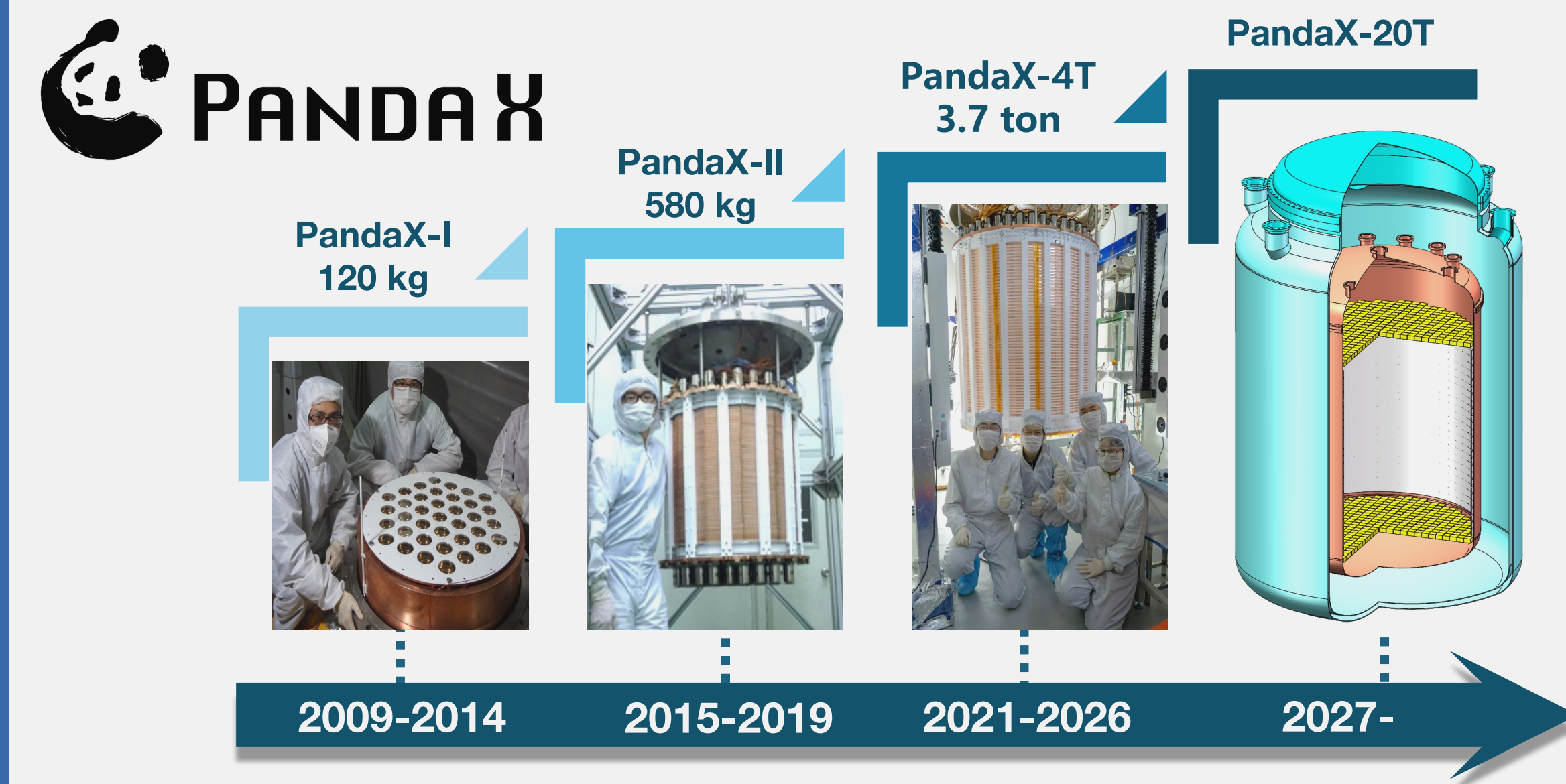
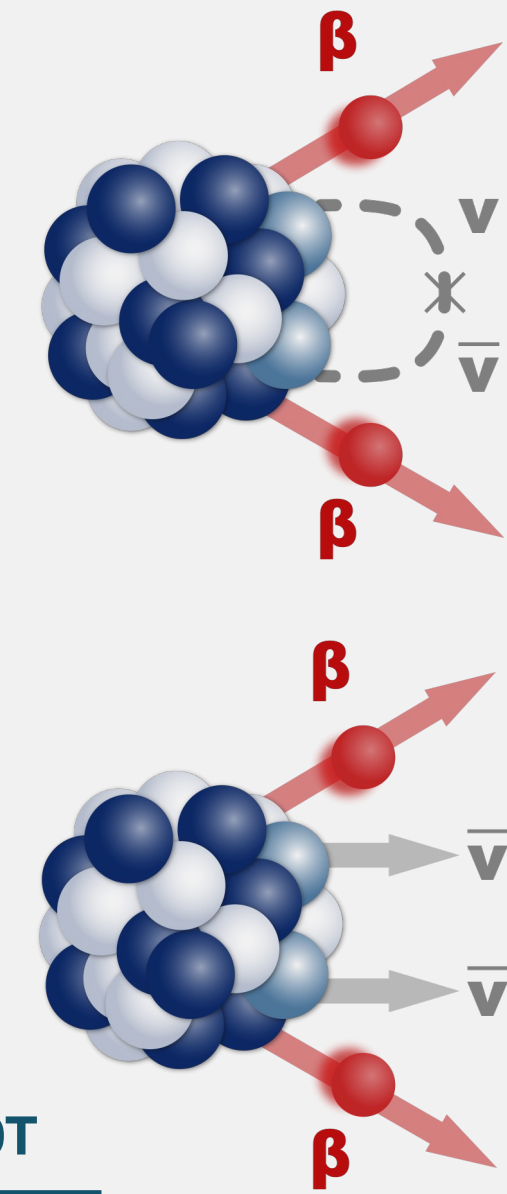


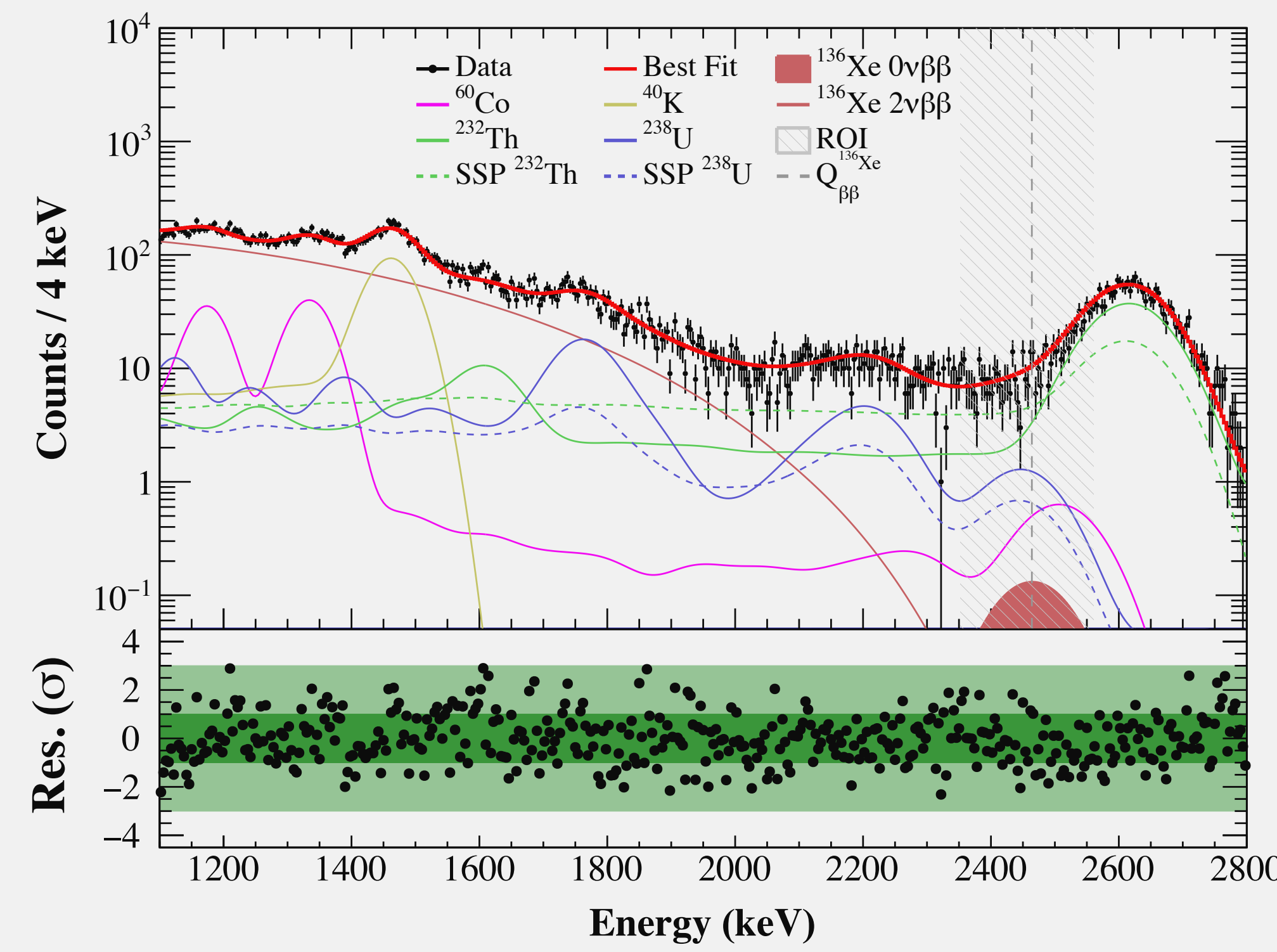
## 1. Physics and detector

- Neutrinoless double beta decay ( $0\nu\beta\beta$ ): Majorana fermions and lepton number violation
- SM-allowed: 2-neutrino double beta decay ( $2\nu\beta\beta$ )
- Liquid Xe Time Projection Chamber (LXeTPC) as a 5D Calorimeter: 3D position, energy, and time
- PandaX for dark matter and neutrino physics
- Started in 2009 at CJPL



## 2. $^{136}\text{Xe}$ $0\nu\beta\beta$

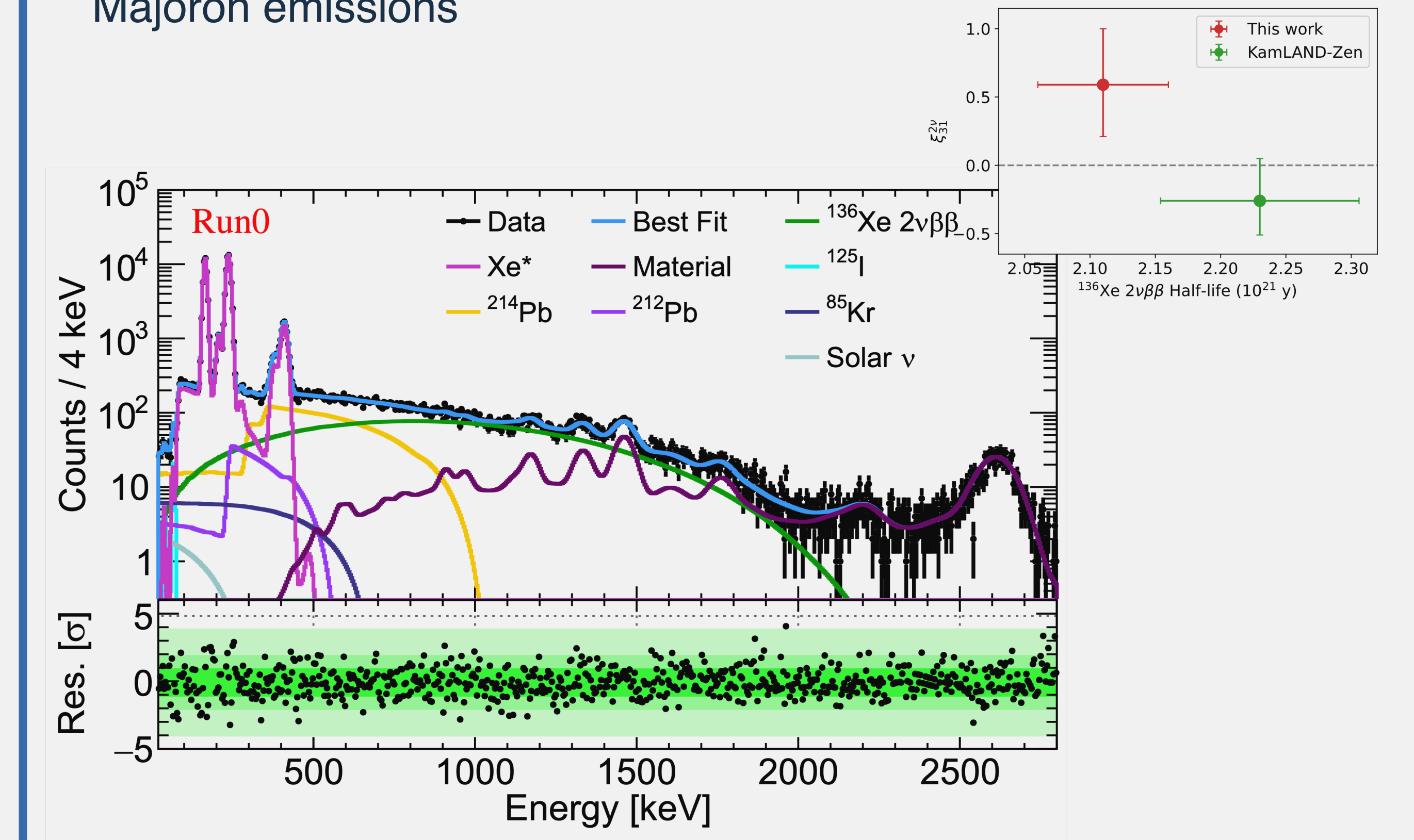
- 44.6 kg · yr isotope exposure
- Stringent half-life limit from a natural xenon detector:  $2.1 \times 10^{24}$  yr (90% C.L.)
- The effective Majorana mass constraint:  $< (0.4-1.6)$  eV



Science Bulletin 70, 1779 (2025)

## 3. $^{136}\text{Xe}$ $2\nu\beta\beta$

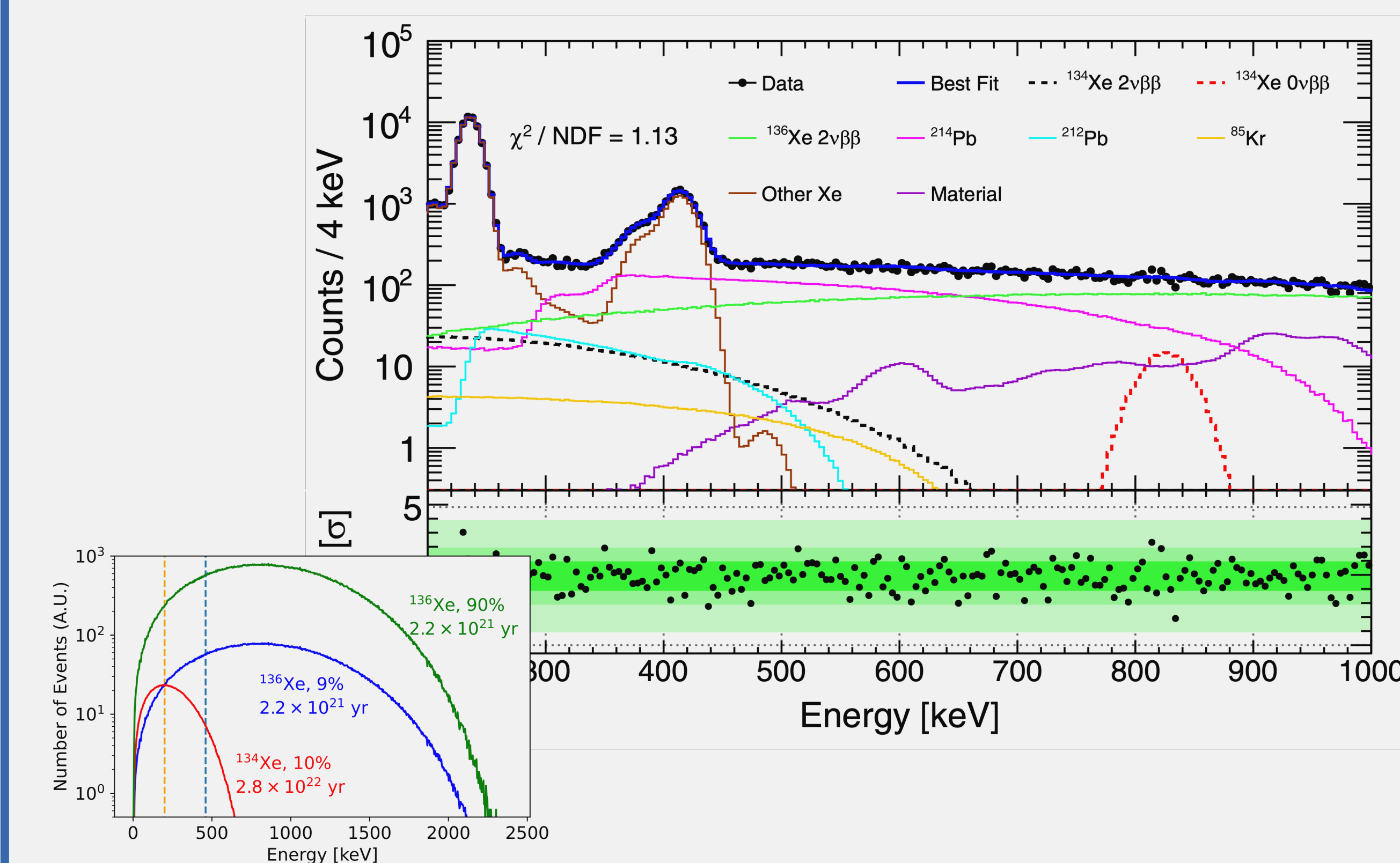
- A near-complete  $^{136}\text{Xe}$   $2\nu\beta\beta$  spectrum from 20 keV to endpoint
- The most precise half-life measurement:  $(2.14 \pm 0.05) \times 10^{21}$  yr
- Constrains higher-order matrix elements contribution  $\xi_{31}^{2\nu}$  and Majoron emissions



PRL 136, 162501 (2026)

## 4. $^{134}\text{Xe}$ $2\nu\beta\beta$ and $0\nu\beta\beta$

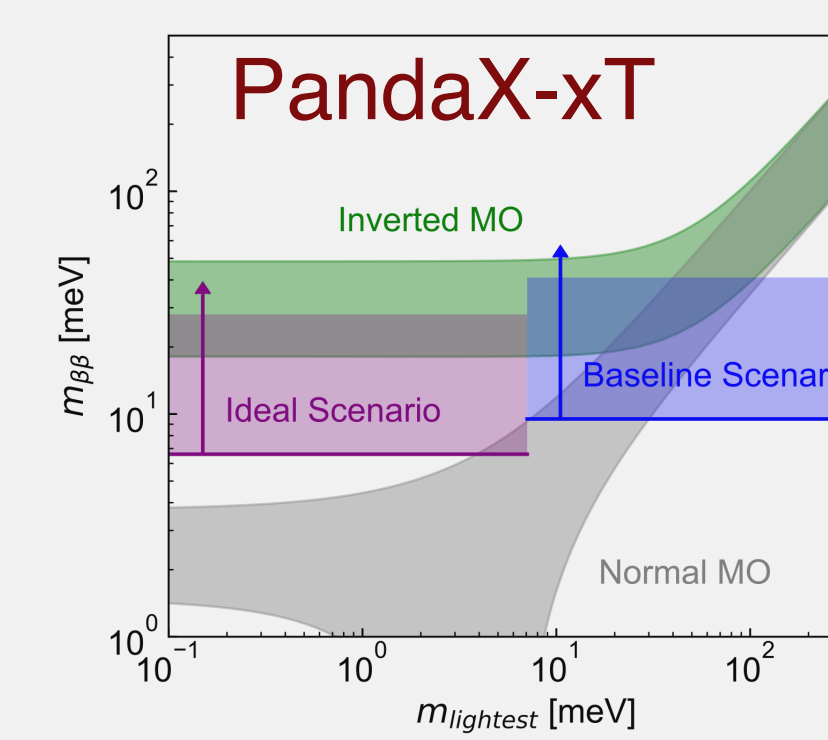
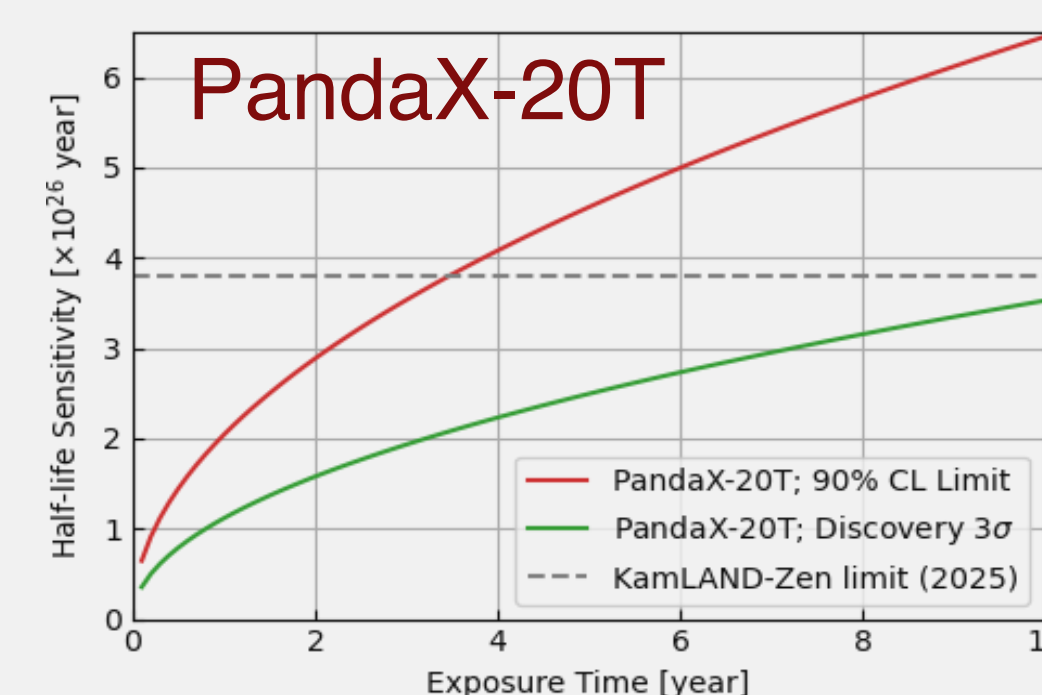
- Wider energy range, fewer  $^{136}\text{Xe}$  "contamination" (v.s. EXO-200)
- The most stringent (when published)  $^{134}\text{Xe}$  half-life limits  $2.8 \times 10^{22}$  yr ( $2\nu\beta\beta$ ) and  $3.0 \times 10^{23}$  yr ( $0\nu\beta\beta$ ) at 90% confidence level



PRL 132, 152502 (2024)

## 5. Future: PandaX-20T and PandaX-xT

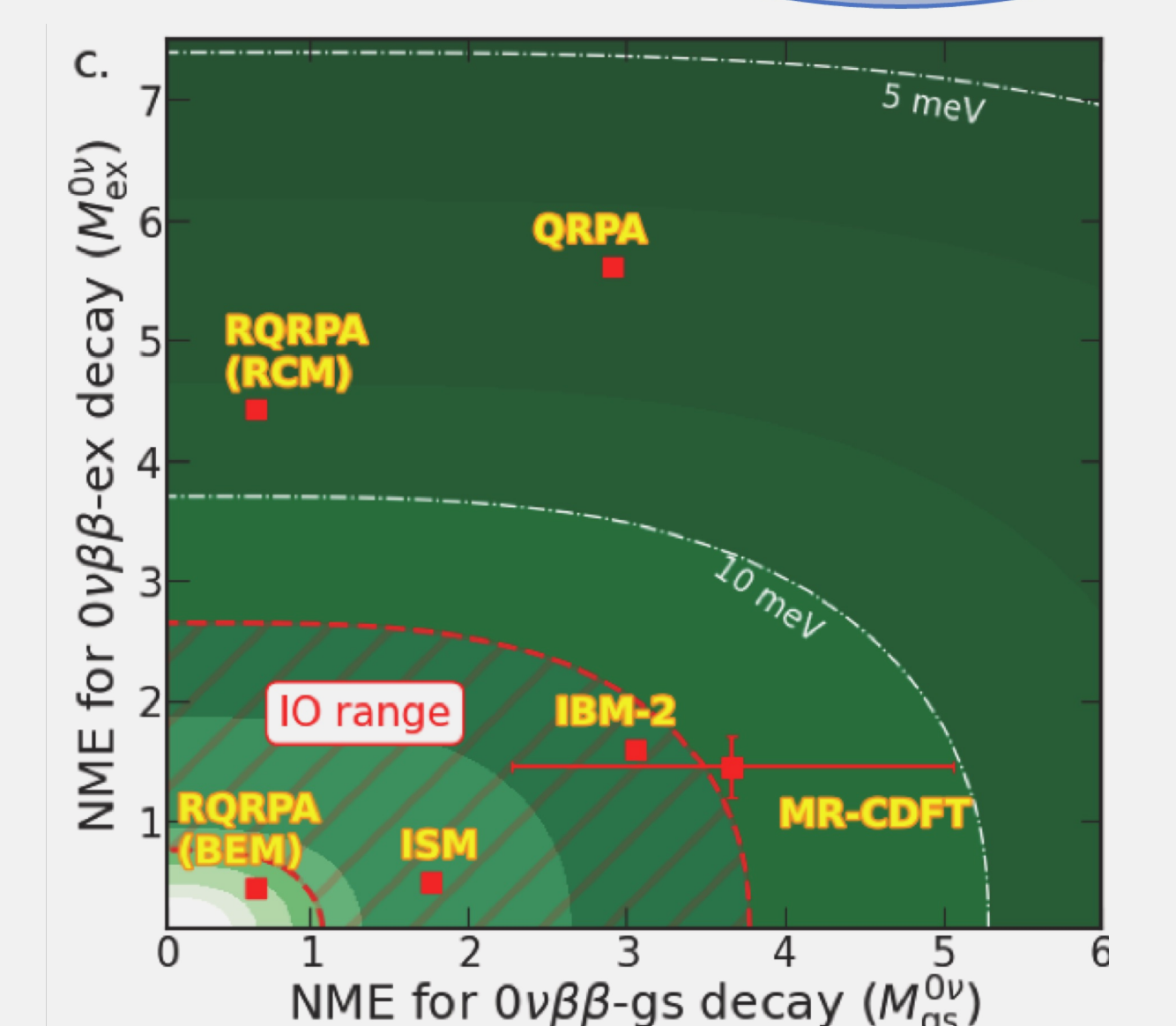
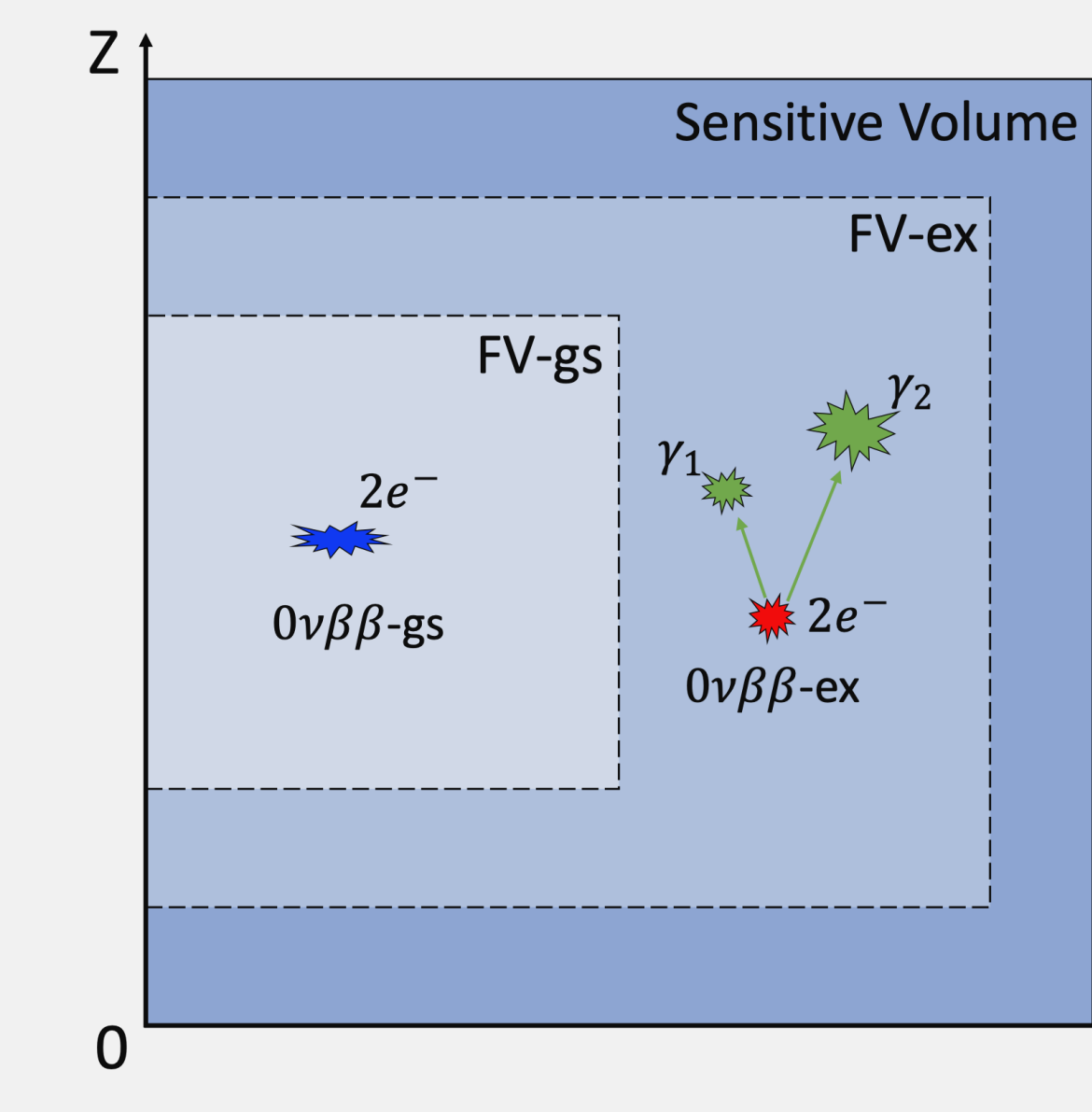
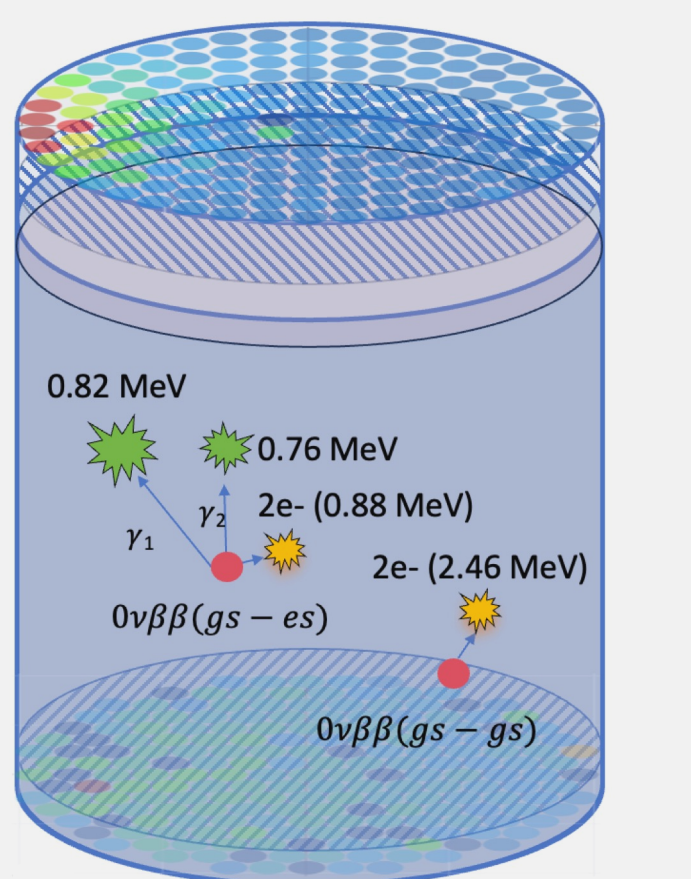
- 20T/43T detector mass: large  $^{136}\text{Xe}$  double beta decay experiment
- PandaX-20T expected data taking: 2028



Sci. China Phys. Mech. Astron. 68, 221011 (2025)

## 6. Better $0\nu\beta\beta$ sensitivity by $0\nu\beta\beta$ -ex + gs analysis

- $0\nu\beta\beta$ -ex may contribute non-trivially to the sensitivity to  $m_{\beta\beta}$
- Event topology in LXe TPC enables  $0\nu\beta\beta$ -ex search with low bkg rate in a large FV
- Combining  $0\nu\beta\beta$ -gs and  $0\nu\beta\beta$ -ex improves the sensitivity to  $m_{\beta\beta}$



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