Direct Detection of Dark Matter

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2010.11. workshop on LHC era physics in Nanning

Outline

1, Introduction

2, Detection technique

3, Physic results

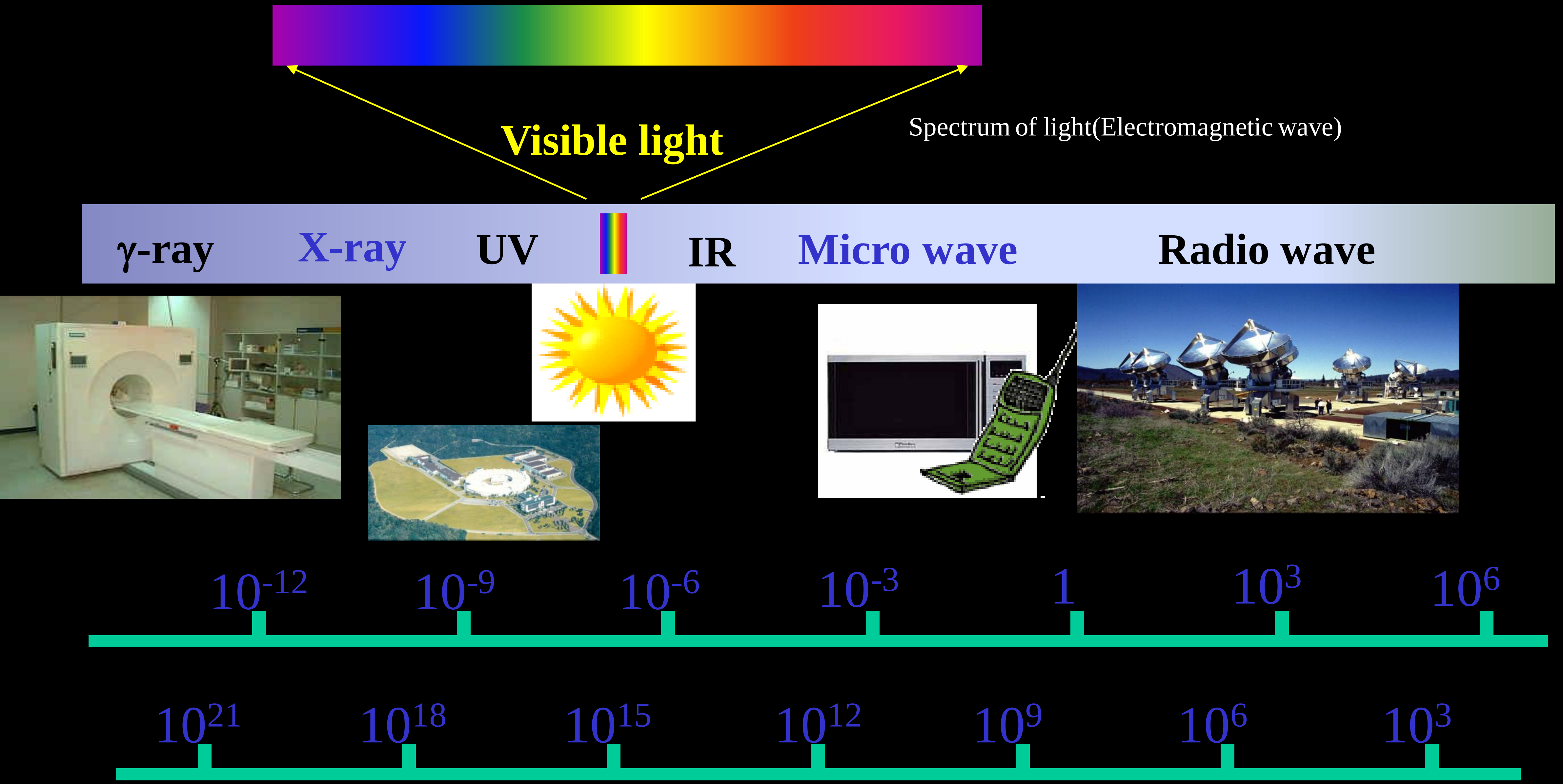
4., Dark Matter Detection in CJPL

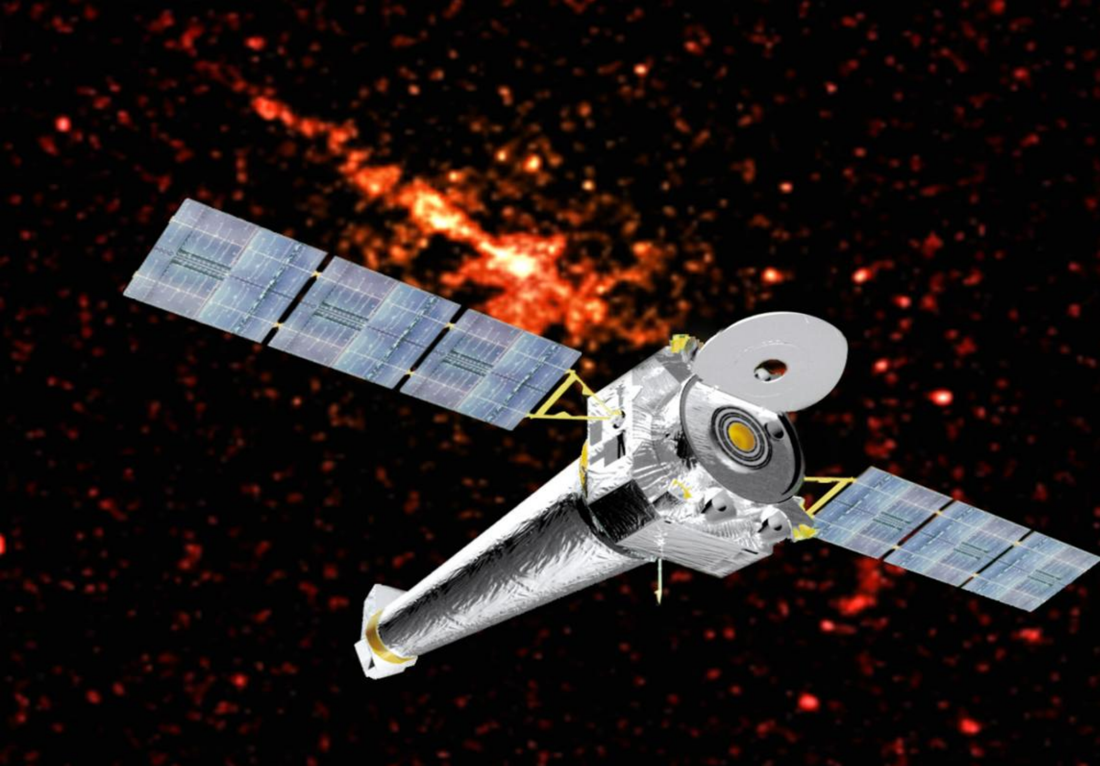
5, Summary

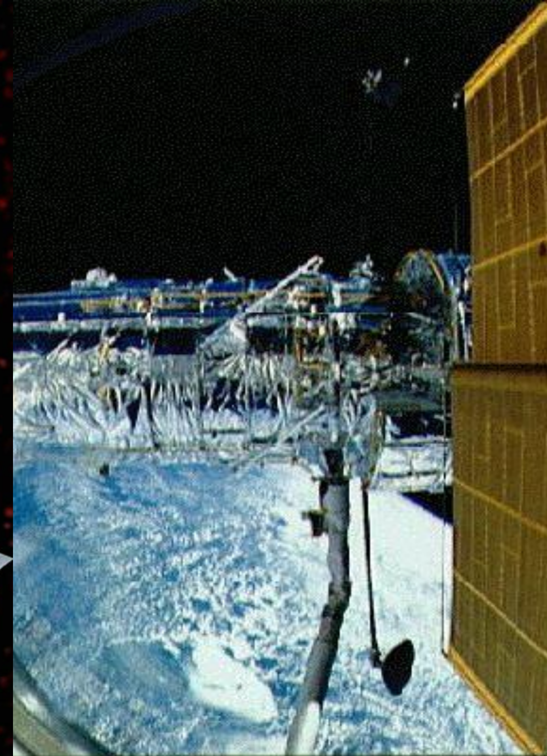
11 Greatest Unanswered Questions

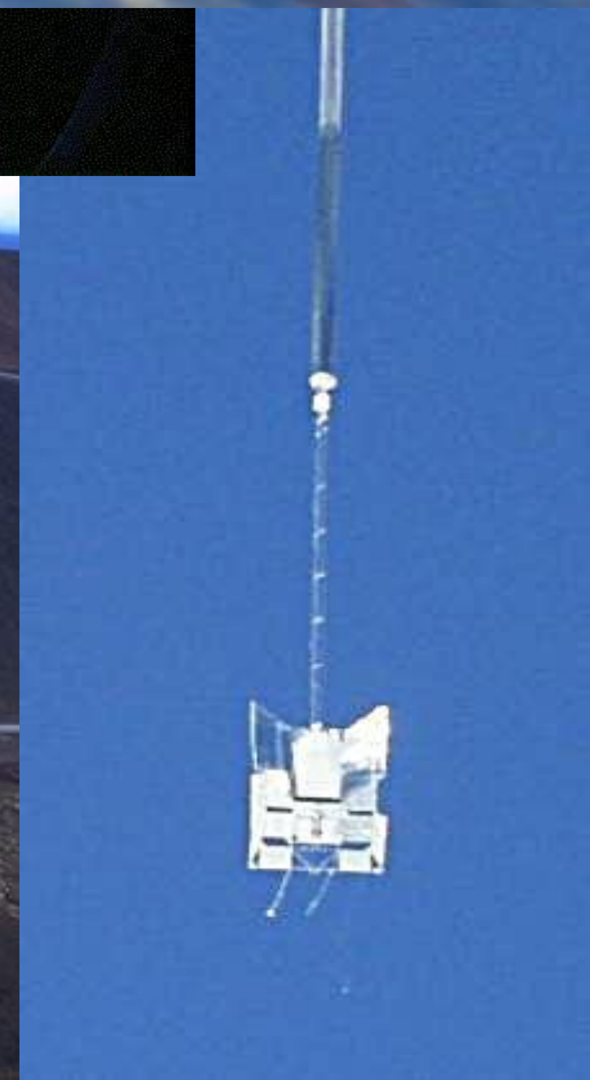
- 1. What is dark matter?
- 2. What is dark energy?
- 3. How were the heavy elements from iron to uranium made?
- 4. Do neutrinos have mass?
- 5. Where do ultra-energy particles come from?
- 6. Is a new theory of light and matter needed to explain what happens at very high energies and temperatures?
- 7. Are there new states of matter at ultra high temperatures and densities?
- 8. Are protons unstable?
- 9. What is gravity?
- 10. Are there additional dimensions?
- 11. How did the Universe begin?

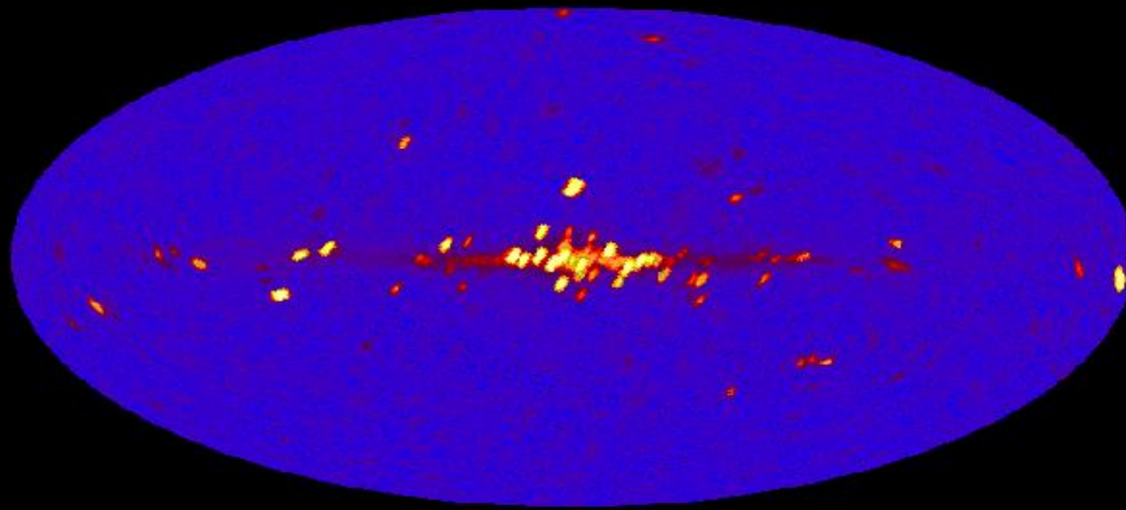
Electromagnetic wave “light” used to observe Universe

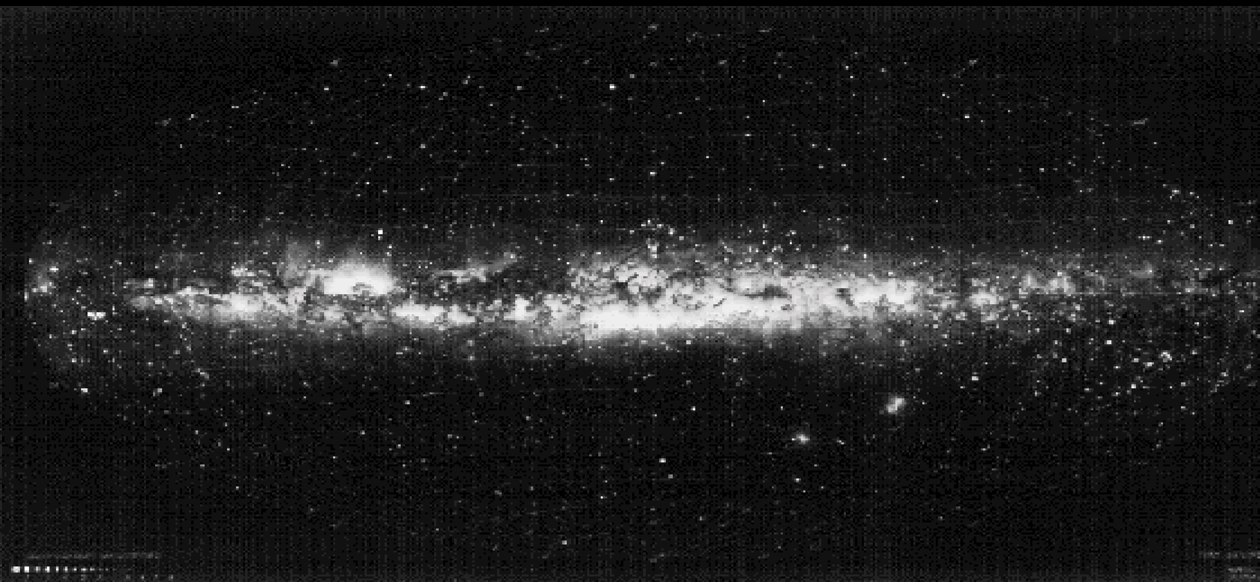


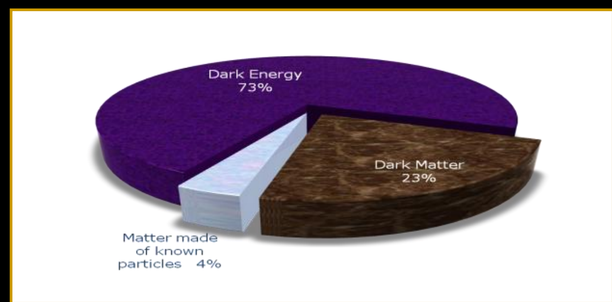











Dark Energy
73%
Dark Matter
23%
Matter made
of known
particles 4%

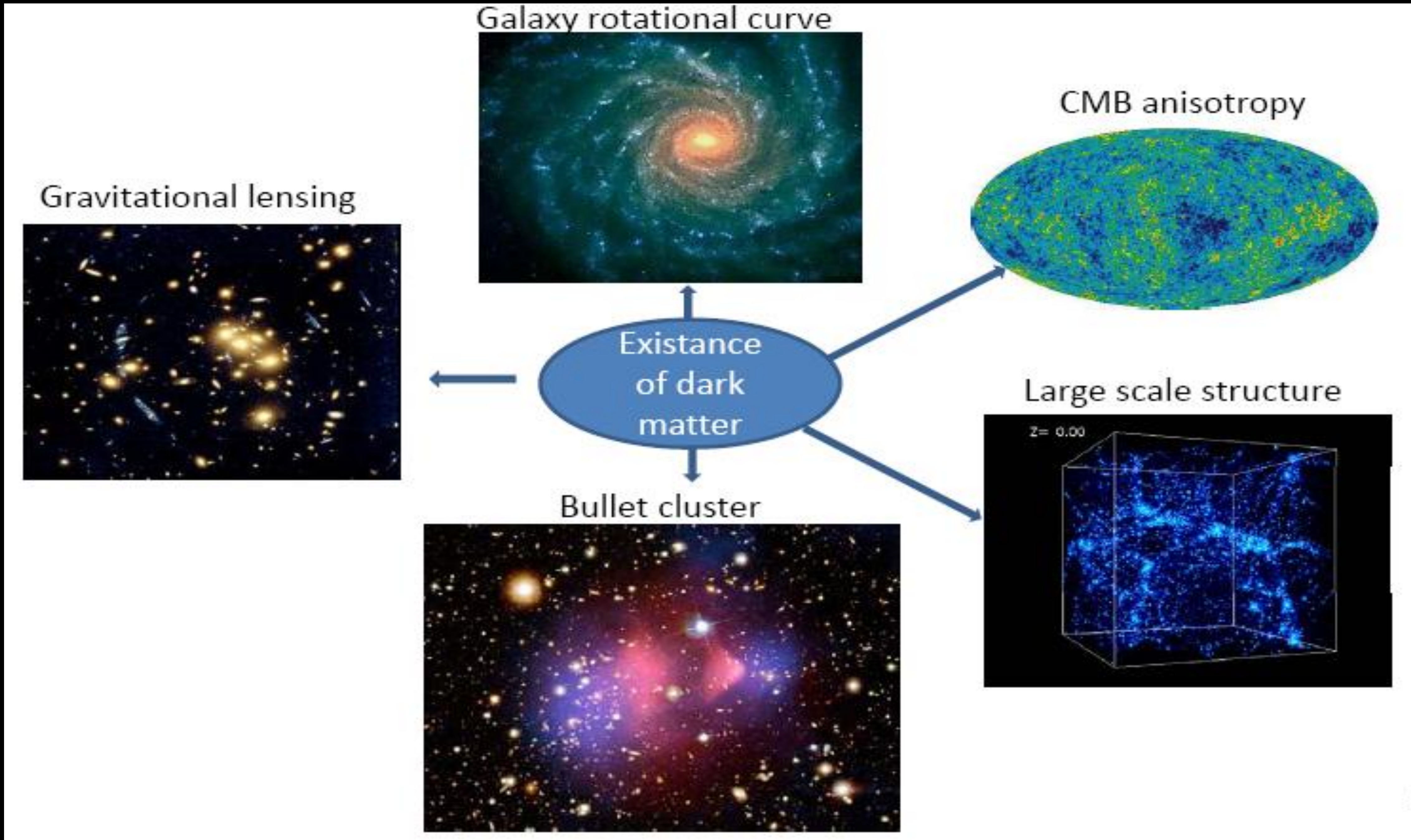
Dark matter

Can not be detected with any kind “light”

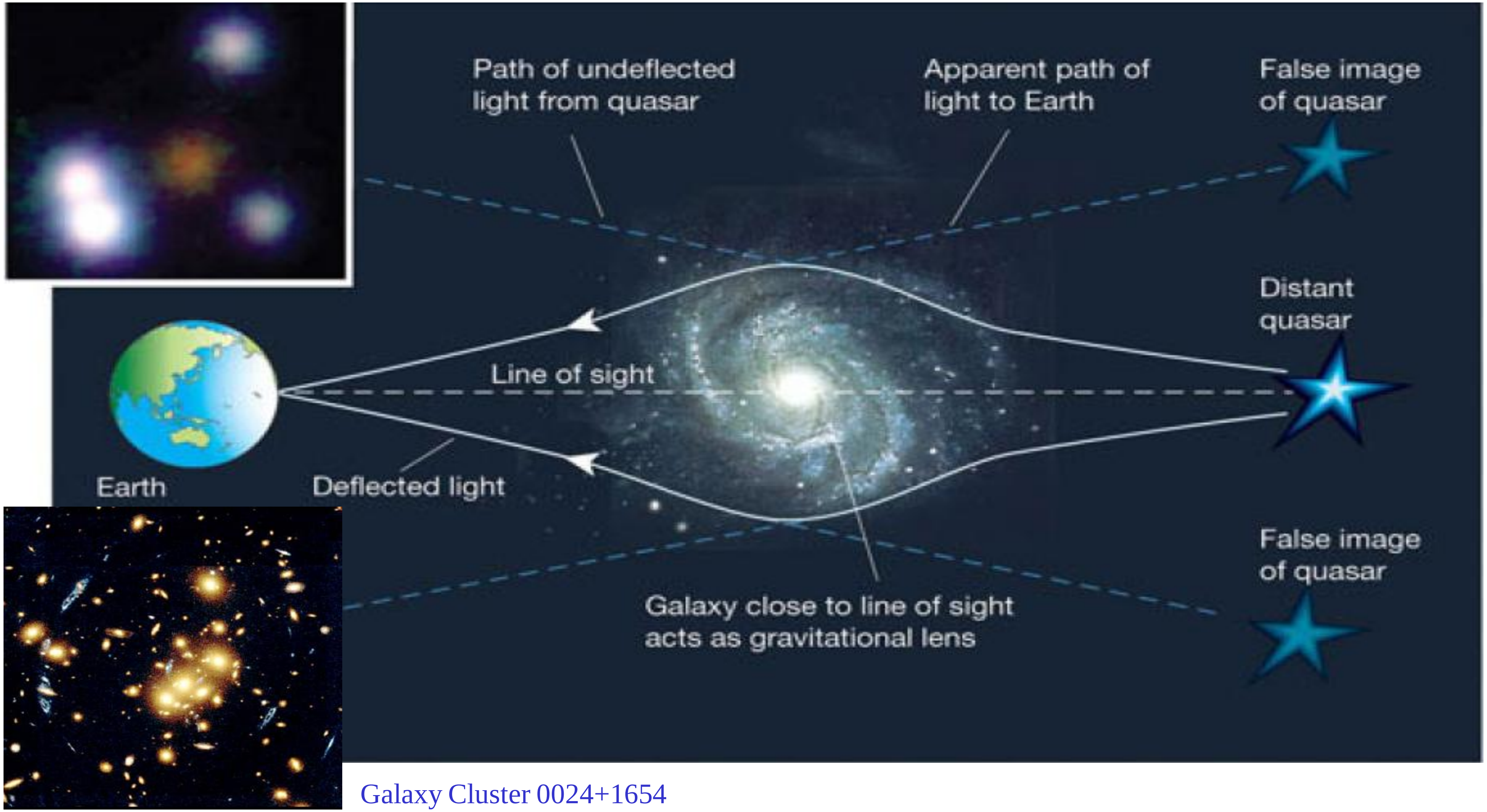
But ,it is in existence

And main part of universe

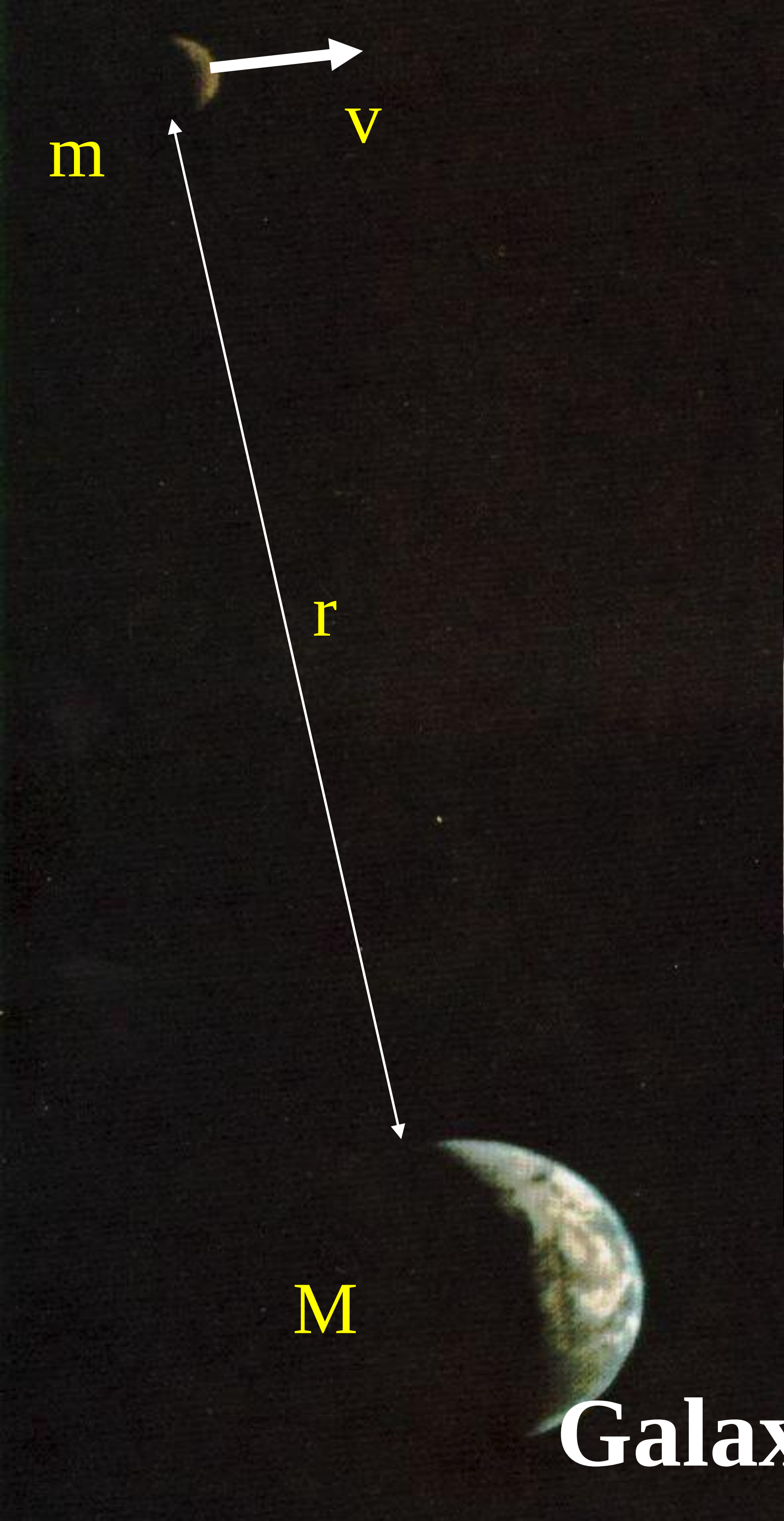
Astrophysical Evidence of DM



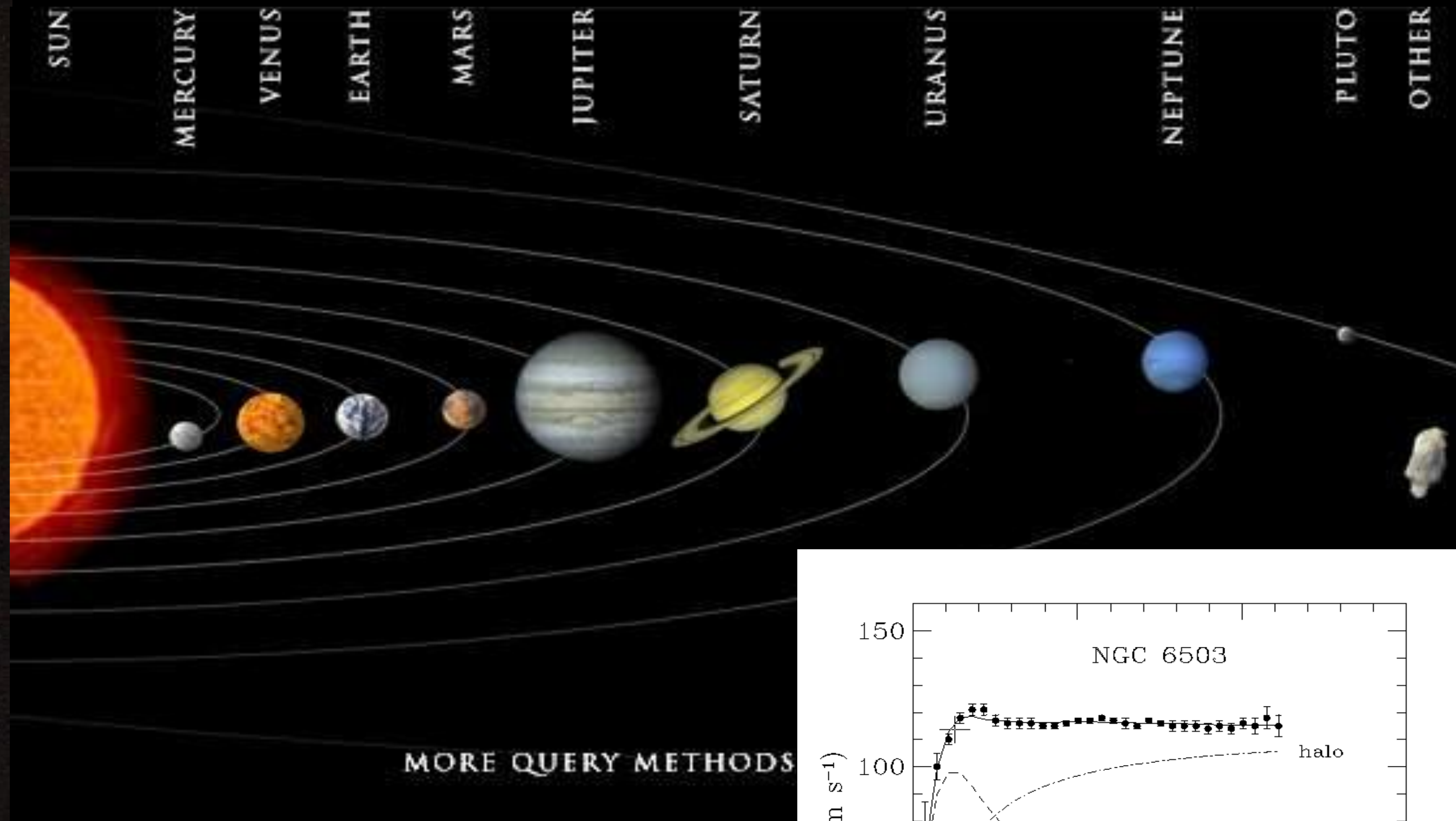
A **gravitational lens** is formed when the light from a very distant, bright source (such as a Quasar) is "bent" around a massive object (such as a cluster of galaxies cluster of galaxies) between the source object and the observer

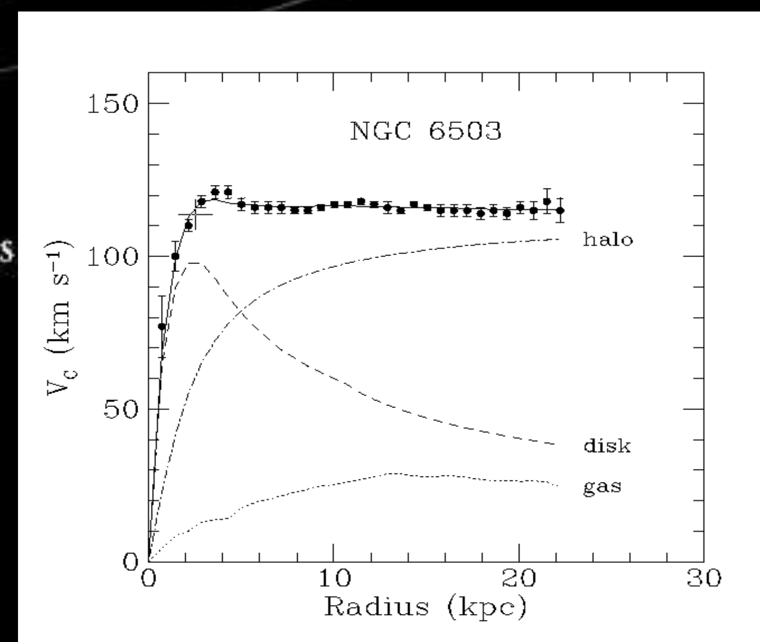


Galaxy Cluster 0024+1654



$$\frac{GMm}{r^2} = \frac{mv^2}{r} \rightarrow v^2 = \frac{GM}{r}$$

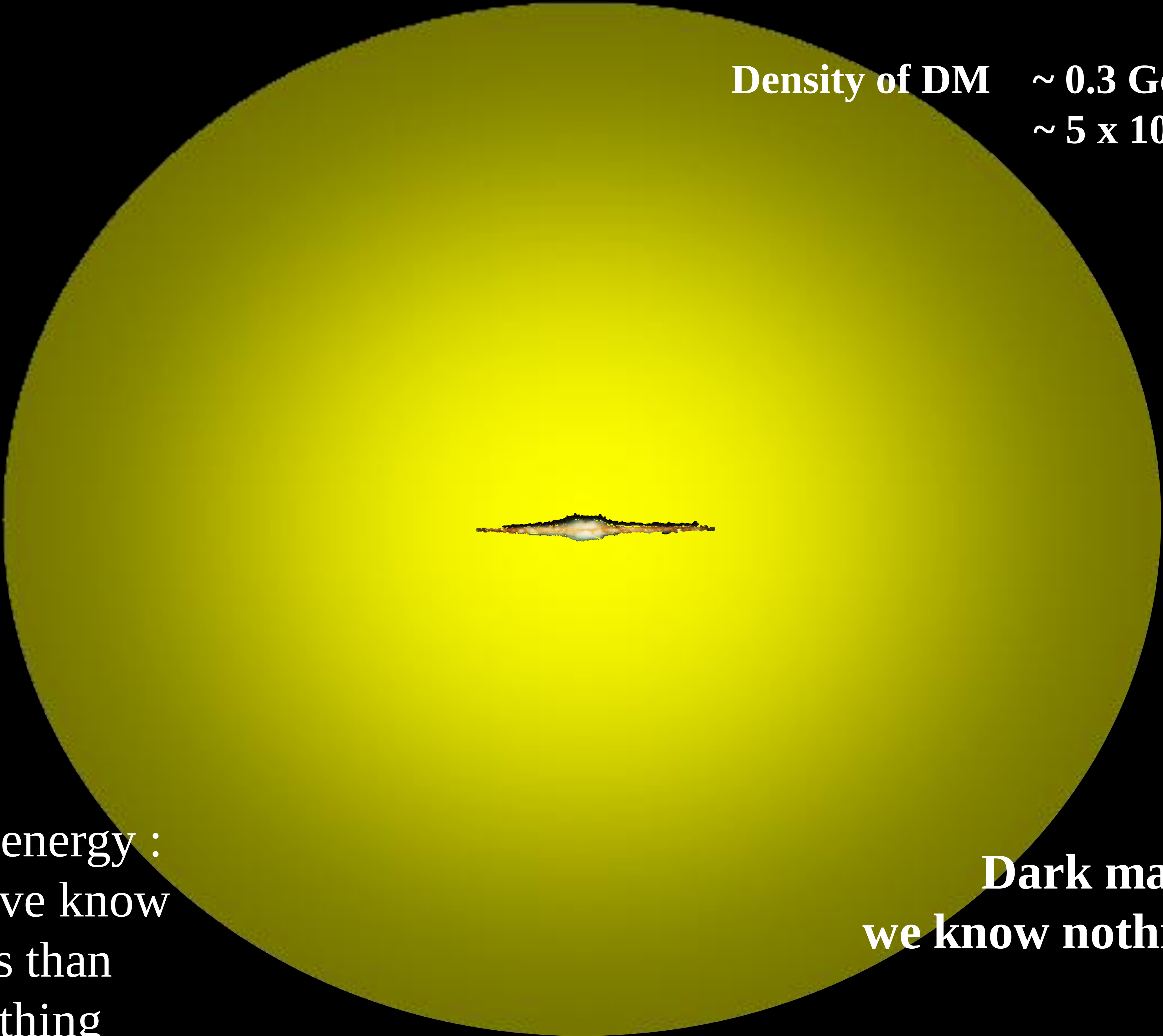




Galaxy Rotation Curve

Density of DM **~ 0.3 GeV /cm^3**

~ 5 x 10^{-28} kg/cm^3



Dark energy : we have know less than nothing

Dark matter : we know nothing ,but …

Dark Matter Candidates

Baryonic
- White Dwarfs
- Brown Dwarfs
- Neutron Stars
- Black Holes

Non-Baryonic
- **Hot Dark Matter (HDM) relativistic**
  - Light neutrino ~ few tens of eV
- **Cold Dark Matter (CDM) non relativistic**
  - Axions ~ 10^{-5} eV
  - WIMP's (Weakly Interacting Massive Particles)
    - a) massive neutrino
      - Majorana > 20 GeV (LEP)
    - b) SUSY(Super Symmetry) Particles
      - Neutralino > 30 GeV (LEP)
  - ....

Property of WIMP

Suppose : Element particle

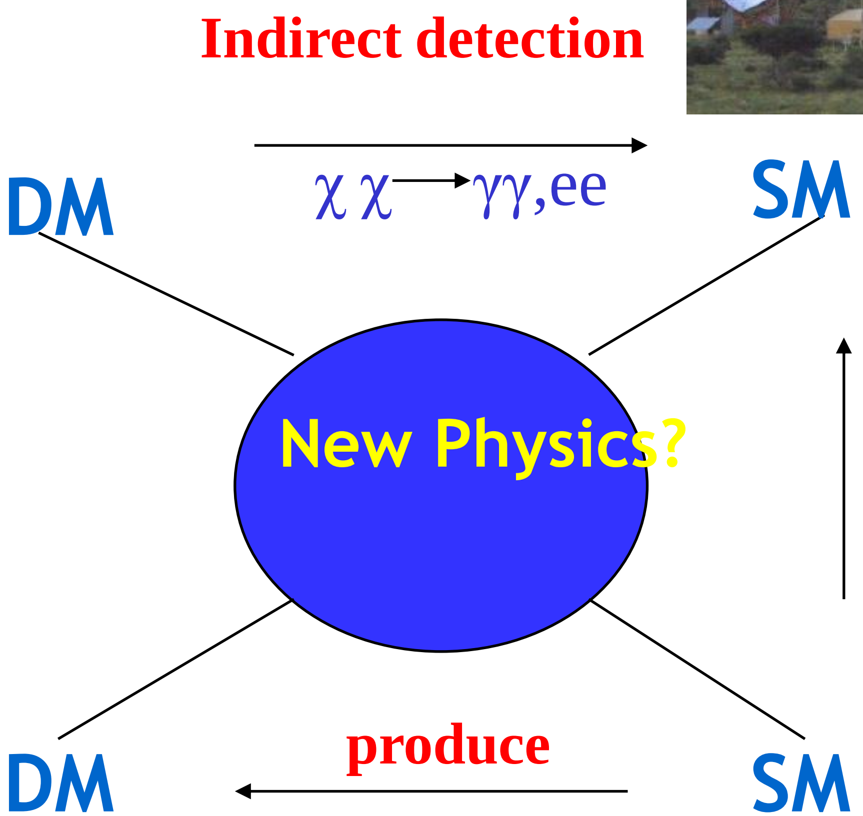
- came from BB
- massive
- neutral
- weak interaction
- speed very low
- stable

WIMP mass : 10~100 GeV（or smaller)

flux: 100,000/cm^2/s

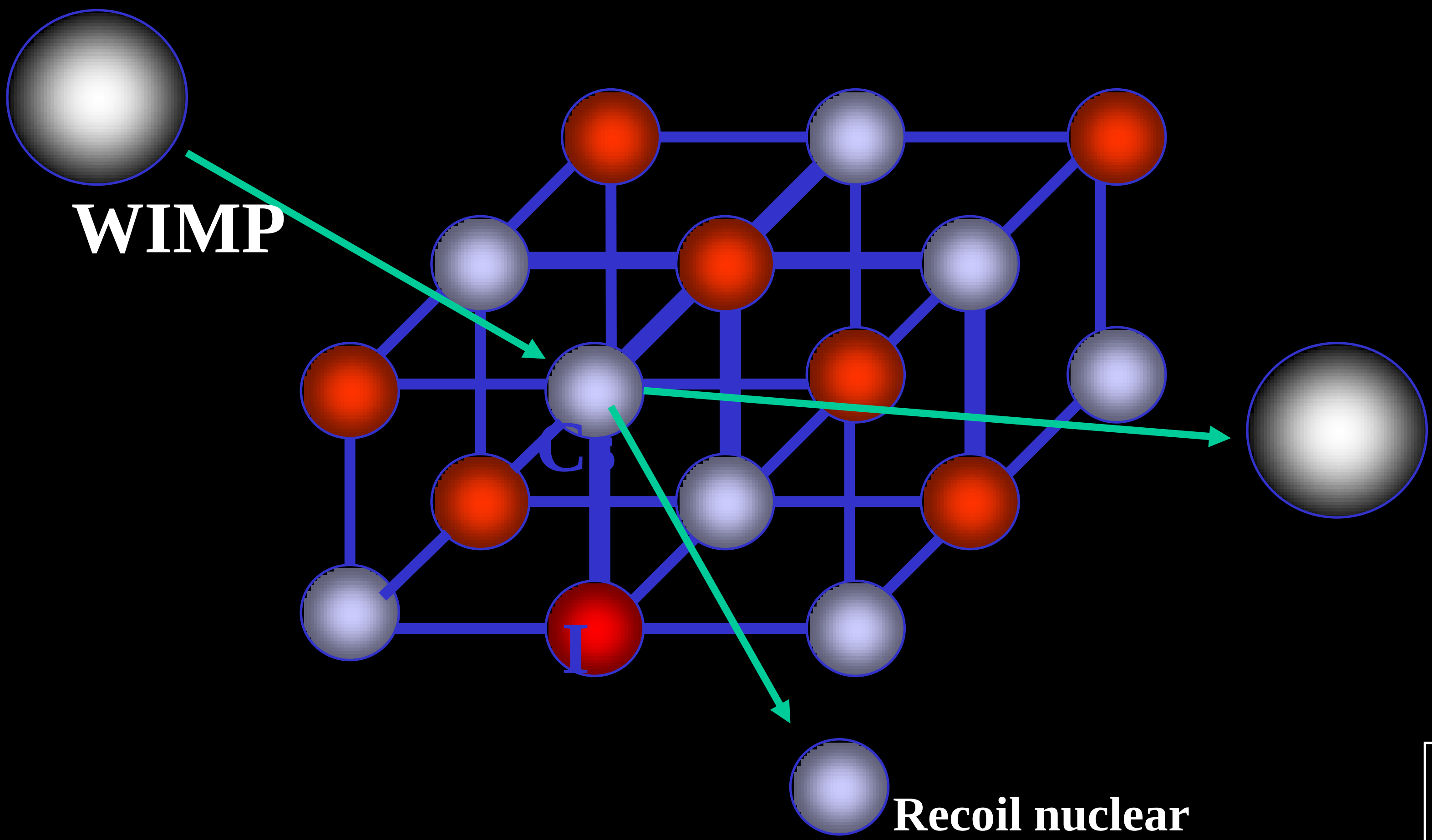
Direct Detection of WIMP

Detection of Dark Matter

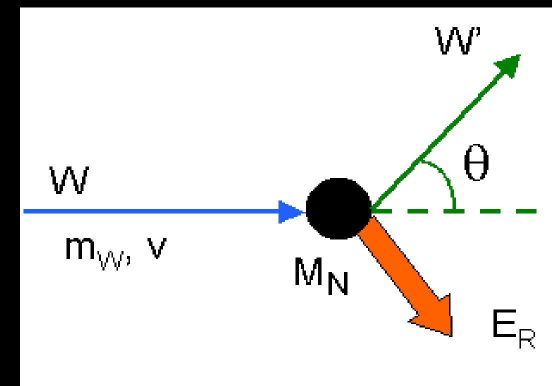


Direct detection

WIMP nuclear elastic scattering

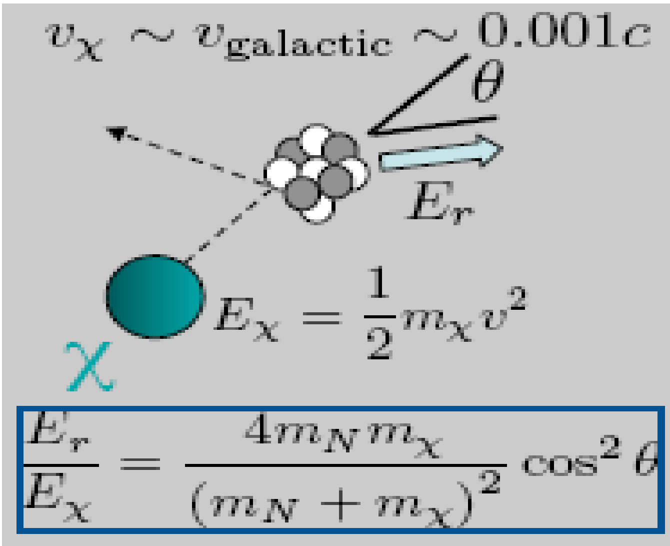


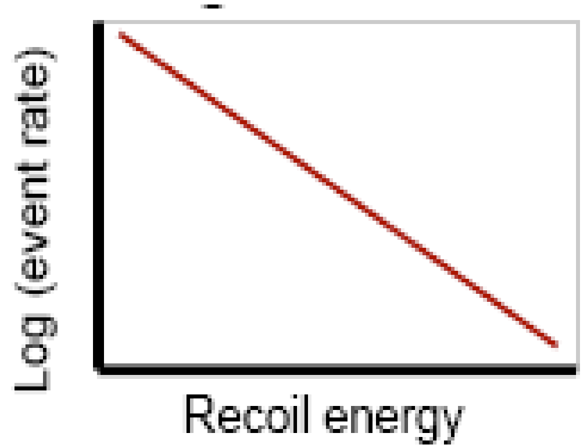
< 1/kg/day



Detector / Target

recoil nuclear is normal particle , can be detected



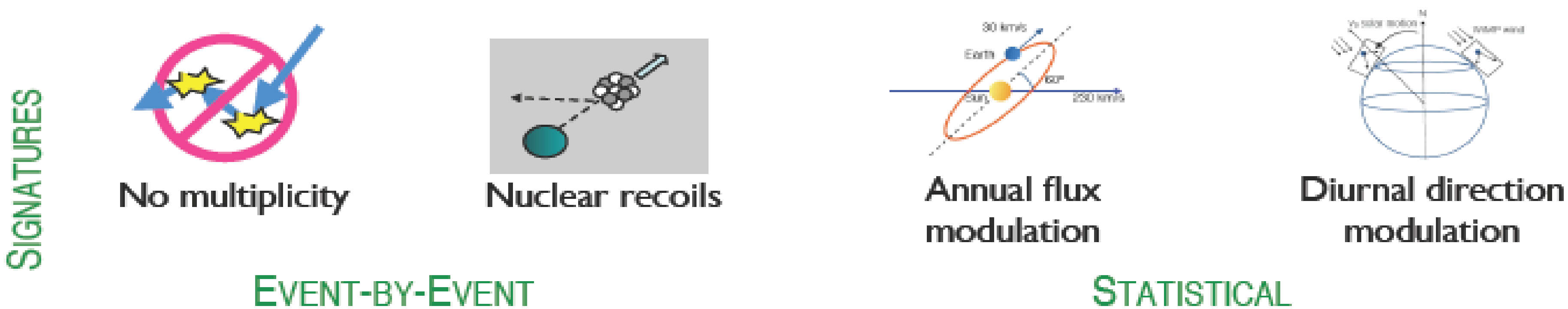


Typical energy 0-50KeV

Exponential spectrum of ⟨E⟩ ~ 30 keV nuclear recoils,
≪ 1/kg/day
Ambient background:
≳10⁶/kg/day

WIMP & normal particle

Normal Particle with Low Energy

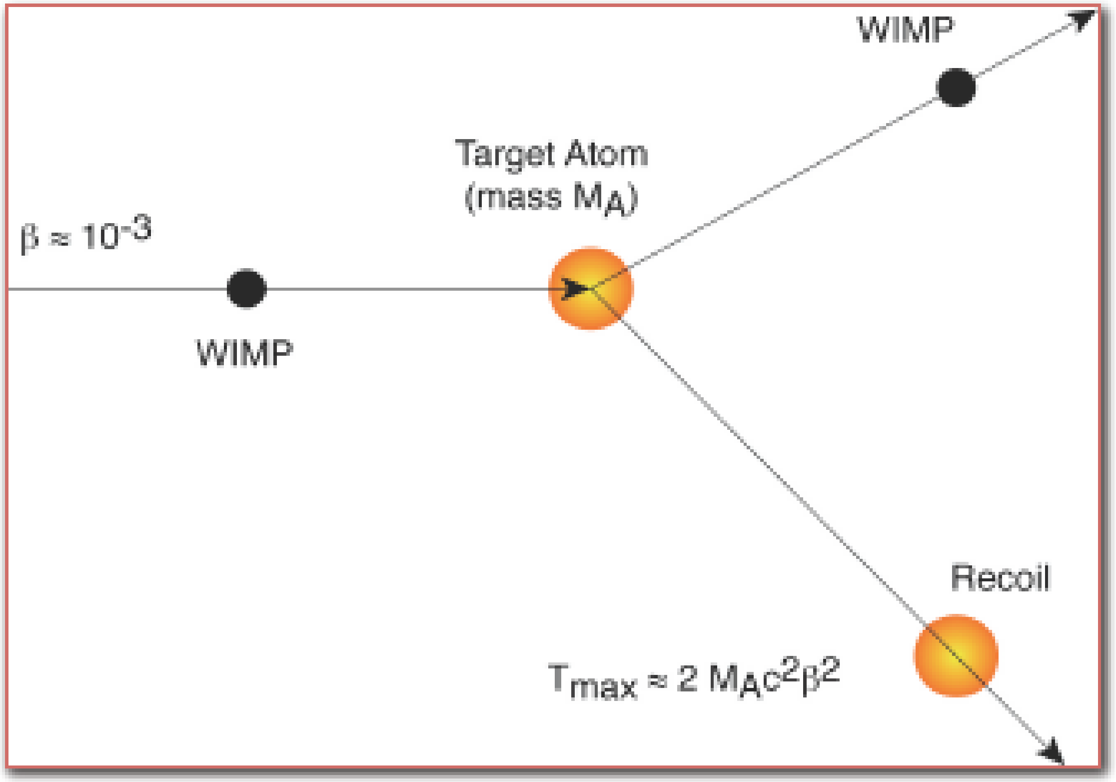


Direct Dark Matter Detection

- Direct WIMP detection is based on the identification of nuclear recoils from elastic WIMP-nucleus interactions.

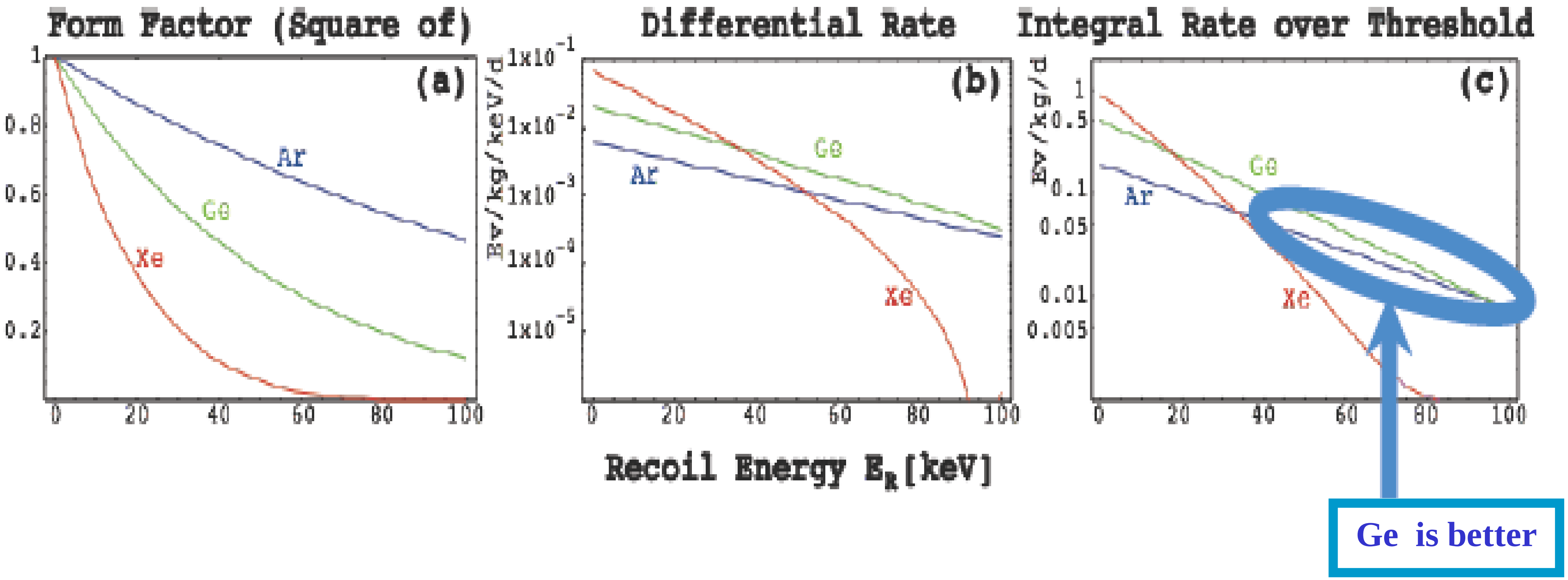
$$\frac{dR}{dE} = R_0 \cdot S(E) \cdot F^2(E) \cdot I$$

- $S(E)$: Spectral Function
- $F^2(E)$: Nuclear Form Factor
- I: Spin-dependent Term



Typical recoil energies: 0 ÷ 100 keV

Comparison of Different Dark Matter Target

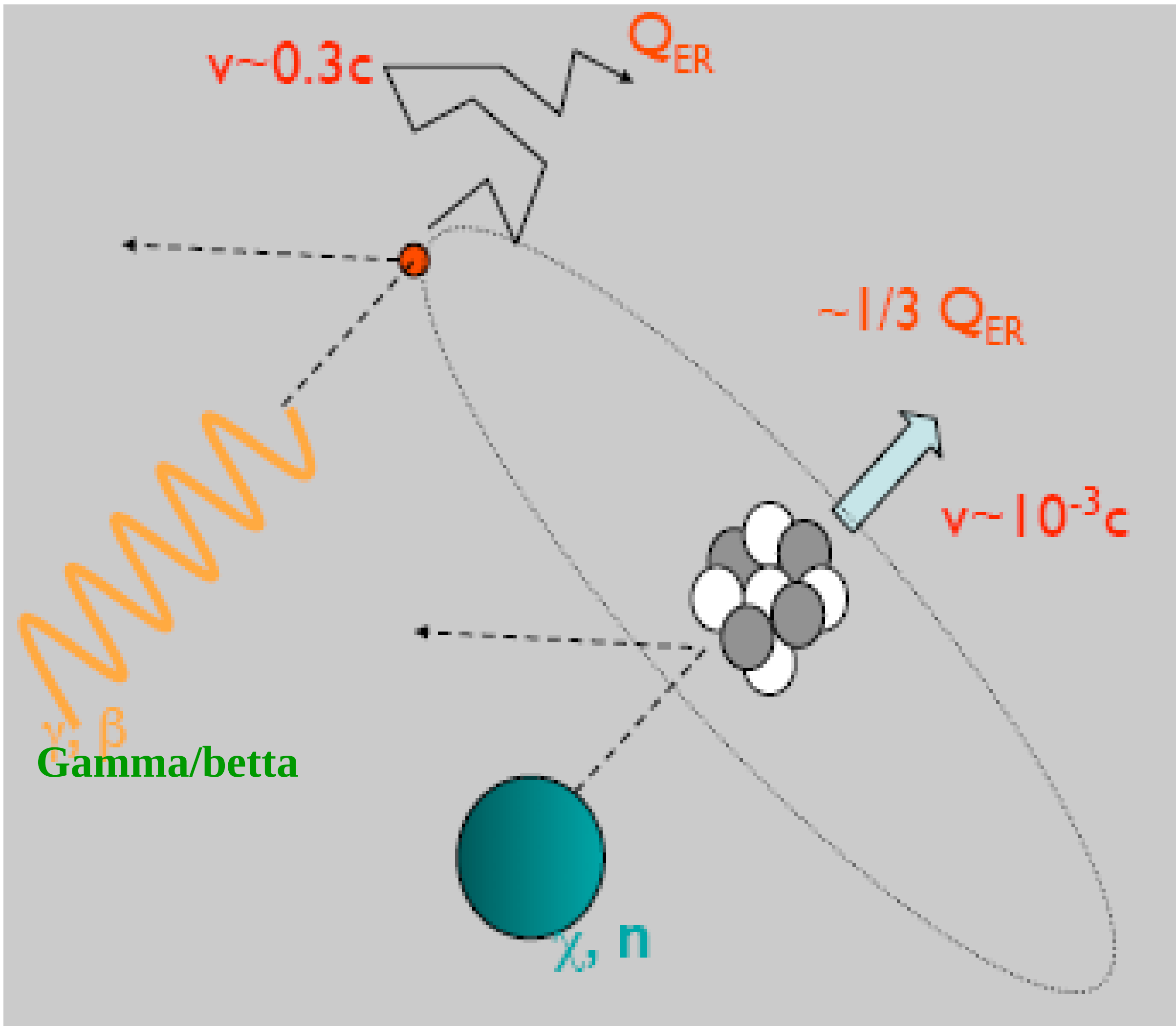


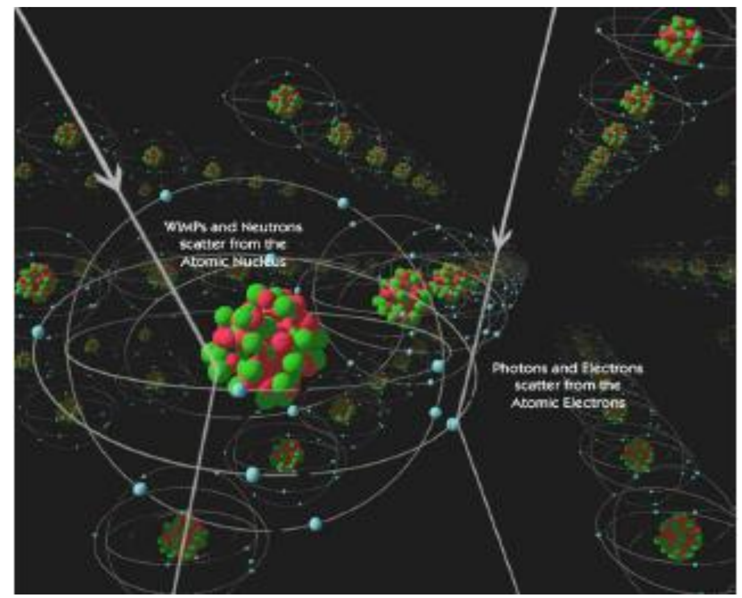
Form factor for Ar,Xe, and Ge;   Differential rate ;Integral rate over threshold

(WIMP 100GeV in mass 10e-6pb incross section)

Expected event rate : 0.01/Kg-d

Larger background events from gamma electron and neutron





Big challenges

Target must be sensitive detector

Very low energy thresholds(<10 KeV) ("Quenching effect" ~1/10)

Very low event rate (0.01/Kg-d)

Long exposures (long term stability)

Big detector (large mass,100kg 1000kg …)

Stringent background control(Cosmogenic ,Radioactive)

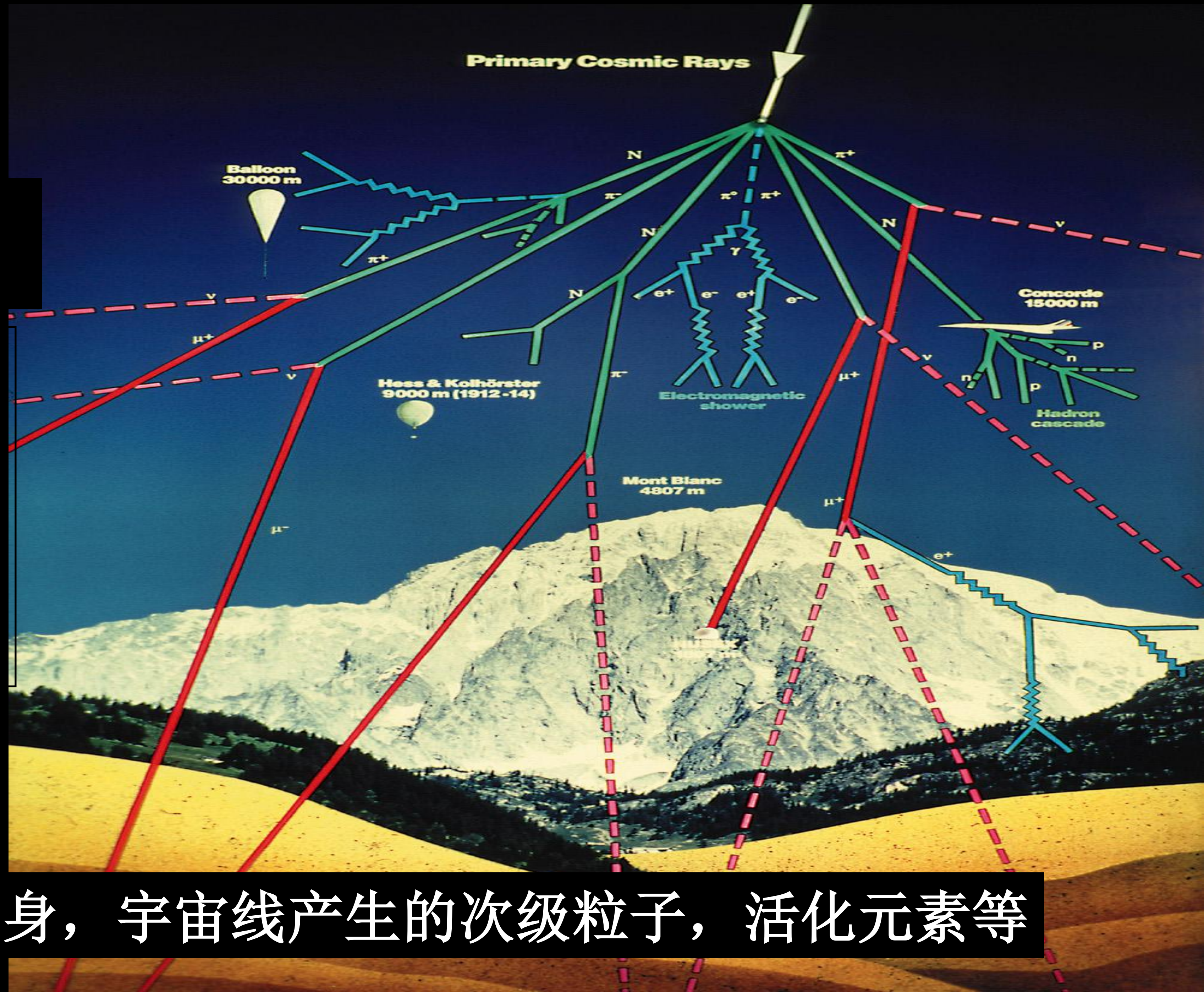
Need Shielding (passive , active , deep site, cleanness)

Need Discrimination background power

Measurement has to be in underground

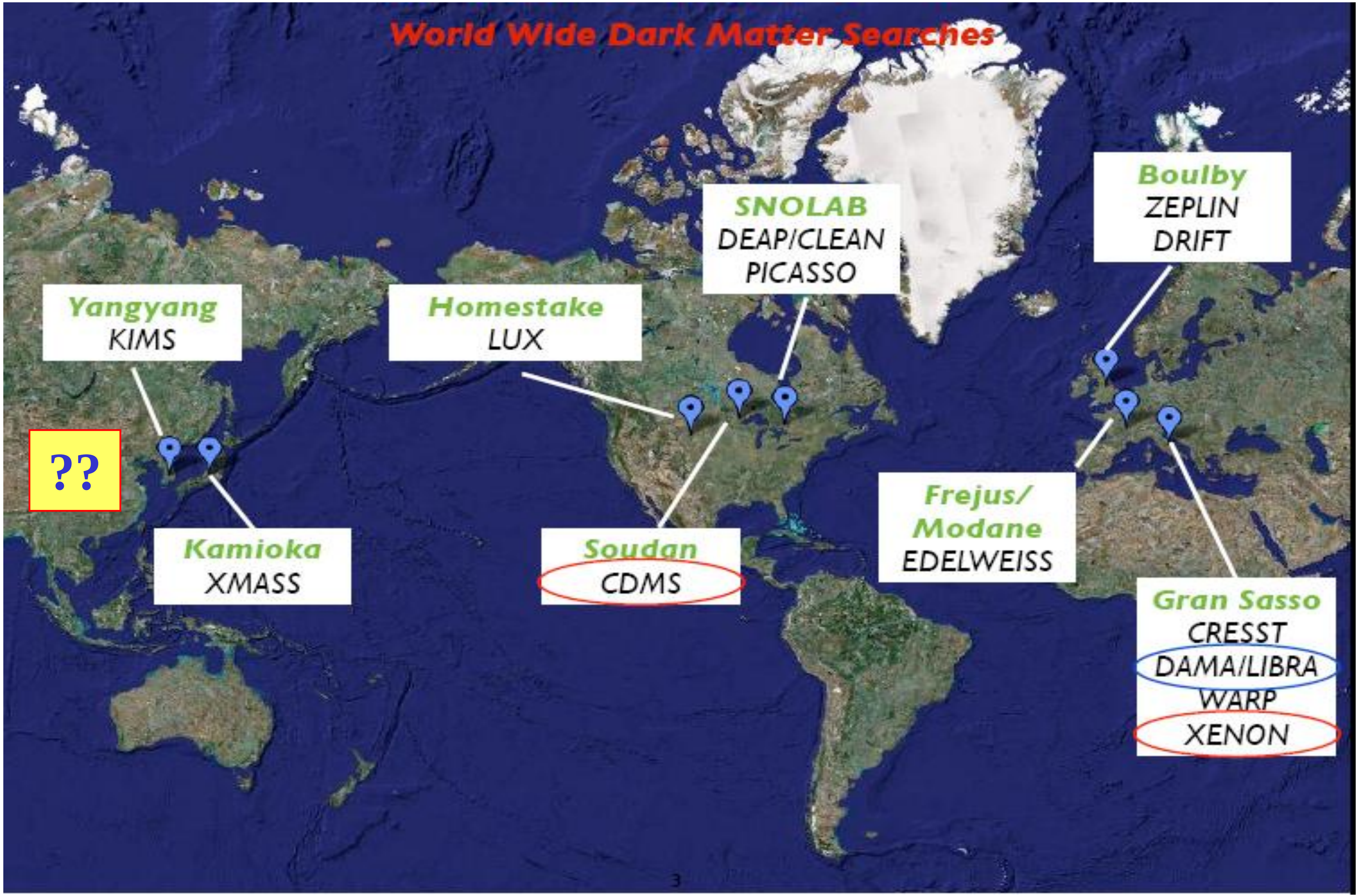
Cosmic ray ,muon
183.8Hz/m2

Nuclear interaction
Secondary particles
on the environment
on the shielding
on the detector



宇宙线本身，宇宙线产生的次级粒子，活化元素等

Underground Lab in the World



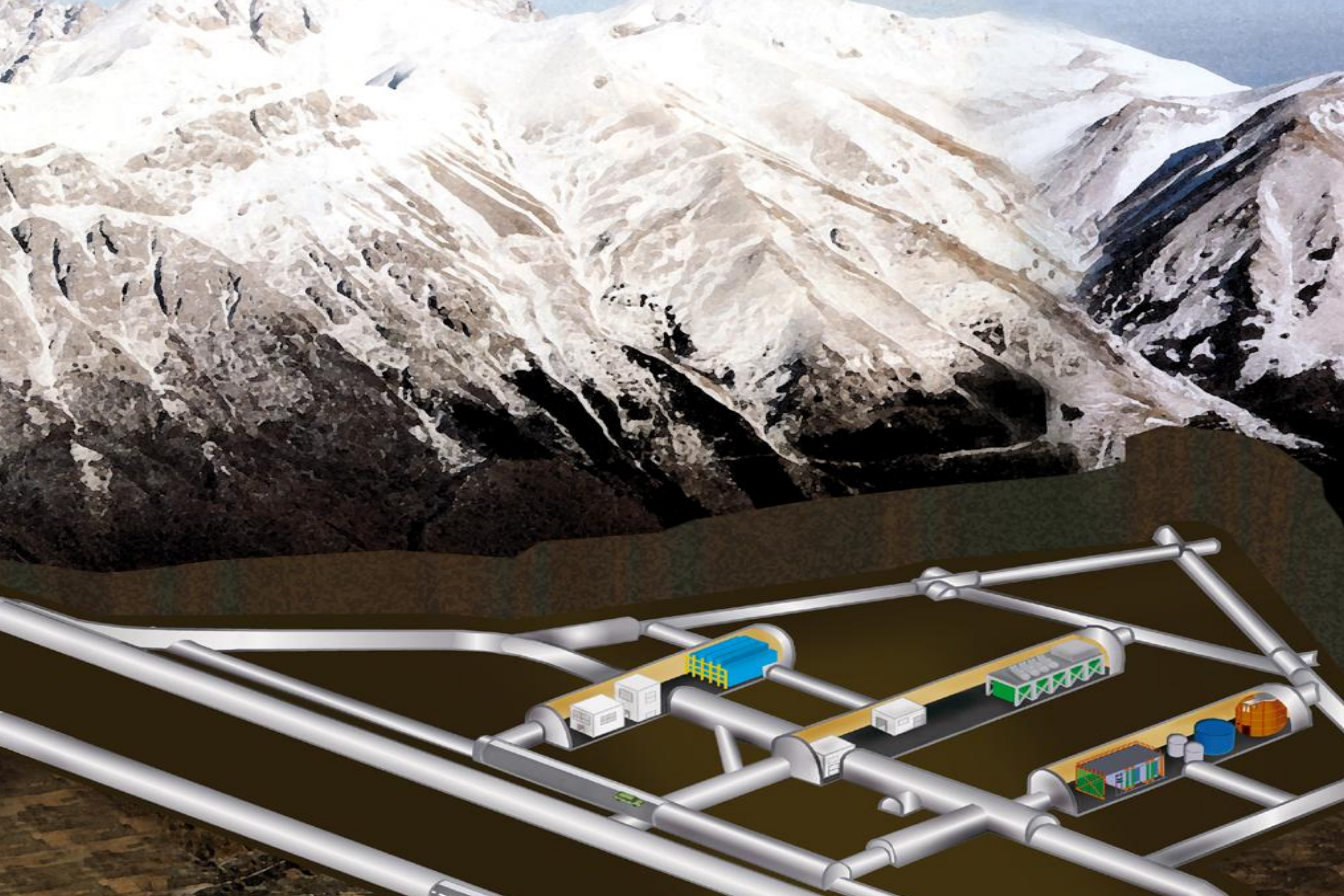
Yangyang Underground Laboratory

Korea Middleland Power Co.

Yangyang Pumped Storage Power Plant

Construction of Lab. buildings done in 2003

Minimum depth : 700 m / Access to the lab by car (~2km)



Passive shielding & Active shielding

PE, PE(B) - Neutron
Lead – Gamma
Cu - gamma
Blow Ar gas – Radon

Active veto

环境本底-天然放射性（α，γ， n）

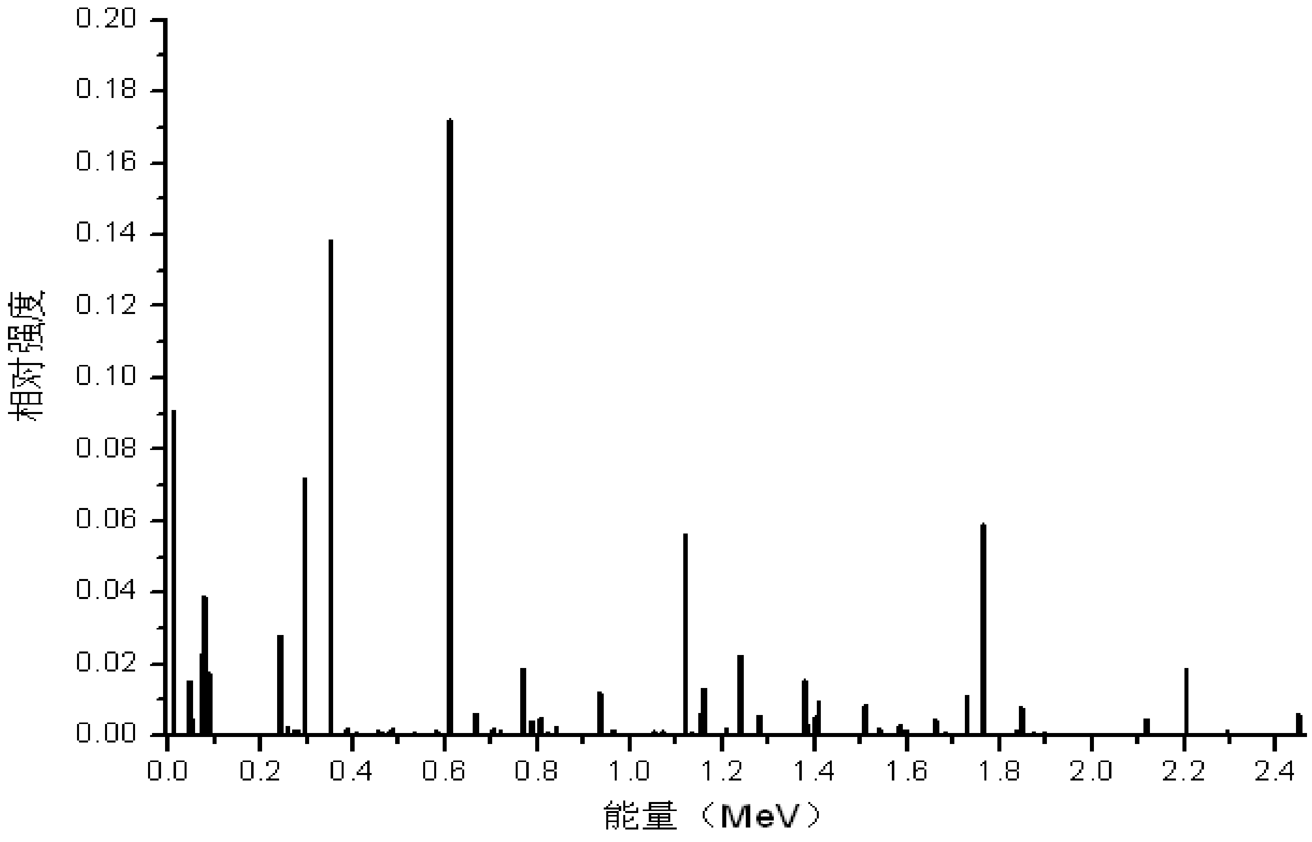
天然放射性系列		核素	半衰期	衰变常数 λ/s^{-1}
钍系	母体	$^{232}_{90}Th$	$1.41\times10^{10}a$	1.57×10^{-12}
铀系	母体	$^{238}_{92}U$	$4.468\times10^{9}a$	4.91×10^{-18}
	子体	$^{234}_{92}U$	$2.45\times10^{5}a$	9.01×10^{-14}
		$^{230}_{90}Th$	$7.7\times10^{4}a$	2.85×10^{-13}
锕系	母体	$^{235}_{92}U$	$7.038\times10^{8}a$	3.12×10^{-17}

核素	**^{226}Ra**	**^{232}Th**	**^{40}K**
含量	**1.8**±0.2 Bq/Kg (145.8 ppb)	< 0.27 Bq/Kg (<66.42 ppb)	< 1.1Bq/Kg (<35.53 ppm)

锦屏地下岩石放射性含量

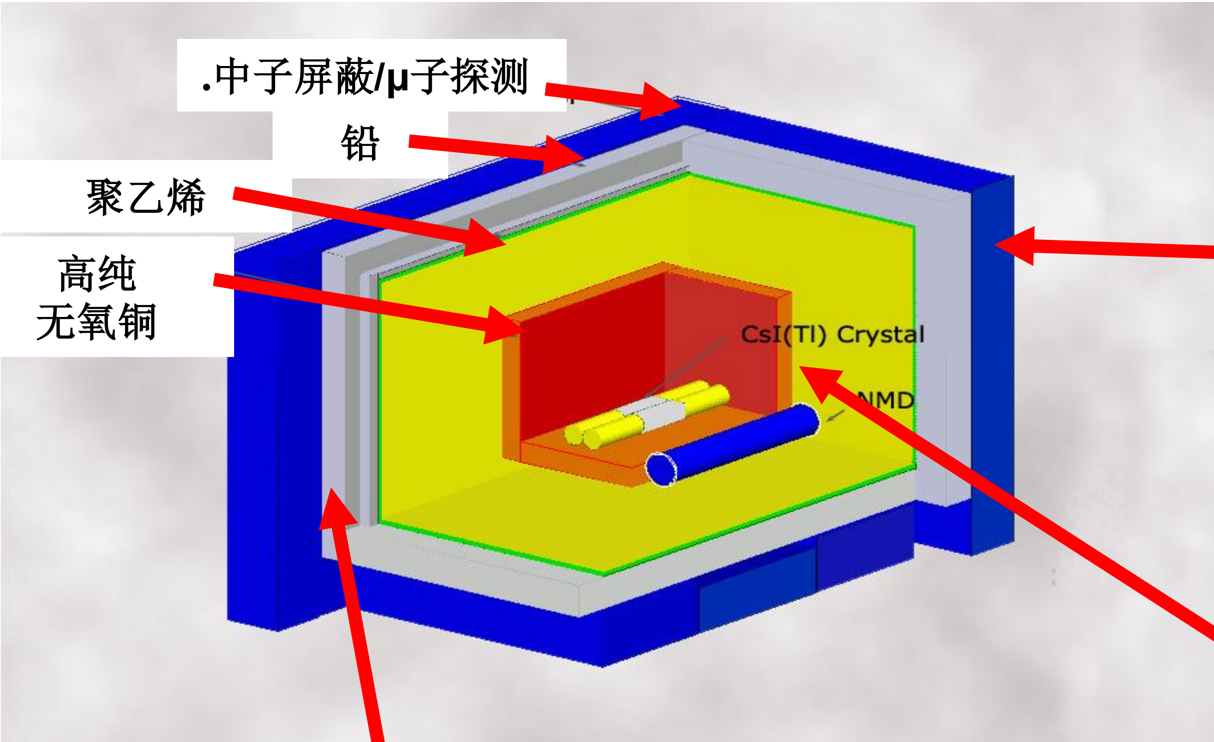
Background from Radon

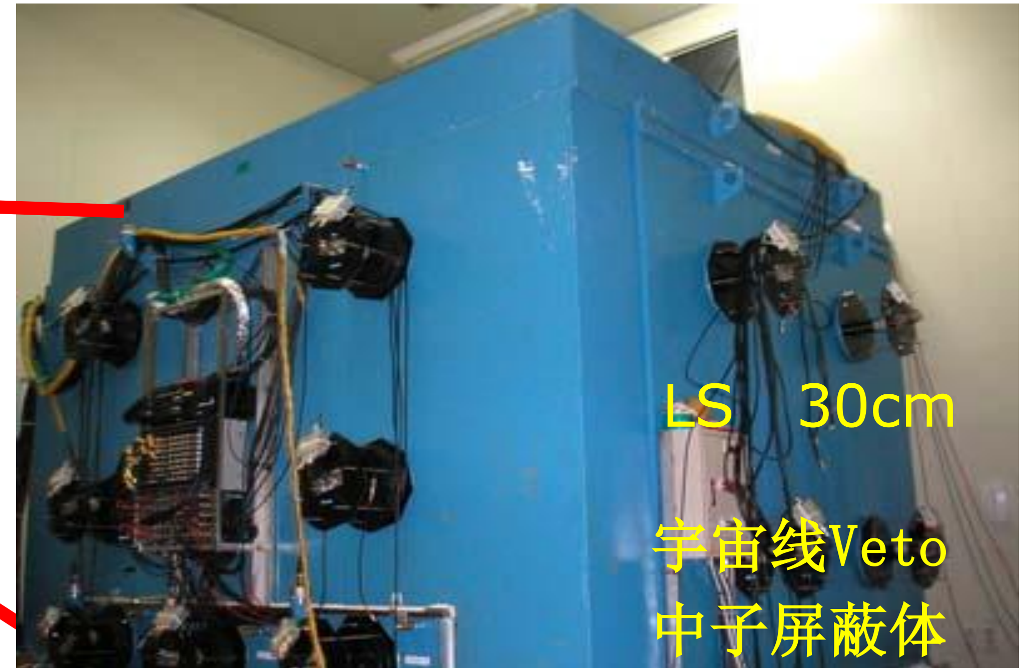
^{222}Rn长期平衡下，^{222}Rn 衰变一次平均放出0.0269个光子



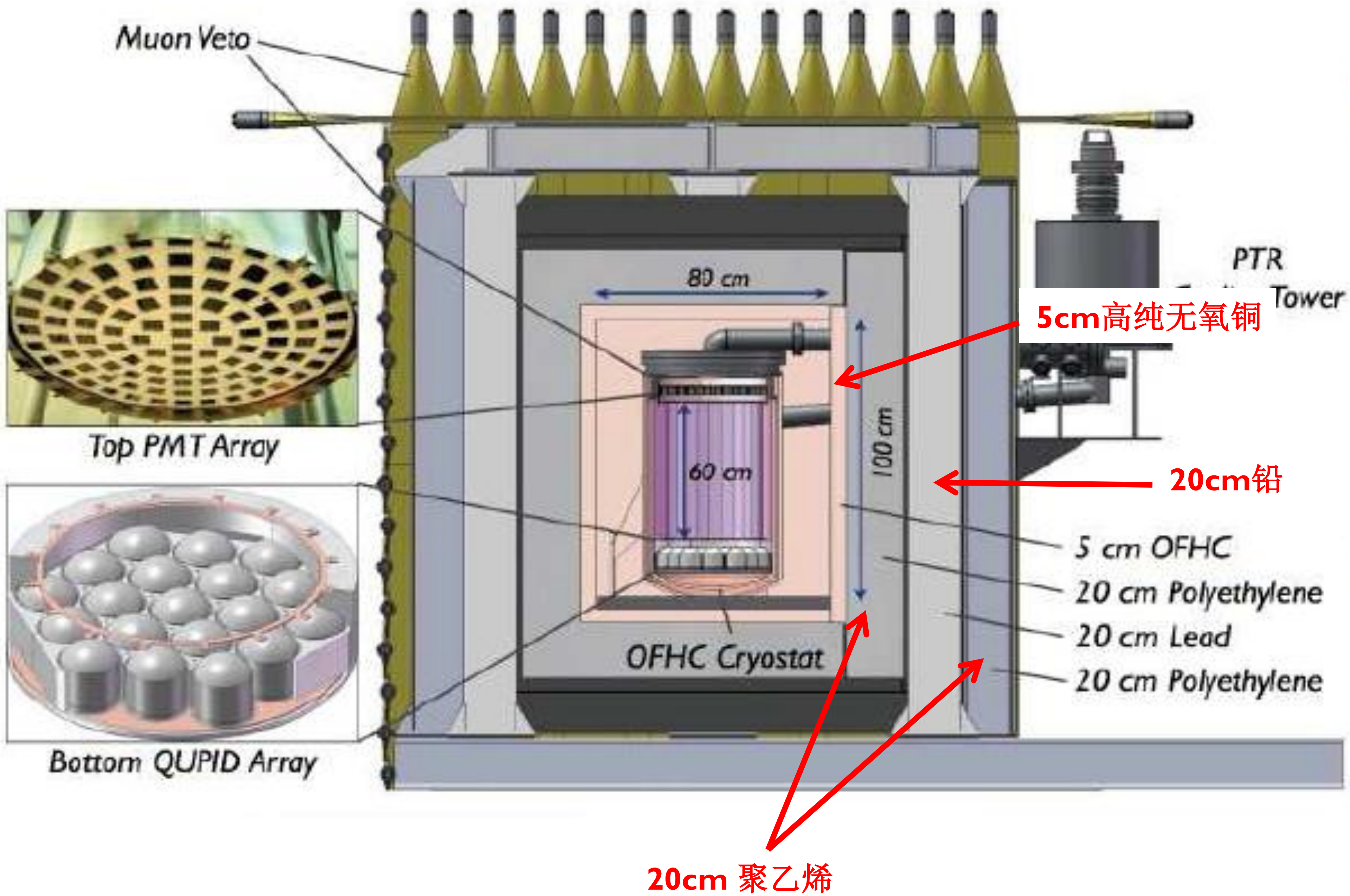
探测器空间中吹氮气减少氡的影响

中韩合作Y2L地下实验室KIMS实验屏蔽体和VETO



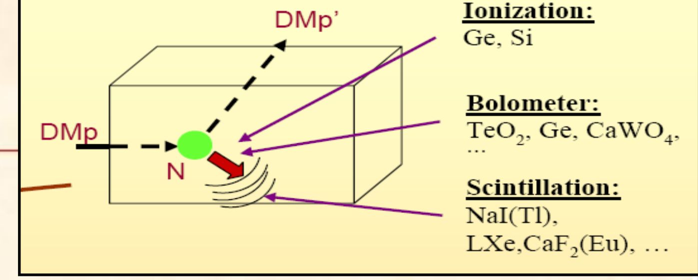


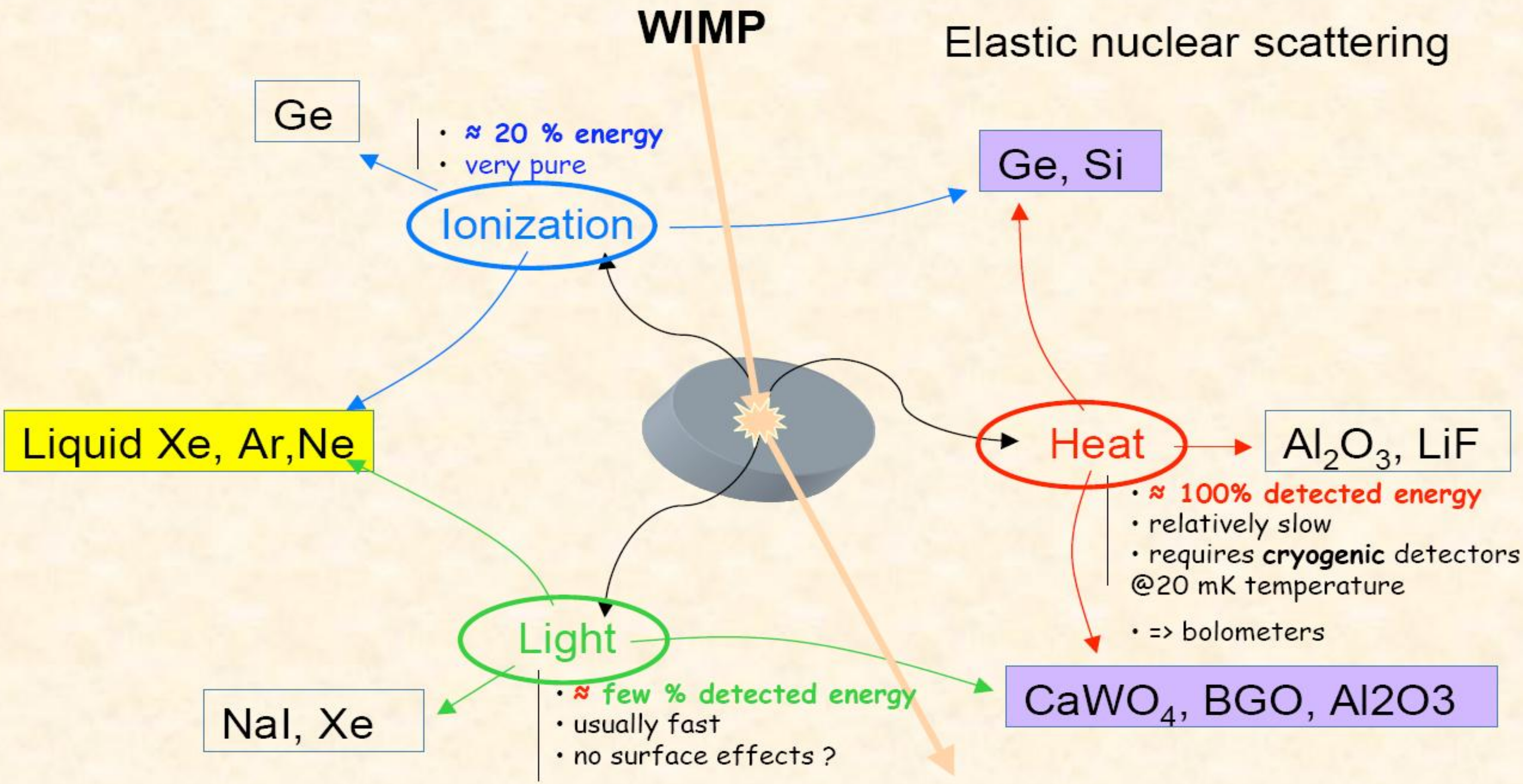
XENON Shielding & Cosmic Ray Veto



Direct detection techniques

Direct detection techniques



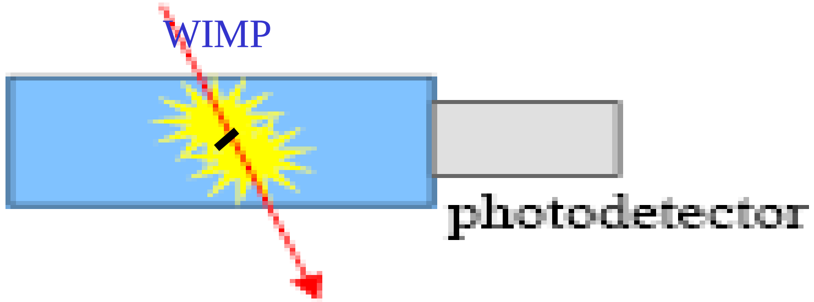


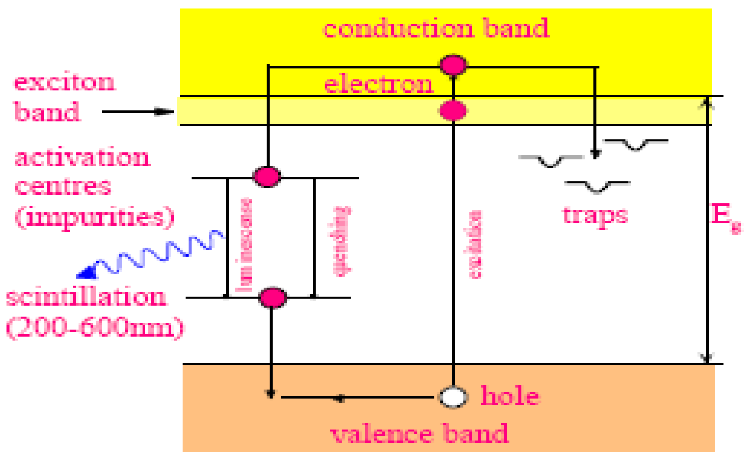
\+ Outsiders : metastable media, gaz…

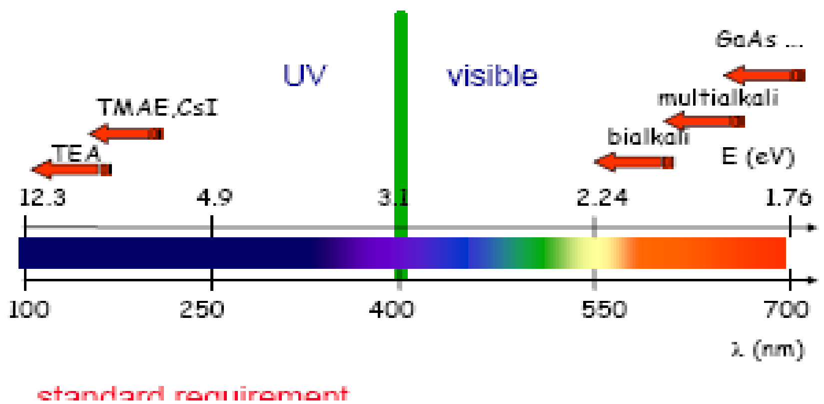
Scintillation Crystal Detector

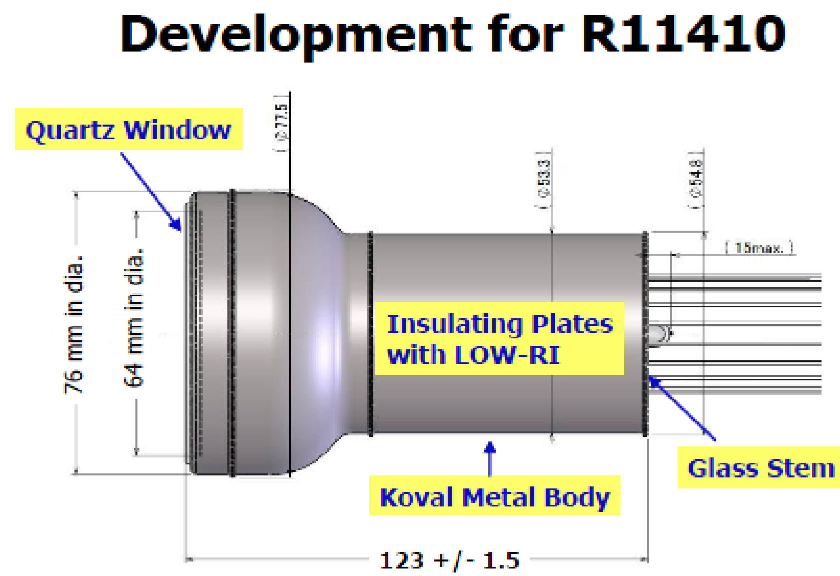
High light yield
Pulse shape discrimination (DSP)
Relatively easy to get large mass
with an affordable cost

WIMP →nucleus→ fluorescence light





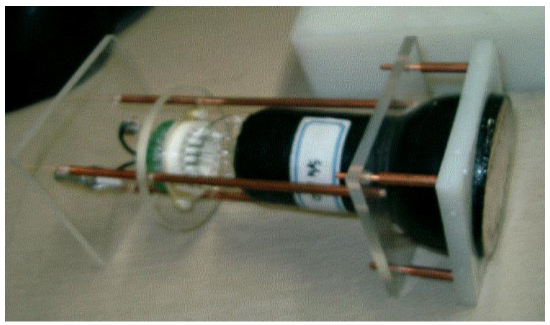




- High light yield
- Pulse shape discrimination
- Relatively easy to get large mass with an affordable cost
- Internal background

CsI CsI(Tl) Crystal Detector

CsI



PMT

CsI(Tl) Crystal

- 8x8x30 cm^3 (8.7 kg)
- ^{137}Cs reduction using purified water
- ^{87}Rb reduction by recrystalization

3" PMT - 9269QA

- Quartz window
- RbCs photocathode

CsI crystal detector module

One 1st CSI's are running now <15 cpd

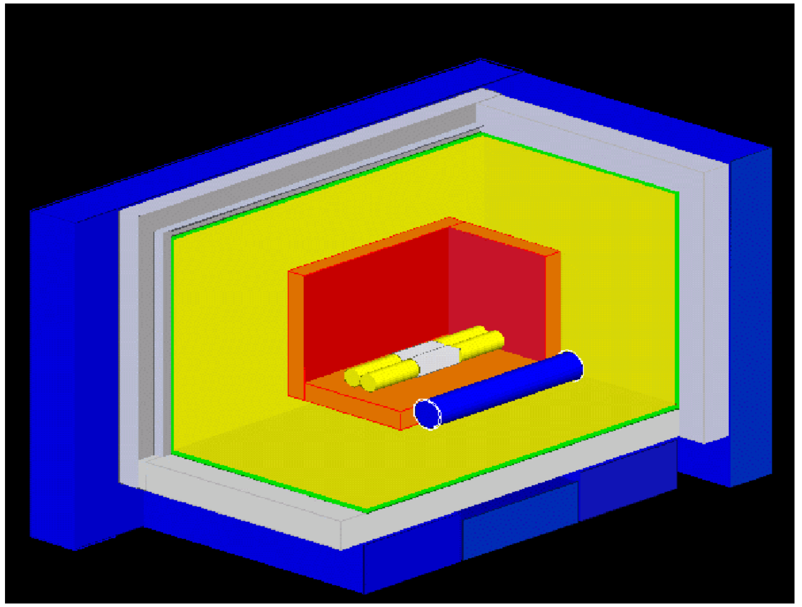
9 crystals (<5 cpd)

within 2003, totally 9 modules

~ 80 kg

KIMS Experiment

CsI(Tl) crystal WIMP search at Yanyang Underground Laboratory in Korea



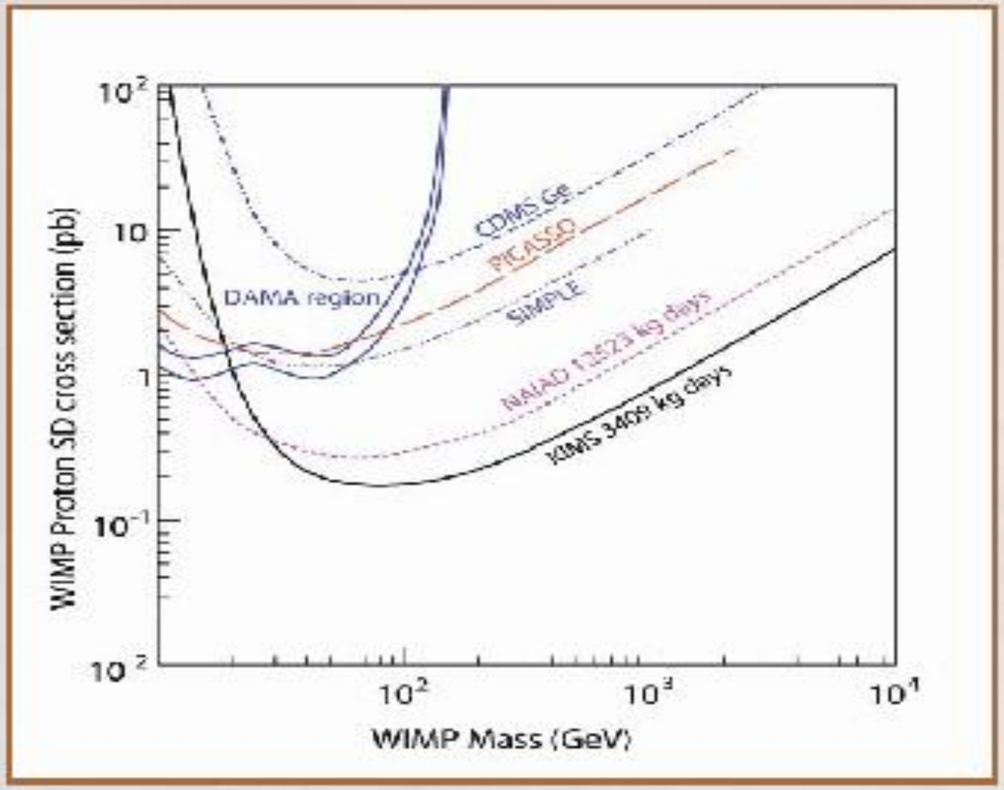
CsI(Tl) crystal

- High light yield
- Pulse shape discrimination
- Relatively easy to get large mass with an affordable cost
- Internal background due to ^{137}Cs, ^{134}Cs, ^{87}Rb

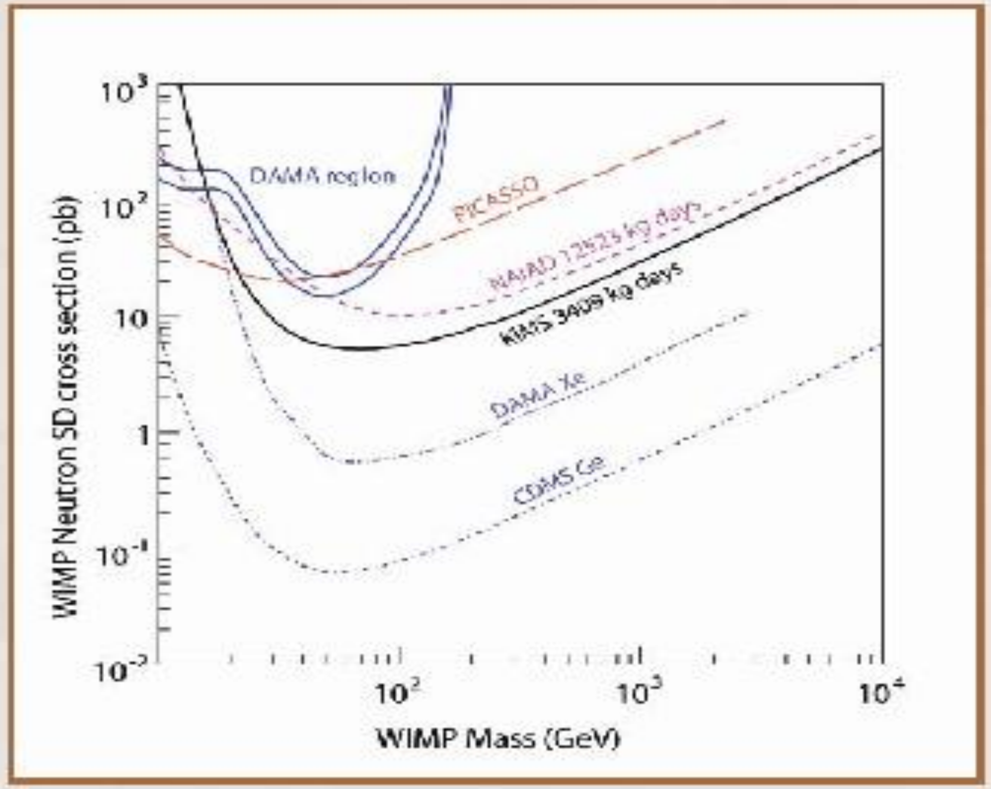
	CsI(Tl)	NaI(Tl)
Density(g/cm3)	4.53	3.67
Decay Time(ns)	~1050	~230
Peak emission(nm)	550	415
Hygroscopicity	slight	strong

Phvsics result of KIMS

Spin dependent limits



Pure proton case

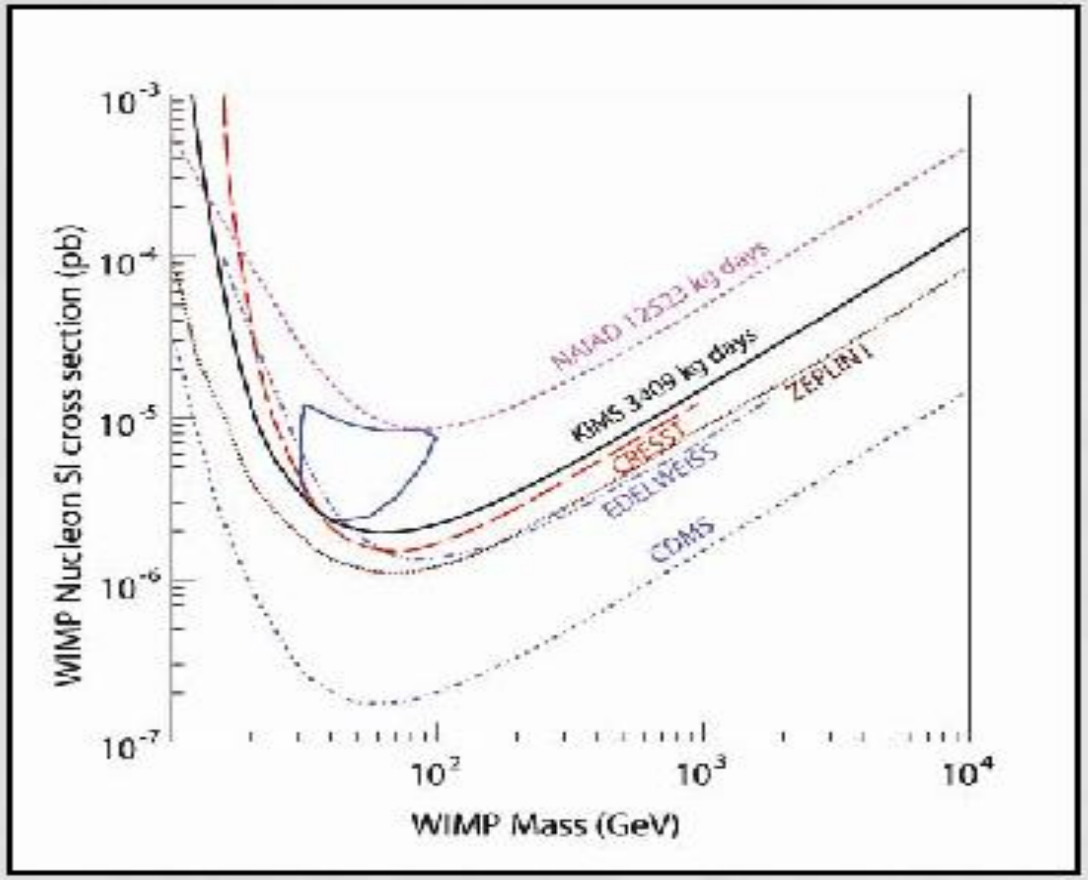


Pure neutron case

PRL 99, 091301 (2007)

KIM resoult

Spin independent limits



ρ_D=0.3 GeV/c²/cm³
v_o=220km/s
v_{esc}=650km/s

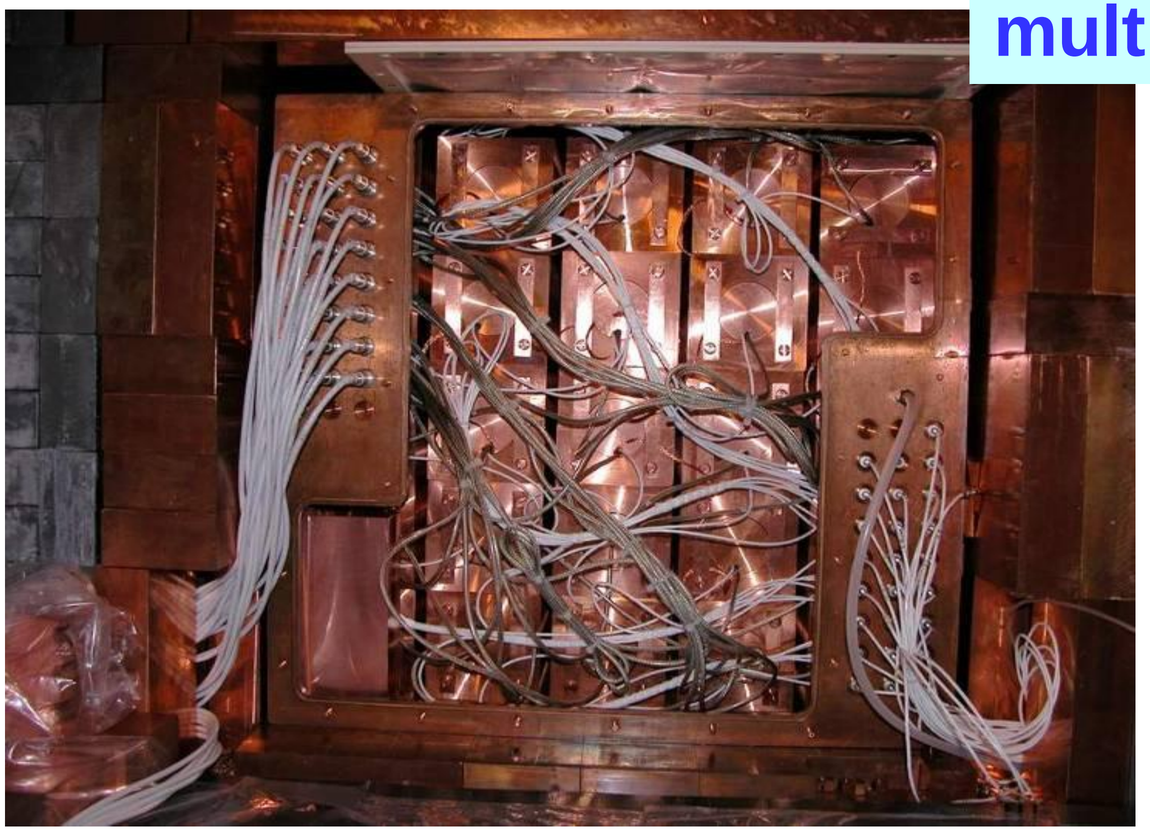
DAMA signal region is ruled out

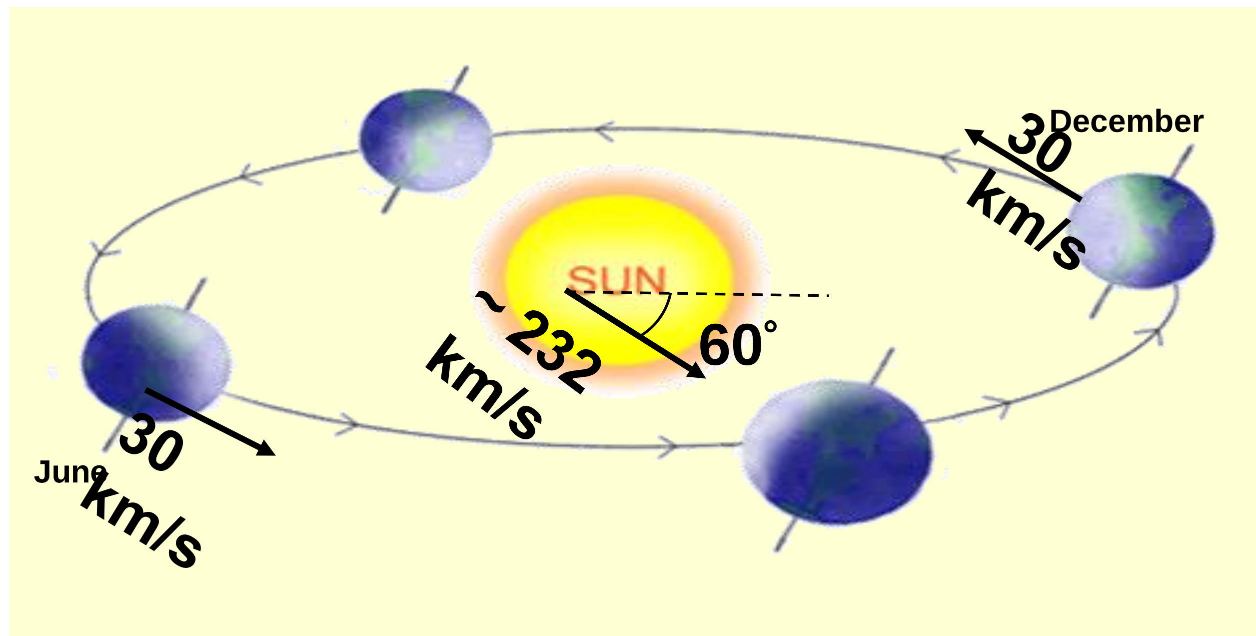
PRL 99, 091301 (2007)

DAMA/LIBRA

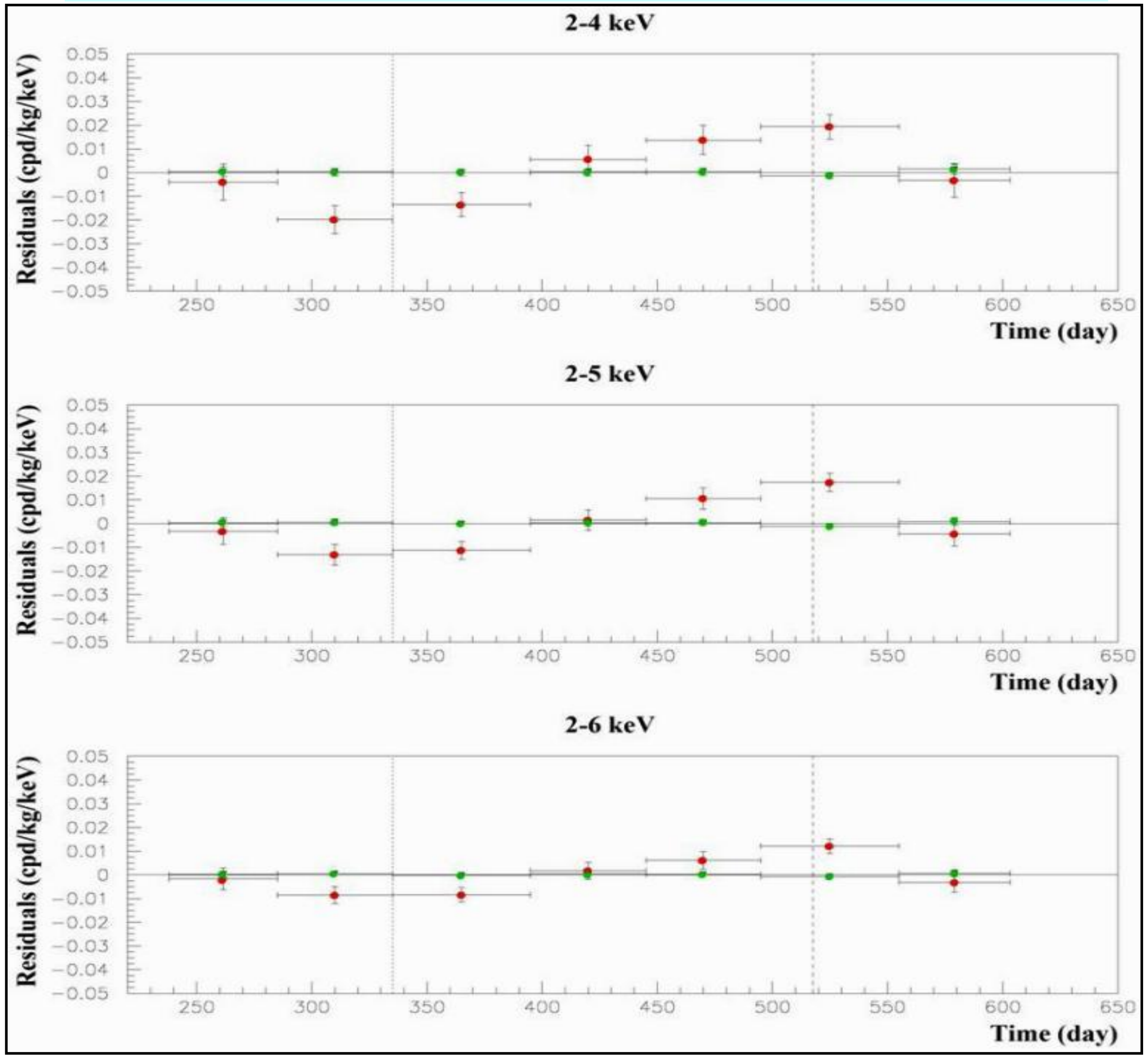
NaI(Tl) Crystal

- NaI(Tl) Scintillator at Gran Sasso : total 0.82 ton-year data
- Observe annual modulation in the 2-6 keV single-hit signal band, total 11 cycles, > 8σ
- Reject gamma by PSD
- No modulations at higher energy & for multiple-hits

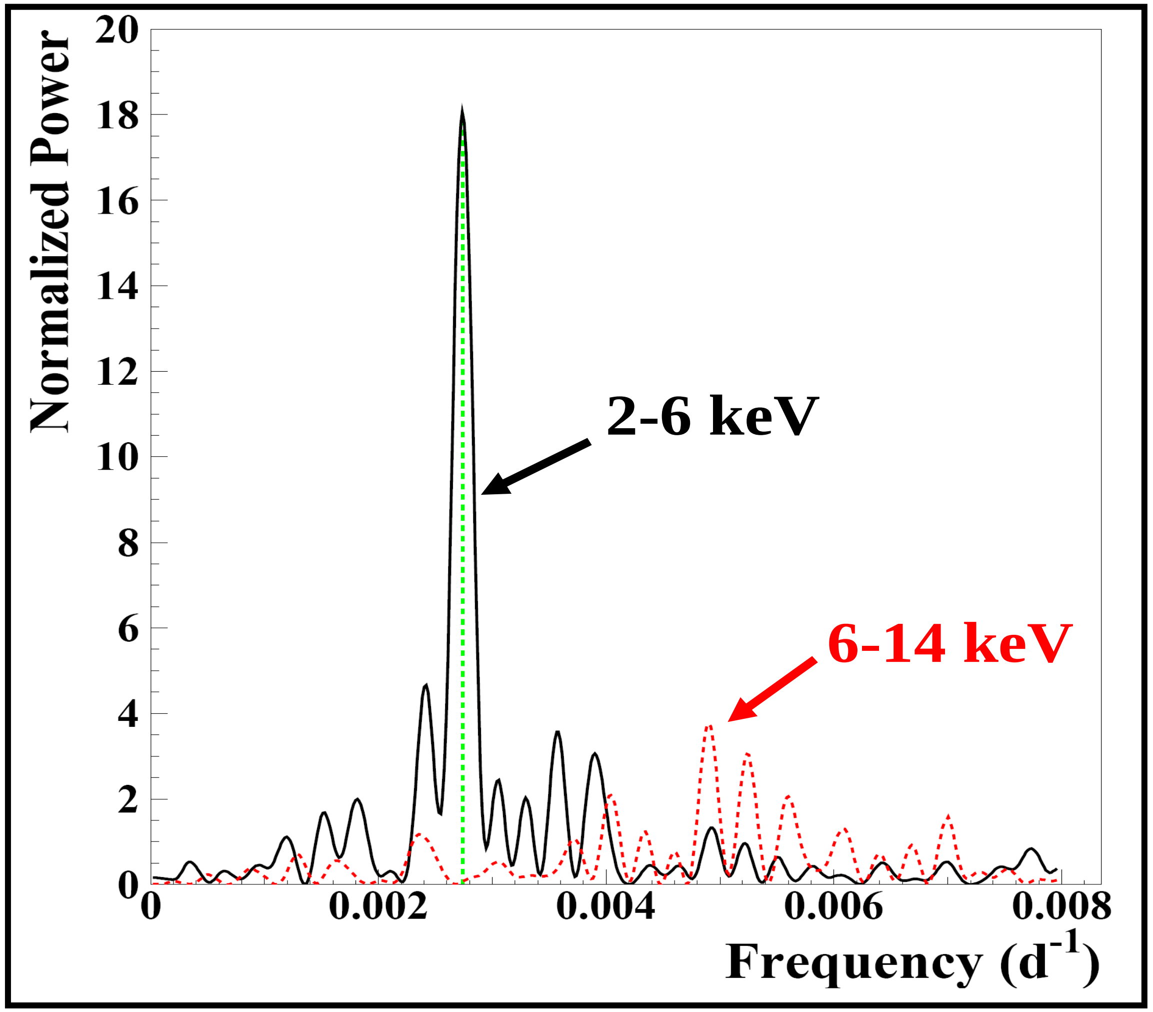




* *multiple-hits* residual rate (green points) vs single-hit residual rate (red points)

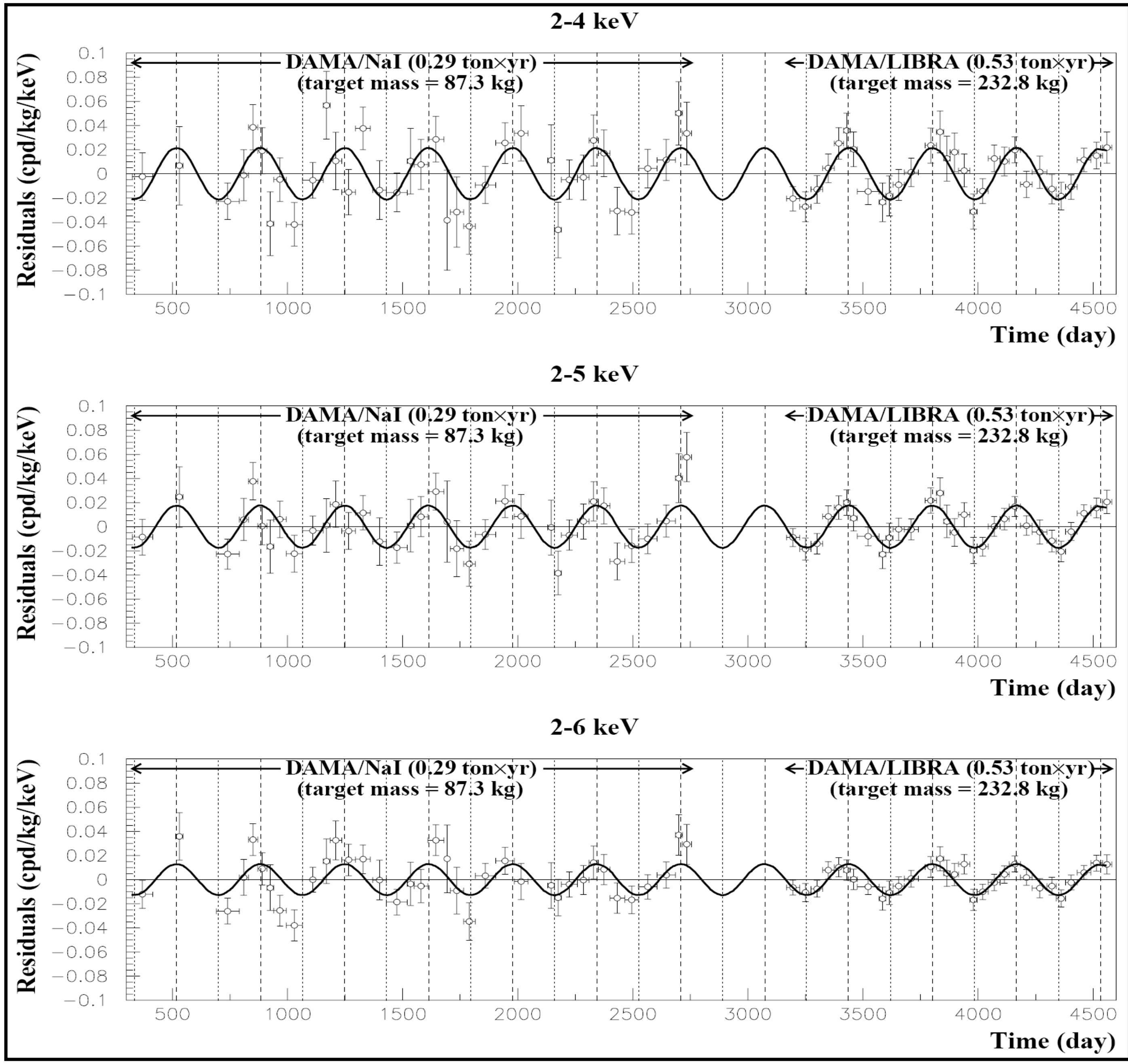


Single-Hit Power Spectrum

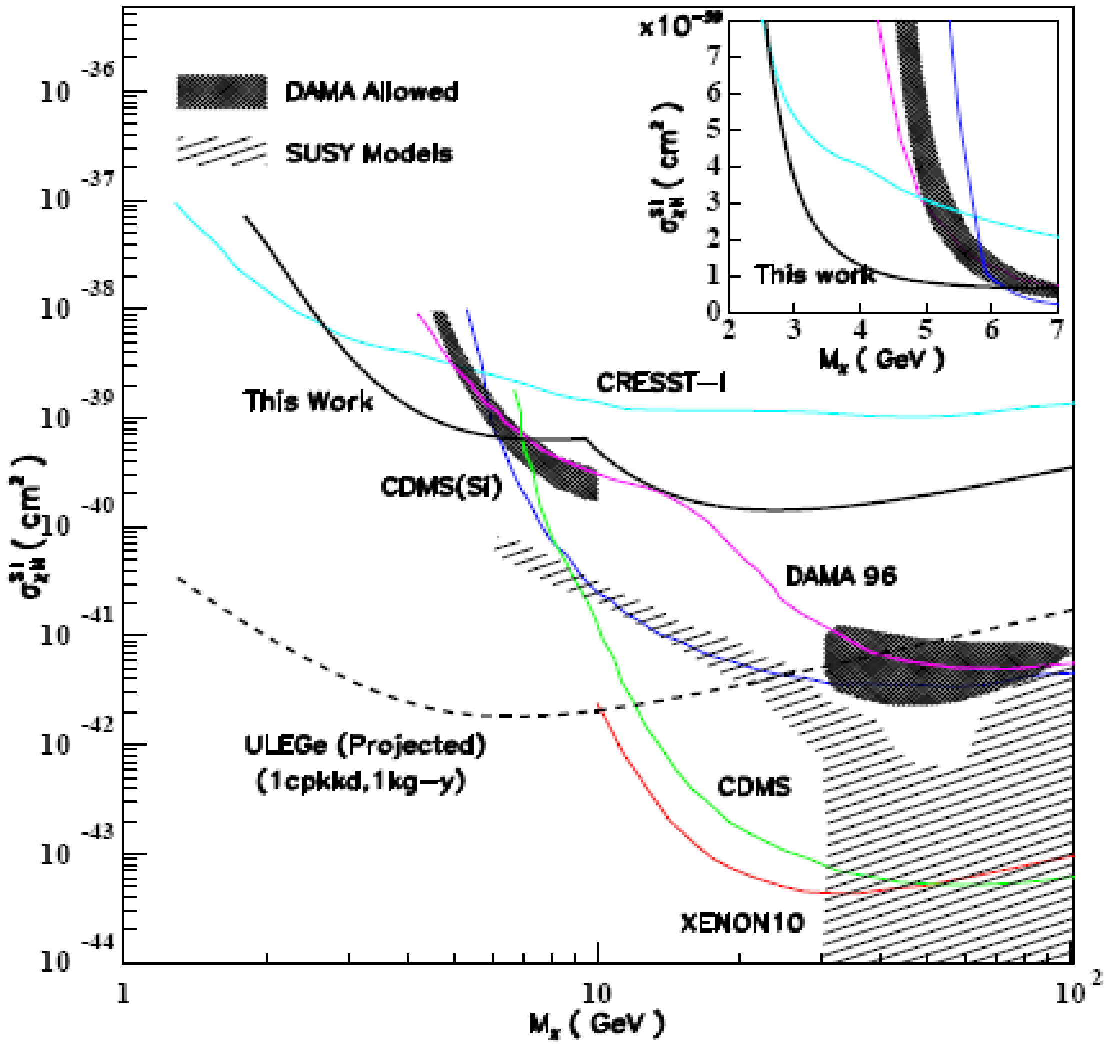


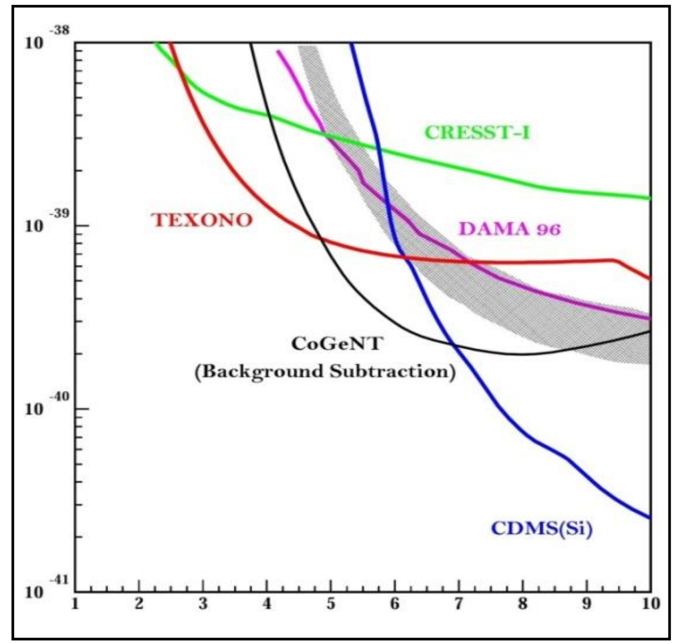
* **Annual Modulation in single hit at 2-6 keV**
* **No Modulation for multiple hits at 2-6 keV**
* **No Modulation for single hit above 6 keV**

- Single Hit 2-6 keV Signal Region
- DAMA/NaI (7 years) + DAMA/LIBRA (4 years)
- Total exposure: 300555 kg×day = 0.82 ton×yr



DAMA Physics Result





HP Ge detector / PC Ge detector

High efficiency

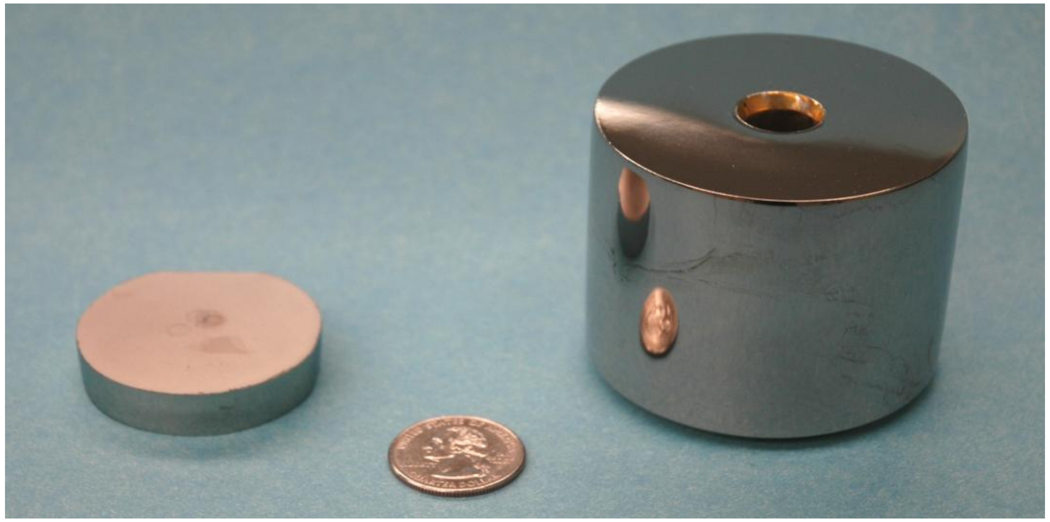
High resolution

Large mass

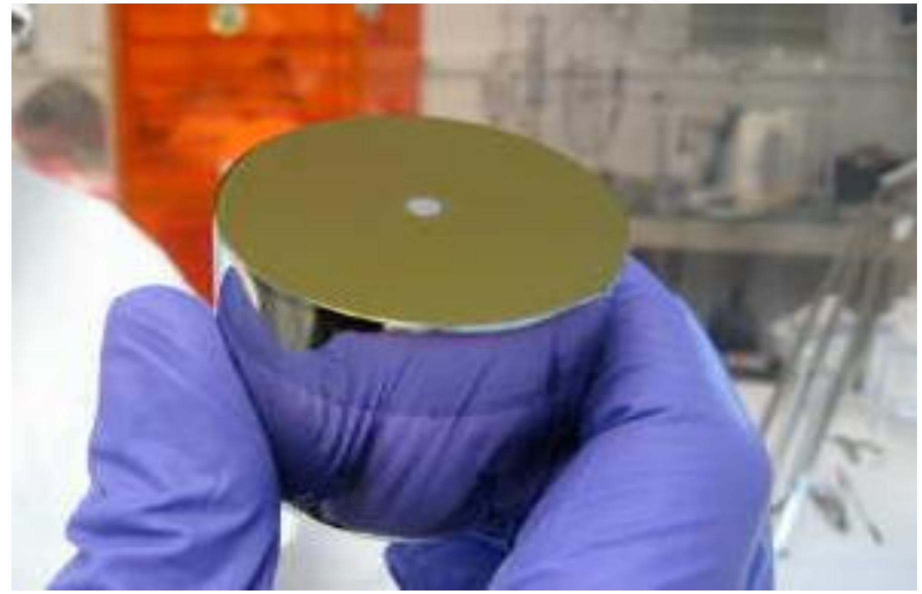
Pure material

Low noise/ Low threshold

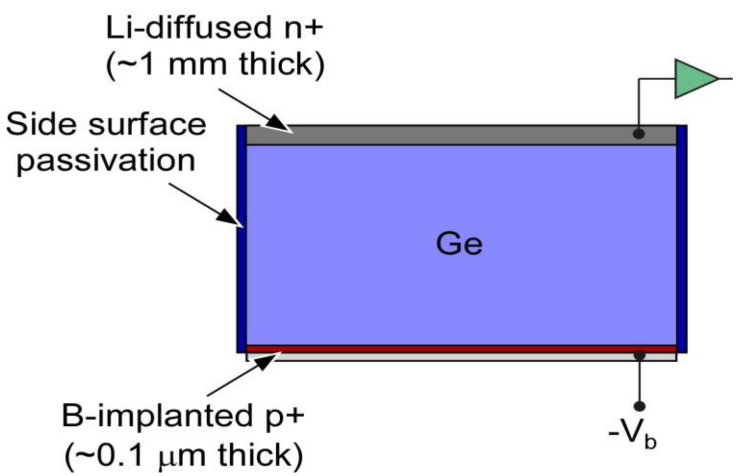
Low noise PCGe

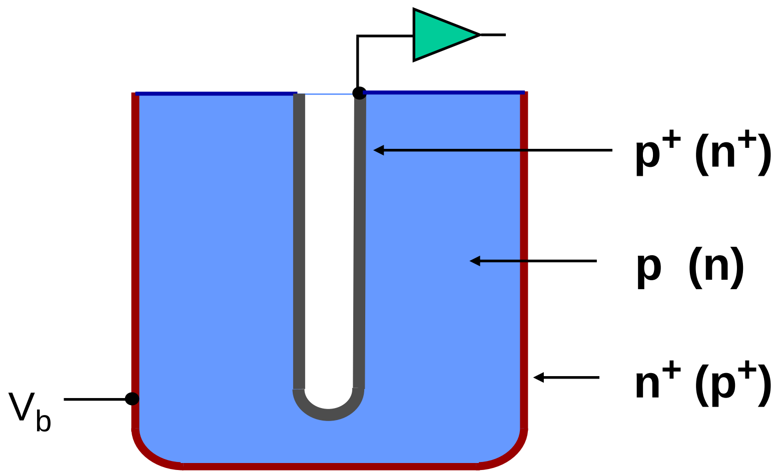


planar Coaxial detector

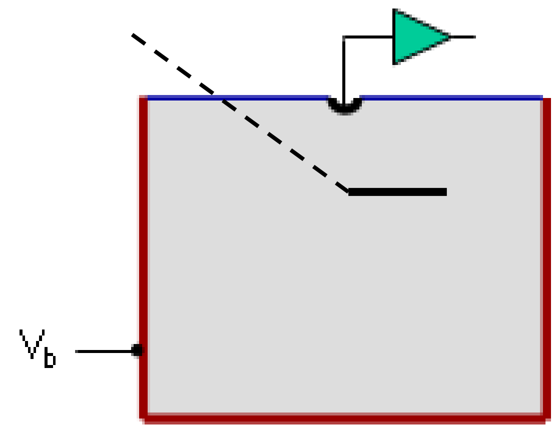


PCGe detector





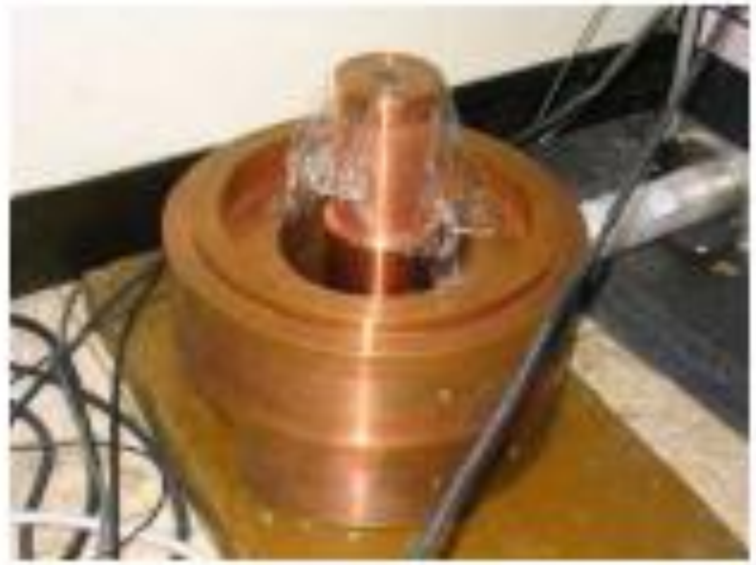
C ~ 20 pF



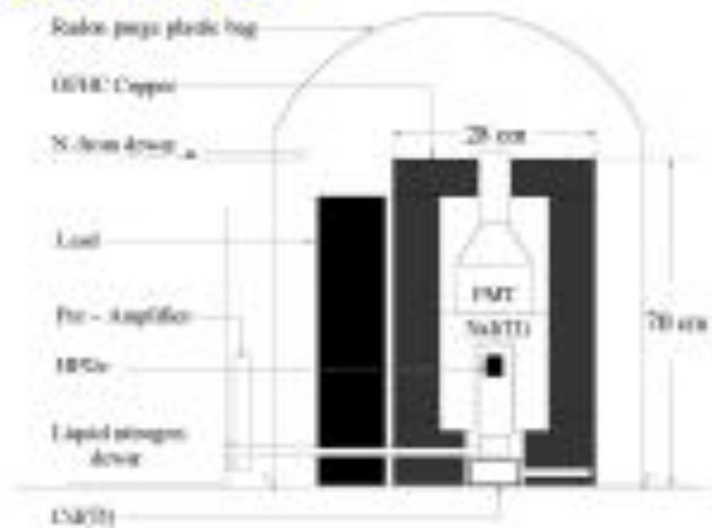
C ~ 1 pF

ULE-HPGe detector

ULE-HPGe



target mass 5 g



ULE-HPGe with anti-Compton detector

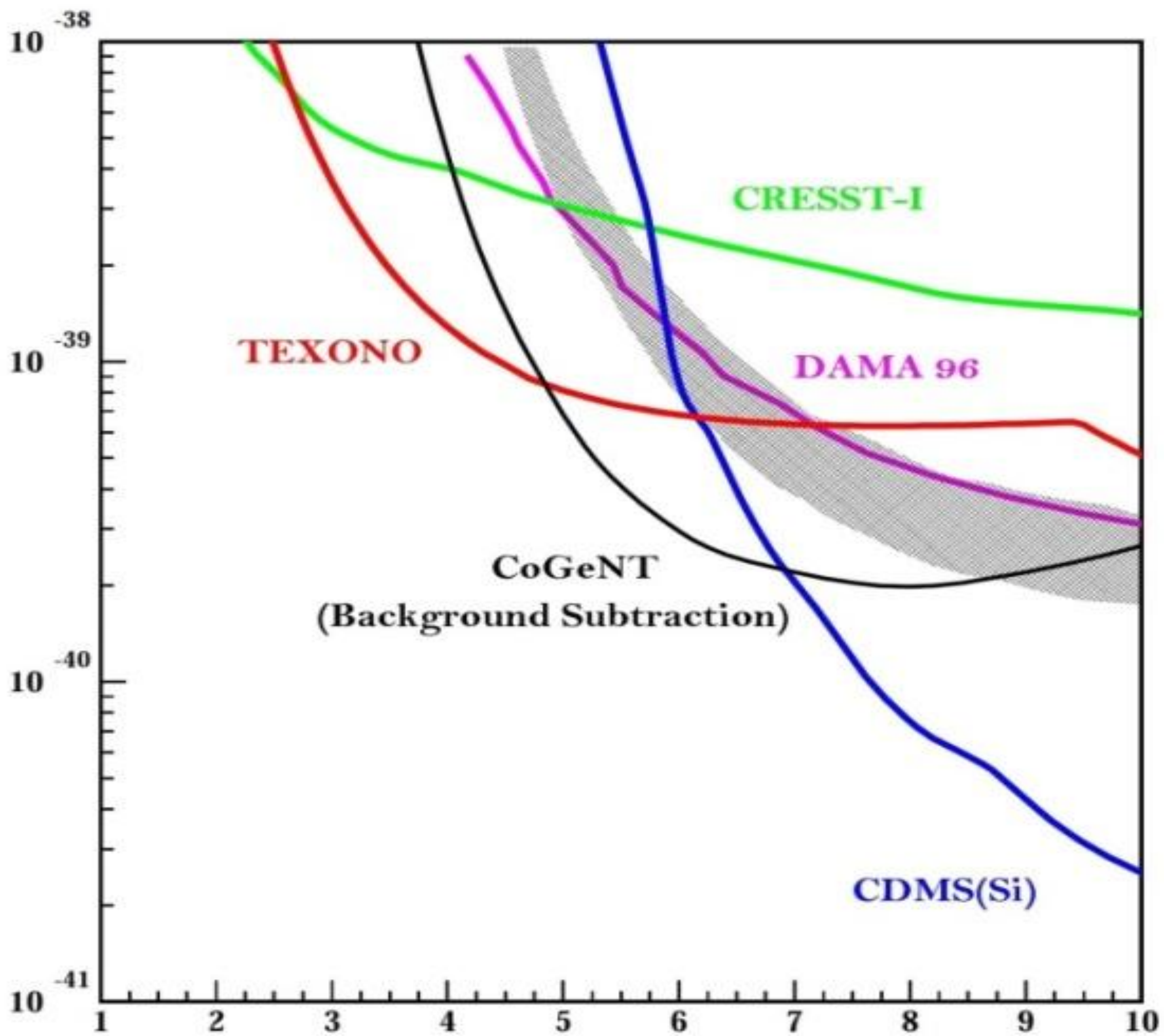
Typical Performance : Summary

Measurement	ULEGe	PCGe
Detector Mass	4 X 5 g	500 g
Pulser FWHM	80 eV	160 eV *[expect ~130 eV in next detector]*
Noise Edge	200-300 eV	~500 eV
50% Trigger Efficiency @ Discriminator Threshold	~80 eV @ 4.3 σ	~ 180 eV @ 3.1 σ
50% Selection Efficiency	~200 eV	~300 eV

CoGeNT detector

- **Lage mass ULE-HPGe detector leading by J.Collar**
- **475g PPC-HPGe detector base on Point-Contact Technology，the threshold**
- **PCGe – kg-scale mass detector and low thrsehold (from 1-2keV drop down to 2-300eV)**
- **ULEGe – developed for soft X-rays detection ; easy & inexpensive & robust operation**

Physics results from TEXONO &CoGeNT



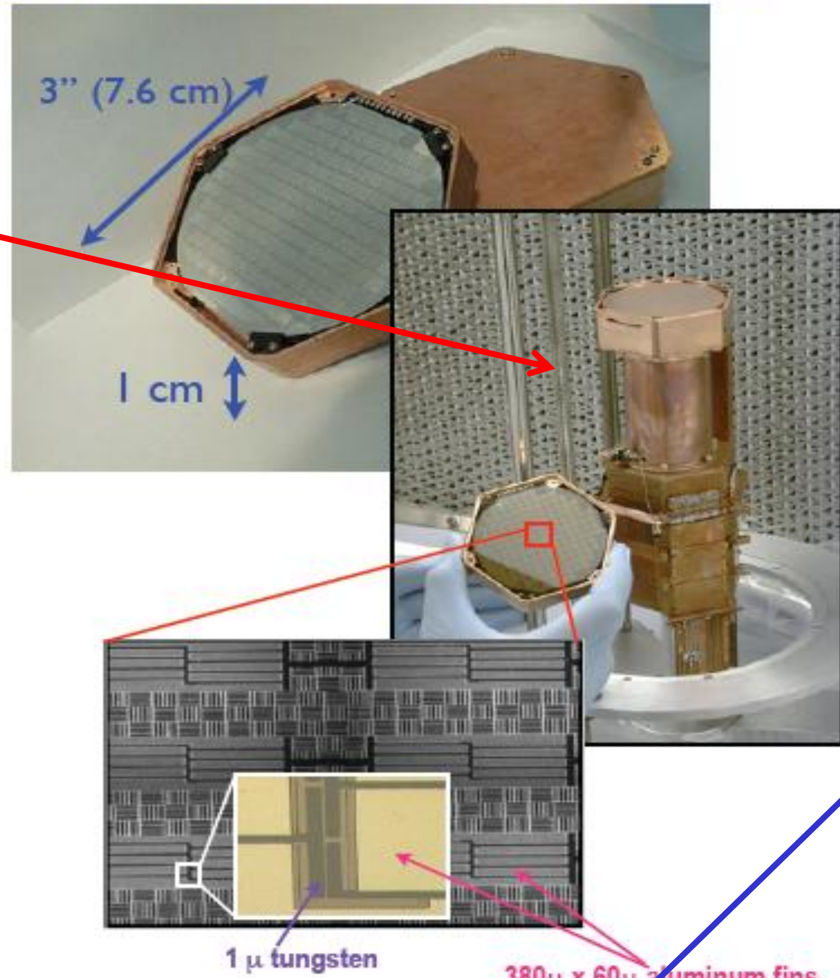
Ge (Si)+ Phonon detector

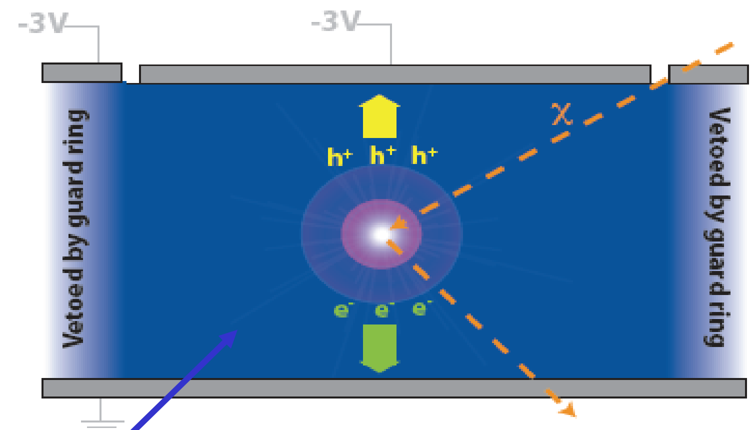
Ionization detection

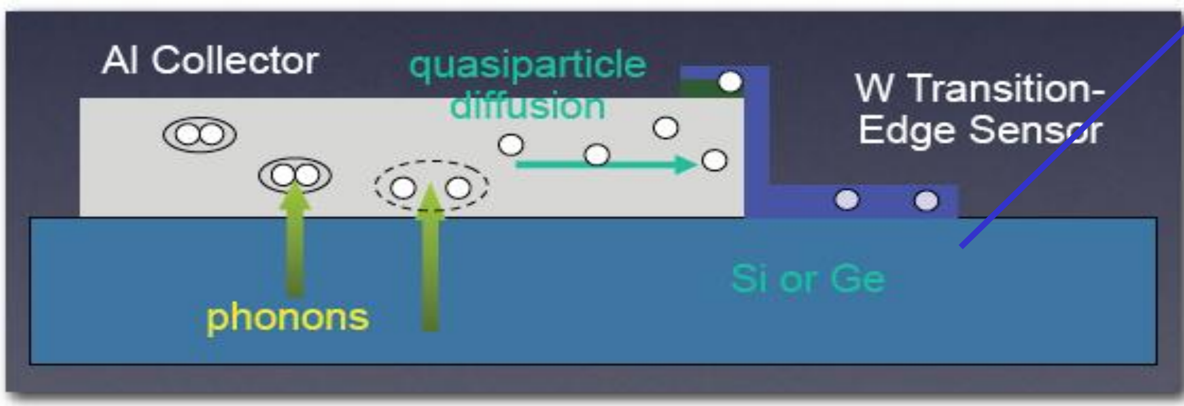
Phonon detection

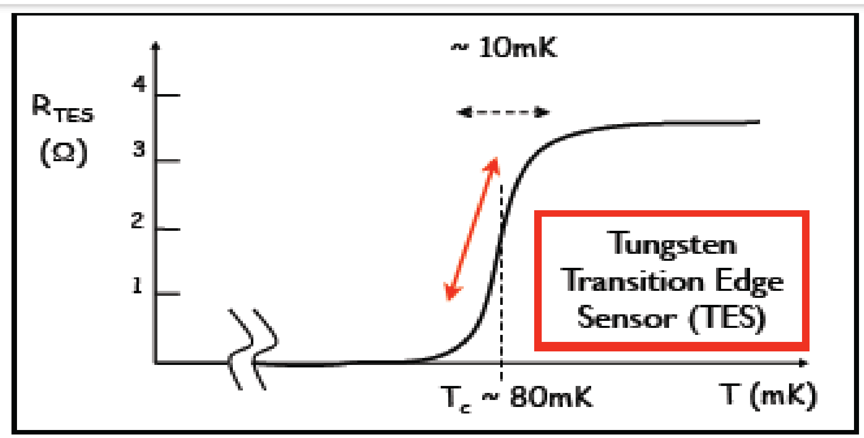
CDMS-II ZIP Detectors

- **Z**-sensitive **I**onization and **P**honon mediated
- **230 g Ge** or **100 g Si** crystals (1 cm thick, 7.5 cm diameter)
- Photolithographically patterned to **collect athermal phonons** and **ionization signals**
  - xy-position imaging
  - Surface (z) event rejection from pulse shapes and timing
- **30 detectors** stacked into **5 towers** of 6 detectors

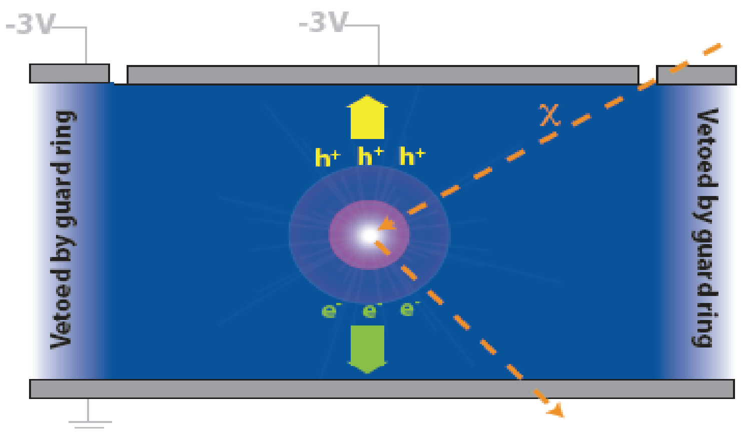




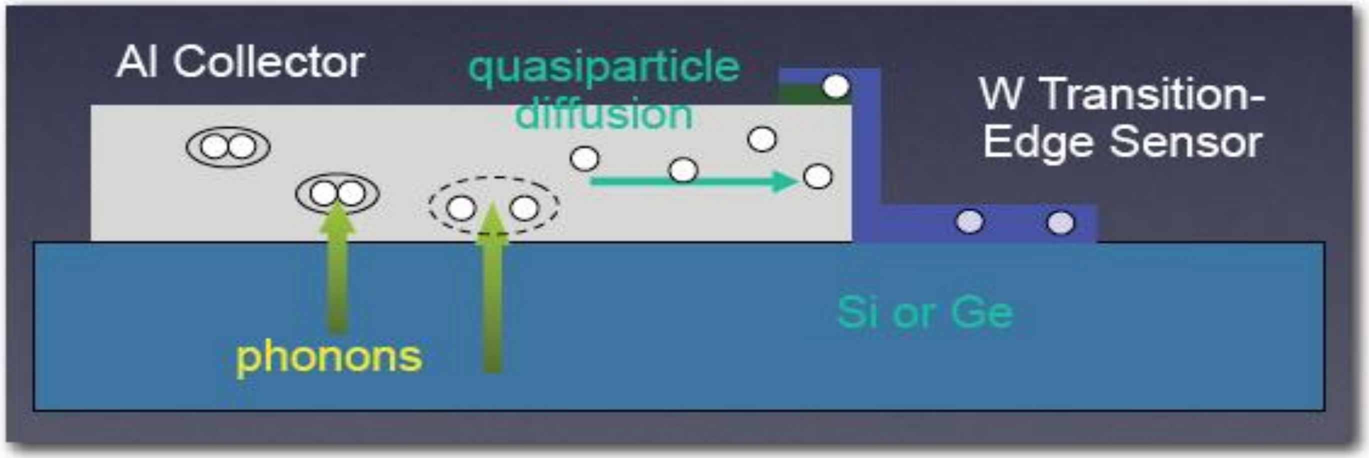


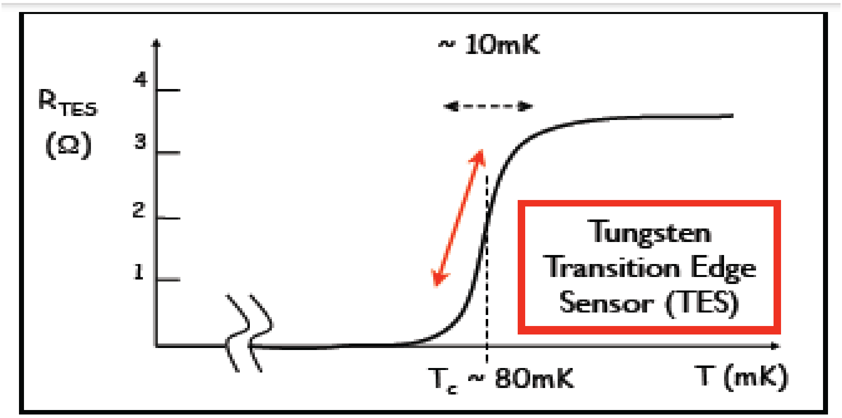


WIMP →nucleus→ Ionization and phonon



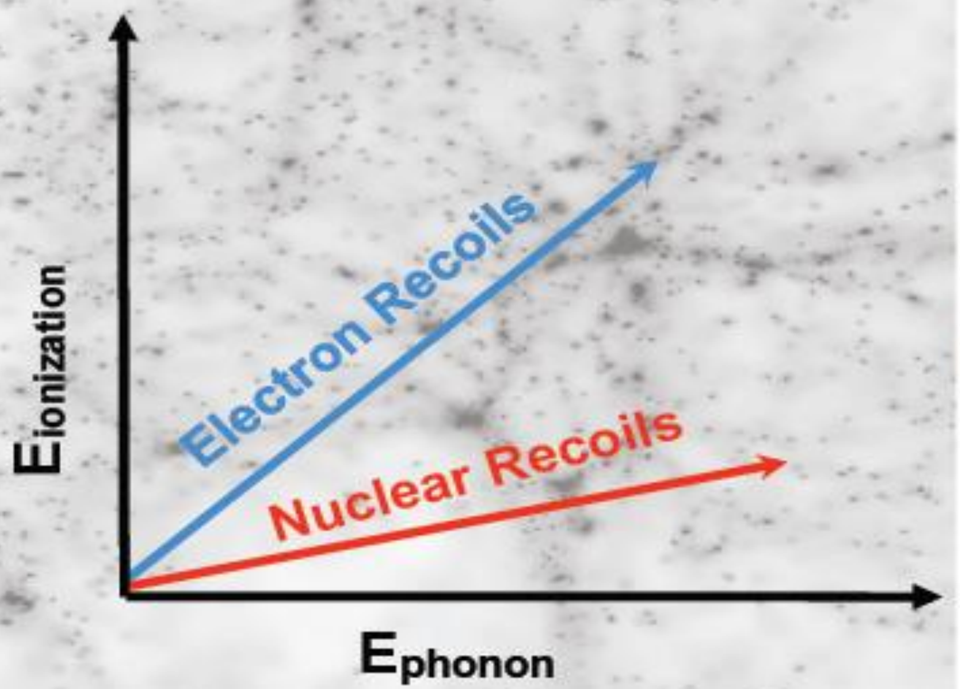
Ionization detection

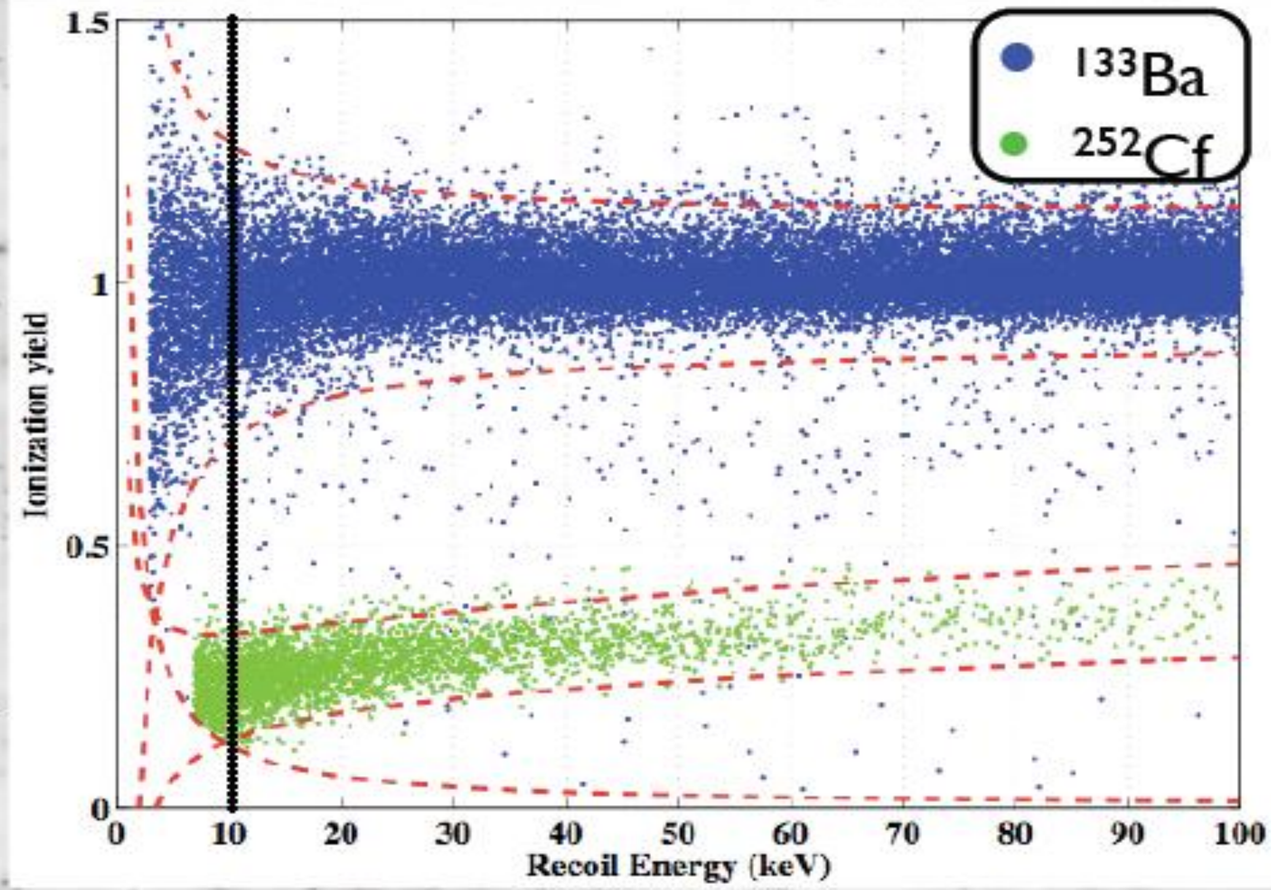




Phonons detection

Ionization Yield and Recoil Energy

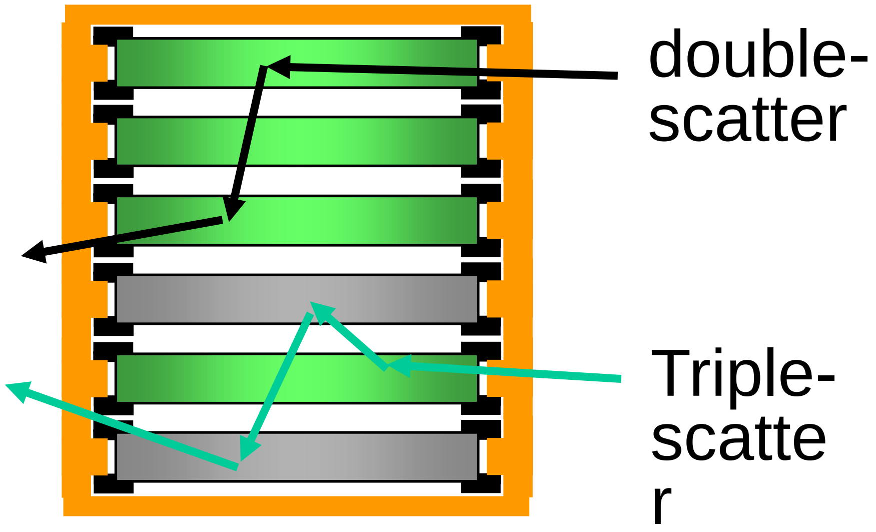


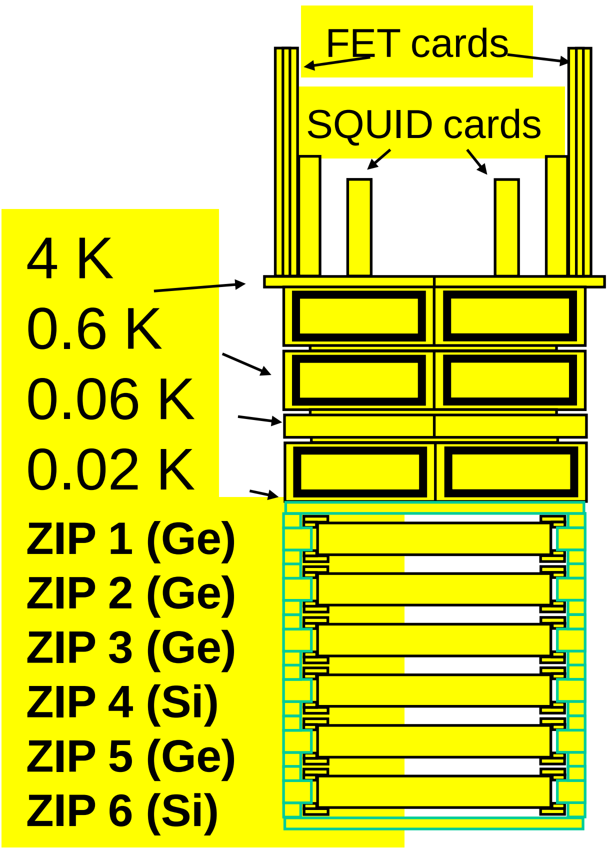


Better than 1:10^4 event by event discrimination based on yield

CDMS-II Detector

- Ge(～ 250g)*19+Si(～ 100g)*11
- T～15mK
- Ionization & phonon
- Single hit and multi-hi
- Pulse shape





WIMPs are much more likely to interact in the germanium than they are in the silicon (about seven times as likely); neutrons are as likely to interact in a silicon detector.

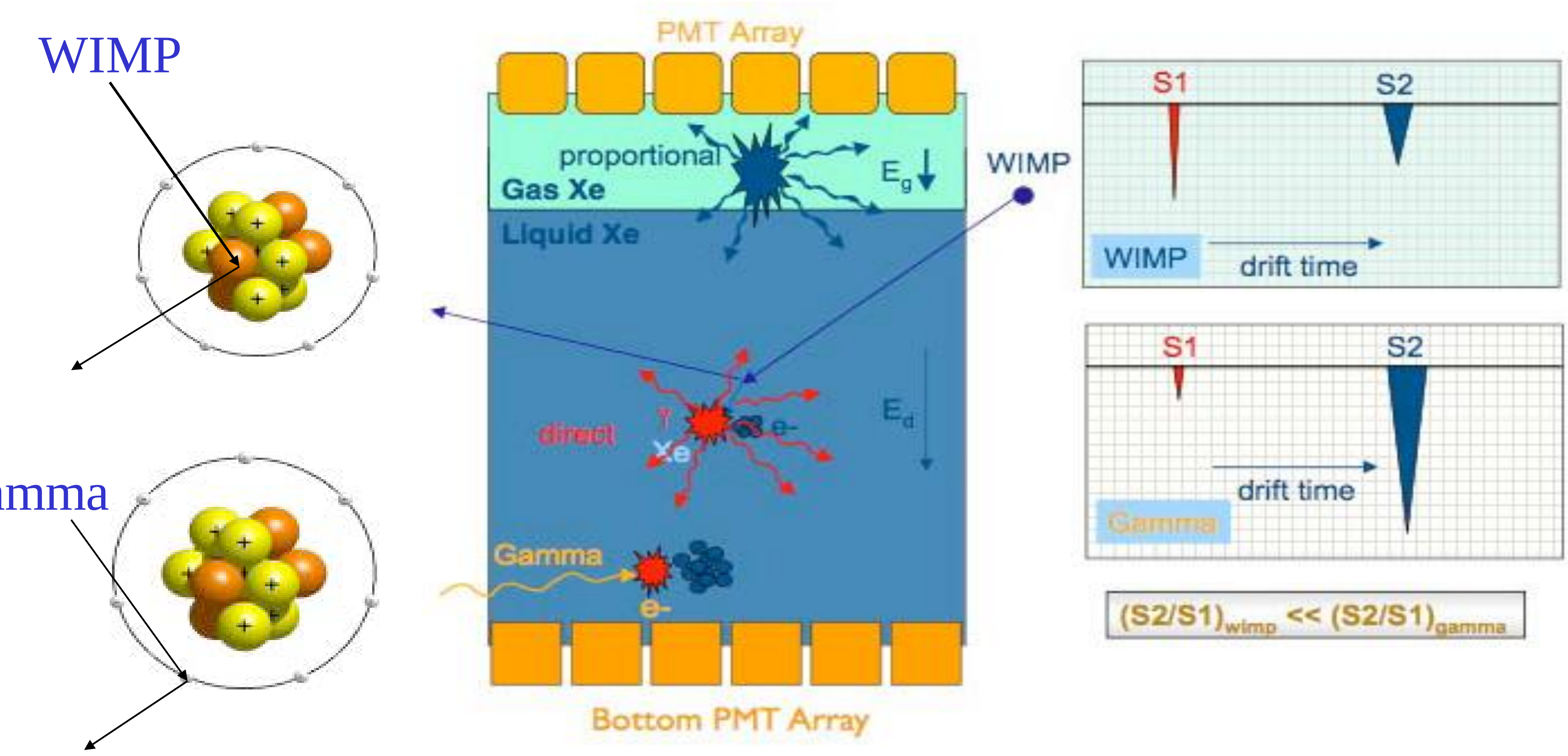
Germanium Events – Silicon Events = WIMP Events.

Liquid scintillation detector

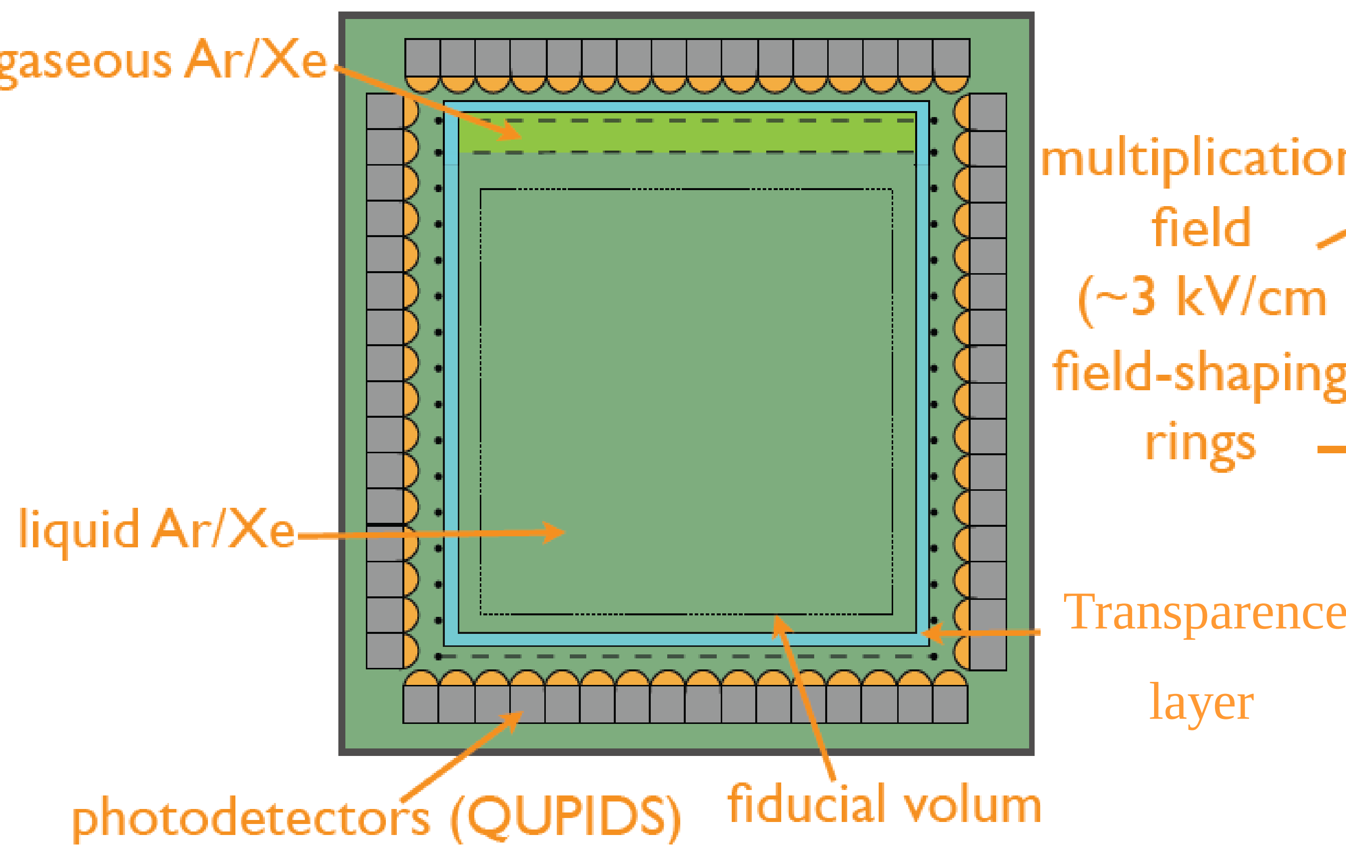
Large mass

Reject background by S2/S1

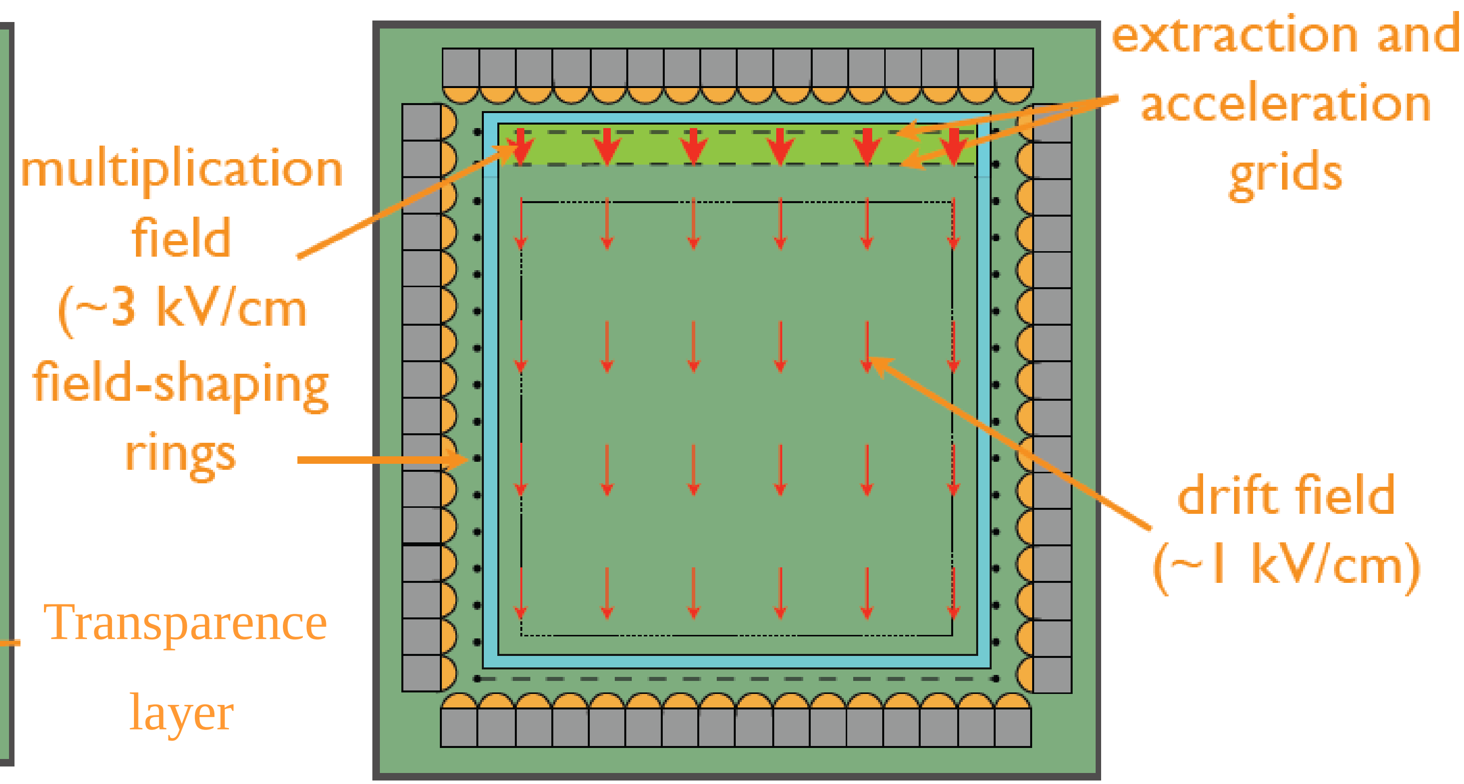
Two-phase Xenon Detectors



TPC in Action



TPC in Action



XENON dark matter search program

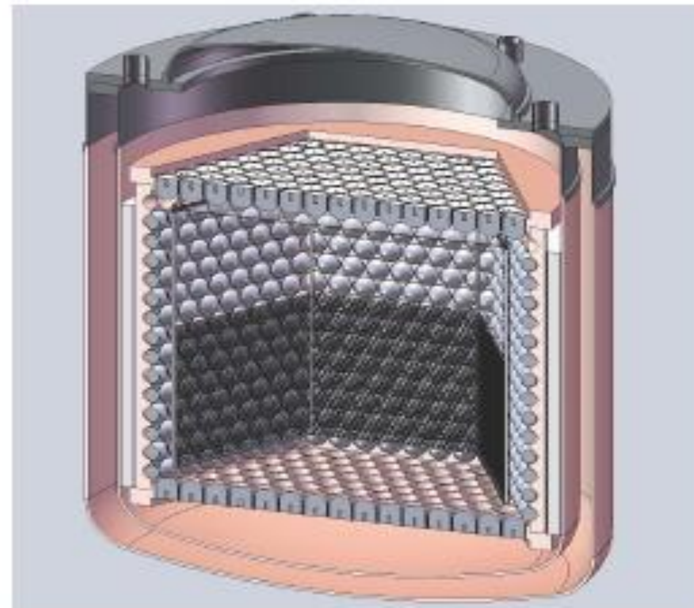
the past
(2006 - 2007)

XENON10

the current
(2007-2009)

XENON100

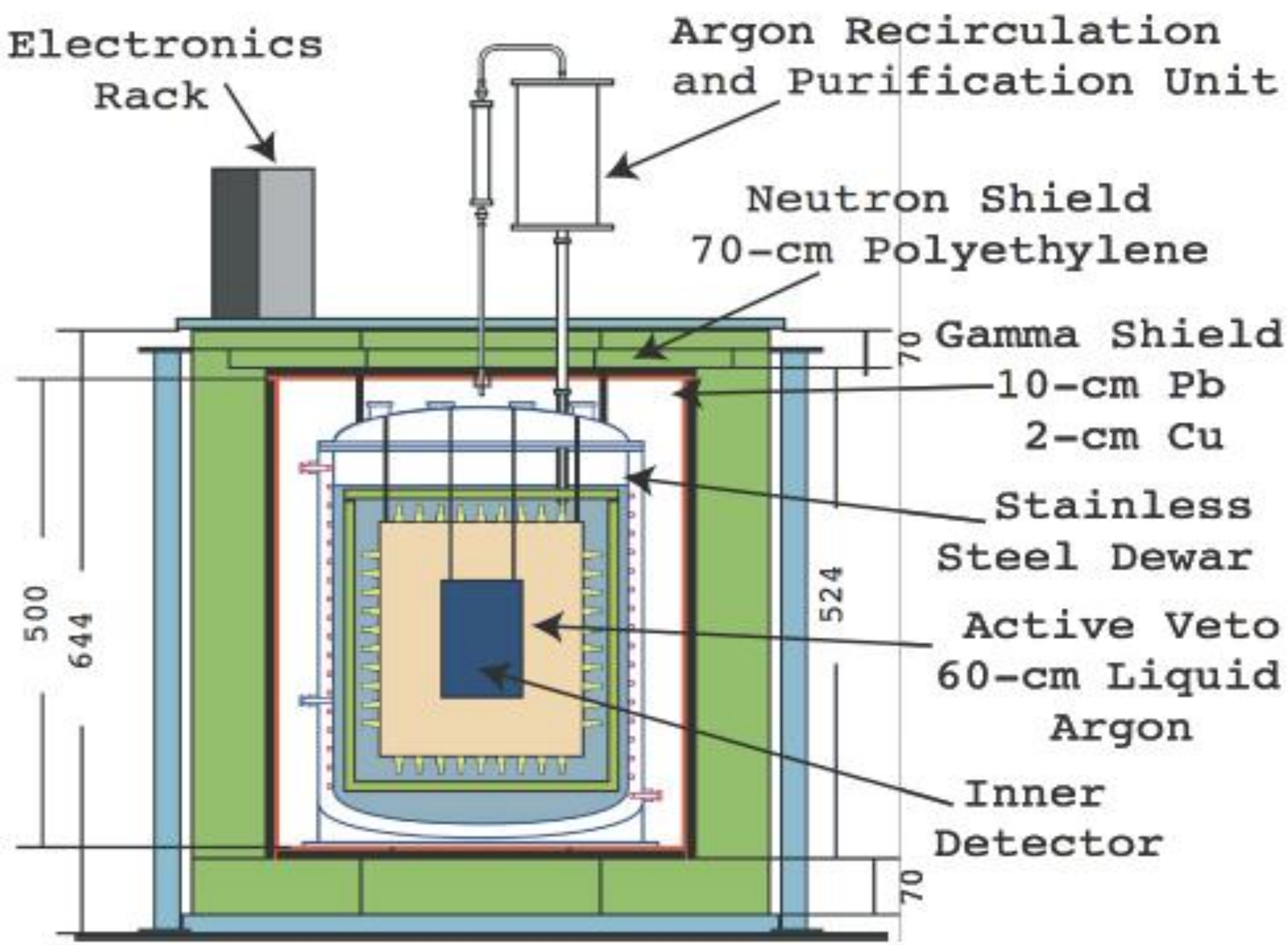
the future
(2009-2013)



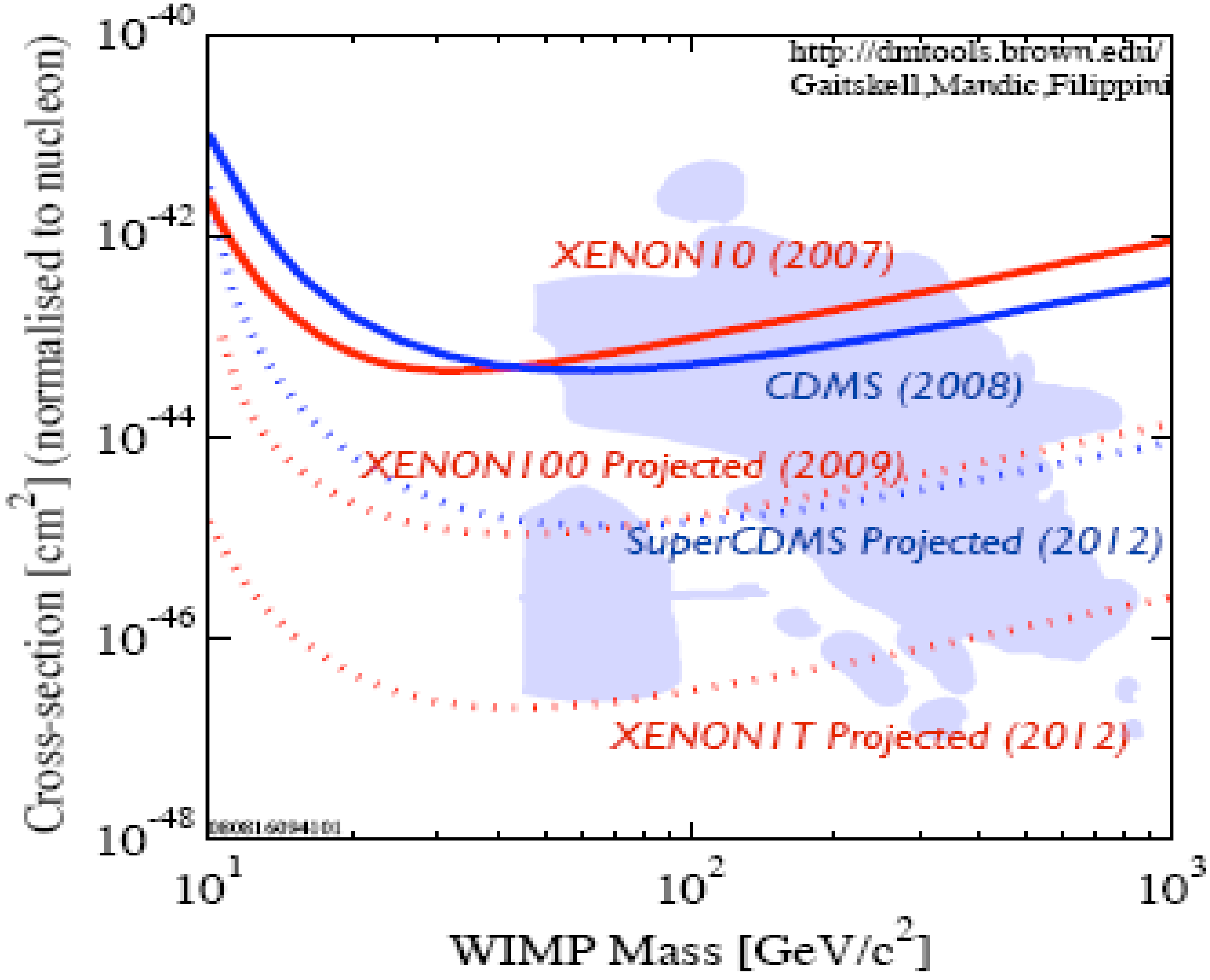
XENON1T

WarP Experiment

Installation Layout



The road to direct DM detector :from XENON 100 to XENON 1T



Physics Results

国际上几个代表性实验及结果

CRESST：Al_2O_3 262g
（法） (phonon)

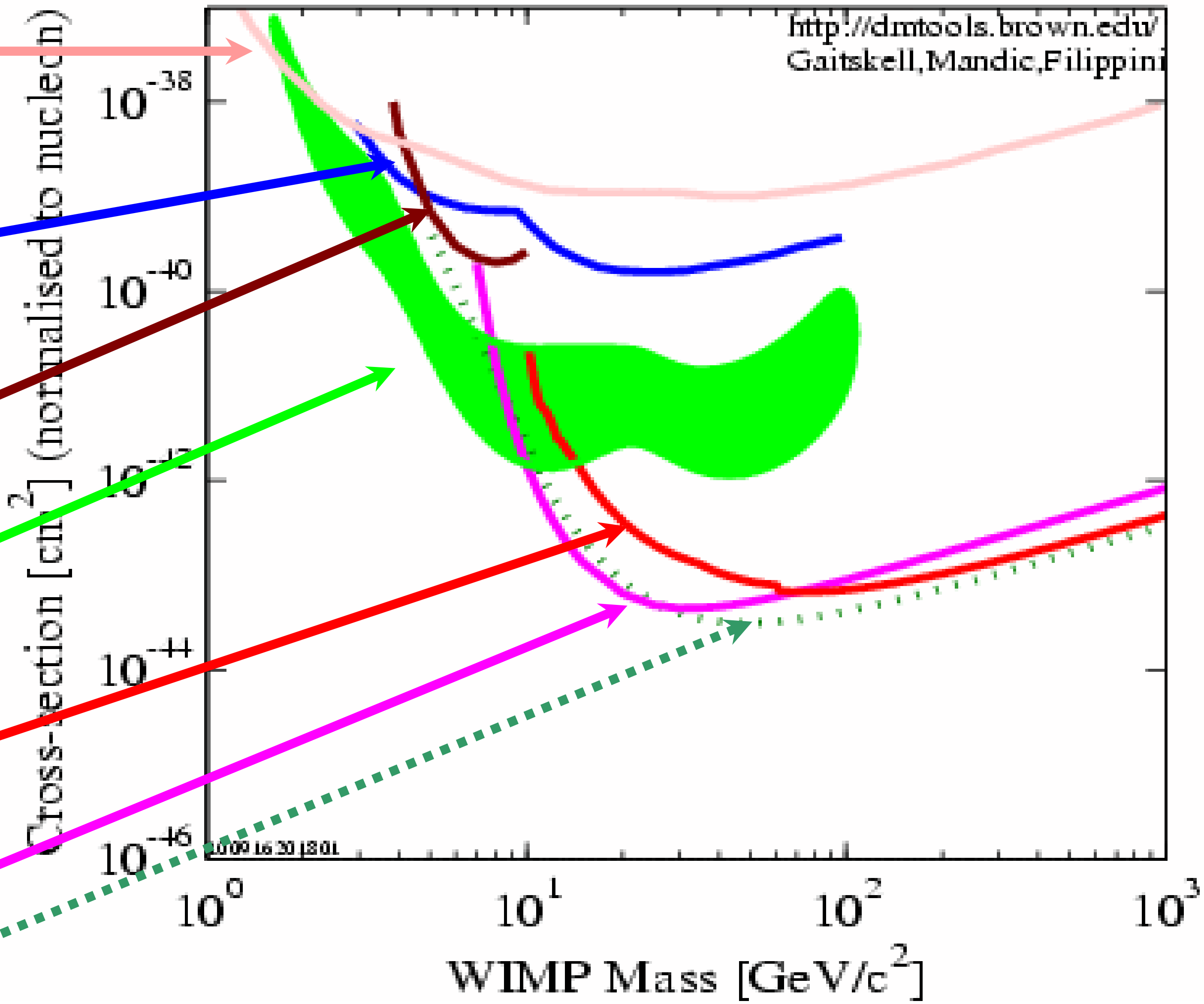
CDEX/TEXONO：2009年
ULE-HPGe Detector Array
（中） (ionization)

CoGeNT：2008年
PCGe Detector
（美）(ionization)

DAMA：NaI晶体~200kg
（意） 2008年 light

CDMS：极低温Ge探测器
（美） 250g×7 2009年
电离及低温量热

XENON10：液态氙 10kg
（美）电离及闪烁光
XENON100:
100kg LXe 2010年



CDMS Dec09 Results

Results from the Final Exposure of the CDMS II Experiment

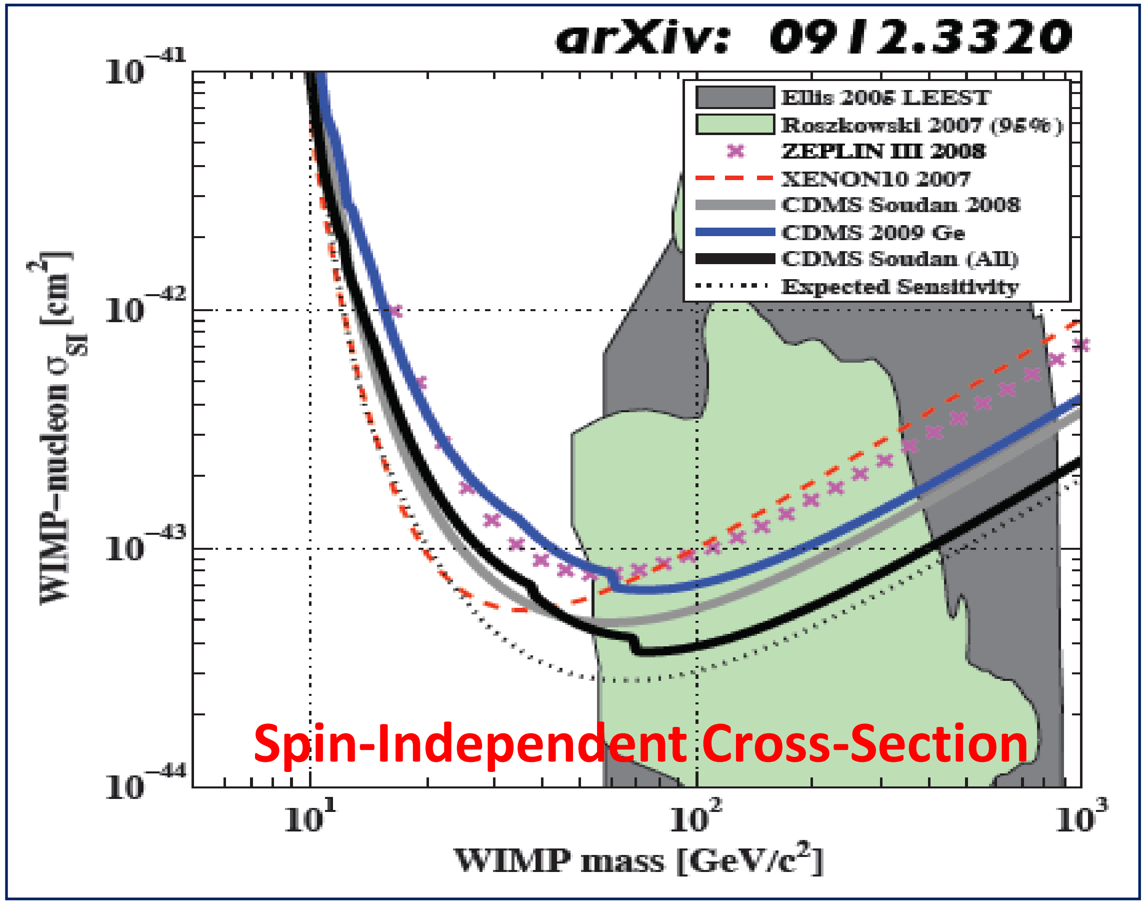
Z. Ahmed,[19] D.S. Akerib,[2] S. Arrenberg,[18] C.N. Bailey,[2] D. Balakishiyeva,[16] L. Baudis,[18] D.A. Bauer,[3] P.L. Brink,[10] T. Bruch,[18] R. Bunker,[14] B. Cabrera,[10] D.O. Caldwell,[14] J. Cooley,[9] P. Cushman,[17] M. Daal,[13] F. DeJongh,[3] M.R. Dragowsky,[2] L. Duong,[17] S. Fallows,[17] E. Figueroa-Feliciano,[5] J. Filippini,[19] M. Fritts,[17] S.R. Golwala,[19] D.R. Grant,[2] J. Hall,[3] R. Hennings-Yeomans,[2] S.A. Hertel,[5] D. Holmgren,[3] L. Hsu,[3] M.E. Huber,[15] O. Kamaev,[17] M. Kiveni,[11] M. Kos,[11] S.W. Leman,[5] R. Mahapatra,[12] V. Mandic,[17] K.A. McCarthy,[5] N. Mirabolfathi,[13] D. Moore,[19] H. Nelson,[14] R.W. Ogburn,[10] A. Phipps,[13] M. Pyle,[10] X. Qiu,[17] E. Ramberg,[3] W. Rau,[6] A. Reisetter,[17,7] T. Saab,[16] B. Sadoulet,[4,13] J. Sander,[14] R.W. Schnee,[11] D.N. Seitz,[13] B. Serfass,[13] K.M. Sundqvist,[13] M. Tarka,[18] P. Wikus,[5] S. Yellin,[10,14] J. Yoo,[3] B.A. Young,[8] and J. Zhang[17]
(CDMS Collaboration)

arXiv:0912.3592v1 [astro-ph.CO] 18 Dec 2009

We report results from a blind analysis of the final data taken with the Cryogenic Dark Matter Search experiment (CDMS II) at the Soudan Underground Laboratory, Minnesota, USA. A total raw exposure of 612 kg-days was analyzed for this work. We observed two events in the signal region; based on our background estimate, the probability of observing two or more background events is 23%. These data set an upper limit on the Weakly Interacting Massive Particle (WIMP)-nucleon elastic-scattering spin-independent cross-section of 7.0×10^{-44} cm^2 for a WIMP of mass 70 GeV/c^2 at the 90% confidence level. Combining this result with all previous CDMS II data gives an upper limit on the WIMP-nucleon spin-independent cross-section of 3.8×10^{-44} cm^2 for a WIMP of mass 70 GeV/c^2. We also exclude new parameter space in recently proposed inelastic dark matter models.

Plus, of course, many theory papers to explain a positive result which was not claimed ……

CDMS Dec09 Results

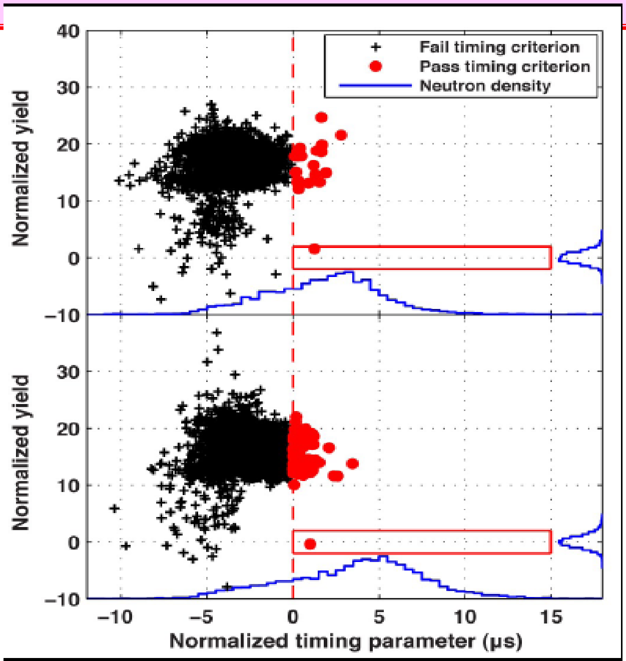


Official Conclusion:

Our results cannot be interpreted as significant evidence for WIMP interactions.

However, we cannot reject either event as signal.

i.e. Very Likely to be Statistical Effects



How Probable is it to Detect N>=2 events at Mean=0.8

- ➡ **~19% from Poisson Distribution**
- ➡ **~ 1.3σ in Gaussian Equivalence**

Results from a Search for Light-Mass Dark Matter with a P-type Point Contact Germanium Detector

CoG e NT collaboration

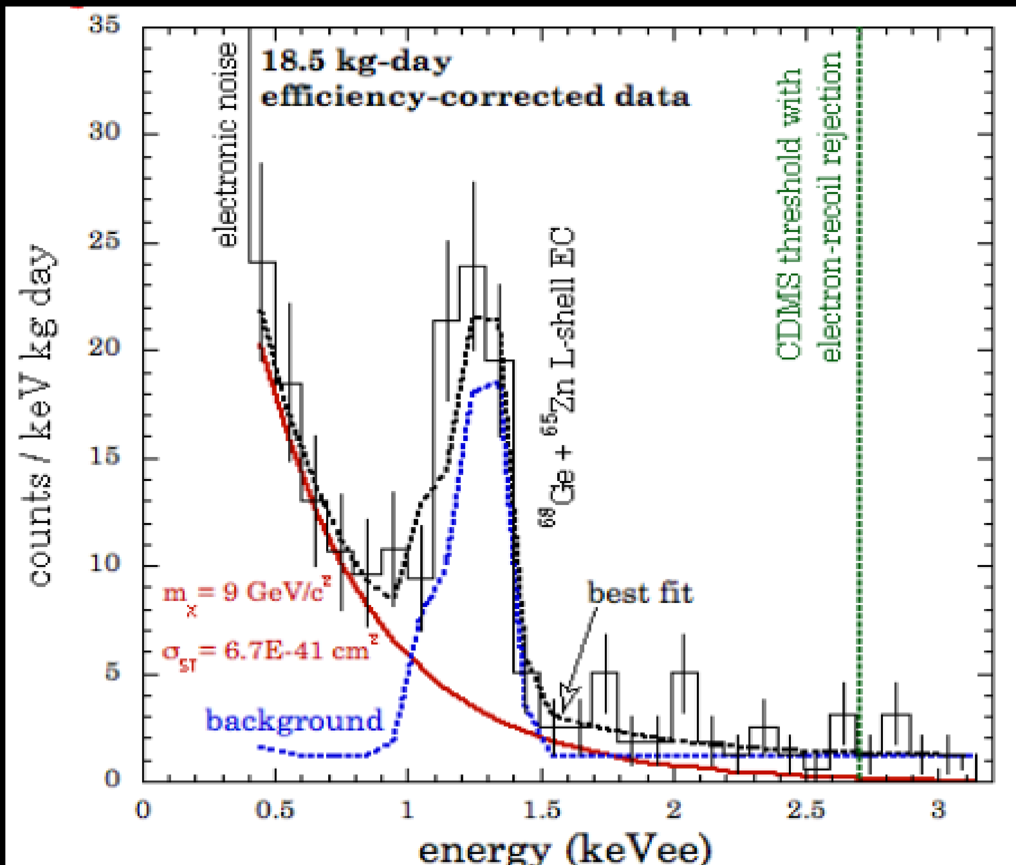
２０１０．２．２５

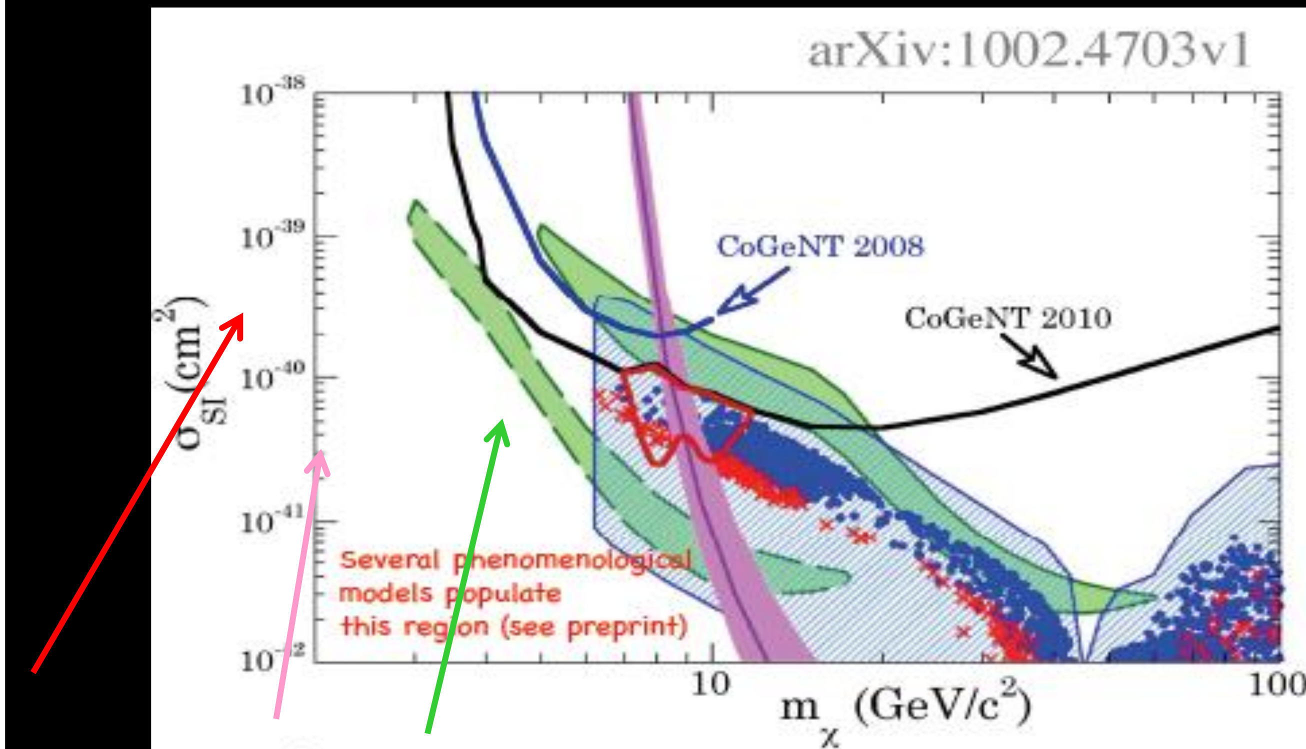
We report on several features present in the energy spectrum from an ultra low-noise germanium detector operated at 2,100 m.w.e. By implementing a new technique able to reject surface events, a number of cosmogenic peaks can be observed for the first time. We discuss several possible causes for an irreducible excess of bulk-like events below 3 keVee, including a dark matter candidate common to the DAMA/LIBRA annual modulation effect, the hint of a signal in CDMS, and phenomenological predictions. Improved constraints are placed on a cosmological origin for the DAMA/LIBRA effect.

1, PPC Ge detector
2，2100m.w.e underground
3，new reject background technology
4，reject more event near 3KeV
5，hint of a signal of CDMS

CoGeNT Feb 2010 Results

- Improved Background and at Underground (Soudan)
- Show both limits & “allowed region”





1, Data after efficiency corrected ,there are Zn, Ge peaks
2, Point line : trigger efficiency ,
Dashed line : trigger + PSD cut,
Real line : trigger + PSD + rise time Cut
3.WIMP signal : 7Gev/c-10Gev/c

Quotable: The excess of irreducible bulk-like events in CoGeNT is compatible with the WIMP hypothesis in a region where CDMS, DAMA and (several) phenomenological models (good thermal relics) can coexist. It is also equally compatible with any exponential background.

Expect : Increasing Interest and Rising Activities in sub-keV Experiments

XENON100

Selected for a Viewpoint in *Physics*
PRL **105,** 131302 (2010) PHYSICAL REVIEW LETTERS week ending 24 SEPTEMBER 201

First Dark Matter Results from the XENON100 Experiment

E. Aprile,[1] K. Arisaka,[2] F. Arneodo,[3] A. Askin,[4] L. Baudis,[4] A. Behrens,[4] K. Bokeloh,[6] E. Brown,[2] J. M. R. Cardoso,[5]
B. Choi,[1] D. B. Cline,[2] S. Fattori,[3] A. D. Ferella,[4] K.-L. Giboni,[1] A. Kish,[4] C. W. Lam,[2] J. Lamblin,[7] R. F. Lang,[1]
K. E. Lim,[1] J. A. M. Lopes,[5] T. Marrodán Undagoitia,[4] Y. Mei,[8] A. J. Melgarejo Fernandez,[1] K. Ni,[9] U. Oberlack,[8]
S. E. A. Orrigo,[5] E. Pantic,[2] G. Plante,[1,*] A. C. C. Ribeiro,[5] R. Santorelli,[4] J. M. F. dos Santos,[5] M. Schumann,[4,8] P. Shagin
A. Teymourian,[2] D. Thers,[7] E. Tziaferi,[4] H. Wang,[2] and C. Weinheimer[6]

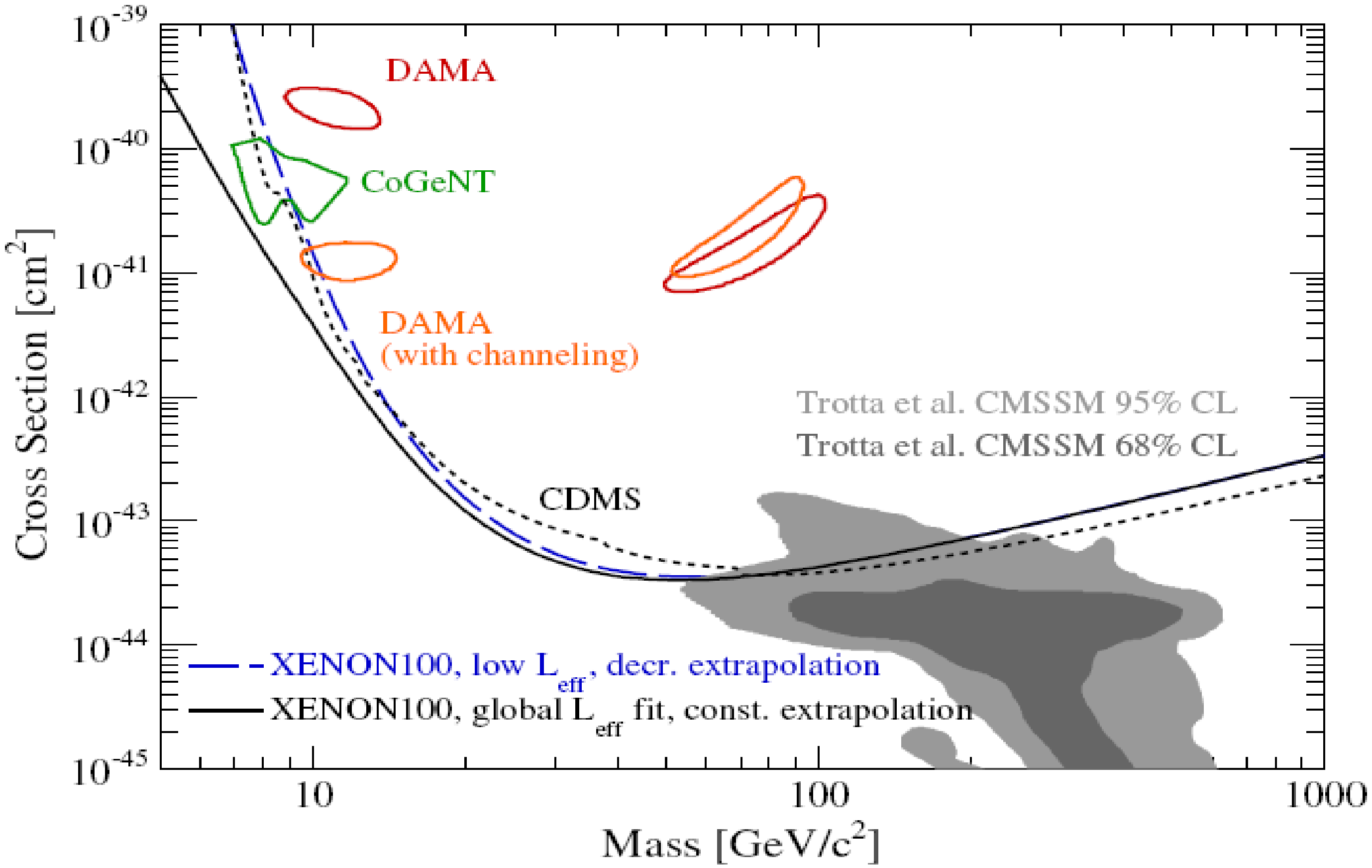
(XENON100

[1]*Physics Department, Columbia Univ*
[2]*Physics & Astronomy Department, U*
[3]*INFN Laboratori Nazionali del*
[4]*Physics Institute, University of Zürich,*
[5]*Department of Physics, University of Coin*
[6]*Institut für Kernphysik, Westfälische Wilhelm*
[7]*SUBATECH, Ecole des Mines de Nantes, Uni*
[8]*Department of Physics and Astronomy, Rice*
[9]*Department of Physics, Shanghai Jiao*

(Received 30 April 2010; revised manuscript rec

The XENON100 experiment, in operation at t
designed to search for dark matter weakly interacti
liquid xenon in an ultralow background dual-phase t
dark matter results from the analysis of 11.17 li
November 2009. In the selected fiducial target of
observe no events and hence exclude spin-indepen
above 3.4×10^{-44} cm^2 for 55 GeV/c^2 WIMPs at
constrains the interpretation of the CoGeNT and DA
light mass WIMP interactions.

DOI: 10.1103/PhysRevLett.105.131302



Comments&discussion on the results from Xenon 100

Comments on "First Dark Matter Results from the XENON100 Experiment"

J.I. Collar[a] and D.N. McKinsey[b]
[a] *Enrico Fermi Institute, KICP and Department of Physics, University of Chicago, Chicago, IL 60637*
and
[b] *Department of Physics, Yale University, New Haven, CT 06520*

The XENON100 collaboration has recently released new dark matter limits [1], placing particular emphasis on their impact on searches known to be sensitive to light-mass (below ~10 GeV/c^2) Weakly Interacting Massive Particles (WIMPs), such as DAMA [2] and CoGeNT [3]. We describe here several sources of uncertainty and bias in their analysis that make their new claimed sensitivity presently untenable. In particular, we point out additional work in this field and simple kinematic arguments that indicate that liquid xenon (LXe) may be a relatively insensitive detection medium for the recoil energies (few keV$_r$) expected from such low mass WIMPs. To place the discussion that follows in some perspective, using the most recently suggested mean value of the galactic escape velocity [4], an example 7 GeV/c^2 WIMP can impart an absolute maximum of 4 keV$_r$ to a xenon nucleus, with the majority (~90%) of the events depositing energies below 1.5 keV$_r$.

It is suggested in [1] that the value of $\mathcal{L}_{\rm eff}$ (the ratio between electron equivalent energy and nuclear recoil energy) adopted to obtain WIMP limits is constant

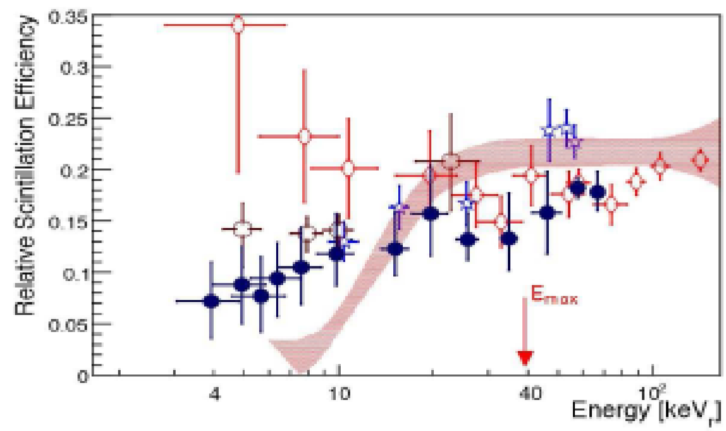
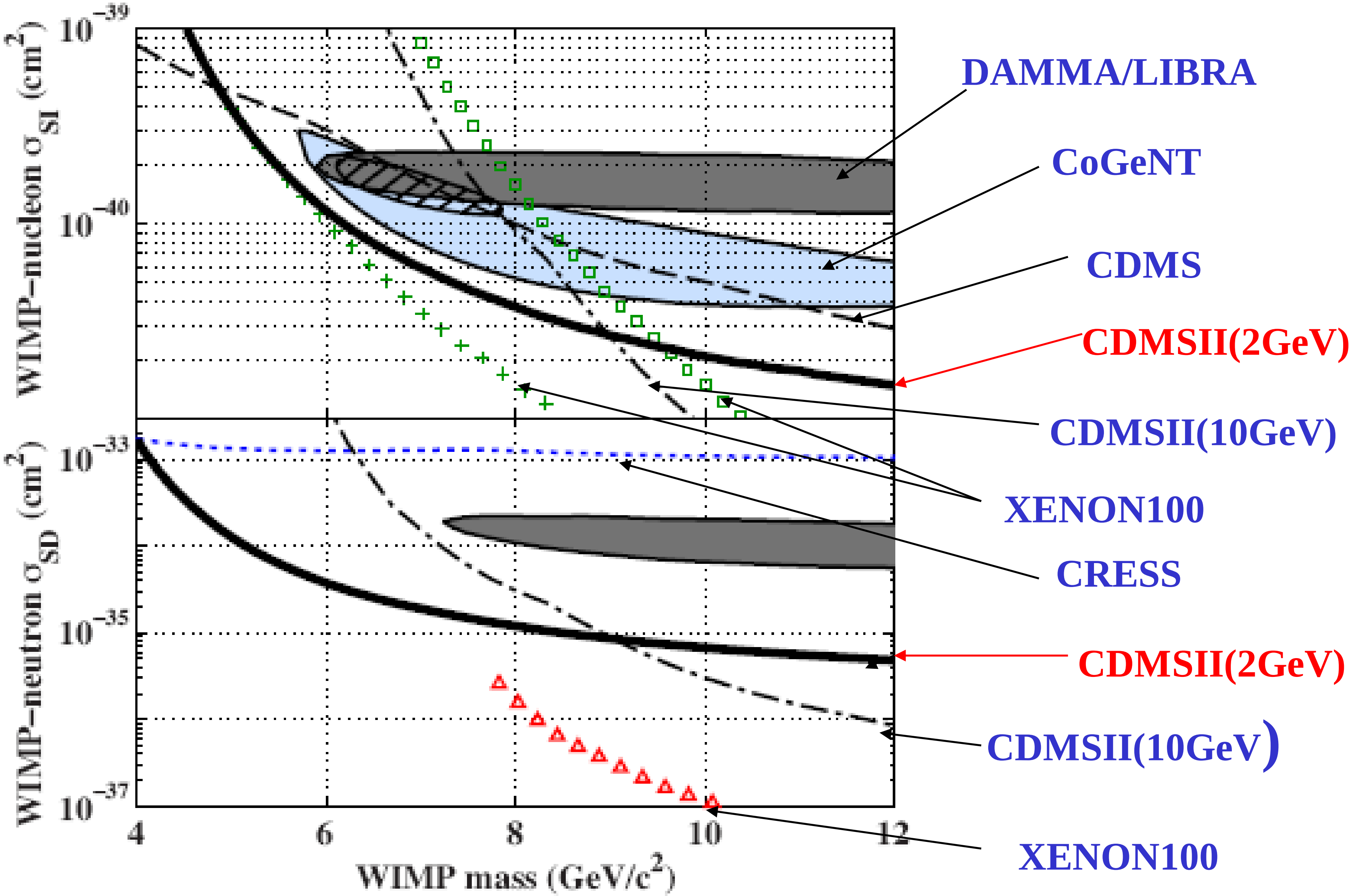


FIG. 1: Measurements of $\mathcal{L}_{\rm eff}$ in LXe. The red vertical arrow indicates the calculated value for the kinematic cutoff in recoil energy (see text). The most recent analysis by the XENON10 collaboration [8], not considered in [1], follows the trend in [5] (dark blue points). Light-mass WIMPs like those claimed to be excluded in [1] concentrate their signal beyond the left margin of this figure. A constant $\mathcal{L}_{\rm eff}$ ~0.12 below ~10 keV$_r$ is used in [1] to obtain dark matter limits.



Results from a Low-Energy Analysis of the CDMS II Germanium Data

arXiv:1011.2482v1[astro-ph.co]10Nov2010

FERMILAB-PUB-10-414-A

Dark Matter Annihilation in The Galactic Center As Seen by the Fermi Gamma Ray Space Telescope

Dan Hooper[1,2] and Lisa Goodenough[3]

[1] *Center for Particle Astrophysics, Fermi National Accelerator Laboratory, Batavia, IL 60510*
[2] *Department of Astronomy & Astrophysics, The University of Chicago, Chicago, IL 60637 and*
[3] *Center for Cosmology and Particle Physics, Department of Physics, New York University, New York, NY 10003*

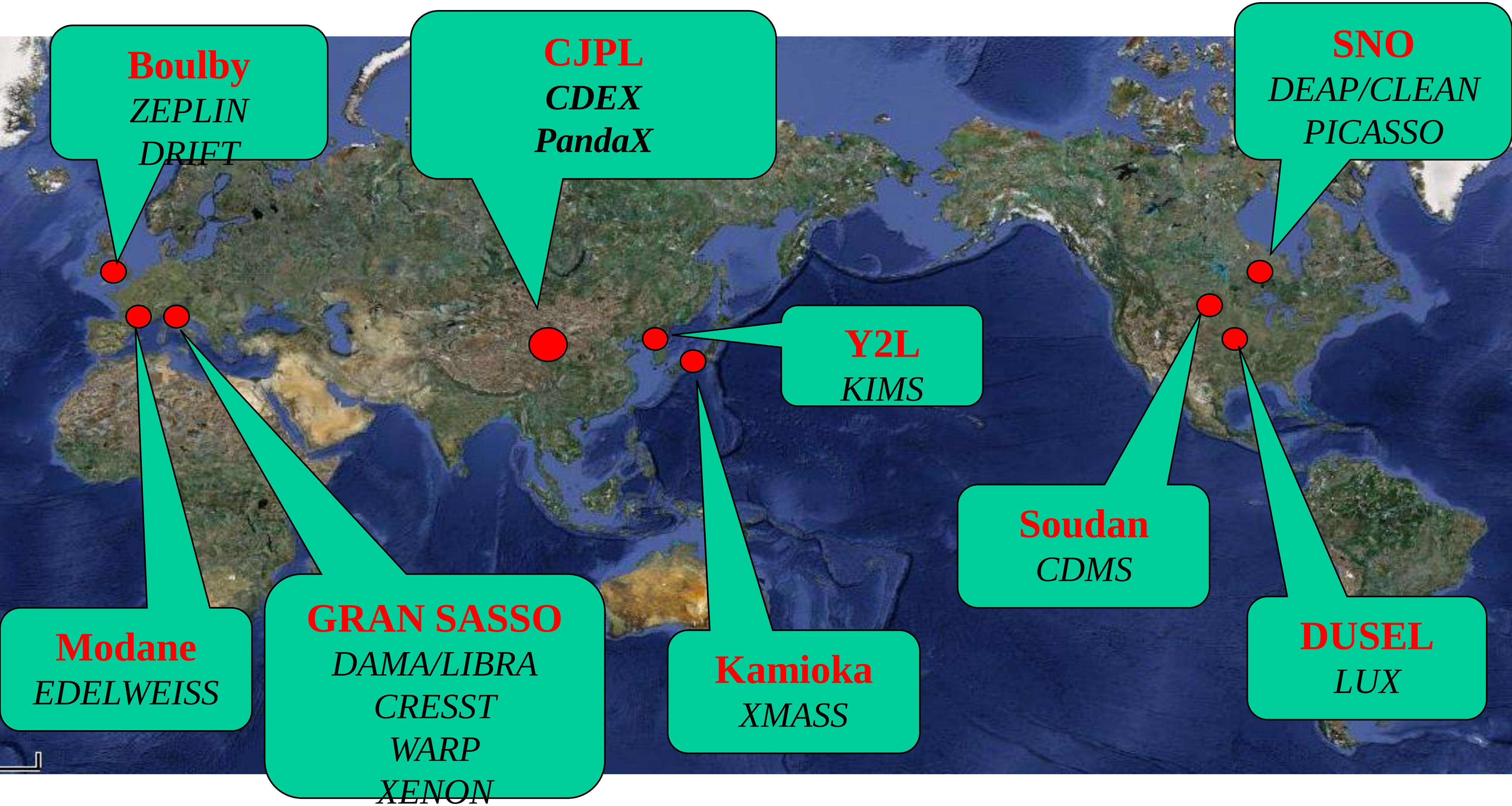
(Dated: October 15, 2010)

We analyze the first two years of data from the Fermi Gamma Ray Space Telescope from the direction of the inner 10° around the Galactic Center with the intention of constraining, or finding evidence of, annihilating dark matter. We find that the morphology and spectrum of the emission between 1.25° and 10° from the Galactic Center is well described by a the processes of decaying pions produced in cosmic ray collisions with gas, and the inverse Compton scattering of cosmic ray electrons in both the disk and bulge of the Inner Galaxy, along with gamma rays from known points sources in the region. The observed spectrum and morphology of the emission within approximately 1.25° (~ 175 parsecs) of the Galactic Center, in contrast, cannot be accounted for by these processes or known sources. We find that an additional component of gamma ray emission is clearly present which is highly concentrated around the Galactic Center, but is not point-like in nature. The observed morphology of this component is consistent with that predicted from annihilating dark matter with a cusped (and possibly adiabatically contracted) halo distribution ($\rho \propto r^{-1.34\pm0.04}$). The observed spectrum of this component, which peaks at energies between 2-4 GeV (in E^2 units), is well fit by that predicted for a 7.3-9.2 GeV dark matter particle annihilating primarily to tau leptons with a cross section in the range of $\langle\sigma v\rangle = 3.3\times10^{-27}$ to 1.5×10^{-26} cm^3/s, depending on how the dark matter distribution is normalized. We discuss other possible sources for this component, but argue that they are unlikely to account for the observed emission.

PACS numbers: 95.35.+d; 95.85.Pw

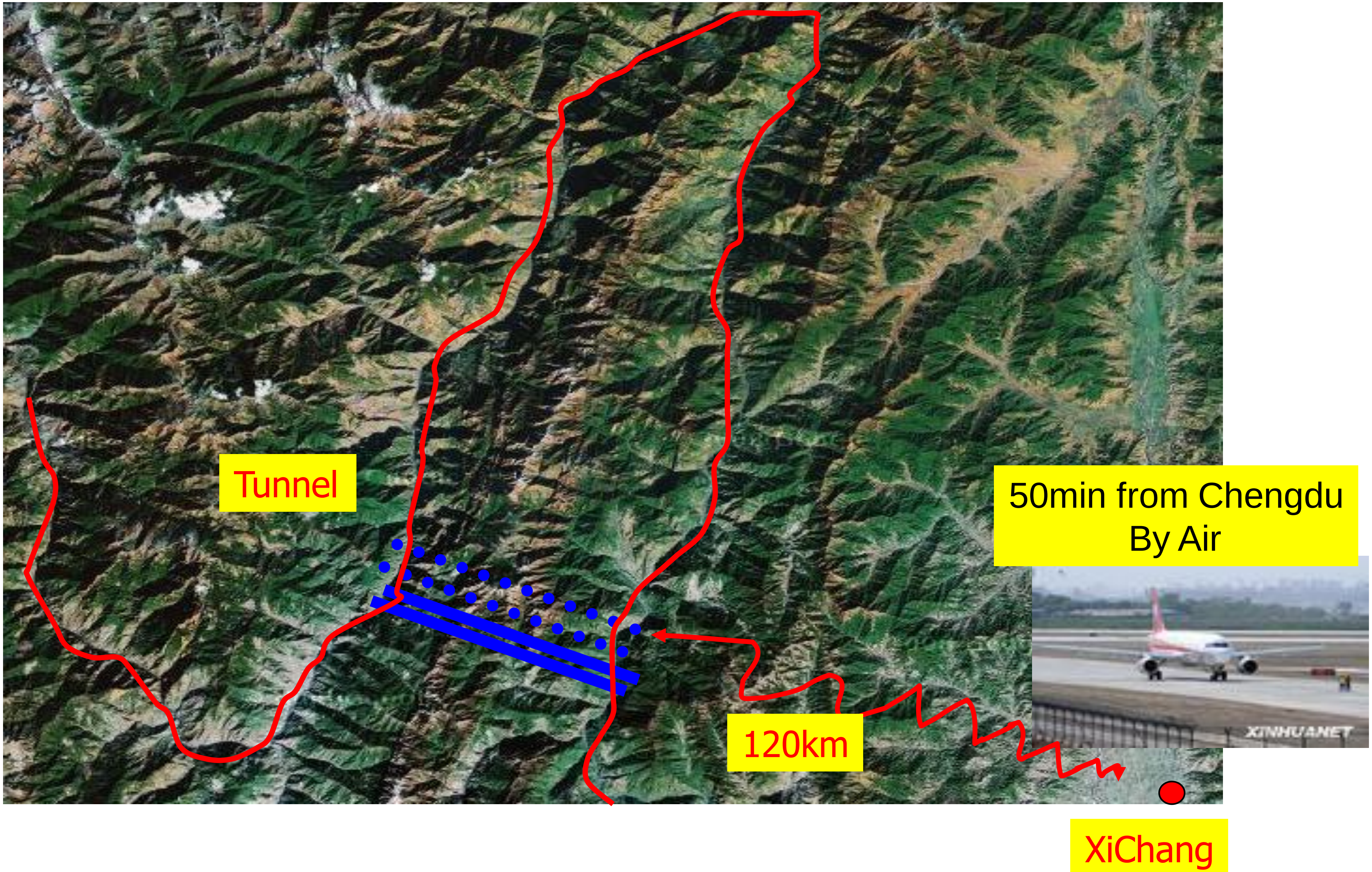
Dark Matter Detection in CJPL

International Main Undergound Laboratories

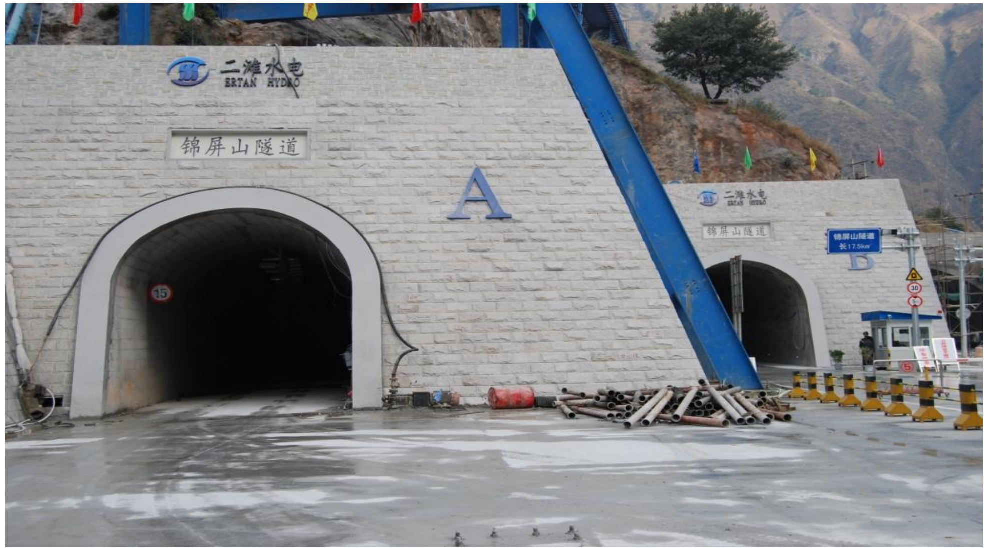



chengdu
Jingping Mountain
350km -> Chengdu
70km -> Xichuang
40km -> Highway

Yalong River and Jinping Mountain

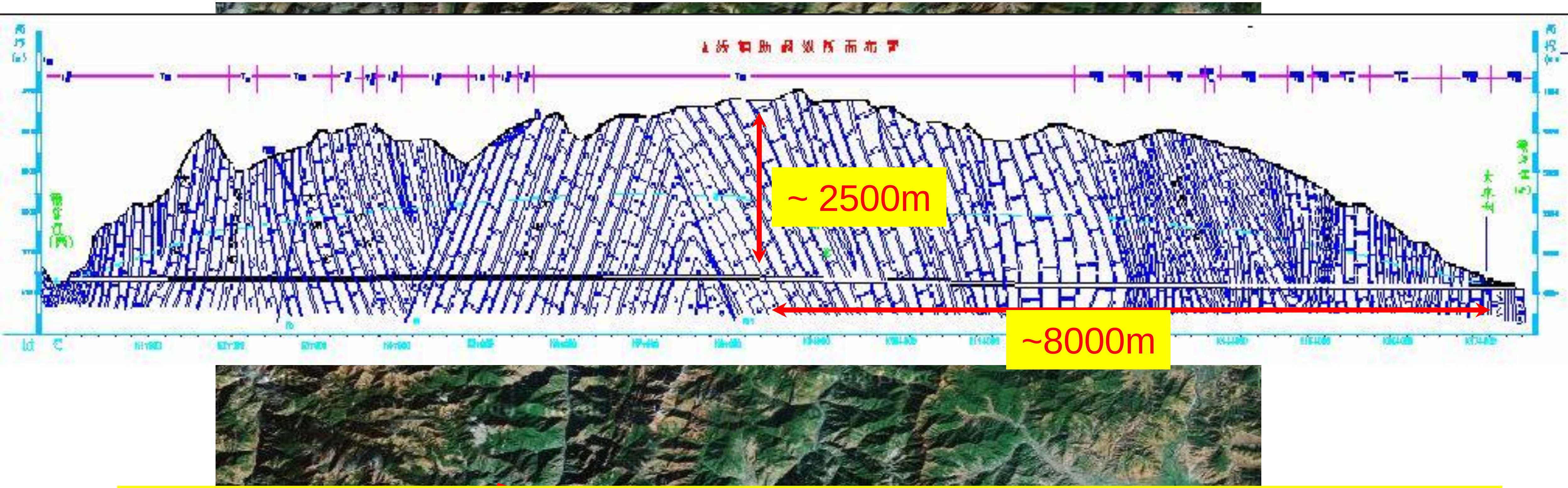


Road and Tunnel



Logistic Condition of this UL

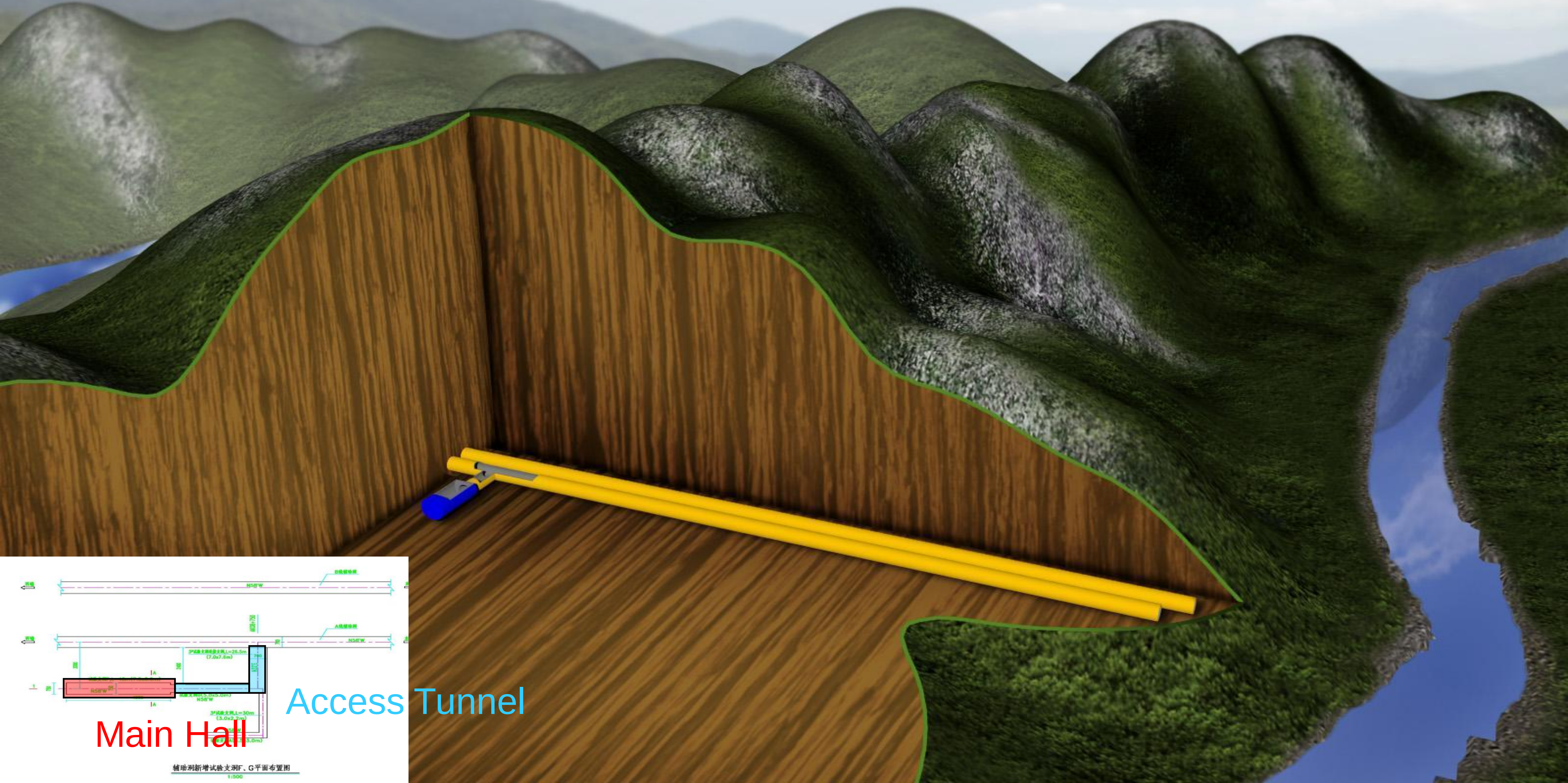
The basic conditions of CJPL



- Peak：4193m ;Maximum rock overburden: ~2500m
- Two tunnels for transportation; Length of Tunnel: 17.5km
- The Lab is in middle of two tunnels

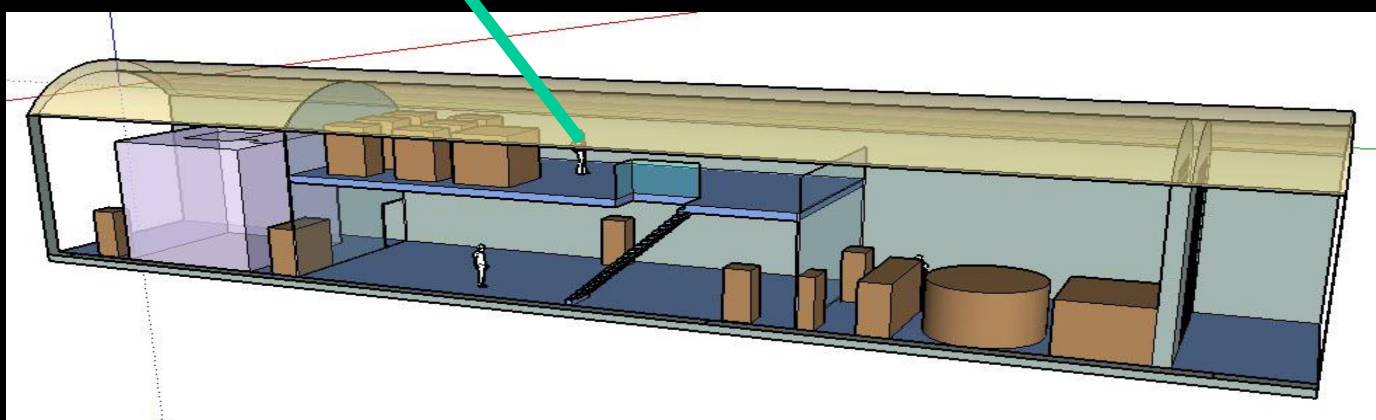
China JinPing Deep Underground Laboratory

(CJPL)



Three Labs have been established

Local Lab near tunnel



Underground Lab

Lab in Tsinghua


1月26日完成喷锚
2010/01/27


混凝土衬砌


2010.02.24

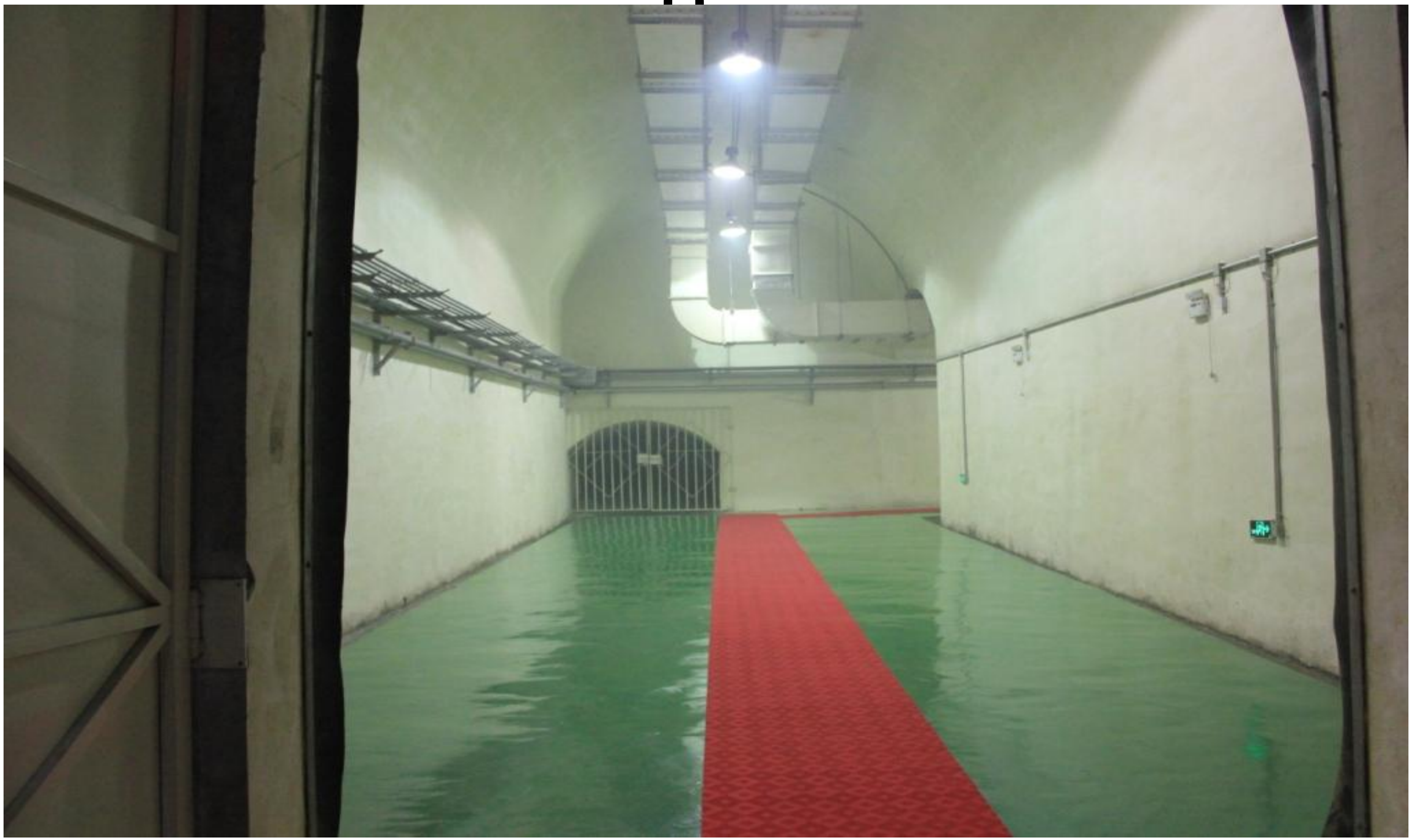

2010/04/24


2010/04/24


2010/04/27


2010/04/28

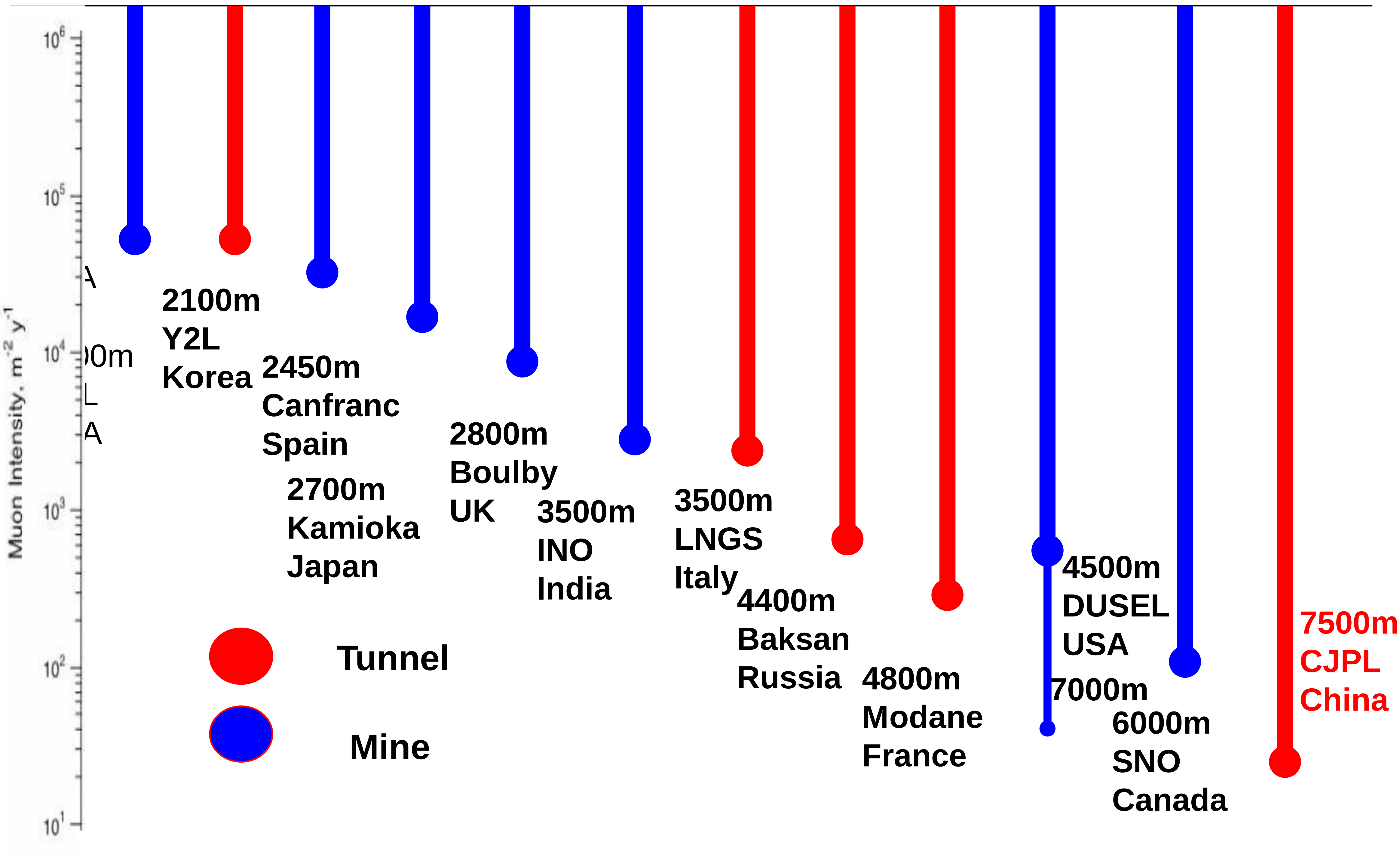
The Gate of CJPL in June 2010



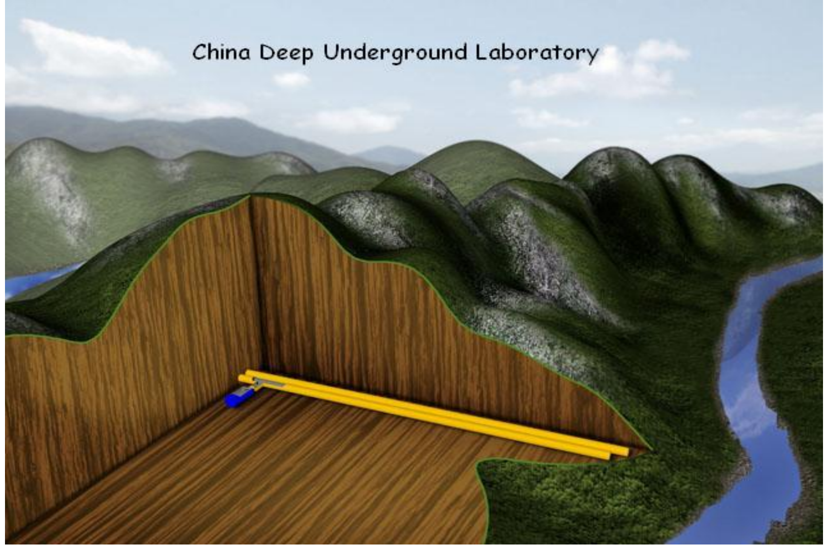

2010.6.19


中国锦屏极深地下暗物质实验室土建及配套工程完工验收会
2010.6.20

Moun flux on the underground



Cosmic-ray Flux



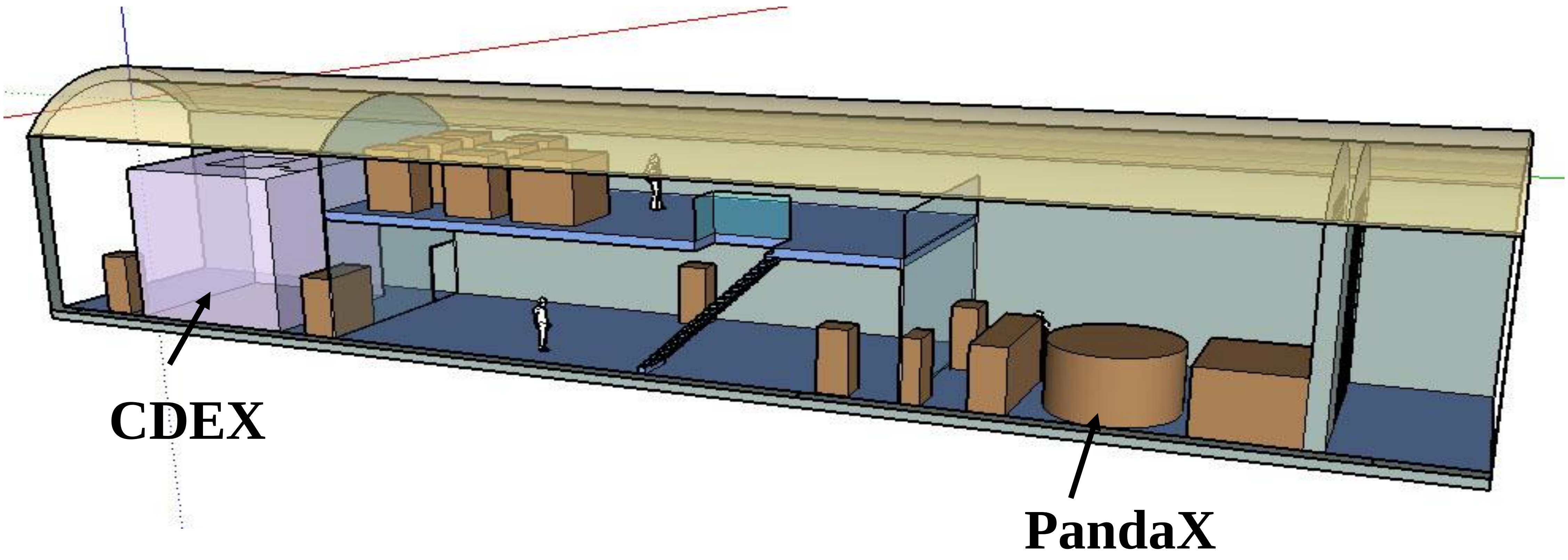
Y2L
(~6×10⁴ m⁻²·y⁻¹)

LNGS
(~ 2×10³ m⁻²·y⁻¹)

CJPL
(~2×10¹ m⁻²·y⁻¹)

Muon flux:
--LNGS 100 times more than CJPL
--Y2L 3000 times more than CJPL

Two Detectors in CJPL



20g, 500g ,1000g HPGe detector

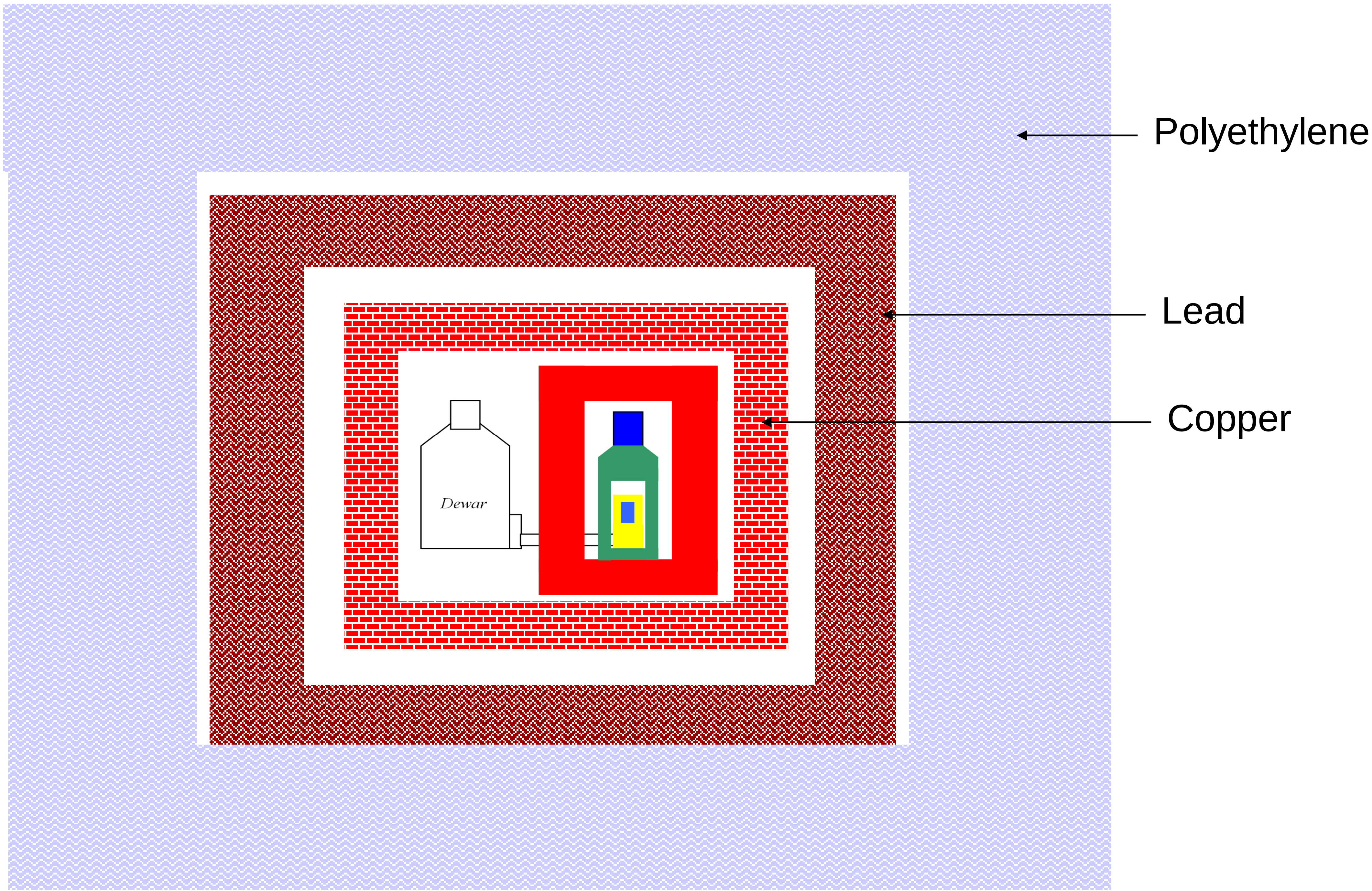
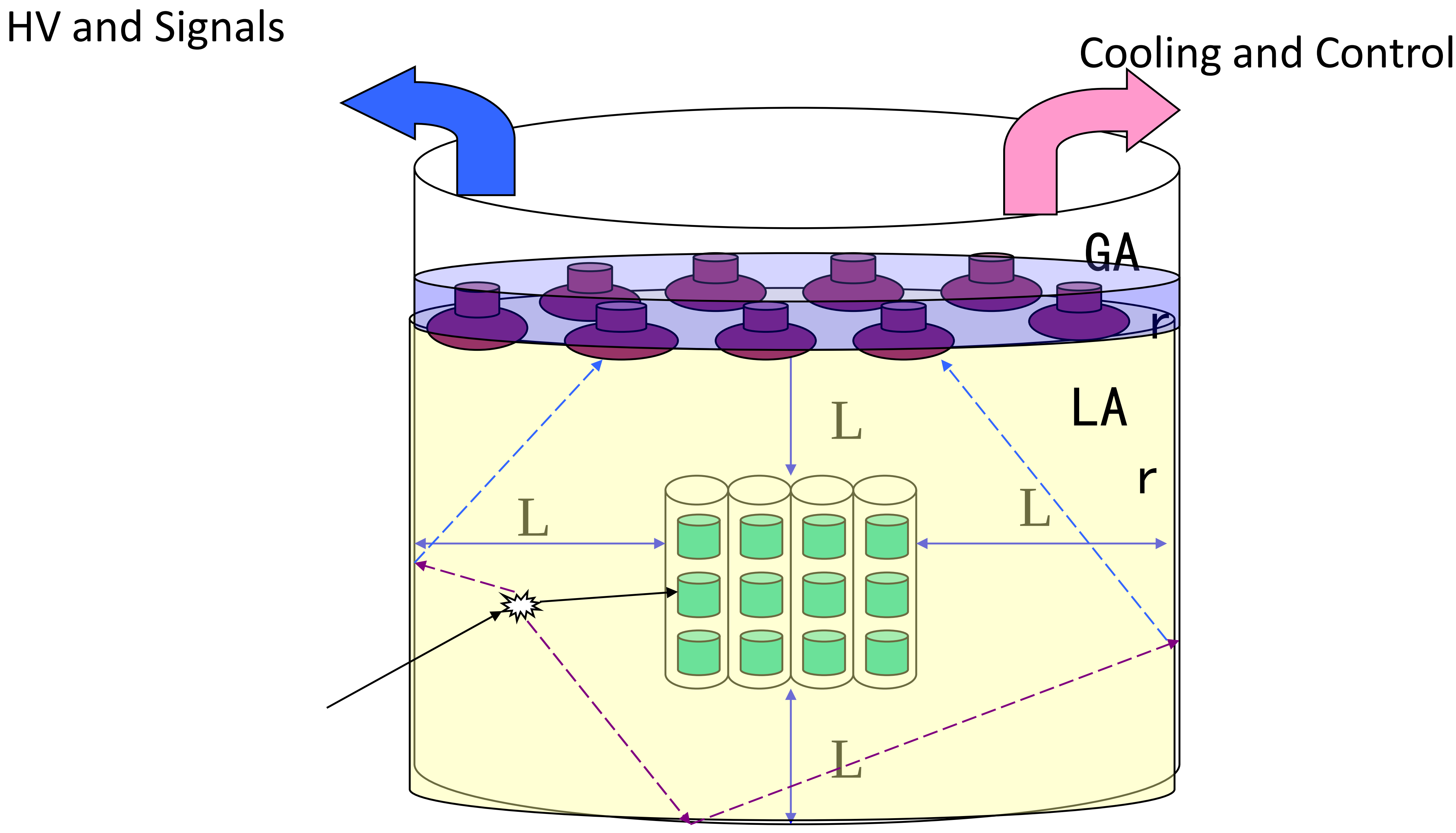
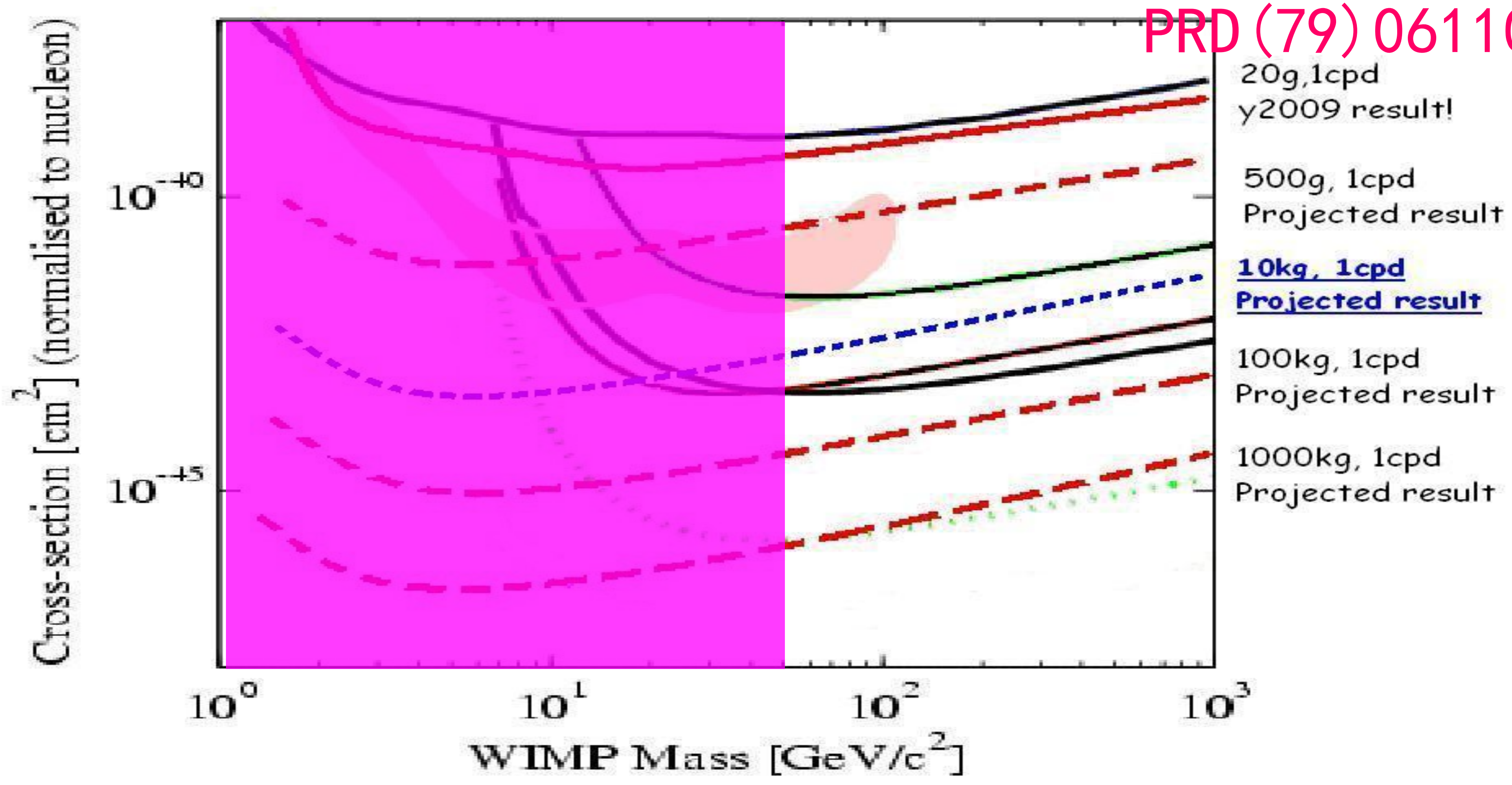


图 5 大门开启

10kg scale PCGe detector array with LAr active shielding



CDEX physics goal

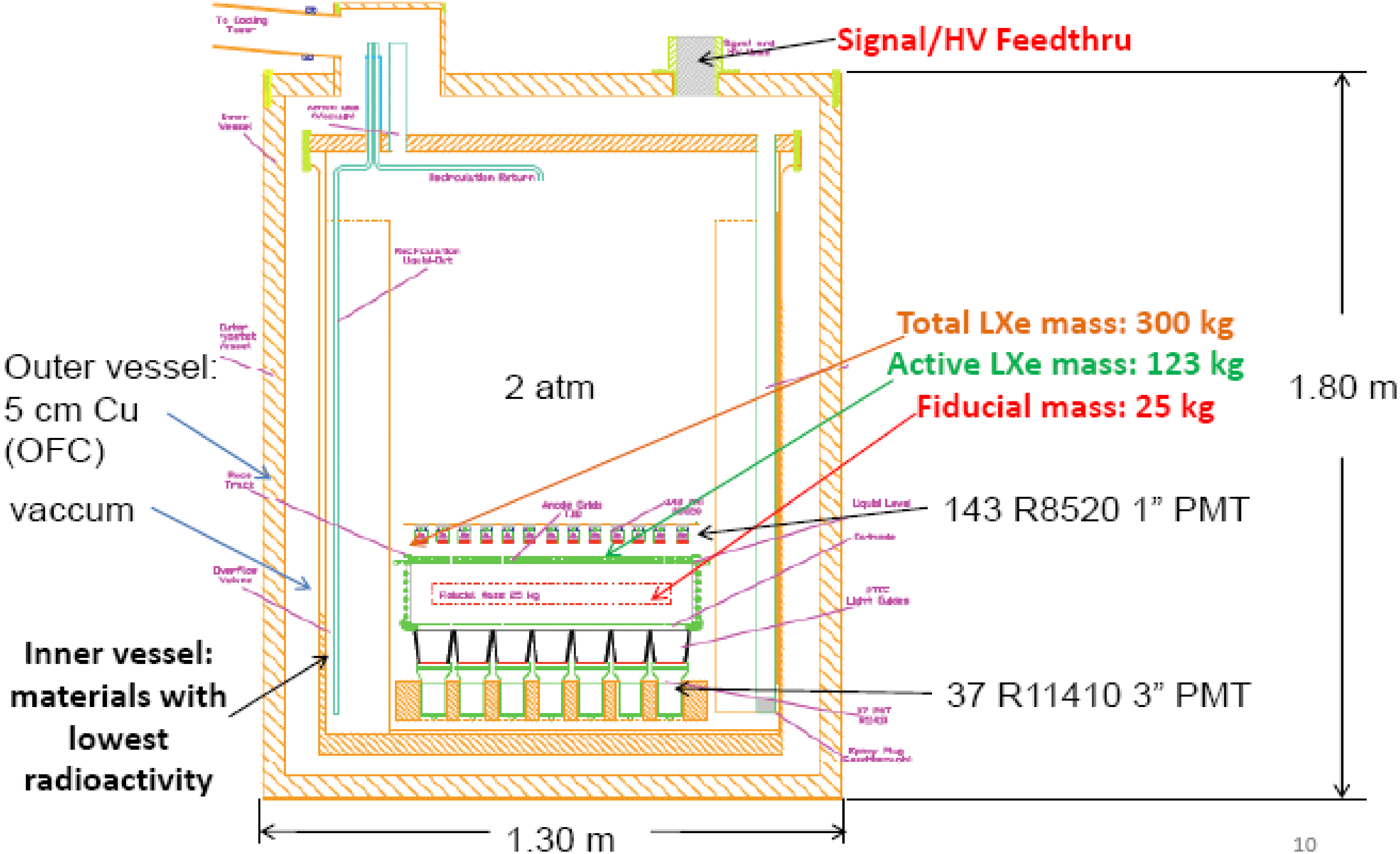


1kg-scale detector: from 2005

10kg-scale detector: from 2010 to 2013

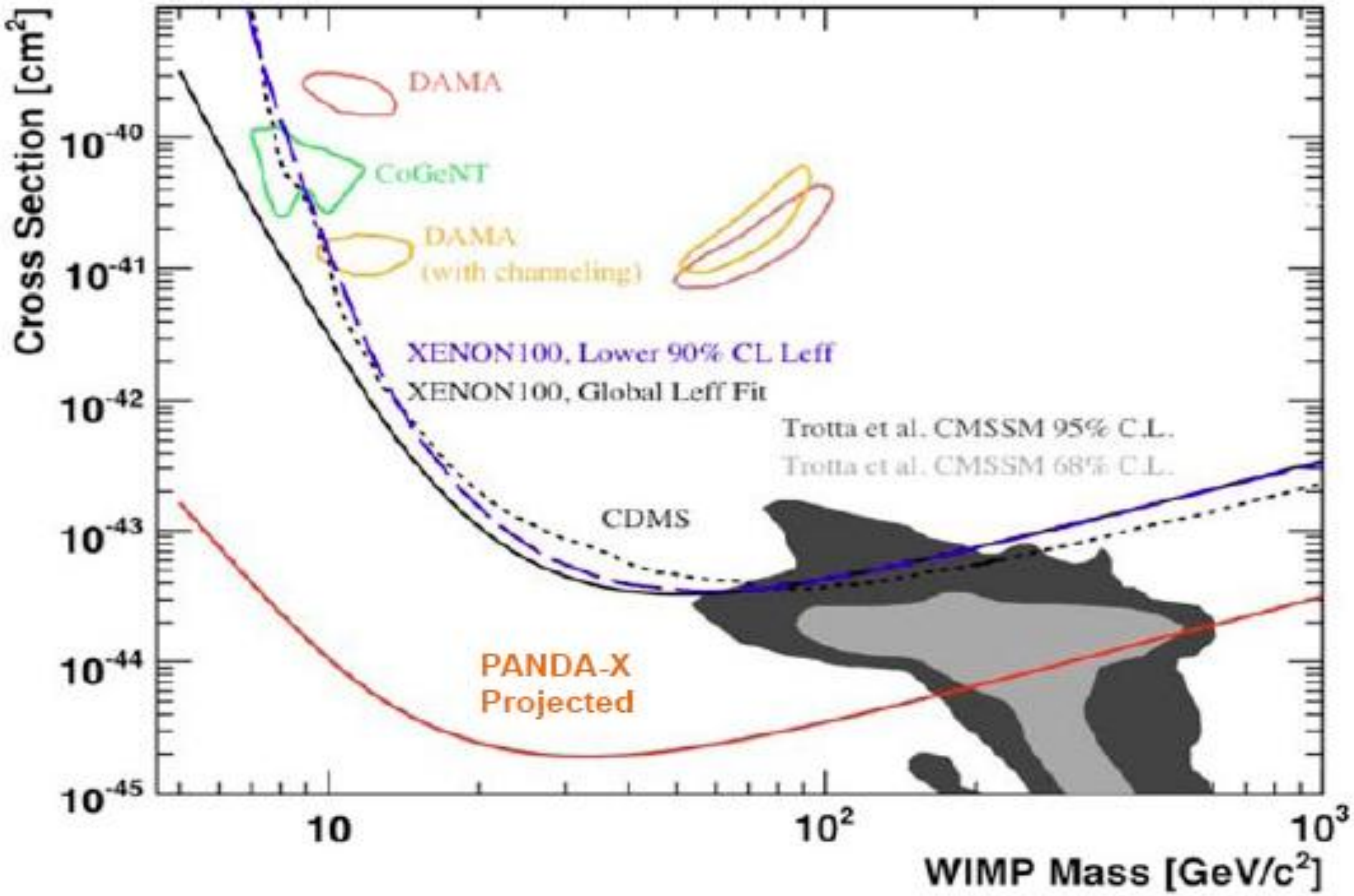
1T-scale PCGe array detector: from 2014

Detector Overview



Sensitivity of PandaX

Assumptions:
•5.5 PE/keV
•Energy range: 3-30 PE
•200 day × 25 kg exposure



Summary

Dark matter search is very importance basic science in 2 1 century , Chinese scientist would like to make con tributions for human being

New development of Radiation detector technique will boost Direct detection of Dark matter

CJPL-the deepest Lab provide very good concourse

for us . We should collaborate to push the DM program go forward

Thanks