

Radioxenon Detector System

PHOSWATCH DETECTOR



The PhosWatch detector is a plastic scintillator cell surrounded by a CsI(Tl) crystal. Beta/gamma coincidences are detected by pulse shape analysis.

Features and Specifications:

- Simple setup and calibration with only a single readout channel.
- Energy resolution:
 - 7-8% at 662 keV (external ^{137}Cs source)
 - 30-35% at 30 keV ($^{131\text{m}}/^{133}\text{Xe}$ X-rays)
 - 26-33% at 129 keV ($^{131\text{m}}\text{Xe}$ conversion electrons)
- Background (in lead enclosure):
 - 3-8 counts/s total,
 - 0.05-0.08 counts/s coincidence
 - ~0.0033 counts/s in Xe region of interest
 - > 99% rejection of external gamma radiation
- Coincidence detection efficiency ~83% at 30 keV
- Excellent linearity in 2D energy spectrum

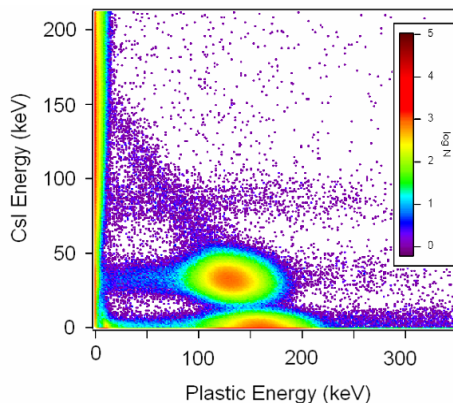


Figure 1: $^{131\text{m}}\text{Xe}$ 2D histogram from PhosWatch

PHOSWATCH ELECTRONICS



The PhosWatch electronics is a COTS all digital spectrometer on a single 3U CompactPCI/PXI card, the DGF Pixie-4.

Features and Specifications:

- Digitizes 4 channels at 75 MHz, 14 bit
- Real time pulse shape analysis, coincidence detection and energy computation
- Accumulates 2D energy histograms and 1D spectra in on-board memory
- Compatible with ARSA, SAUNA, Phoswatch
- High speed PCI interface, over 80MByte/s data readout from on-board memory
- Compact system using commercially available embedded PC and cPCI HV modules
- Software library and support for system integration (Windows, Linux)
- CompactPCI/PXI programmable coincidence pulse generator available for in-system testing

AVAILABILITY

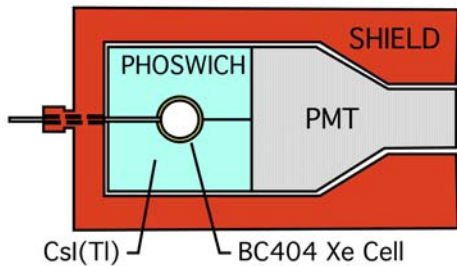
PhosWatch loaners are available now for interested beta testers. Please inquire.

Lead time for detectors 2-3 months, electronics generally in stock.

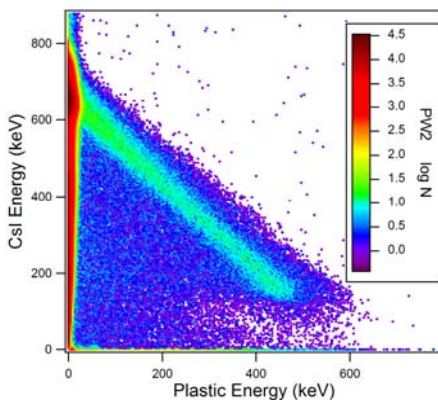
SYSTEM DESCRIPTION

Systems for detecting radioxenon can improve their sensitivity by looking for beta-gamma coincidences from Xe, in current systems (e.g. ARSA, SAUNA) using separate detectors. An alternative to separate detectors is the use of a single phoswich detector in which beta-gamma coincidences are detected by pulse shape analysis. The PhosWatch detector consists of a plastic scintillator (absorbing betas) optically coupled to a CsI(Tl) scintillator (absorbing gammas), as outlined below. It requires only a single photomultiplier tube and electronics readout channel, which greatly simplifies setup and calibration.

The PhosWatch detector generates fast pulses for betas, slow pulses for gammas, and mixed pulses for coincidence events. In XIA's COTS Pixie-4 readout electronics card, pulses from the detector are analyzed by summing over characteristic regions of the pulse, using an on-board digital signal processor. These sums are used online to categorize pulses as gamma only, beta only, or coincidence, and to compute beta and gamma energies separately. Computed energies are binned into a 2D spectrum for quantitative analysis. The host can simply read out spectra periodically, or it can read detailed event-by-event list mode data with PSA sums and energies to re-compute energies and/or re-bin spectra with custom binning parameters at a later time.



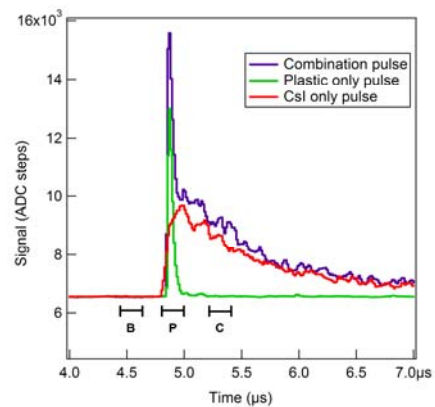
The PhosWatch detector is a cylindrical plastic cell (with a gas inlet) surrounded by CsI(Tl) crystal. It generates fast pulses for betas, slow pulses for gammas, and mixed pulses for coincidence events.



Gamma and beta event energies are computed separately and histogrammed into 1D and 2D spectra. (^{137}Cs shown above)



Scintillation light is amplified with a photomultiplier tube, and processed using digital electronics (DGF Pixie-4).



Coincidences are identified through pulse shape analysis performed in the Pixie-4's DSP.