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2021

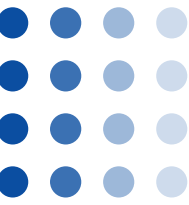
*Interview of the Chung-Yao Chao Fellowship*

*Xiangyi Cui (崔祥仪)*

*Prof. Jianglai Liu*

2021-6-5





CONZINCS

- 1 *Personal Resume*
- 2 *Previous Work and Achievement*
- 3 *Working Plan*



## Education and Professional Experience:

2009-2013	Shandong University	Bachelor	
2013-2019	Shanghai Jiao Tong University	Ph.D	Prof. Xiangdong Ji
2020-now	Tsung-Dao Lee Institute	Post Doc.	Prof. Jianglei Liu

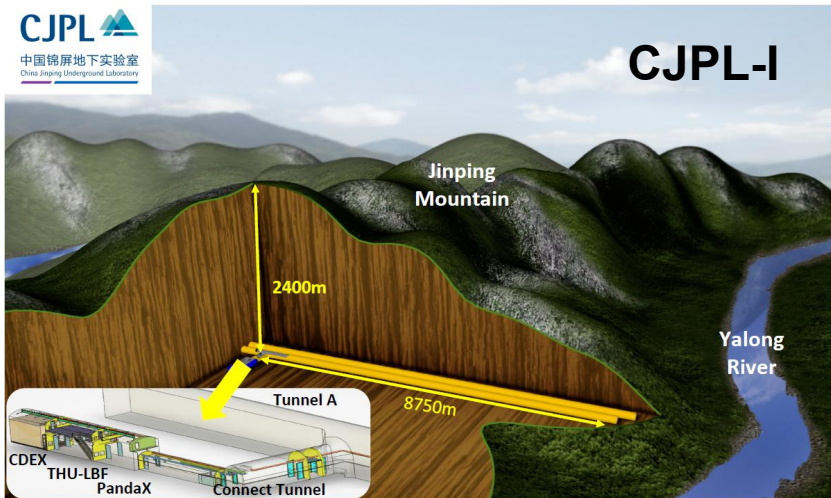
## Research:

### PandaX Experiment - Dark Matter Direct Detection Experiment

- Cryogenics and Purification Technology
- Xenon intrinsic background analysis and Distillation Technology
- Comic Ray Boosted Dark Matter Analysis

PART TWO

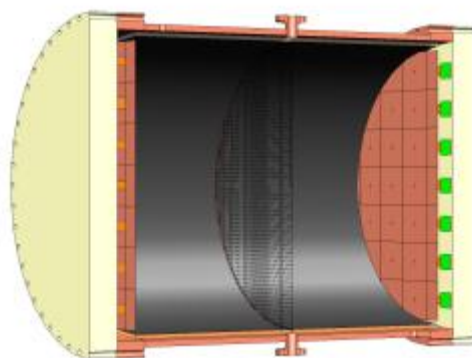
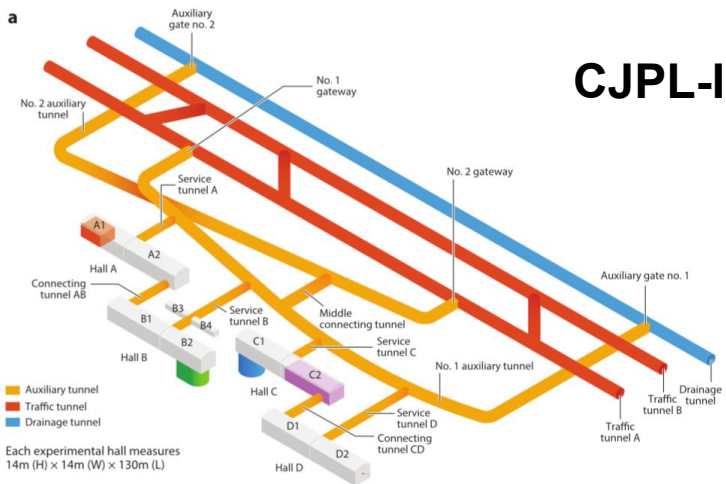
# Review - PandaX Experiment



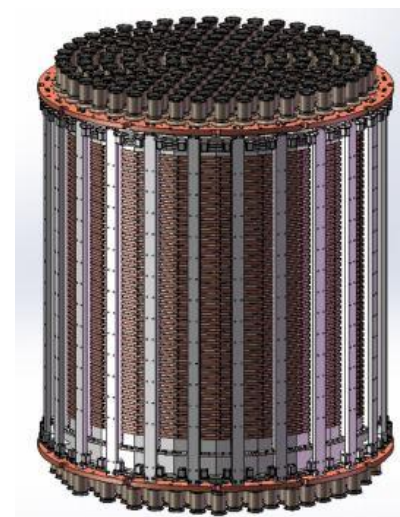
PandaX-I DM 120kg



PandaX-II DM 1.1ton



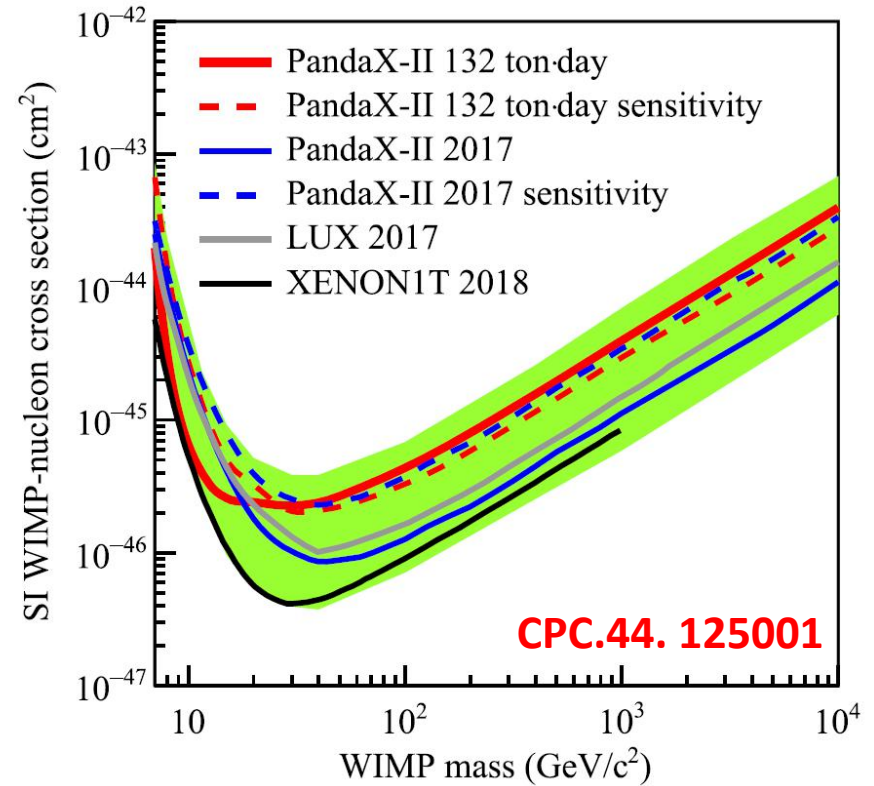
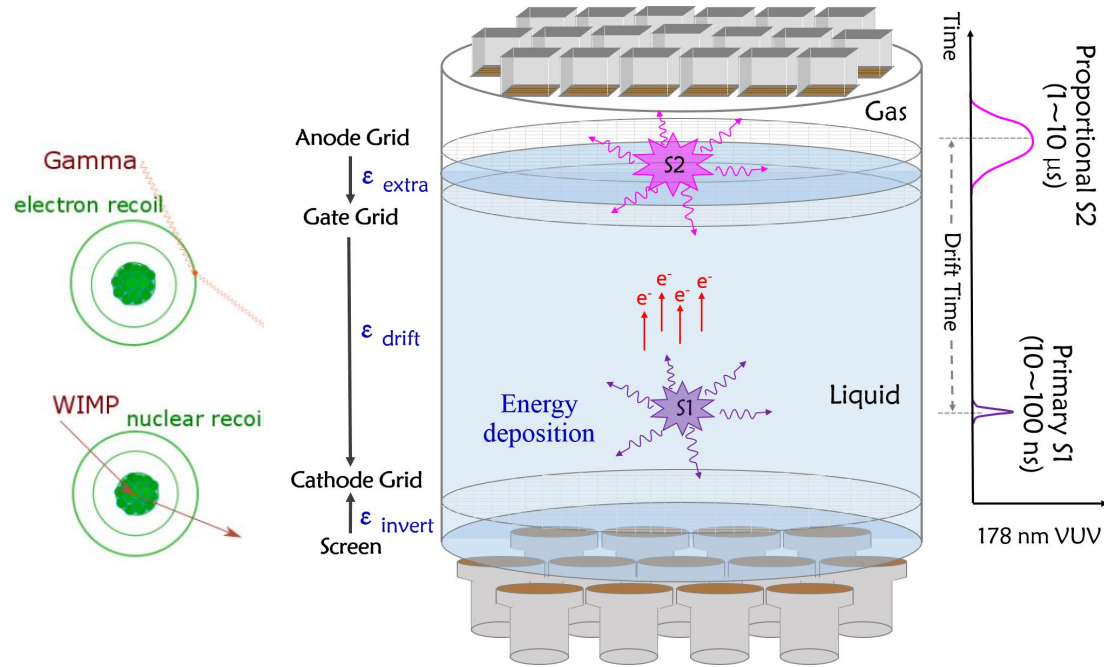
PandaX-III  $0\nu\beta\beta$  Xe136



PandaX-4T DM 6ton

PART  
TWO

Previous work - PandaX-II



Main Author:

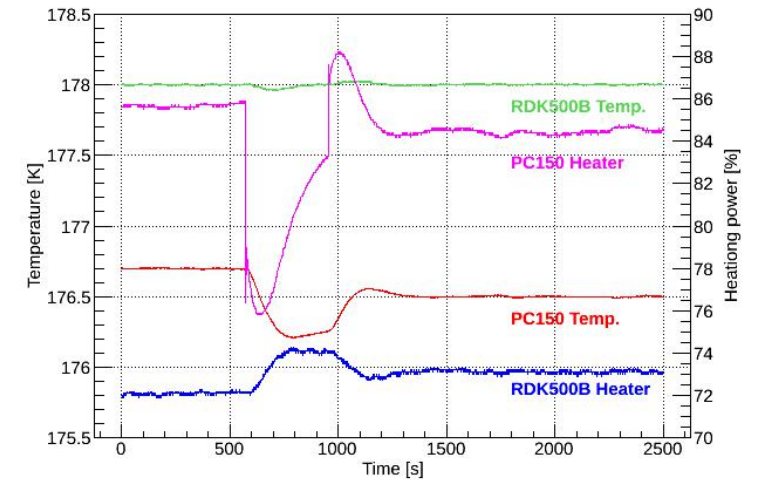
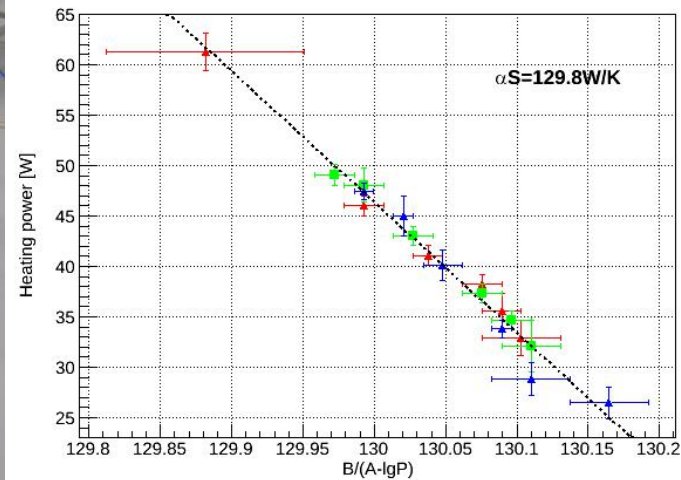
- PRL(1st) PandaX-II 54 Ton-Day Result
- PRL(3rd) PandaX-II First 98.7 Day Result
- PRL(2nd) PandaX-II Spin Dependent Result
- PRD(3rd) PandaX-II Commissioning Result

- Xenon handling and purification;
- Reduce krypton (6.6ppt) and tritium background via PandaX-II distillation;
- Kr and Rn background analysis;

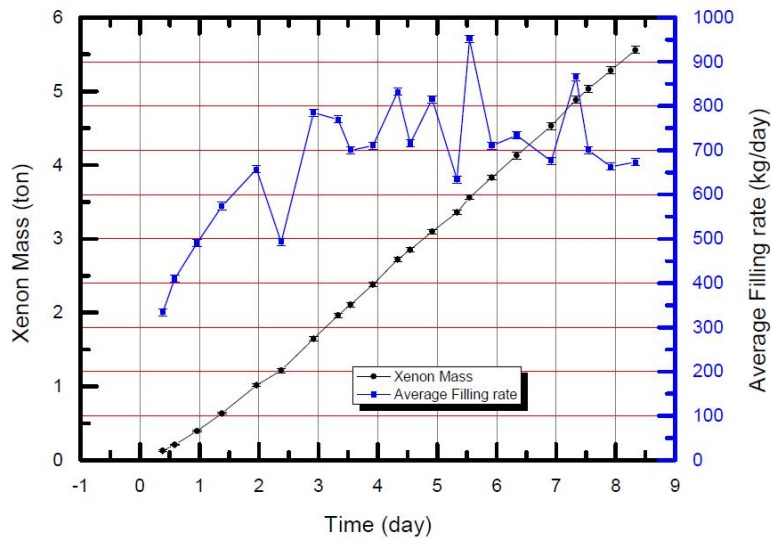
## Previous work - PandaX-4T Cryogenics System



- > 600 W cooling power achieved;
- > 700 kg/day filling and 500 kg/day emergency recuperation speed;
- Multi-cryocooler working condition;



## Previous work - PandaX-4T Cryogenics System



- **Firstly study multi-cryocooler working conditions, and temperature control method;**
- **< 0.01 Bar inner pressure and < 0.1K detector temperature variation during stable running;**

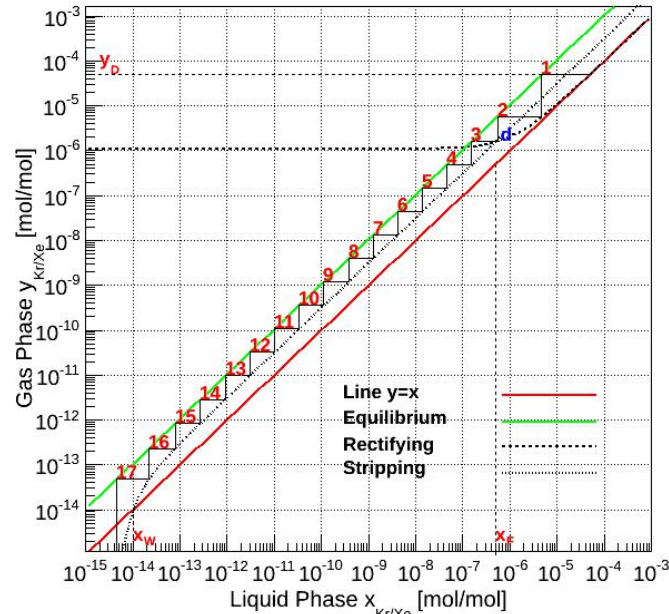
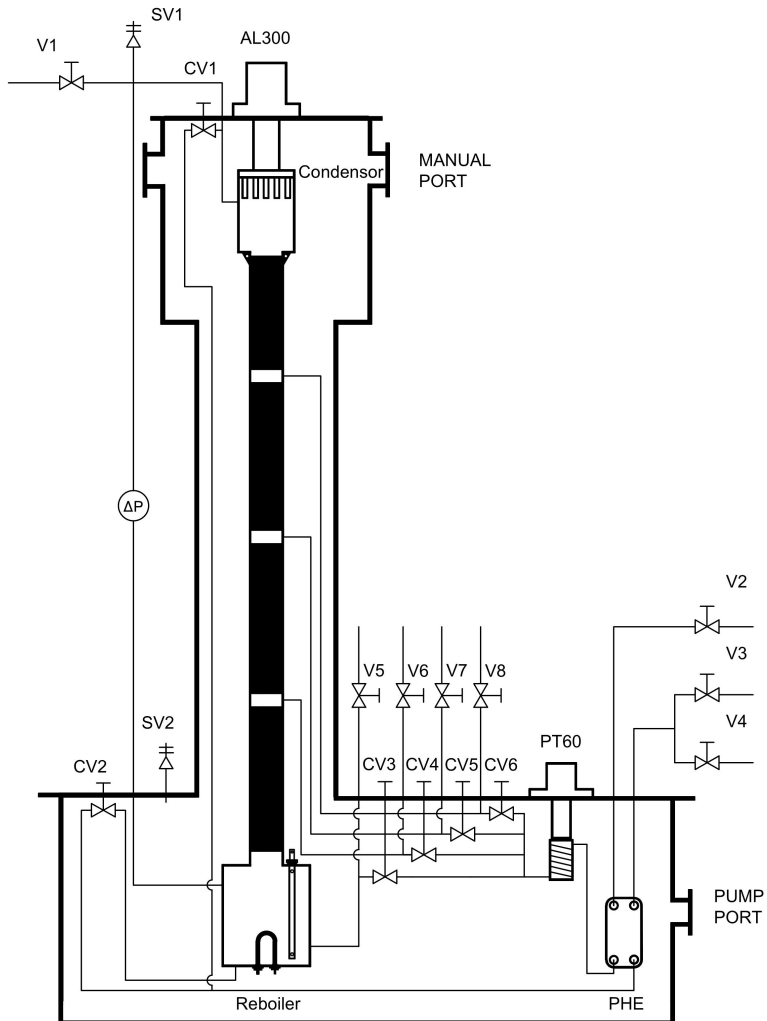
## Previous work - PandaX-4T Circulation System



- In order to removal impurity gas from xenon, two parallel circulation loops is construted;
- ~150 slpm purification flow rate, including liquid and gas phase;



## Previous work - PandaX-4T Distillation System



Kr M-T diagram

$$y_{n+1}^{Rn} = \frac{RD \cdot x_n^{Rn} + D \cdot y_D^{Rn} - n \cdot y_C^{Rn}}{RD + D}$$

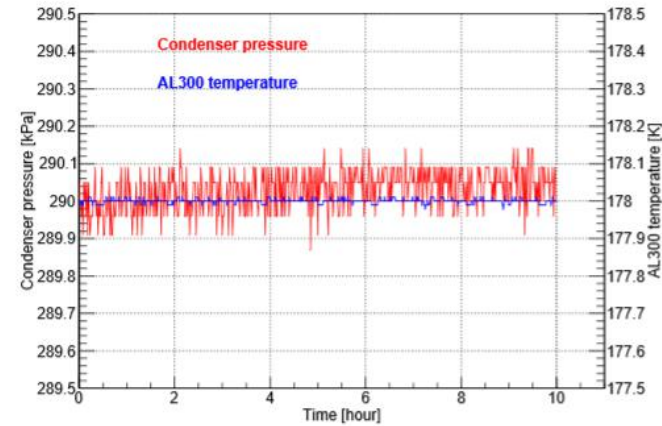
$$y_{m+1}^{Rn} = \frac{RD \cdot x_m^{Rn} - W \cdot x_W^{Rn} - (N - X - m) \cdot y_C^{Rn}}{RD - W}$$

Rn removal function

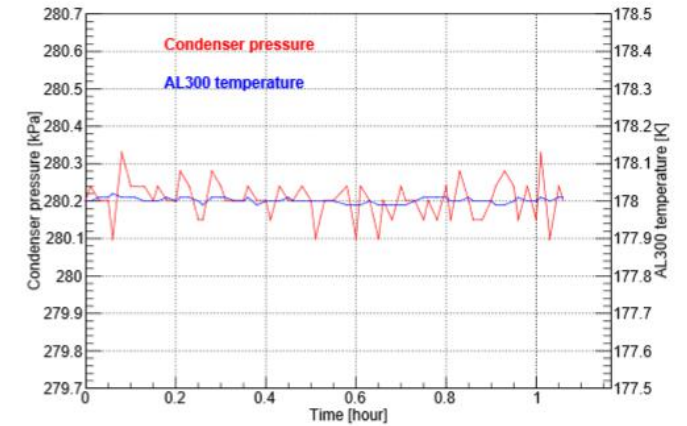
- In order to remove krypton and radon from xenon;
- Firstly radon removal calculation with and without the packing emanation effect;
- Firstly combine Kr and Rn removal by one system;
- Kr removal reduction factor improve to 7 orders of magnitude(3 previous) and 3 times flow rate 10 kg/h;

## Previous work - PandaX-4T Distillation System

ArXiv:2012.02436  
Reviewed by JINST



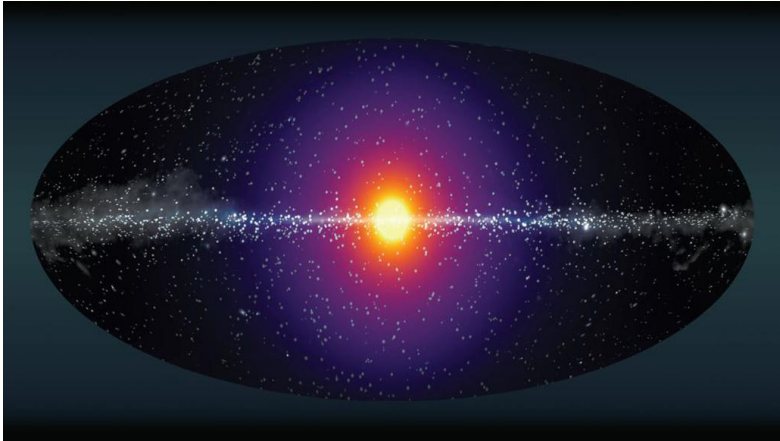
(a) The total reflux period



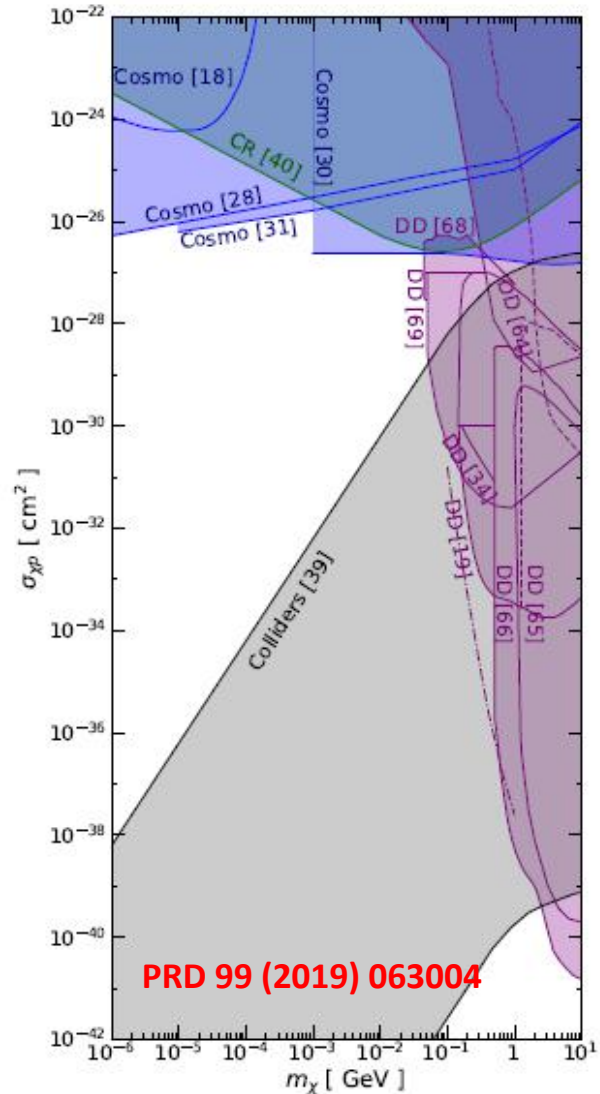
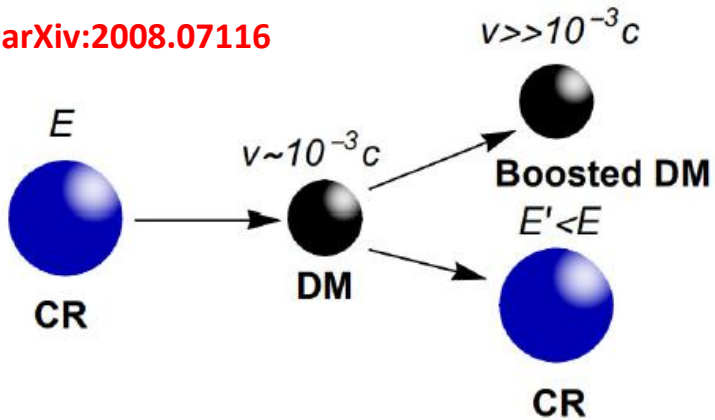
(b) The radon removal period

- **Finish installation in CJPL-II before commissioning in the company;**
- **6-ton xenon krypton removal distillation finished and measured to be less than 8 ppt by RGA-based measurement system;**

# Previous work - Cosmic Ray Boosted Dark Matter Analysis



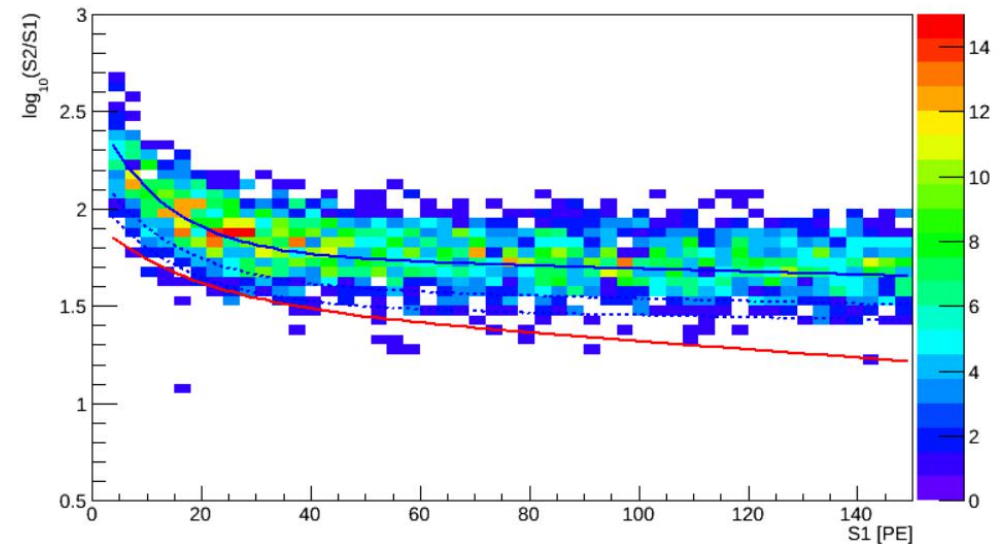
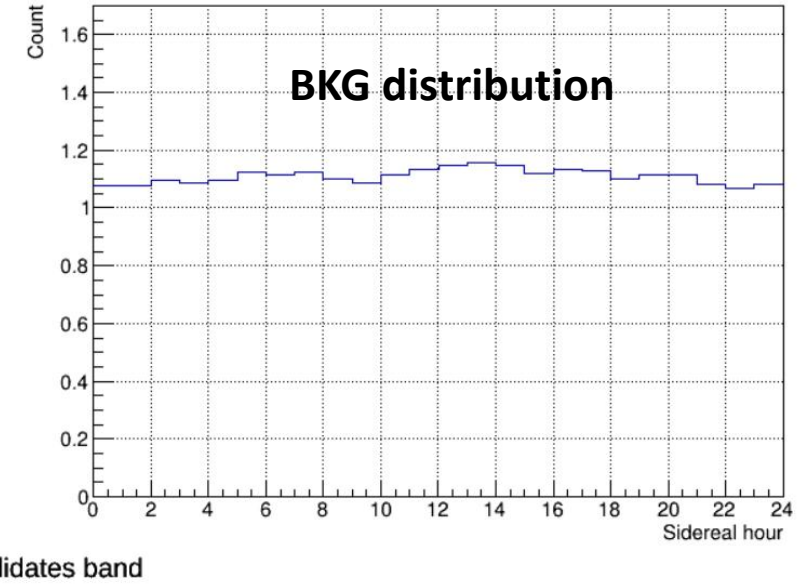
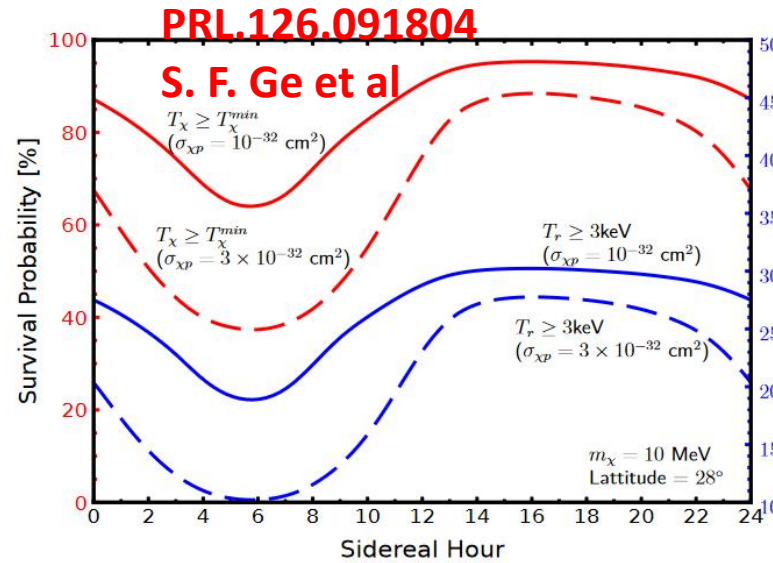
arXiv:2008.07116



- Light DM in the galaxy will be boosted by Cosmic Rays, carried with more kinetic energy so called CRDM;
- >GeV WIMPs not detected yet and sub-GeV & large cross section area still miss;
- No direct DM experiment analysis for the CRDM;

## Previous work - Cosmic Ray Boosted Dark Matter Analysis

- Individual signal performance calculation at PRL.126.091804;
- Specific candidates selection and background analysis applied;
- Sidereal hour and Energy 2D Profile likelihood method for fitting;
- Ongoing...



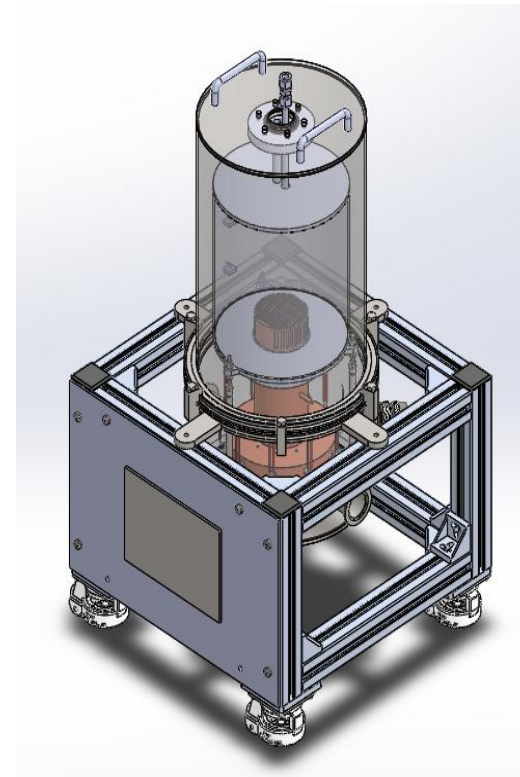
## Working Plan

- **Finish PandaX-II CRDM anlysis, search for the low mass dark matter;**
- **PandaX-4T Cryogenics, Circulation and Distillation system improvement;**



## Working Plan

- **PandaX-4T Dark Matter analysis;**
- **PandaX-30T Cryogenics and Circulation system R&D and design;**





THANKS FOR  
YOUR  
ATTENTION!