



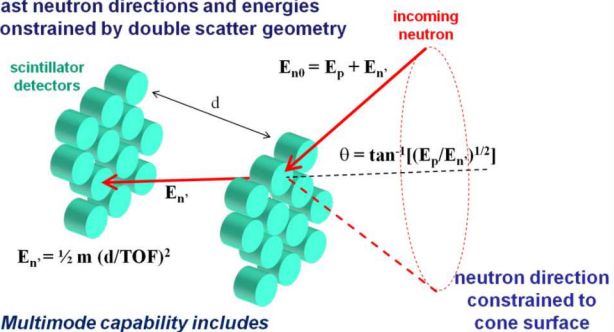
Development of a Compact Single Volume Neutron Scatter Camera

Josh Brown on Behalf of the SVSC Collaboration

Kinematic Neutron Imaging

- Established technique using discrete volumes for position localization

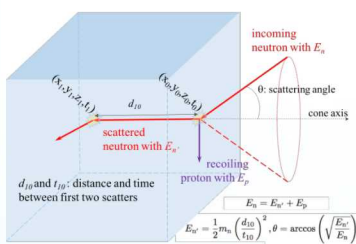
Fast neutron directions and energies constrained by double scatter geometry



Multimode capability includes

- Neutron energy spectrum.
- Compton imaging.

- Implementations with discrete volumes and photo-multiplier tubes lead to meter cubed sized detectors



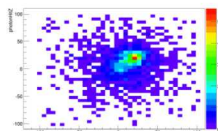
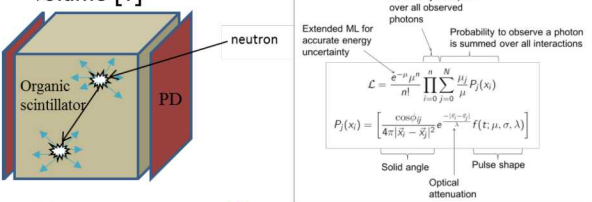
- Localizing multiple neutron interactions in a single volume can lead to both smaller prospective devices and improved efficiency for useful energies

Localizing multiple neutron interactions with an average interscatter time and distance of a few ns and cm provides a great technical challenge!

Interaction Localization

Collaboration is exploring multiple paths

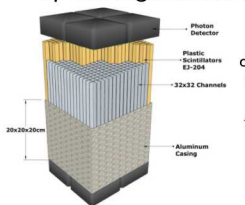
- Direct likelihood reconstruction in a single continuous volume [1]



list of photon arrival positions and times

Position (x,y,z)
Time
Energy deposition
For each interaction

- Optical segmentation in two dimensions [2]



Photon transport constrained in two dimensions. Localization in the third dimension possible through temporal or amplitude differences between readout on opposite faces.

Position (x,y,z)
Time
Energy deposition
For each interaction

- Both approaches have been validated through simulations
- Strong overlap in technical requirements
- Pixelated photodetectors with good temporal and spatial resolution
- High temporal resolution readout
- Fast scintillators
- Strong quantitative understanding of the behavior of these components

Component Characterization And Development

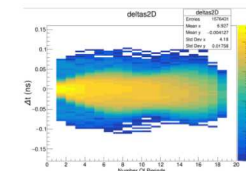
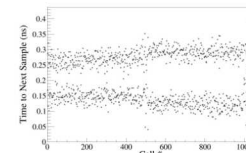
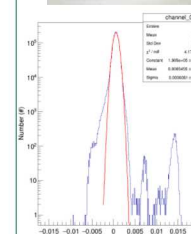
(personally focused)

Development of Scalable Compact Waveform Capture

- In house development of compact modular 16 channel 5Gs/s waveform digitizers based on the DRS4 SCA [3]

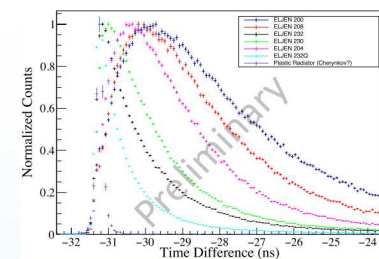
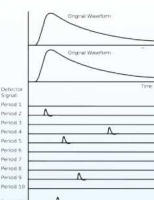
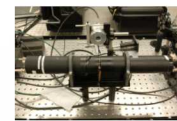


After temporal and voltage calibrations, boards show noise of < 0.5mV and temporal resolution of < 12ps using sub sample interpolation



Characterization of Fast Scintillators

- High resolution pulse shape measurements of a suite of prospective fast plastic scintillators



A time correlated single photon counting setup was constructed and characterized to have a temporal resolution of < 100ps.