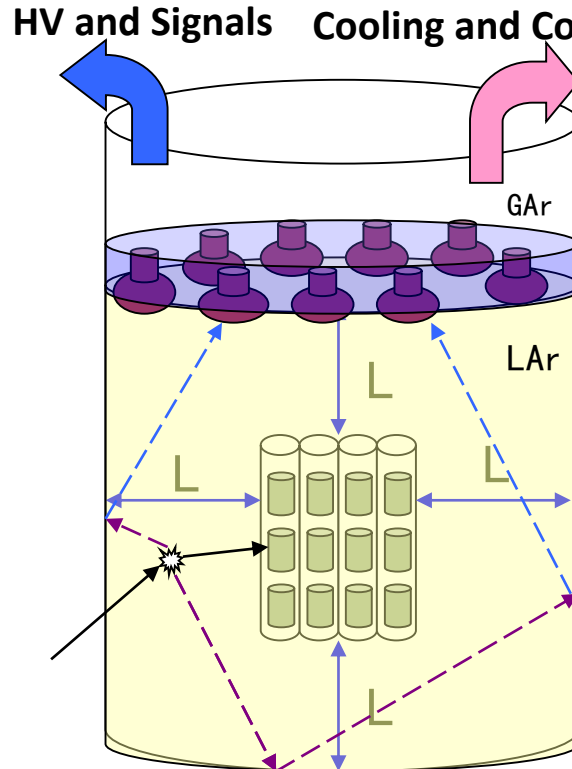
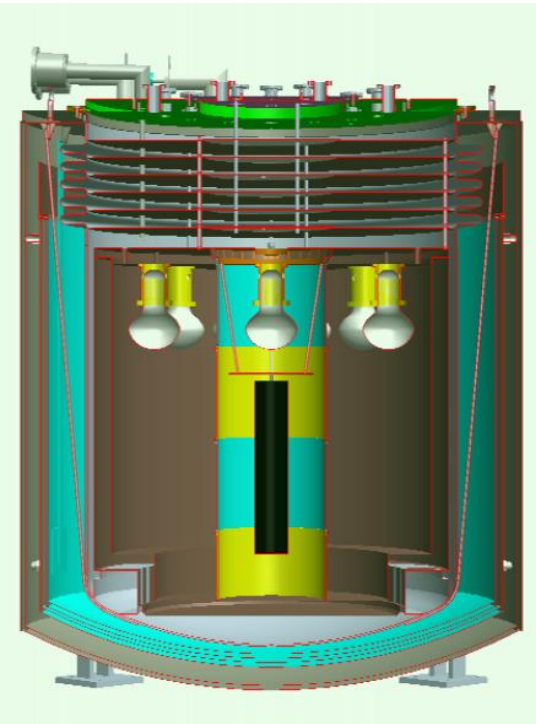
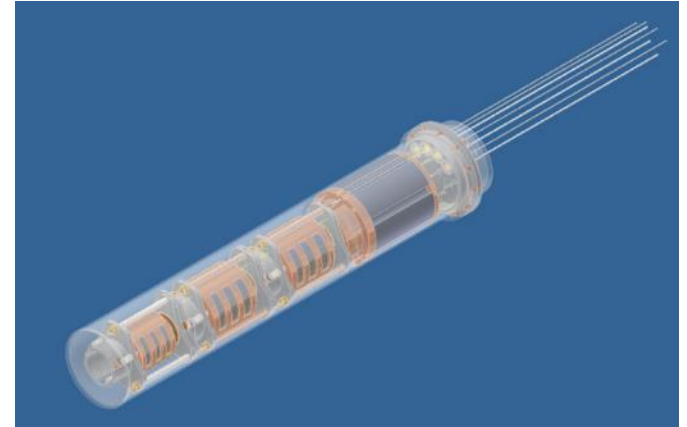
- ◆ **An order of magnitude improvement.**
- ◆ **The spectrum are consistent with the understood background model.**
- ◆ **Competitive sensitivities at low mass region has been achieved.**

CDEX-10 kg Experiment

LAr: Passive/Active shielding.

Ge: Sealed into Cu/Al vacuum tube.

WLS: shifted 128nm to ~420nm.

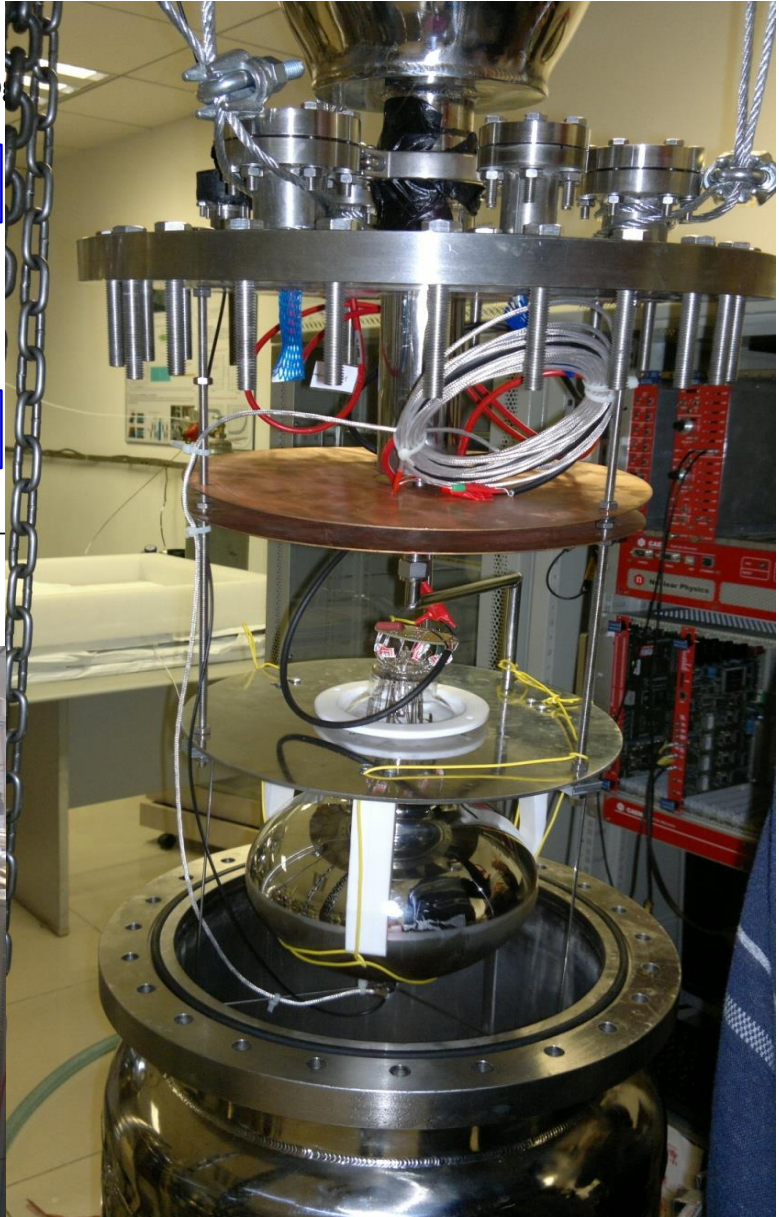
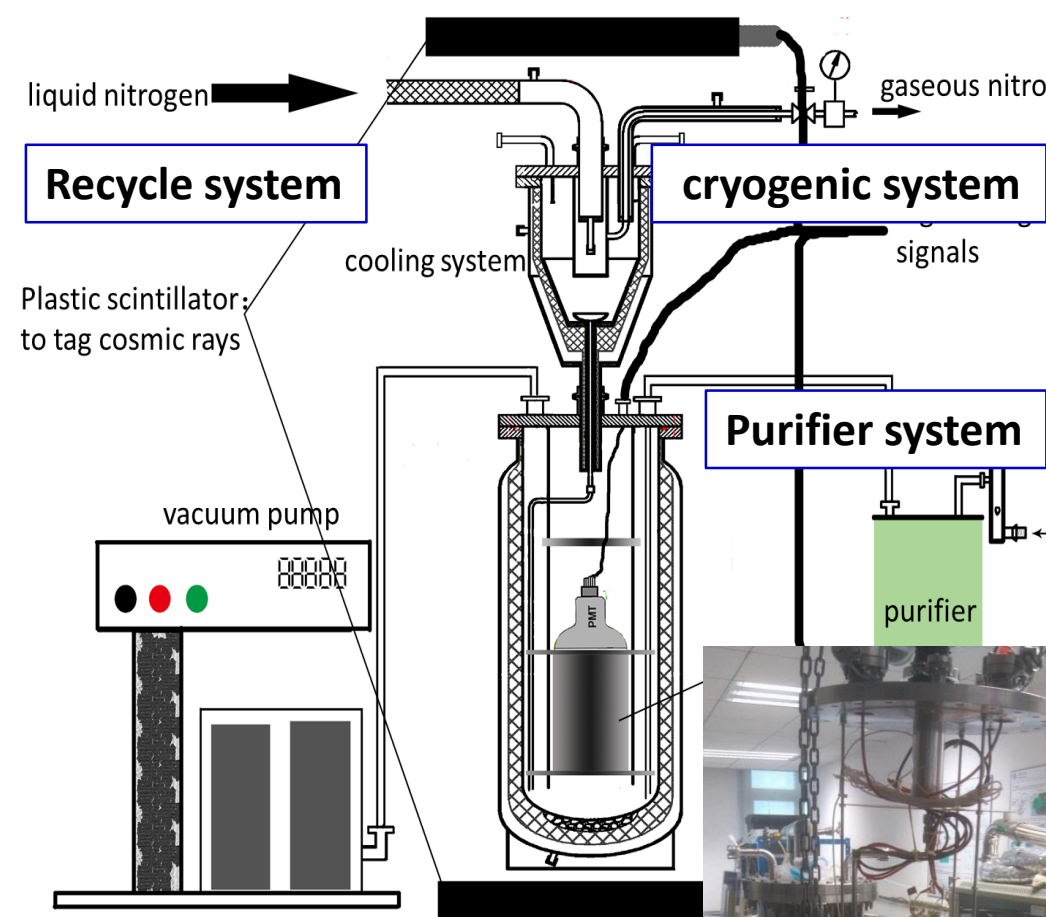


PCGe

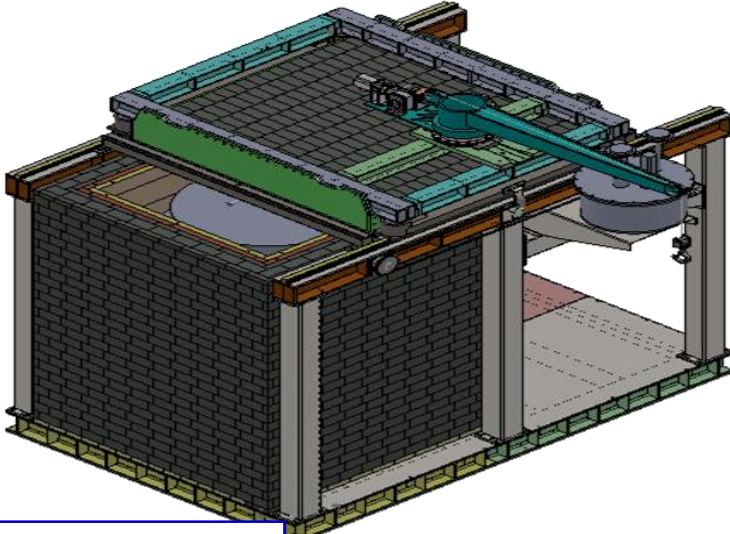
Target

~9 Kg of PCGe
⊕
1.5 Ton of LAr

Study on the performance of LAr



CDEX-10 : Mechanical Support & Shielding system



Inner copper tank



cap

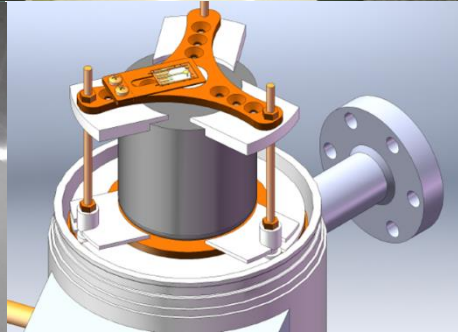
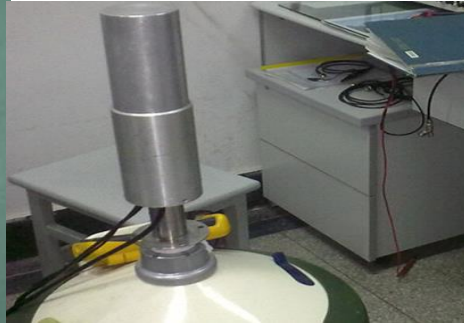


500 公斤测试

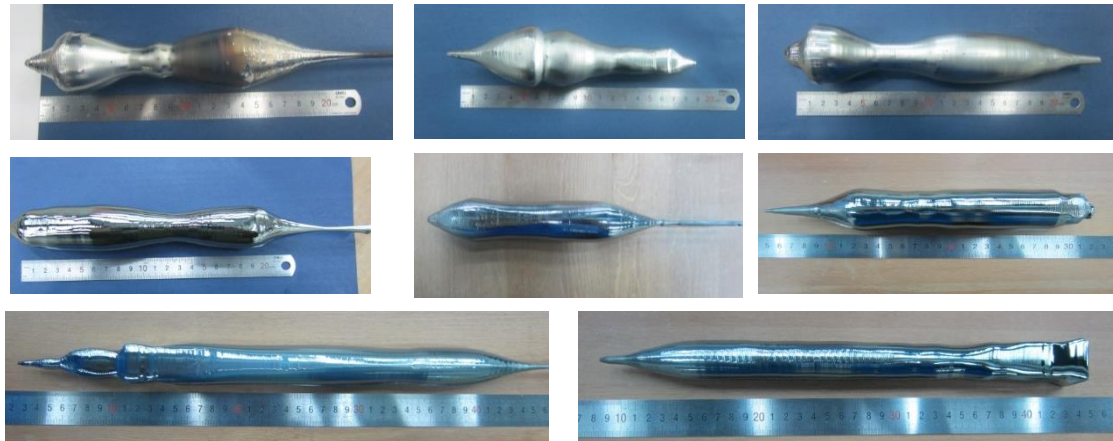
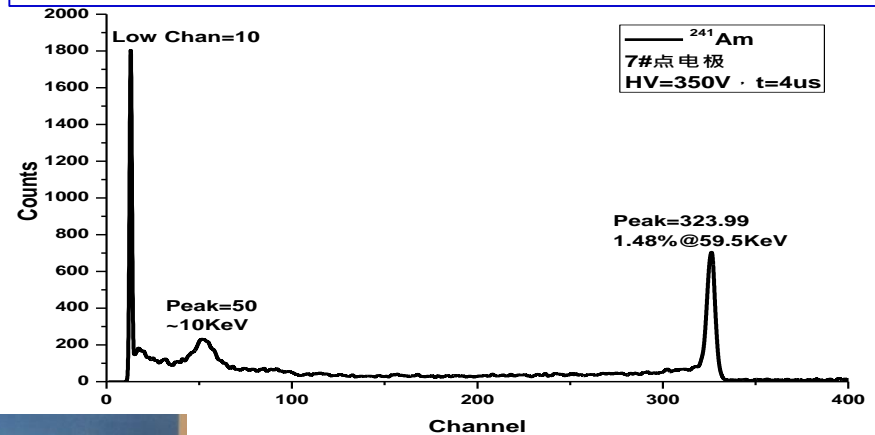


Detector fabrication & Ge crystal growth

Mass: ~10 g

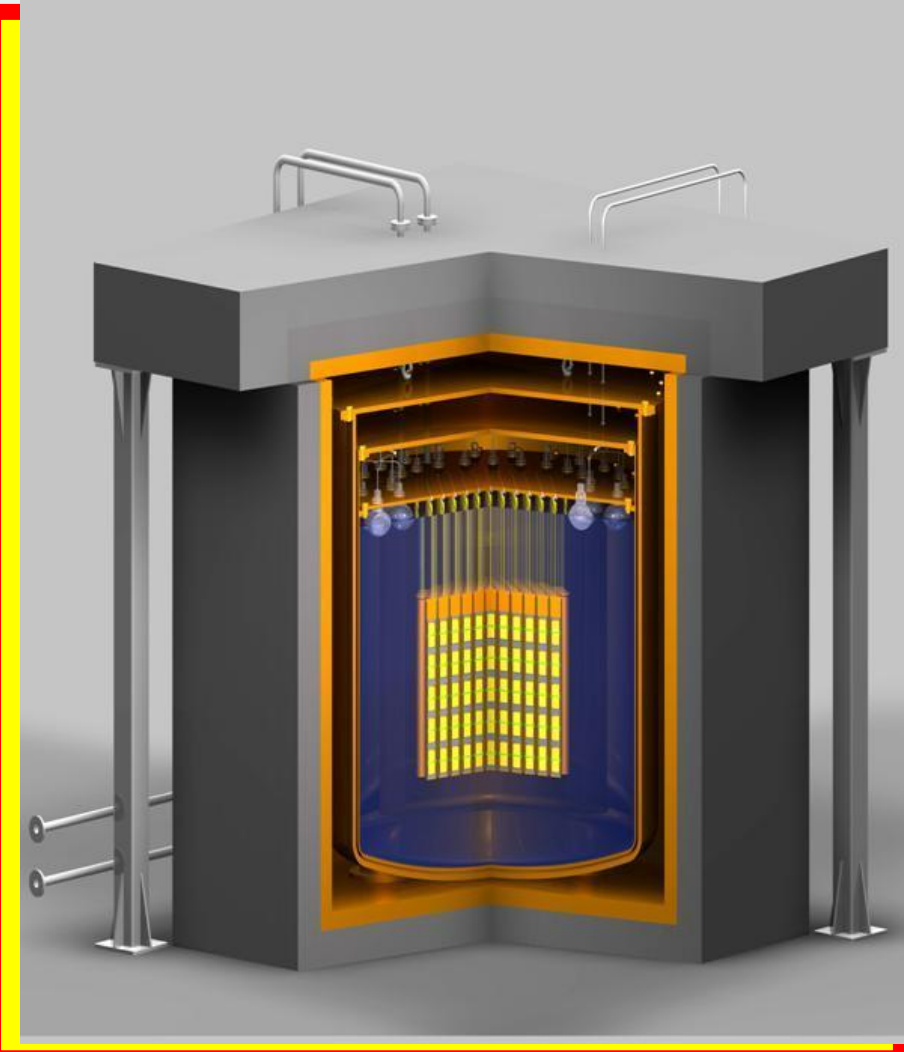


- Successful on **10 g**, Energy resolution is fine
- Testing **500g PCGe** fabrication



- Germanium crystal with uniform diameter can be grown..
- Study on the quality measurement

Plan on CDEX-1T

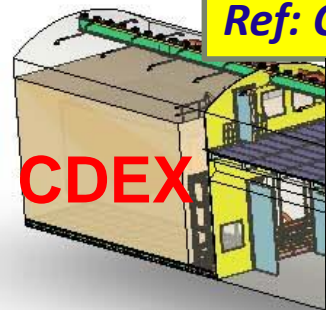


Goals : Both Dark Matter & Double beta decay

Environmental Background

- μ flux ~ 60 /year/m²

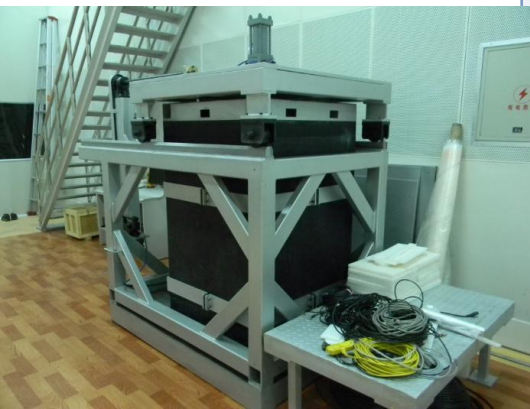
Ref: *Chinese Physics C* 37, 8 (2013) 086001



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



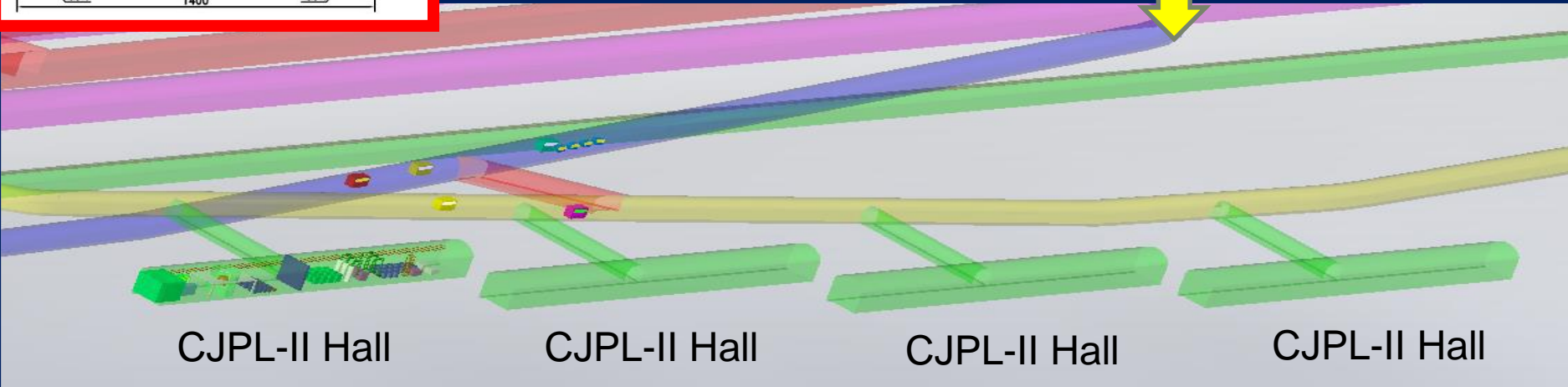
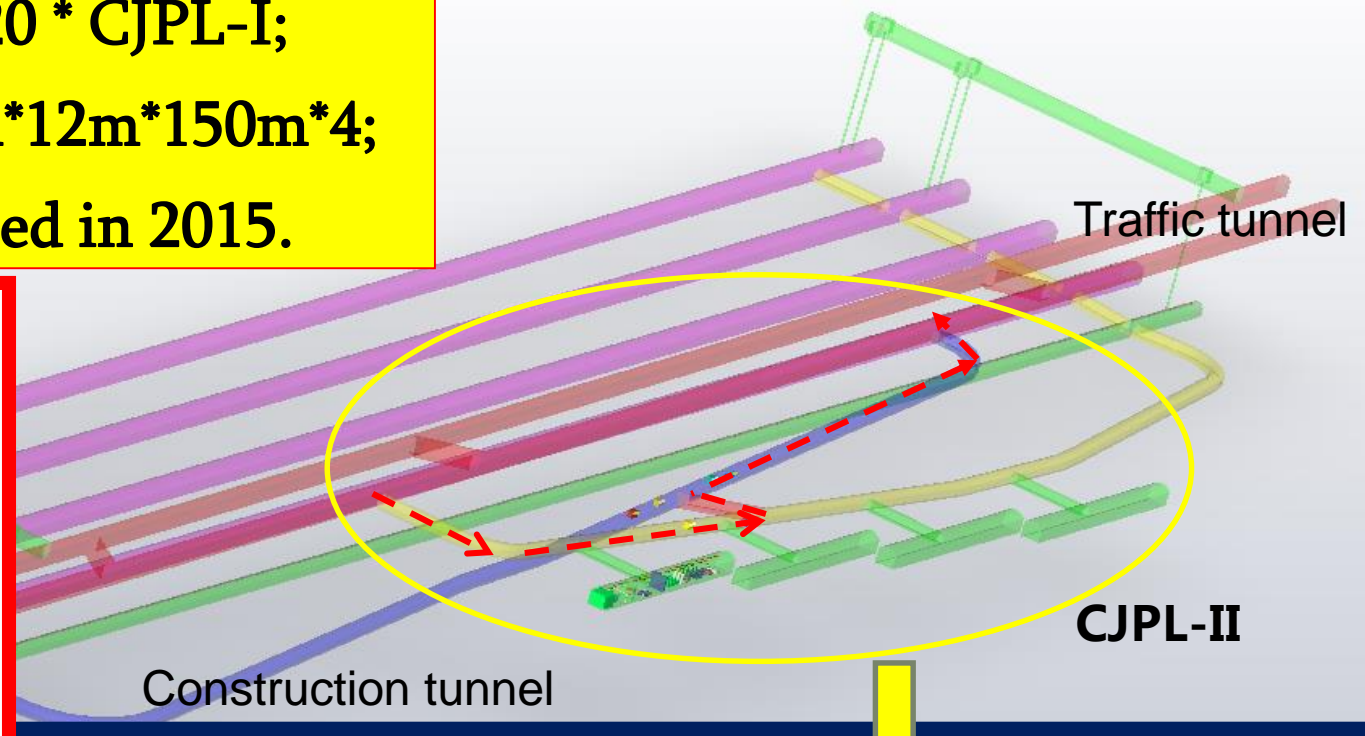
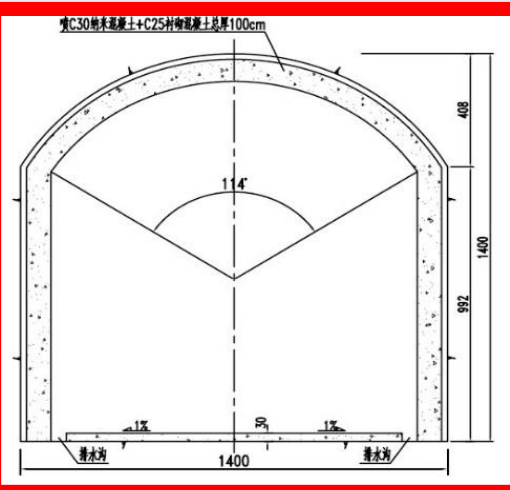
Rock Background



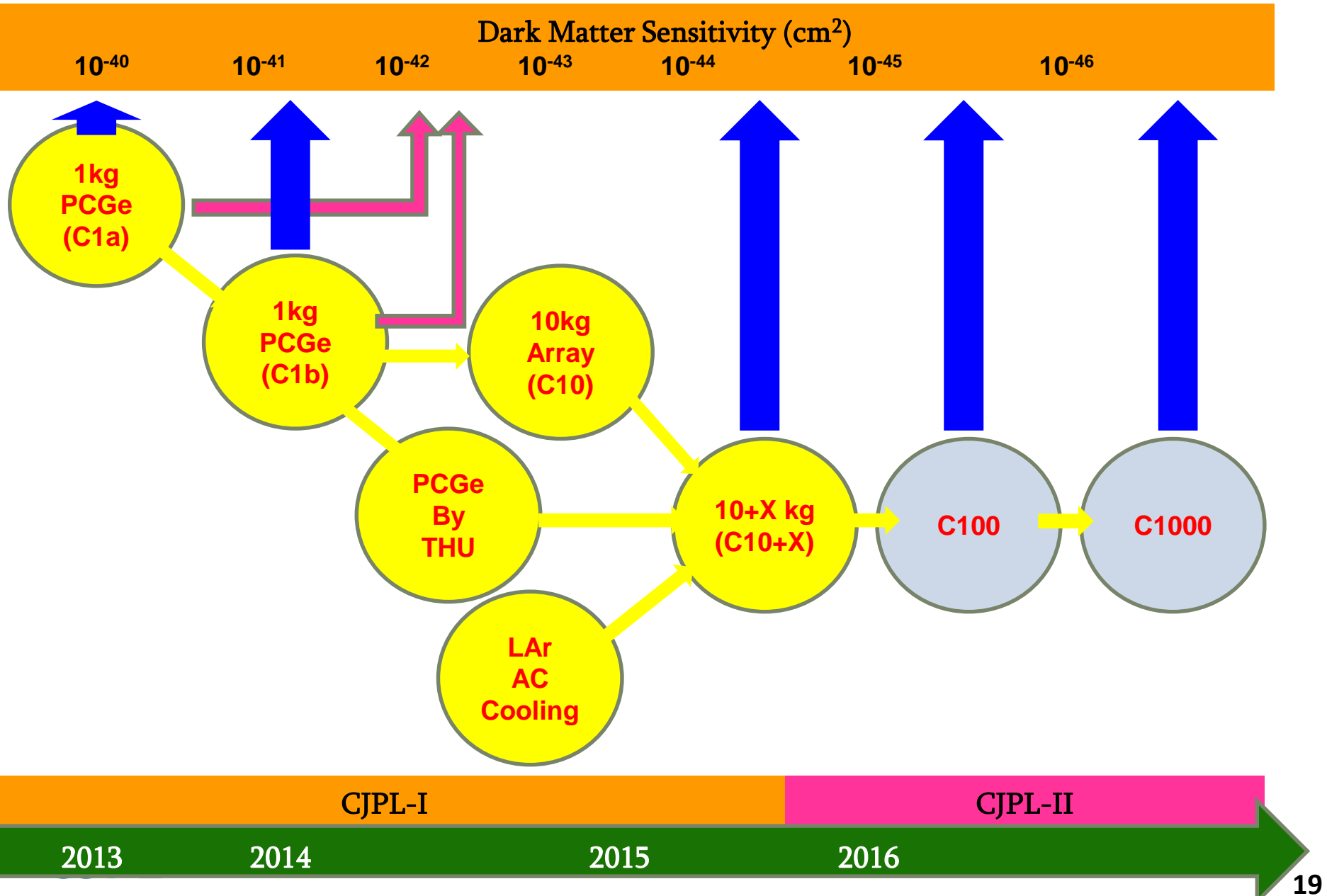
(Unit : Bq/kg)	K-40	Ra-226 (609keV)	Th-232 (911keV)
Rock Sample	< 1.1	1.8±0.2	< 0.27
Ground Level (Beijing)	~60 0	~25	~50

Plans for CJPL-II

- CJPL-II: space 20 * CJPL-I;
- Dimension: 12m*12m*150m*4;
- Plan to be finished in 2015.



Plans of CDEX experiment



Summary

- Latest result of CDEX-1 shows **no excess events** at **sub-keV** region. **An order of magnitude improvement** on the searches of **light WIMPs** from our previous measurement in 2013.
- CDEX-10 (**PCGe**⊕**LAr** A-C) has started off the ground testing at SCU on and plan to ship to CJPL from **2014/2015**.
- 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. Plan to be done in **2015**.

Thank you for your attention

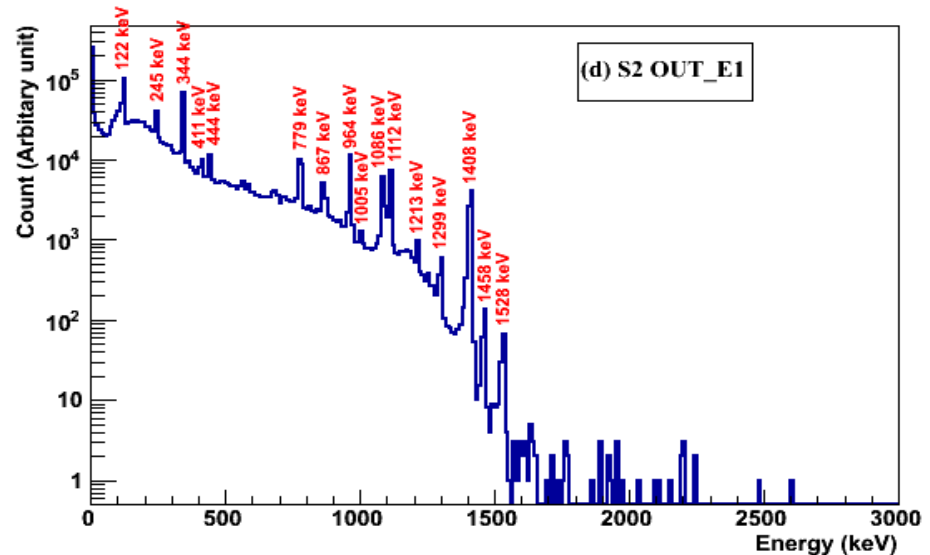
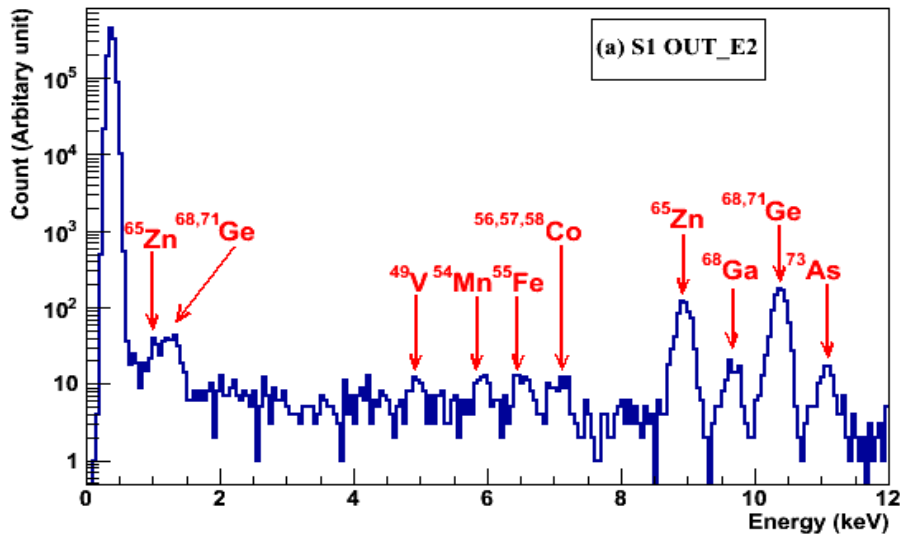
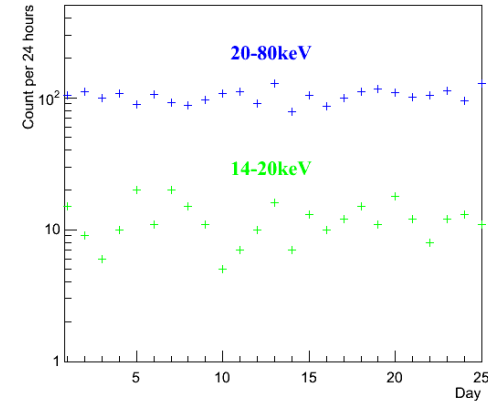
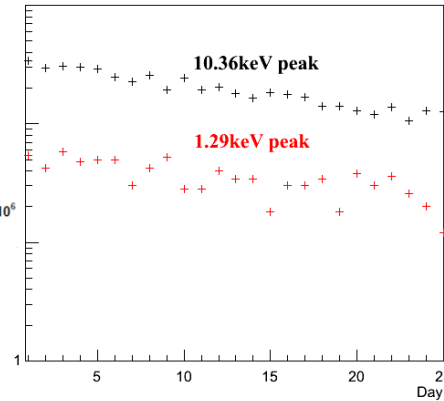
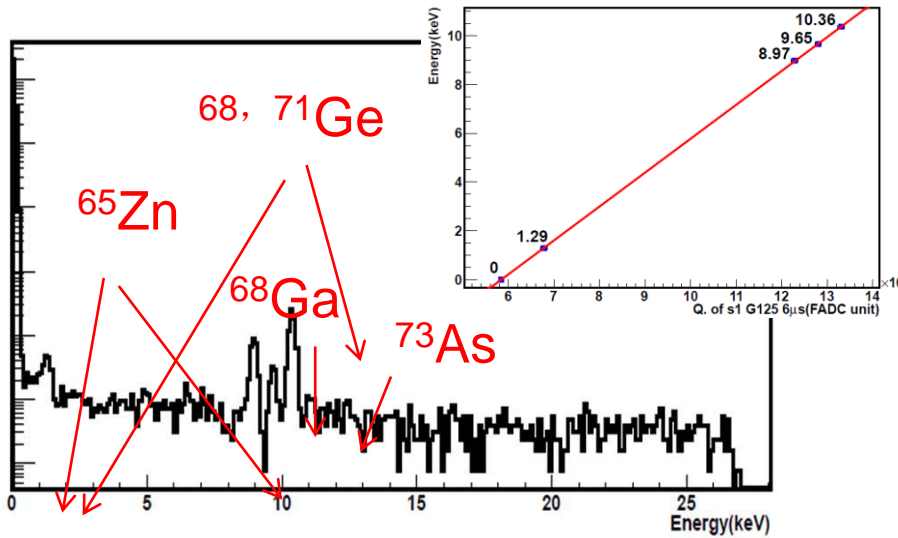


Backup slides



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China Jinping Underground Laboratory

Recoil spectrum of P-PCGe detector



CDEX-10 : Design of shielding system

