

Status and Prospects of China JinPing underground Laboratory (CJPL)

Yulan Li

Tsinghua University

October 16, 2009

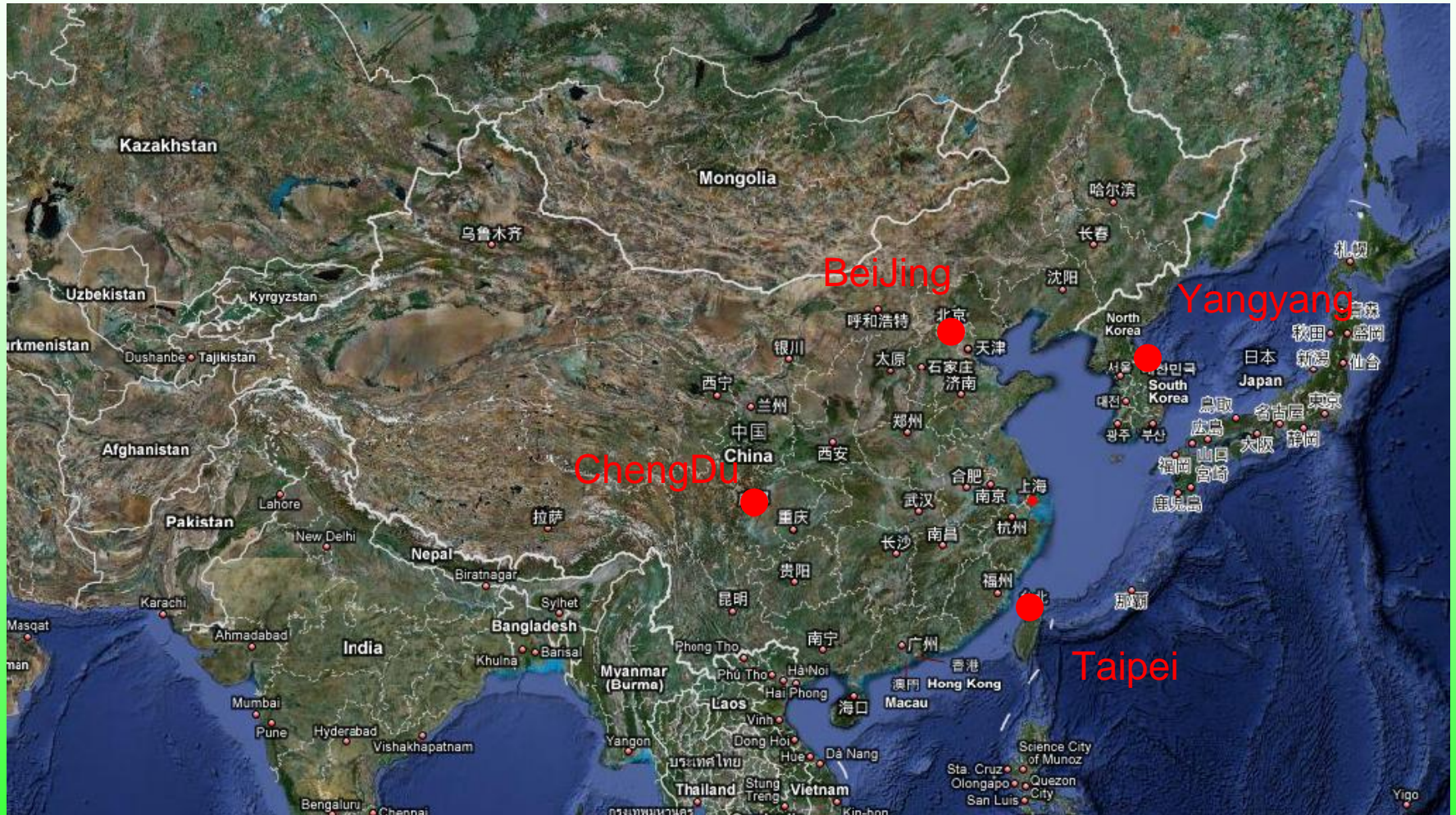
Contents:

- Survey of Low Background Experiment in China
- The site of the Deep UL in China
- The condition of CJPL
- Plan for the construction of CJPL
- CDEX collaboration

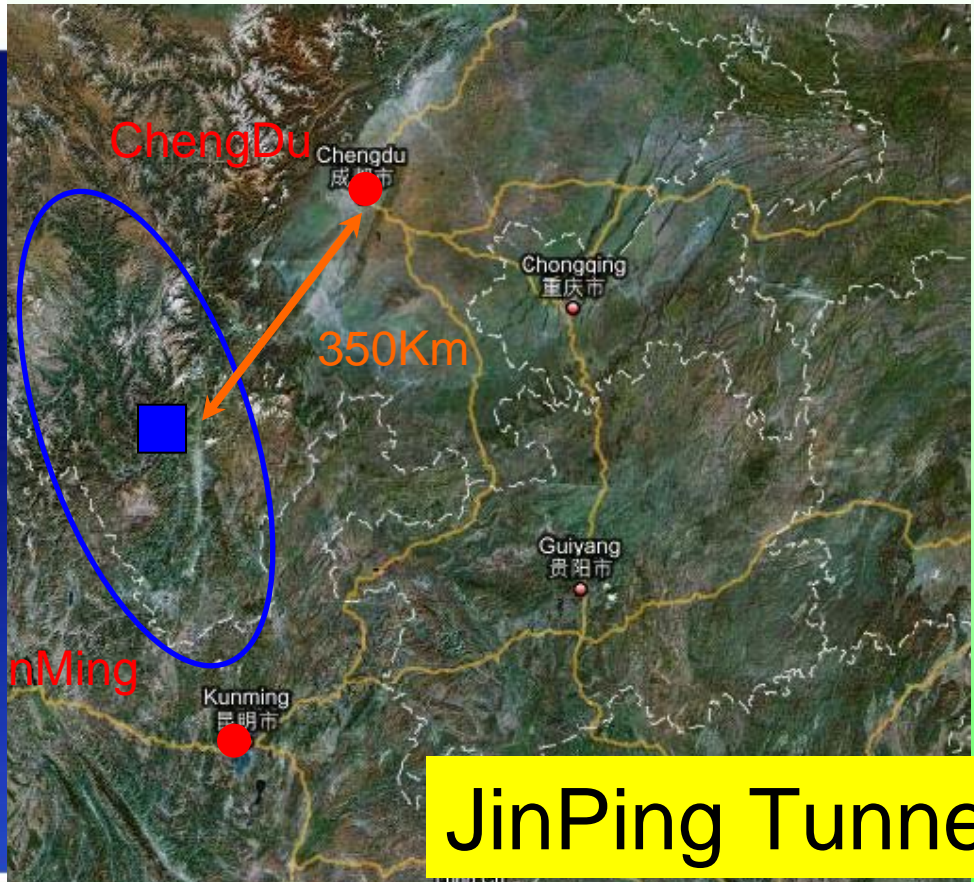
Brief Survey of Low Background Experiment in China

- Double Beta Decay @ Coal Mine in Beijing
1980s
- Dark Matter Search as a member of DAMA
1990s
- Reactor neutrino experiment of TEXONO
1997
- Dark Matter Search of KIMS Collaboration
2002
- DayaBay neutrino experiment 2004

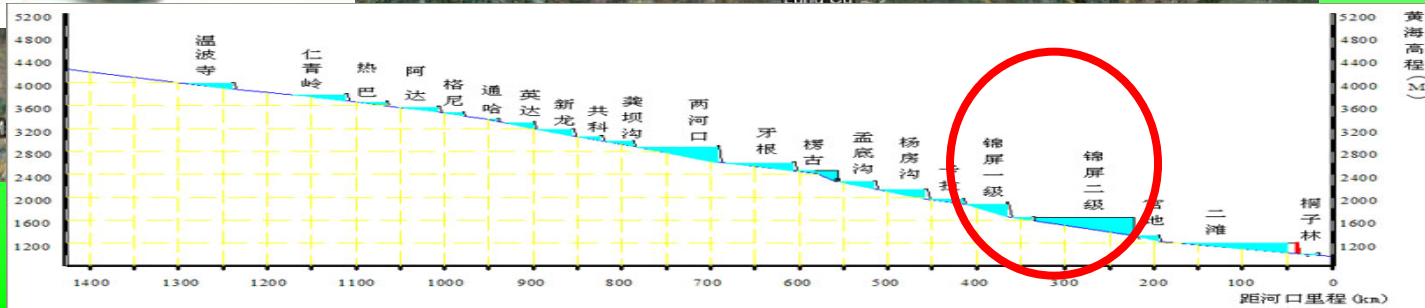
The site of a new UL in China



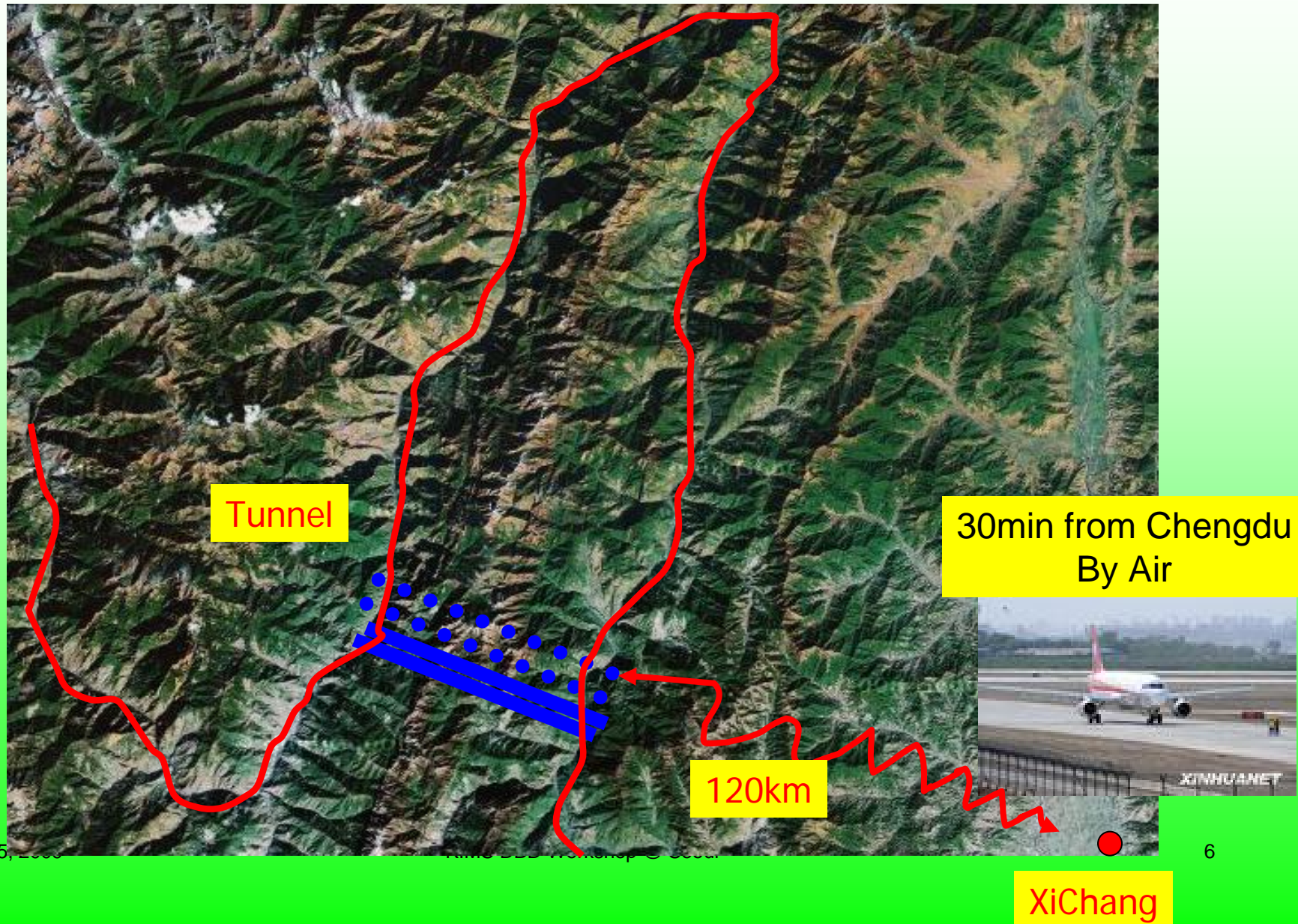
The site of a new UL in China



Oct.15, 2009



Yalong River and Jinping Mountain



Road and Tunnel



Small UL under construction



March, 2009
Gate of the tunnel

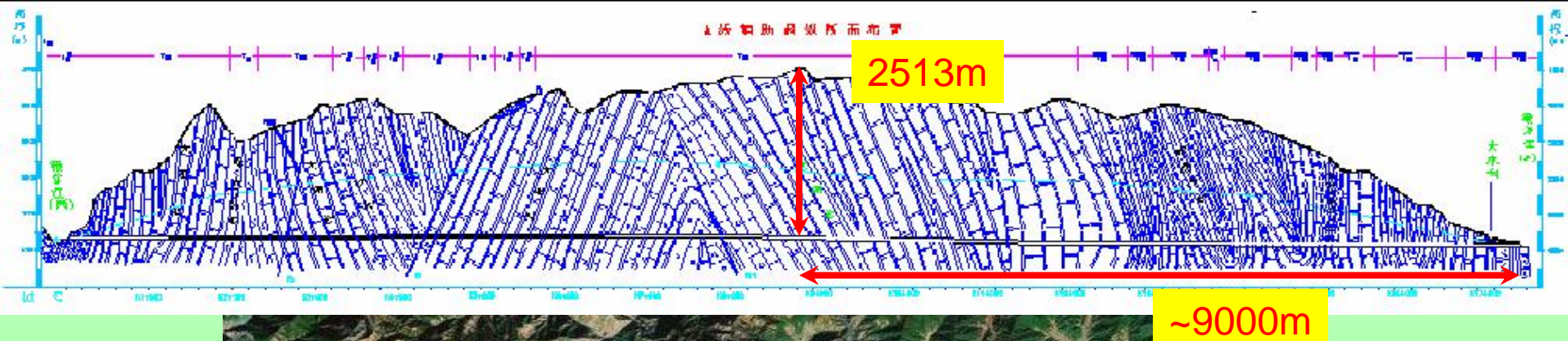


July, 2009
30m tunnel finished

Logistic Condition of this UL

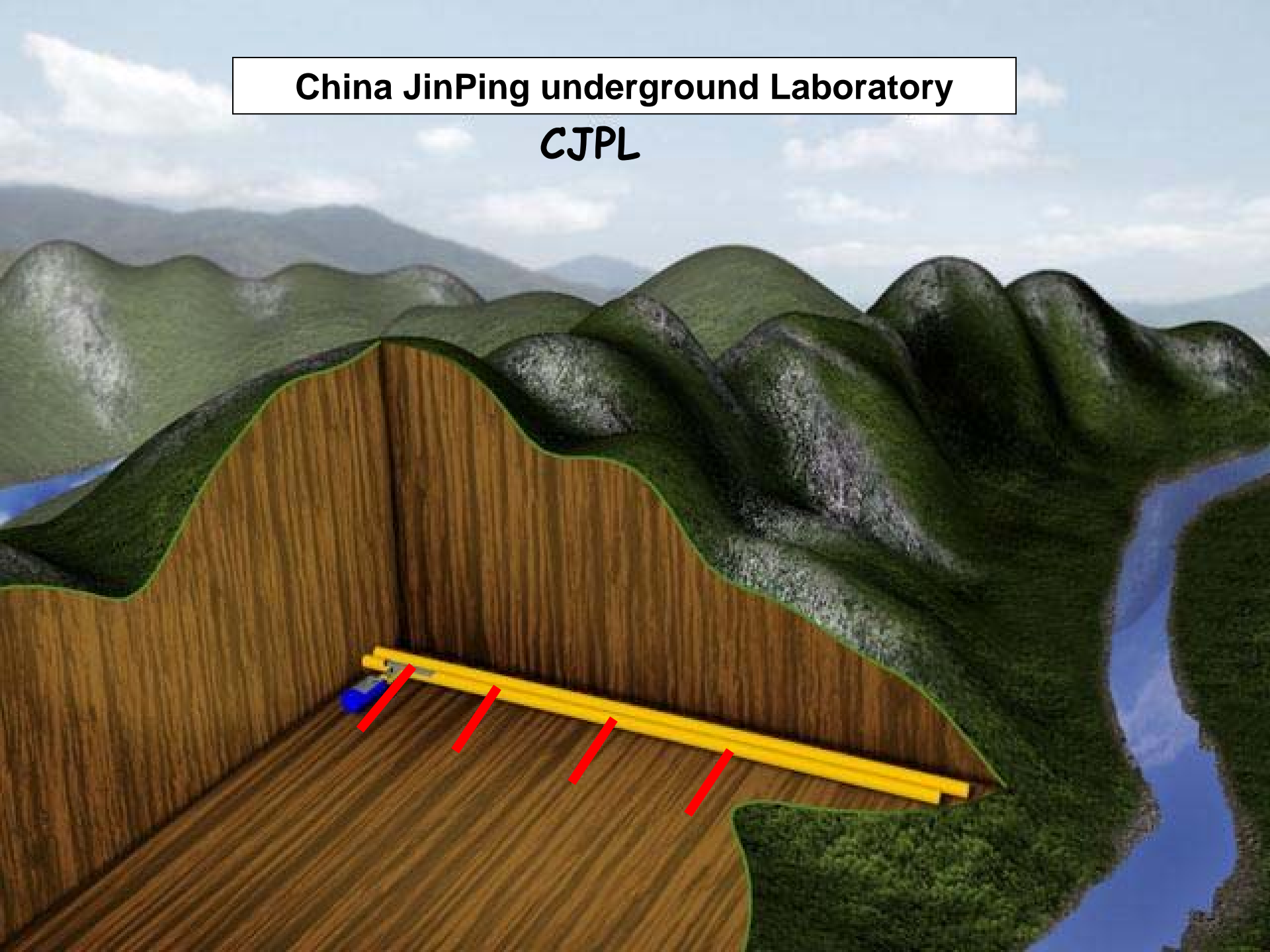


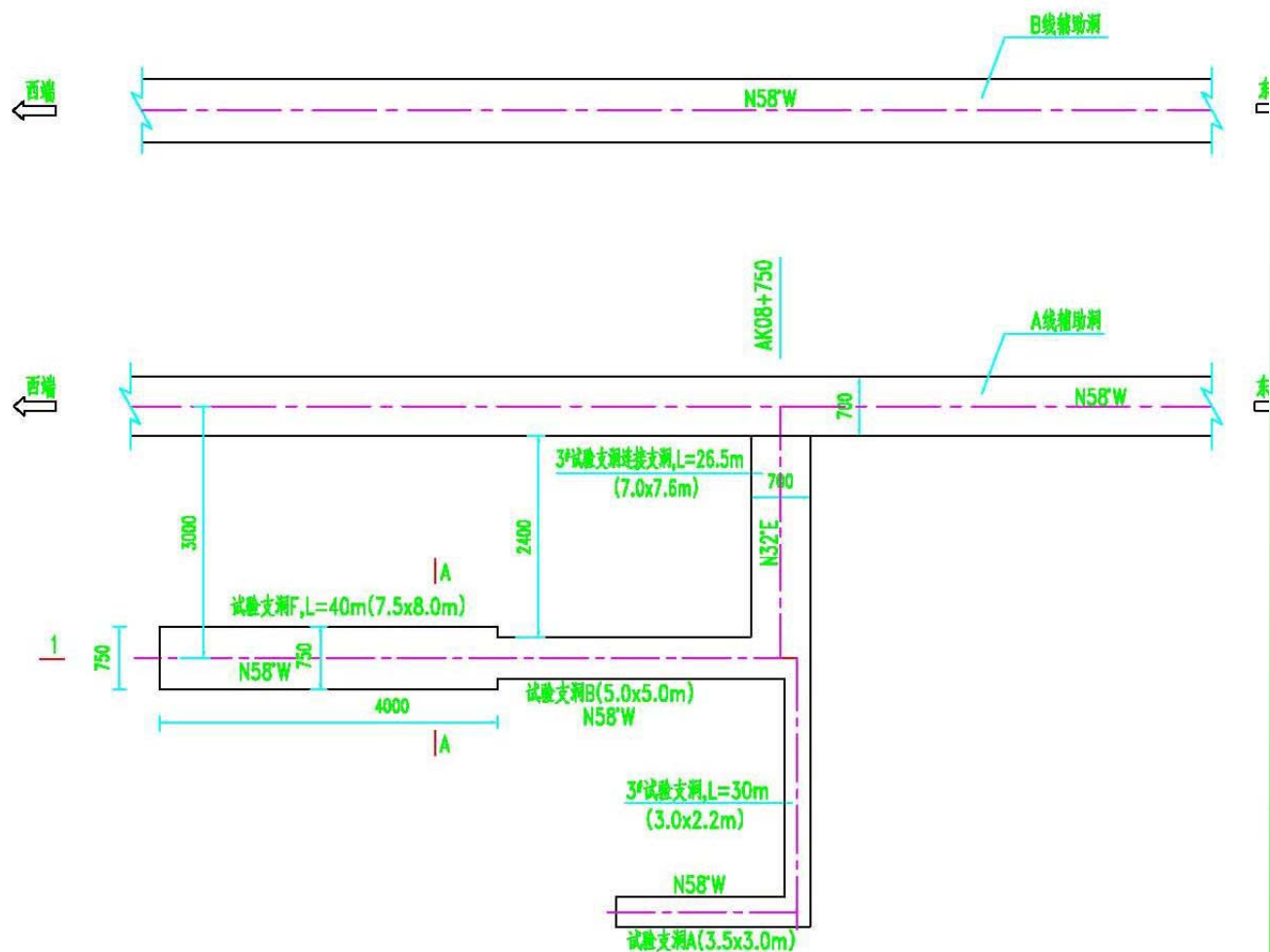
The basic conditions of CJPL



- Peak: 4193m
- Maximum rock overburden: ~2500m
- Length of Tunnel: 17.5km
- Rock cover larger than 1500m: >70%
- Two tunnels for transportation

China JinPing underground Laboratory CJPL



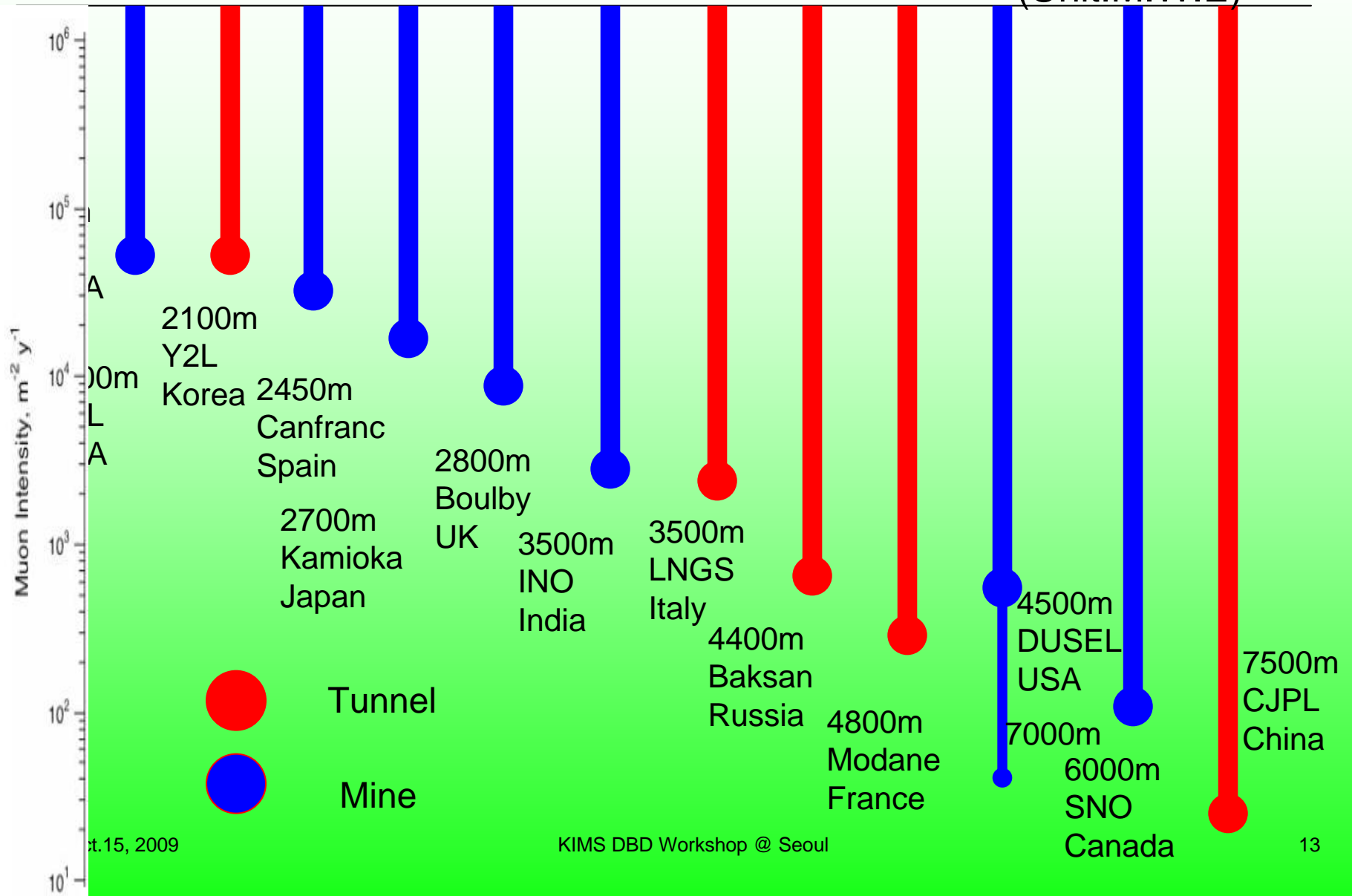


辅助洞新增试验支洞F、G平面布置图

1:500

Comparison of main ULs in the world

(Unit:M.W.E)



Cosmic-ray Flux



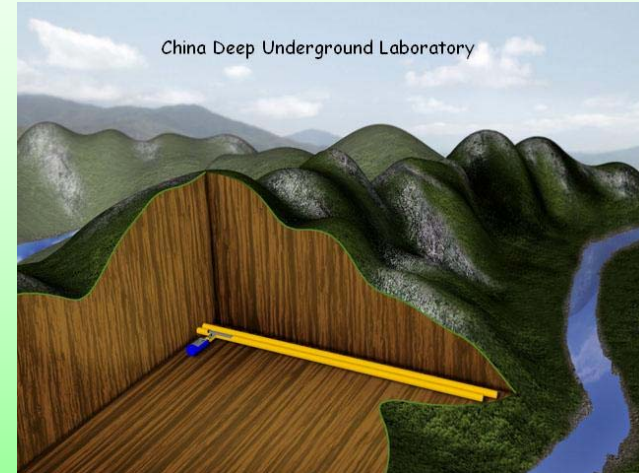
Y2L

$(\sim 6 \times 10^4 \text{ m}^{-2} \cdot \text{y}^{-1})$



LNGS

$(\sim 2 \times 10^3 \text{ m}^{-2} \cdot \text{y}^{-1})$



CJPL

$(\sim 2 \times 10^1 \text{ m}^{-2} \cdot \text{y}^{-1})$

Muon flux:

--LNGS 100 times more than CJPL

--Y2L 3000 times more than CJPL

MOU between EHDC and THU Signed



(MOE, SASAC, SDIC, NNFSC, THU, EHDC)



Going deep. Chinese scientists hope this tunnel will soon host a premier underground lab.

PARTICLE PHYSICS

Chinese Scientists Hope to Make Deepest, Darkest Dreams Come True

Particle physicist Yue Qian had his eureka moment in front of the TV set. For over a decade, Chinese scientists have longed for an underground laboratory that would enable them to join efforts across the globe to detect dark matter, observe neutrinos, and watch for exotic particle physics phenomena. Searches for suitable sites repeatedly came up empty-handed. But last August, after Yue caught a news report on the completion of two tunnels piercing Jinping Mountain in Sichuan Province, he felt that the long quest for such a lab might finally be over.

After months of negotiations, on 8 May Tsinghua University in Beijing, where Yue is an associate professor, signed an agreement with the tunnels' owner, Ertan Hydropower Development Co., to hollow out an experimental chamber. The Jinping lab would be the deepest underground science facility in the world, edging out—by 100 meters or so—the Deep Underground Science and Engineering Laboratory that the U.S. National Science Foundation may build in an abandoned mine in Lead, South Dakota. By placing sensors deep in the earth, physicists hope to reduce spurious signals from cosmic rays. China's subterranean aspirations have been circulating in Asia for months; the international community will get its first glimpse of the project at a dark-matter workshop in Shanghai on 15 June and

at an astroparticle and underground physics conference in Rome next month.

An underground lab has been a dream for several generations of Chinese scientists, says Wang Yifang, a particle physicist at the Institute of High Energy Physics of the Chinese Academy of Sciences in Beijing. Past candi-



Short cut. Tunnels between the Jinping dams on the Yalong River offer a serendipitous lab site.

date sites, including an underground aviation museum near Beijing and coal and gold mines around the country, all were judged too shallow or impractical.

Jinping, on the other hand, “looks ideal,” Wang says. The lab would have approximately 2500 meters of marble and sandstone above it: more shielding than any similar site in the world. Researchers will be able to make a 1-hour drive from a regional airport to the lab's front door. And the tunnels are sized for construction equipment, promising smooth delivery of instruments and supplies.

Wang cautions that the lab is not a done deal. “It's really at a very early stage,” he says. To start with, Yue's group must verify that the rock overburden really does screen out unwanted cosmic rays and that there is no unexpected radiation emanating from nearby rock or groundwater. To provide space for instruments, by the end of the year the team plans to have hollowed out a 5-meter-high, 5-meter-wide, 30-meter-long chamber. They will then measure cosmic ray flux and background radiation for about 6 months. And they will begin at least one experiment. Yue is forming a collaboration to install a germanium detector to search for a postulated component of dark matter known as WIMPs, or weakly interacting massive particles. Chinese physicists are also talking about observations of atmospheric and solar neutrinos as well as experiments to watch for neutrinoless double-beta decay, an extremely rare phenomenon that might help refine estimates of neutrino mass.

Yue doesn't yet know what the first phase will cost, as design efforts are just starting. “But [Tsinghua] university has promised strong support,” he says, and they are seeking funds from the science ministry. If the project develops as hoped, says Yue, “we would want to get more universities and institutions from China and around the world to join us and push this project ahead.”

The good fortune befell physicists thanks to a mammoth hydroelectric project about 350 kilometers southwest of Chengdu, the capital of Sichuan Province, where the Yalong River makes a 150-kilometer-long U-turn around Jinping Mountain. Ertan Hydropower is building two dams: Jinping 1 at the start of the U-turn and Jinping 2 at the end. To move workers and materials between the construction sites, Ertan blasted a pair of 17-kilometer-

CREDITS (TOP TO BOTTOM): YUE QIAN; INTERNATIONAL WATER POWER & DAM CONSTRUCTION

The plan of CJPL construction

6*6*40m Tunnel

Status:

- Provided by EHDC by the end of 2009
- 50cm concrete protect
- No special fresh air supply
- Power, Internet, 3G wireless, Water is easy to provide

Job to Do :

- Measurement of Cosmic-ray flux
- Measurement of radioactive background in the ambient rock
- Measurement of Radon concentration
- The effect of shock from vehicles on detector
- The method for fresh air supply

In 2010

The plan of CJPL construction

- More discussions have to be done.
- Collection of needs from China and World
- Layout of the CJPL, depend on
 - Project
 - Space
 - Possibility to widen
 - Safeguard
 - Experimental logistic system
- Budget of the establishment of CJPL
- Funding

China Darkmatter EXperiment (CDEX)

J. P. Cheng, Z. Deng, D. Han, K.J. Kang, J. Li, Y.J. Li, Y.L. Li, Y. Wang,
Q.F. Wu, Q. Yue, Y.G. Yang, Z. Zhang

(Tsinghua University, THU)

K.X. Jing, C.J. Tang, Z.Y. Tang, H.Y. Xing, C. W. Yang, J.J. Zhu

(Sichuan University, SCU)

X.Q. Li, Y. Xu, C.X. Yu

(Nankai Univeristy, NKU)

K.J. Dong, X.C. Ruan, Z.Y. Zhou

(China Institute of Atomic Energy, CIAE)

Y.H. Chen, B.M. Shen, J.M. Wang, S.Y. Wu, X.H. Zeng

(Ertan Hydropower Development Company, EHDC)

K.M. Cheung, S.C. Lee

(National Tsinghua University, NTHU)

TEXONO Collaboration
KIMS Collaboration

CDEX schedule

Phase-I (2009.12-2010.12)

- 20g ULE-HPGe detector @ CJPL
- Shielding system construction
- HPGe detector for radioactive measurement
- Radon monitor system

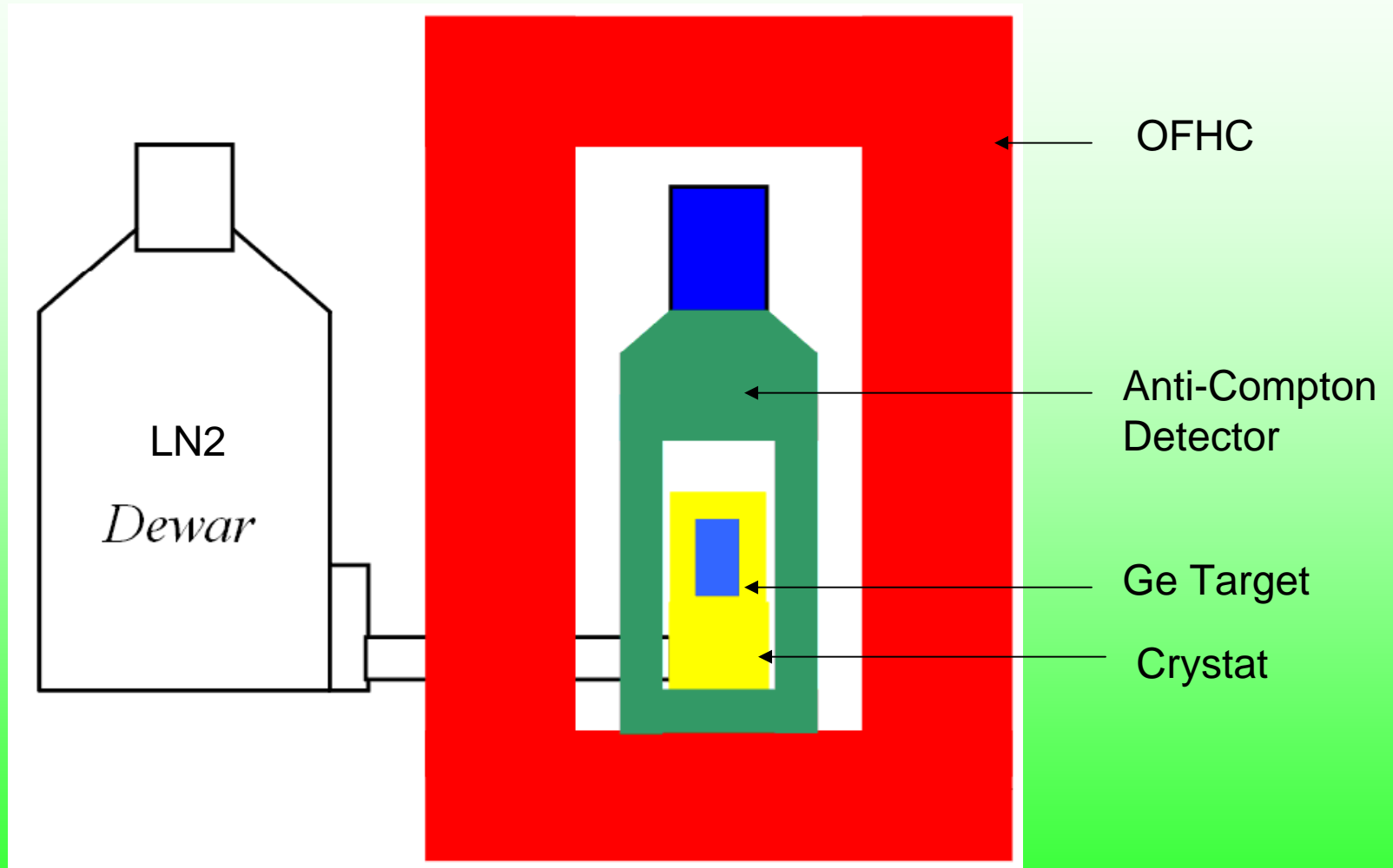
Phase-II (2010.12-2011.12)

- ULE-HPGe detector(~500g)

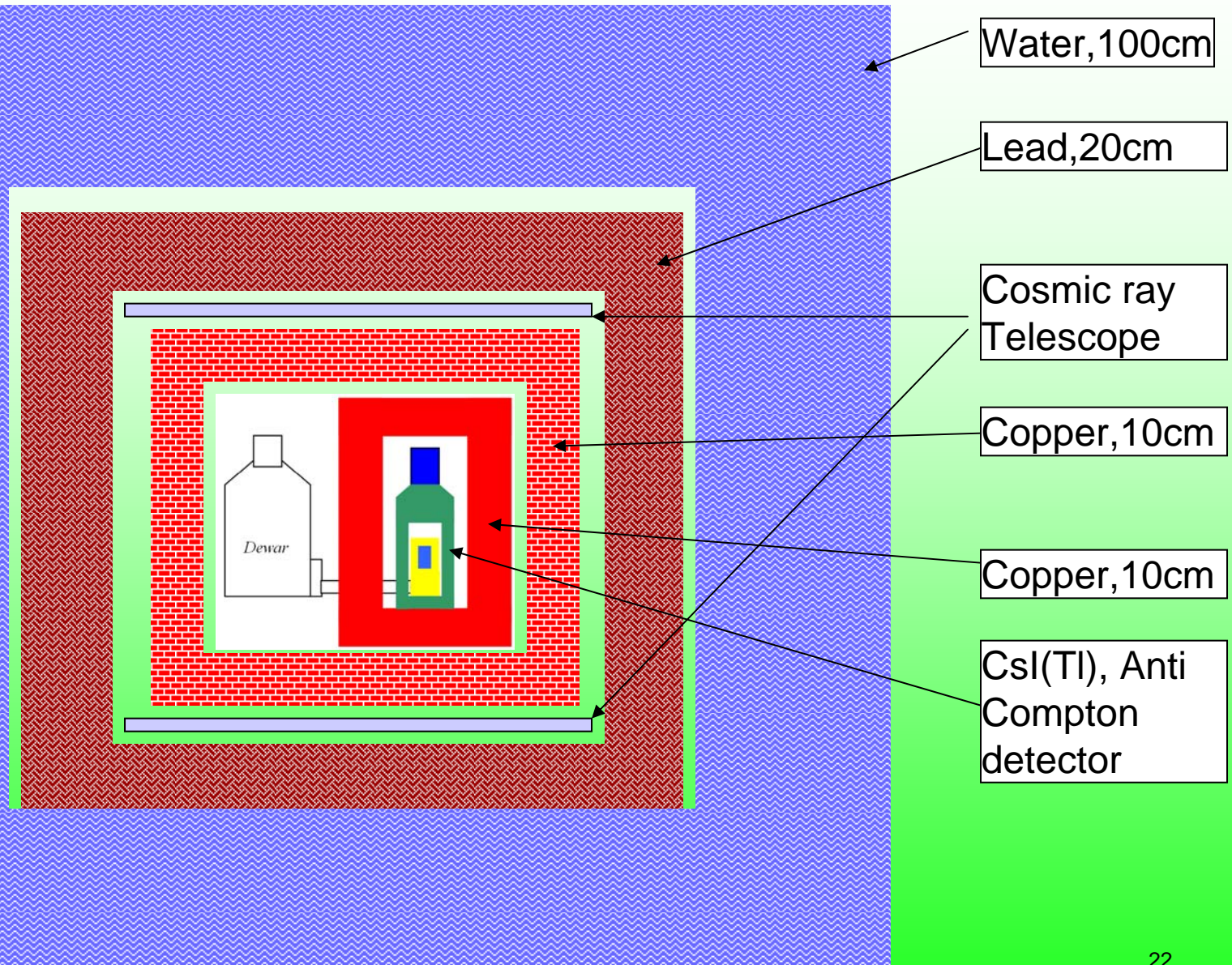
Phase-III (2012-)

- ULE-HPGe detector(~10kg scale)

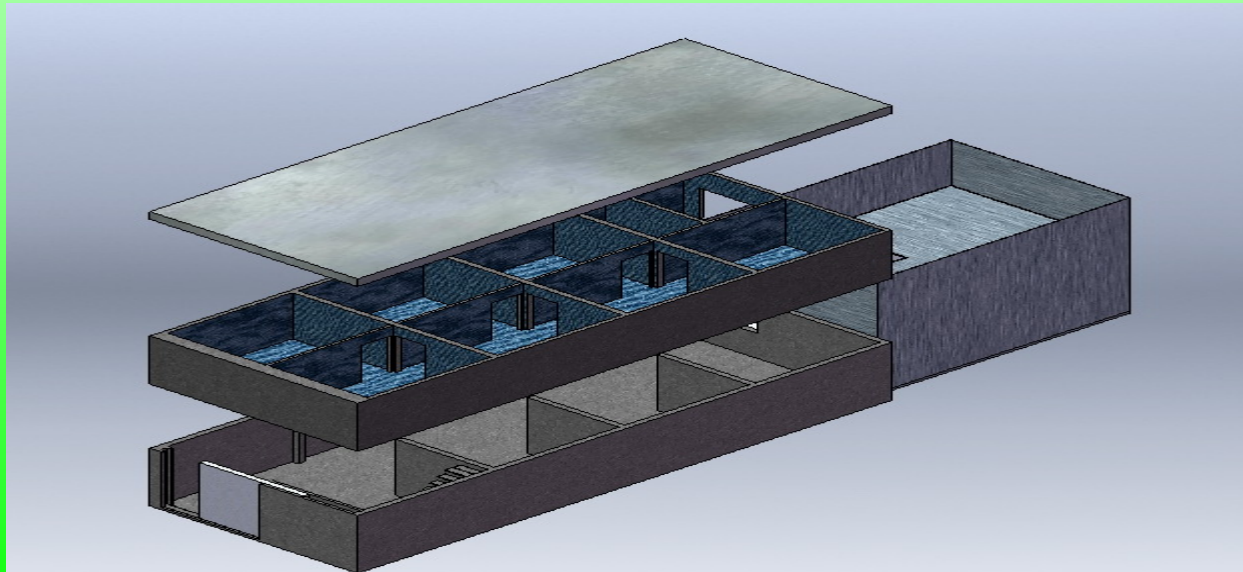
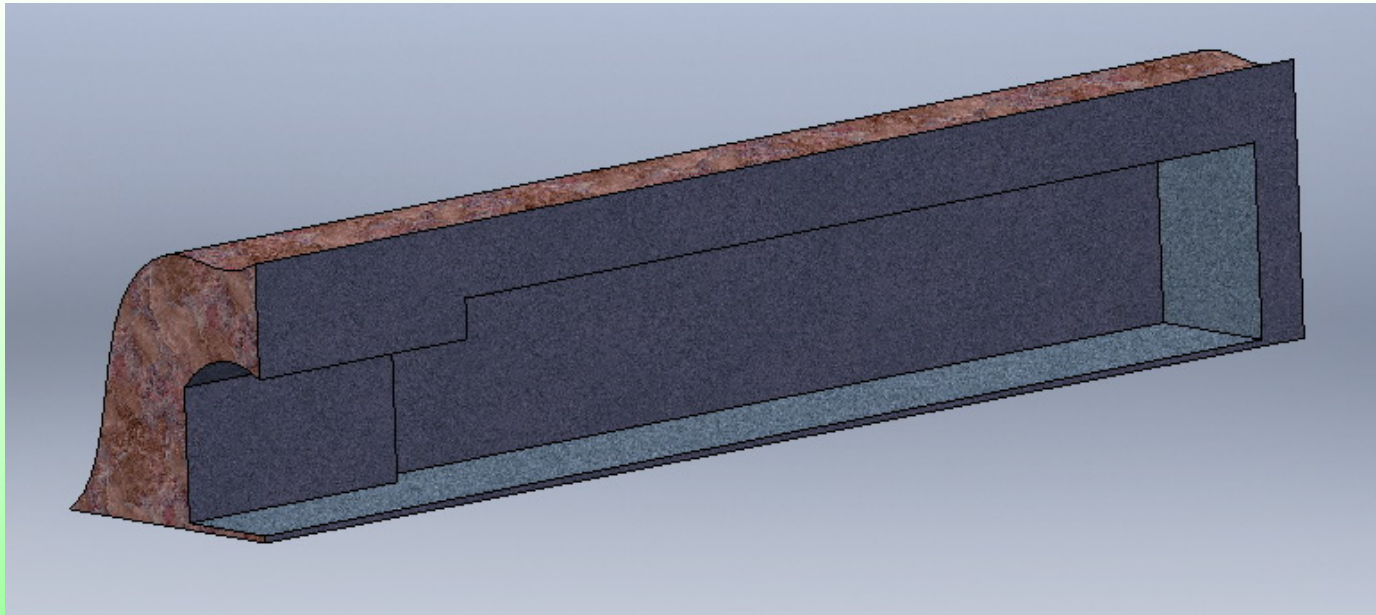
Detector and Shielding



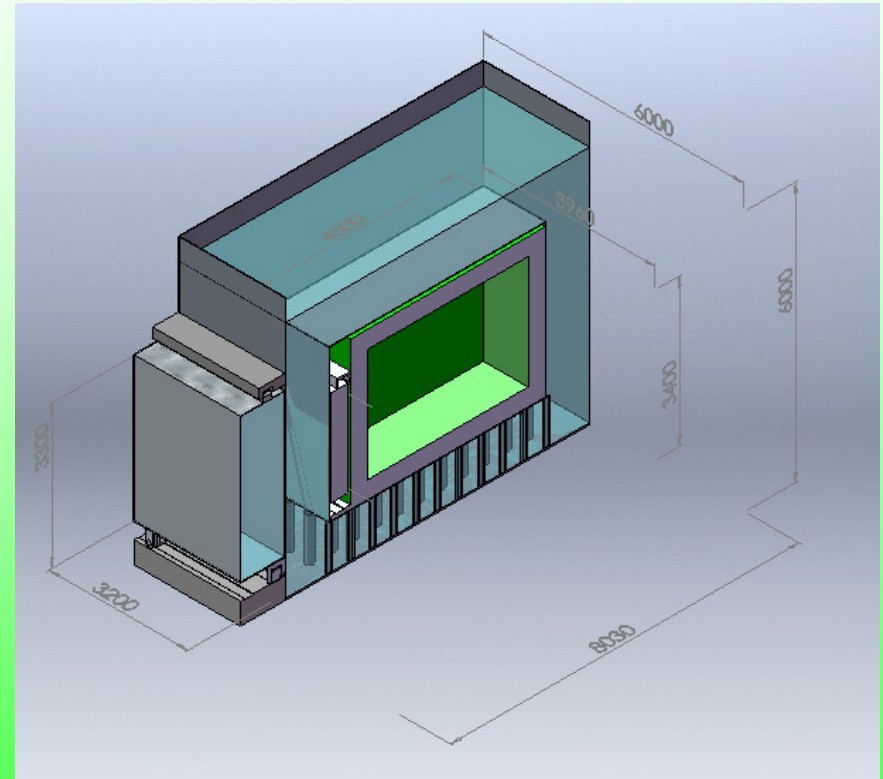
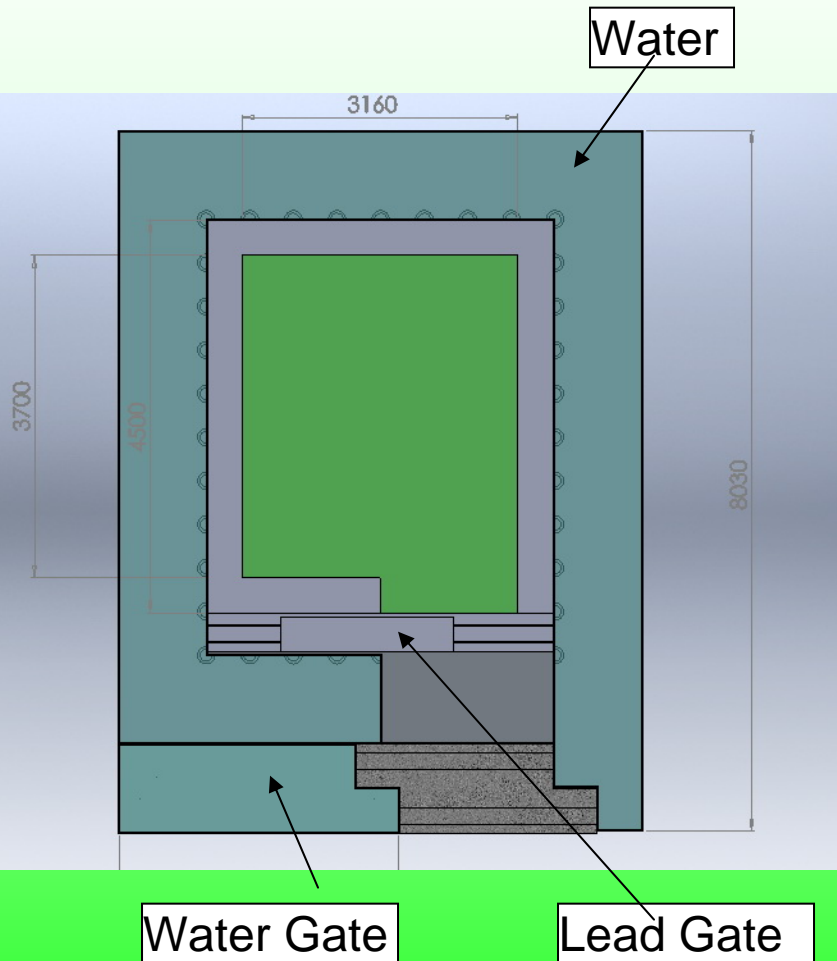
Detector and Shielding



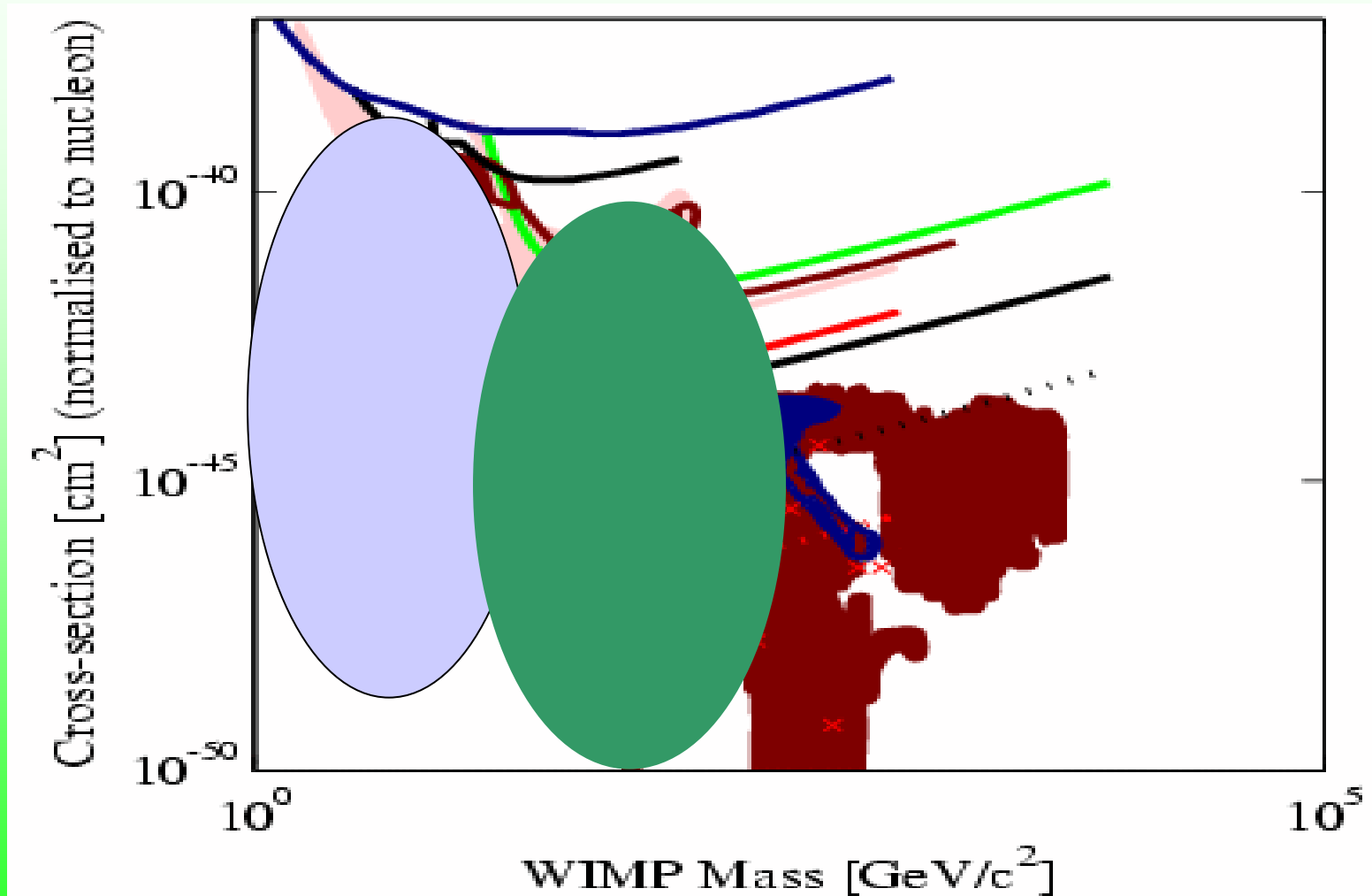
Tunnel Layout



Water and lead shielding



CDEX target



DBD Experiment with KIMS

- Dark Matter Search has made us close and strong collaboration
- New story from KIMS Collaboration about DBD will make this collaboration more fruitful.
- We wish DBD can be another topic we can work together.
- UL share discussion can start.

Summary

- ✓ A new site for UL in china has been found.
 - ✓ The logistic conditions are pretty good for establishment of a deep underground Laboratory at Jinping Tunnel.
 - ✓ A small cavity 6*6*40m provided by EHDC for evaluation of the possibility to establish CJPL.
- ✓ A HPGe detector with nice shielding system will be setup for Ultra-Low Level Radioactive Background measurement.
- ✓ A new Collaboration CDEX has been setup for DM search with ULE-HPGe detector first and more technologies will be developed for DM and DBD experiments.
- ✓ New topic for us to collaborate----- from DM to DBD