Measurement of the Light and Charge Yield of Low Energy Electronic and Nuclear Recoils in Liquid Xenon for Different Electric Fields

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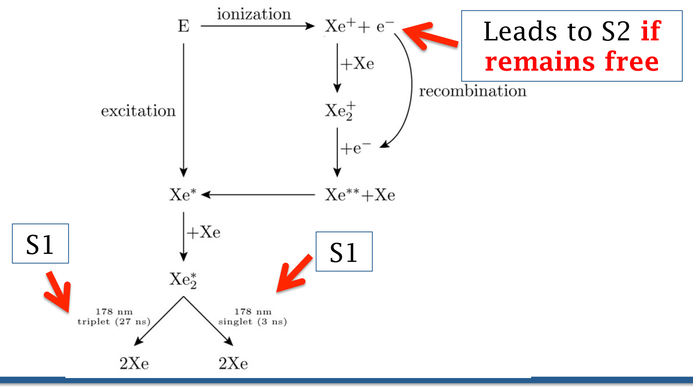
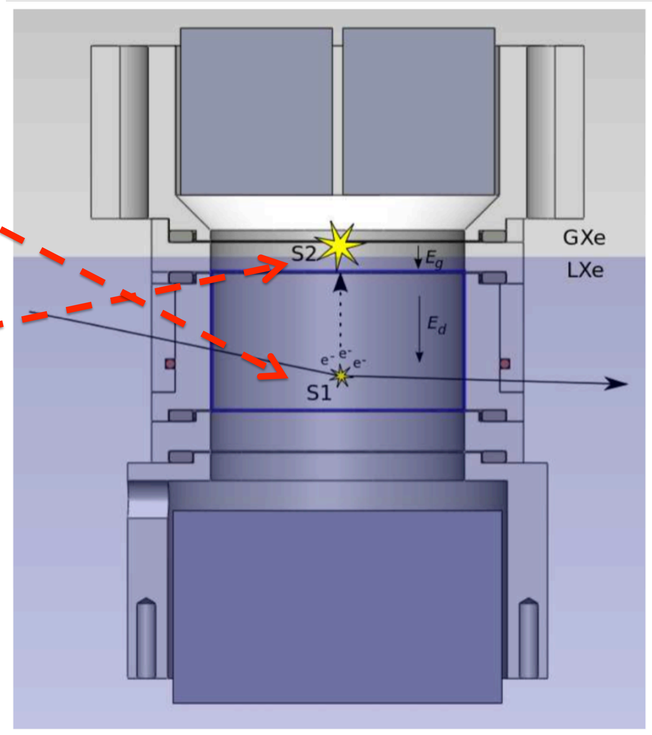
Dual-Phase LXe Detectors

- Simultaneous detection of light and charge
  - **S1**: Prompt light emission from interaction in LXe
  - **S2**: Complementary signal from acceleration of electrons through GXe after electrons drift through LXe

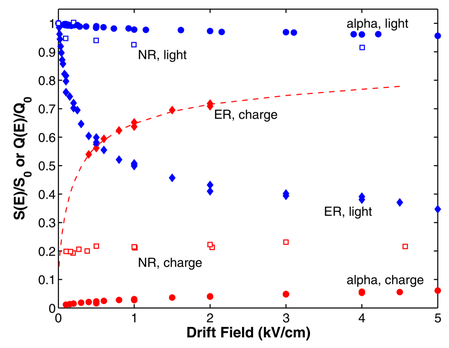




Light and Charge Yield

- Light and charge yield **non-linear** in energy and drift field
  - Light Yield = Photoelectrons / Energy
  - Charge Yield = Free Electrons / Energy

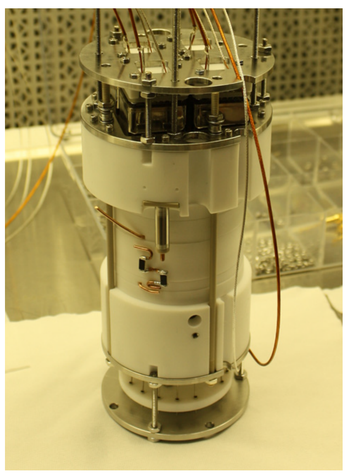
Light and Charge Yield vs. Drift Field, Aprile *et al.*, 2007

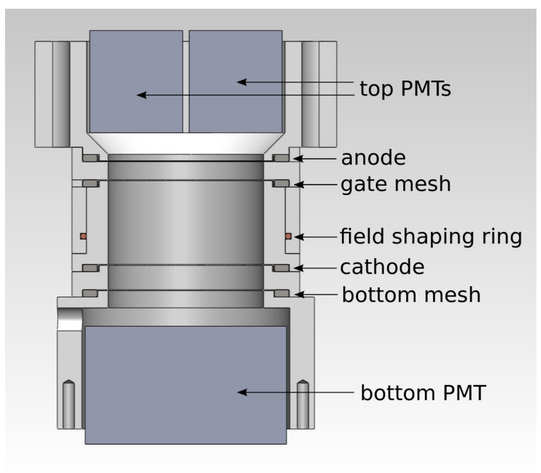


Given an electronic or nuclear recoil at a certain energy in an electric field, how much light and charge do you expect to be produced?

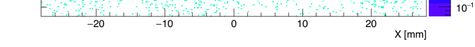
neriX Detector

- Dual-phase LXe Time Projection Chamber for measuring **n**uclear and **e**lectronic **r**ecoils **i**n **X**enon
  - Small size and minimal materials surrounding fiducial volume make this detector well suited for measurements of light and charge yield
  - Can measure light and charge yield as a function of energy and drift field
- Goal of neriX is to improve our understanding of low energy interactions in LXe

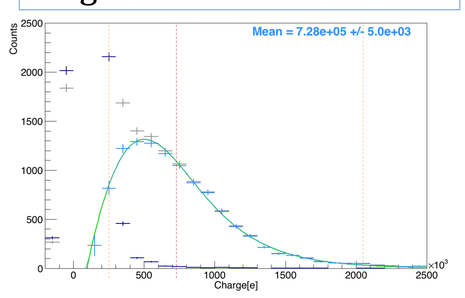




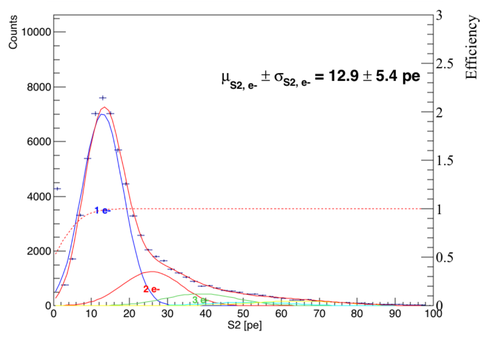
Position Reconstruction



Single Photoelectron Gain



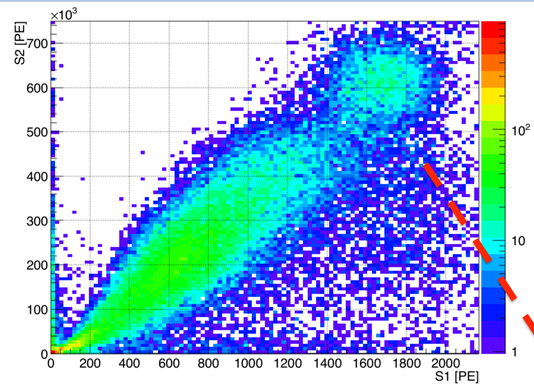
Single Electron Gain

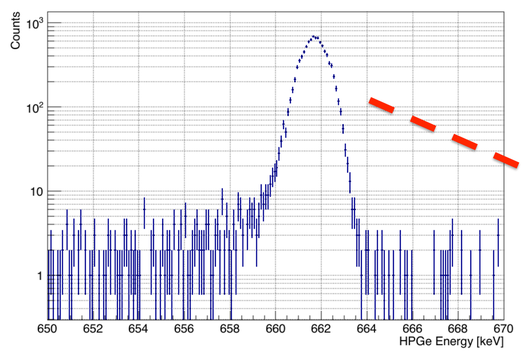


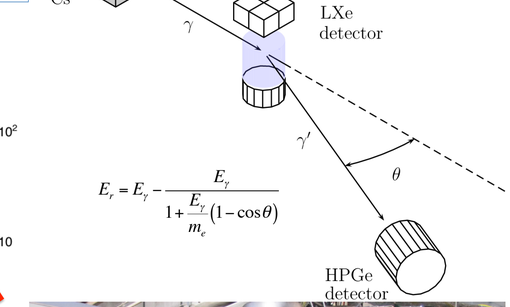
Compton Coincidence Technique

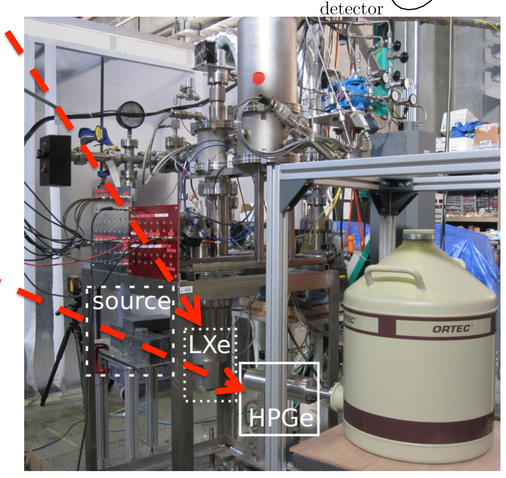
- Photons Compton scatter in LXe then deposit remaining energy in HPGe detector

Cs-137 Spectra in LXe and HPGe



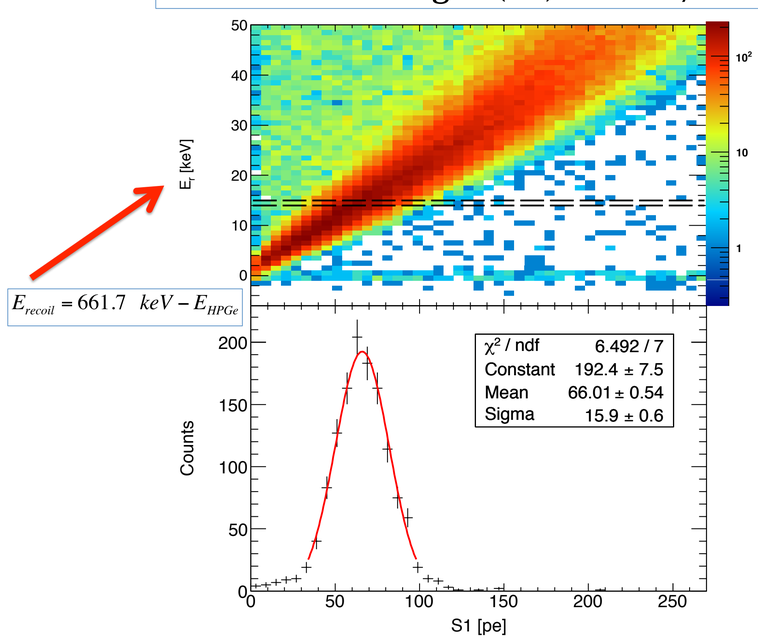






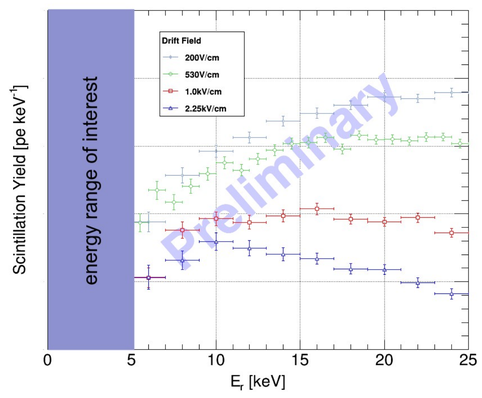
Preliminary Electronic Recoil Results

Energy Deposited in LXe vs. Prompt Scintillation Light (S1) - 490 V/cm



- By taking slices of 1-2 keV in the recoil energy vs. S1 and S2 spectra we can determine the light and the charge yield respectively
- Expected anti-correlation present
- Results shown are preliminary – light and charge yields were both measured down to 1 keV

Light Yield vs. Recoil Energy



Charge Yield vs. Recoil Energy