

Energy Window Algorithms for Plastic Scintillator RPMs

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November 19, 2008

Motivation for Spectral Analysis in RPMs

- ▶ Sensitivity of radiation portal monitors (RPMs) operating in pure gross-count mode is challenged by naturally occurring radioactive material (NORM) and background suppression
- ▶ Spectral shape analysis can
 - Reduce nuisance alarms due to NORM
 - Improve sensitivity to threats obscured by varying backgrounds
- ▶ Energy window (EW) algorithms are a form of spectral analysis for polyvinyl toluene (PVT-based) RPMs

Origin of EWR for PVT RPMs: Thermo Fisher

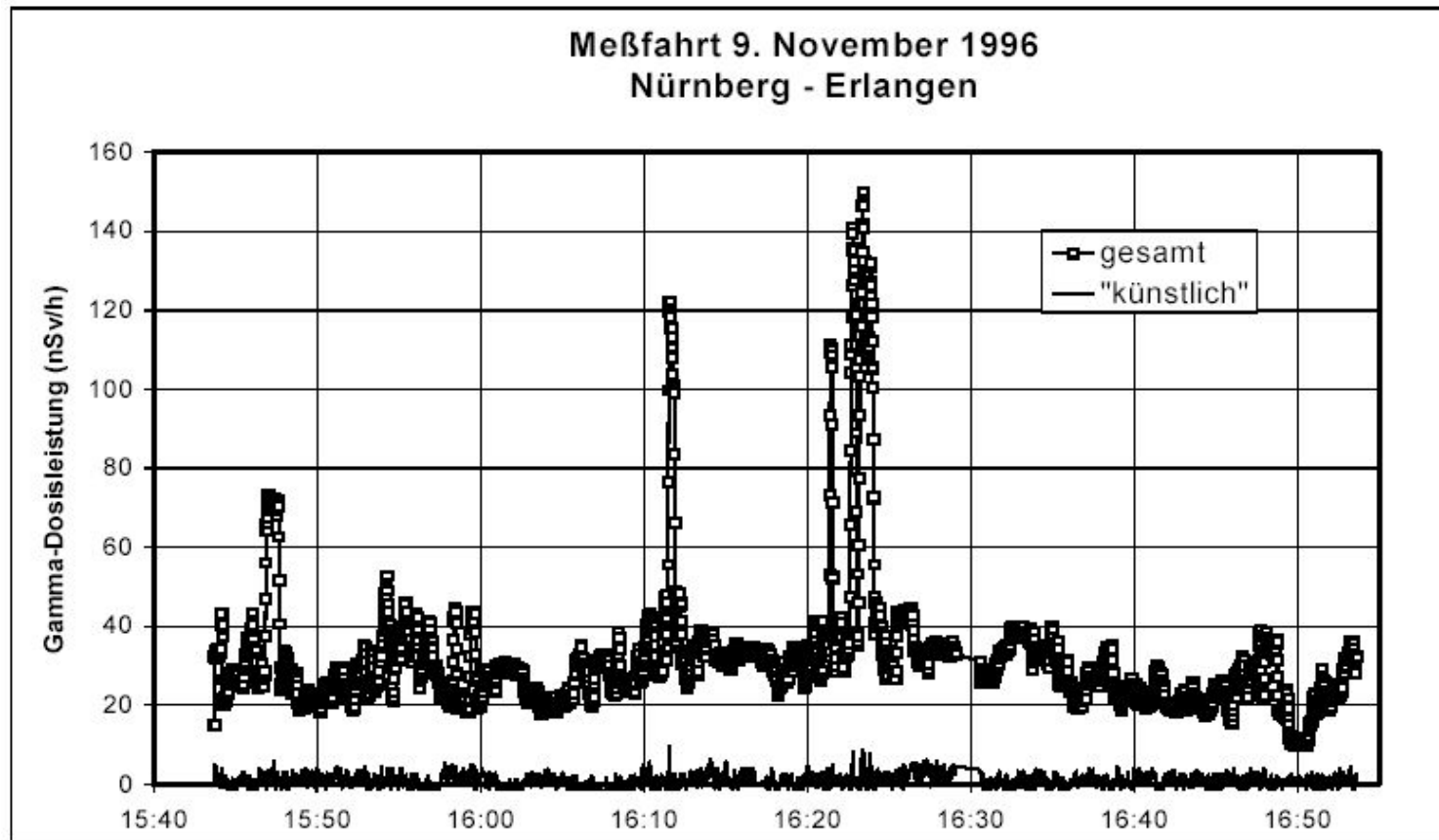
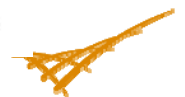


Abb. 2: Meßfahrt mit NBR-Detektionssystem in urbaner Umgebung

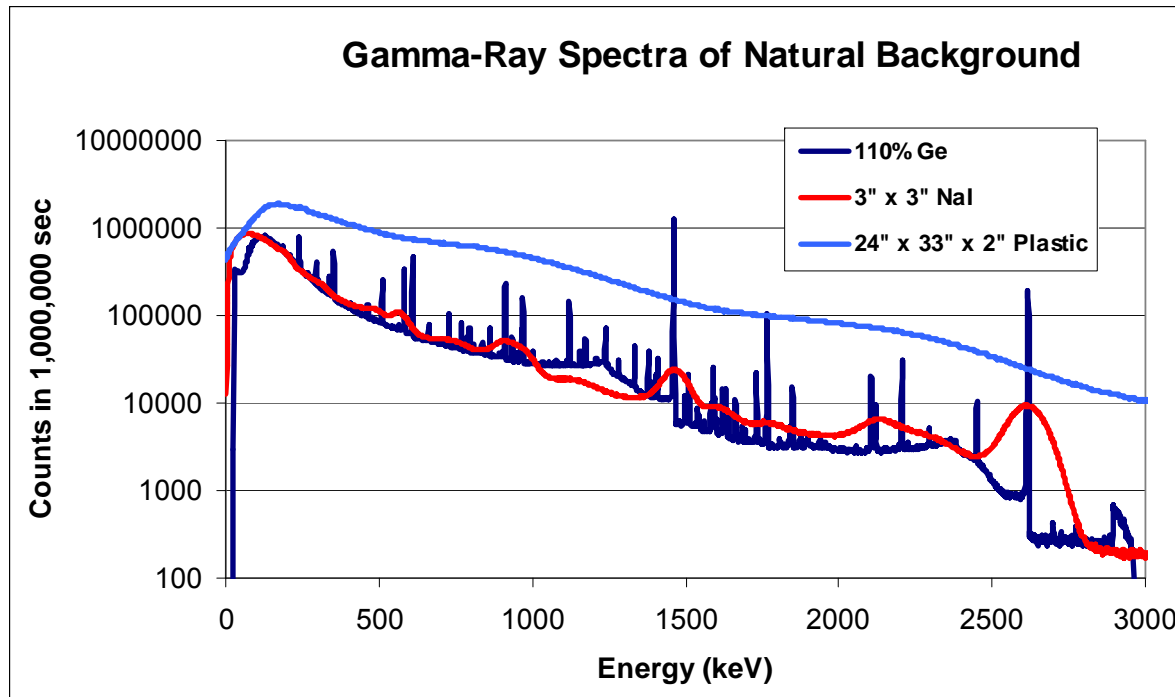


Implementations of EW for PVT

- ▶ Thermo Fisher (Natural Background Reduction)
- ▶ SAIC
- ▶ Ludlum
- ▶ NucSafe

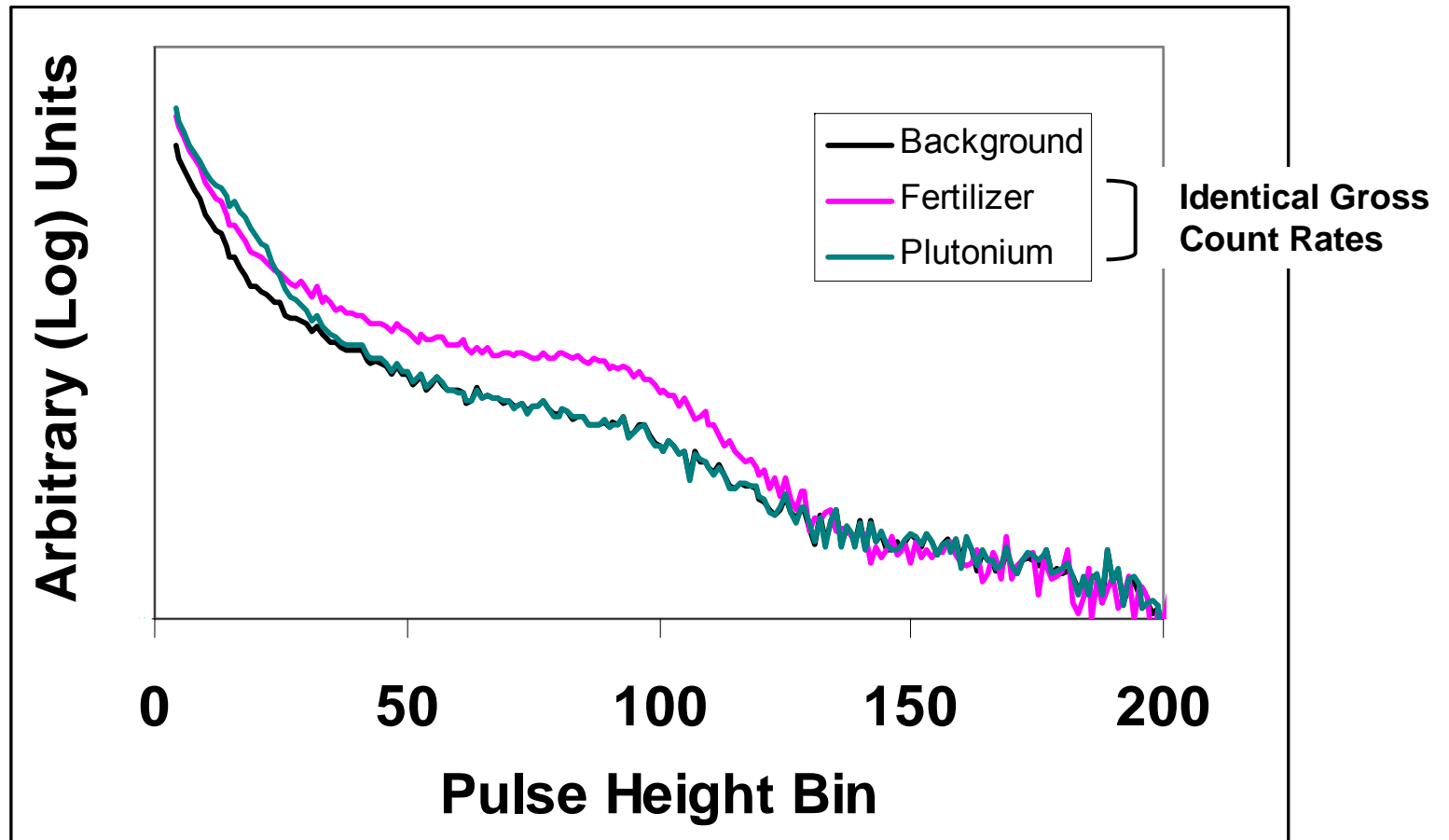


Spectral Analysis Using PVT...Possible?

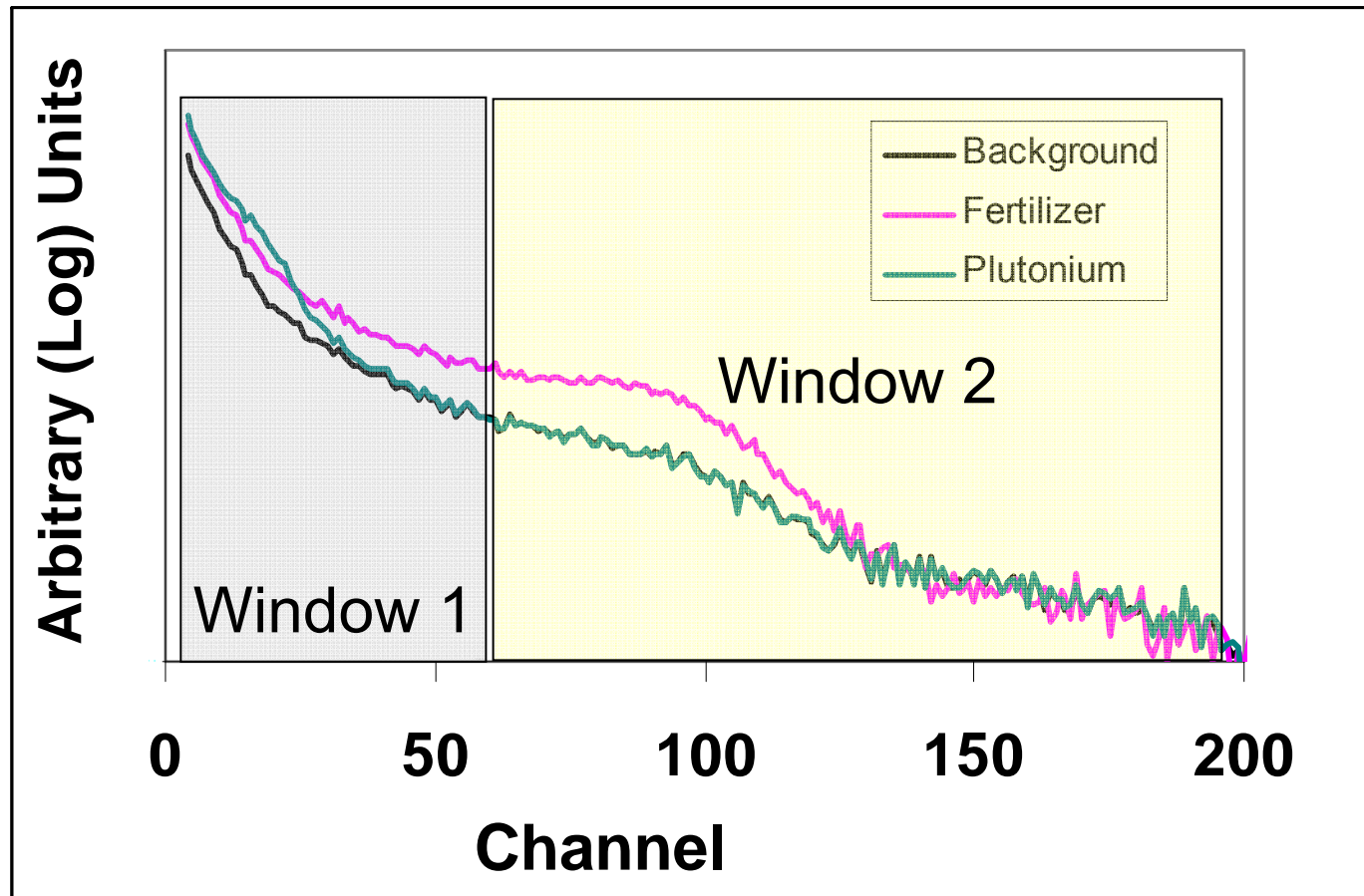


PVT can provide spectral information to improve discrimination

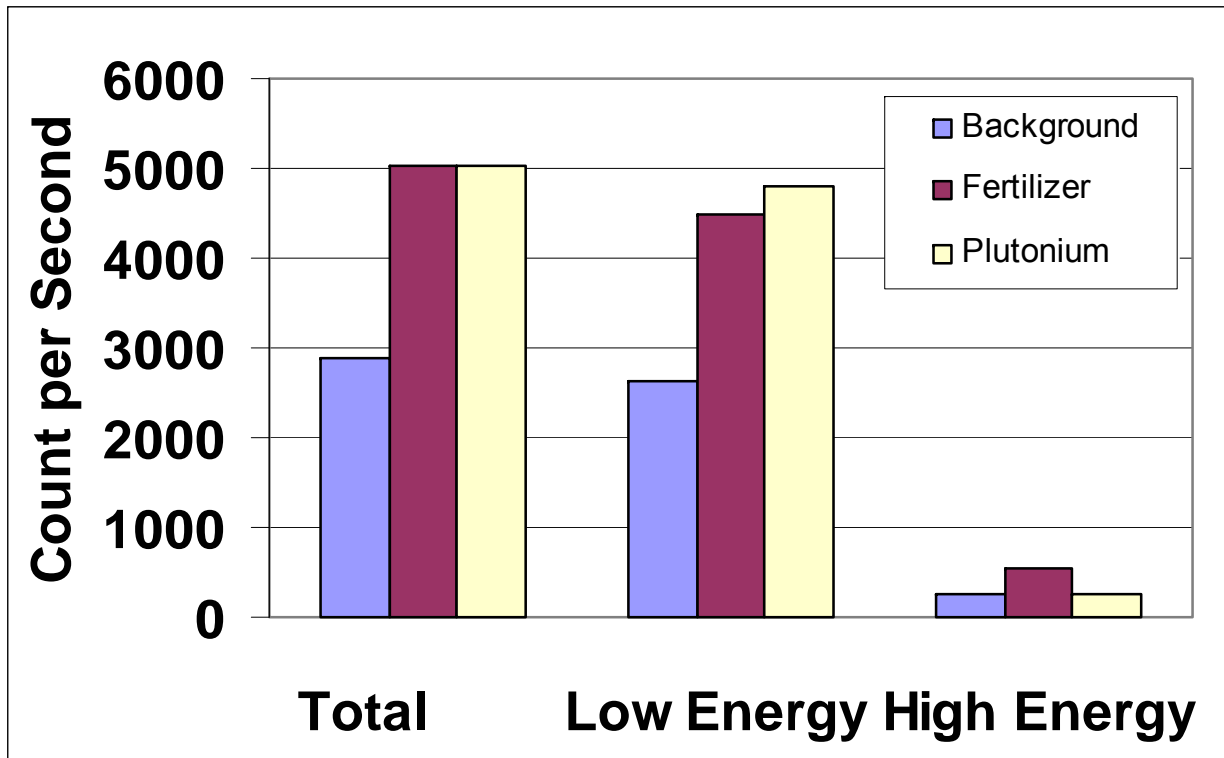
Utilizing PVT Spectral Shape for Discrimination



Utilizing PVT Spectral Shape for Discrimination



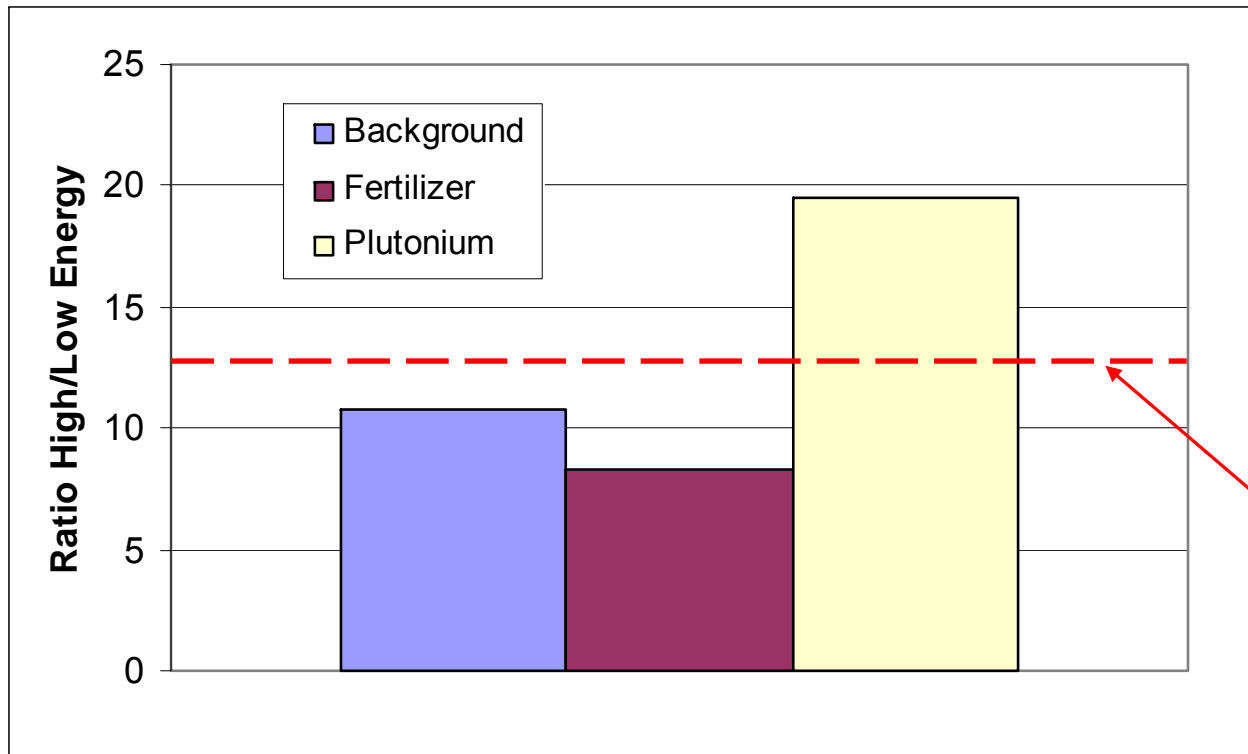
Energy Binning (no ratios yet)



Simple energy binning provides very limited discrimination between NORM and threats

EWRs to Extract Spectral Shape

$$EWR = \frac{N_{LOW}}{N_{HIGH}}$$

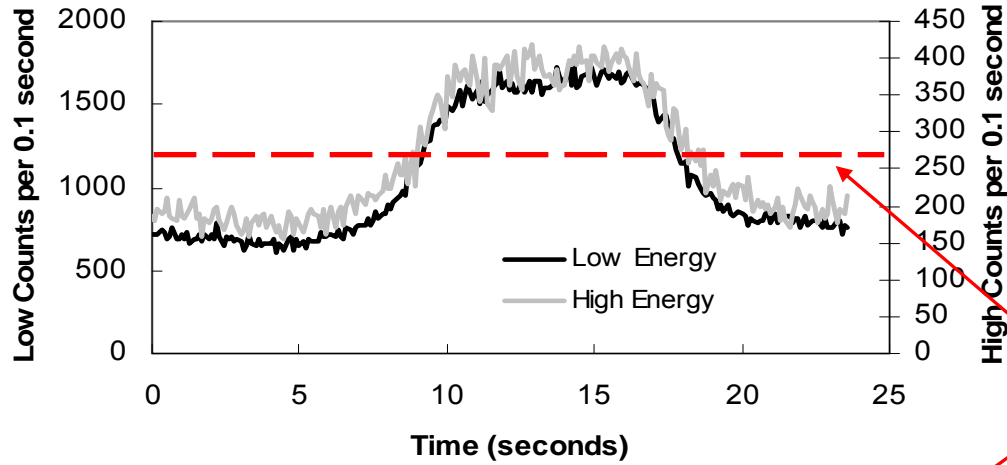


Creating ratios between energy regions enhances discrimination significantly and removes effect of intensity variations

Notional EWR Threshold

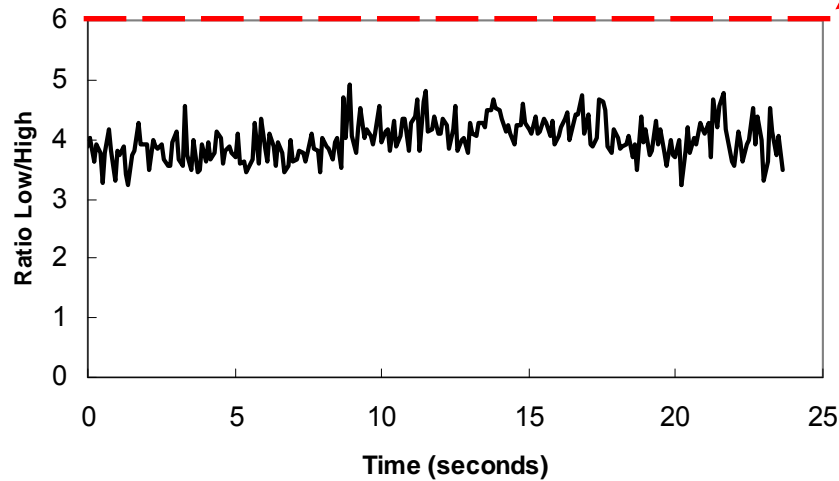
EWR: Reducing NORM Alarms

Gross Count



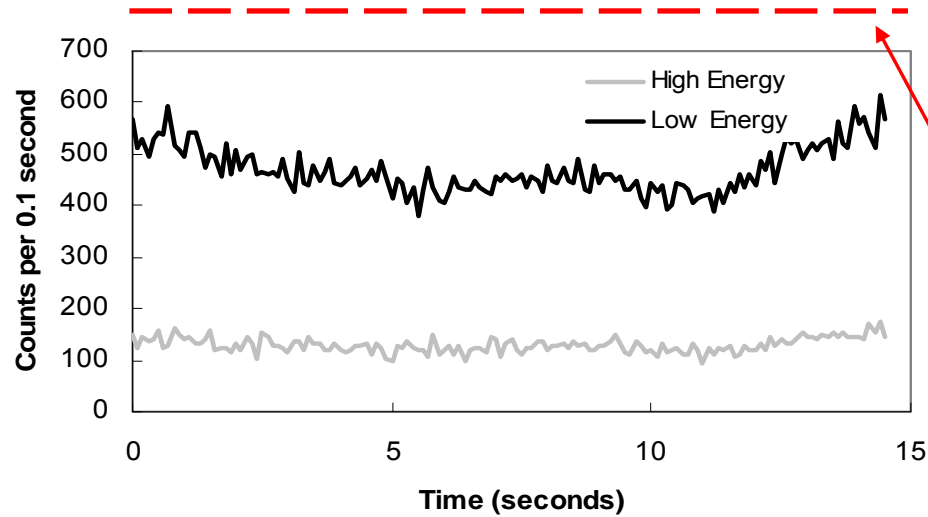
*Notional
Thresholds*

Simple EWR



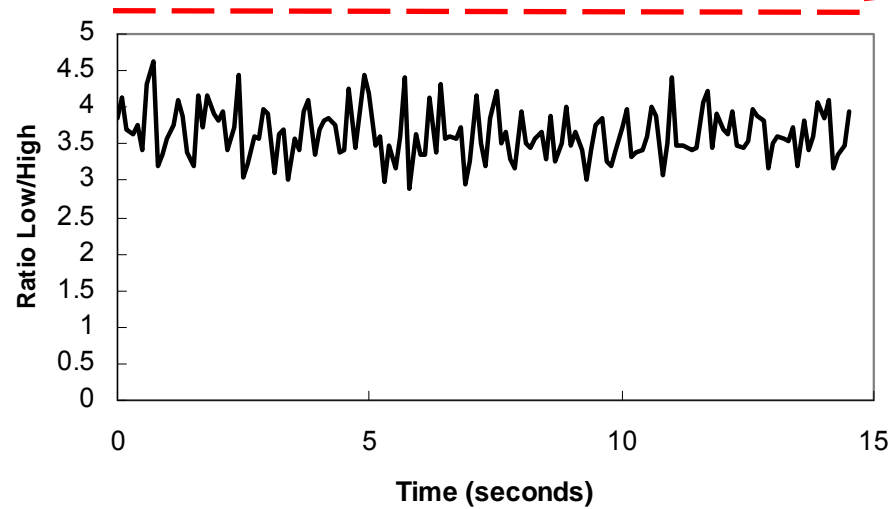
EWR: Reducing Effects of Background Suppression

Gross Count

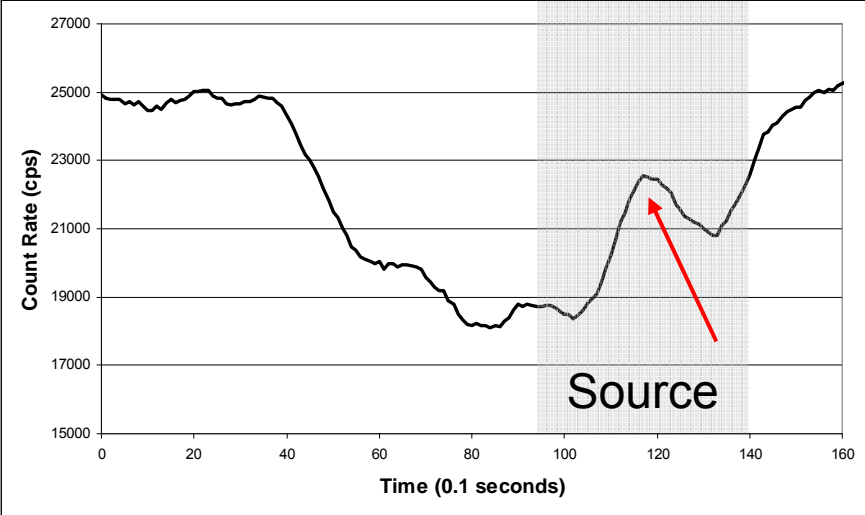


**Notional
Thresholds**

Simple EWR

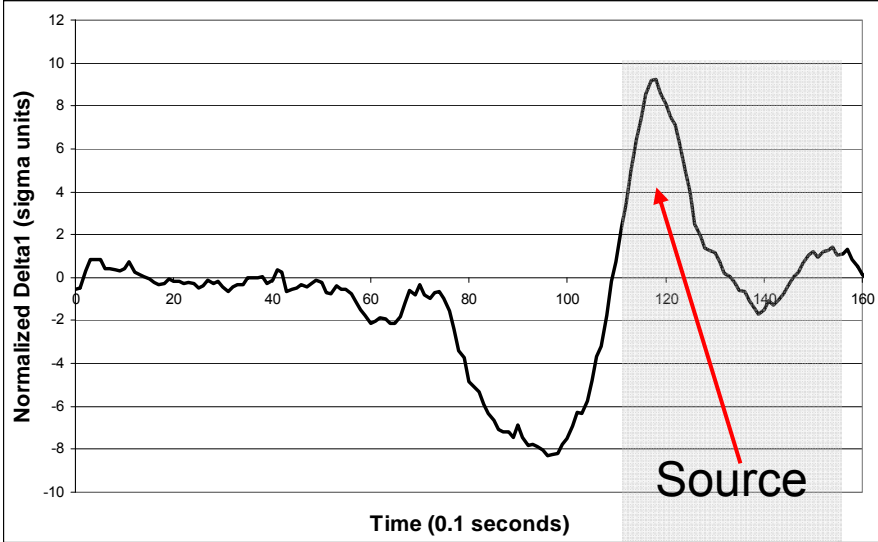


Background Suppression Example

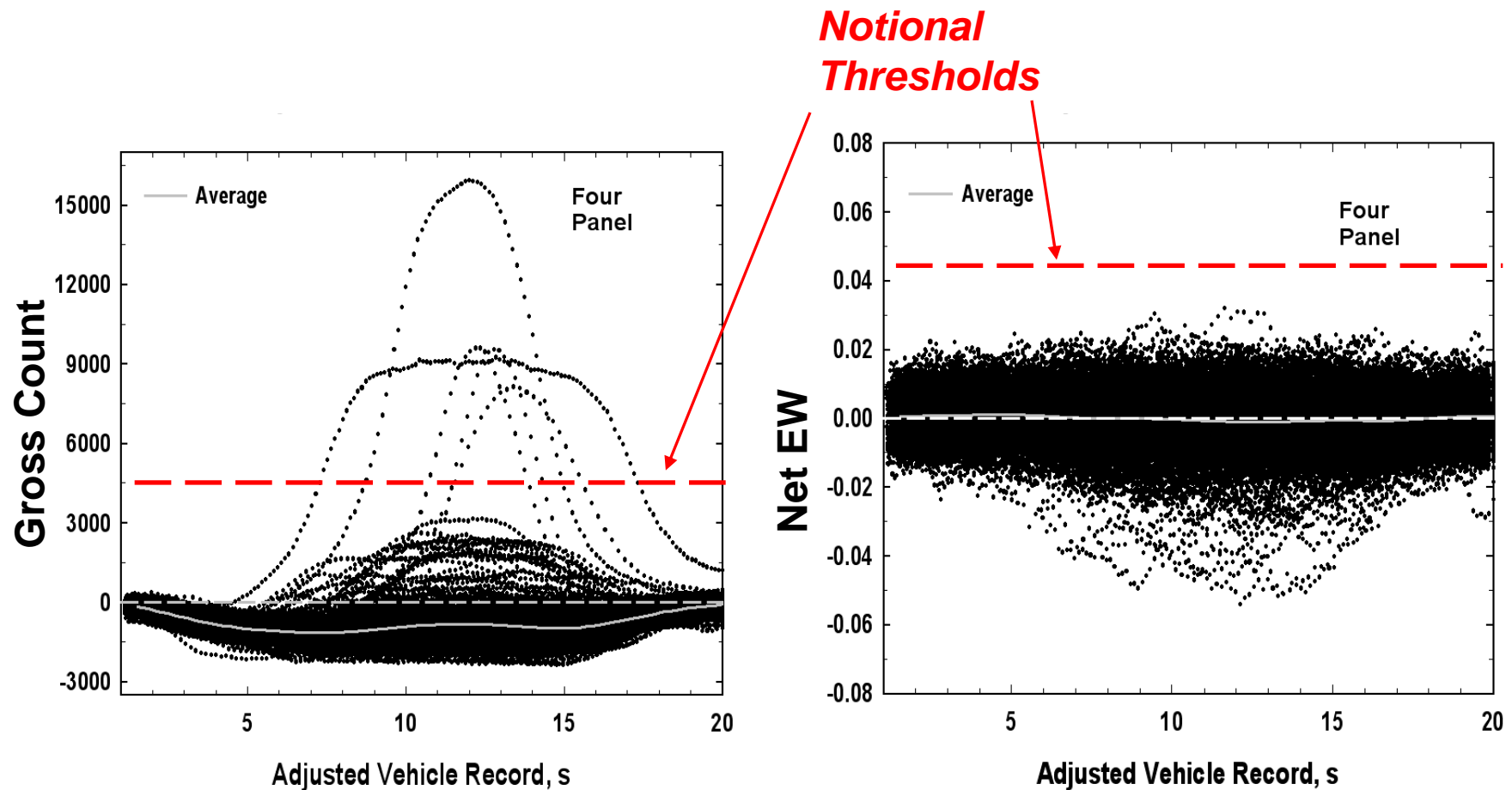


Gross counting cannot detect due to background suppression

EW can detect

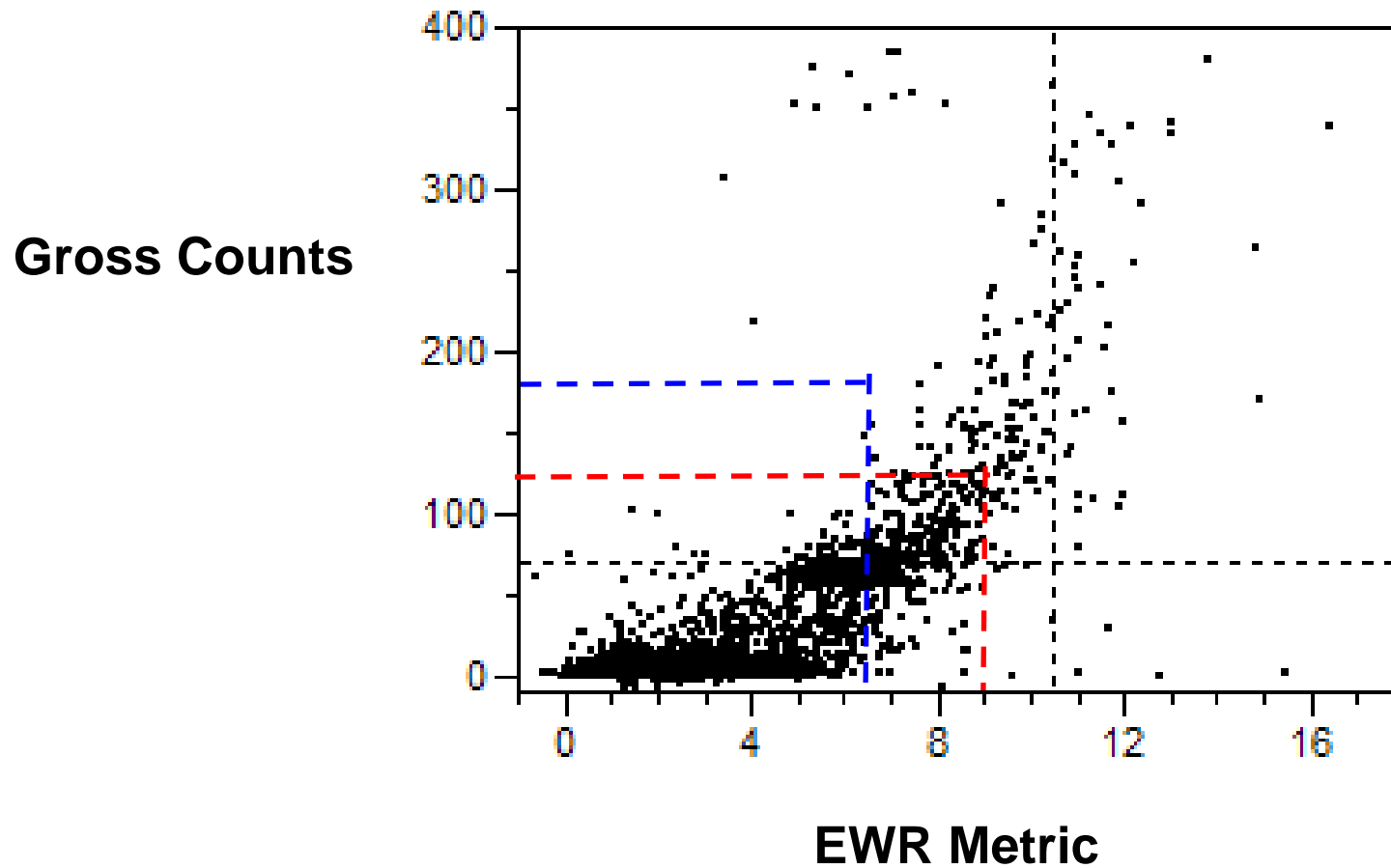


Gross Counting and EW for Port of Entry Population



PVT RPMs use Hybrid Algorithms

Balancing Gross Counts and EW Algorithms



Energy Windowing Issues

- ▶ Typically no gain stabilization in PVT detectors
 - Temperature may affect photomultiplier tubes and the precision of EW
 - ▶ For EW, like all spectral analysis methods:
 - Discrimination of threat-like sources is difficult (e.g., medical isotopes)
 - Detection of threat sources resembling NORM are difficult
 - Masking challenge remains
 - These effects are more significant in PVT than sodium iodide, high-purity germanium
- Need to use in conjunction with gross-counting thresholds

Summary

- ▶ EW methods are a simple form of gamma-ray spectroscopy—for discrimination NOT identification
- ▶ EW needs to be implemented with gross-counting as a hybrid metric
- ▶ EW analysis and implementation by the RPMP has shown steady progress toward improved sensitivity to threats of interest