Neutron beam test with a scintillator tracker for long-baseline neutrino experiments

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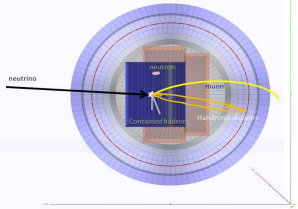
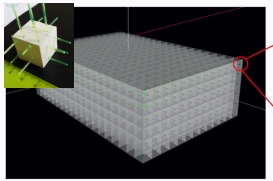
Motivation

- Current long-baseline neutrino oscillation experiments are largely blind to neutrons.

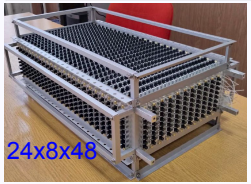
- Neutron kinetic energy measurement enabled by the ToF technique with a low-threshold, fast-timing and fine -granularity 3D projection tracker



Detectors



Each cube read out by 3 orthogonal fibers

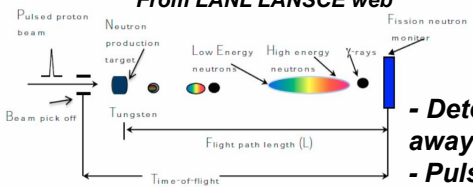


superFGD prototype

US-Japan prototype

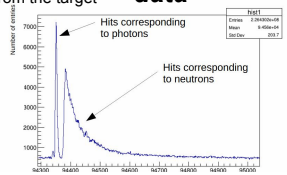
Experimental setup

From LANL LANSCE web

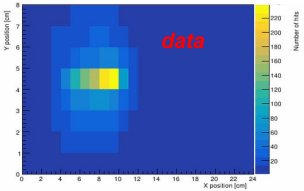


- Detectors 90 m away from target
- Pulse narrow enough to allow individual neutron kinetic energy measurement with time-of-flight

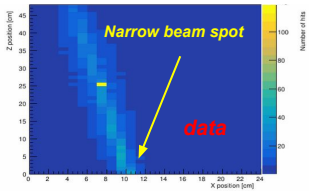
90 m from the target ***data***

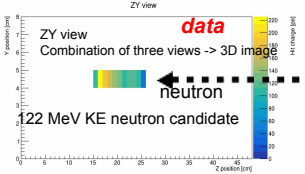


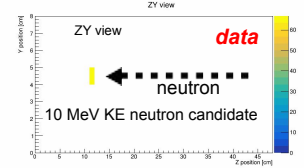
Beam spot XY



XZ







Physics goals

- measuring the response of the detector to n-p scattering and pion/gamma production as a function of primary neutron kinetic.
- A first result will be the measurement of the total neutron cross section as a function of neutron kinetic energy.

Number of event in the first layer (l=0)

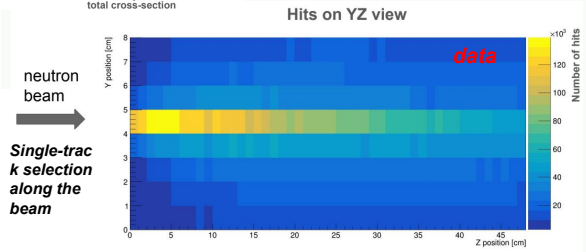
$$N(l) = N_0 \cdot \exp(-T \cdot \sigma_{total} \cdot l)$$

Nuclear density · total cross-section · the depth along the beam (z layer)

$$N_{e,l} = \sum_{\text{Energy}} \sum_{\text{Layer}} \begin{pmatrix} N_{\text{single-track,e,l}} \\ N_{\text{invisible,e,l}} \\ N_{\text{two-track,e,l}} \\ N_{\text{100-track,e,l}} \end{pmatrix} = \sum \begin{pmatrix} N_{\text{single-track, e,l}} \\ N_{\text{single-track, e,l}} \times \varepsilon \end{pmatrix}$$

ε is the cross section Ratio between "other-than single track" and single-track, it only depends on energy, regardless of layer

Hits on YZ view



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