



NEWAGE

(New generation WIMP search with an advanced gaseous tracking device experiment)

Direction-sensitive direct dark matter search

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1. Dark Matter

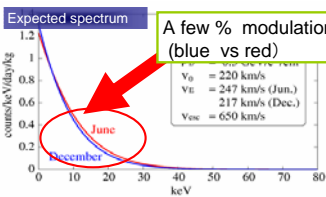


- Promising candidate of dark matter
 - WIMPs (neutralino)
 - Axions
 - Machos
- Dark Matter search
 - Direct search: Search for DM - nuclei elastic scatterings
 - Indirect search: Search for γ , antiproton, e+ ... from DM annihilations
 - Accelerator: Search for missing mass

2. "Conventional" Direct Dark Matter Search

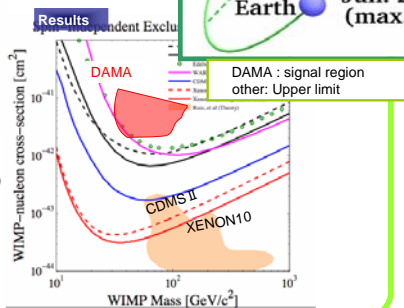
- Large mass
 - Low background
 - High energy resolution
- Nal, CsI
Si, Ge
LXe, LAr

Annual modulation in energy spectrum



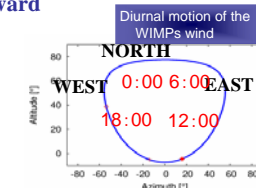
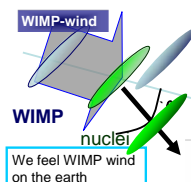
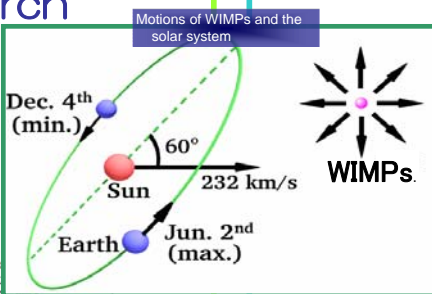
DAMA-signal was observed again. (EPJC56(2008)333)

Other reliable method is required.



3. Direction Sensitive Direct Dark Matter Search

- Detect the "WIMPs wind"!
- Recoil nuclei scattered forward



Forward events are 10 times larger than backward event

Very strong evidence

Simulation with neutron background in Kamioka mine

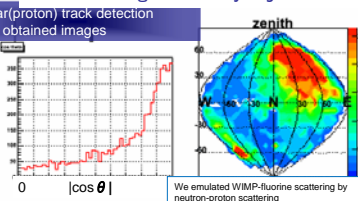
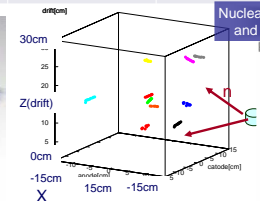
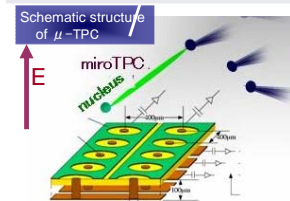
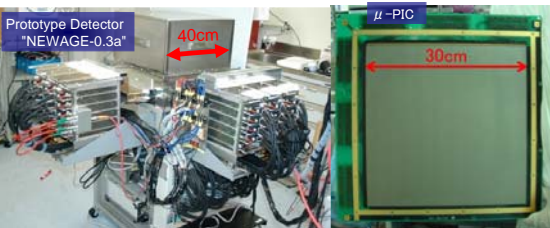
4. Detector

Astropart. Phys.31 (2009) 185, PLB 654(2007) 58 Detector Performance and Development plan

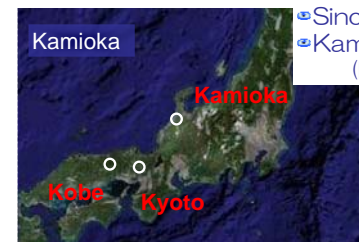
- μ -TPC: micro Time Projection Chamber (3D-tracking device) consists of
 - μ -PIC: (2D gas detector 400 μ m pitch gas gain \sim 3000, 30 \times 30 cm²) + 100MHz readout system

| | Current | Plan |
|-----------------------------------|--|-----------------------------|
| Detection Volume | 30 \times 30 \times 31 cm ³ | >1 m ³ |
| Gas | CF ₄ 152 Torr | CF ₄ 30 Torr |
| Energy threshold | 100 keV | 35 keV |
| Energy resolution (@ threshold) | 70% (FWHM) | 50% (FWHM) |
| Gamma-ray rejection (@ threshold) | 8 \times 10 ⁻⁶ | 1 \times 10 ⁻⁷ |
| Angular resolution (@ threshold) | 55 $^\circ$ (RMS) | 30 $^\circ$ (RMS) |

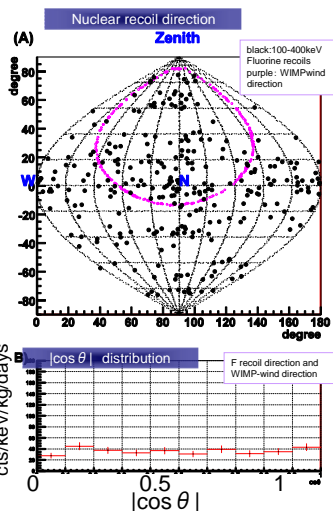
- Fluorine has large spin-dependent cross-section.
- Lower pressure gas provides
 - lower threshold
 - better angular resolution
- Uniform pixels provide
 - better energy resolution
 - better gamma-ray rejection



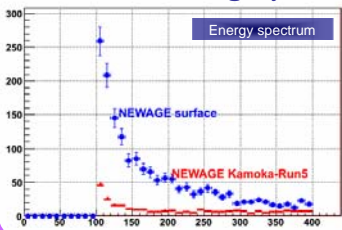
5. Underground Measurements



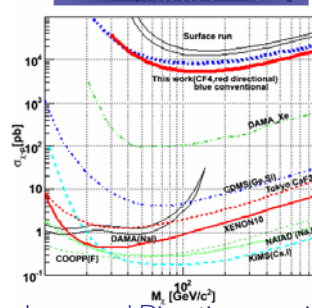
- Since 2007
- Kamioka mine (2700 m.w.e.) (N 36.25 E 137.18)



- After several pilot runs
- Kamioka RUN-5: First Dark Matter run \sim 0.52 kgdays



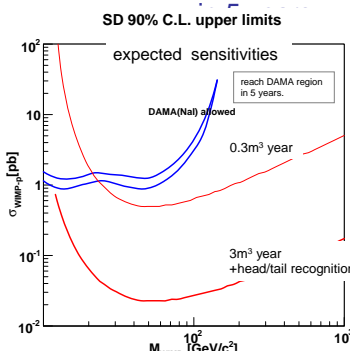
SD 90% WIMP cross section limits



- Improved Direction-sensitive limits
- but..
- Still worse than conventional methods
- Internal radioactive BG restricts the sensitivities
- We are working on to reduce the backgrounds!

6. Plans

- Low BG detector by material selection
- Larger volume (\sim 1 m³)



Direction-Sensitive WIMP-search NEWAGE