



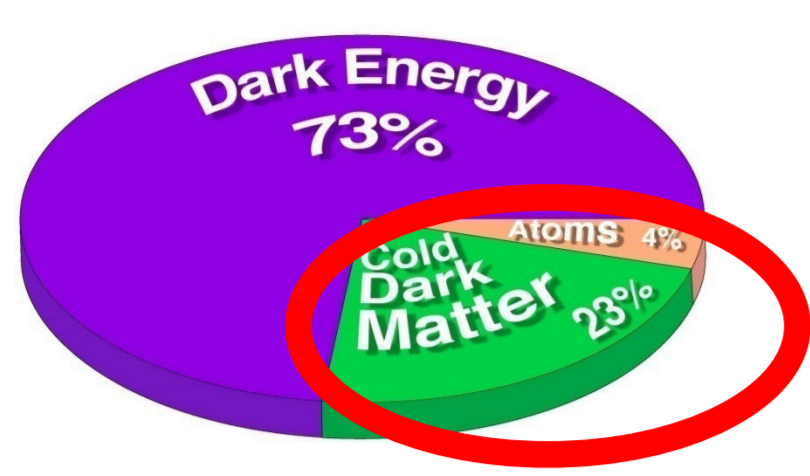
NEWAGE

Direction-sensitive direct dark matter search with μ -TPC

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The 1st international conference on Technology and Instrumentation in Particle Physics (TIPP) in Tsukuba

1. Dark Matter

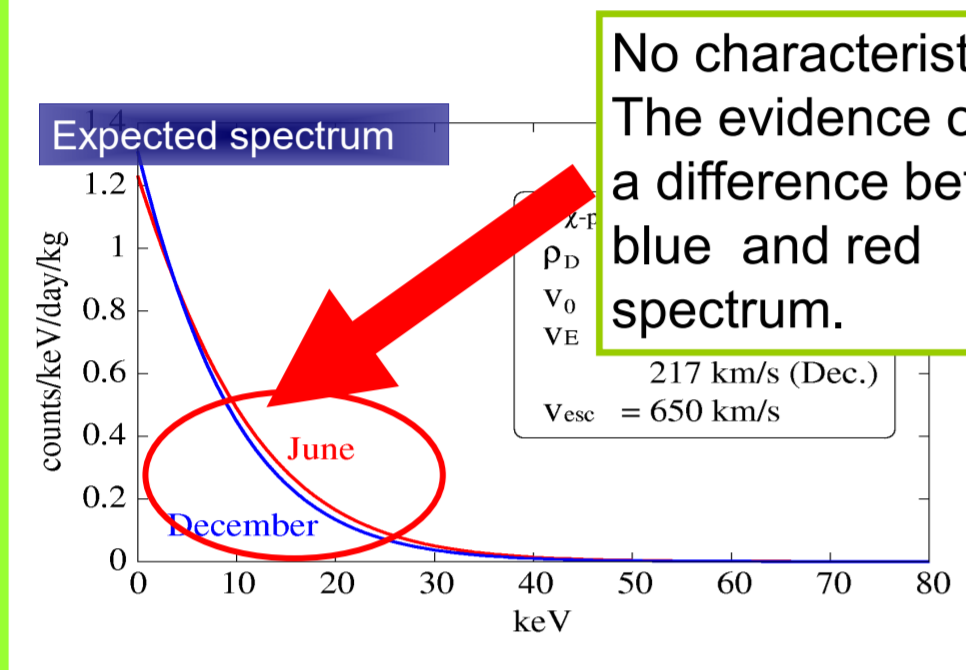


- Promising candidate of dark matter as an elementary particle
 - WIMP (neutralino)
 - Axion
- Dark Matter search
 - Direct search**: To detect interaction between DM and nuclei on the earth
 - Observation In underground
 - Indirect search**: To detect γ , antiproton, e^+ and so on produced by DM pair creation in the galaxy.
 - Observation For sky

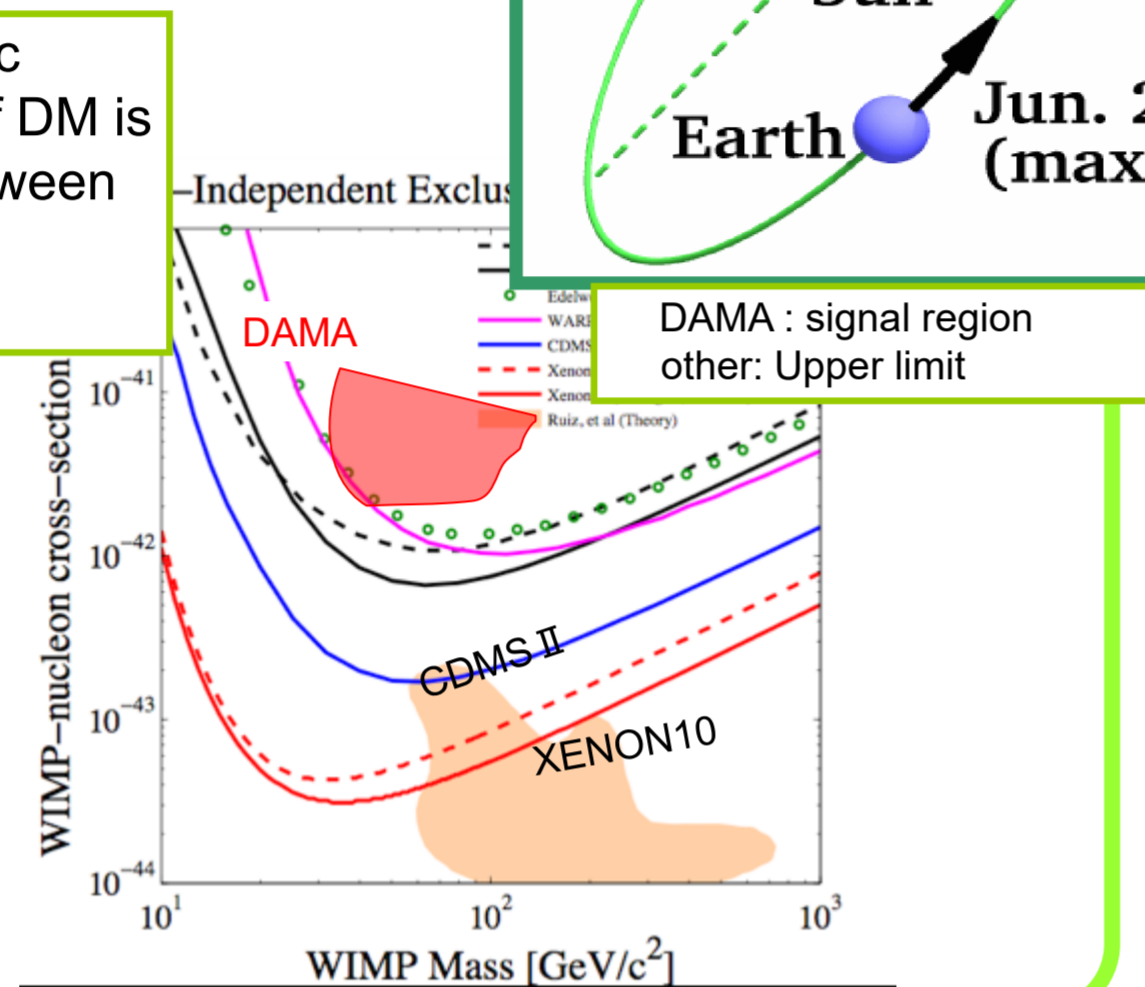
2. Direct Dark Matter Search

- DM \rightarrow Nuclei Elastic scattering
 - Large mass
 - Low background
 - High energy resolution
- Conventional method: NaI, CsI, Si, Ge, LXe, LAr

using energy spectrum

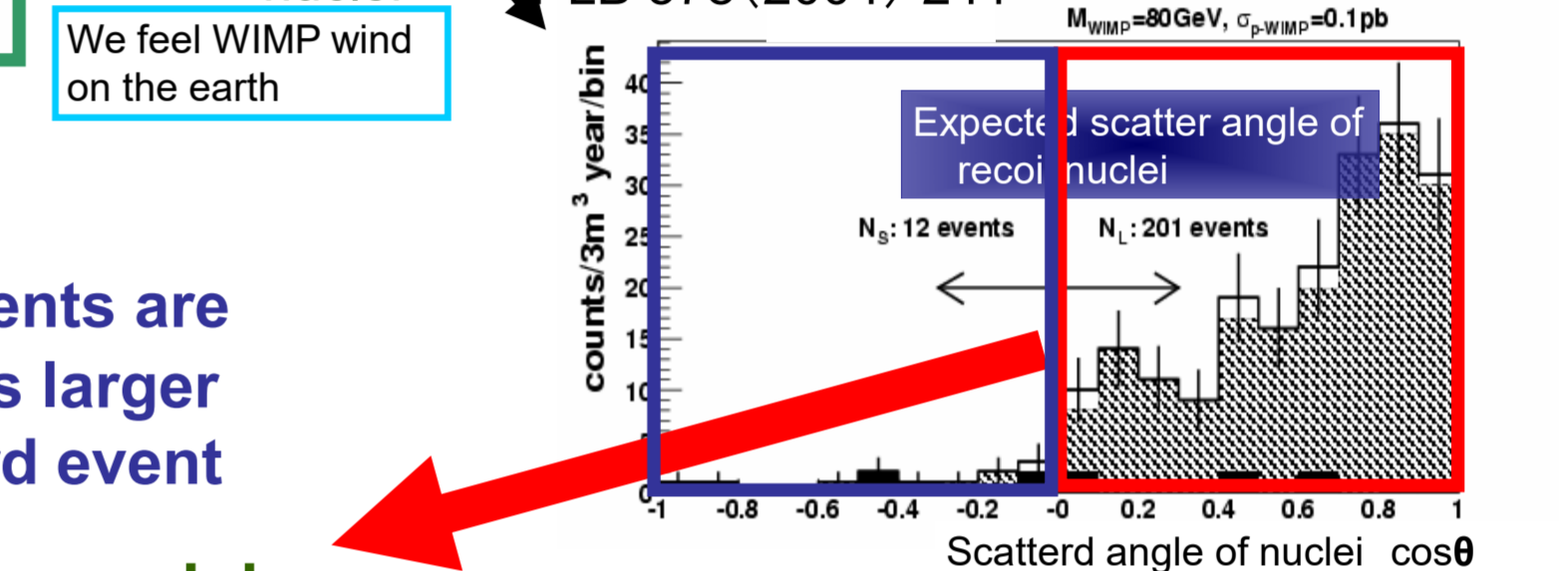
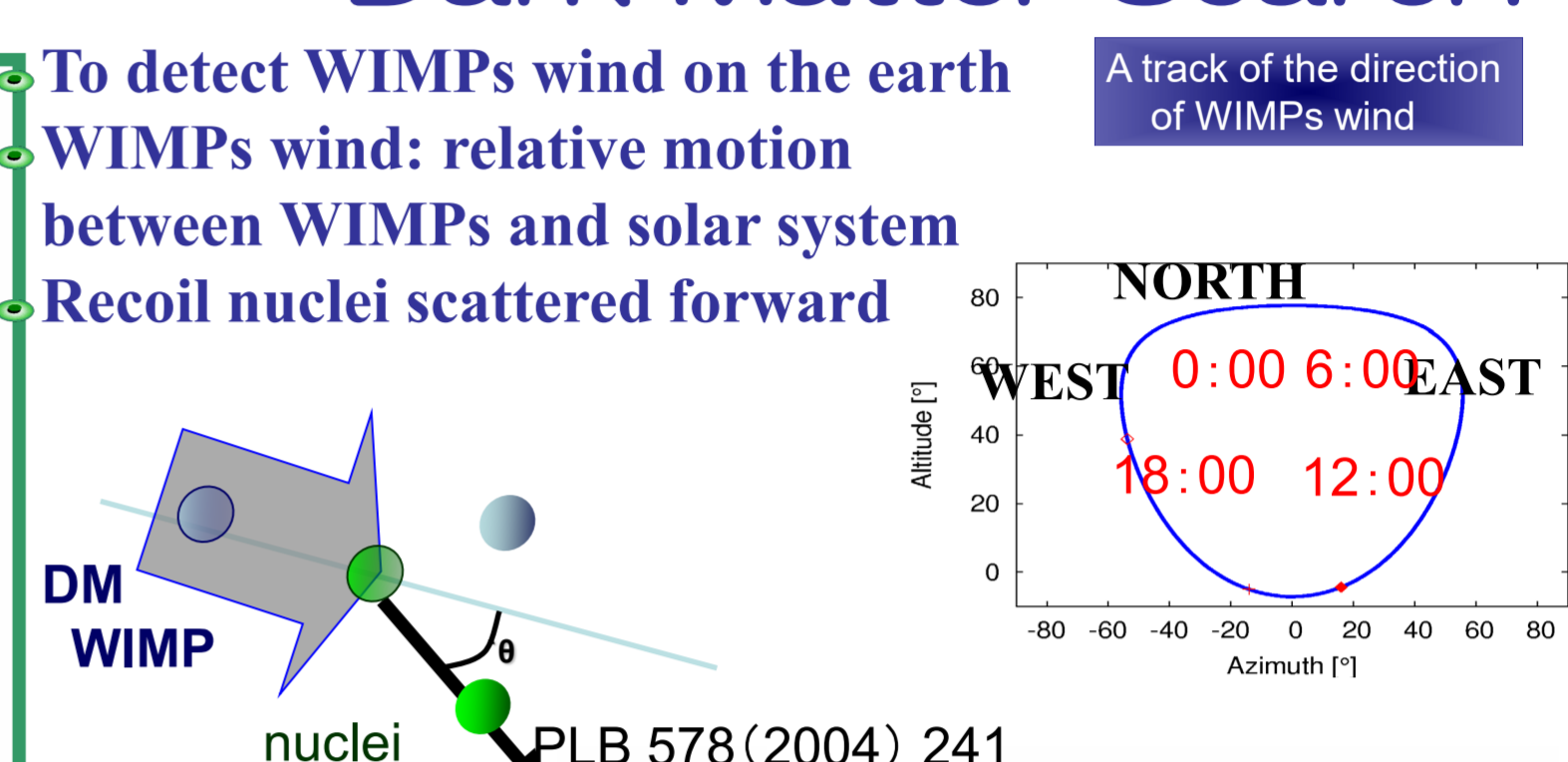
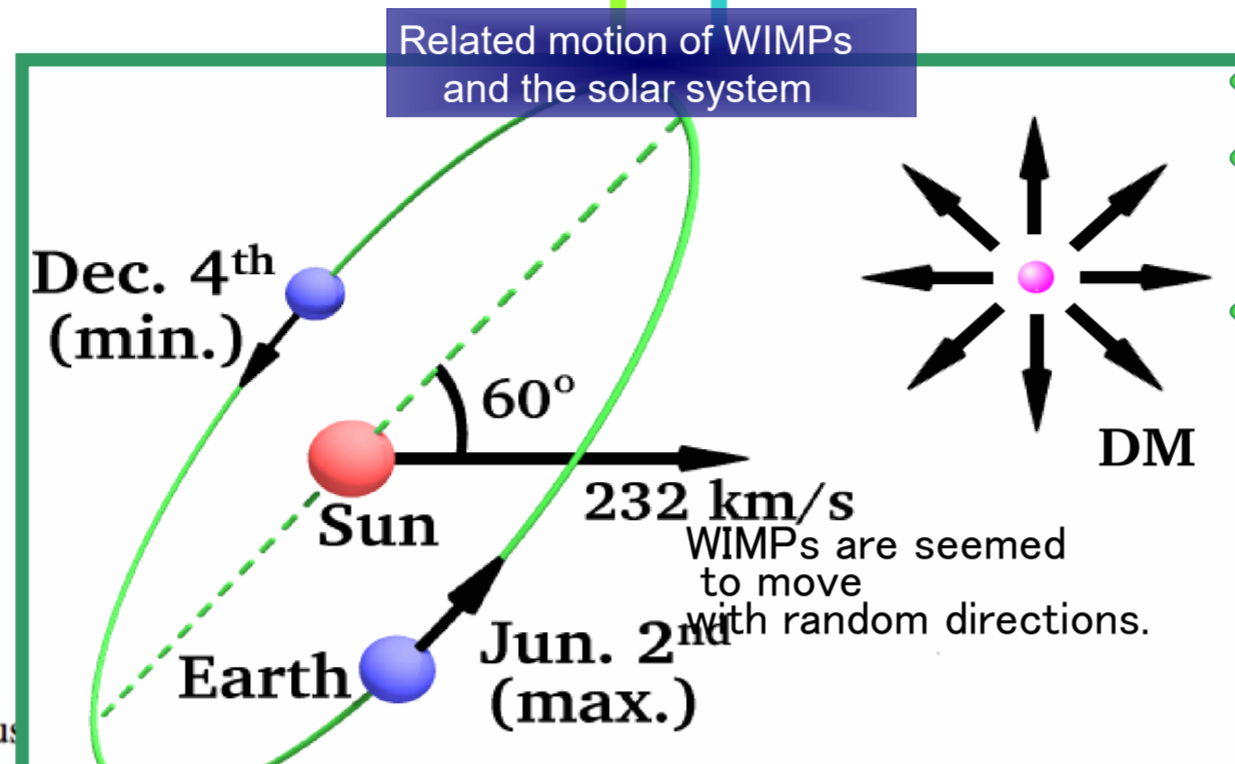


No characteristic evidence of DM is a difference between blue and red spectrum.



Relay on the annual modulation
Few % of the total events.
Not enough.

3. Direction Sensitive Direct Dark Matter Search

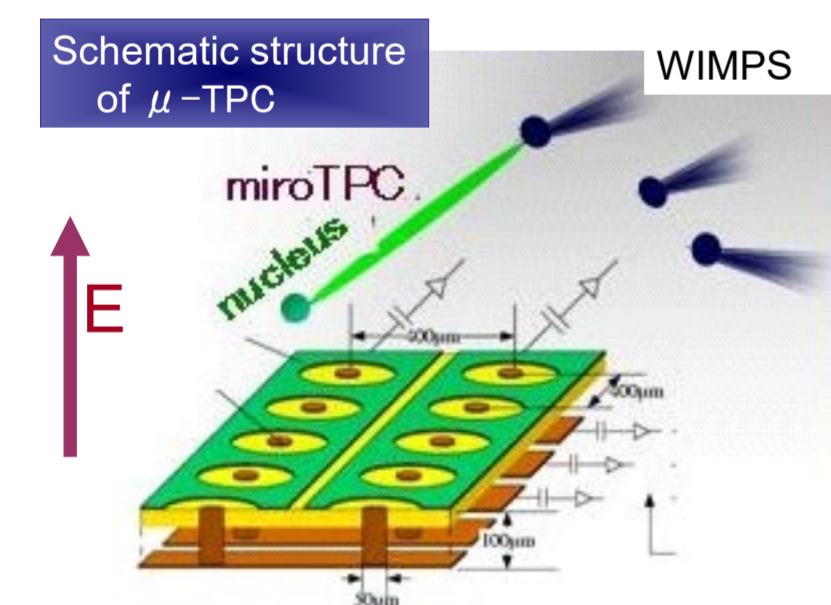


Forward events are 10 times larger than backward event

Very strong evidence

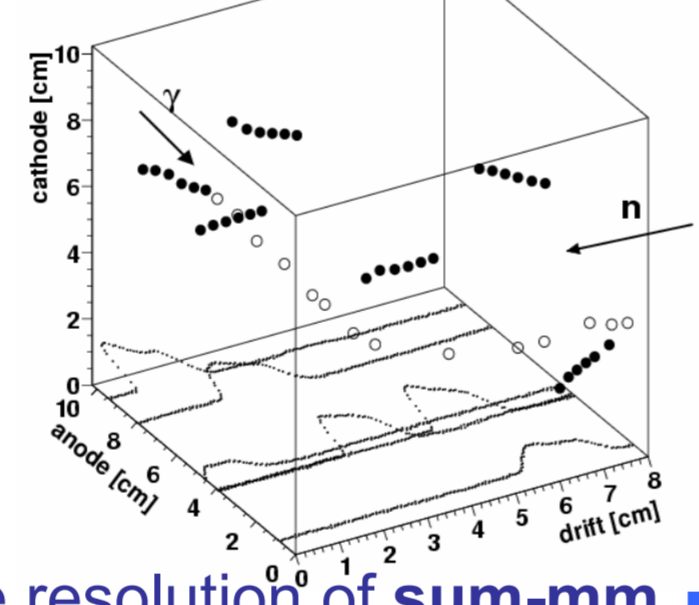
4. 3D-Tracking Detector for recoil nuclei (μ TPC)

- μ -TPC micro Time Projection Chamber
- μ -PIC 2D gas detector 400 μ m pitch, gas gain $10^3 \sim 10^4$, $30 \times 30 \text{ cm}^2$
- 100MHz readout system



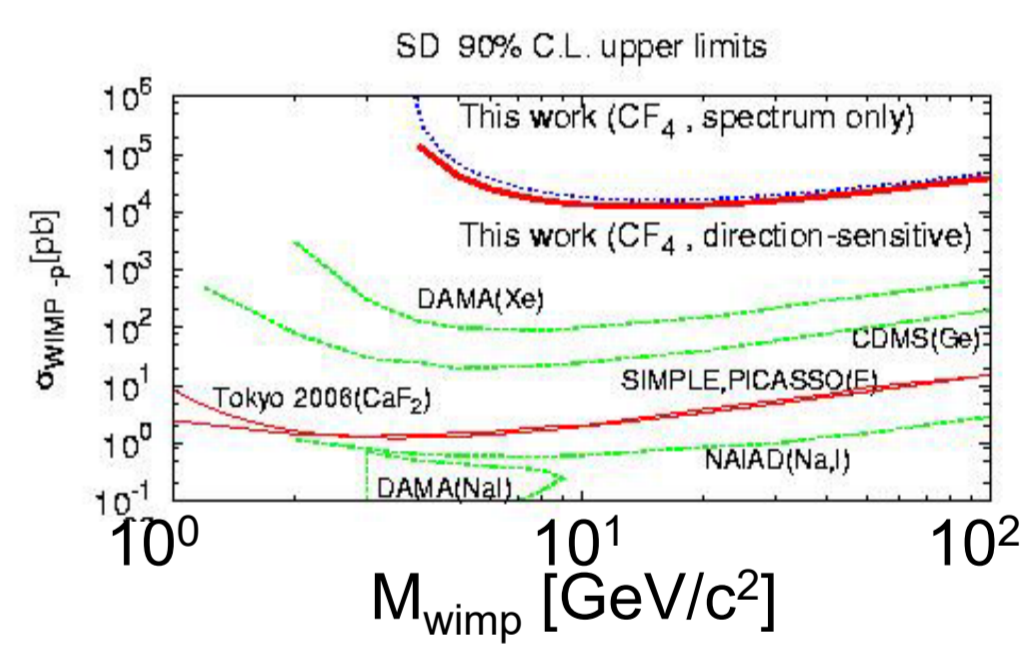
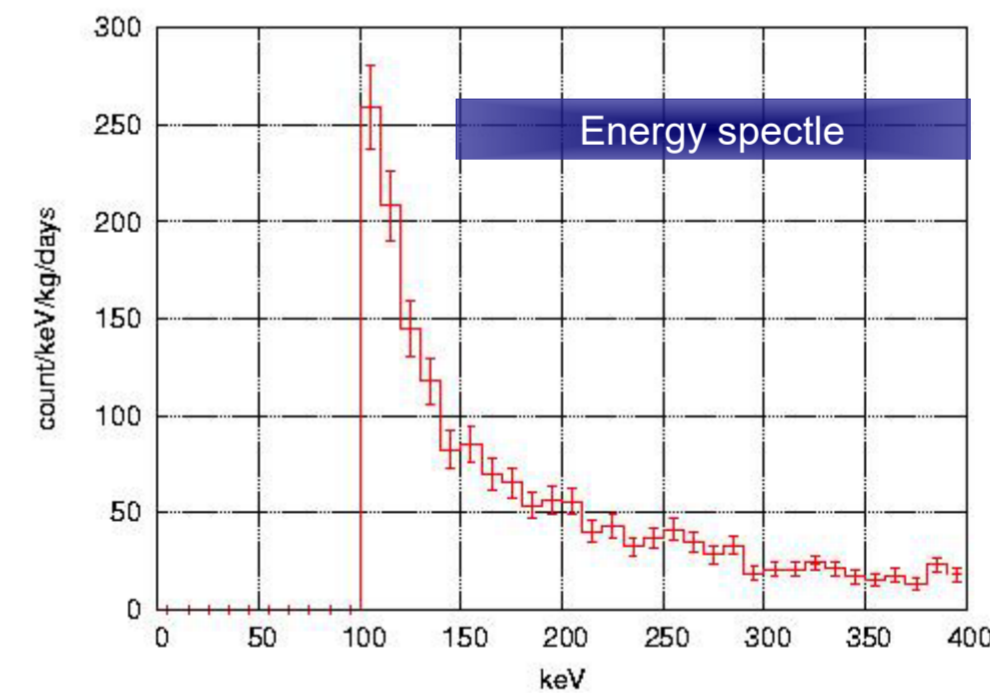
- 3D tracks with the resolution of **sum-mm**
- Energy resolution of **40% @5MeV**
- Particle discrimination by dE/dx
- $\rightarrow \gamma$ -ray rejection power $< 10^{-5}$

Ex. Track of recoil nuclei scattered by neutron



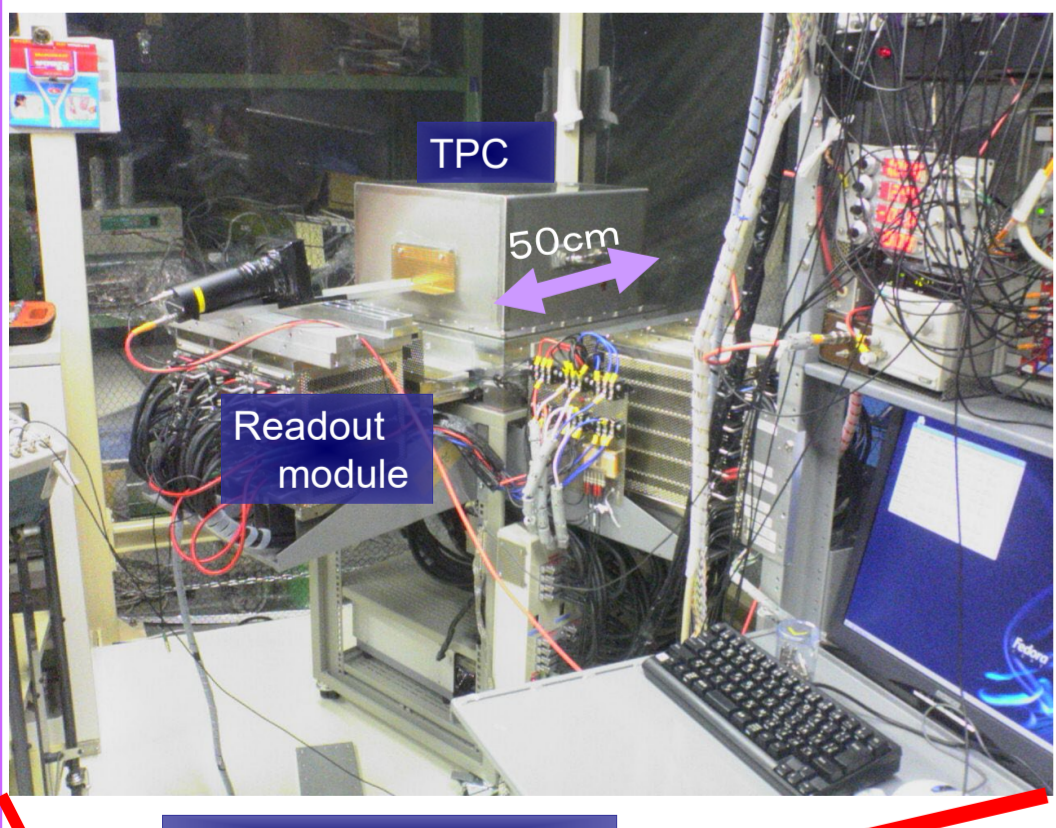
5. Direction Sensitive DM Search on Surface

- Surface run in the laboratory of Kyoto university
- Nov 1-27, 2006 0.15kg \cdot days
- N 35.03 E 135.783**
- Gas: CF₄ 0.2atm**



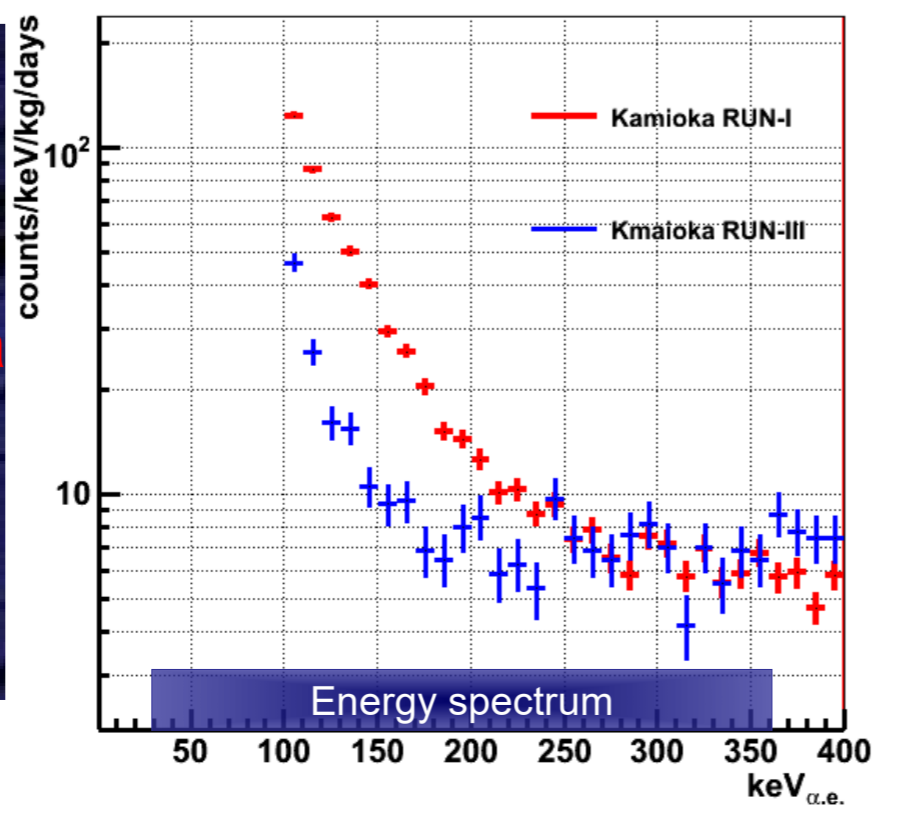
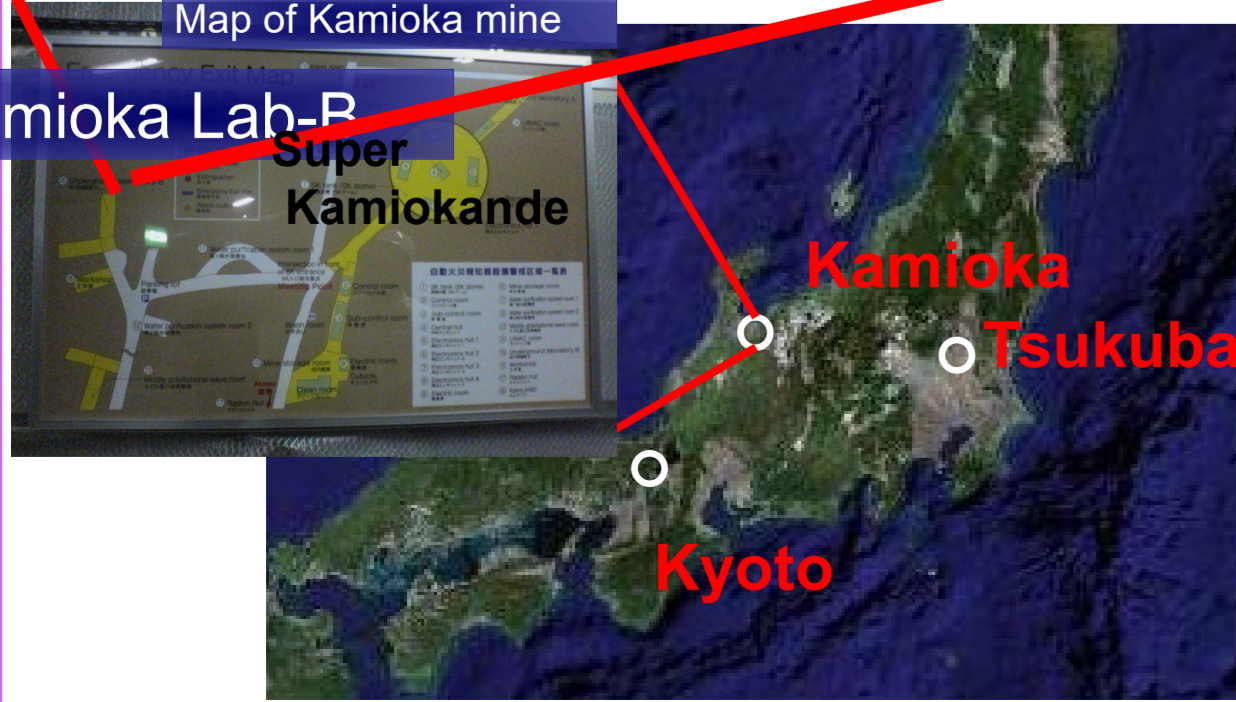
The first result of the direction-sensitive with a gas detector in the world

6. Operation in Kamioka mine

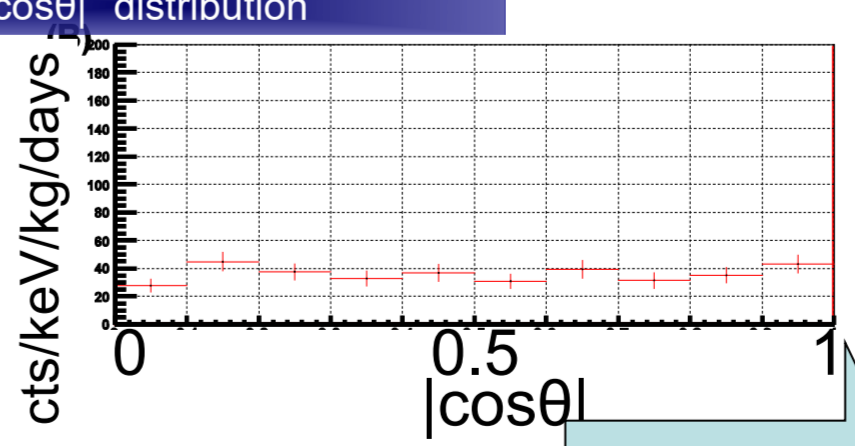
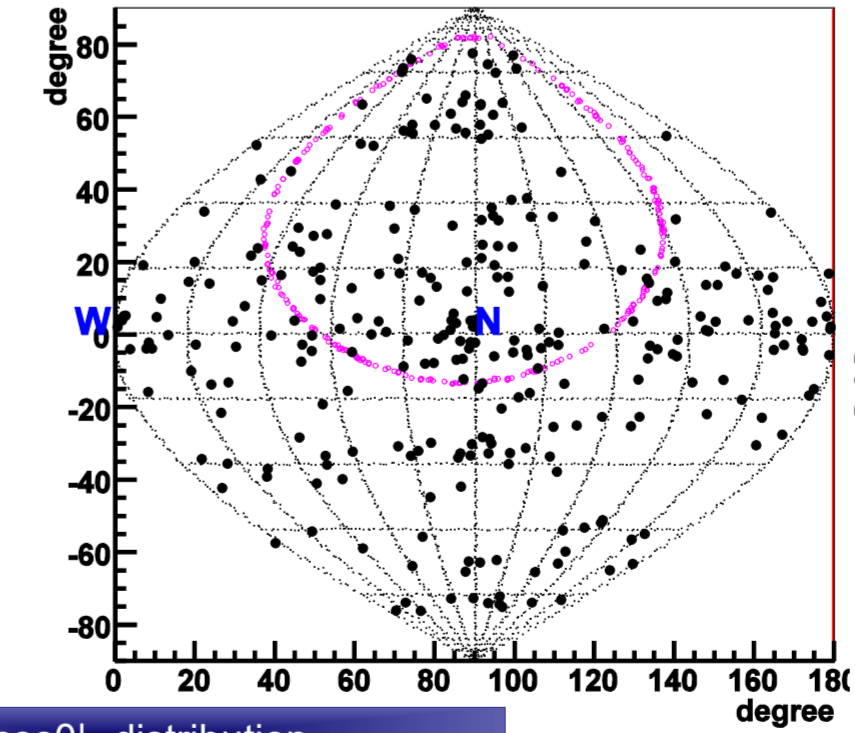


- Gas CF₄ 0.2atm
- Fiducial volume $20 \times 25 \times 31 \text{ cm}^3$
- N 36.25 E 137.18**
- Jan. 2007 Operation Start!!

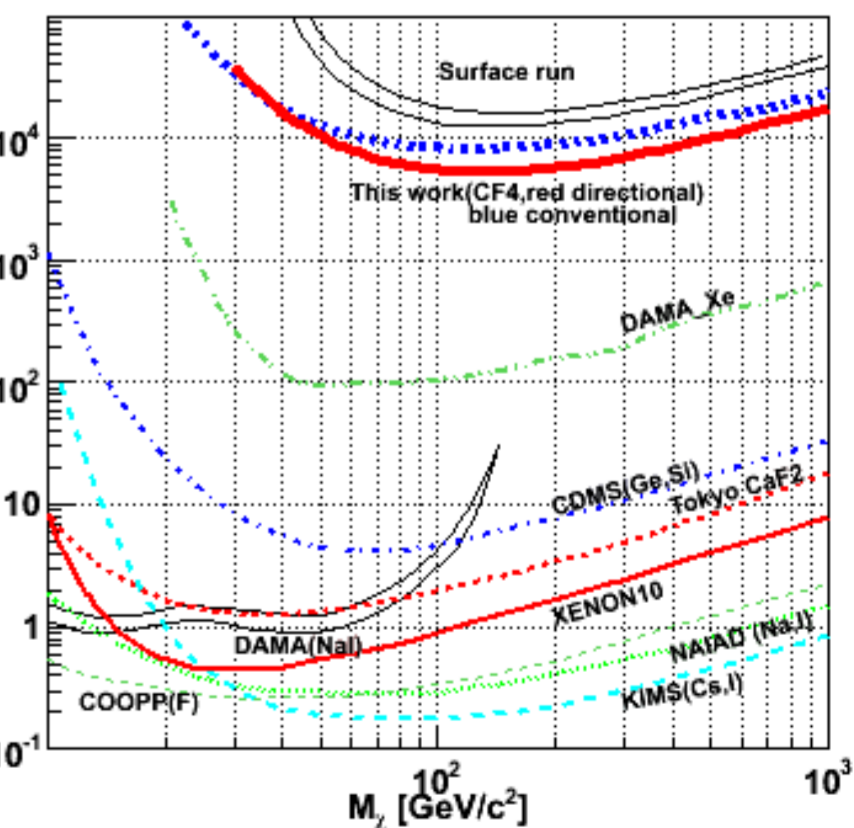
- Kamioka RUN-I: First Kamioka Run $\sim 1.74 \text{ kgdays}$
- Kamioka RUN-III: Optimized run $\sim 0.52 \text{ kgdays}$



Nuclear recoil direction Zenith



SD 90% C.L. upper limits and allowed region



Background @100keV : decrease to 20% of surface run.

Future work

- Low BG detector
- Larger volume $\rightarrow 1 \text{ m}^3$
- Lower pressure $\rightarrow 0.05 \text{ atm}$
- 2010 ~ : With 1 m^3 detectors NEWAGE will reach the frontier of the direct dark search and SUSY region.