1 Introduction

1.1 TEXONO collaboration

TEXONO was established in 1996. First big collaboration between China and Taiwan. Magnetic moment results published.

1.2 Period II — Ge detector data.

Period II → n scattering with ULE-HPGe detector.

1.3 Spectrum and Recoil Energy Spectrum

The spectrum of $\delta > 0$ at detector site:

with a total flux of $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

The recoil energy spectrum is given by the magnet moment

$\frac{dN}{dE} \propto \frac{1}{E^{2}}$.

The spectrum of $\delta > 0$ at detector site:

In the experiment, we focus at 10 - 100 keV range, in which magnetic moment related event rate is "decoupled" from standard model "background" at $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

The magnetic moment bound provides a limit on neutrino radiative decay constant in the process.

The neutrino radiative decay constant is related to magnetic moment in this equation:

$\frac{1}{\tau_{\nu}} = \frac{\delta}{m_{\nu}} \propto \frac{1}{E_{\nu}}$.

1.4 $\delta > 0$ coherent scattering

The differential cross-section for $\delta > 0$ coherent scattering could be described by $\delta > 0$.

The scattering cross-section is $\sigma_{\nu}(\delta > 0)$.

The magnetic moment bound obtained by $\delta > 0$. However, due to the nuclear mass and quenching factor, the recoil energy of nuclear has a very low energy at $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

2 The Experiment

2.1 Location

The Kuo-Sheng nuclear power plant is located at the southeast coast of Taiwan, with two 280 MW reactors. The distance from the reactor core and detector is shown in figure at right.

The experiment site is overlapped by 10 m of concrete(50 mixer), which effectively absorbed hadron component of cosmic ray.

2.2 Shielding

3 Data and Event Selections

3.1 Data

Period I data:

- 472 hours of reactor-on, 1250 hours of reactor-off data
- Detector mass 138 kg
- Energy resolution of 6 keV(HPGe) at 10 keV.

An effective measured was achieved thanks to 1/4 of the background (see above). Table at right shows the background and signal for different periods.

The effective recoil energy cut-off is shown in the following figure.

3.2 Event Selections

The time cut-off at the detector is $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

The $\nu = 0$ scattering experiment is limited by $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

The neutrino radiative decay constant is related to magnetic moment in this equation:

$\frac{1}{\tau_{\nu}} = \frac{\delta}{m_{\nu}} \propto \frac{1}{E_{\nu}}$.

4 Results

4.1 Neutrino Magnetic Moment

The following image shows the reactor-on/off spectrum. The spectrum is calibrated by peaks from $^{137}$Ba, $^{208}$Tl and $^{153}$Sm.

4.2 Limits from Other Experiments

The limits quoted by EPC [4] are $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

The limit from other reactor ($\nu = 0$) scattering experiment is $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

The neutrino radiative decay constant is related to magnetic moment in this equation:

$\frac{1}{\tau_{\nu}} = \frac{\delta}{m_{\nu}} \propto \frac{1}{E_{\nu}}$.

4.3 Sensitivity

The limits slightly better than previous $\nu = 0$ scattering experiment. The most important thing is that our experiment is able to see at relatively high threshold, at which magnetic moment contributions are separated from standard model "background" and false rates.

The detector location was also important in this respect.

The effective recoil energy cut-off is $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

5 $\delta > 0$ coherent scattering and ULE-HPGe detector

5.1 ULE-HPGe Calibration Data: Threshold

With ULE-HPGe, measurement of $\nu = 0$ coherent scattering is possible. Figure at right shows the spectrum with $\nu = 0$ background scattering on a 5 kg ULE-HPGe detector with threshold $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

Figure at right shows that noise and signal have different PSD for noise edge at $\delta > 10^{23}$ m$^{-2}$ s$^{-1}$.

However, with such a small detector, integral count rate of $\nu = 0$ scattering is $\sim 10$ counts per day. A larger detector is needed.

6 CsI: Period II

6.1 Background spectrum of Period II CsI

The period II CsI array detector consists of 2 kg CsI crystal with PMT matched at both ends, as shown in figure at right.

The energy resolution is $\sim 10$ keV at 662 keV.

Position resolution is $\sim 2$ cm at 662 keV.

Calibration by $^{137}$Ba, $^{208}$Tl and $^{153}$Sm.

7 Summary

Period I HPGe:

- $\delta > 0$ analysis: results published
- Period II HPGe:
  - additional 400/750 hours reactor-on/off data
  - background and analysis improvement
- Period II CaT:
  - Measure electron-weak parameter at MeV range with $\delta > 0$.
  - Data analysis
- Period II and III HPGe:
  - continue with HPGe and CaT configuration at period II.
  - new potentials on $\nu = 0$ coherent scattering with ULE-HPGe
  - study quasi-free and pulse shape with neutron beam experiment
  - study on-site ULE-HPGe background

References