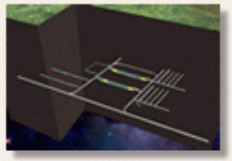

国家深地实验室
National Deep Underground Laboratory

Deep underground Lab. In China

Changgen Yang

Inst. Of High Energy Physics, Beijing

The next generation projects in Deep underground laboratories

July1, 2011

- The earliest time of Chinese physicists looking for underground site for physics study can be traced to 70th, which is about the same time of Gran Sasso and Kamioka proposal;
- A few (primary) underground experiments include participation in DAMA, an double beta experiment in MenTouGou (Beijing) in 80th …
- Many years of occasional search for underground site until Jin Ping hydropower construction project, by Ertan Hydropower Development company, appear on the web several years ago …

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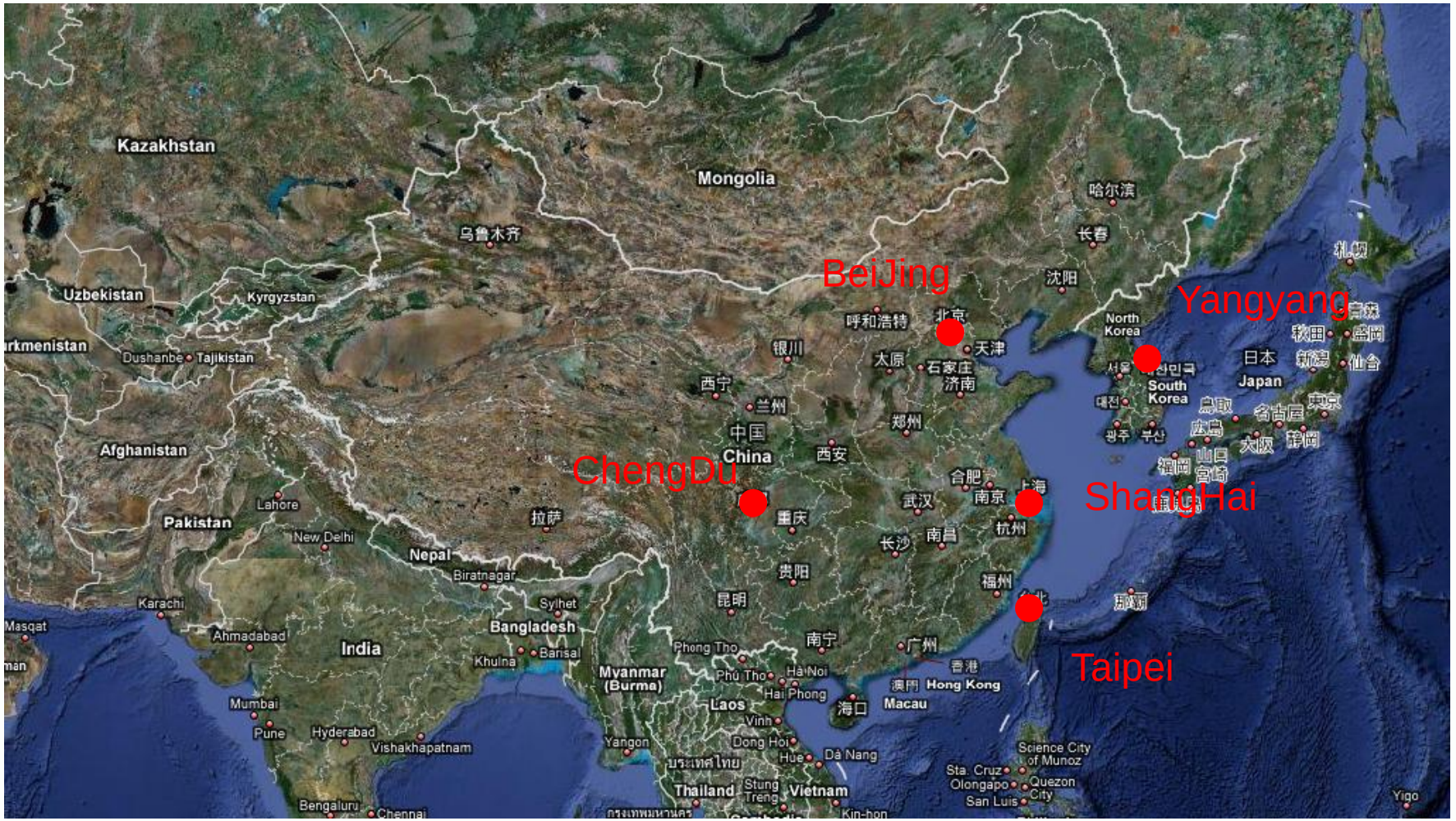
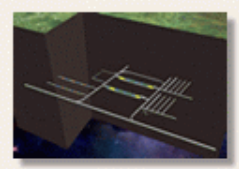
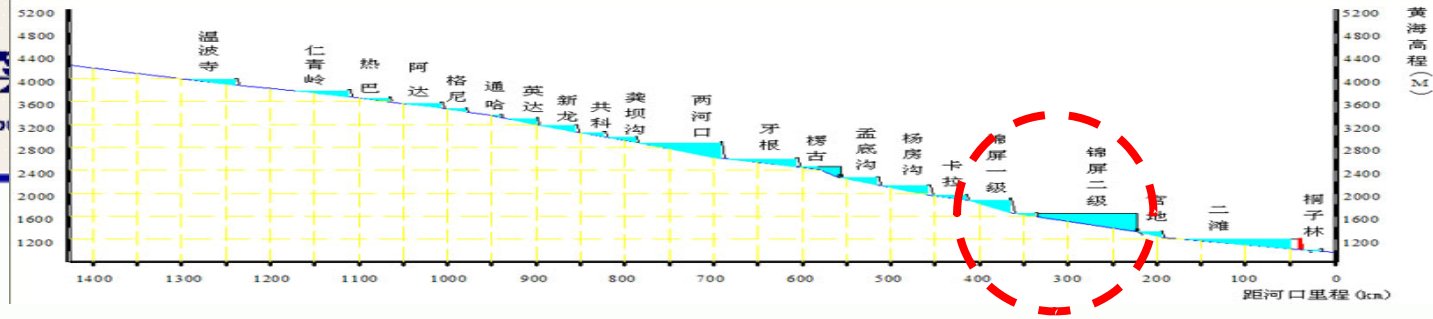
The site of Jin Ping

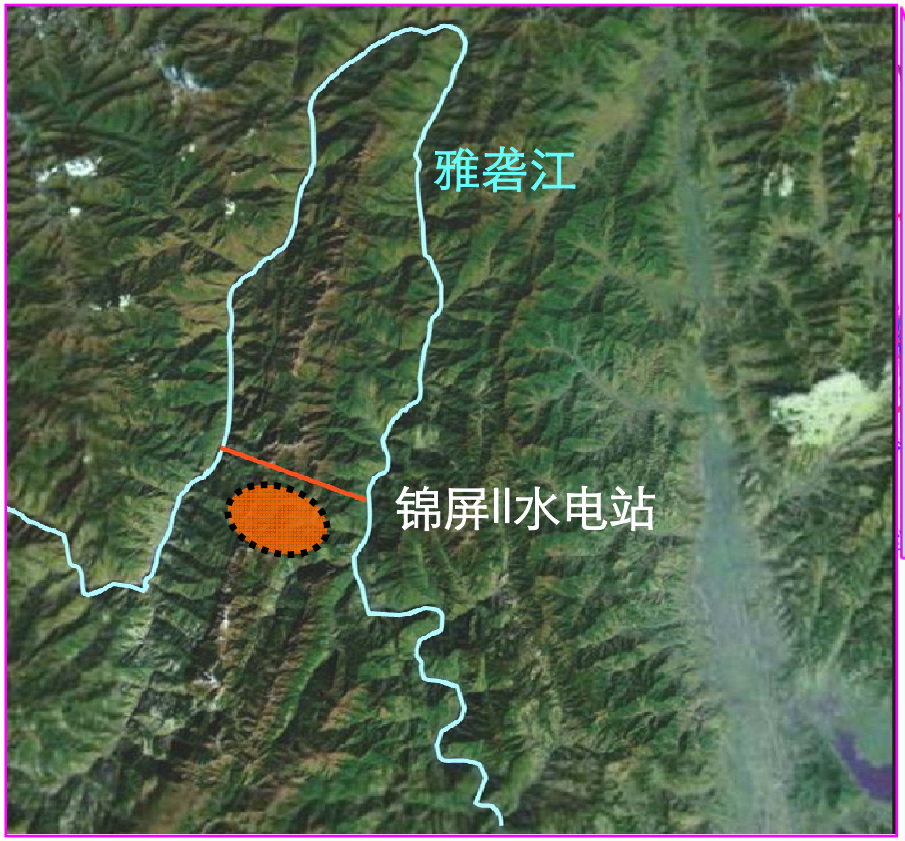


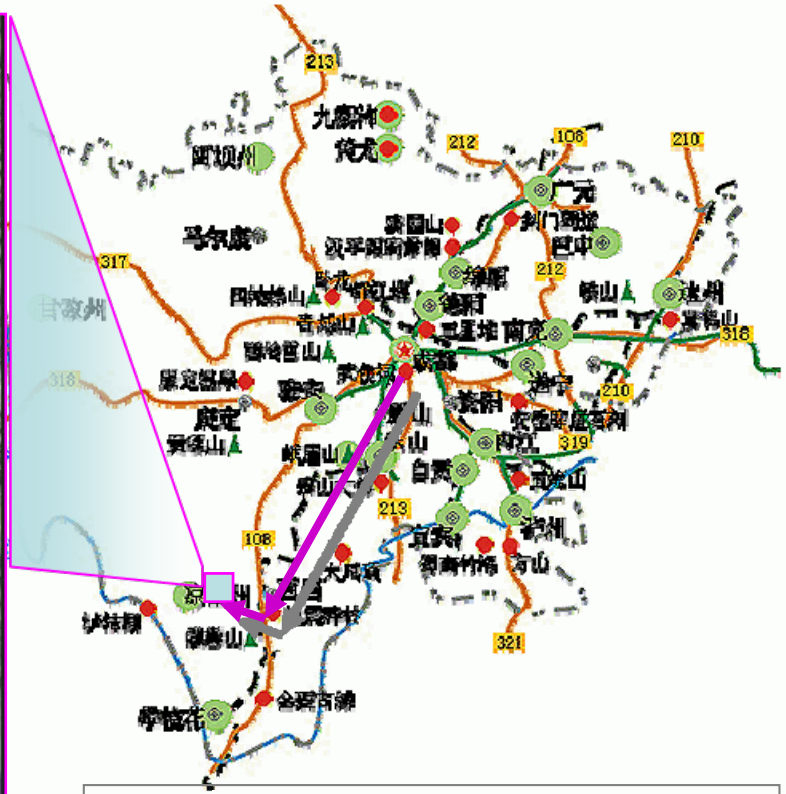


国家深地实

National Deep Undergro





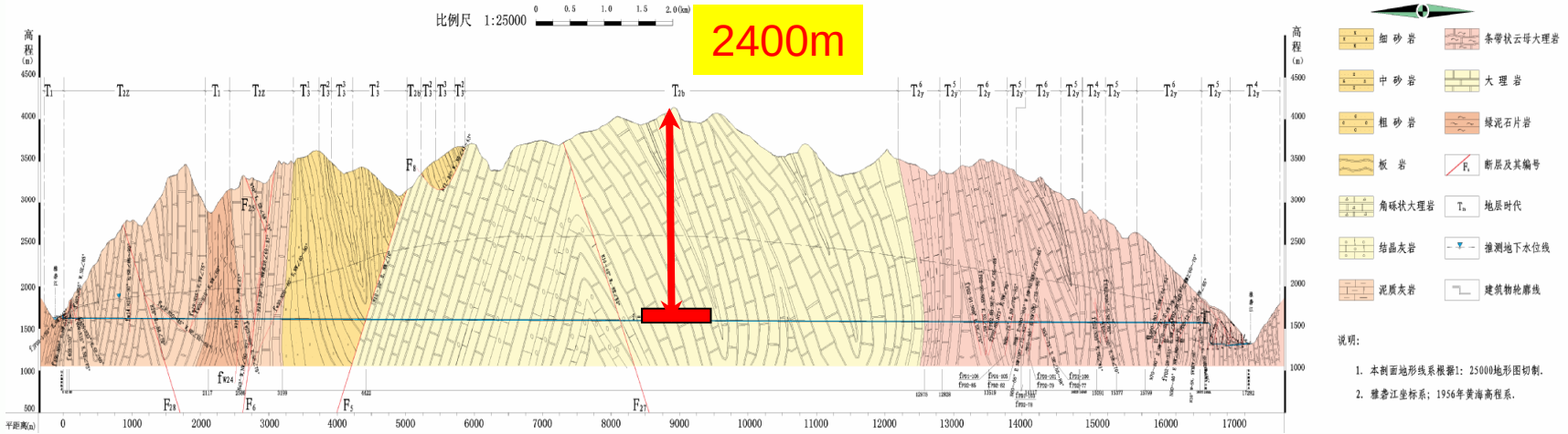


Jin Ping mountain & Ya long River

- 0.5 hr. flight from Chengdu to Xichang;
- 1.5 hr. driving from Xichang to JinPing

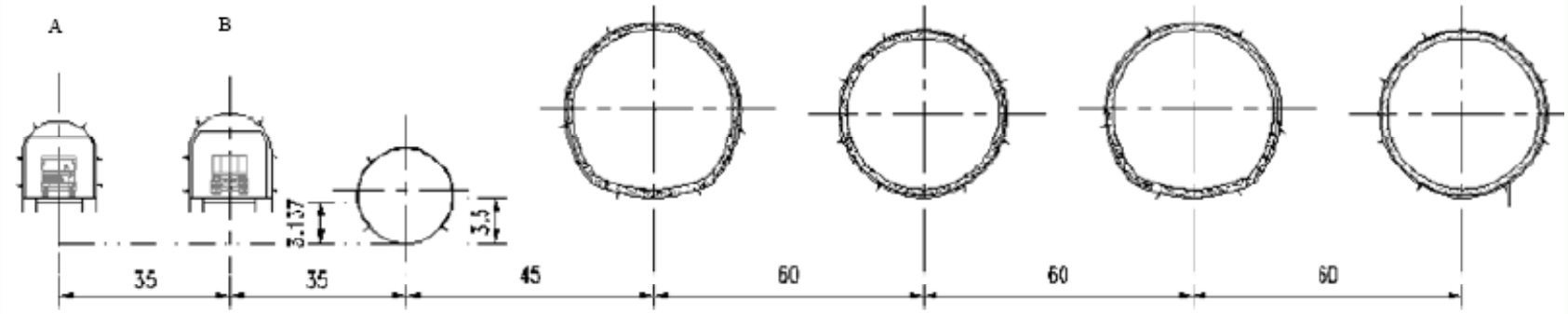
Road class 1，1.5 hr.

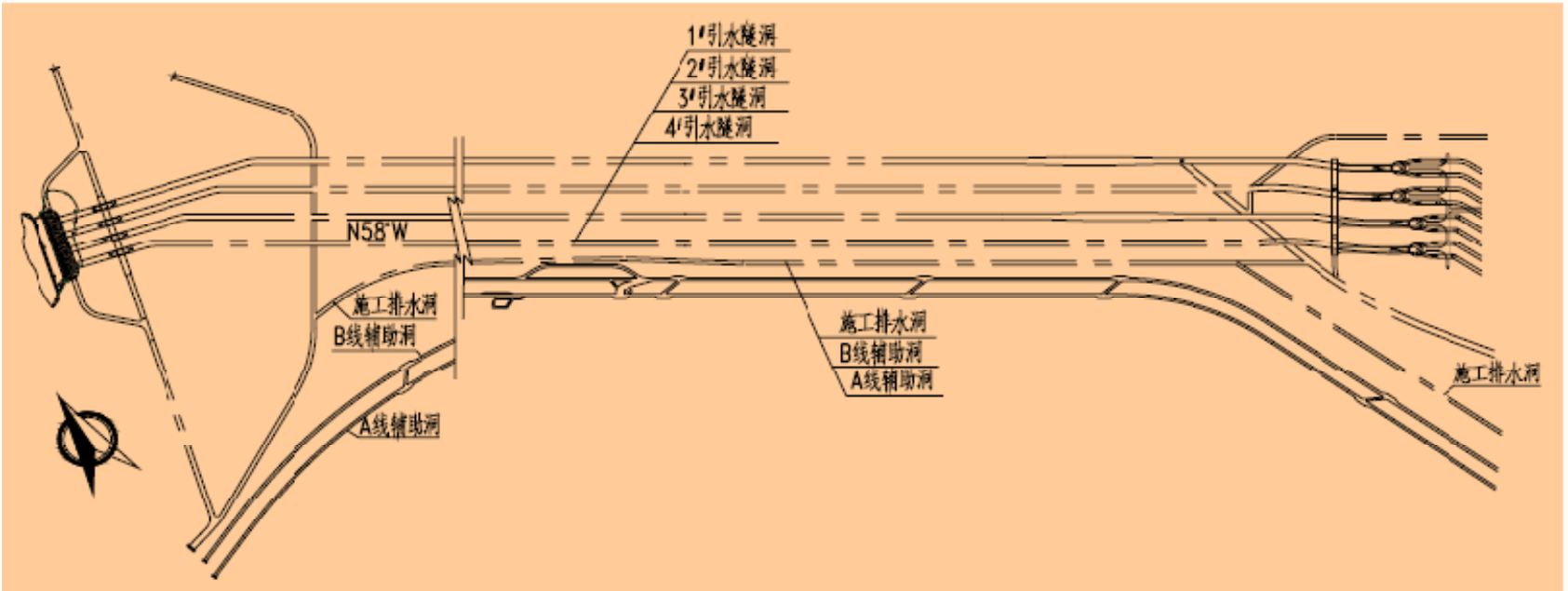
Logistics on site



Tunnel length
~17.5km

辅助洞、施工排水洞及引水隧洞关系图

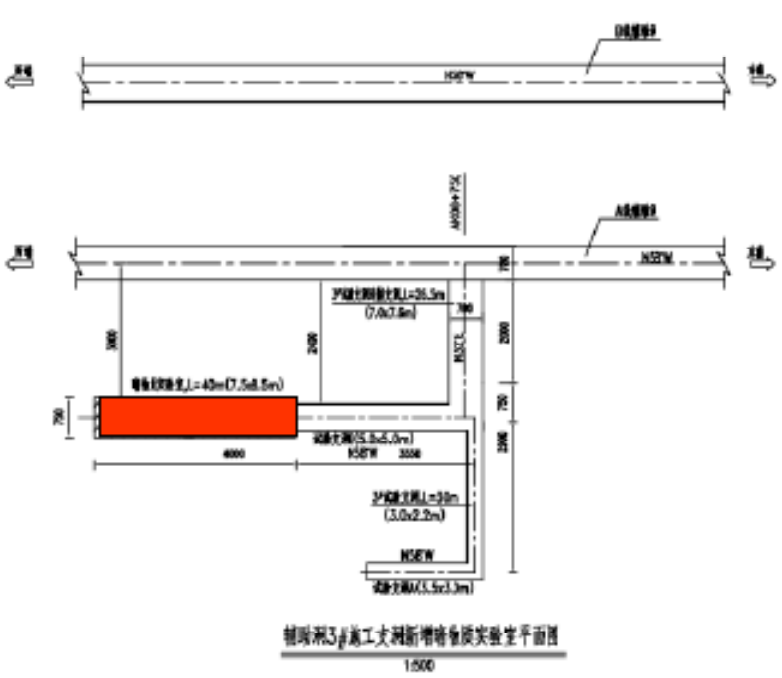


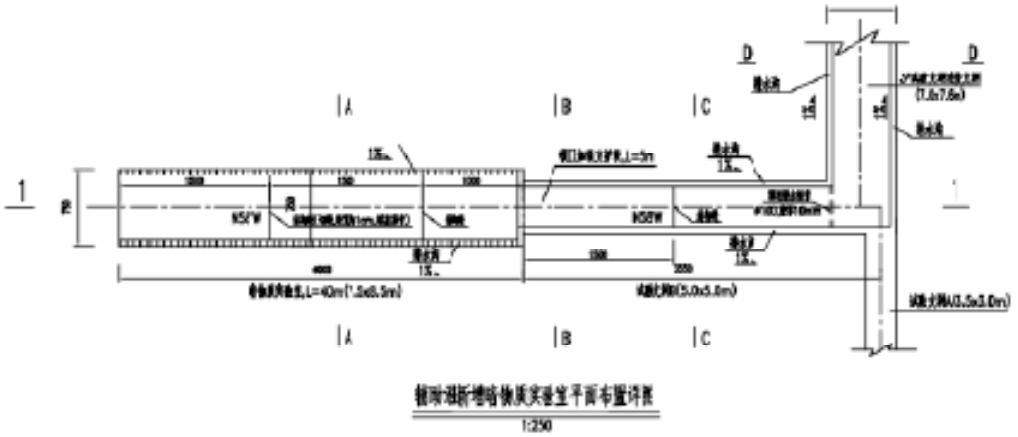


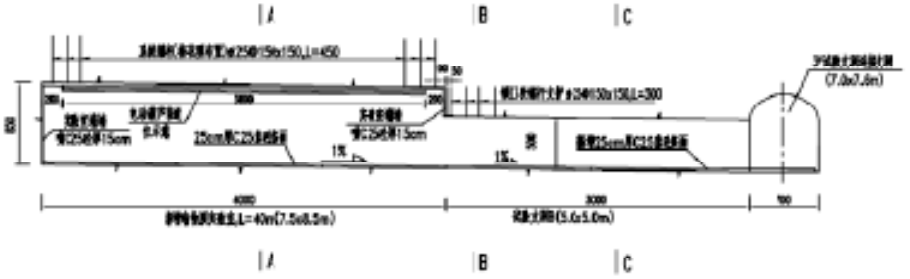

中铁十四局集团承建锦屏辅助洞工程
树诚信精品意识 创业主满意工程
A洞
英勇顽强 拼搏奉献
昔日戎装竞风
快速有序优
今朝锦屏
中铁十四局集团承建锦屏辅助洞工程
立志汗发锦屏 奉献水电事业
B洞
大水沟隧道

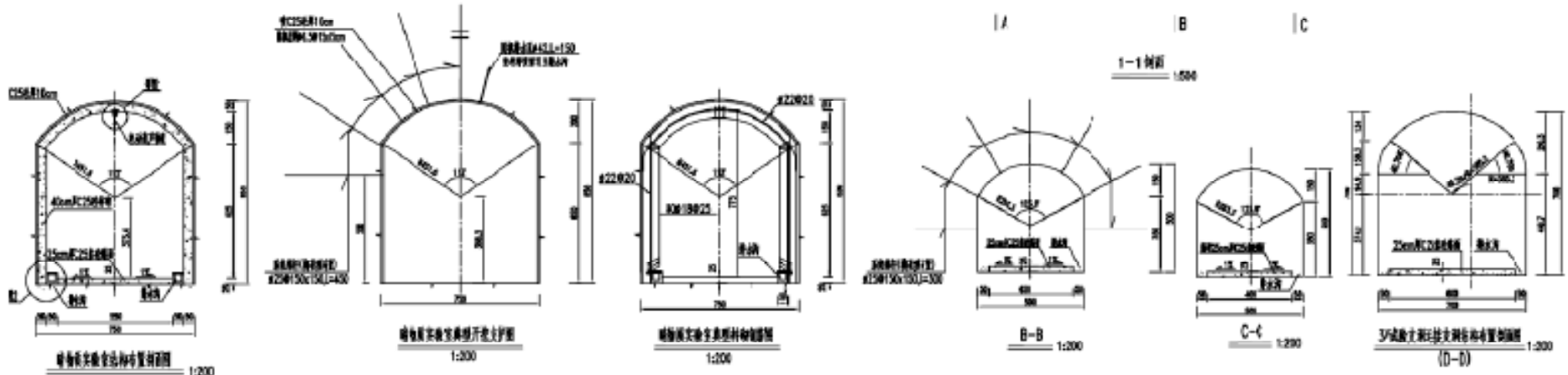

高 速 优 质 安 全 环 保
中铁十八局集团热烈祝贺锦屏1#TBM顺利步进
穿山钢甲驰骋锦屏展风采
引水蛟龙搏击雅砻立新功
Robbins
2008 8 12

Design of CJPL (TsingHua Univ. & Ertan)









Civil Construction finished in June, 2010

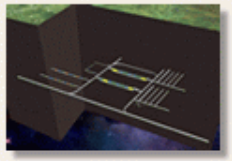
暗物质实验室整体形象

连接支洞整体形象

Visit of CJPL

Hallway to Exp. Hall

View of Experimental Hall



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Visit of CJPL

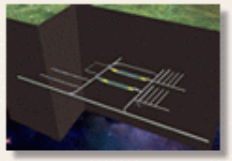
- Right now, is hosting two (CDEX, PandaX) experiments there;
- Plan to have some work for ventillation when we visit there；

Local rock sample radioactivity measurements

- 开挖处岩石样品天然放射性含量分析：

(Unit: Bq/kg)	K－40	Ra -226 (609keV)	Th -232 (911keV)
Local Sample	< 1.1	1.8 ± 0.2	< 0.27
Ground level	600	25	50

- 非常好的低本底围岩环境。



国家深地实验室
National Deep Underground Laboratory

Brief history about NLAB in CAS

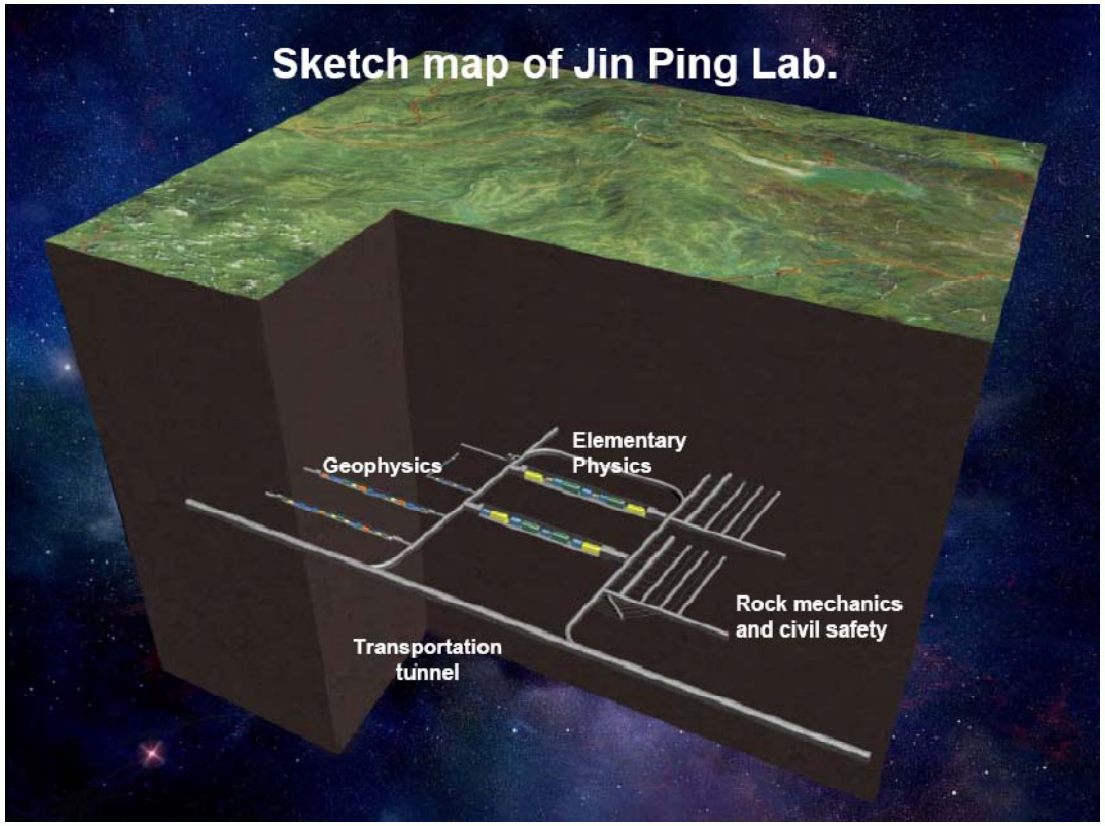
- 2006-2008, Propose for a National underground lab.
- Nov. 2008, CAS organized for deep underground laboratory discussion
- Feb.-Mar, 2009, support the funding application for Dark matter and Dark energy studies from government.
- Oct. 29-30, 2009 organized XiangShan workshop
- Mar. 2010, Developed underground laboratory proposal for the 12th 5 year planning, it didn't pass the last round of voting.

5 Institutions from CAS are included in the proposal：

Institute of Geodesy and Geophysics, Institute of High Energy Physics, Institute of Modern Physics, Institute of Physics and Mathematics, Institute of Rock and Soil Mechanics

Target and Planning

- **Target：Deep underground national laboratory**
  - **Deep(est) underground laboratory**
  - **Multi-purpose**
  - **International platform**



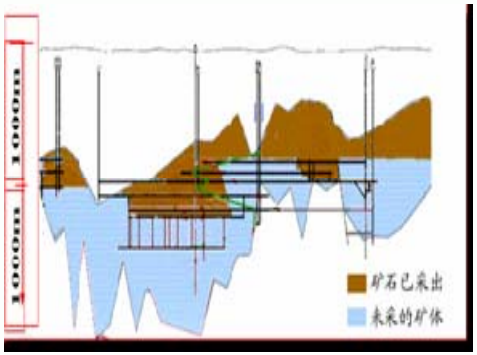
Rock mechanics

Deep underground construction is important in China

Mine：Mine is toward deeper than 1000m, getting more and more difficult;

Hydrolic Power station：Tunnel could be 20km long, overburden 2525m like in JinPing

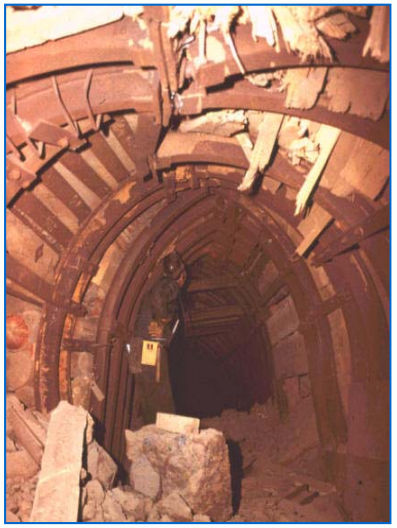
Transportation： Total length of tunnel > 5000km



Rock mechanics

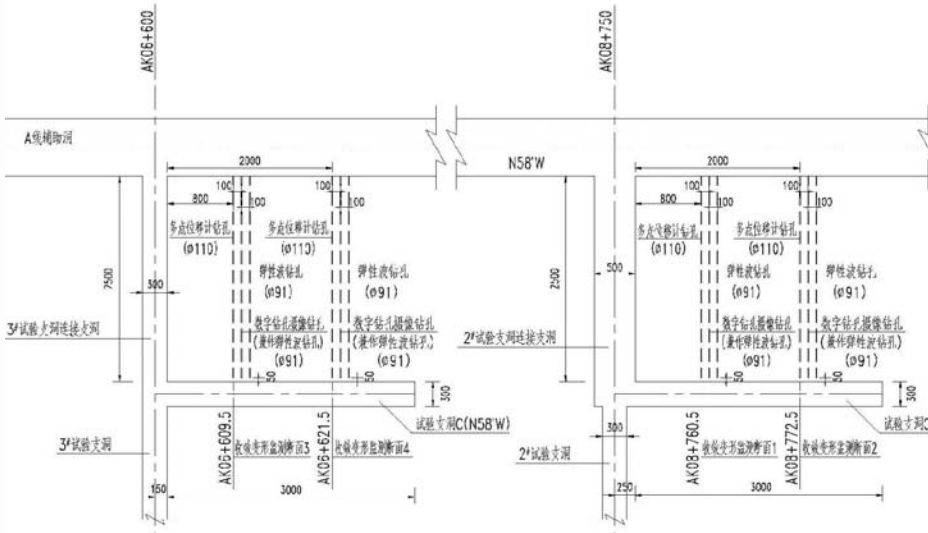
- All are correlated with safety problems

High pressure water leakage

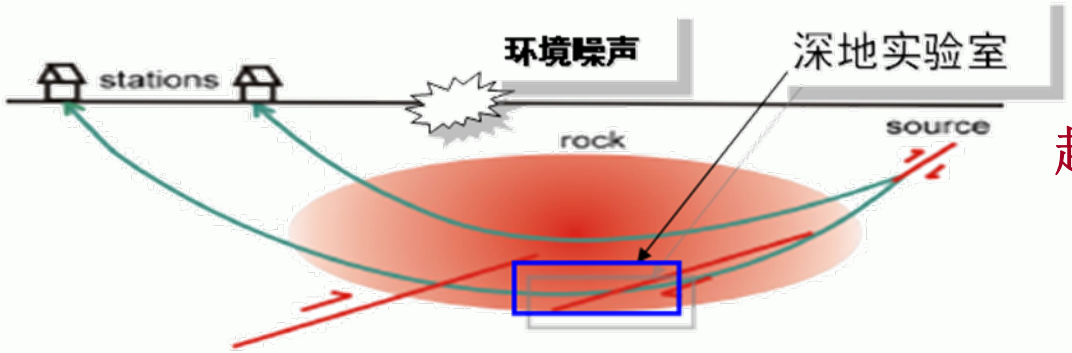


Deformation

- Already some cooperation studies exist

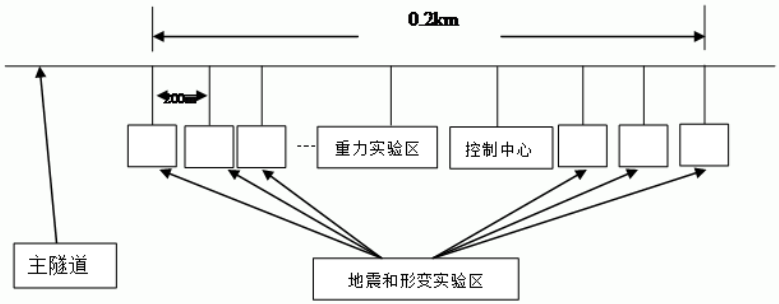


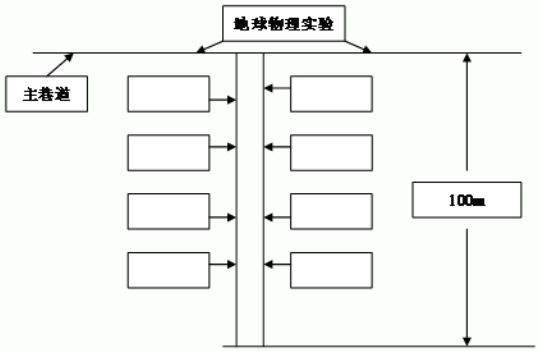
Geophysics

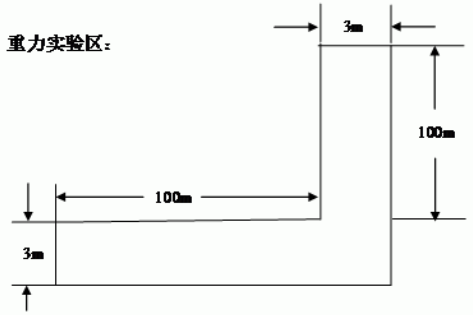


超导重力仪

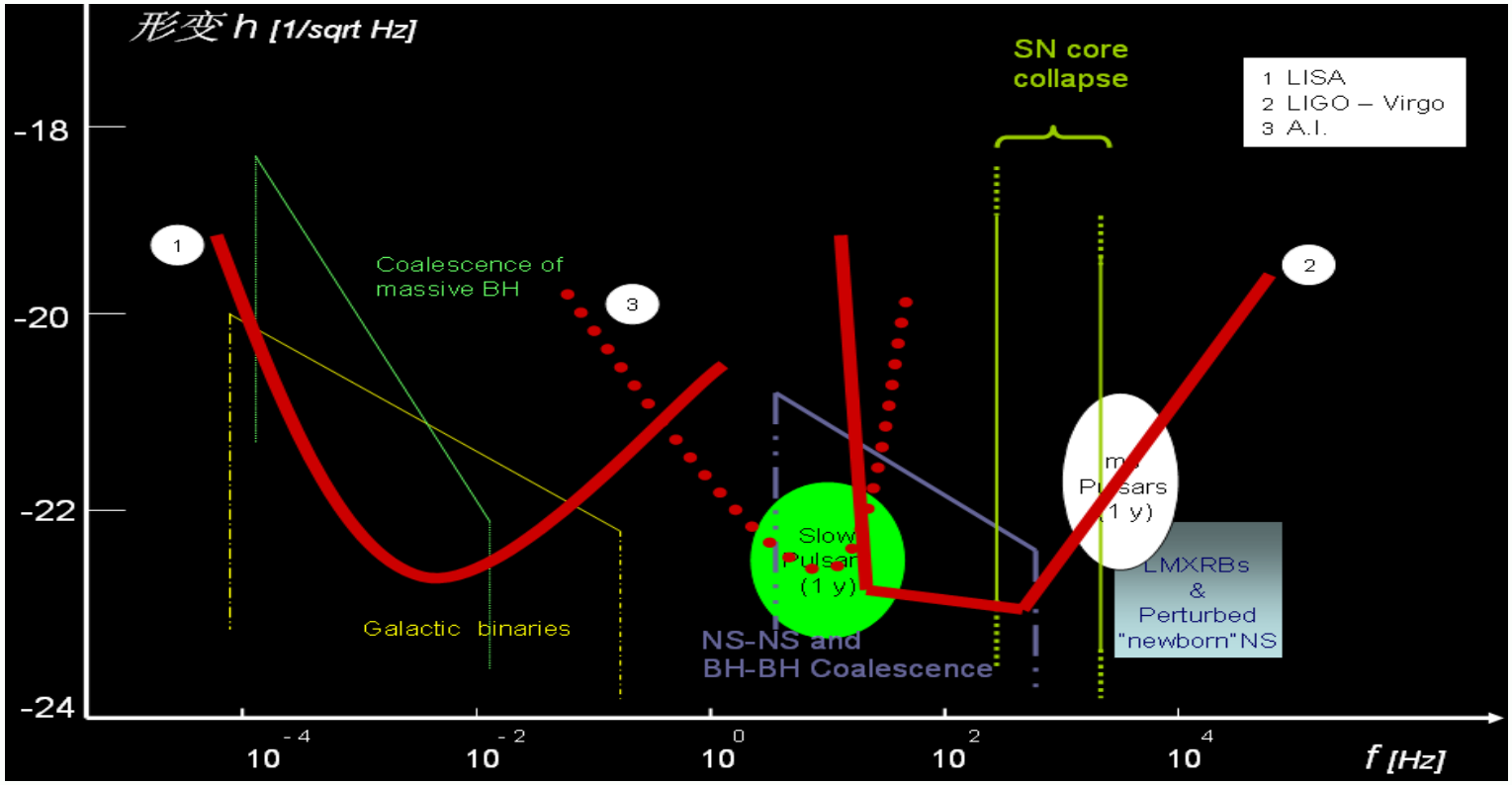
地震仪

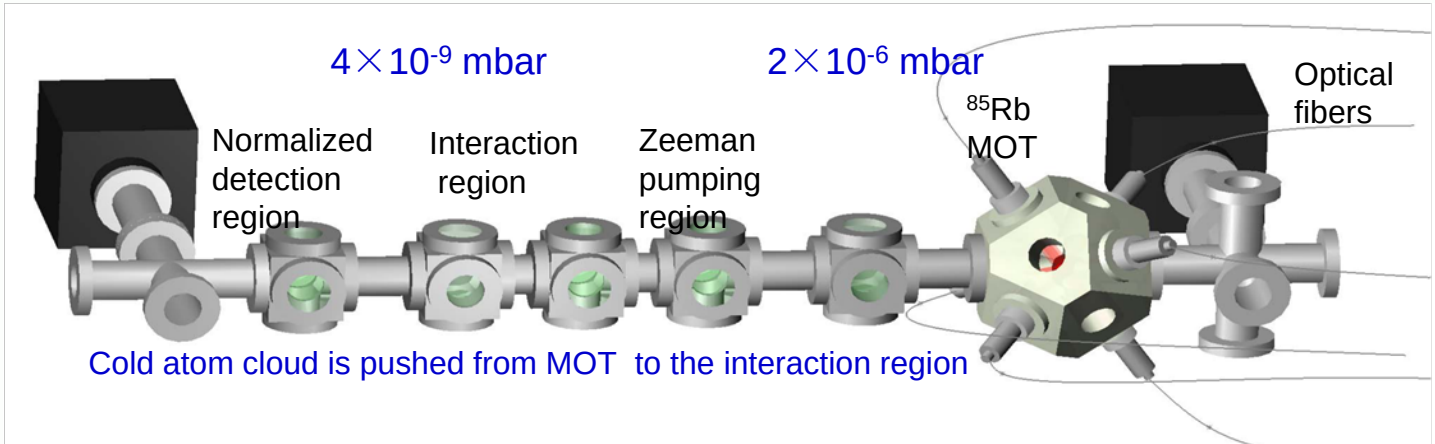




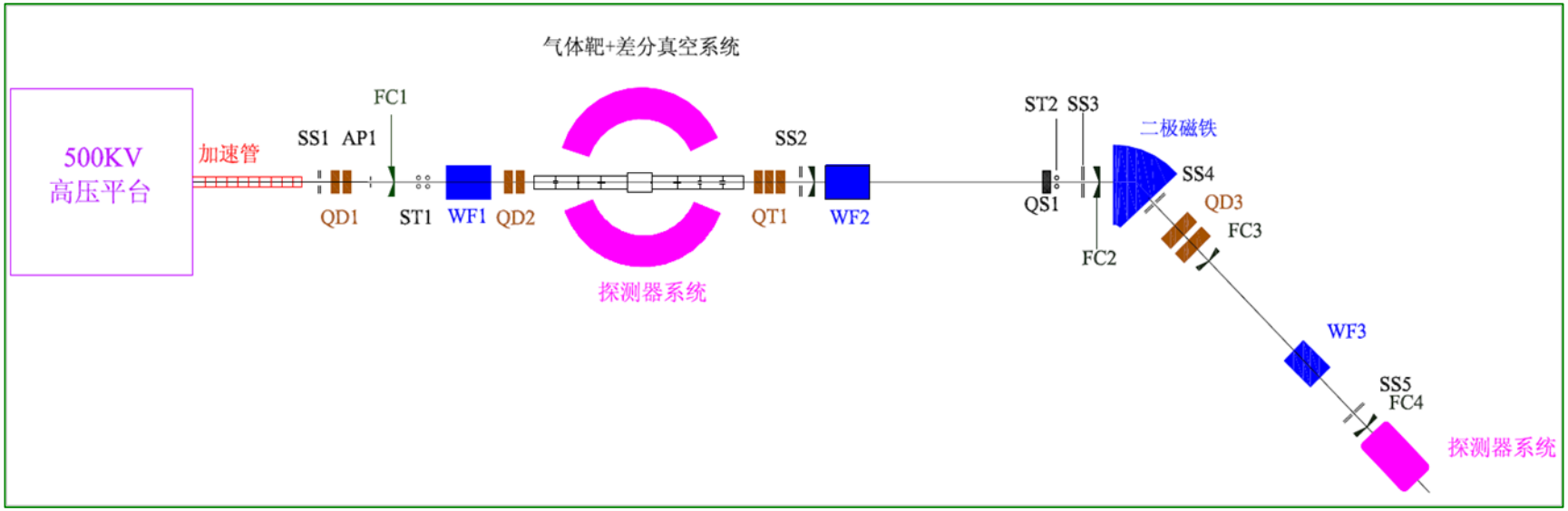


Atomic Interference





Nuclear Astrophysics



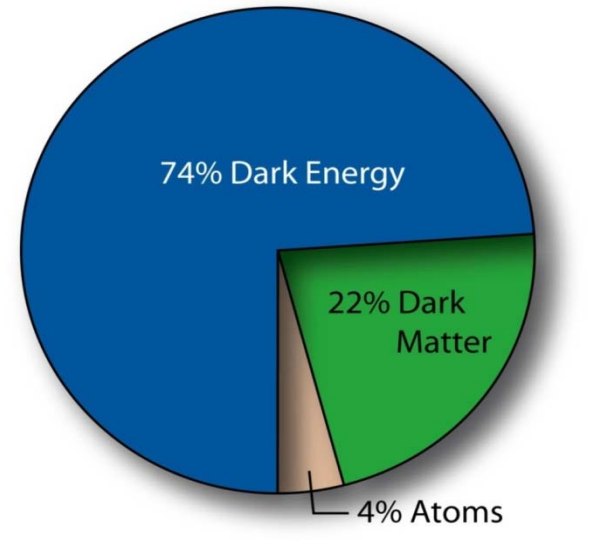
- **加速器系统**：500 kV高压平台加速器
- **无窗靶系统**：差分抽气系统
- **实验探测装置**：带电粒子探测器、探测器阵列、反冲核测量磁谱仪
- **配套实验室**

主要指标：

– 离子能量：50 ~ 500 keV
– 离子种类：质子到铁离子
– 束流强度：气体离子流强1mA，金属离子束流强略低

Particle Physics

Astronomical Observation

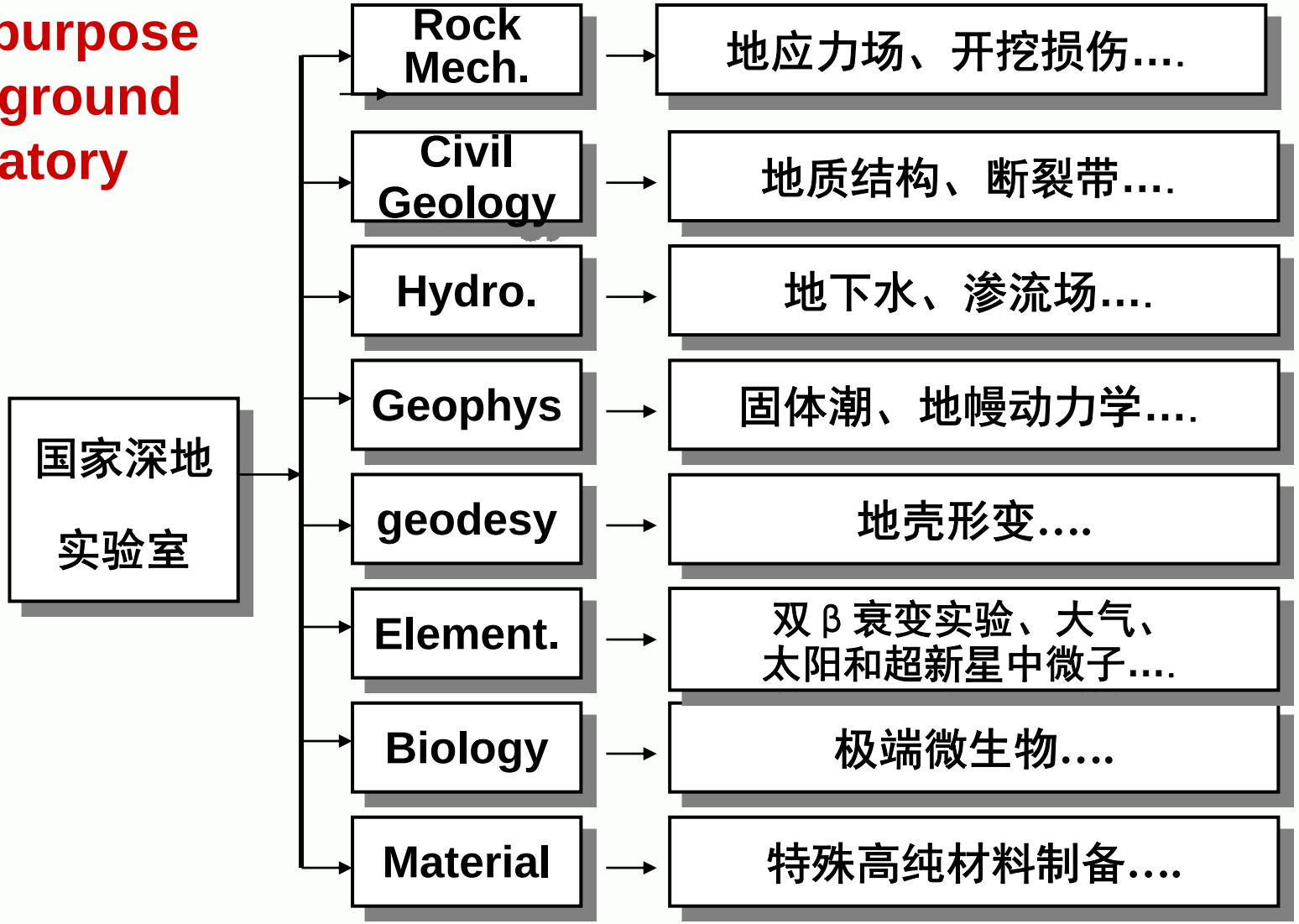


We still don't know what is the dark matter?

- **Atmospheric neutrino**
- **Solar neutrino**
- **Supernova neutrino**
- **Double beta decay**
- **Proton decay**
- **Dark matter**
- **Dark energy**
- **Very long base line neutrino experiment**

The Planning of CAS

Multi purpose underground Laboratory



What to do next?

- The Ertan hydro power company need another 2 years to do the power plant installation, no other civil work is possible;
- The next 5 year plan start from 2016, need to prepare 2 years earlier(?)
- Have time to think it how should proceed.

Questions?

- How deep is deep? Does it need to go beyond 2400m ?

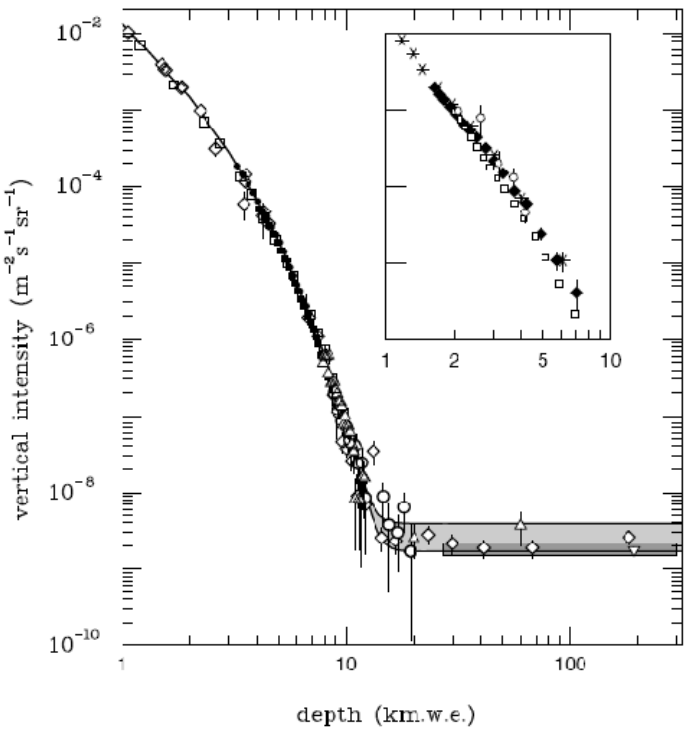


Figure 24.6: Vertical muon intensity vs depth (1 km.w.e. = 10^5 g cm^{-2}of standard rock). The experimental data are from: ◊: the compilations of Crouch [55], □: Baksan [60], ○: LVD [61], •: MACRO [62], ■: Frejus [63], and △: SNO [64]. The shaded area at large depths represents neutrino-induced muons of energy above 2 GeV. The upper line is for horizontal neutrino-induced muons, the lower one for vertically upward muons. Darker shading shows the muon flux measured by the SuperKamiokande experiment.

Questions?

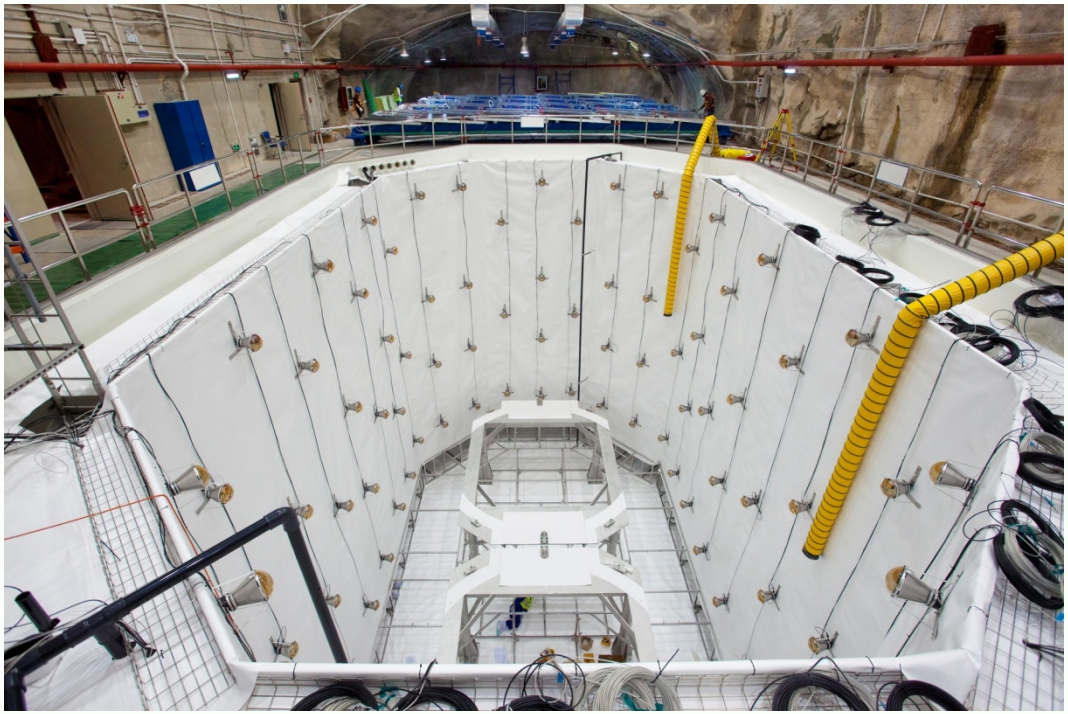
- Will the hydropower company continue use the transportation tunnel for other project?
- The underground Lab may need years for its civil work. What is the interference tolerance between each other?
- Will the existing transportation tunnel be good enough to accommodate the underground lab. requirement, e.g. the ventillation duct, the power and electric power lines, more work is needed in the half length of the tunnel which is 9km.

- Big caverns can be constructed (diameter > 13m) ?
- Will the 300m water drop cause noise for some measurements?

Summary

- Underground Lab is necessary both for natural science studies and other society construction project, CAS is very supportive to construct it as multi-purpose, open, international underground laboratory.
- Jin Ping is an ideal site for underground laboratory because of the depth, low radioactivity, horizontal access.
- We plan to form the underground national lab proposal in the 13th 5 year planning, need to think clear over those questions in order to push it forward.

Getting some experience in Daya Bay experiment, include civil, equipment and low background



Thank you，谢谢！