I. Abstract

$^6\text{Li}$ glass scintillator detectors are being tested and integrated into the Chi-Nu apparatus at LANSE/WNR. Chi-Nu is an array of neutron detectors used for detecting neutrons in neutron-induced fission experiments. $^6\text{Li}$ glass scintillators have better detection efficiency in the neutron-energy range below 1 MeV than currently used EJ301 liquid scintillators. Various reflectors are being tested to determine which optimizes the performance by increasing detected scintillation light. Increasing the thickness of the scintillator is also being studied to optimize detection efficiency at 1 MeV. Calibrations using several sources verify the expected detection peak at 4.8 MeV.

II. Chi-Nu / FIGARO Apparatus

- Fast-neutron Induced GAmmma Ray Observer.
- An array of 20 scintillator neutron detectors.
- Uses coincidence of fission and detected neutron.

III. $^6\text{Li}$ Detector

- Detects neutron from exothermal reaction:
  $$^6\text{Li} + n \rightarrow ^4\text{He} + ^3\text{H} + 4.8\text{MeV}$$
- Kinetic energy of the charged particles, $^4\text{He} + ^3\text{H}$, is converted into scintillation light.
- Light is converted into an electronic signal by a photo-multiplier tube.

V. Reflectors

- Goal is to increase detected scintillation light.
- Reflectors cover scintillator to reflect scintillation light into photo-multiplier tube.

Currently testing:
- Aluminum Foil
- PTFE (Teflon™) Tape
- PTFE (Teflon™) Sheet
- 3MVM2000 Polymeric Film: 99+% reflective

Results:
- Best reflector is PTFE (Teflon™) Tape by ~10%
- 4.8 MeV peak is on higher channel, meaning better energy resolution.

VI. Calibrations

- Gate Pulse Height vs. $E_n$ to identify neutrons.
- Use $^{137}\text{Cs}$ and $^{60}\text{Co}$ $\gamma$-sources to calibrate Energy Spectrum using Compton Edge.
- For $\gamma$-rays where $h\nu >> mc^2/2$: Energy difference between edge and actual $\gamma$-ray energy = ~0.256 MeV.
- Channels are linearly proportional to Energy.

VII. Conclusions

- Data from $^6\text{Li}$ scintillator are meeting expectations.
- PTFE tape is best reflector due to its diffuse reflective properties and ability to tightly wrap around the scintillator.
- Increasing thickness of scintillator increases efficiency near 1 MeV, but also increases background.