THE STEREO PROJECT

Search for Sterile Neutrino at ILL reactor:

On behalf of STEREO collaboration:

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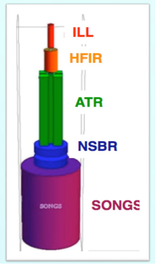
Introduction

The motivation of the STEREO experience is looking for the sterile neutrino by observation of this oscillation with the ILL reactor, the principle of detection of the antineutrinos is the inverse beta decay. The target of the detector is a scintillator doped with Gd in order to sign the capture of the neutron by the cascade of associated gamma (8 MeV).
for a 2 MeV energy, we have obtained a resolution of the order of 12% energy.
the second part of the work concerns the signal delayed by using neutrons as the incident particle,
To study the efficiency of detection, 25 keV uniformely distributed neutrons were simulated in the center target. 25 keV constitutes the typical energy of neutrons induced by inverse beta decay. The resulting detected energy spectrum is represented on the right figure.

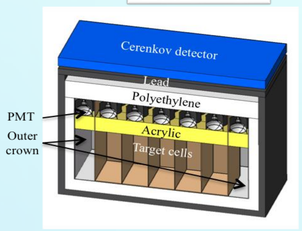
Methods

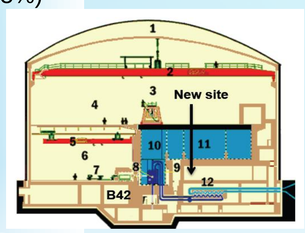
ILL:

- 50 MW
- Pure 235U fuel
- Compact core (φ=40cm, H=80cm)



- **1x1x2 m** target vessel filled with **Gd** doped Liquid scintillator
- **5** baseline bins materialized by diffusive foils
- Simple and safe readout from top
- Acrylic buffer between PMTs and target
- Side **γ** catcher for better resolution and neutron efficiency (55%)



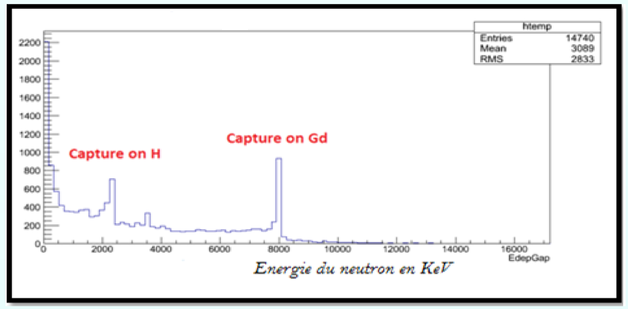


Investigating possible site at **ILL**, Grenoble

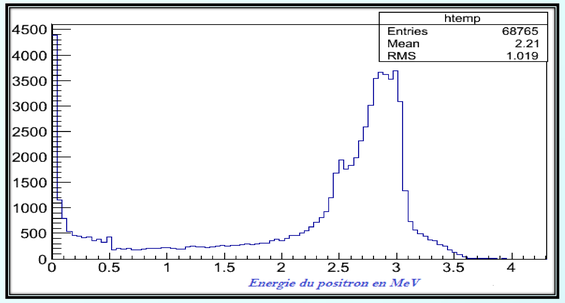
- Protected by a thick water channel
- Target in **[6.5-8.5]** m range from core
- Upcoming **γ** and **n** background measurements

Results

- These two simulations allow to estimate the efficiency of detection in the whole target.



- Simulated response to neutron capture (0.2% Gd-doped liquid).
- The signal of the neutron capture is the emission of rays. About 3 γ s and a total energy of 8 MeV for the capture on Gadolinium, a single 2.2 MeV for the capture on hydrogen. Figure. Shows the simulated response to neutron capture. Assuming a cut of 6 MeV for neutron capture candidates, the predicted detection efficiency is 56%.



- Good energy resolution . δE/E = 12% @ 2 MeV.
- This result shows that the energy leaks of the detector are very low thanks to its geometry but at the same time highlights the importance of calibration.
- Threshold on visible E_{prompt} ~ 3 MeV.

Conclusion

The study presented here shows efficiency of detection estimated on the response of the target. We found a good resolution of the energy of the order of 12% for a 3 MeV energy,
Analysis of data from beam shows testing efficiency expected detection in the whole target is 66% with a threshold of 5 MeV on neutron capture and approximately 52% to a threshold of 6 MeV.
The STEREO experiment is expected to be sensitive to the parameter space corresponding to the RAA, by looking at distortions of the energy spectrum.

References

1.CEA/Irfu - Service de Physique Nucléaire.
2.Long-Term Proposal of a search for sterile neutrinos at ILL: the STEREO experiment.

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