PANDAX Results and Outlook

Karl Giboni for the PANDAX Collaboration,

10th Symposium on Large TPC for Low Energy Rare Event Detection,

Paris 15 17 Dec, 2014

The PANDAX Collaboration

Collaboration started in 2009

(~40 people from 7 institutions)

Shanghai Jiao Tong University,

Shandong University,

Shanghai Institute of Applied Physics, CAS

Beijing University

University of Michigan

University of Maryland,

Yalong Hydropower Co., Ltd.

China JinPing Underground Laboratory (CJPL) in Sichuan Province

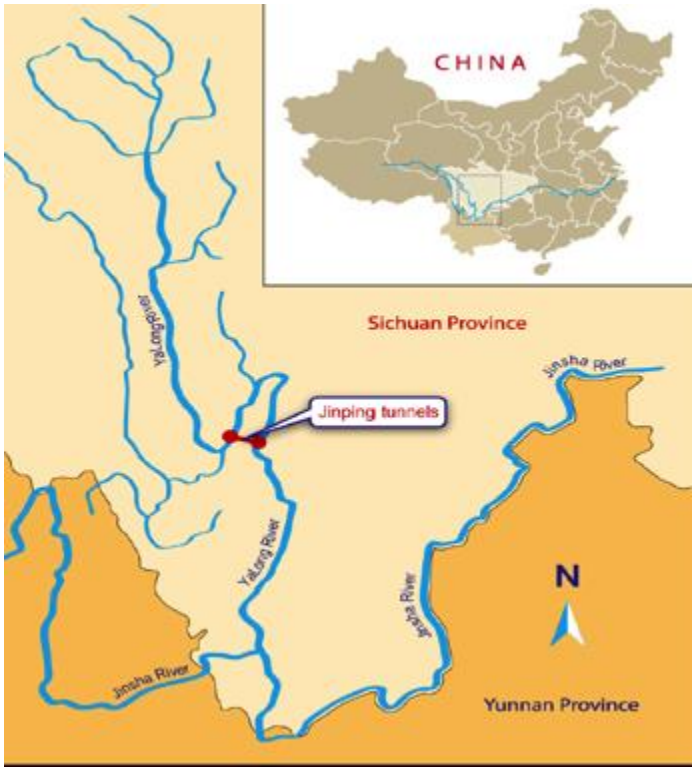
- ~2400 m overburden of rock
- Deepest underground lab in operation

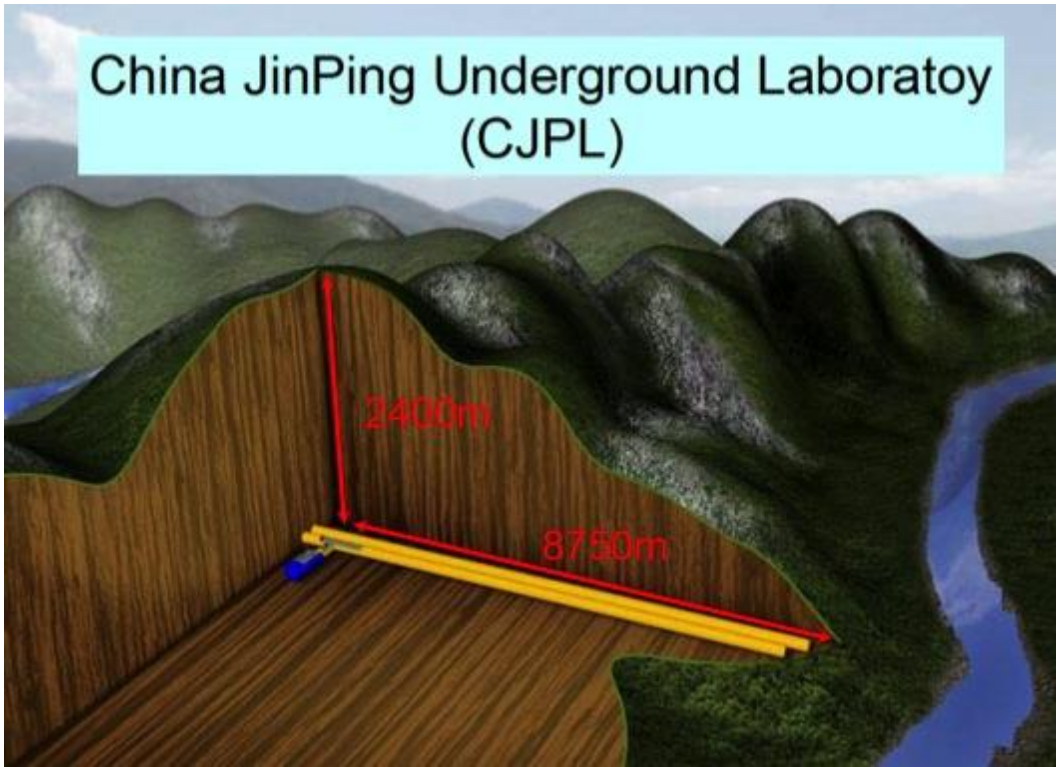
6720 m.w.e. ~57 muons/year / m^2

- Low radioactivity marble rock

→

- μ – veto system unnecessary
- compact shielding structure possible
- 'easy' access by road





CJPL

facility	depth [mwe]	μ flux [events/m^2/yr]	rock	^{238}U [Bq/kg]	^{232}Th [Bq/kg]	^{40}K [Bq/kg]
Jinping (PandaX)	6,800	60	marble	1.8 ± 0.2	< 0.27	< 1.1
SURF (LUX)	4,300	950	rhyolite	100	45	900
Grand Sasso – Hall B (XENON)	3,500	8,030	dolomite	5.2	0.25	4.9

The PANDAX Experiment

Ge - Counting station

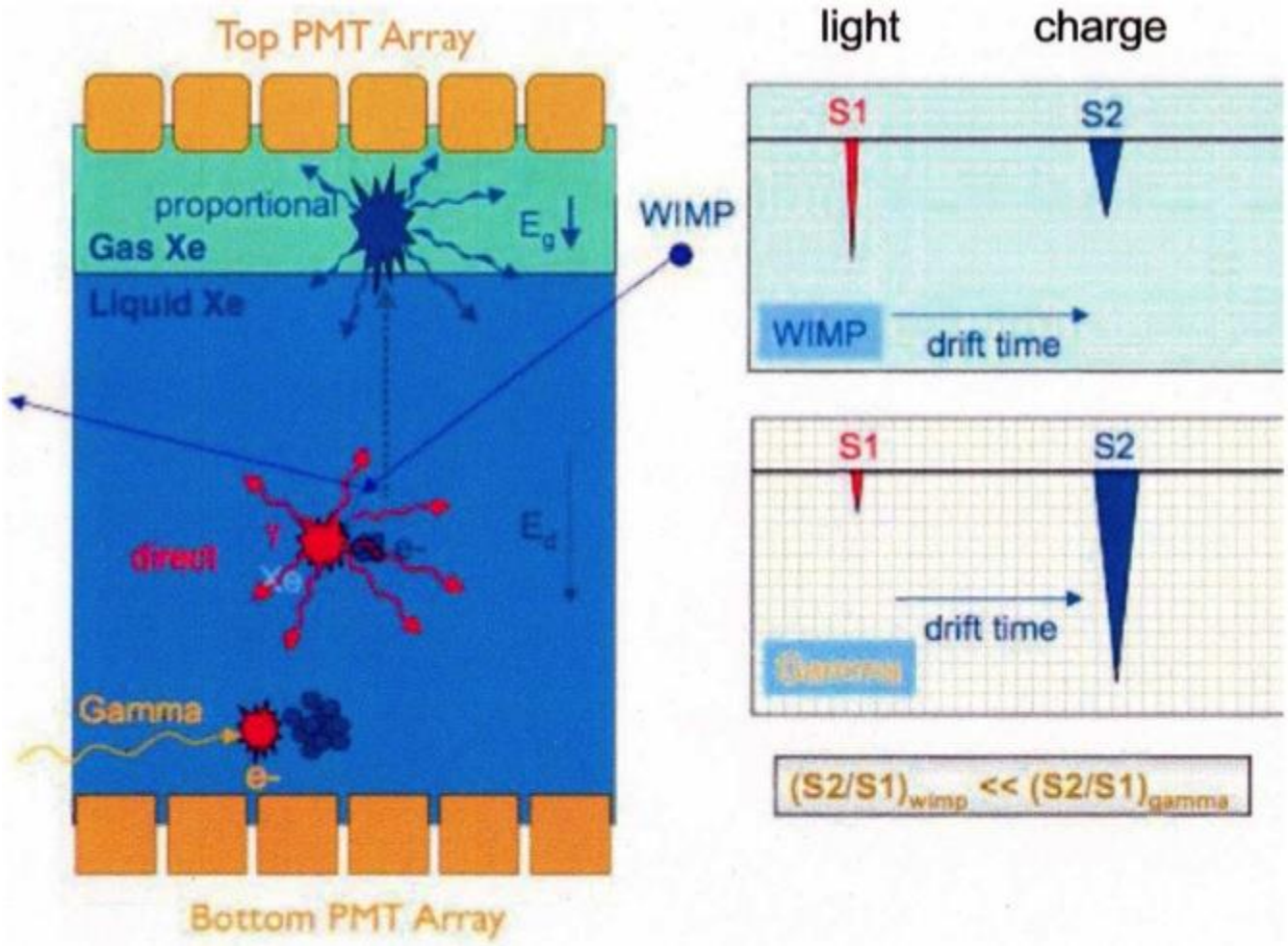
Storage Cylinderss with Gas Xenon

Xe - Detector

Tireless Collaborator

The PANDAX Method

- Dual phase Xe TPC
- Probing WIMP-nucleon cross section



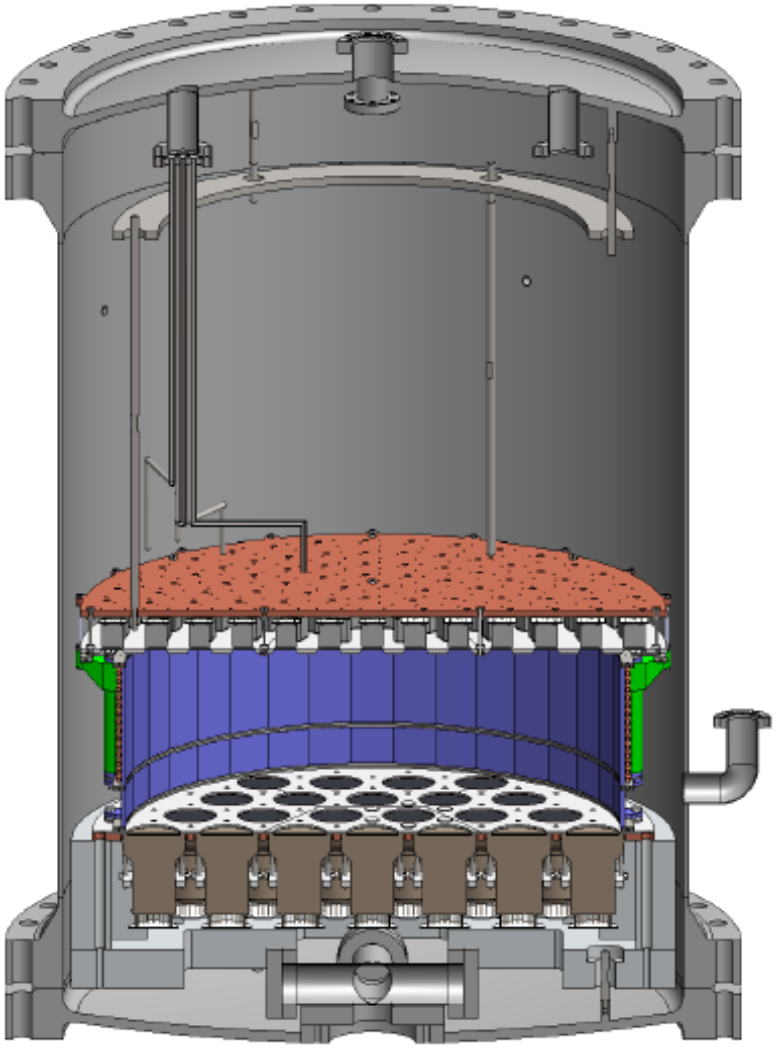
PandaX-I

Detector characteristics:

- TPC radius: 30 cm
- Drift length: 15.4 cm

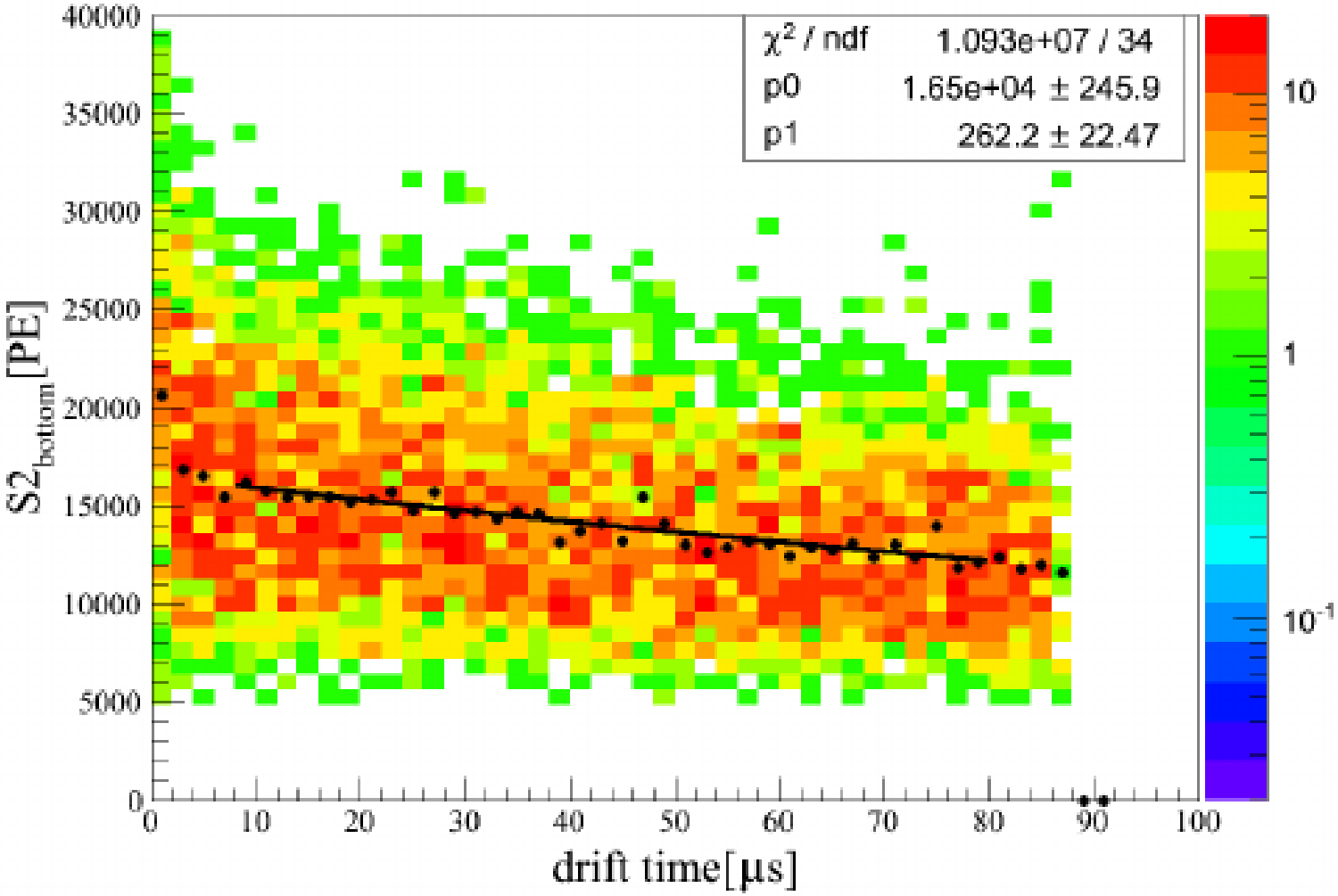
- Total Xenon mass: 400 kg
- Sensitive target: Xe mass: 125 kg
- Fiducial volume: Xe mass 37 kg

- Top PMTs array (R8520): 143
- Bottom PMTs array (R11410): 37



Xenon Purity

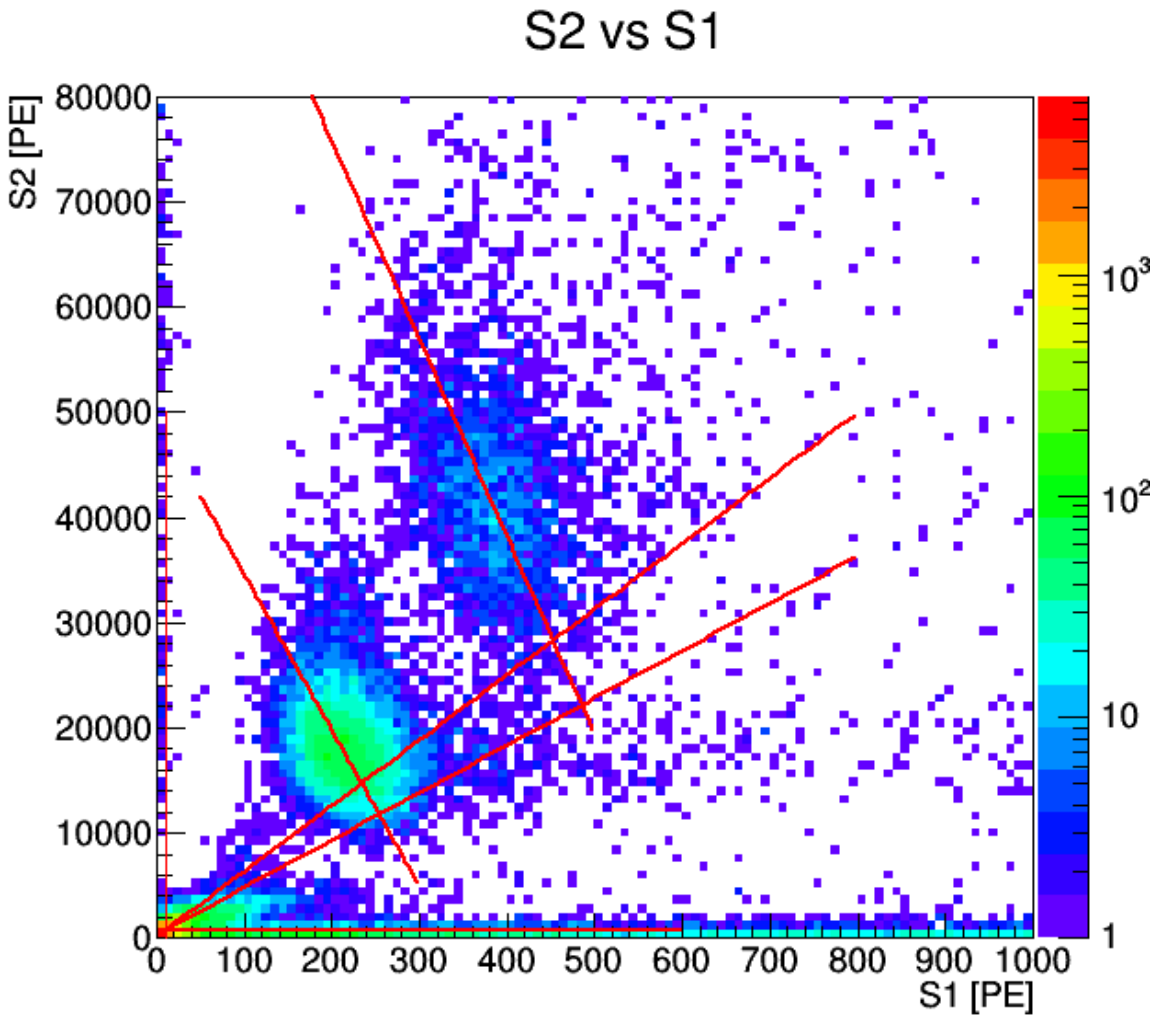
- Electron lifetime ~262 us



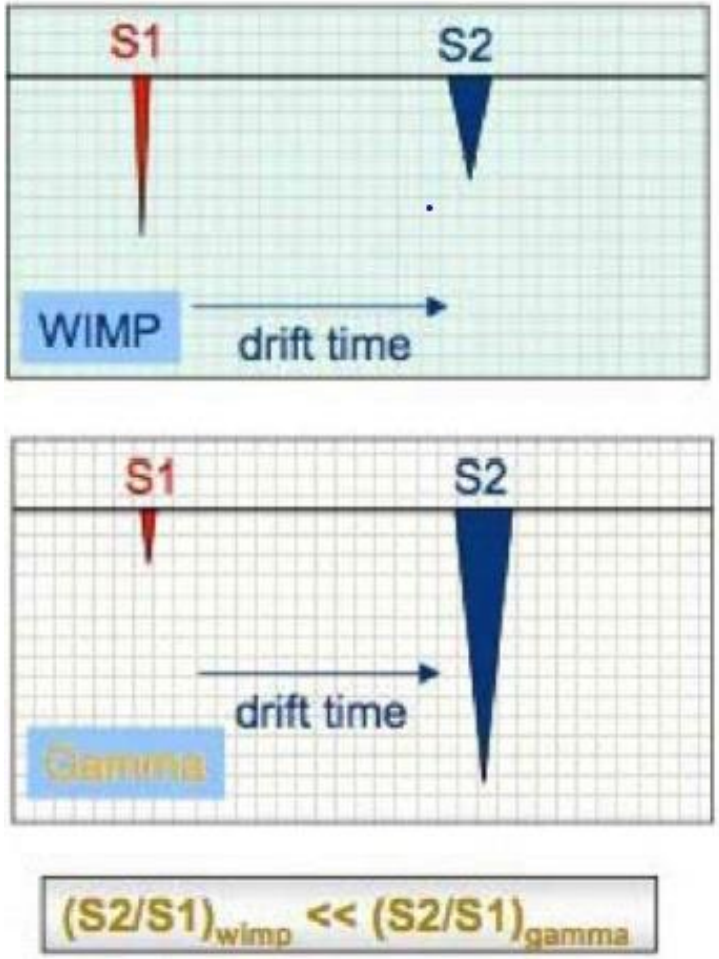
S2 vs S1 light anticorrelation

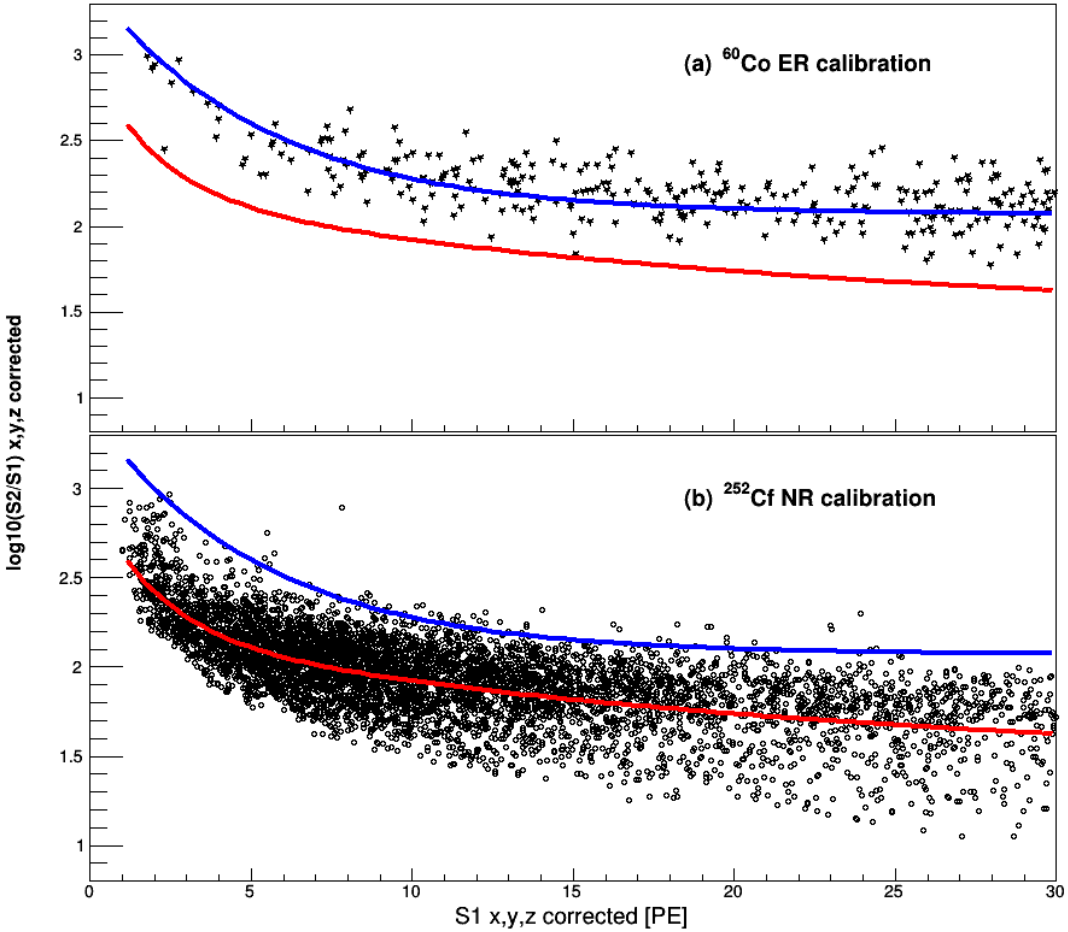
80 keV (Xe-131)

40 keV (Xe-129)



Gamma background rejection





ER / NR measured discrimination: ~99.7%-99.9% from independent analysis

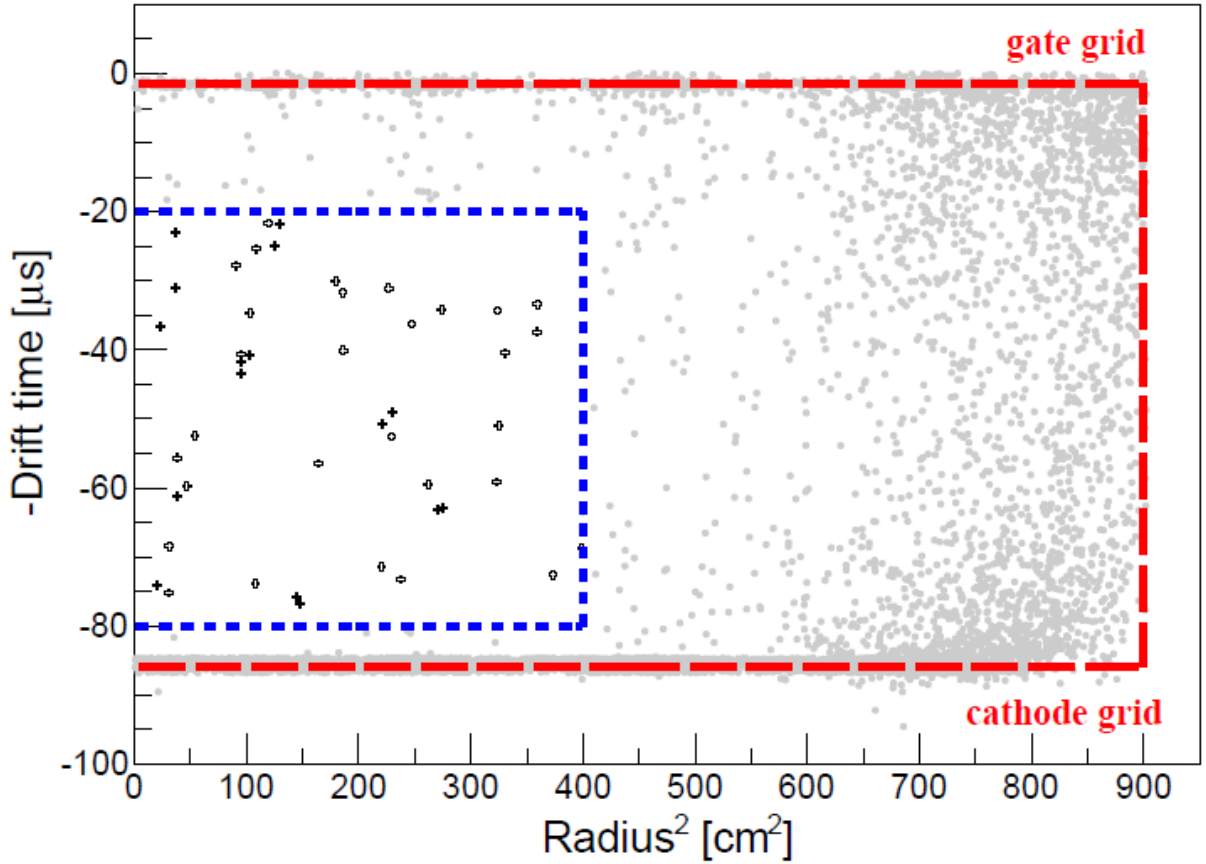
Radioactive background: Kr in Xe

Radioisotope Kr-85, $T_{1/2}$=10.756 years. Beta maximum energy decay 687 keV

Kr-Xe distillation system

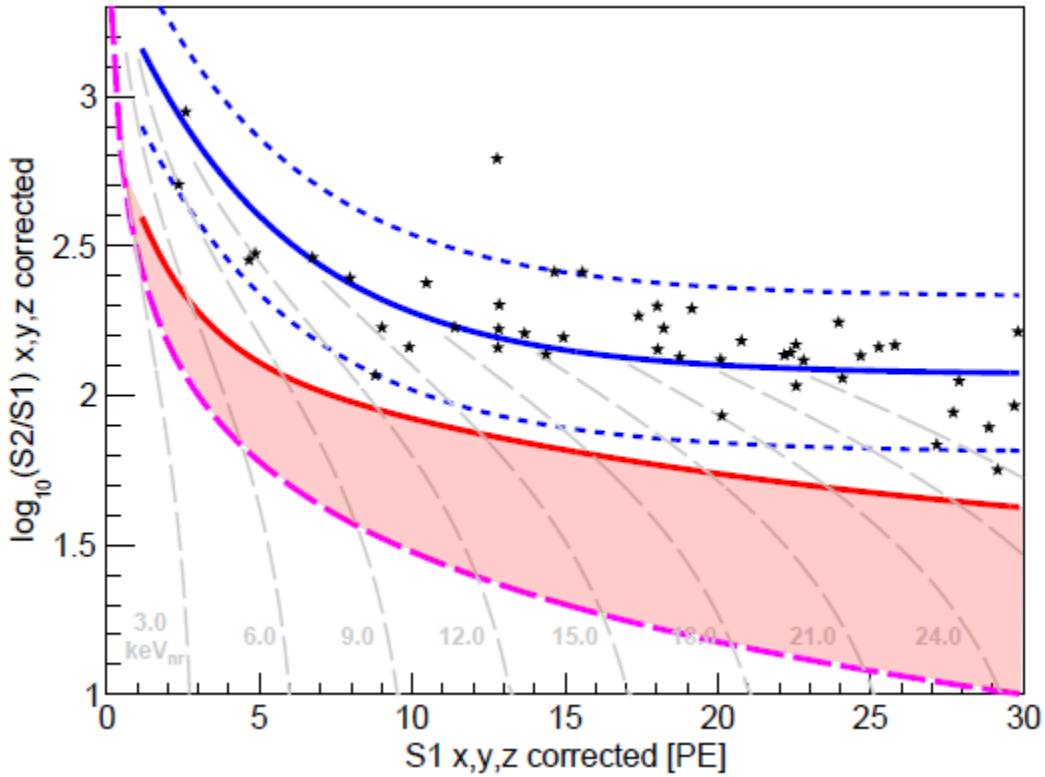
- We employ a SJTU made distillation column to remove Kr from gaseous Xe.
- We use an ultrasensitive Purity Analysis System

Event Location



- **Dominating background: PMTs and inner vessel**
- **Vertical asymmetric fiducial cut to balance the background from the top/bottom PMT array**
- **Radial direction cut to shield background from the vessel**

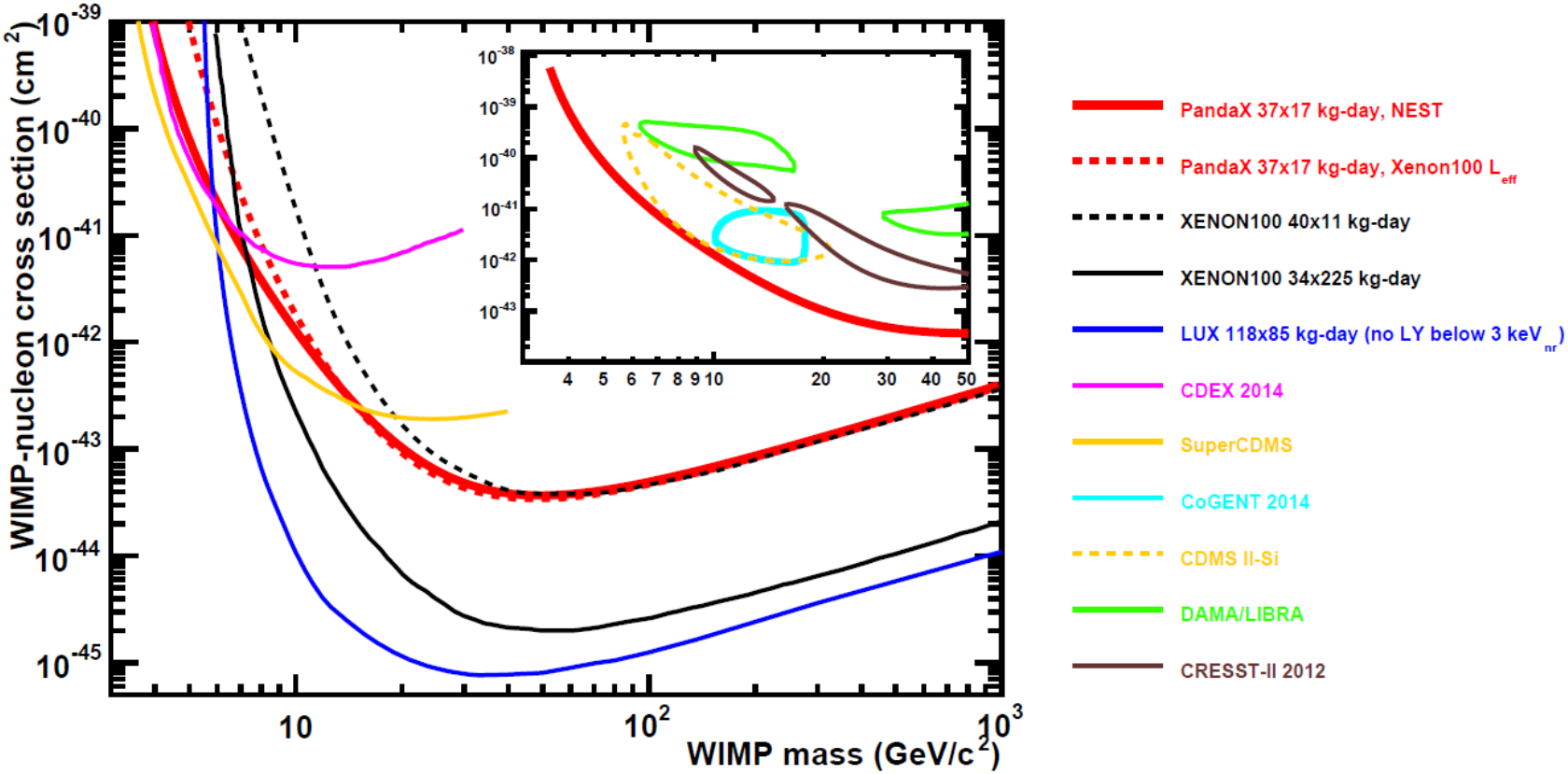
Dark Matter Search



No events found in the DM search region!

46 events. All consistent with ER background

PandaX-I First Results (37 days)



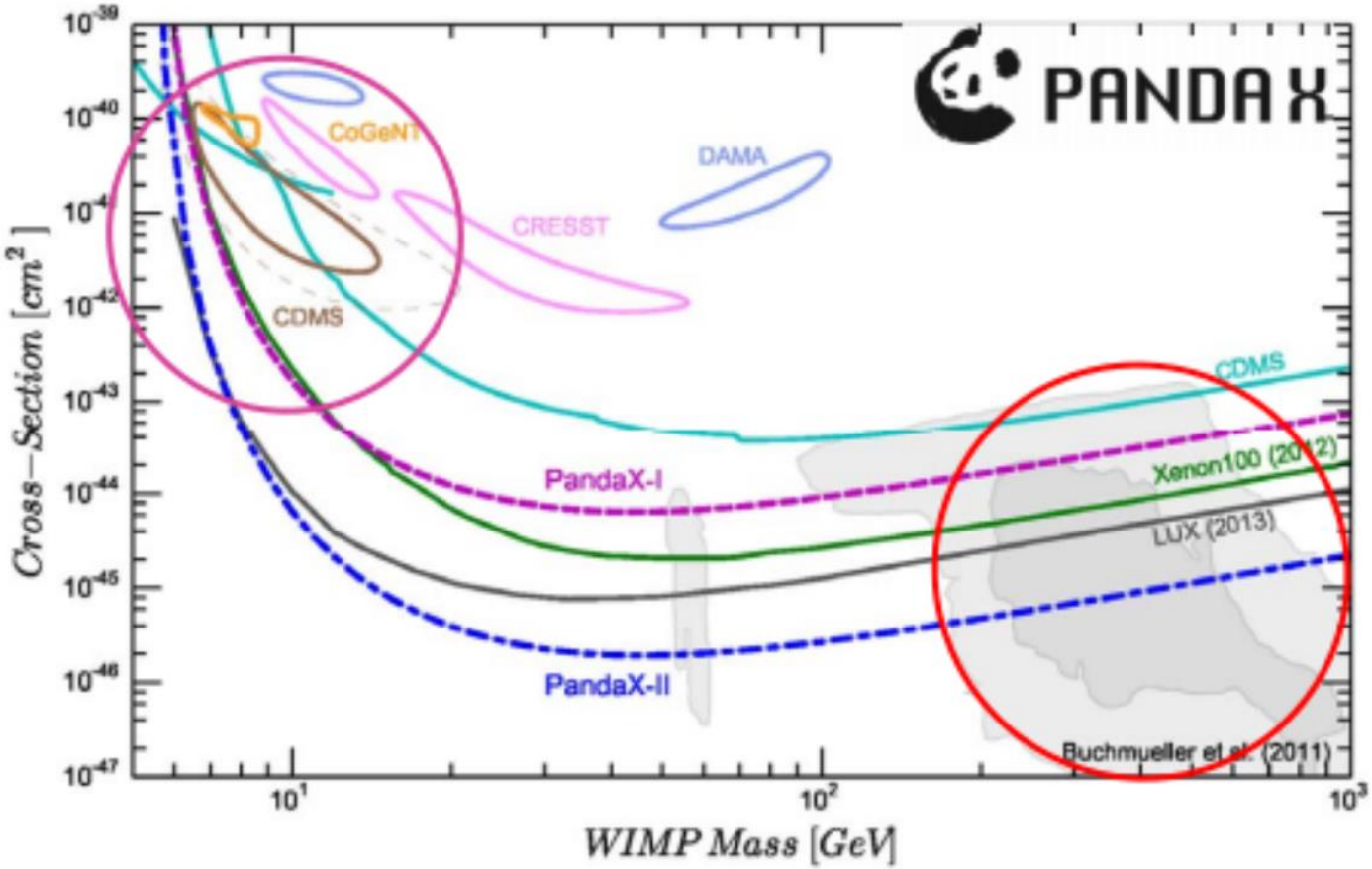
- **Our results disfavor previous reported signals at low WIMP masses**
- **Limits similar using NEST or XENON100 Leff at high mass**
  the latter gives a more conservative limit at low mass

PandaX is dead! Long live PandaX

- PANDAX I Upgrade to PandaX II
- PandaX I experiment stopped 3 weeks ago
- Design for new detector (Pandax II)
- In principle only larger mass, but we also change: Vessel (low background steel), Field Cage (larger), Upper PMT Array (37 3” PMT, like bottom array), HV Feedthrough (higher voltages), add more xenon for 1.3 ton total xenon mass
- Increase in detector mass by enlarging drift length

	PandaX I		PandaX II
Active :	125 kg	→	500 kg
Fiducial :	37 kg	→	300 kg

Sensitivity Projection for Final Data



L_{eff} Cut-off below 3 keV

PandaX I

Light yield: 6 pe/keV

S1 range 3 – 30 pe

25 kg x 100 days

Estimate Background

1.8 events

PandaX II

Light yield: 4.4 pe/keV

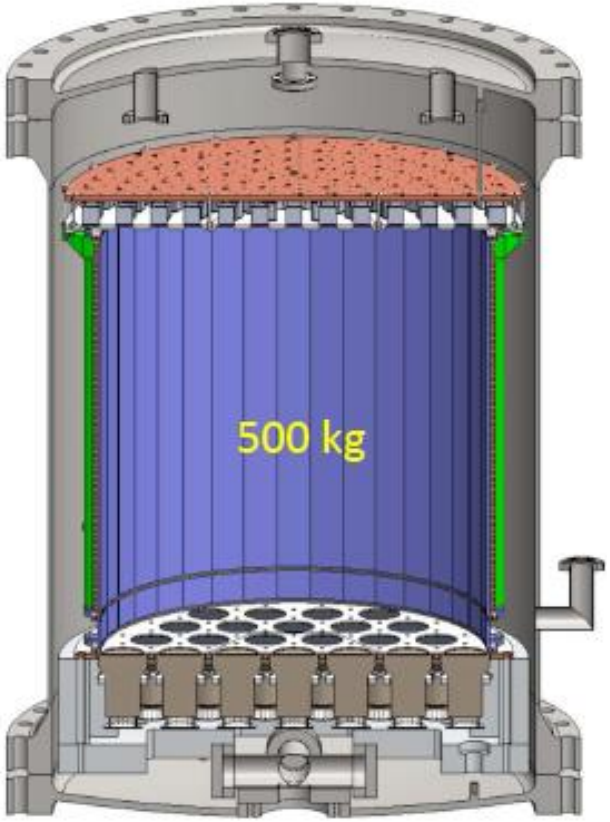
S1 range 3 – 30 pe

300 kg x 360 days

Estimate Background

3.7 events

Upgrade to PandaX II



Goals:

- Commissioning during early 2015
- Fiducial Mass 300 kg
- Sensitivity Reach 2 x 10^{-46} cm^2 @100 GeV in 180 days

Summary

- PANDAX I has made a good progress in the past year. First results have been published.
- More data are available Data analysis in ongoing. Results to be published soon
- Data taking is stopped after many more calibration runs. Detector will be disassembled.
- New detector PandaX II has been designed and will be installed in the JingPin laboratory
- Increase in detector mass

active : 125 kg → 500 kg

fiducial : 37 kg → 300 kg