

First Light for the GammaTracker Handheld Radioisotope Identifier

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on behalf of the GammaTracker collaboration

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GammaTracker basics

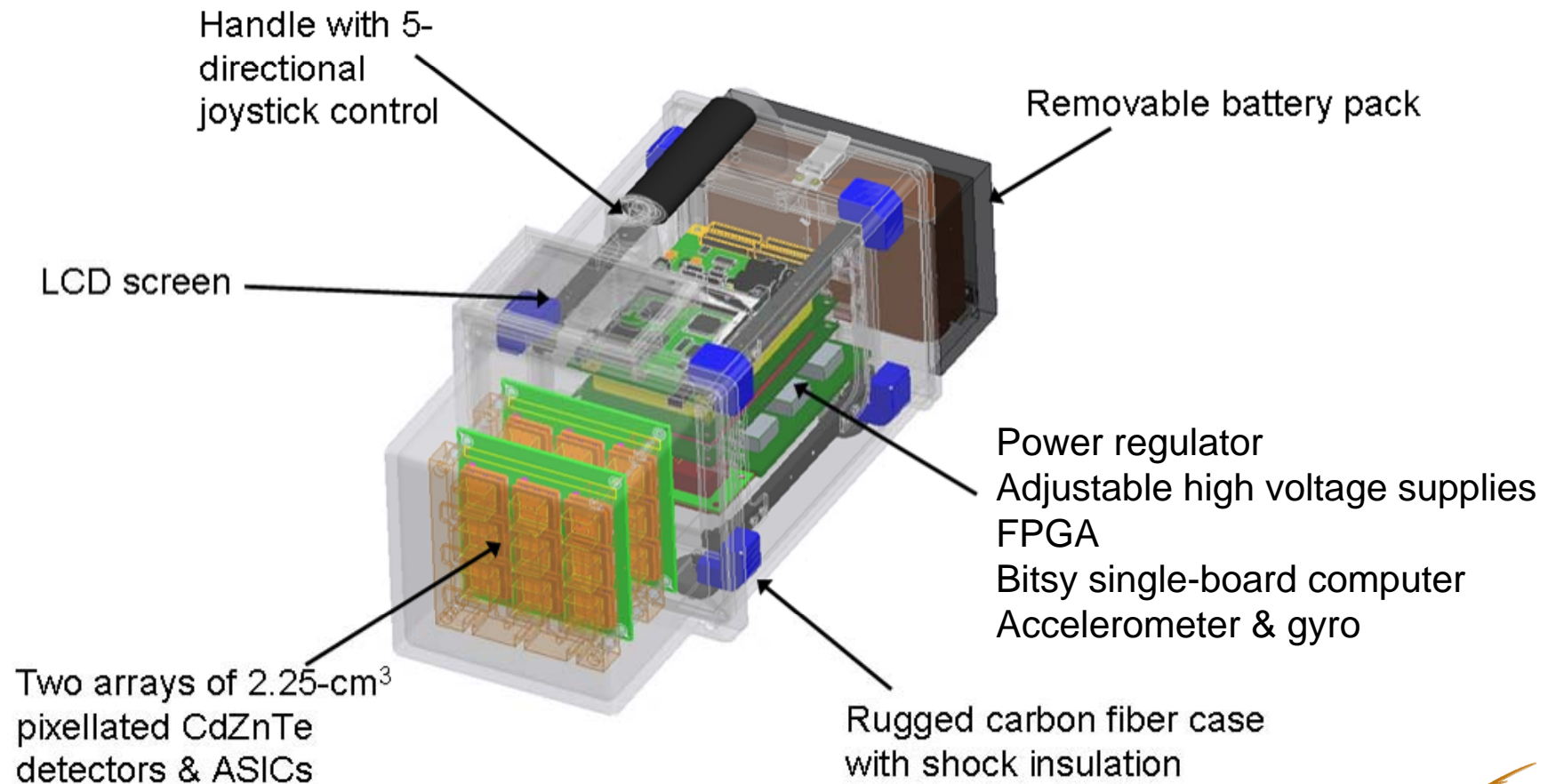
- ▶ GammaTracker is a rugged, high-resolution handheld radioisotope identifier for search, survey, and characterization of radioactive materials.
 - Incorporates eighteen 15x15x10 mm³ pixellated CdZnTe detectors based on University of Michigan Polaris technology to achieve high energy resolution performance
 - Uses peak-based isotope identification methods with common isotope library
 - Uses newly developed “method of intersections” to perform energy-selective Compton backprojection image reconstruction with no *a priori* knowledge of source distribution
 - Detects gamma rays from $^{113}\text{Cd}(n,\gamma)^{114}\text{Cd}$ to confirm presence of neutrons
 - Displays source direction to the user
 - Operates on two batteries for up to 6 hours
 - Weighs ~7 lb



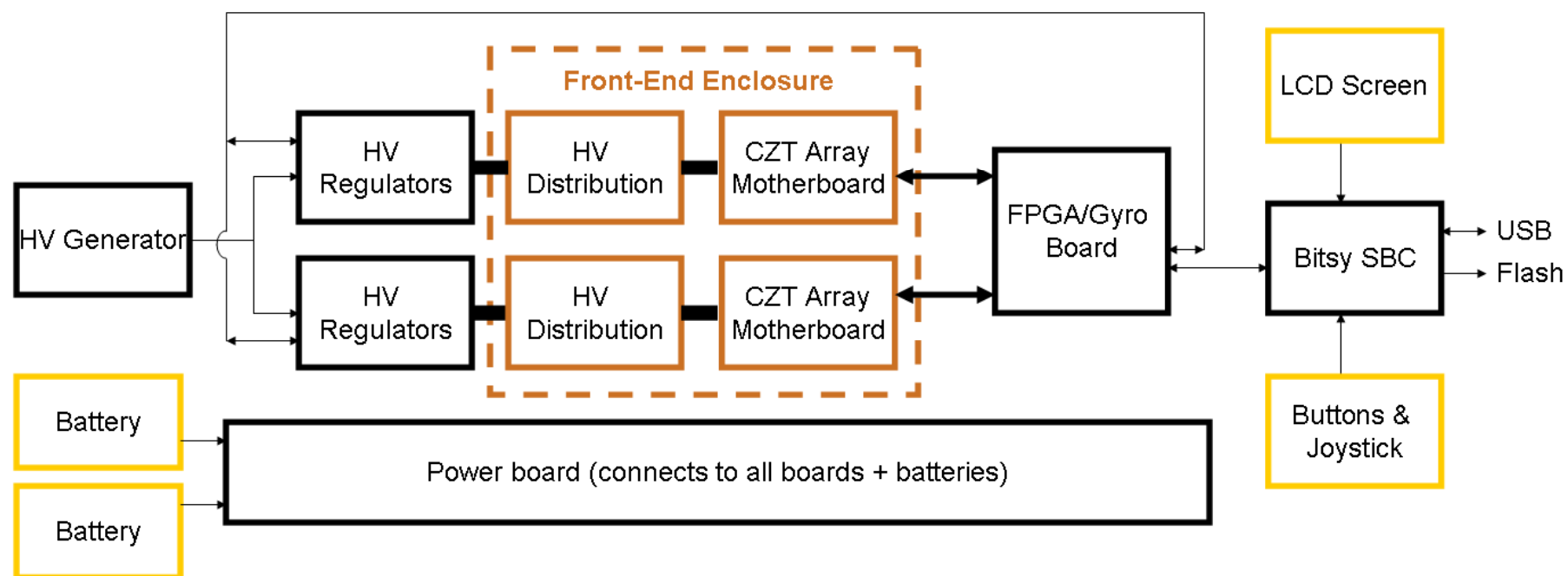
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GammaTracker design

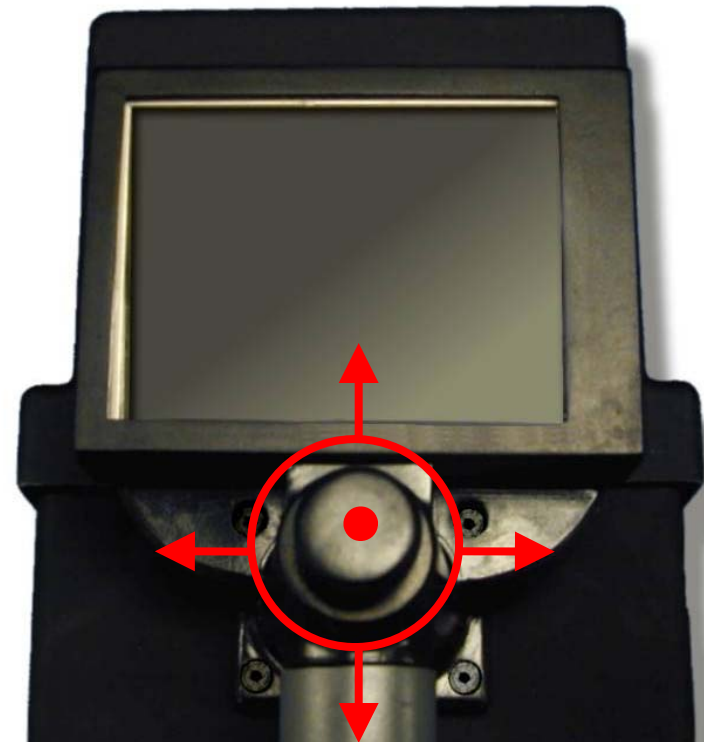
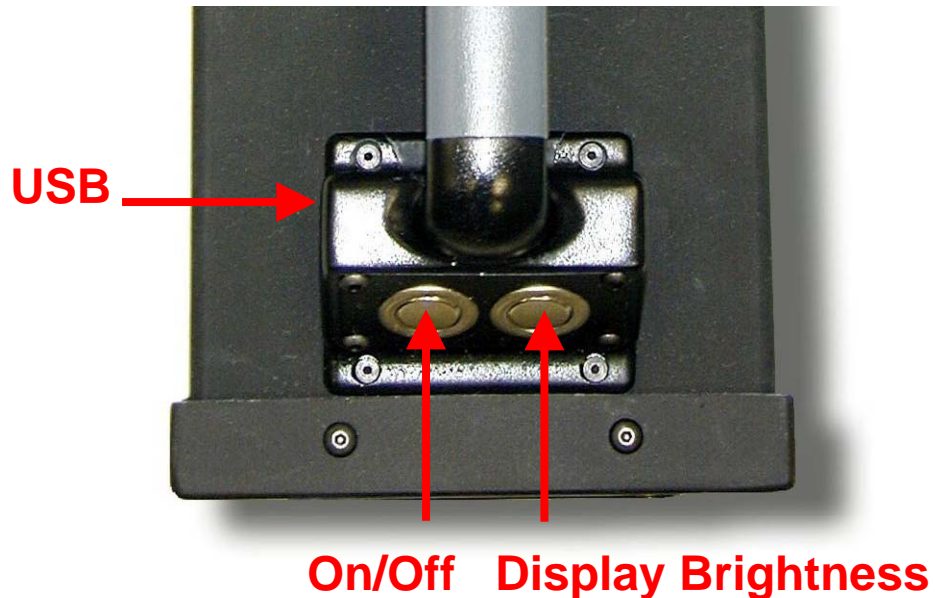


GammaTracker is a complete system incorporated into a single handheld package.

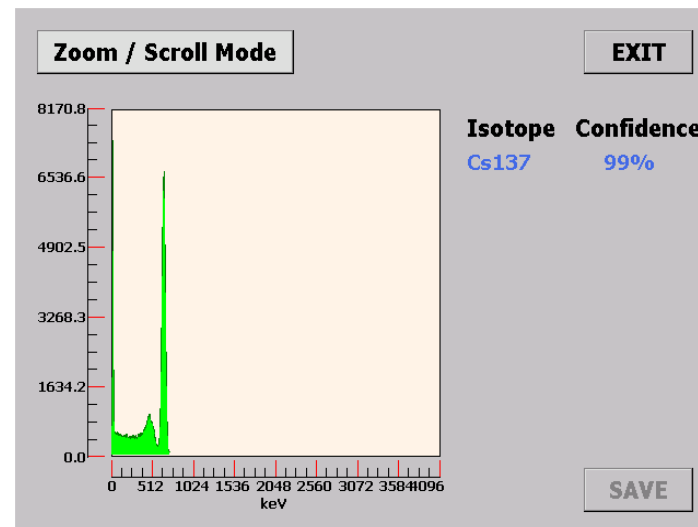
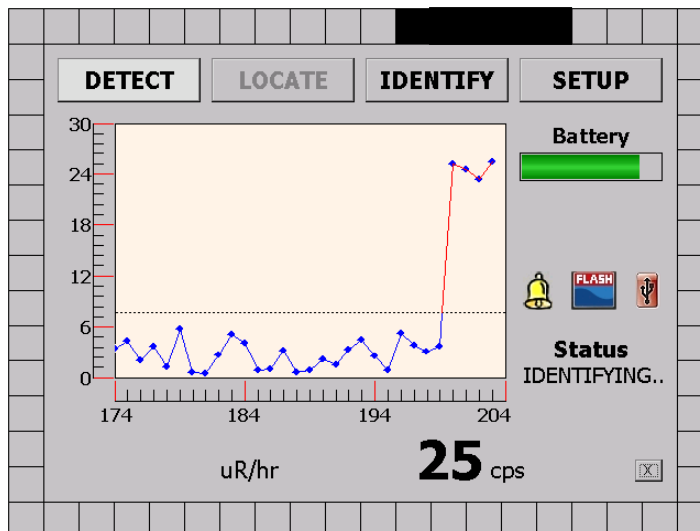


User interface: how to navigate

- ▶ All menus driven from the joystick
- ▶ On/off button
- ▶ Mini-USB connection



The graphical interface is designed for ease of use for novice and expert users.



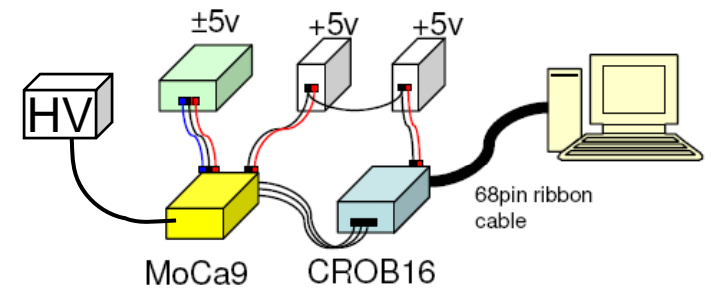
The "SETUP PARAMETERS" interface allows users to configure various settings. It features a vertical list of buttons on the left: EXIT, DETECT, LOCATE, IDENTIFY, DISPLAY, CALIBRATION, DATE / TIME, and DATA LOGGING. The main area contains the following parameters:

- Alarm: On
- Alarm Type: Sigma
- Count Rate Threshold: 1000 cps
- Sigma Threshold: 3
- Avg Background Time: 30 seconds

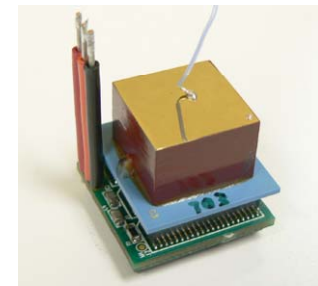
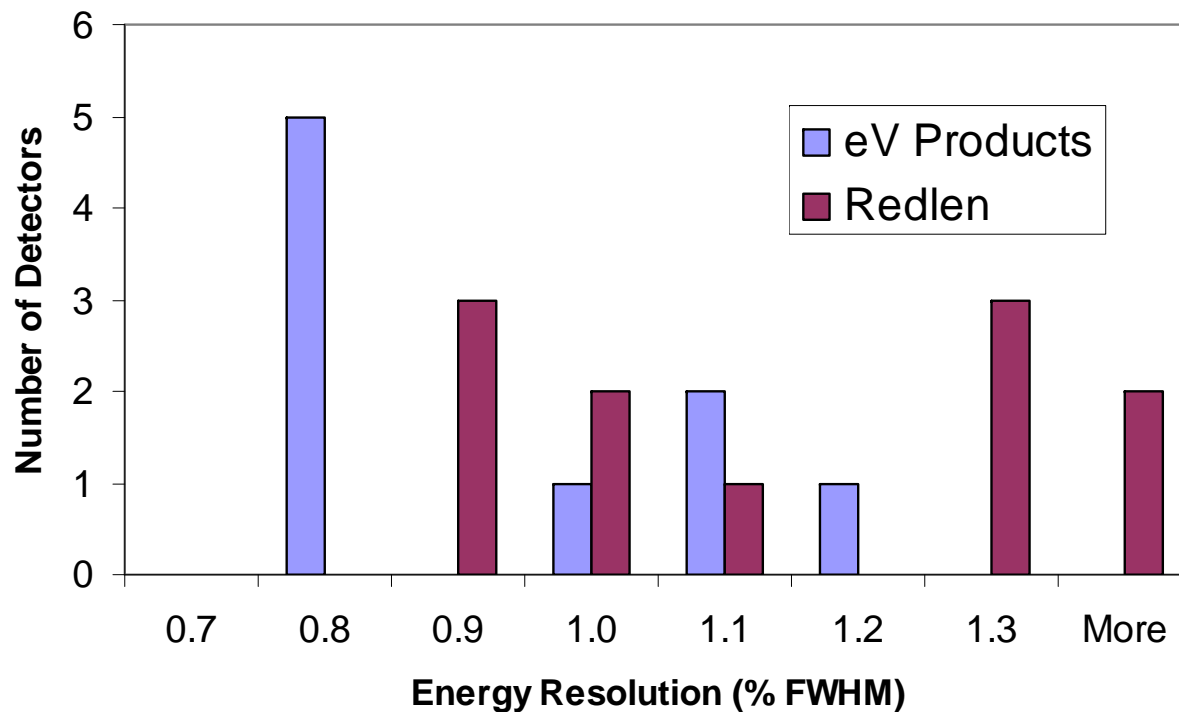
The "SETUP PARAMETERS" interface also includes a "Save Raw Cal Data" button and a "STOP" button. Below these, the storage status is displayed as "20.1 MB [Filling] (64MB Capacity)", accompanied by a blue progress bar. The same vertical list of buttons as the previous interface is present on the left.

Detector performance as measured with Polaris varies significantly.

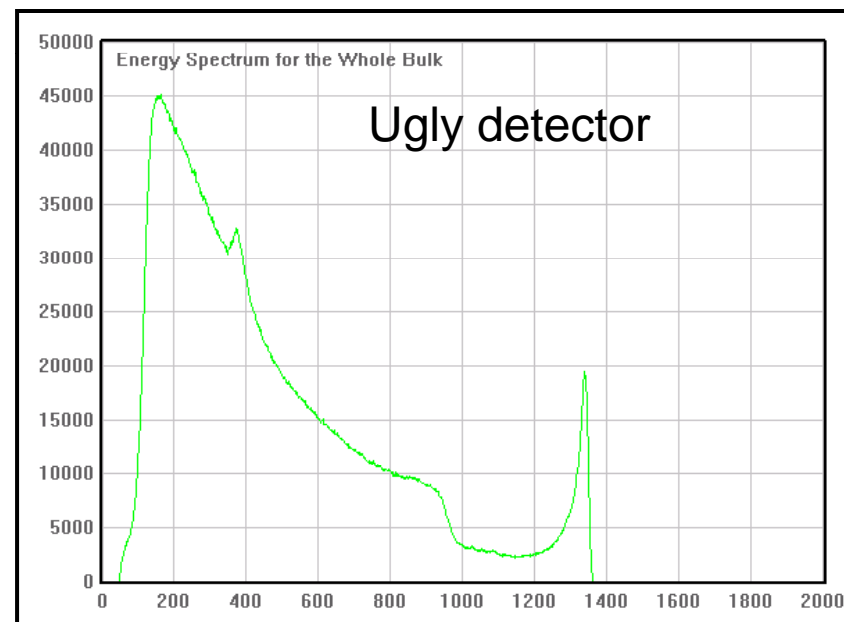
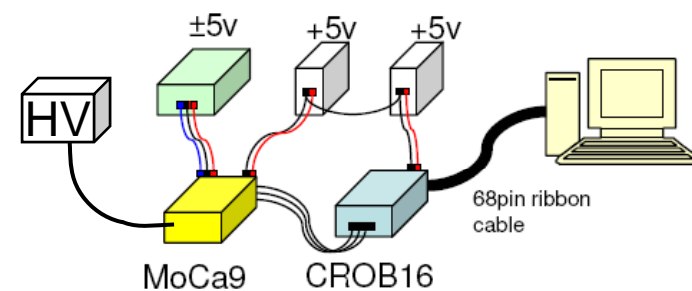
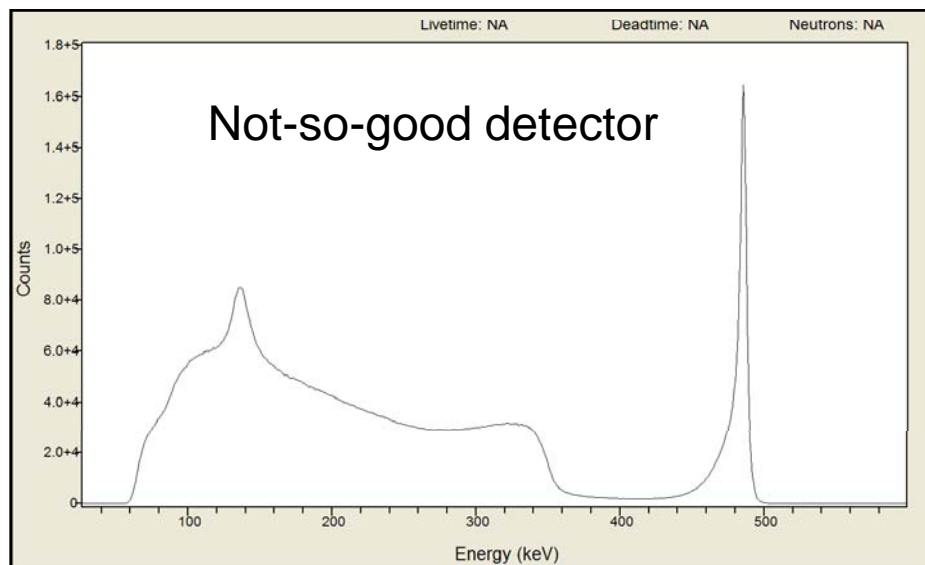
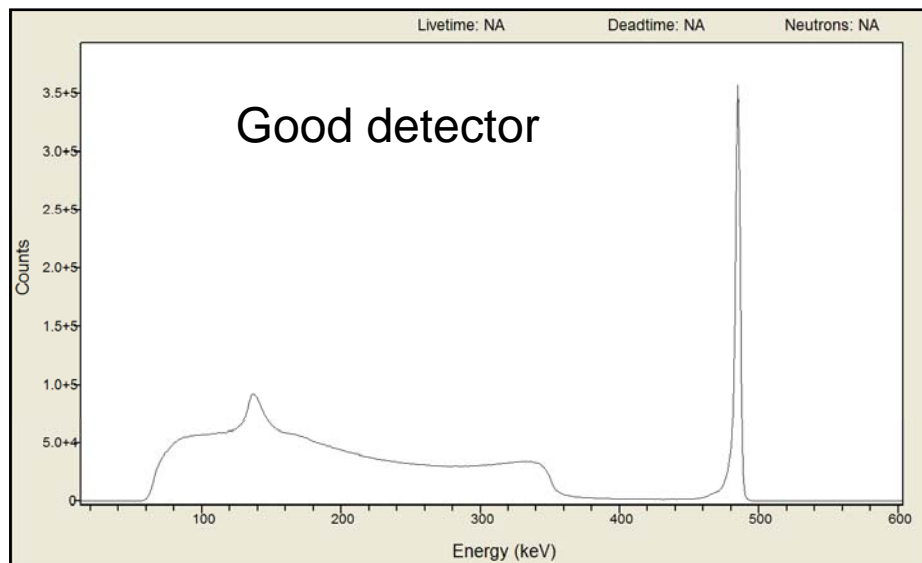
Technical specifications differed between eV Products and Redlen detectors.



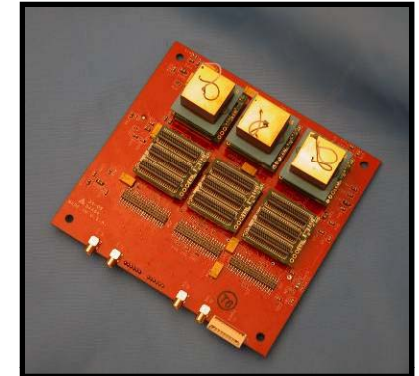
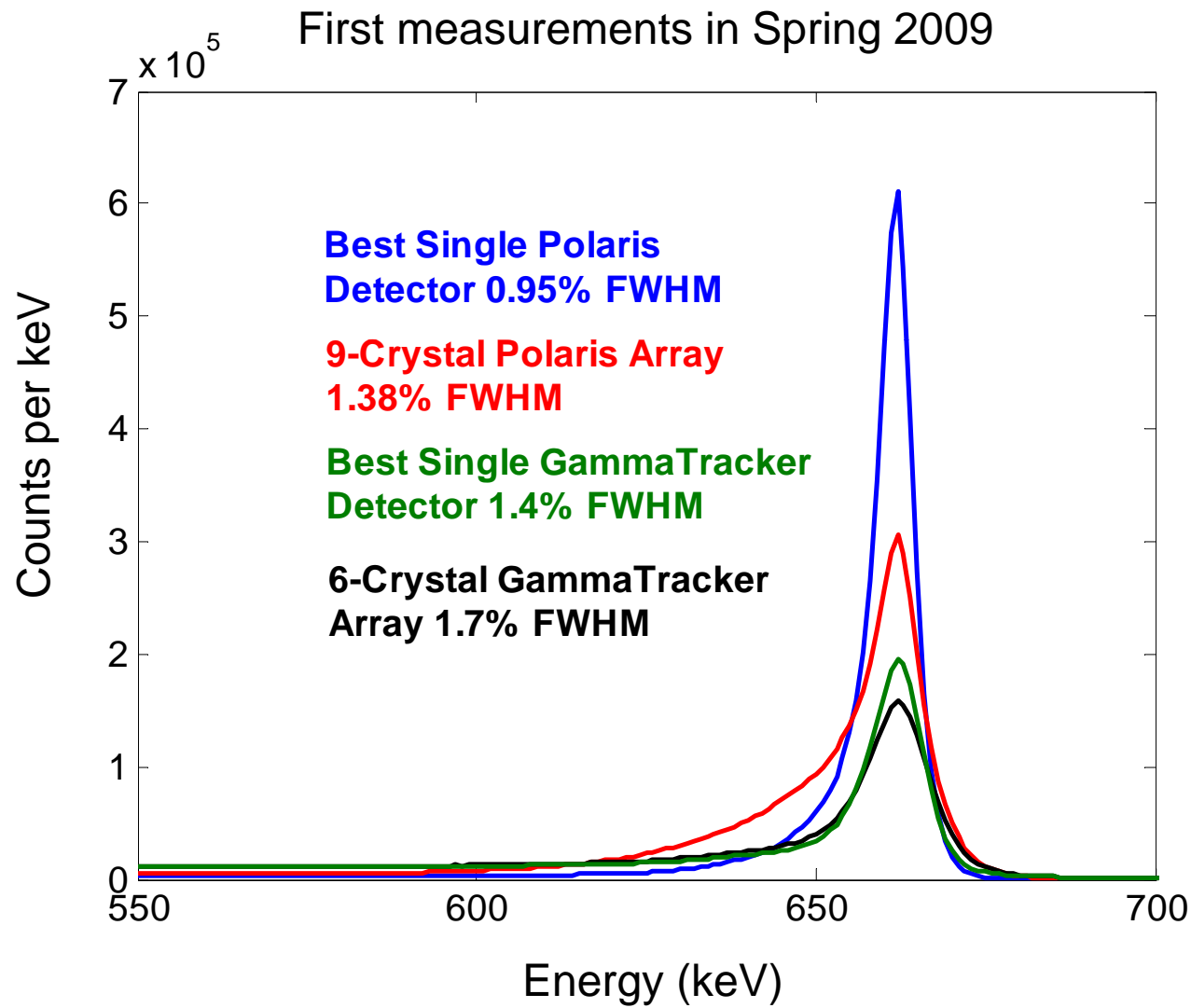
Single-pixel energy resolution at 662 keV



The good, the bad, and the ugly: a sampling of detectors



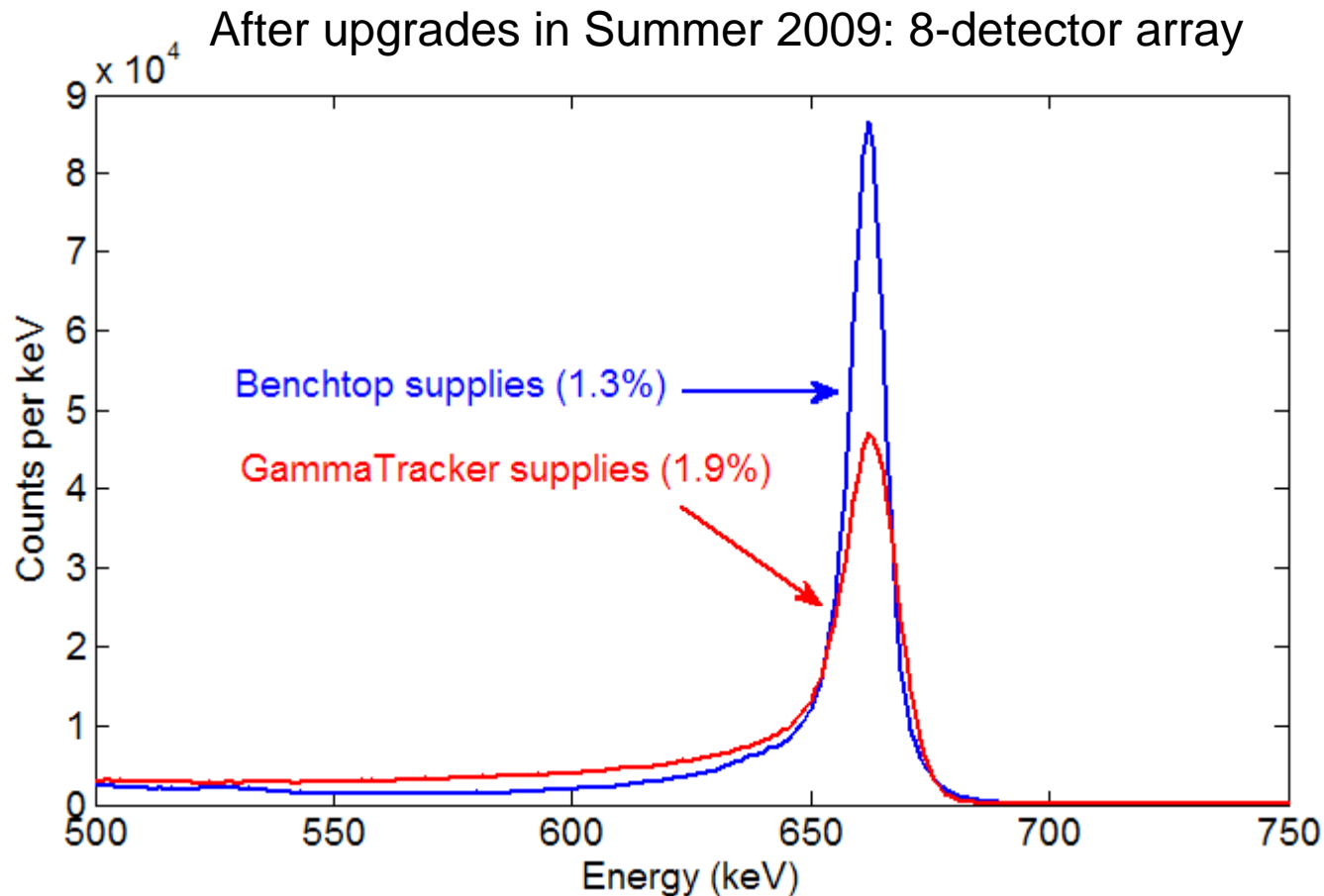
Single-Pixel energy resolution in GT using benchtop power supplies



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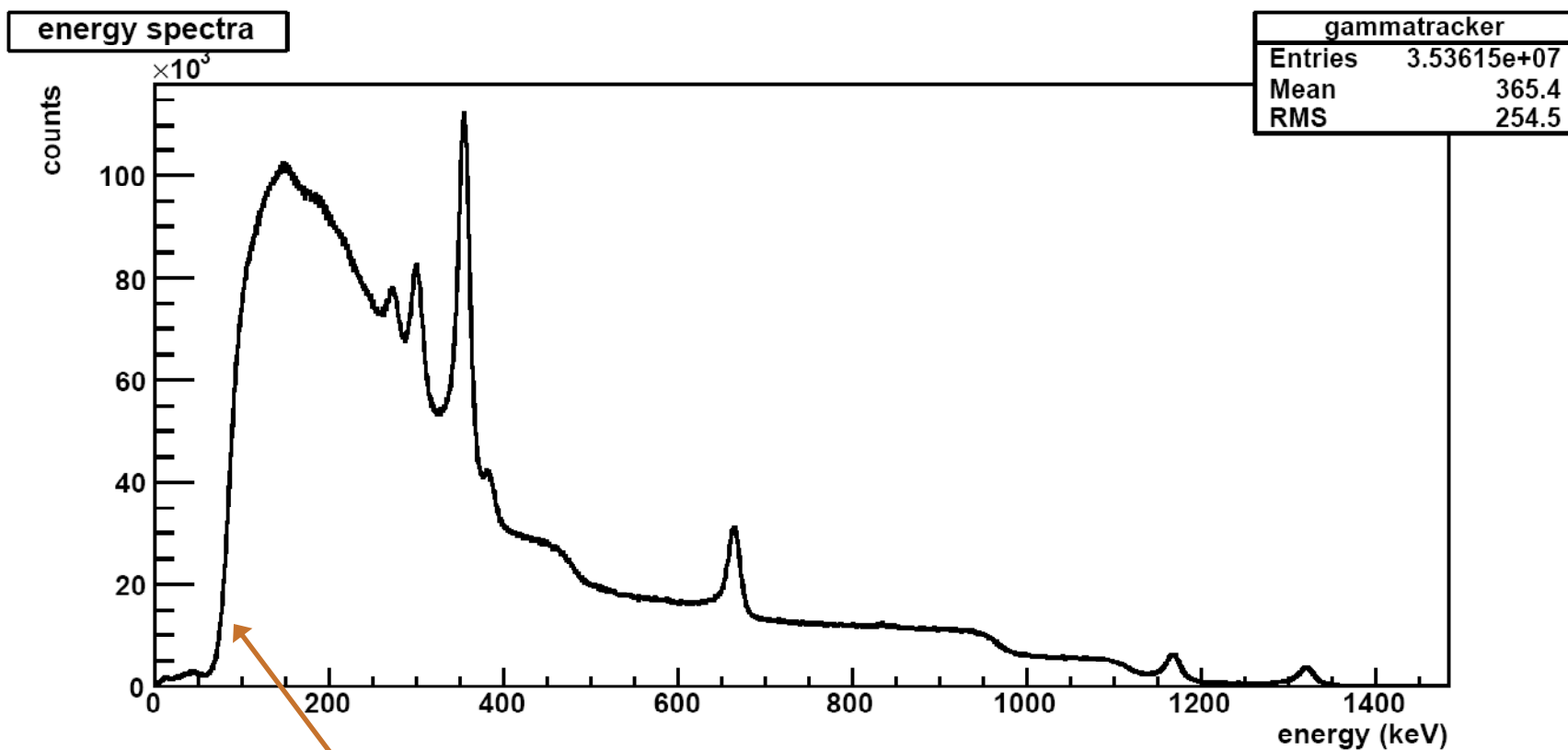
Single-Pixel energy resolution in GT using embedded GT power supplies



- ▶ Single-pixel energy resolution performance improved from 1.7% to 1.3% FWHM at 662 keV when system is on benchtop power.
- ▶ Noisy -2.0 and +1.5 V lines for ASIC on GT power board add ~ 9 keV noise (in quadrature).

Full energy spectrum (all events) in assembled GammaTracker prototype

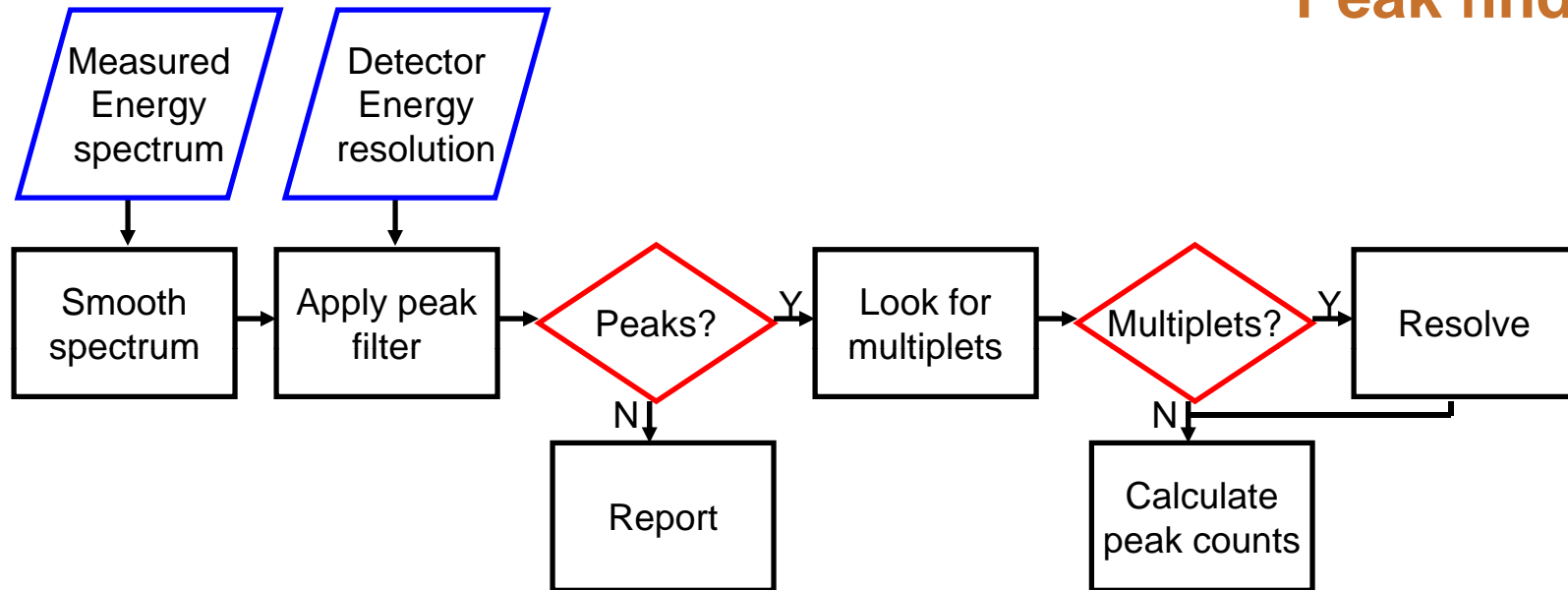
^{133}Ba , ^{137}Cs , and ^{60}Co sources



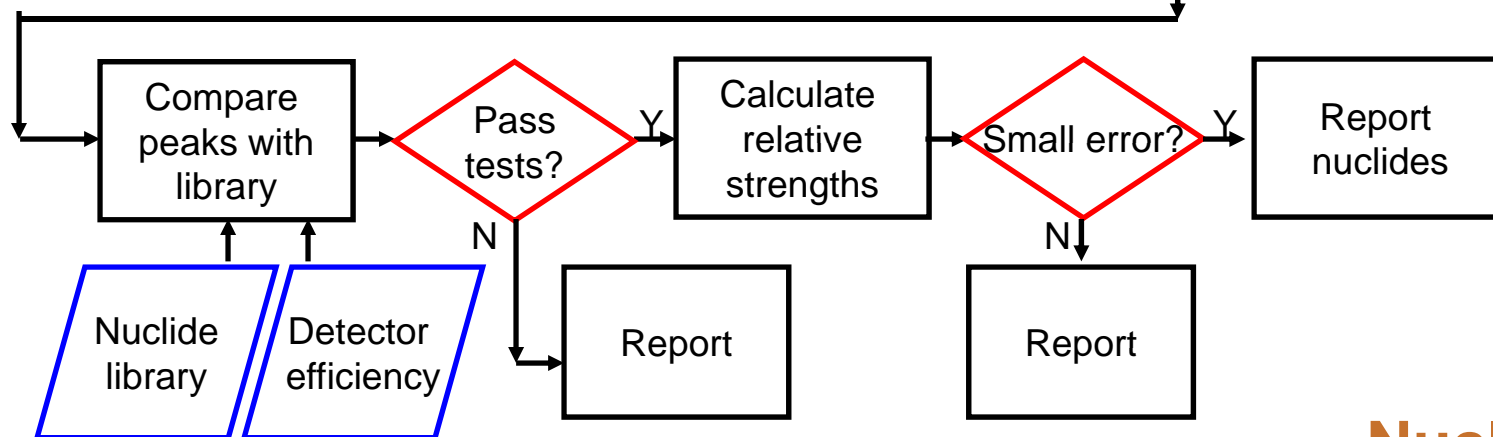
High noise threshold due to noisy supplies

Isotope identification process

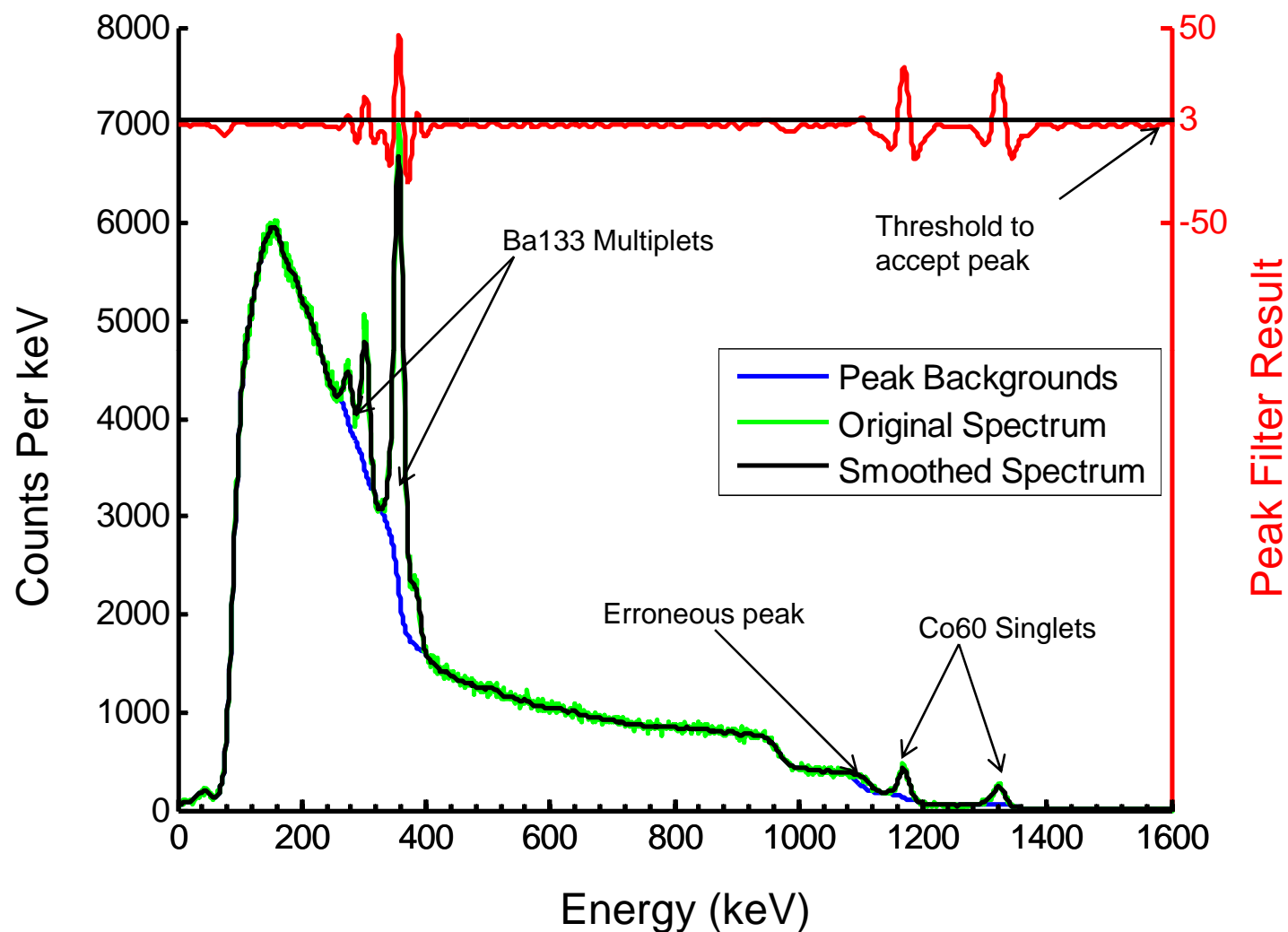
Peak finding



Nuclide ID

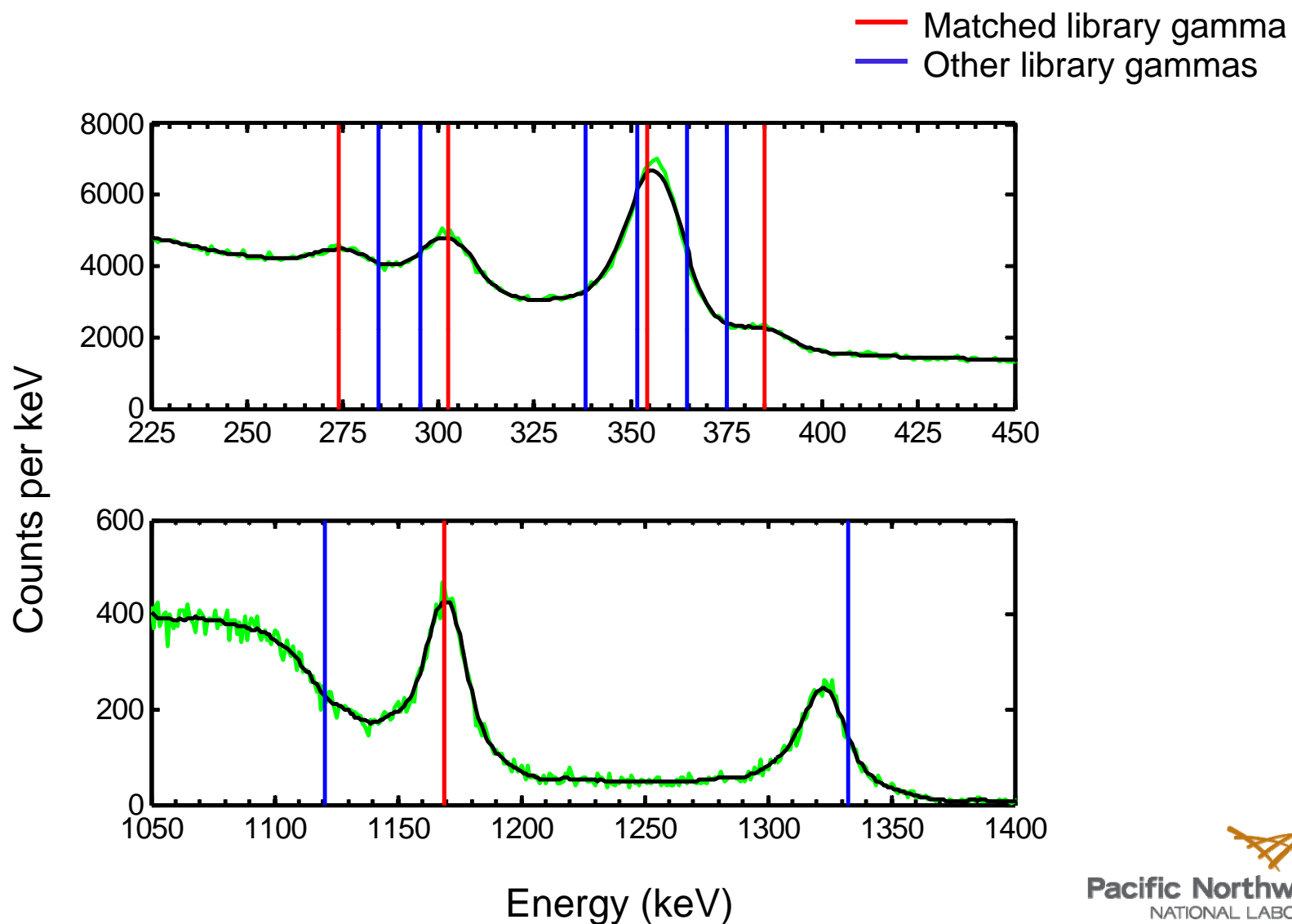


Isotope identification of ^{133}Ba and ^{60}Co



See also N13-207 from this morning's poster session.

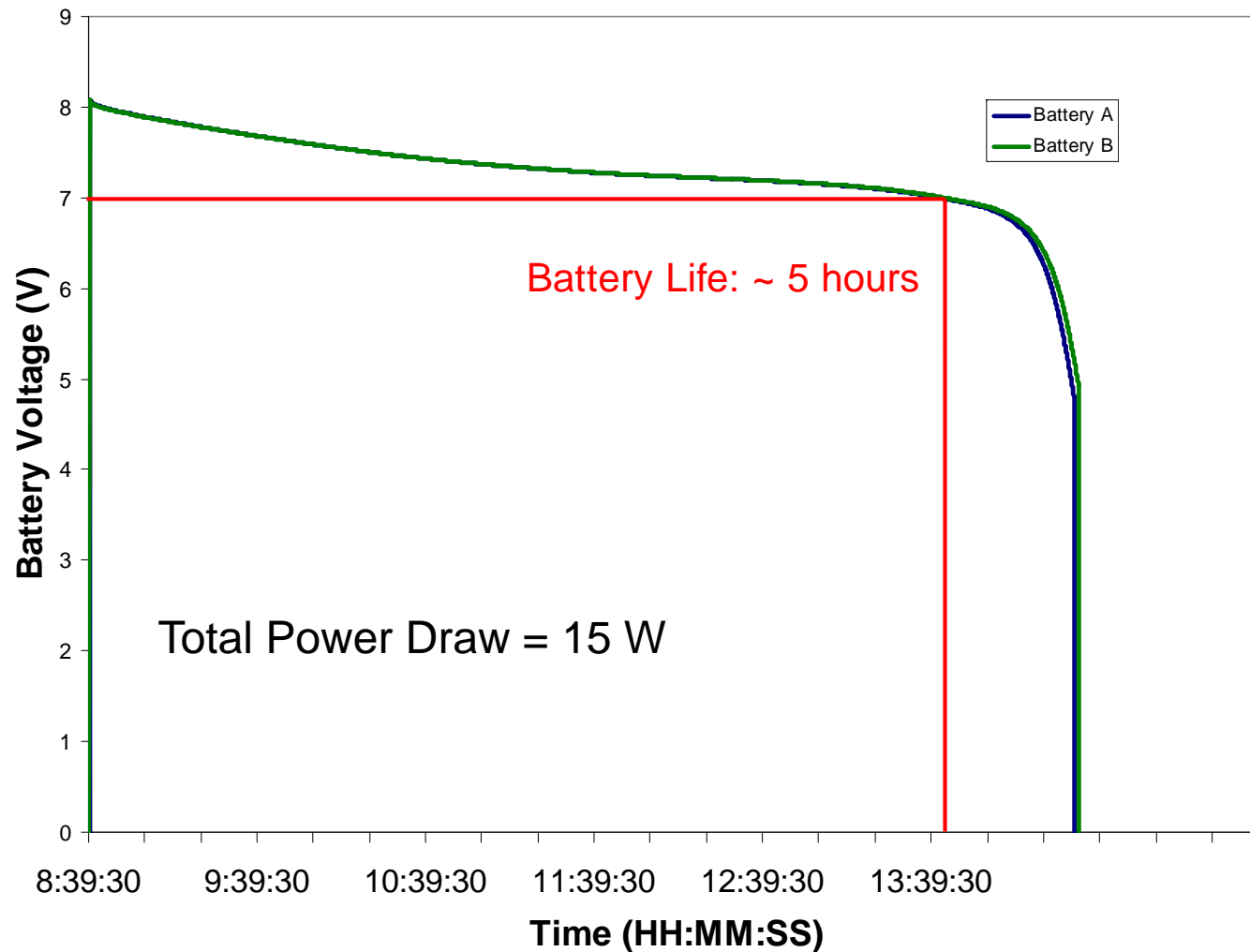
Isotope identification functions properly even when spectra are not correctly calibrated.



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Battery life is predicted to be ~ 5 hours.



GammaTracker summary

- ▶ Demonstrated 1.9% FWHM single-pixel resolution at 662 keV (reduced from 1.3% on bench power).
- ▶ Isotope ID is robust even when spectra are non-ideal.
- ▶ New voltage regulation test circuit for ASIC biases demonstrates 90% reduction in line noise, which will improve energy resolution.
- ▶ Testing, evaluation, and optimization continues.

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For more information or prototype demonstration,
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