Study of Silicon drift sensor for Gamma-ray Compton Camera
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Introduction
Sub-MeV (100keV-MeV) is undeveloped area!
If we can get information about this energy range, we may understand astrophysics more, e.g. (1) Supernova nucleosynthesis: $^{56}$Ni: 847, 1238keV, $^{58}$Ni: 1157keV, $^{20}$Mg: 1809keV, (2) Gamma-ray radiation from accretion disk and jet around black holes. But a lot of background and Compton scattering prevent us from observing well, so detection sensitivity of Sub-MeV range is worse than the other energy ranges.

Compton camera
Compton camera uses Compton scattering. This detector can constrain the direction of photon as annulus. Forthmore if we can observe recoil electrons, background rejection can be higher, and sensitivity will improve.

Silicon Drift detector (SDD)

Silicon Drift detector (SDD) has 64 readout channels. We made the test SDD. which charges drift to anode between 0 and 500V. SDD doesn't show breakdown at voltage < 500V.

Purpose
To study basic properties of test SDD especially about the depletion layer and the drift field with checking performance.

Result

1. current measurement

We measured photoelectric absorption counts with $^{241}$Am 59.5keV. If SDD is completely depleted, detected counts for 1 hour is expected to be 7.2 x 10^5.

2. reverse bias voltage dependency of gamma-ray count

We checked the spectrum and detection counts of $^{241}$Am 59.5keV at reverse bias voltages. Results shows that SDD's spectrum shows a something like a noise, but SDD's advantage is high energy resolution and low power consumption.

3. position dependency of detected count

We checked the spectrum and detection counts of $^{241}$Am 59.5keV at three irradiation positions. Irradiation time is 6 hours.

4. 780nm LED irradiation

The experiment in section 2 shows that gamma-ray count is extremely low than expected. Then instead we irradiate LED. We set intensity of LED as SDD has enough count.

Future work
- Scan with LED
- Use longer LED's wavelength
- Find cause of something like a noise

Summary
- SDD doesn't show breakdown at voltage < 500V.
- SDD is sensitive at only near anodes.
- Drift field probably exists, but only surface.