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中国锦屏地下实验室二期 CJPL-II情况简介

2018/4

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自然背景

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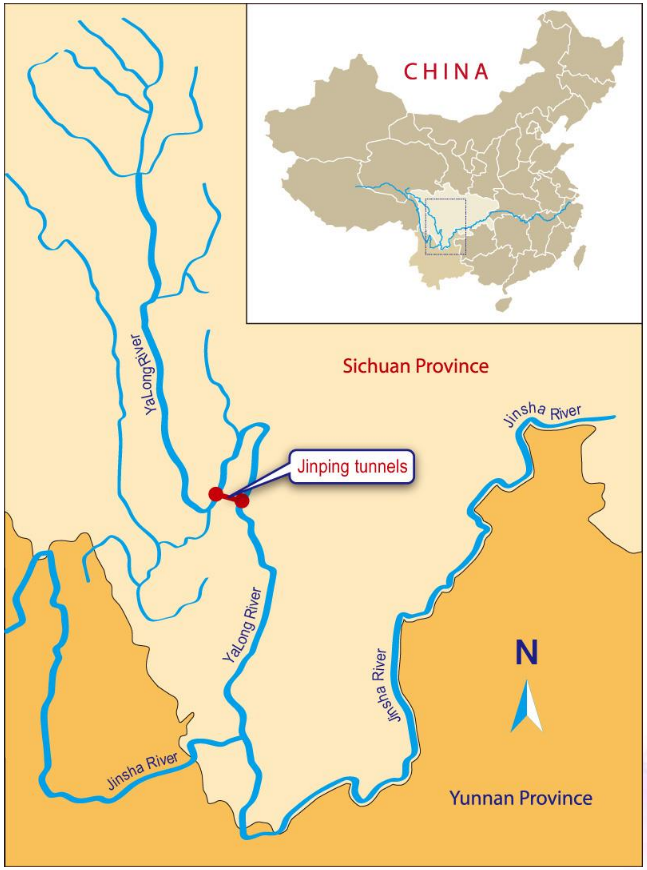
锦屏水电站工程



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锦屏水电站工程

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锦屏水电站工程

锦屏水电站工程

雅砻江下游河段有一个大河弯,长约150 km，河流环绕锦屏山，形成一南北向长条形天然弯道。

从河湾西端的棉沙沟至东端的大水沟，直线距离约16.5 km，天然落差310m，是落差最为集中的河段，通常把这一段称锦屏大河湾段。锦屏二级水电站利用雅砻江大河湾天然落差，裁弯取直，开挖隧洞引水发电。

2008年8月，历时四年多建设的锦屏辅助洞贯通，在满足电站对外交通和运行管理需要，以及为锦屏二级水电站长引水隧洞地质勘探、科研试验和开挖施工支洞提供条件的同时，也为中国锦屏地下实验室建设提供了条件。

一期

机遇

机遇

- 中国锦屏地下实验室建设机遇
- 2008年8月，历时四年多建设的锦屏辅助隧道贯通，为锦屏地下实验室提供了难得的建设机遇和得天独厚的条件
- 机会总是留给有准备的人

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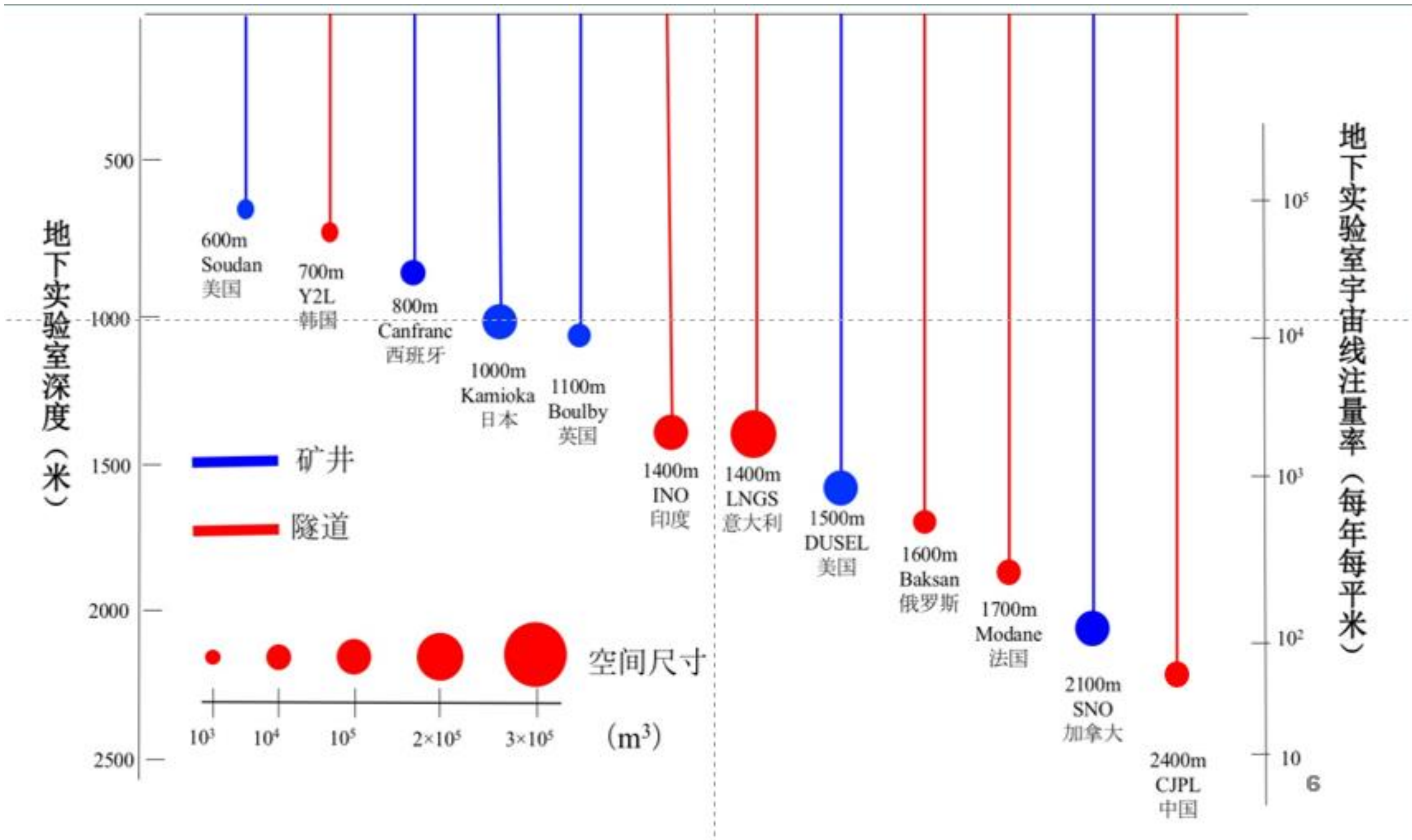
机遇



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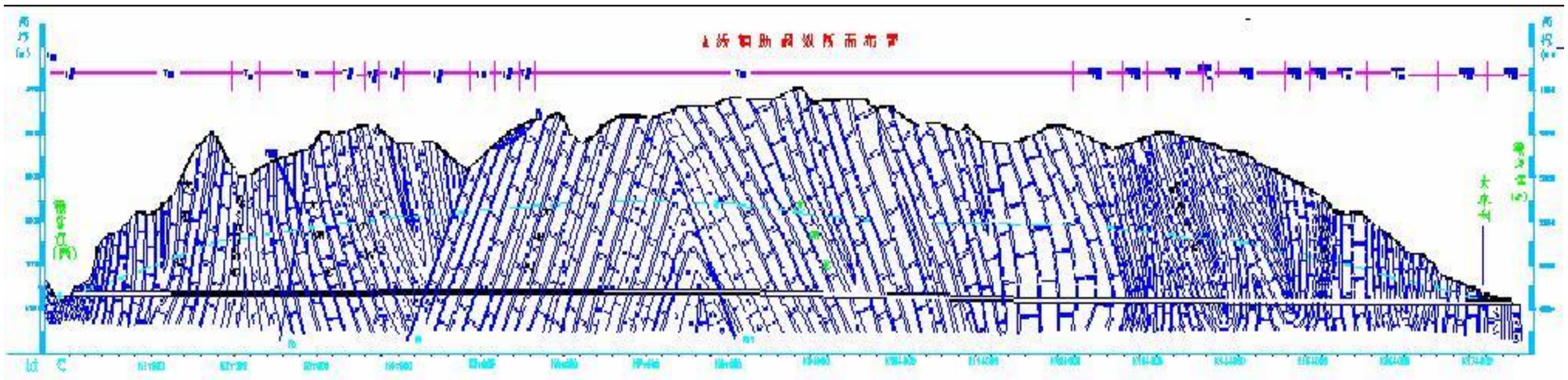
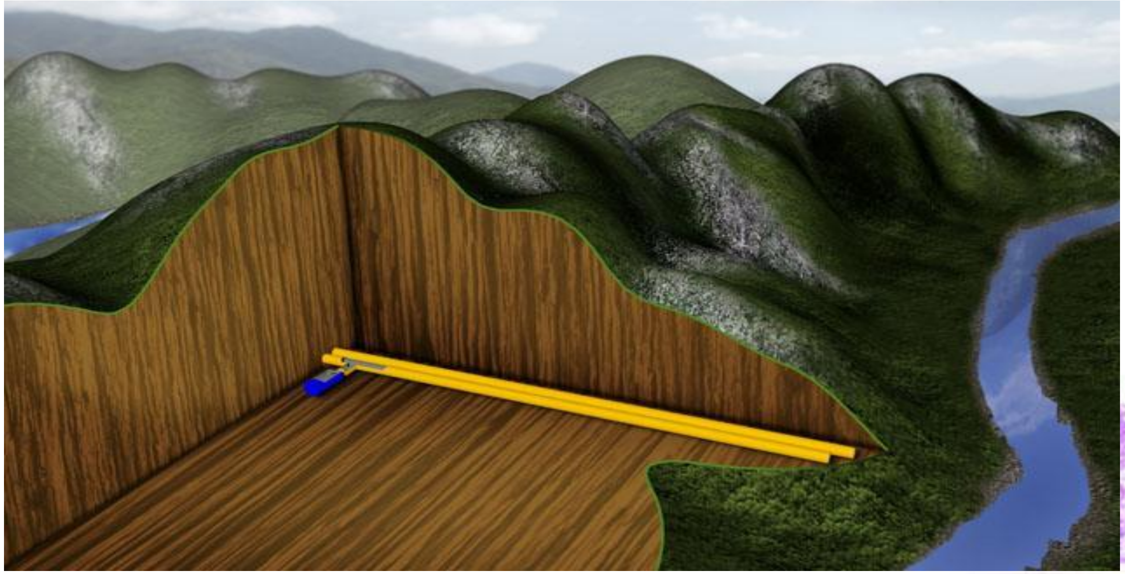
机遇





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2009/3

	钾-40	镭-226	钍-232
锦屏岩石样品	< 1. 1	1.8	< 0. 27
北京岩石样品	600	25	50

2009/5

2009/8

2010

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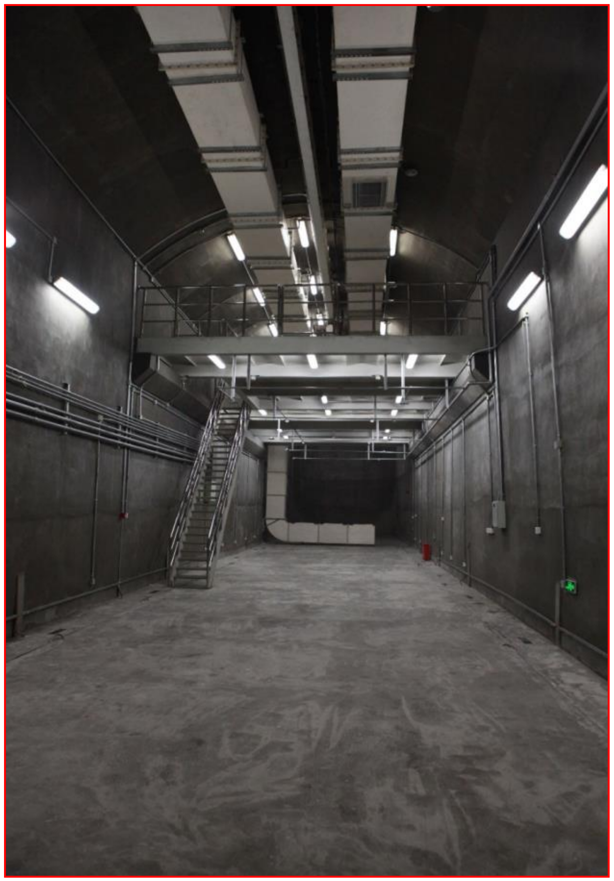
2010/4

2010/6



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通风系统

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2010/12

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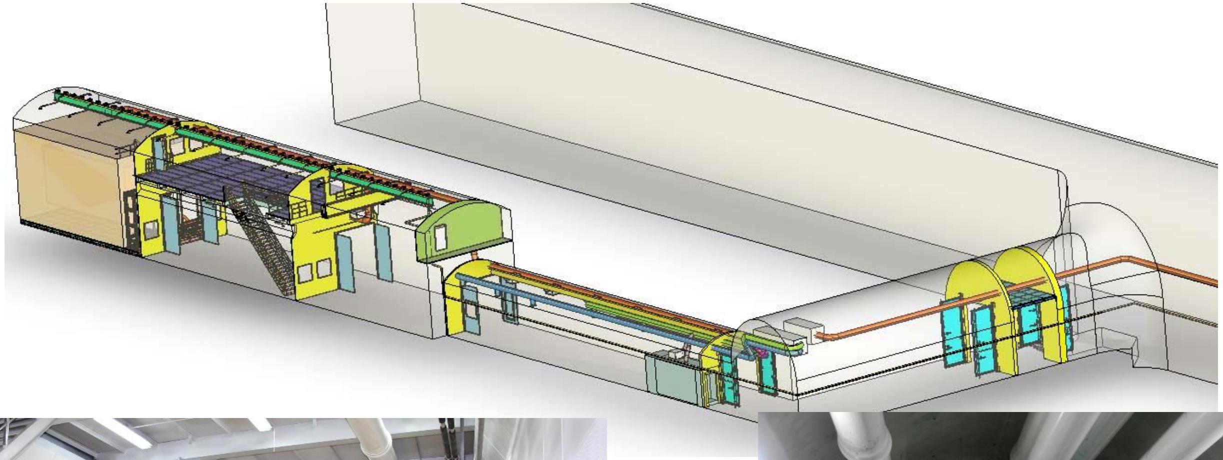
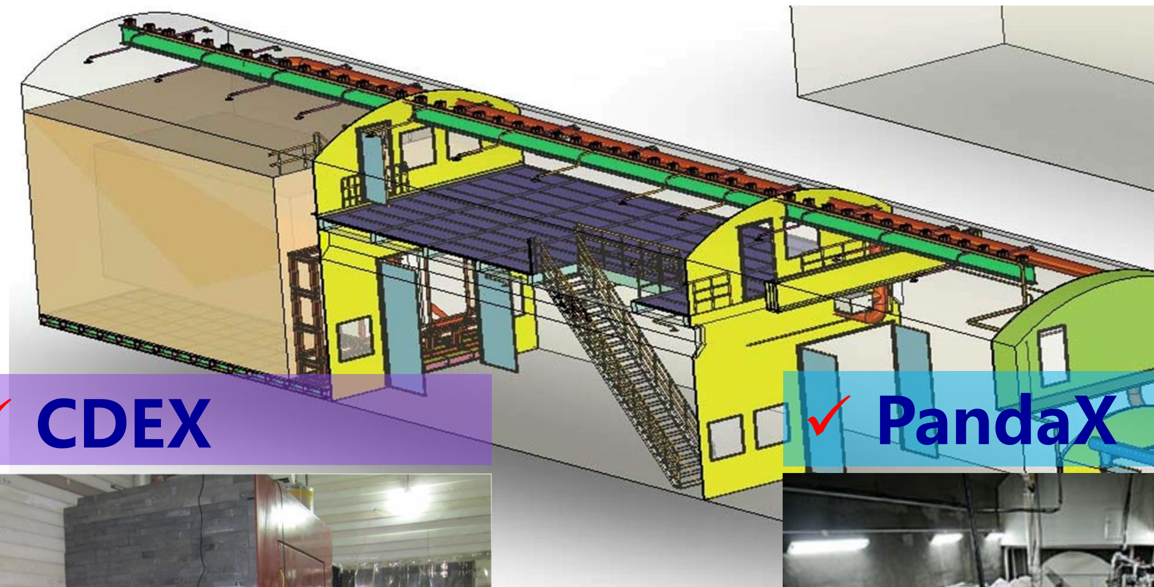
CJPL-I



CJPL-I



✓ **CDEX**

✓ **PandaX**

二期

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二期

- CJPL-I的建设运行，以及暗物质实验取得的成果推动了我国相关基础前沿领域迅猛发展，同时也吸引了不少国际需求：
- CDEX吨量级暗物质双贝塔实验
- PandaX吨量级暗物质实验
- 中科院高能所---吨量级液氩暗物质实验
- 中国原子能科学院---核天体物理实验
- 四川大学---深地岩石力学实验
- 美国普林斯顿大学---液氩暗物质实验
- 美国加州大学洛杉矶分校---双贝塔实验
- ……

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二期

- 德国《南德意志报》2014年6月9日“中国四川锦屏地下实验室--物理学家的山”
- 在四川，中国希望打造一个无与伦比的极深地下实验室。在物理学家眼里，中国近乎创造了一个天堂，但这也让一些西方研究者很紧张。
- ……
- 与其相比，位于意大利中部格兰萨索山区的欧洲地下实验室就像个游戏室。在川藏群山下，粒子物理学家最头痛的宇宙线的强度比格兰萨索山区要弱200倍，为实验提供了“干净”的环境。
- ……
- 对许多欧美研究人员来说，中国地下实验室的条件犹如天堂。而中国也正在吸引世界名列前茅的学者前往四川开展科研。但与中方合作的人须清楚一点，中国将主导实验的一切。这从中方拒绝西方提供部分资金就可看出。中国只对西方科学家的经验和知识感兴趣。对美国人来说，中国人雄心勃勃的计划令其受挫，一些美国物理学家已出访四川并留在那里工作。
- ……
- 中国的大胆步伐将颠覆耗资巨大的粒子物理研究领域。20年前这场竞赛还在美欧间展开。如今这个新兴大国已不甘于在西方各研究机构中扮演客人的角色。问题已变成问题已变成：谁能紧跟中国的步伐？

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2014/8

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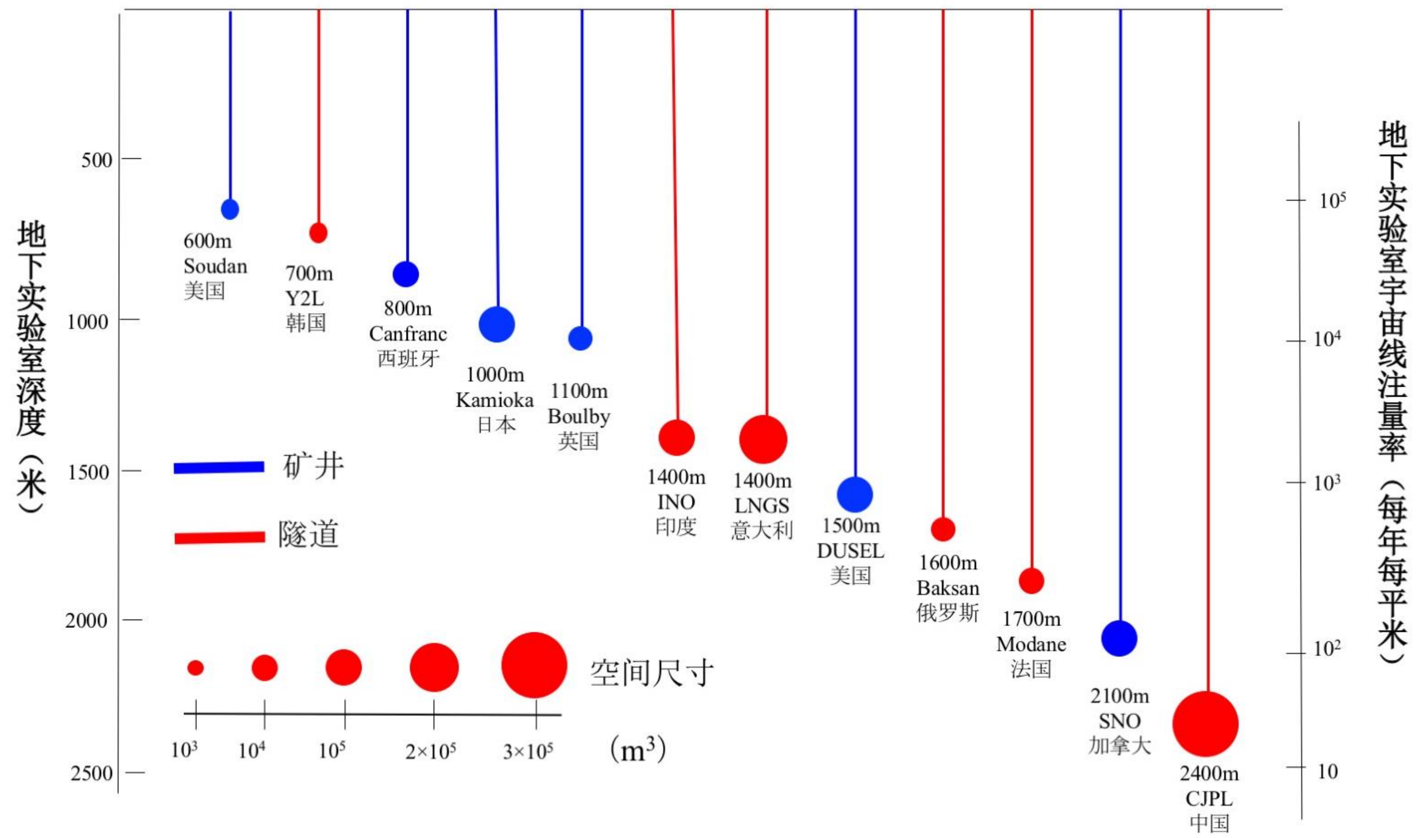
二期



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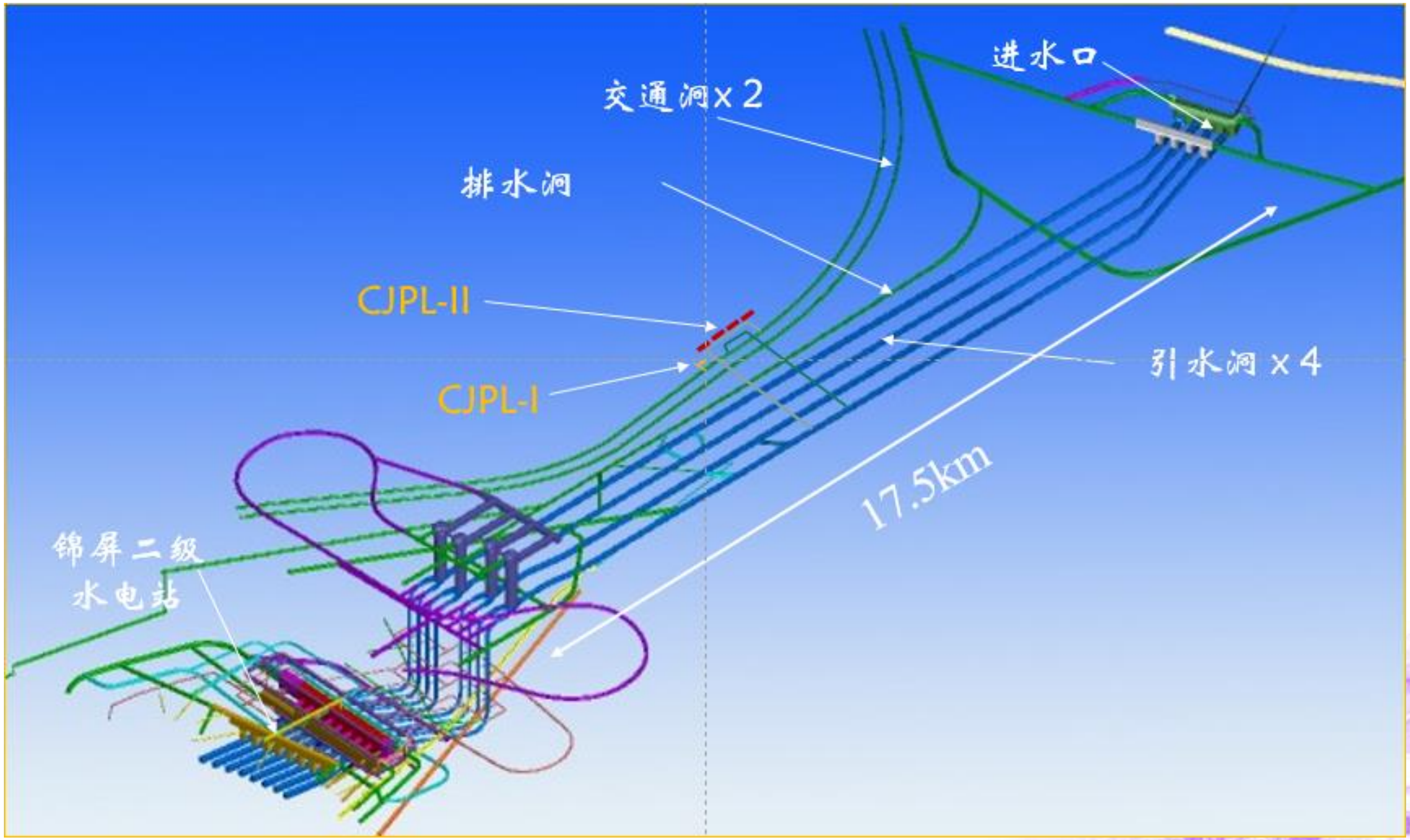
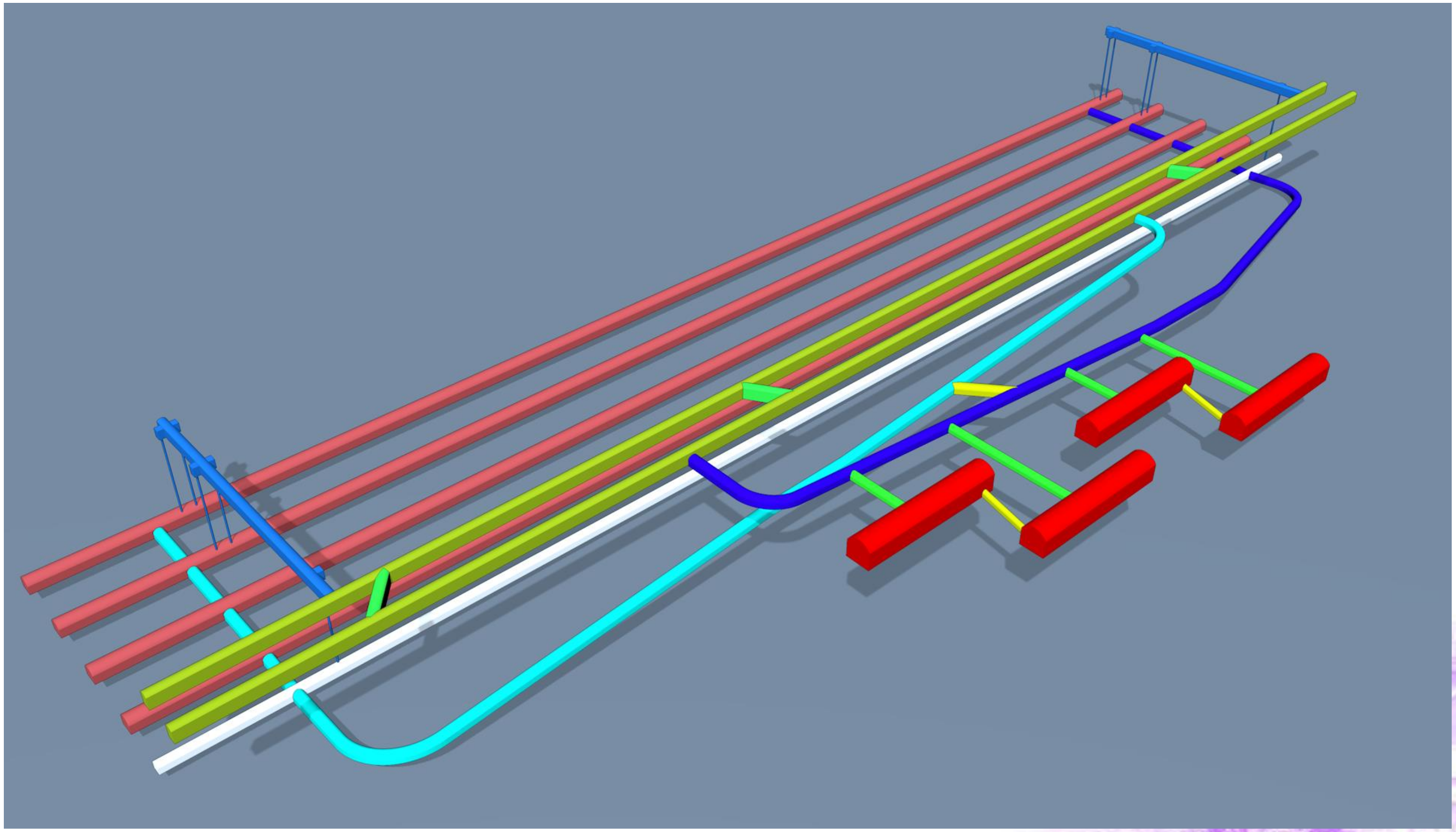


二期



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二期

2017

2017

- 完成4洞8室地下岩土开挖工程
- 完成B2、C1两个洞局部扩挖工程
- 完成通风管道安装工程

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地面实验室

人民日报：中国首个极深地下实验室扩建

新华社、科技日报，光明日报，四川日报等数十家媒体对这一消息进行了报道，引起了公众高度关注

中央电视台《新闻联播》报道锦屏二期建设

Science, Nov. 30, 2014

《Science》高度评价CJPL-II建设

PHYSICS

China supersizes its underground physics lab

Planned expansion could pave way for "ultimate dark matter experiment"

By Dennis Normile

The world's deepest physics laboratory is about to become one of its largest. Early next year, workers will start carving four cavernous experiment halls along a tunnel through Jinping Mountain in China's Sichuan province. Once the science at the China Jinping Underground Laboratory (CJPL) is scaled up as well, "[illegible] physics," [illegible] undergro[illegible]

Opened [illegible] deepest facility of its kind, with 2400 meters of rock shielding it from background radiation (see chart). The lab so far has focused on the hunt for dark matter, the universe's postulated missing mass. More space will allow larger and more sensitive dark matter detectors and an expanded research agenda that will include a nuclear astrophysics accelerator to replicate the inner workings of stars. CJPL also hopes to branch out into observing neutrinos and studying exotic particle phenomena.

Deep underground labs elsewhere have a head start in all of these areas. This means the Chinese will [illegible] research targets carefully based on [illegible] and where they can do better" than existing experiments, says Alessandro Bettini, director of the Canfranc Underground Laboratory in Spain. Others have confidence in the Chinese quickly coming up to speed. "It's a highly competitive site [with] lots of potential," says John Ellis, a theorist at King's College London who chairs a new international advisory committee that visited the lab last month.

China's ascent in underground physics began serendipitously in August 2008, when Qian Yue, a physicist at Tsinghua University in Beijing, saw a TV report about access tunnels being bored through Jinping Mountain for a massive hydroelectric project. Tsinghua approached the Yalong River Hydropower Development Co. Ltd., which agreed to excavate two experiment halls totaling 4000 cubic meters along one of the tunnels (*Science*, 5 June 2009, p. 1246).

CJPL, run by Tsinghua, now hosts two dark matter experiments. The Particle and Astrophysical Xenon (PandaX) experiment uses a 37-kilogram liquid xenon target to watch for dark matter in the form of postulated weakly interacting massive particles (WIMPs). If WIMPs exist, they should occasionally travel unmolested through the mountain and collide with a xenon nucleus, producing a flash of light. In the other experimental hall, the China Dark Matter Experiment (CDEX) aims to catch the electrical signal produced if a WIMP bumps into a nucleus within a germanium crystal. "There is complementarity" between the two approaches, says Henry Wong, [illegible] radiation, whereas the more sensitive germanium detectors ought to be able to spot interactions involving lighter WIMPs. Although neither experiment has yet detected a WIMP, they both have helped confirm results from other labs indicating that WIMPs are likely to have very little mass.

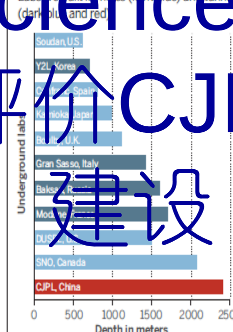
For an initial effort, the results are "pretty decent," says Wick Haxton, a theorist at the University of California, Berkeley. To boost its chances of sighting WIMPs and determining their mass, CJPL needs a larger volume of xenon, more germanium crystals, and better shielding. All of that requires more space. "If they significantly enlarge those experiments [illegible] ton says, [illegible] petitive." [illegible] room it [illegible] construction work wraps up next year, crews will bore another four 130-meter-long experiment halls. When lined with concrete, each will be 13.2 meters wide with an arched ceiling 13.2 meters high. All told, the enlarged facility will have 120,000 cubic meters of research space, second only to Italy's Gran Sasso National Laboratory, which has 180,000 cubic meters. By piggybacking on the hydropower project, Tsinghua limited the expansion's cost to $50 million. Yue hopes to start experiments in the new halls by the end of 2016.

CDEX aims to boost its sensitivity by increasing its germanium target from 1 to 10 kilograms and by adding more elaborate shielding. The PandaX team is thinking much bigger. "We are interested in building the ultimate dark matter experiment: a 20-ton scale liquid xenon experiment," says Xiangdong Ji, a physicist at Shanghai Jiao Tong University and the University of Maryland, College Park. That would be several times larger than existing liquid xenon experiments. Realizing such a mammoth project, says Ji, who leads PandaX, could require teams worldwide to pool resources.

A new experiment planned for the expanded space is the Jinping Underground laboratory for Nuclear Astrophysics (JUNA). Its pièce de résistance would be a particle accelerator used to replicate the nuclear processes generating energy within stars and the synthesis of heavier elements from hydrogen and helium in the primordial universe. The rock shielding would reduce background noise, making it easier for researchers to detect rare and subtle signals. With a more powerful accelerator and a deeper location than other efforts, says project head Weiping Liu, a physicist at the China Institute of Atomic Energy in Beijing, "JUNA has the potential to take a favorable position among underground nuclear astrophysics labs." ■

Deep, dark labs

In the hunt for dark matter, deeper is better. Labs are built in mines (light blue) and tunnels (dark blue and red).



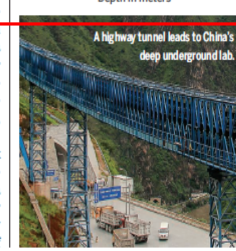

A highway tunnel leads to China's deep underground lab.

PHOTO: CJPL

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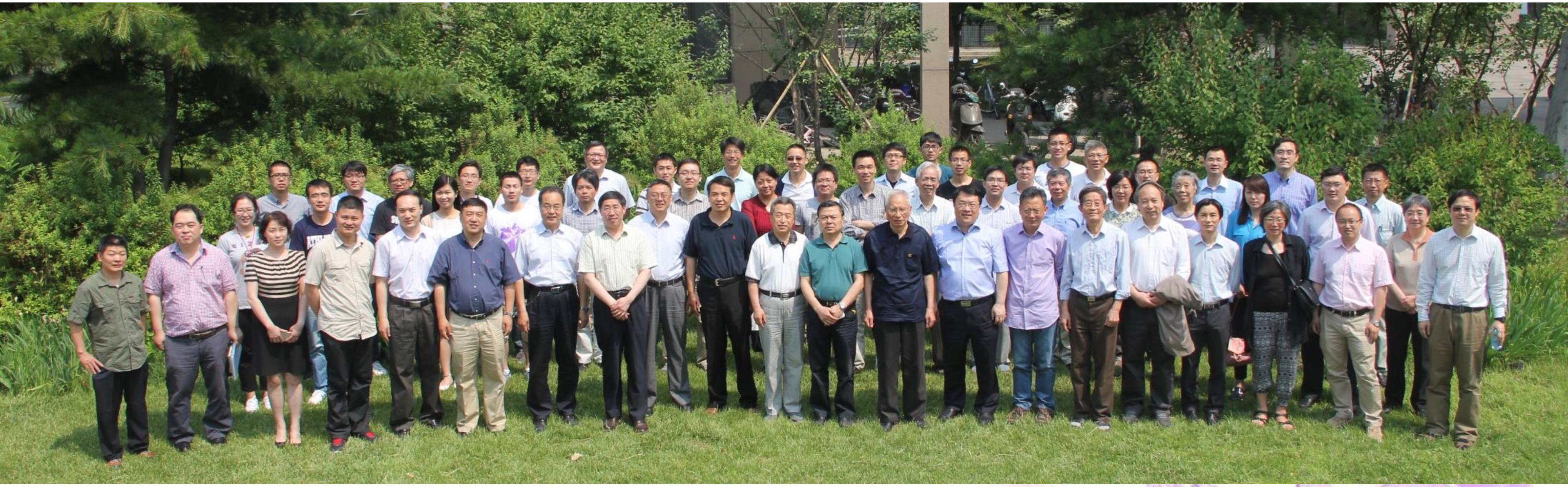
中国锦屏地下实验室物理研讨会

- 清华大学 2015.5.25-26



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