# Experimental studies on low mass WIMPS with the modified electrode structure, ultra low energy HPGe detectors

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## Introduction

The discovery of dark matter is of fundamental importance to the present-day particle physics and cosmology. The origin and nature of dark matter, however, remain largely unknown, which is a great challenge of the present decade. There are more than 20 underground experiments around the globe investing huge efforts for detecting and exploring the nature of dark matter. With the help of advancements in various detection technologies rapid progresses have been made in improving the sensitivities for the dark matter detection.

The **TEXONO–CDEX** collaboration **(T**aiwan **EX**periment **O**n **N**eutrin**O–C**hina **D**ark matter **EX**periment) explores high purity Germanium **(HPGe)** detection technology towards the development of sub-keV energy threshold detector to pursue studies on low mass WIMPs. The present article aims at introducing the facilities at **C**hina **J**ing-**P**ing underground **l**aboratory **(CJPL)** towards dark matter searches **[1].** We will also summaries analysis procedures and results obtained by 220 eV energy threshold HPGe (segmented 4×5g) detector on spin-independent, spin-dependent $\chi$N coherent interactions [2] and on axion-like dark matter at Kuo-Sheng Neutrino laboratory **(KSNL)** [3, 4].

## CJPL dark matter laboratory

CJPL is located in Jin-Ping Mountains, 350 km south-west of Chengdu, the capital of Sichuan province in China. Fig. 1 depicts the geographical location of the laboratory and comic ray Muon flux at various underground dark matter laboratories around the globe. The laboratory bears about 2500 meters of rock over burden, making it the world's deepest laboratory. A 6m × 6m × 40m cavern host the laboratory in one of 17.5 km long transportation tunnels. The fig. 2 demonstrates these features.

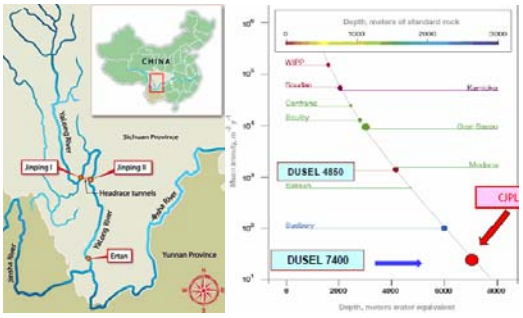


**Fig. 1:** Geographical location of CJPL and muon intensity at various underground labs with respect to depth.

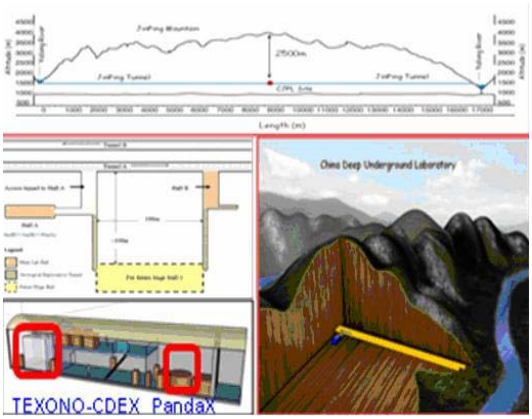


**Fig. 2:** Top: 2500m rock burden; Bottom left: Layout of the Lab; Bottom right: The two transportation tunnels.

## Detectors and Shielding

The 4×5g ultra low background (ULB), ultra low energy (ULE) HPGe detector used in the dark matter analysis in [2] is installed and operational at CJPL laboratory. The detector is enclosed by copper, Lead and boron loaded

polythene shielding is shown in fig. 3. The analysis procedures described in [2] are being set up for the acquired data at CJPL towards searches on low mass WIMPs.

**Fig. 3:** The 4×5g ULE-ULB-HPGe detector enclosed by copper, lead and boron loaded polyethylene shielding respectively in clockwise direction from top.

## Cosmic muon flux measurement

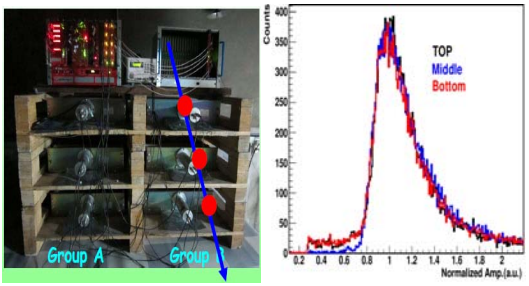


**Fig. 4:** The three layered plastic scintillation set up for cosmic ray muon flux measurement.

The cosmic ray muon flux measurement apparatus is depicted in fig. 4. The first, 3-level coincident cosmic ray muon event was observed on December 02, 2010 at 04:49:19. We observed 6 events in 33 days ($01m^2$), which is consistent with the expectations.

## Status and Plans

In parallel to dark matter studies on 4×5g ULE-ULB-HPGe detector collaboration is working towards the commissioning of 1 kg **P**oint **C**ontact **H**igh **P**urity **Ge**rmanium detector **(PCGe).** Studies are also pursued on neutron and γ-ray background. We will then proceed in 2012-14 towards 10 kg range and higher mass array of PCGe detector with liquid Argon as anti-Compton Veto as schematically shown in fig. 5.

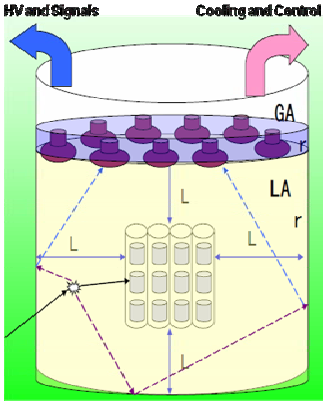


**Fig. 5:** The schematic diagram depicting array of PCGe detectors, each having kg mass with LAr as anti-Compton veto configuration.

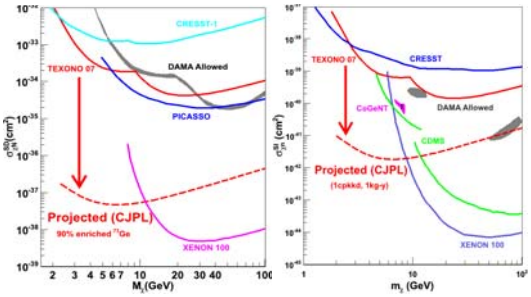


**Fig. 6:** Exclusion plots of (R) the spin-independent χN and (L) the spin-dependent χN on cross-sections versus WIMP mass, displaying the KS-ULEGe limits. Projected sensitivities of full-scale CJPL experiments are indicated as dotted lines [2].

## References

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