The other dark matter experiment in Kamioka Mine: NEWAGE

New generation WIMP-search with an Advanced Gaseous tracking device Experiment

Direction-sensitive search for spin-dependent WIMP interactions

Why “direction-sensitive”? 

Motion of solar system relative galactic halo gives apparent “WIMP-wind”

WIMP-wind will appear to come from the direction of Cygnus

Angular distribution of nuclear recoils (from WIMP scattering) can reveal presence of dark matter!
NEWAGE Detector

μ-TPC detector

- gaseous \( (CF_4) \) time projection chamber
  
  Nucleus scatters in gas, causing e\(^-\) cloud along track
  
  Cloud pulled down by drift field \((\sim 200 \text{V/cm})\)

- active gas volume: \(23 \times 28 \times 31 \text{ cm}^3\)

- 2-D position + time = 3-D readout

GEM (Gas Electron Multiplier)

used as pre-amplifier \((\text{gas gain } \sim 10)\)

μ-PIC (μ-Pixel Chamber)

used for amplification and readout

- gas gain \(\sim 1000\)
- 400 \(\mu\)m pitch
- 768 'x' channels \(\sim 1000\)
- 768 'y' channels \(\sim 1000\)

digitized by ASD chips

readout sync with 100 MHz clock

Position resolution: \(800 \mu\text{m}\)

Angular resolution: \(\sim 15\) degrees
NEWAGE Performance

Proton tracks

$^252\text{Cf}$

Source

$\text{CF}_4 + \text{C}_4\text{H}_{10}$

$^252\text{Cf}$ run

$n \rightarrow p$ forward scattering (emulates WIMP scattering)

- Sky map shows large excess in direction of source
- Angle between source and reconstructed proton track peaks in direction of source

Demonstration of directional sensitivity for dark matter searches with a gaseous detector

Jan 27, 2007  3rd MPGD workshop
NEWAGE Results & Plans

Surface run consistent with flat distribution
- Kyoto Univ.
- 0.15 kg-days exposure
  (0.0089 kg x 16.7 days)

Set limit on spin-dependent WIMP-proton $\sigma$
  (surface run: not competitive)

Since then, moved detector to Kamioka
Background studies underway:
  radon, alphas, gammas, neutrons

Future planned improvements:
  larger detector volume
  lower gas pressure (allows for lower energy threshold)
  reduce radon background by circulating gas
  upgrade readout (VME bus $\rightarrow$ KEK-designed ASIC)