PandaX-III: Searching for Neutrinoless Double-Beta Decay of ^{136}Xe

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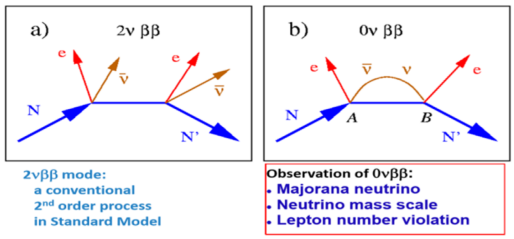
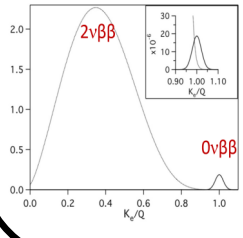
On behalf of PandaX-III Collaboration

Neutrinoless double-beta decay



2νββ mode:
a conventional 2nd order process in Standard Model

Observation of 0νββ:
- Majorana neutrino
- Neutrino mass scale
- Lepton number violation

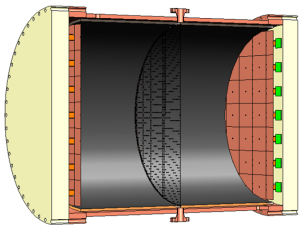


- 2νββ: 11 nucleus discovered, half-life~10^{20} year
- 2νββ decay for ^{136}Xe isotope: EXO200
- 0νββ: half-life > 10^{26} year

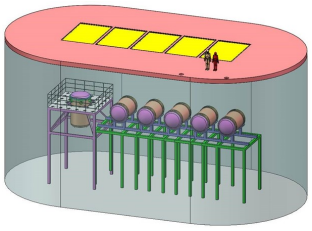
0νββ requirements:
- High energy resolution.
- Large Isotope mass.
- Low background

PandaX-III experiment

- First phase： 200 kg of 90% ^{136}Xe enriched gas TPC (Time Projection Chamber).
- Final phase: a ton scale experiment (5 modules).
- @ Hall #B4 at China Jin Ping underground Lab (CJPL-II): 5 m of ultra-clean water shielding in all directions
- Advantage : reconstruct both the track and energy, high energy resolution



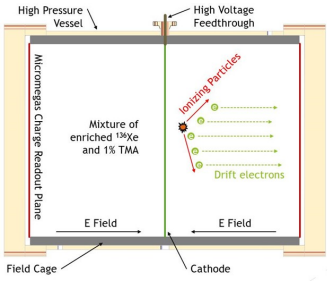
PandaX-III detector of first phase

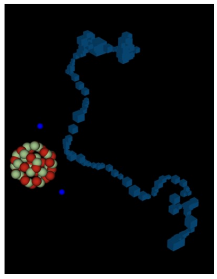


Tank of water at CJPL-II

PandaX-III detector of 1st phase

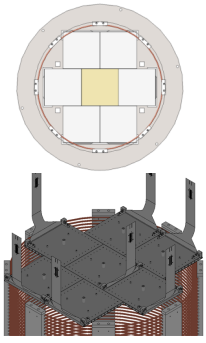
- Copper Vessel: operated at 10 bar
- TPC (Time Projection Chamber): symmetric, double-end charge readout with cathode in the middle
- Amplification: Microbulk Micromegas (Micro-Mesh Gaseous Structure)
- Readout: 2 series of strips (x, y)
- Digitization : AGET chips electronics, 512 time bin, up to 100MHz





Prototype TPC at SJTU

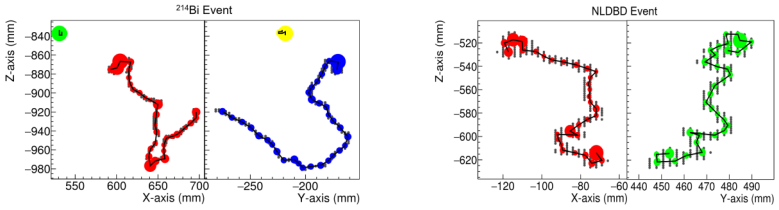
- Vessel: 600L(18kg Xe at 10bar)
- 7 Micromegas modules
- To optimize the design of Micromegas readout plane
- To study the energy calibration of TPC
- To develop algorithm of 3D track reconstruction



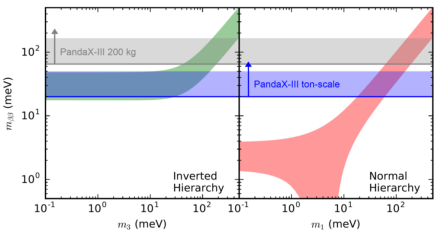
PandaX-III Prototype TPC

Expected Performance and Sensitivity

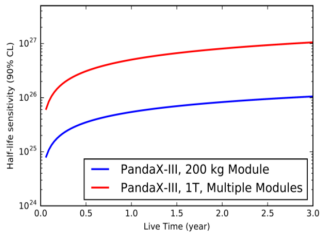
- 0νββ events in 10bar Xe gas : ~15cm track, higher energy depositions at both ends of the track
- Background events (around $Q_{\beta\beta}$) : only one higher energy blob at one of the track's ends



Reconstruction of the projected electron tracks (XZ and YZ) produced by two Monte Carlo



Connectivity plot between the effective Majorana mass $m_{\beta\beta}$ and the lightest neutrino mass, mlightest for the two mass orderings



PandaX-III sensitivity as a function of live time

- First module:
  - → 3% FWHM, 35% signal efficiency
  - → 1 x 10^{-4} c/keV/kg/y in the ROI
  - → 10^{26} y half-life limit
  - → 65 – 165 meV $m_{\beta\beta}$
- Ton scale:
  - → 1% FWHM
  - → 1 x 10^{-5} c/keV/kg/y in the ROI
  - → 10^{27} y half-life limit
  - → 20 – 50 meV $m_{\beta\beta}$

PandaX-III collaborating institutions： *Shanghai Jiao Tong University, China Central Normal University, CEA Saclay (France), Lawrence Berkeley National Laboratory (USA), China Institute of Atomic Energy, Moscow Engineering Physics Institute (Russia), Peking University, Shandong University, Sun Yat-Sen University, Universidad de Zaragoza (Spain), University of Science and Technology of China*