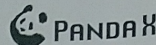


Signal yield and field dependence study in PandaX-II experiment



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Abstract
In this poster, I show the basic techniques searching for dark matter and the electron-recoil(ER) response of PandaX-II detector in different electrical field, which are the standards of a good detector. And I introduce the calibration sources that are used in my study. I also present the light yield at these fields as well as the NEST prediction. Comparing the event distribution, higher cathode voltage causes more uniform field.

Introduction

- It is believed that Dark Matter consists of 24% of the universe
- Three methods of Dark Matter detection: direct detection and indirect detection and detection in collider
- PandaX (Particle and Astrophysical Xenon experiment) is one of the leading collaborations in direct Dark Matter detection.
- PandaX-II contains ~560kg LXe in fiducial volume. The upcoming PandaX-4T contains ~4 tons LXe in sensitive volume
- TPC (Time Projection Chamber) is the sensitive detector in our experiment which includes two critical electric field. Field intensities are ~500V/cm and ~320V/cm for extraction field and drift field respectively



Fig 1: TPC diagram

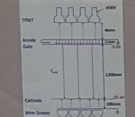


Fig 2: Field configuration

Signal results comparison

- In PandaX-II, light yield results are consistent with NEST Model
- More calibration source will be used, like tritium Methane

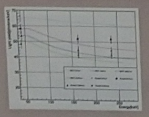


Fig 6: Light yield result using PandaX-II detector



Fig 7: qS2 spectrum from krypton 83m events

- S2 resolution is extraction field dependent
- Higher extraction contributes higher EEE
- More electrons will be extracted and diffuse more

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Scintillation and ionization mechanism

- Scintillation signal S1, ionization signal S2 and heat signal (nuclear recoil only)
- Energy reconstruction principle
 - $E_{\text{recoil}} = L W_0 (S1/S2 + S2/S3)$
 - Landau factor $L = 1$ (electron recoil)
 - $W_0 = 13.7 \text{ eV}$
 - Photon detection efficiency (ϵ)
 - EEE
 - SEG

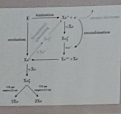


Fig 3: signal production

Calibration source

- Using mono-energy source to calibrate our detector
- Two internal source: krypton 83m and activated xenon (^{135}Xe)
- 415 keV event from krypton 83m
- 164 keV event and 236 keV event from activated xenon (^{135}Xe)

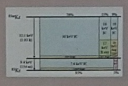


Fig 4: decay scheme of krypton 83m (1)

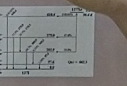


Fig 5: decay scheme of xenon 127 (2)

Event distribution in different fields

- Krypton 83m event distribution in the whole TPC
- It can be easily seen that lower cathode voltage case will cause more wrong reconstructed events

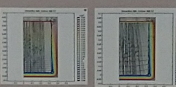


Fig 8: electric field simulation in COMSOL. Left is 28.8kV voltage case, right is 7.8kV case. The electric field is more uniform in the left case.

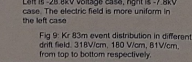


Fig 9: Kr 83m event distribution in different drift field. 318V/cm, 180 V/cm, 81V/cm, from top to bottom respectively.

Summary & reference

- PandaX-II detector performs good in 318V/cm drift field and 4.42kV/cm extraction field
- PandaX-II detector's signal yield is consistent with NEST model

[1] arxiv:1708.02566 [2] arxiv:1403.1299