



# 2022 Shanghai Particle Physics and Cosmology Symposium (SPCS 2022)



上海交通大學

SHANGHAI JIAO TONG UNIVERSITY

李政道研究所

Tsung-Dao Lee Institute

# SPCS 2021

Shanghai Particle and Cosmology Symposium 2021:  
**Emerging Frontiers of Axion,  
Dark Photon,  
Fractional Charged Particle  
and MonoPole**

2021.11.19-11.21

Location: MEHOODLESTIE Hotel

Website: <https://indico-tdli.sjtu.edu.cn/event/445/>

#### Sponsors:

Shanghai Jiao Tong University  
University of Science and Technology of China

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Shu Li (Co-Chair, TDLI & SPA, SJTU)  
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Jing Shu (Co-Chair, ITP)  
Yusheng Wu (USTC)  
Lailin Xu (Co-Chair, USTC)  
Haijun Yang (SPA & TDLI, SJTU)  
Yong Yang (SPA, SJTU)  
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MEPA 2022 [Introduction by Yusheng Wu & Lailin Xu]

Emerging Frontiers of Axion,  
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## What we do in Shanghai next year?

# New Physics beyond SM



Neutrino oscillation is the first new physics beyond the SM

## 宇称不守恒

SU(2): 二重态 单态

中微子  $\nu$

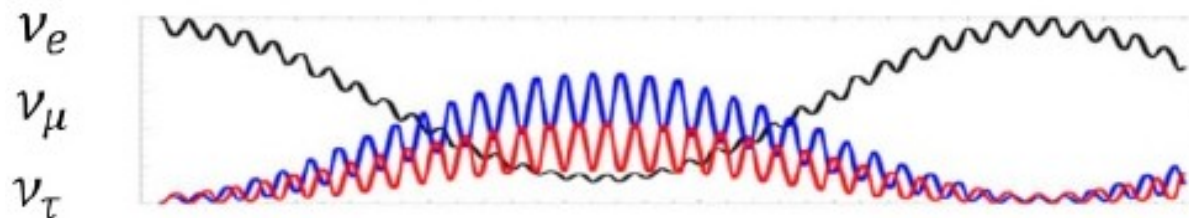
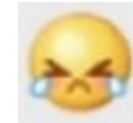
带电轻子

$$\begin{pmatrix} \nu_L \\ \ell_L \end{pmatrix}$$



?

$\ell_R$



质量差 + 混合  $\rightarrow$  中微子振荡

Proposed in early 60's!

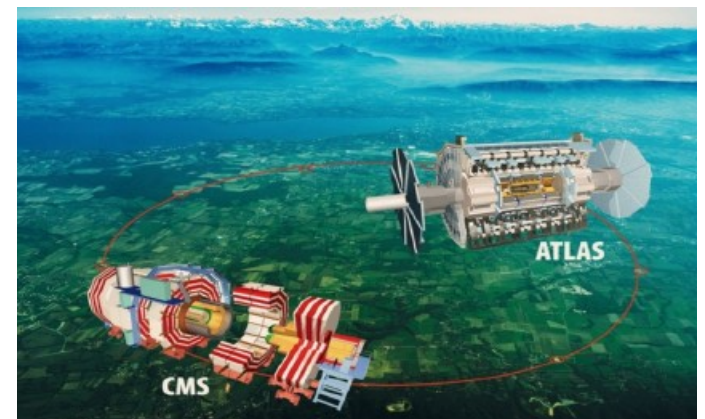
Various experiments

# Daya Bay in 2012

- **Higgs boson**  $\Rightarrow$  electroweak symmetry breaking & mass.  $\sim O(100)\text{GeV}$
- **QCD (量子色动力学)**  $\Rightarrow$  majority of mass.
- The world seems not affected by the tiny neutrino mass?
  - Neutrino mass  $\Rightarrow$  Mixing
  - 3 Neutrino  $\Rightarrow$  possible **CP violation**
  - CP violation  $\Rightarrow$  **Leptogenesis**
  - $\Rightarrow$  **Matter-Antimatter Asymmetry**
  - There is something left in the Universe.
  - **EW Baryogenesis** is not enough.



大亚湾实验 @ March 8, 2012

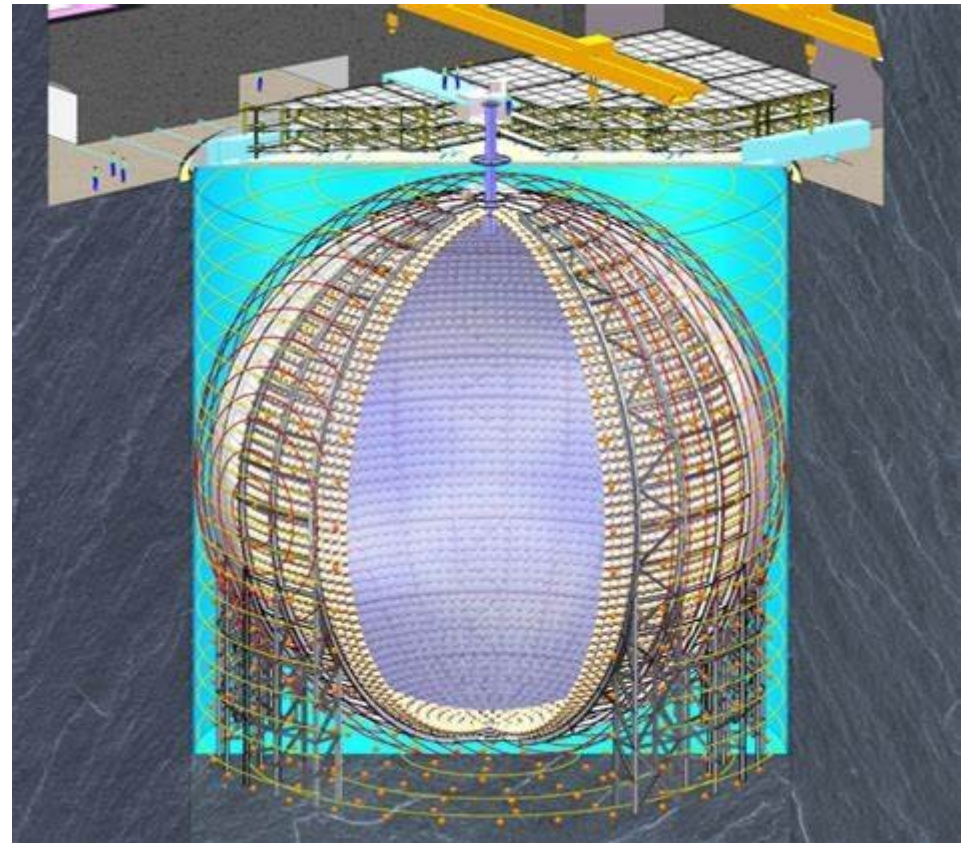


LHC @ July 4, 2012

# Unknowns of Neutrino

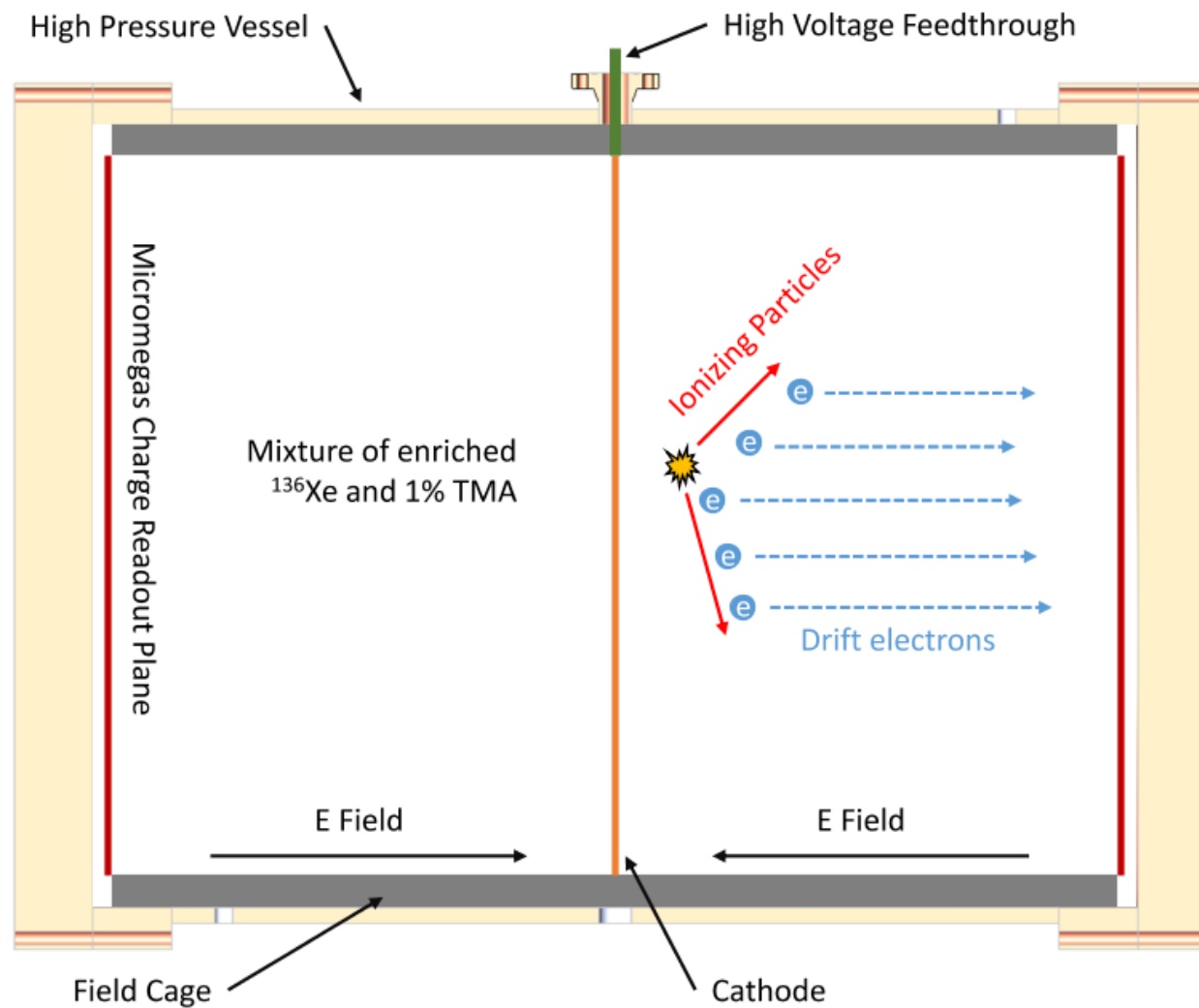
Neutrino physics enters a precision era after Daya Bay in 2012.

- Mass Ordering
- 2–3 Mixing
- CP Phase
- Absolute mass
- Dirac vs Majorana nature
- .....



Construction in 2022 & start data taking in 2023

# PandaX-III



**Construction & test run in 2022**



# Trident (海铃)



Build a Neutrino Telescope 3 KM under water in South China Sea

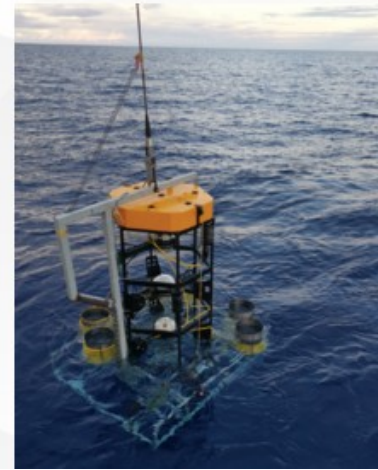
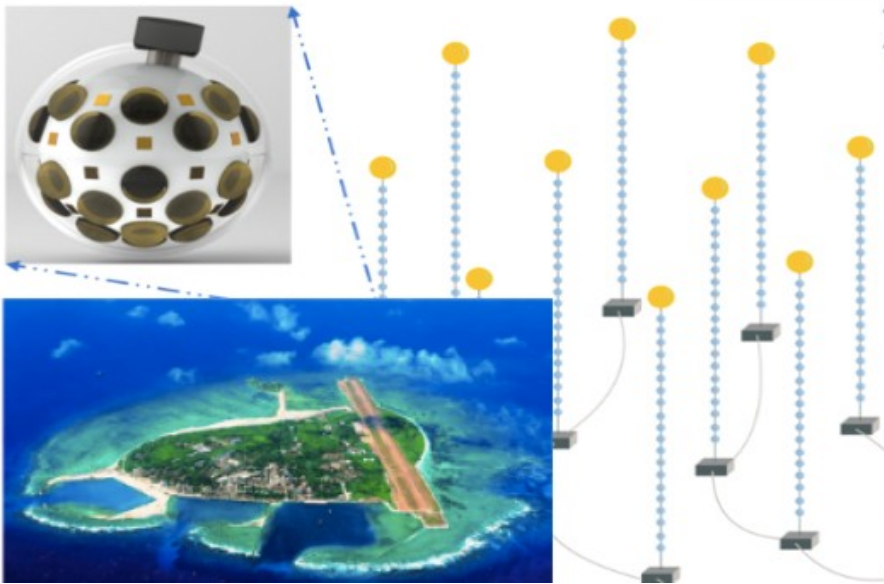
Detect ultra high energy neutrino cosmic ray

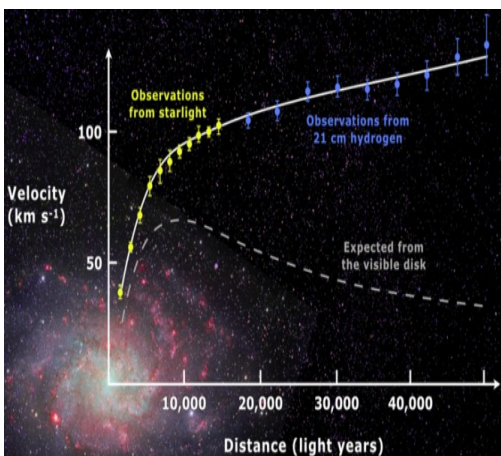
Study neutrino oscillation at cosmic scale

Detection of Dark Matter

Multi-messenger studies

Seeing through the earth core





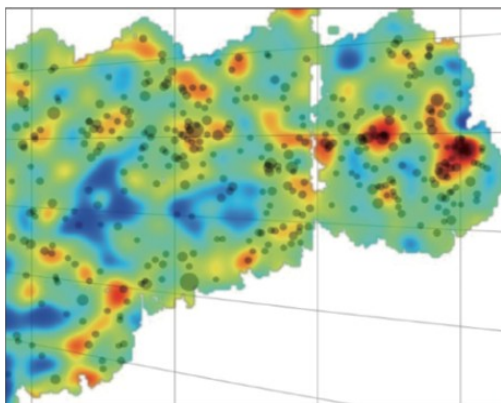
星系旋转曲线



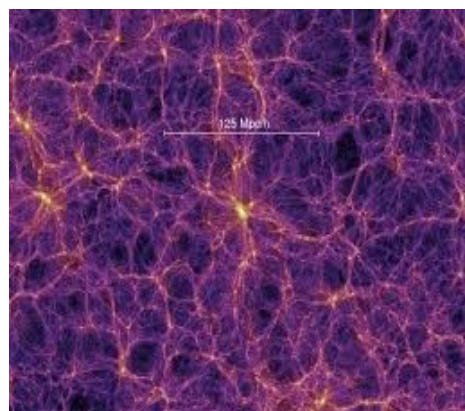
子弹星系



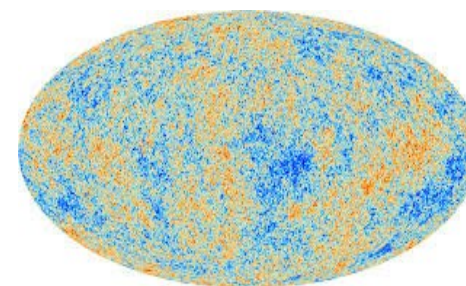
引力透镜



星系团

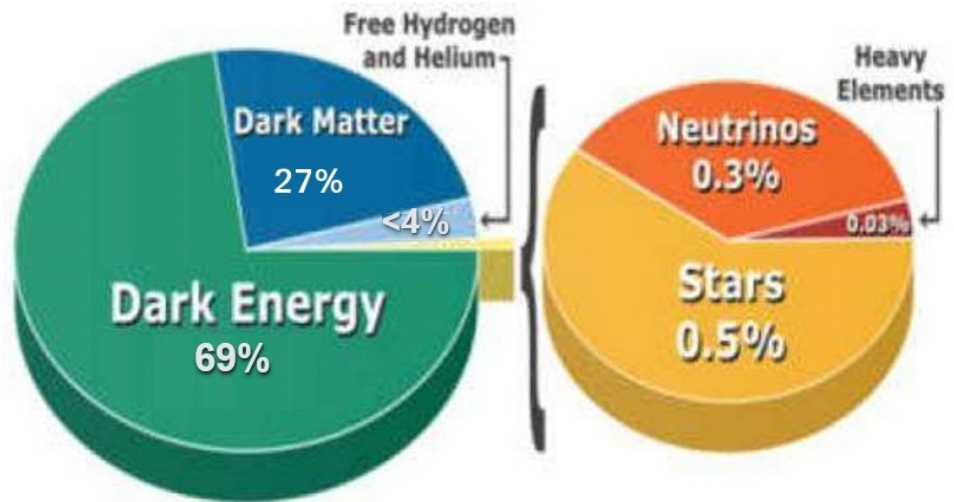


大尺度结构

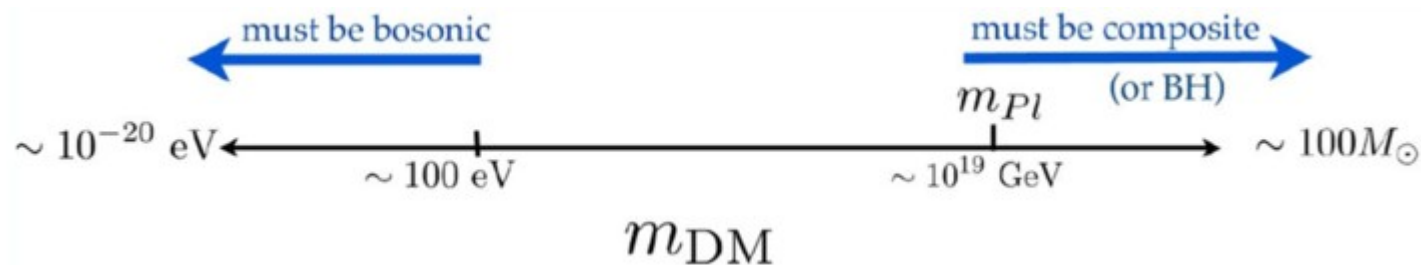


宇宙微波背景

# Unknowns of Dark Matter

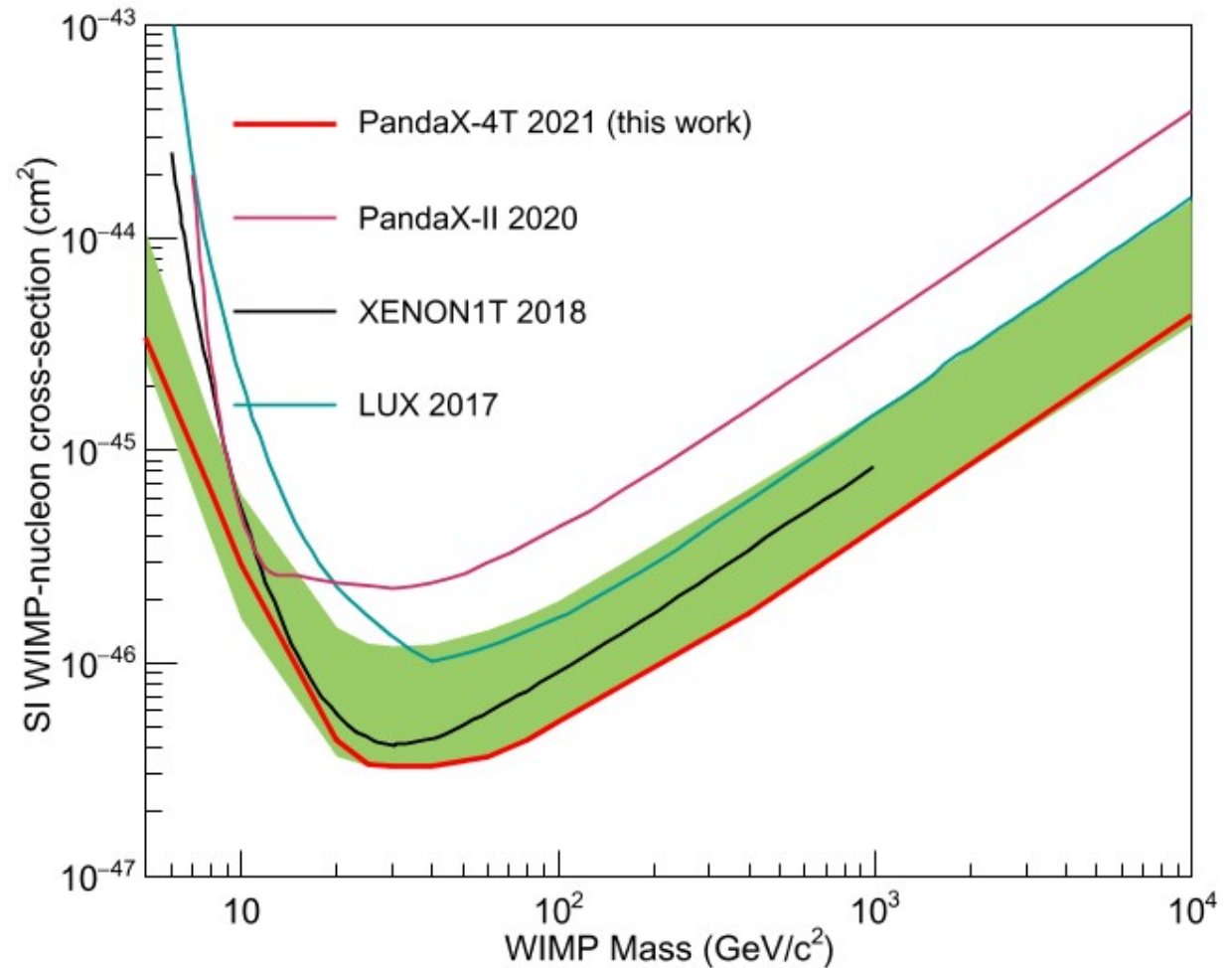


- Matter ~5%
- Dark Matter ~ 23%
- DM determines cosmic evolution



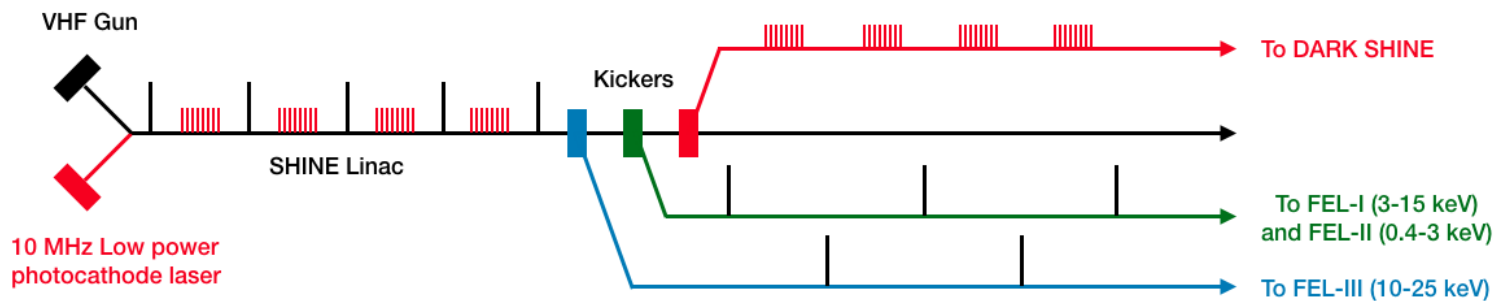
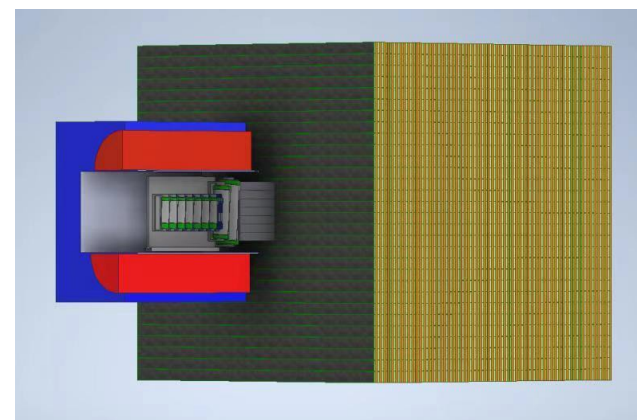
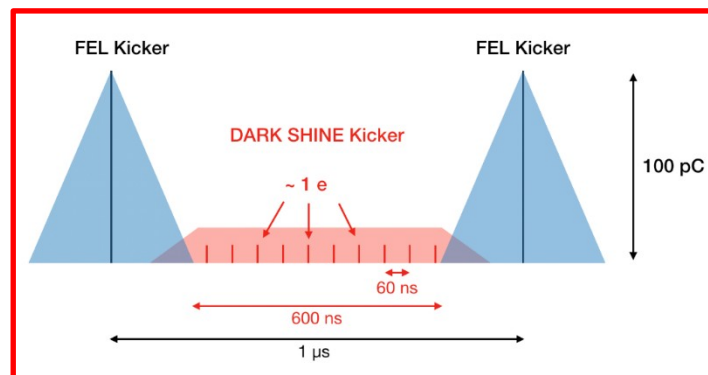
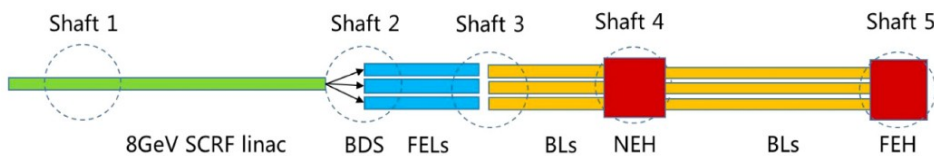
**Almost everything is unknown!**

# PandaX-4T



**2107.13438** - Dark Matter Search Results from the PandaX-4T Commissioning Run

# DarkSHINE





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# Welcome to Shanghai in 2022



**TDLI**



**SPA**