The development of low dose calibration in CJPL

Zhi Zeng
2019/11/06
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IV. Summary
I. CJPL Introduction
The China Jinping Underground Laboratory (CJPL), inaugurated in 2010, is an underground research facility with the deepest rock overburden (2400m) and largest space by volume (~300k m³) in the world.
Tunnel Layout inside Jinping Mountain

- 4 hydraulic tunnels for electric power generator
- 2 traffic tunnels (Jinping Tunnel)
- Drain tunnel
- West inlet
- Power generator

CJPL-I
CJPL-II

Fig. 1. Cross section of Jinping mountain and location of the CJPL.
Layout of CJPL-I

- **Total space**: 4000 m³
- **Main Lab Space**: 6.5(W) x 6.5(H) x 42(L)
Current Status of CJPL-I

Physics experiments:
- 2 dark matter experiments: CDEX, PandaX
- 1 neutrino experiment: Jinping Neutrino experiment

Low background counting facilities:
- 3 low-background gamma spectrometers
CJPL-II current status

Underground ventilation system with 9 km length for fresh air

PandaX in B2

Stainless steel tank in C1 Pit
Logistics of CJPL

High way from Xichang airport to CJPL
Direct access to underground by car or truck

Office building
Hotel (~200 person)

Sports & swimming pool
Auditorium

Convenient & Comfortable
Main Underground lab in the world

- 600m Soudan, USA
- 700m Y2L, Korea
- 800m Canfranc, Spain
- 1000m Kamioka, Japan
- 1100m Boulby, UK
- 1400m INO, India
- 1400m LNGS, Italy
- 1500m SURF, USA
- 1600m Baksan, Russia
- 1700m Modane, France
- 2100m SNO, Canada

Jinping
II. Low-dose comparison activities in CJPL
### Low-background comparison on Dec. 2013

<table>
<thead>
<tr>
<th>scene</th>
<th>Date</th>
<th>Dose rate prediction (nGy/h)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cosmic-ray dose</td>
<td>Dec. 3</td>
<td>60</td>
<td>Qionghai lake, Xichang City, Sichuan</td>
</tr>
<tr>
<td>field</td>
<td>Dec. 3</td>
<td>60</td>
<td>Playground yard in Xichang Campus</td>
</tr>
<tr>
<td>road</td>
<td>Dec. 3</td>
<td>80</td>
<td>Near Xichang wetland Park</td>
</tr>
<tr>
<td>In door</td>
<td>Dec. 3</td>
<td>100</td>
<td>Meeting room 3, Yuanyuan hotel</td>
</tr>
<tr>
<td>Low-dose rate</td>
<td>Dec. 4</td>
<td>20</td>
<td>Jinping underground lab</td>
</tr>
<tr>
<td>Mid-dose rate</td>
<td>Dec. 4</td>
<td>400</td>
<td>Near pile of rare earth, Fangxing Company</td>
</tr>
<tr>
<td>High-dose rate</td>
<td>Dec. 4</td>
<td>800</td>
<td>Closed pile of rare earth, Fanxing Company</td>
</tr>
<tr>
<td>‘zero’ point</td>
<td>Dec. 4</td>
<td>&lt;3</td>
<td>Darkmatter shielding room in CJPL</td>
</tr>
</tbody>
</table>
Low-background comparison on Dec. 2013

Low-dose rate scene

Absorbed dose rate (nGy/h) vs. Number of instrument
Low-background comparison on Jan.2019
III. Design 0.1 nSv/h dose calibration lab in CJPL-II
Monte Carlo simulation

- Shileded by 1 meter PE wall enough (without Radon indoor contribution)
- Radon concentration in PE room should reduced to 0.1mBq/m³ to achieve 0.1nSv/h goal
DURF Project

- **Deep Underground and ultra-low Radiation background Facility for frontier physics experiments (DURF)** is one of the 10 prior projects of *National Major Science & Technology infrastructure*.

- CJPL-II was selected to build DURF, and the proposal approved in the Dec. 13, 2018, ~177 million euros.

- DURF would involve:
  - Three Shielding devices for different experiment
  - Low background counting facilities
  - Ultra pure copper production devices
  - Crystal growth and process
Polythene Shielding Room in C2
Prepare for demo/prototype experiments, 0.1nSv/h calibration chamber and Low background facility in C2 hall:

- Whole size: L10m*W6m*H4m
- 1 meter thickness polythene shielding wall
- **Radon reduction Air input (< 0.1 mBq/m³)**
IV. Summary

• the deepest underground lab CJPL, could be used for low-dose rate calibration;

• In 2013 and 2019, two low-dose rate comparison had been successful hold in CJPL-I.

• To achieve 0.1nSv/h calibration condition, a new PE shielding room is designed, and is apart of DURF project which would be finished in 2023.
Thanks!