

# SpectrumViewer

## Quick Start Guide

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# Background

- Originally created as a tool for distribution to analysts associated with the NNSA Megaports Initiative, and others without access to the LANL PeakEasy code.
- Subsequently extended with additional capabilities and tools
  - Read and write more spectral formats
  - Ability to display and edit more header information
  - Display and compare data by energy or channels
  - Spectral manipulation tools
    - Spectral smoothing
    - Multiply spectral data by a constant
    - Smear spectral resolution
    - Gain shift
    - Correct spectrum for NaI intrinsic nonlinearity
    - ...

# Basic operations and controls

- How to open a spectrum...
  - The primary spectrum
    - This is the spectrum that you want to learn more about.
  - A background spectrum
    - This is a system background spectrum preferably acquired for at least one hour in the same vicinity as the primary spectrum when only naturally occurring radioactive materials (NORM) is present.
  - A reference spectrum
    - This is a spectrum of a known suspect material.

# Opening the primary spectrum

The screenshot shows the Spectrum Viewer application window. The 'File' menu is circled in red. Below it, the 'Drop Primary Spectrum Here' button is also circled in red. A red arrow points from this button to the plotting area. Another red arrow points from the 'File-Open Spectrum...' menu item to the same plotting area. The plotting area is a semi-log graph with 'Counts' on the y-axis (log scale from 0.1 to 100) and 'Energy (keV)' on the x-axis (linear scale from 0 to 3000). The status bar at the bottom shows acquisition details: Acquisition Date: 21/12/2012 @ 06:06:06, Live Time (s): 0.00, Real Time (s): 0.00, DeadTime: 00.0 %, Channels: 65536, Offset Multiplier: 1.0000.

**File** Edit Background Spectrum Reference Spectrum Graph Options Help

Scale: Semi-Log Linear Grid: None Coarse Fine Drag: Rubber Band Zoom Vertical and Horizontal

Primary Spectrum

Drop Primary Spectrum Here

Primary Spectrum #

< 1 of 1 >

Background Spectrum

Drop Background Spectrum Here

Clear Background Spectrum

Reference Spectrum

Drop Reference Spectrum Here

Clear Reference Spectrum

Isotope Lines

Show Lines

No Source Selected

Calibration Lines

Show Lines

No Source Selected

Zero (keV) keV/Channel

0.0 1.0

Zero Offset Gain Adjust

Sample ID Sample\_ID

Offset Multiplier 1.0000

Acquisition Date 21/12/2012 @ 06:06:06 Live Time (s) 0.00 Real Time (s) 0.00 DeadTime 00.0 % Channels 65536

Counts

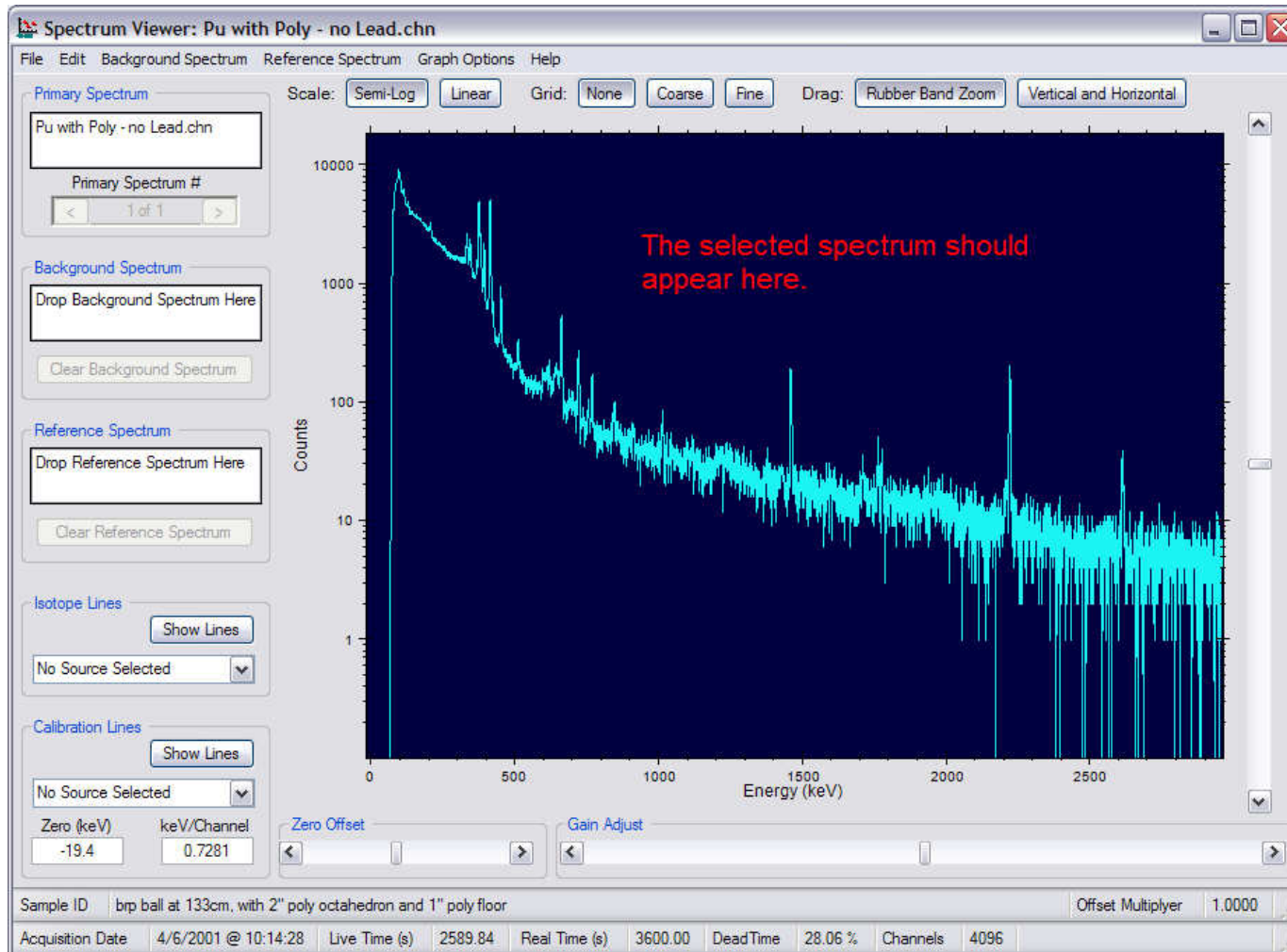
Energy (keV)

The spectrum to be viewed may be selected from the File-Open Spectrum... menu item.

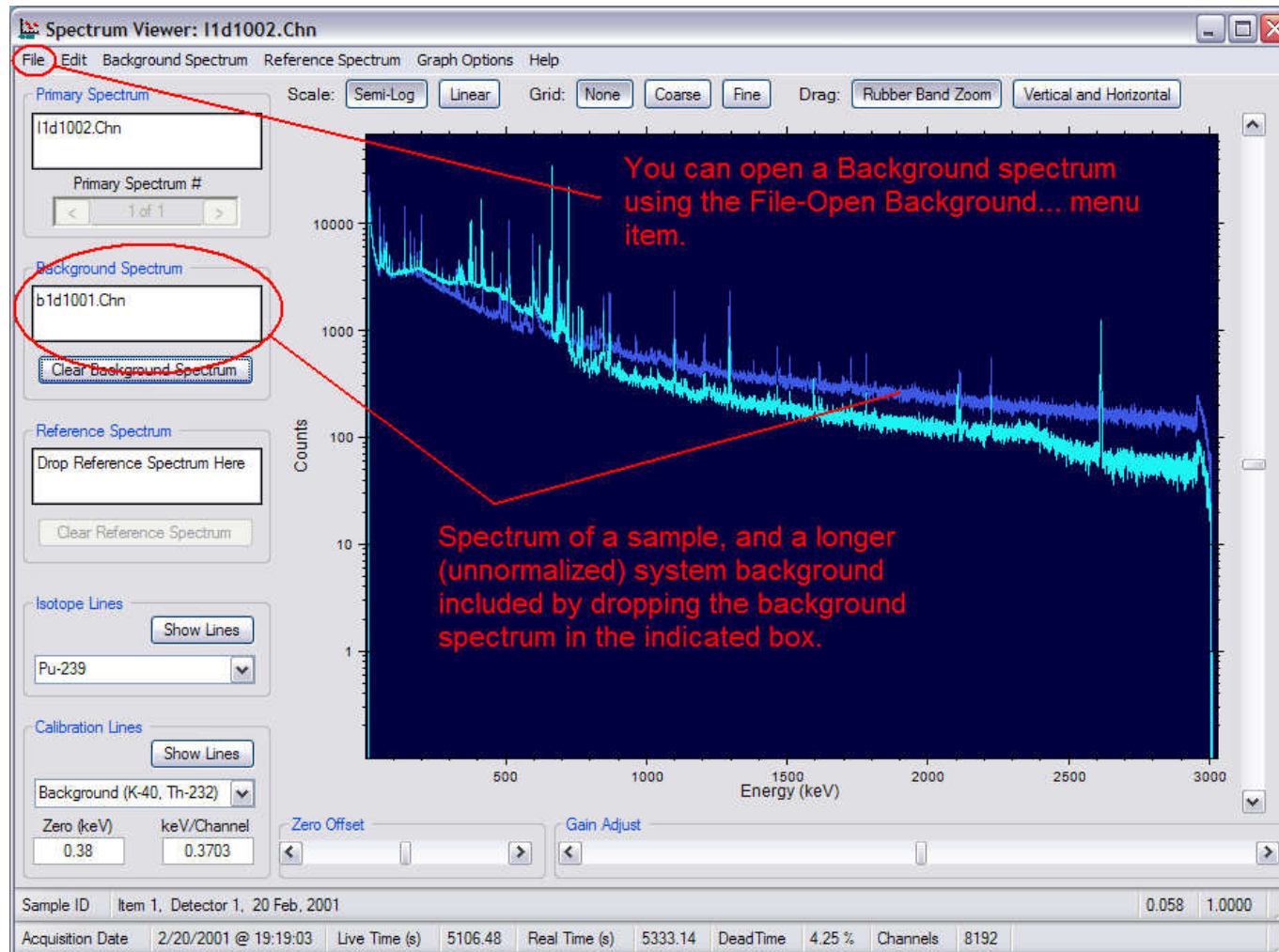
You may also "Drag and drop" the selected spectrum into the indicated box.

You may also Drag and drop" the selected spectrum directly into the plotting area. Note: this method only works for the primary spectrum.

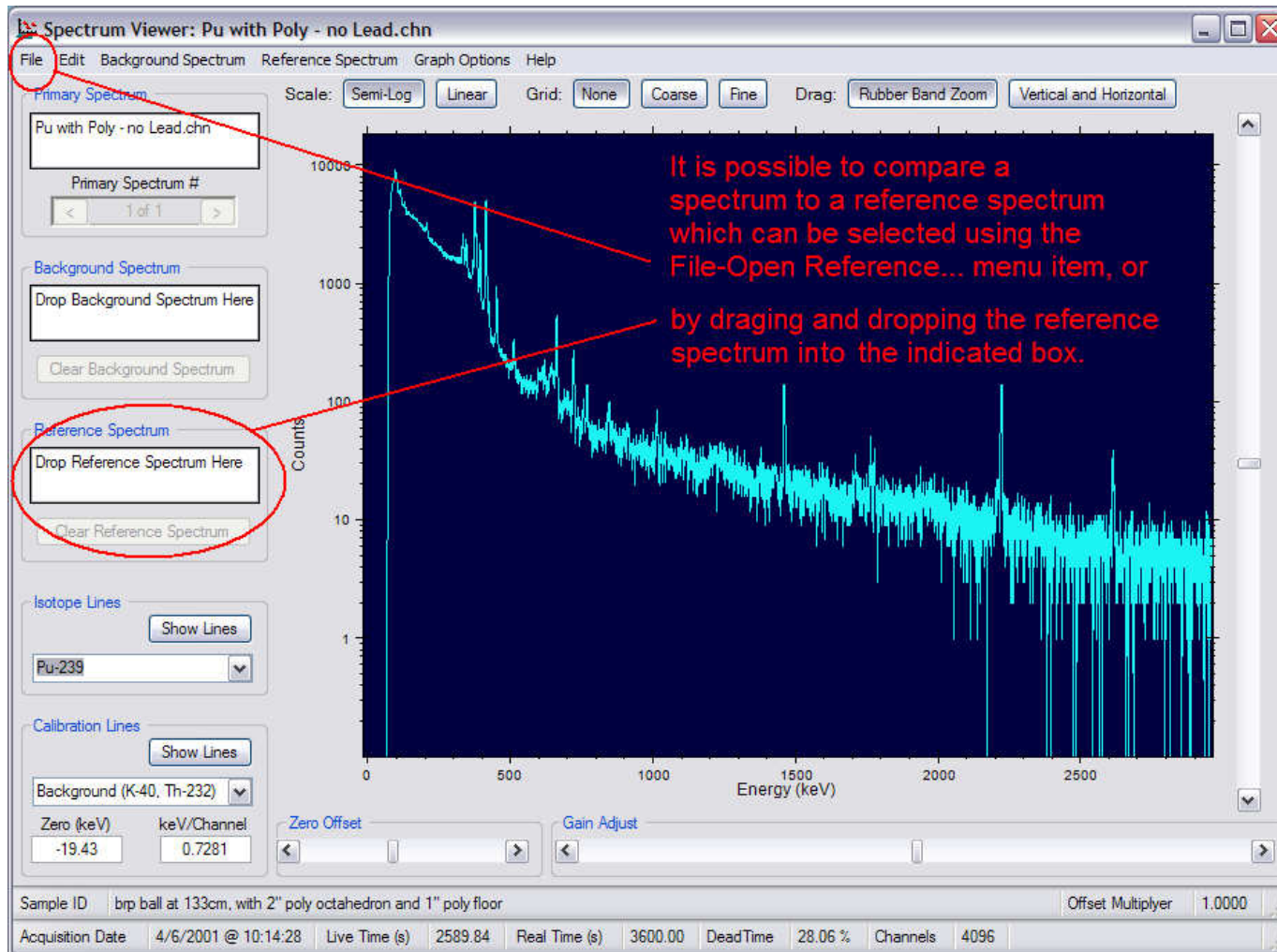
# A plot of the primary spectrum



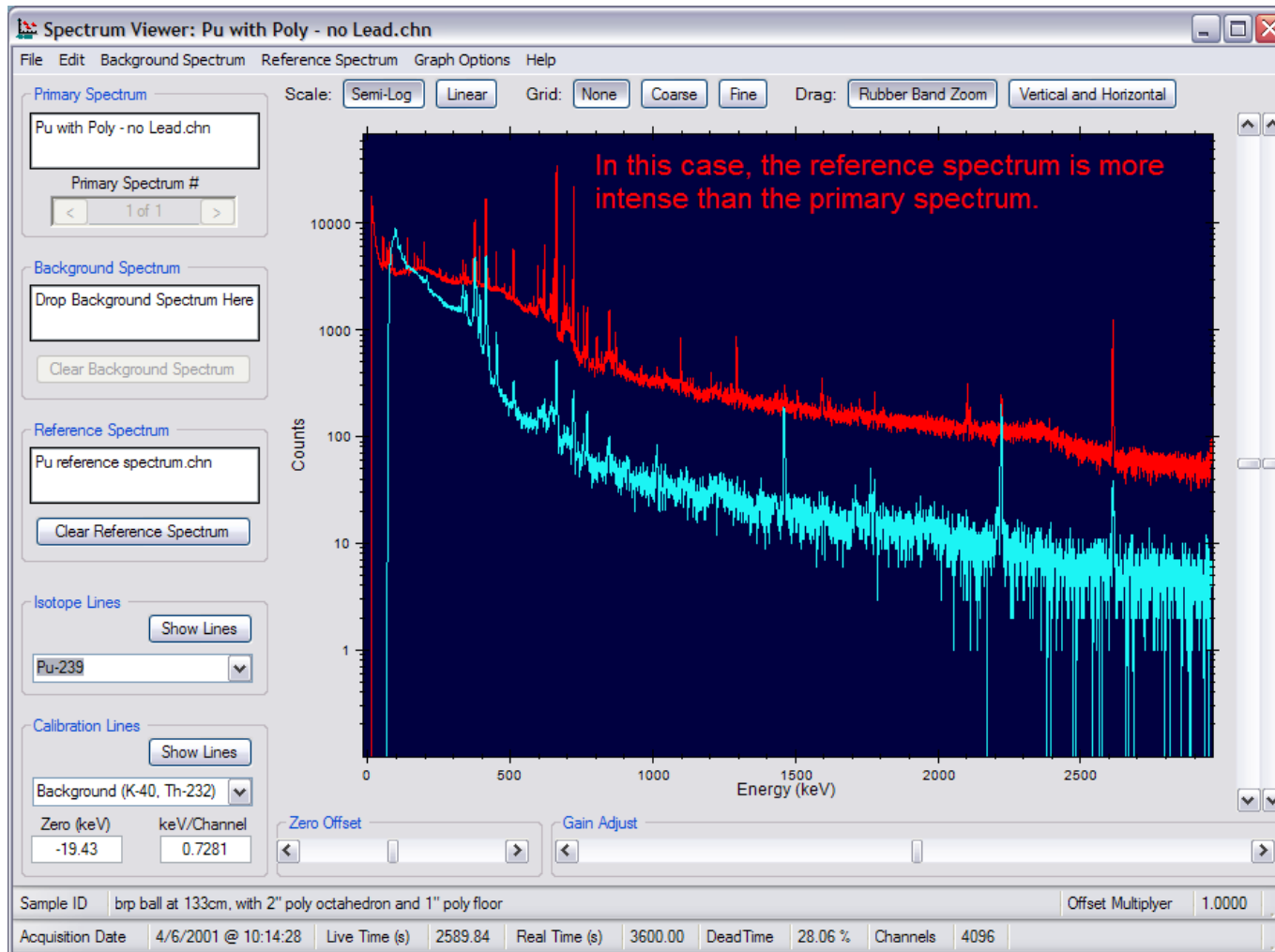
# Opening a background spectrum



# Opening a reference spectrum...



# Opening a reference spectrum...

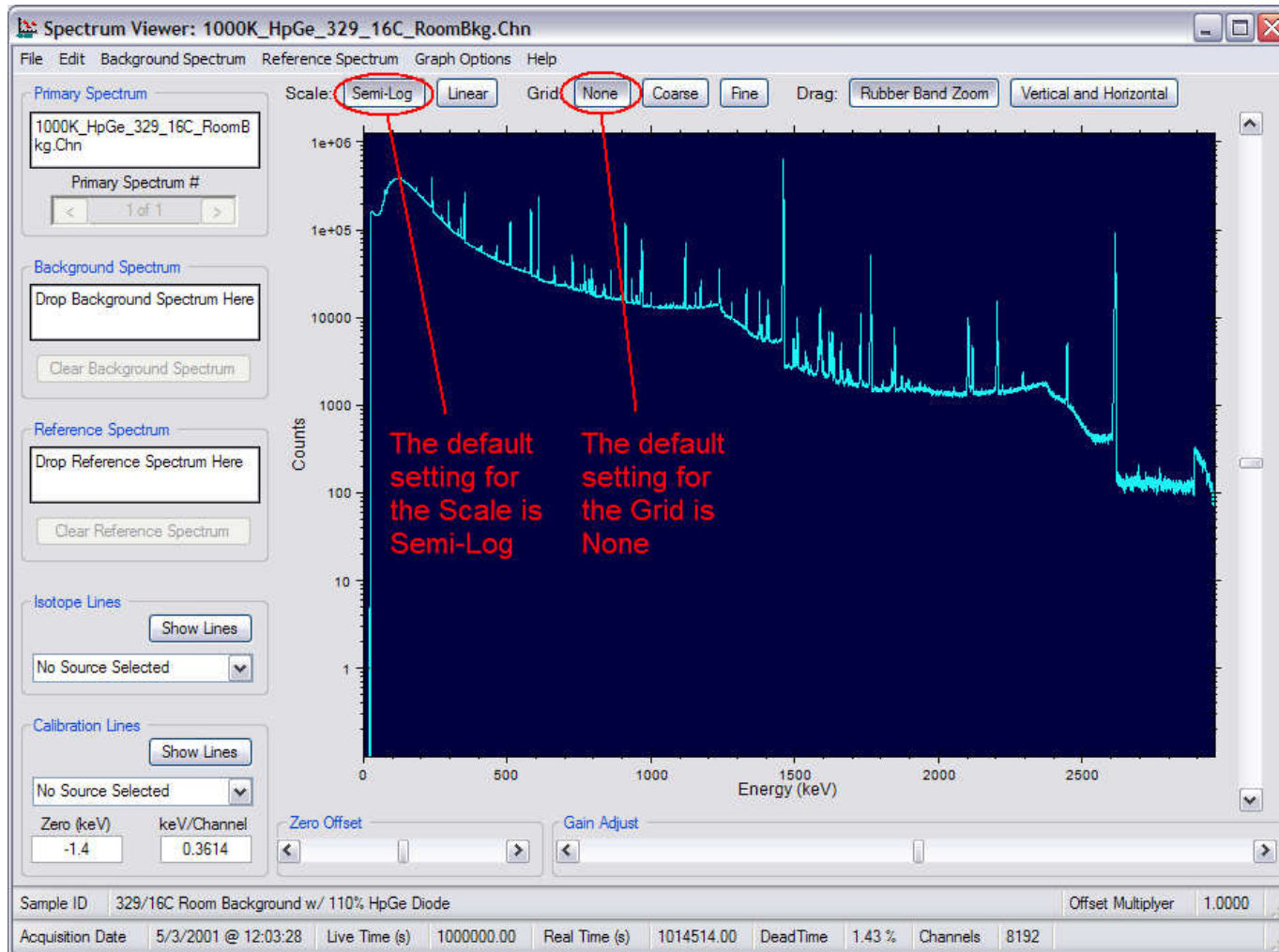




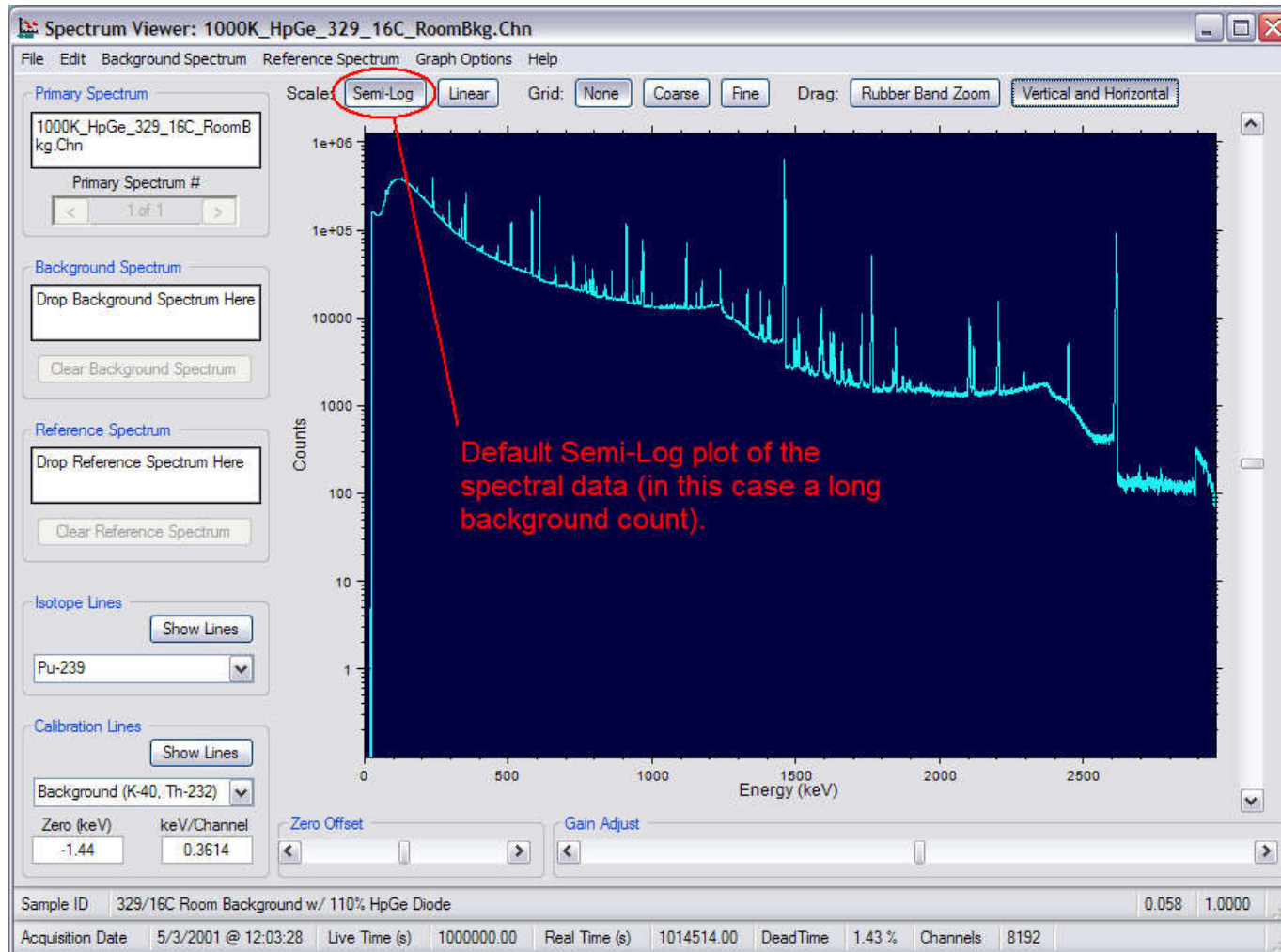
# Basic controls

- Display Options
  - Display Mode (Scale)
    - Semi-Log (Default)
    - Linear
  - Grids
    - None
    - Coarse
    - Fine

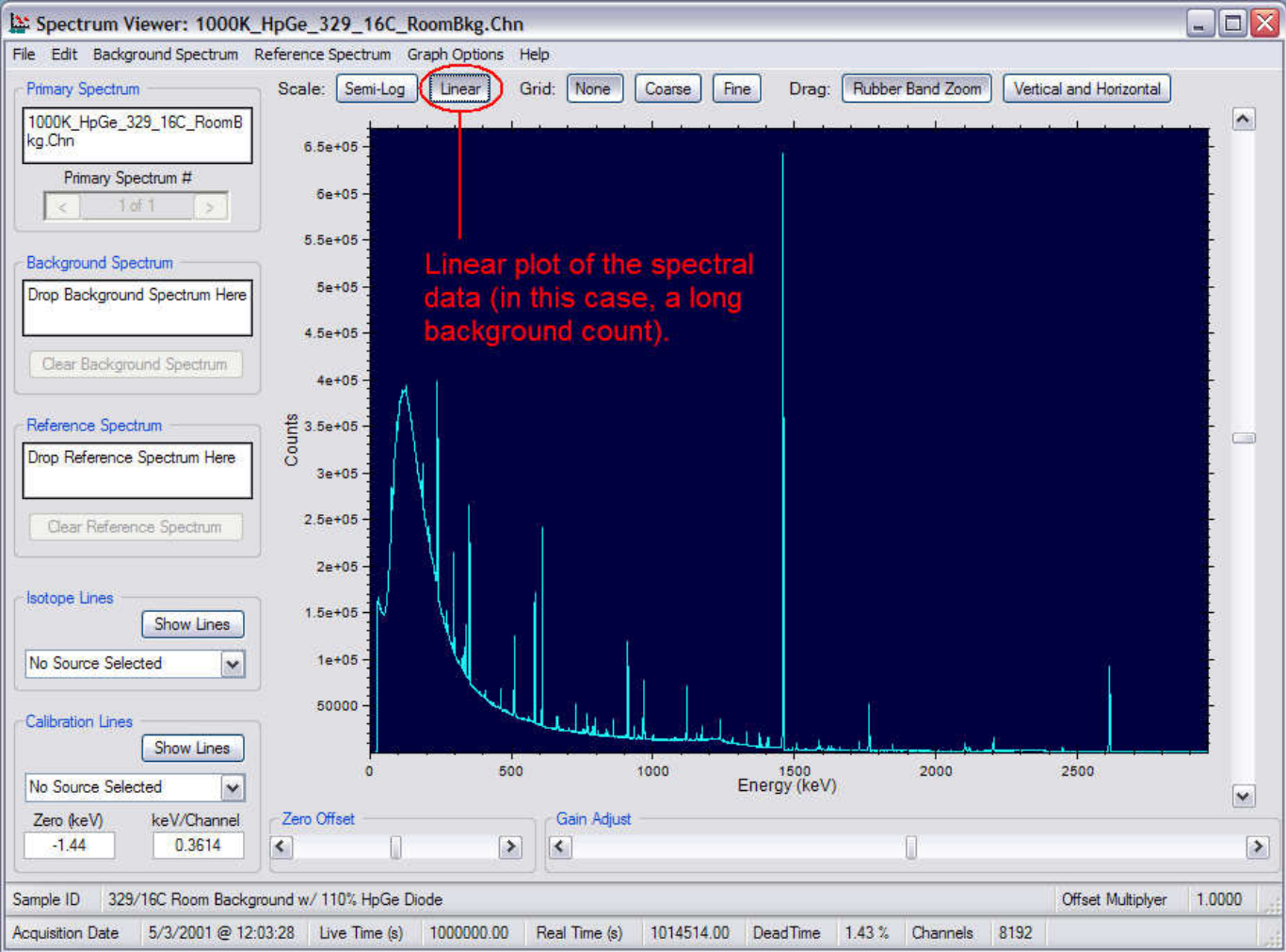
# Default settings for the display options



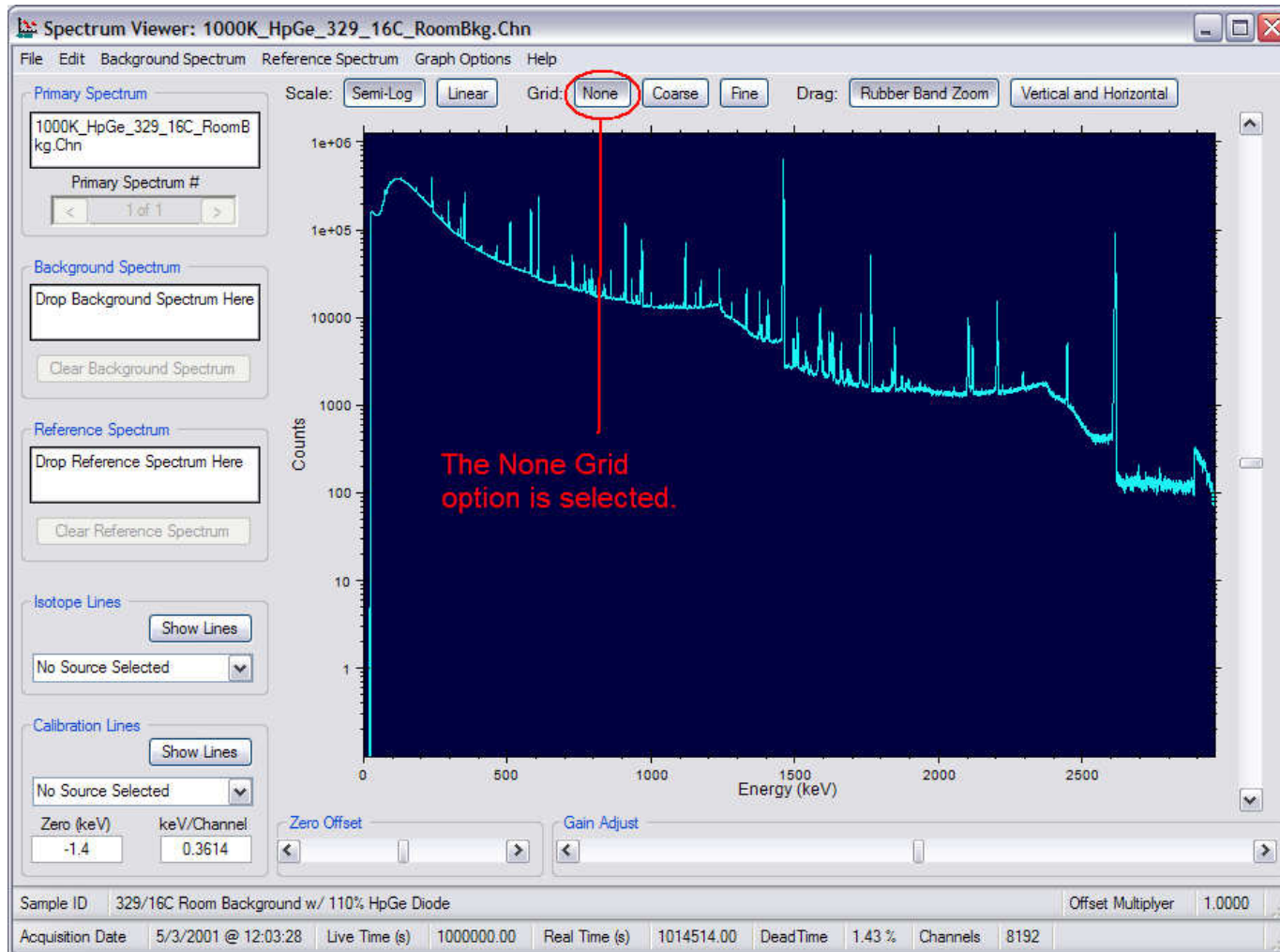
# Spectral data plotted in Semi-Log mode



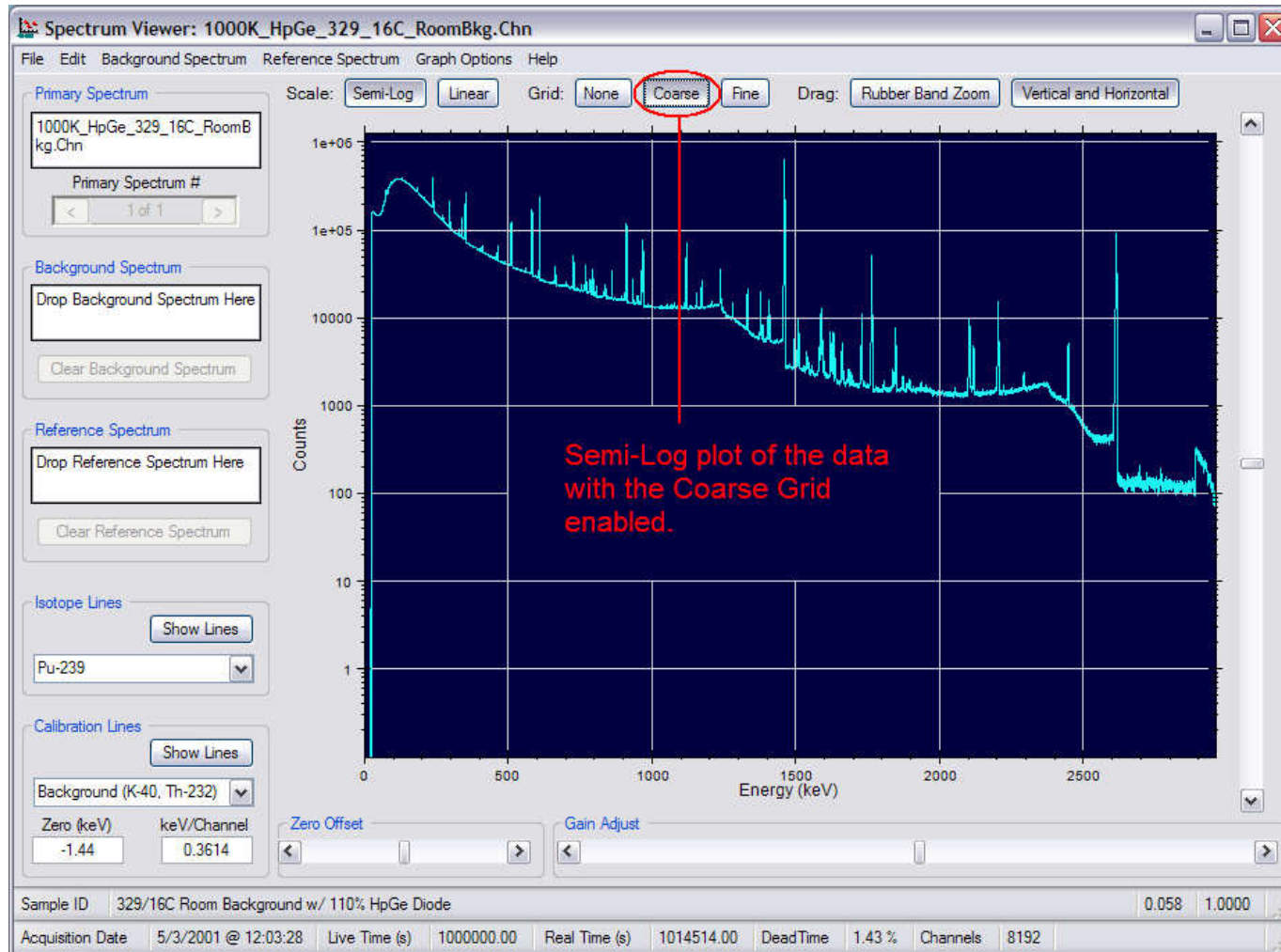
# Spectral data plotted in Linear mode



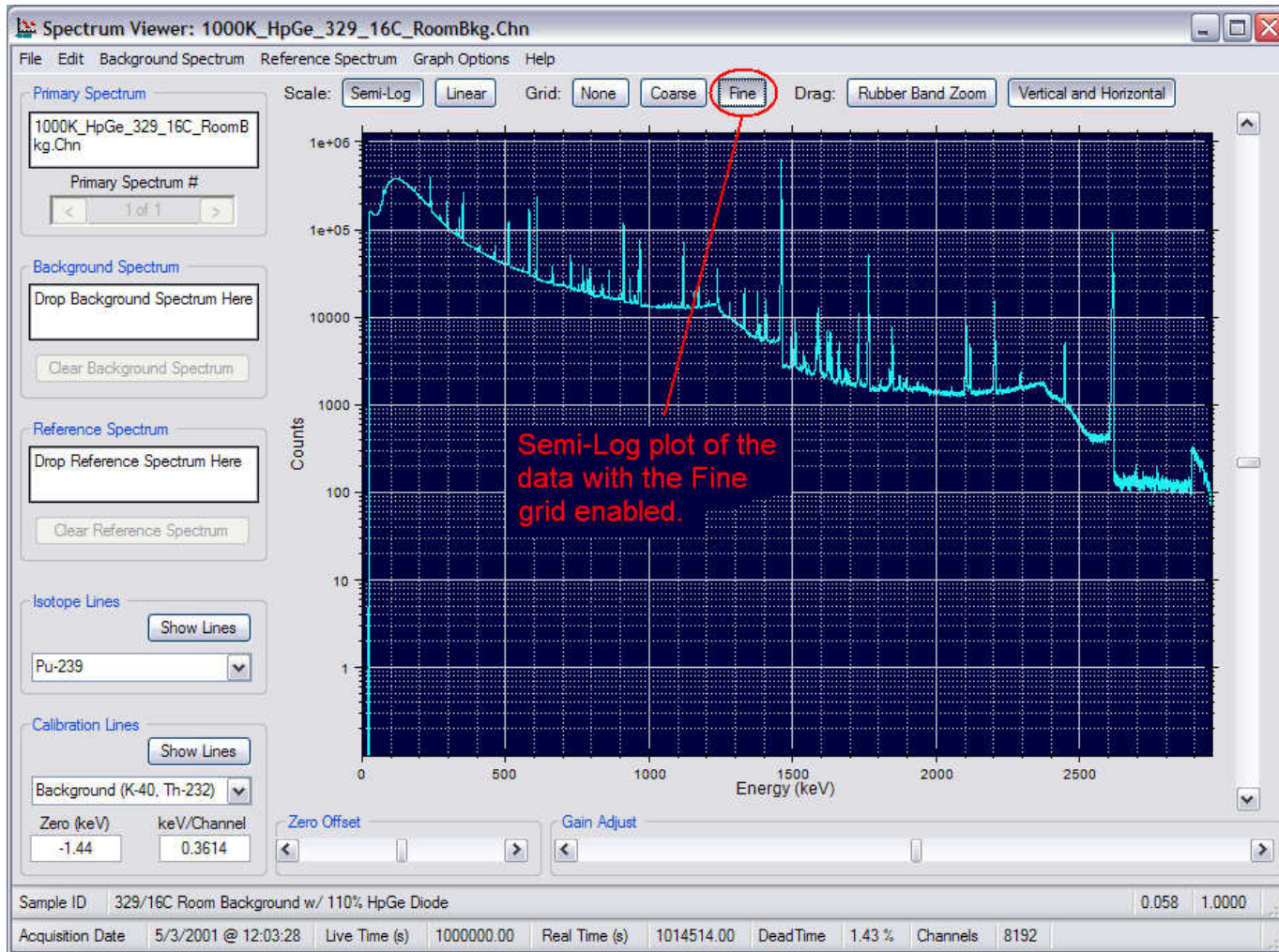
# Plot with the None grid option selected



# Plot with the Coarse grid option selected



# Plot with the Fine grid option selected

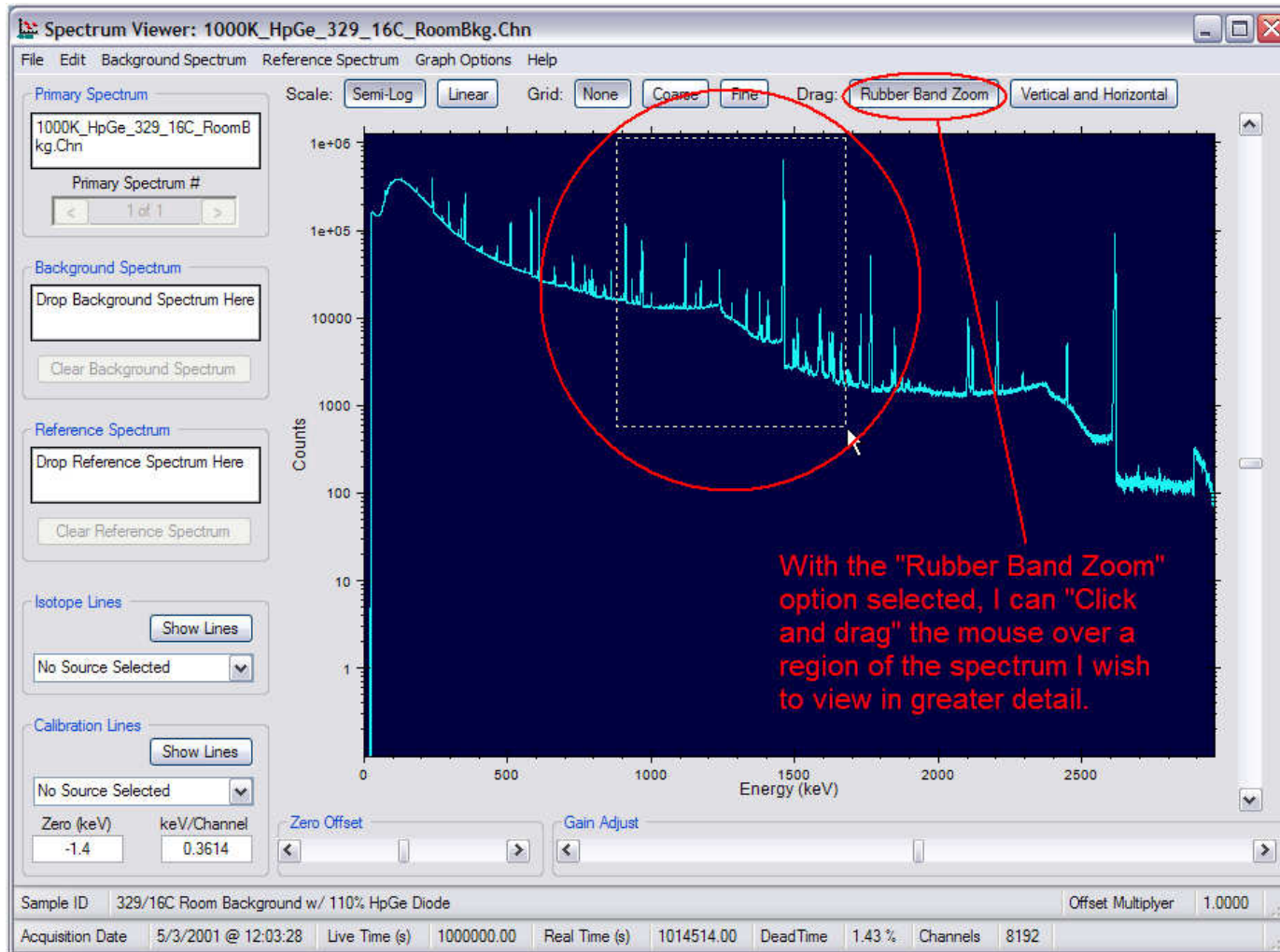


# Basic controls

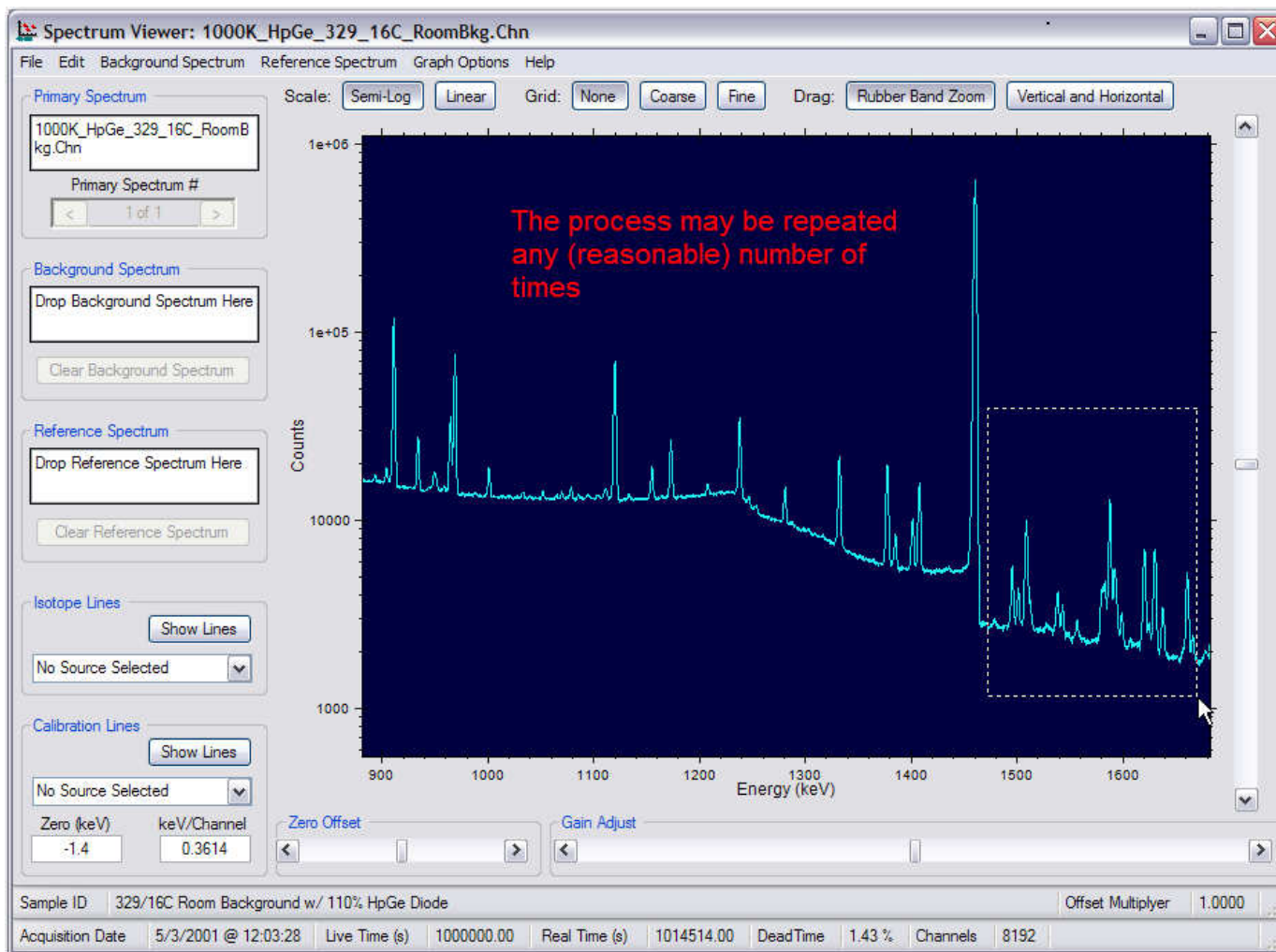
- Clicking and Dragging with the Mouse
  - “Zoom” --- Expanding a portion of the displayed spectrum
  - “Pan” --- Using the mouse to move around an expanded region to another portion of the spectrum It is like scanning a large page with a small magnifying glass.



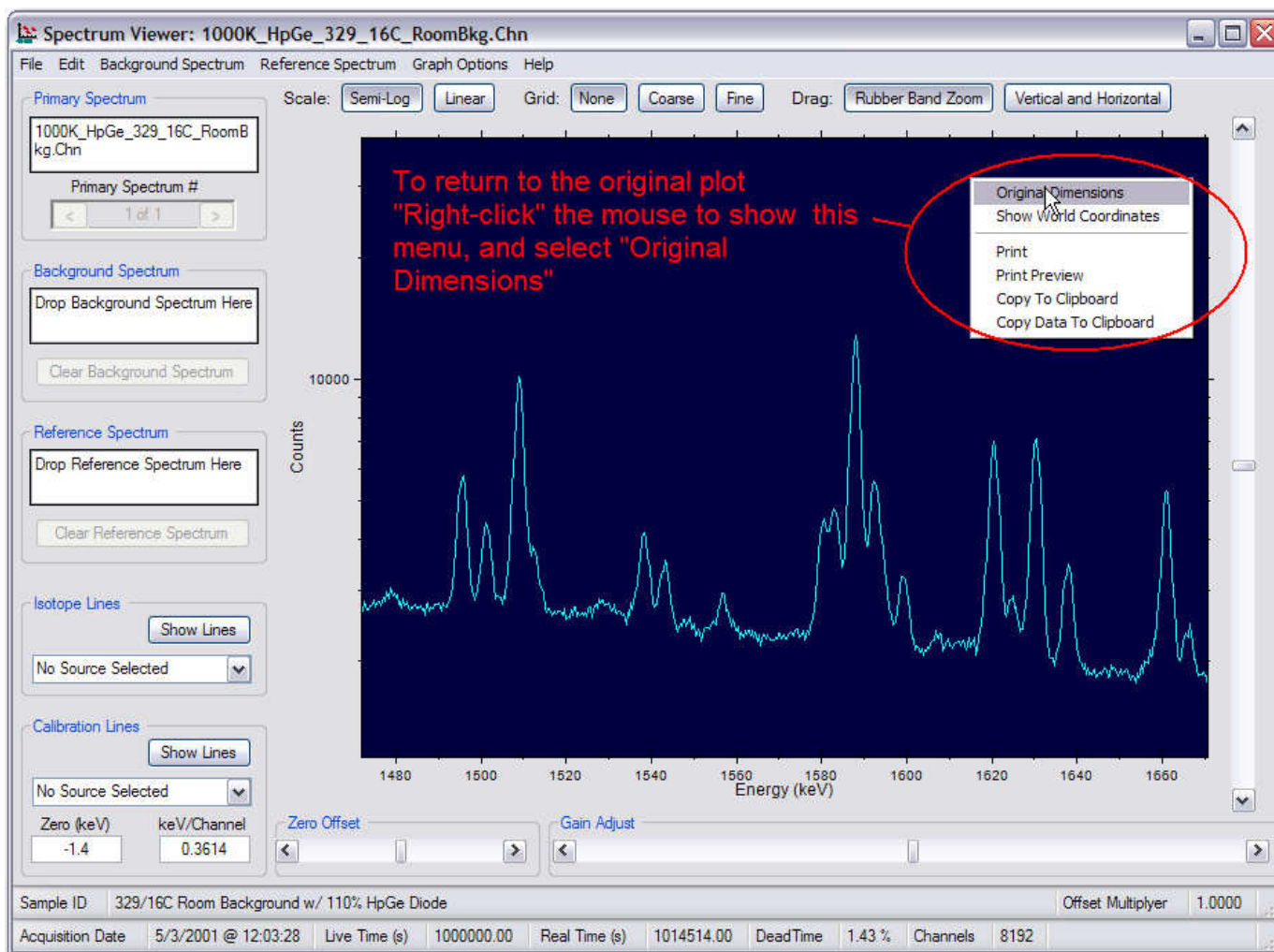
# Rubber Band Zoom



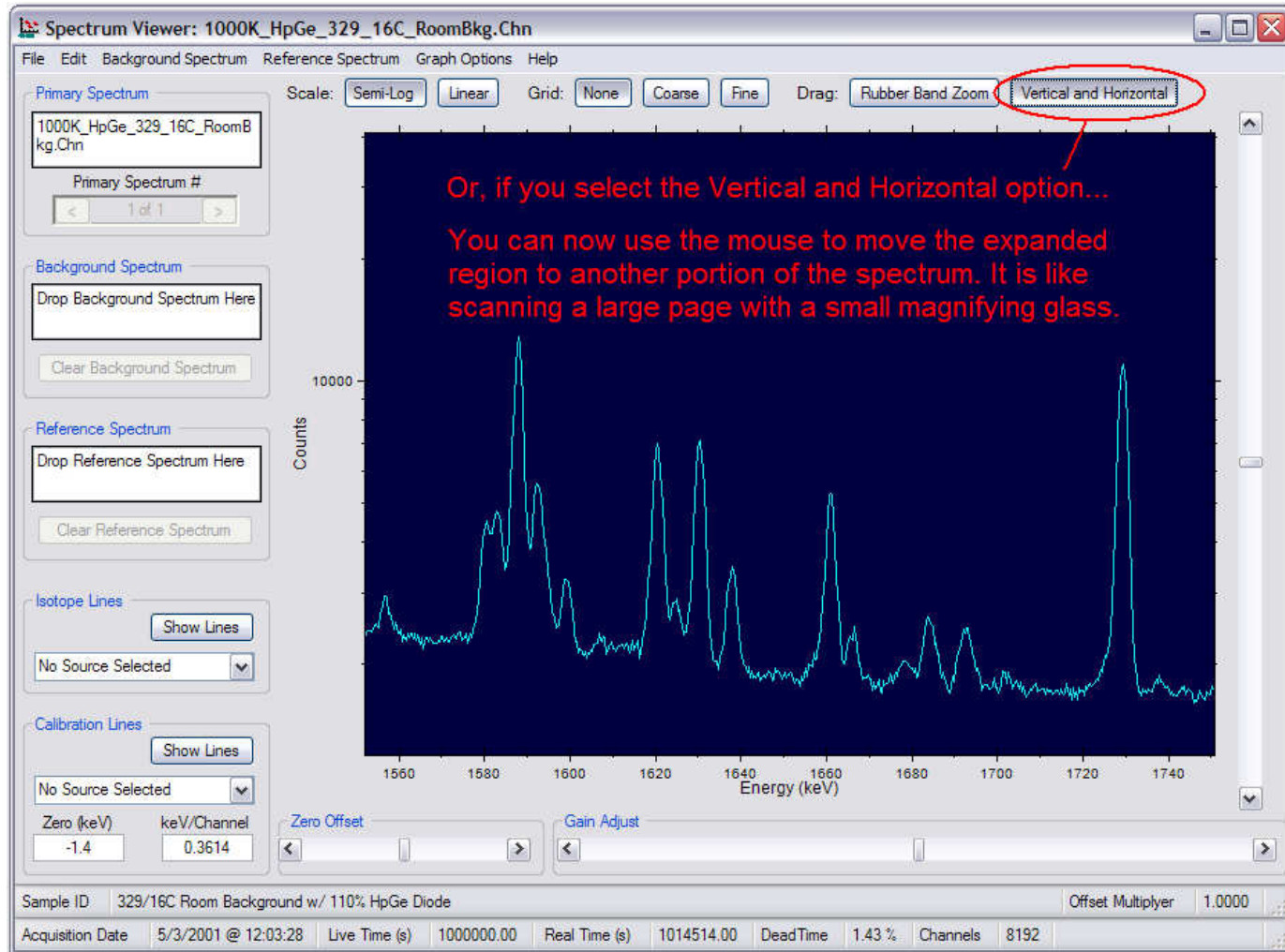
# Rubber Band Zoom



# Rubber Band Zoom



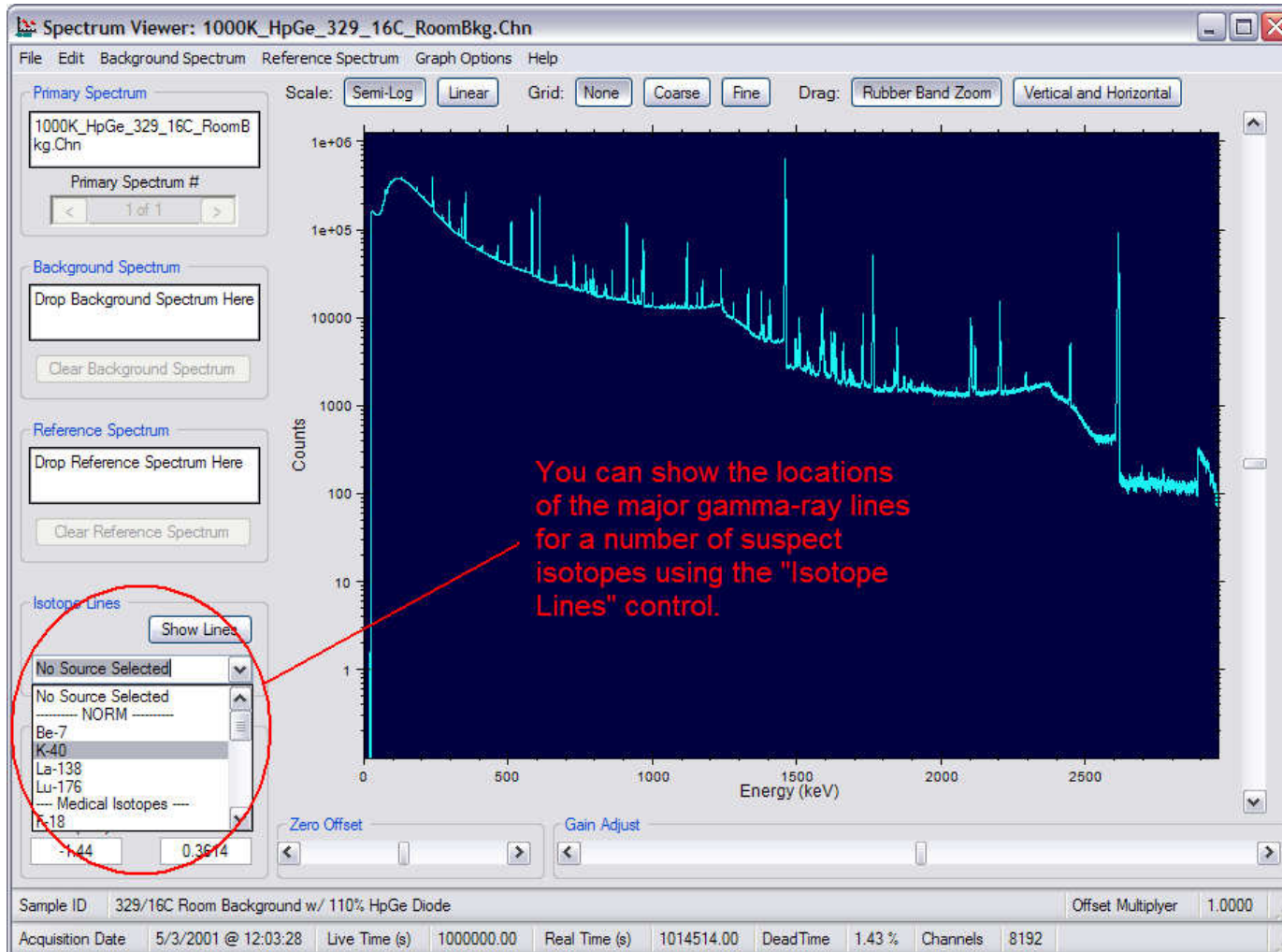
# Vertical and Horizontal “Pan”



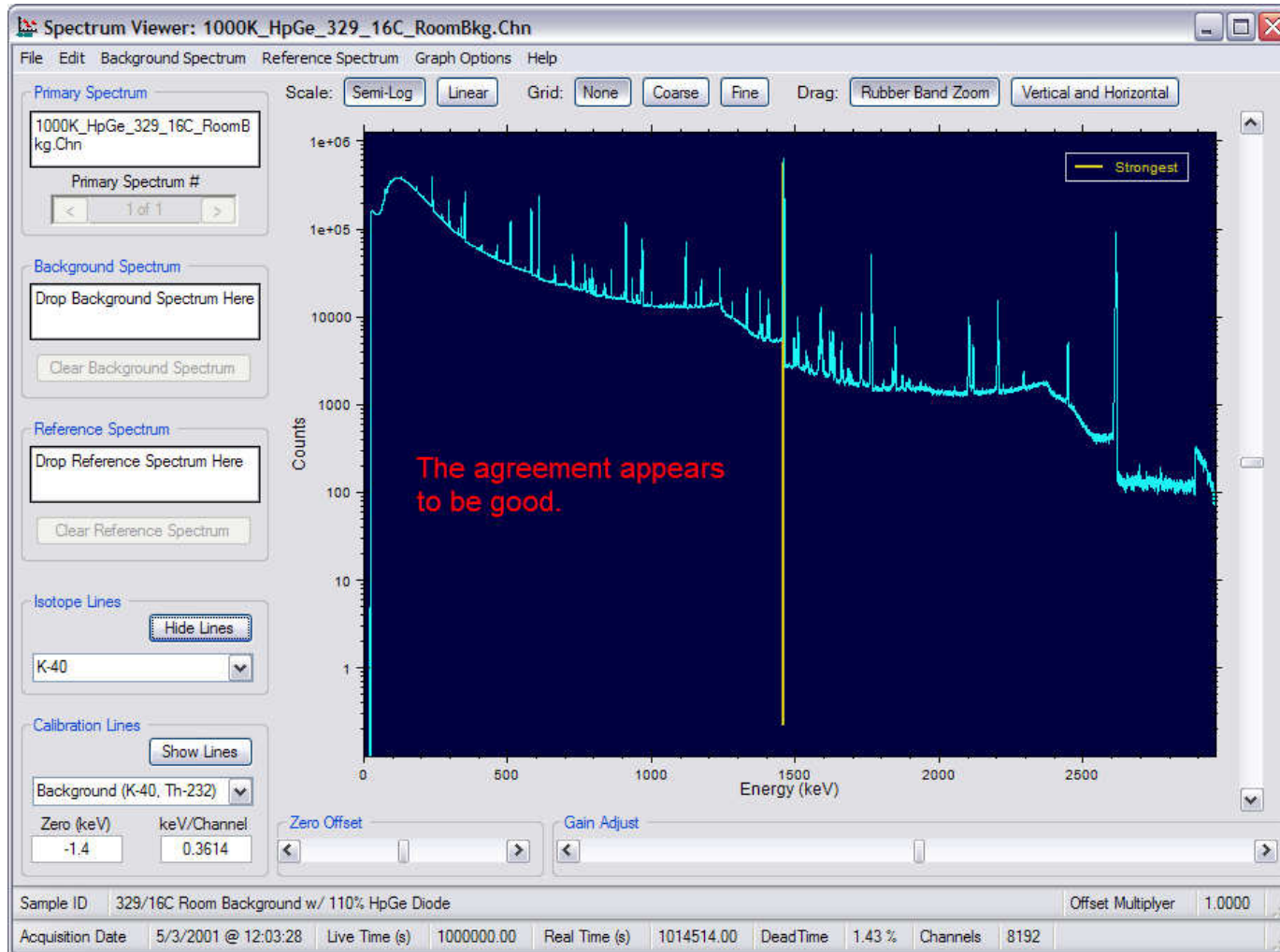
# Known energy lines

- Isotope (suspect) lines
- Energy calibration lines

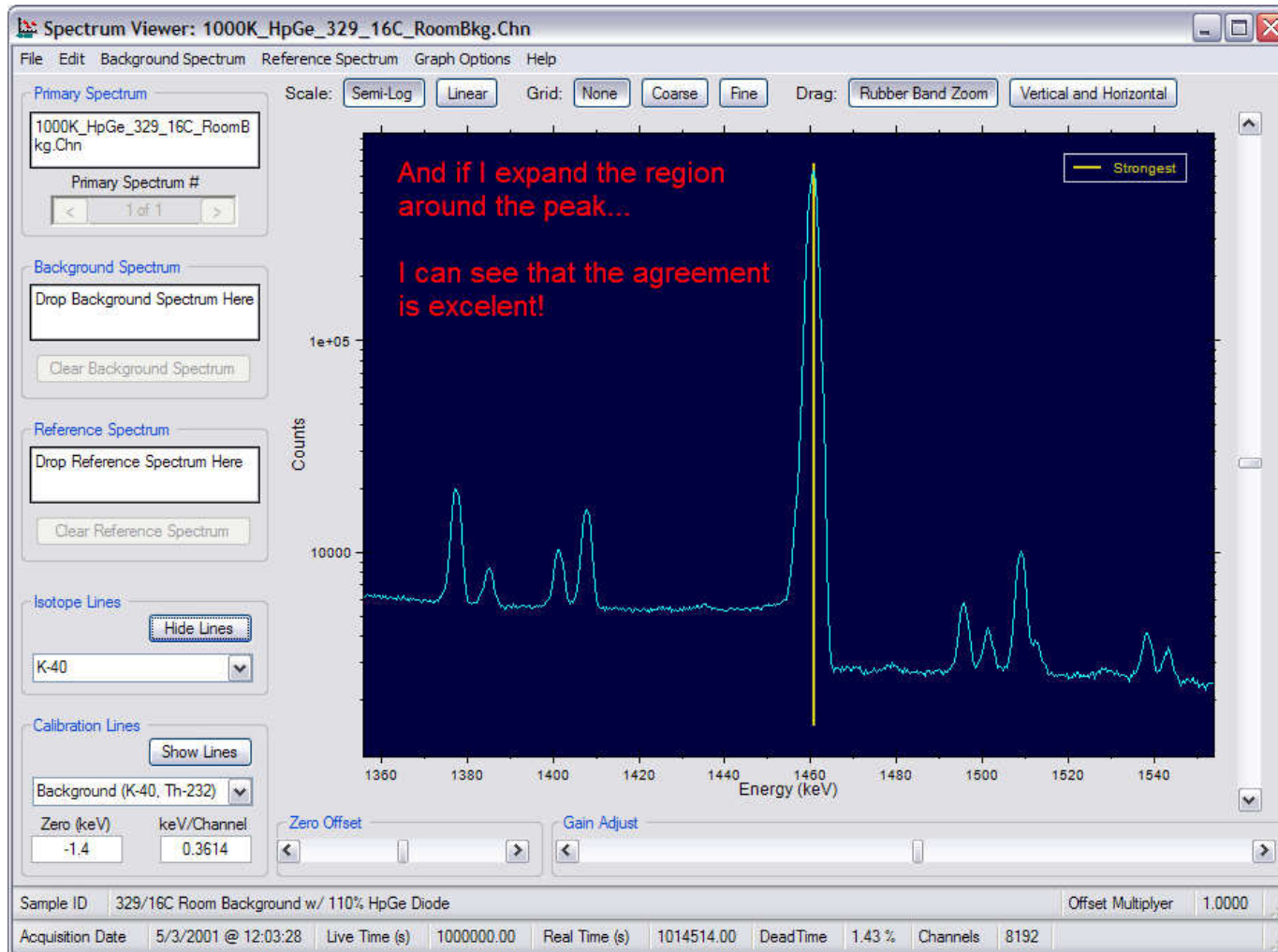
# Isotope lines



# Isotope lines

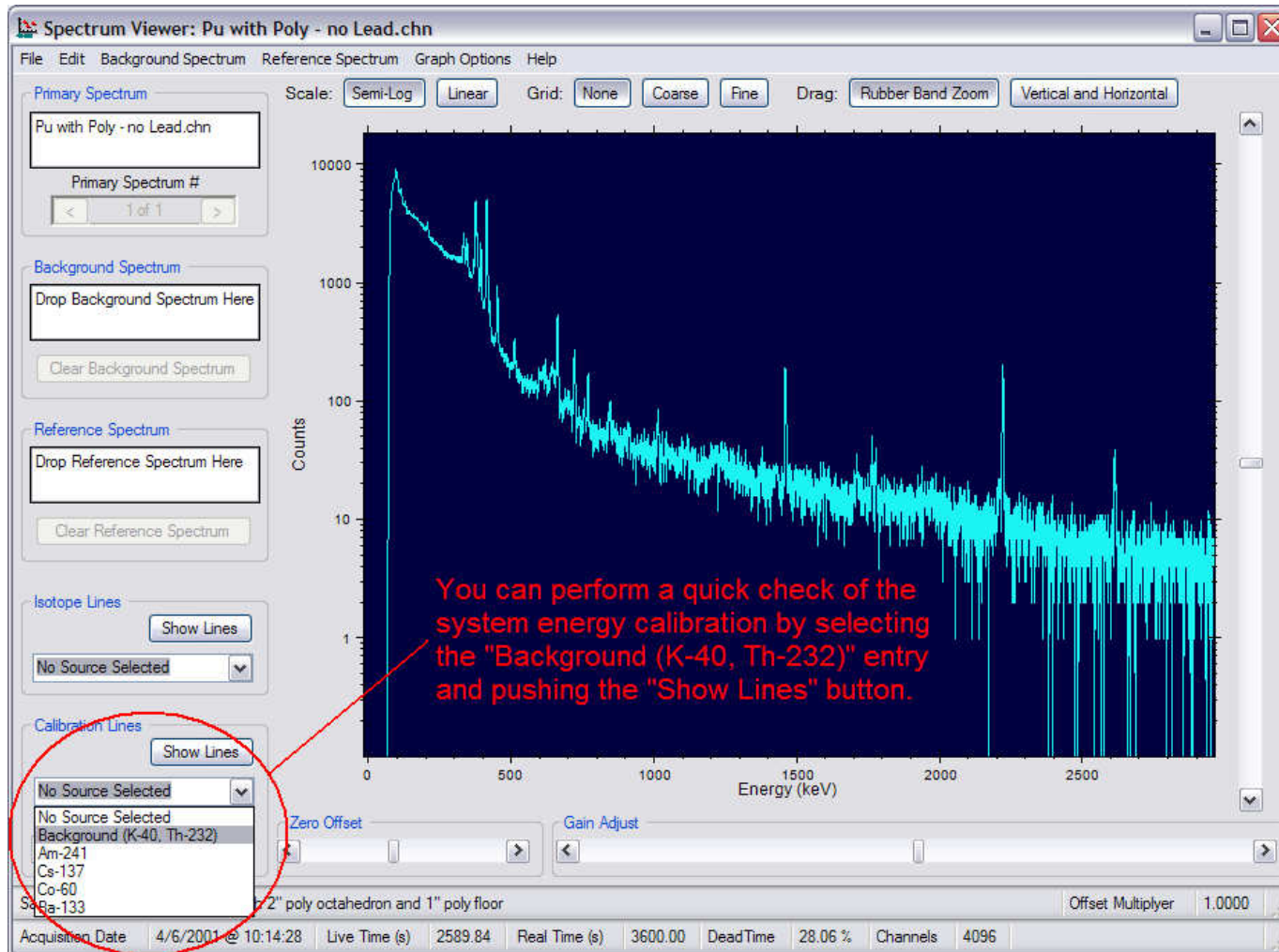


# Isotope lines

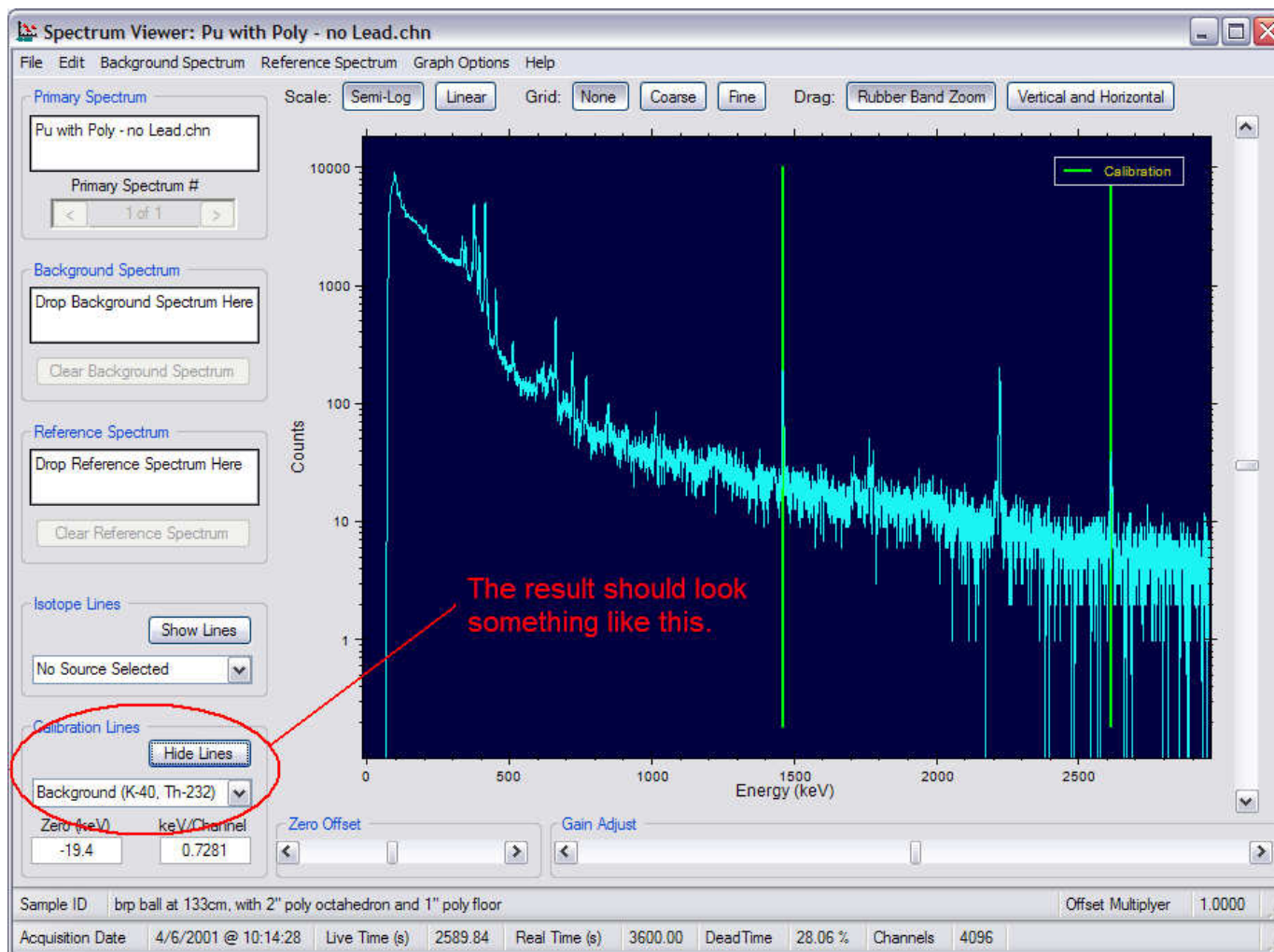




# Energy calibration check...



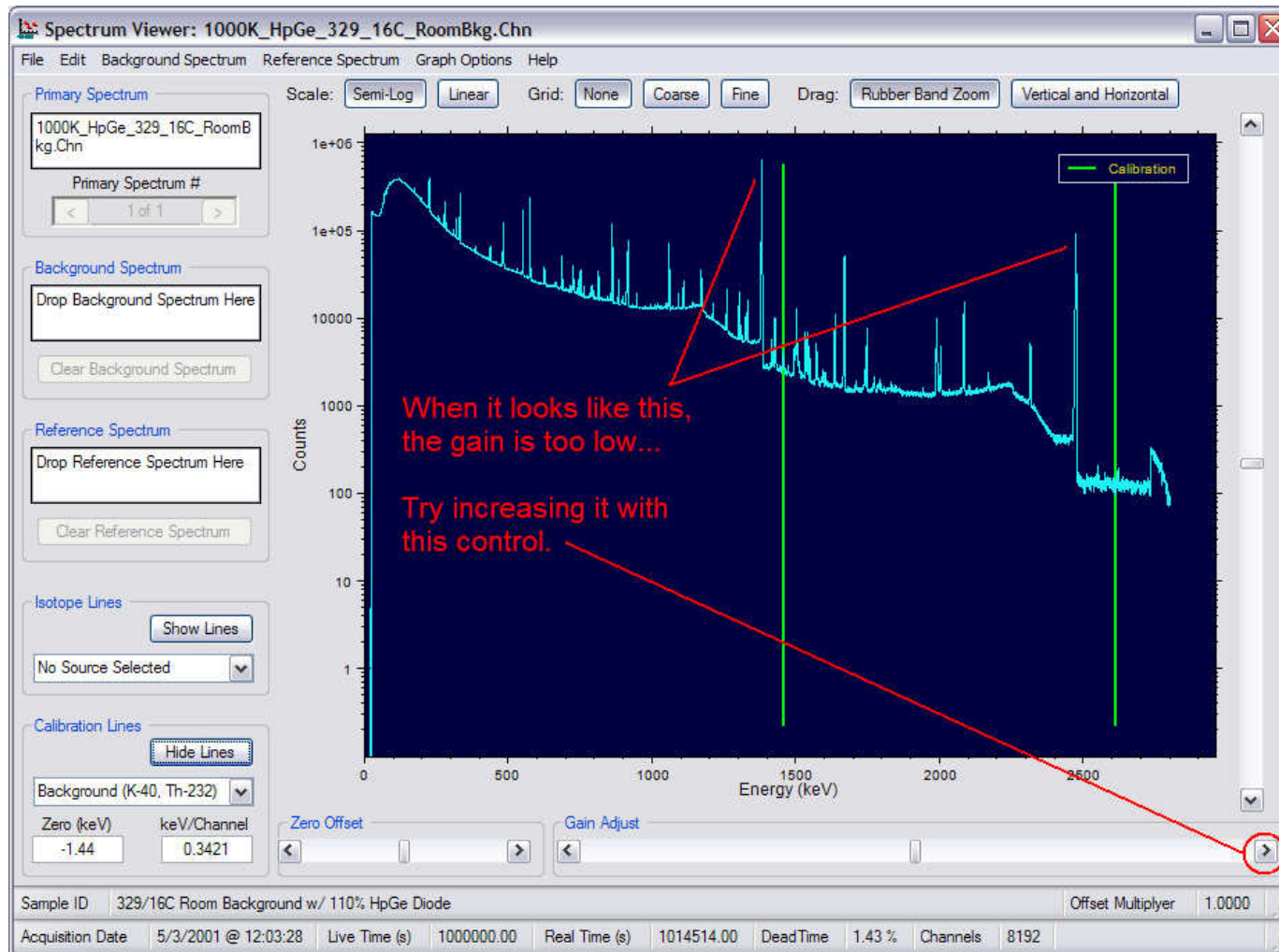
# Energy calibration check...



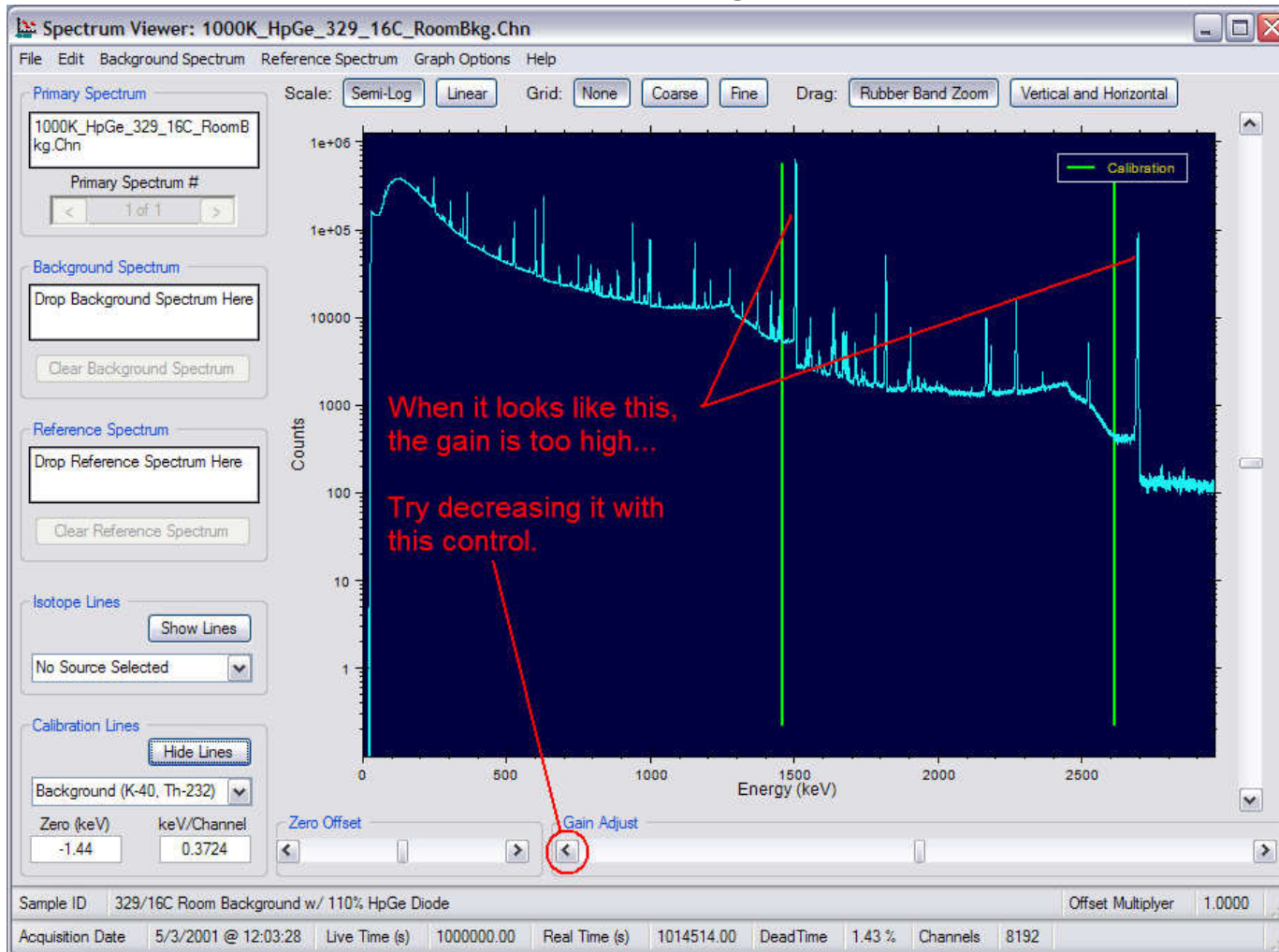
# Energy calibration check...

- If there is not good agreement between the actual and expected locations of the calibration markers (green lines) and the associated peaks in the spectrum, this is a serious problem.
- The first priority is to have the instrument recalibrated.
- Then, there is the possibility that the spectrum has an incorrect energy calibration. Here, you really only have two options.
  - Acquire a new spectrum if at all possible.
  - Change the energy calibration in the existing spectrum.

# Changing the energy calibration with the Gain Adjust controls



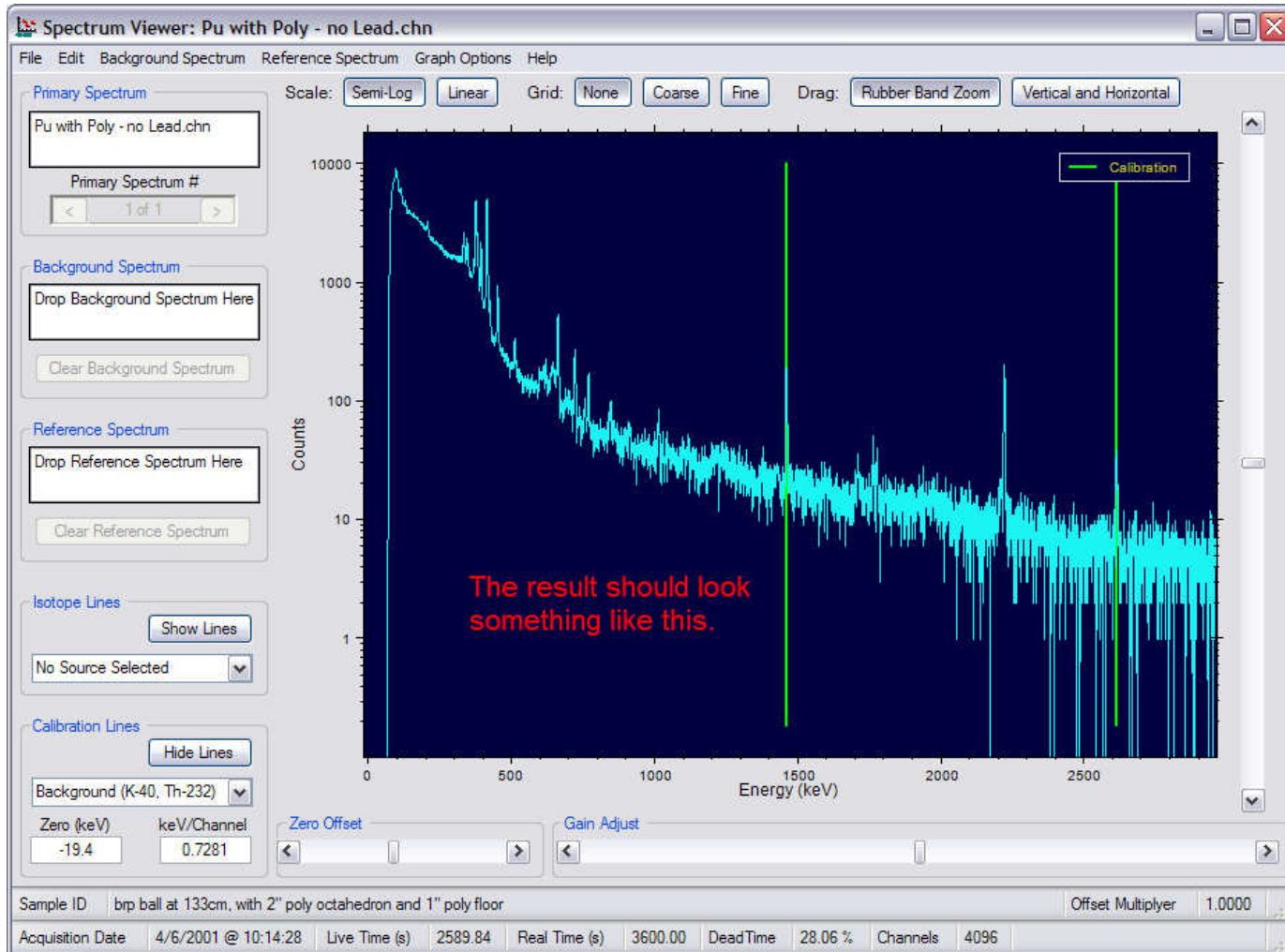
# Changing the energy calibration with the Gain Adjust controls



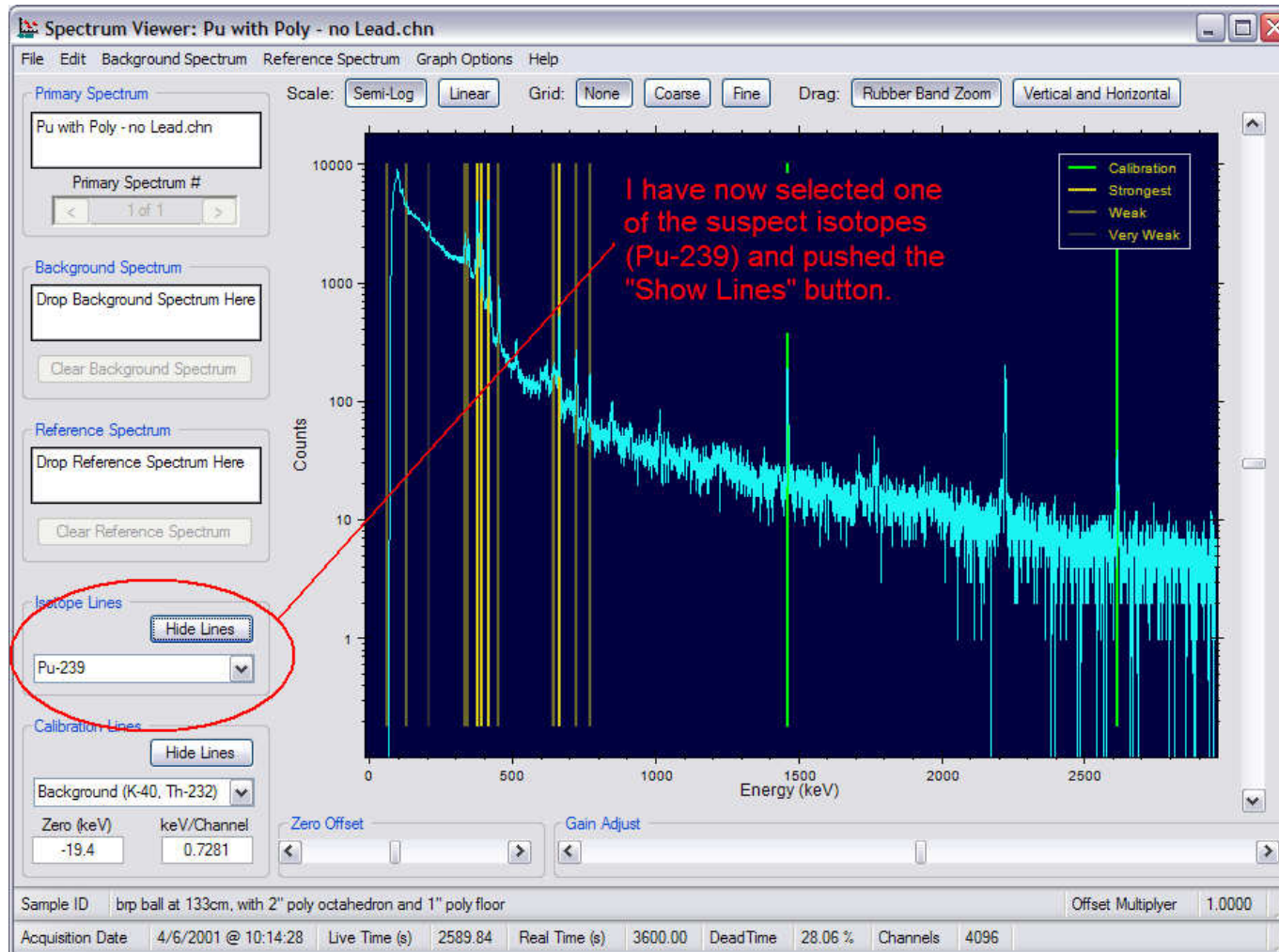
# Analysis Methods

- First, a quick energy calibration check
- Comparison to known energy lines
- Comparison to a reference spectrum
- Comparison to a background spectrum

# Quick energy calibration check

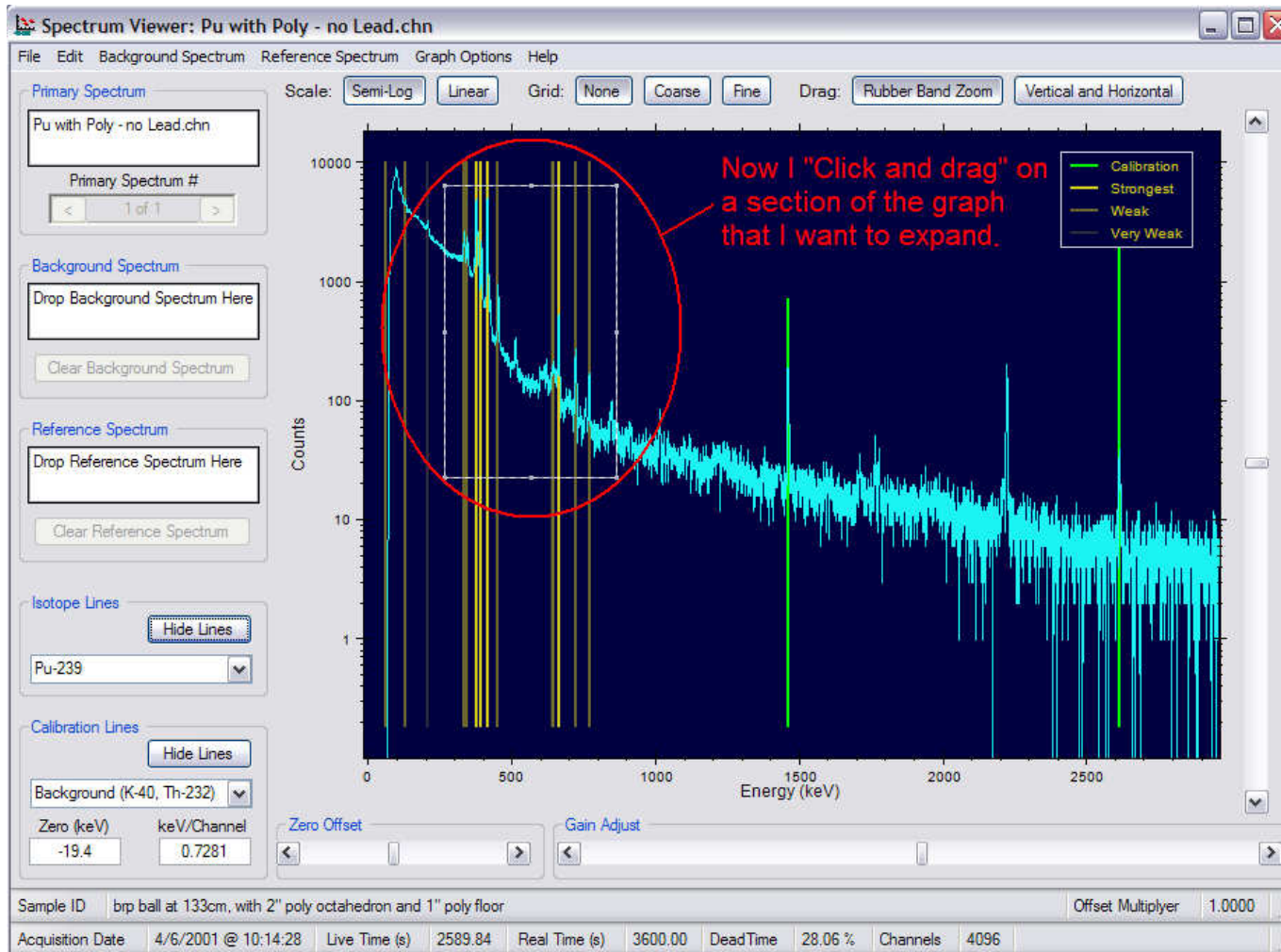


# Comparison to known energy lines...

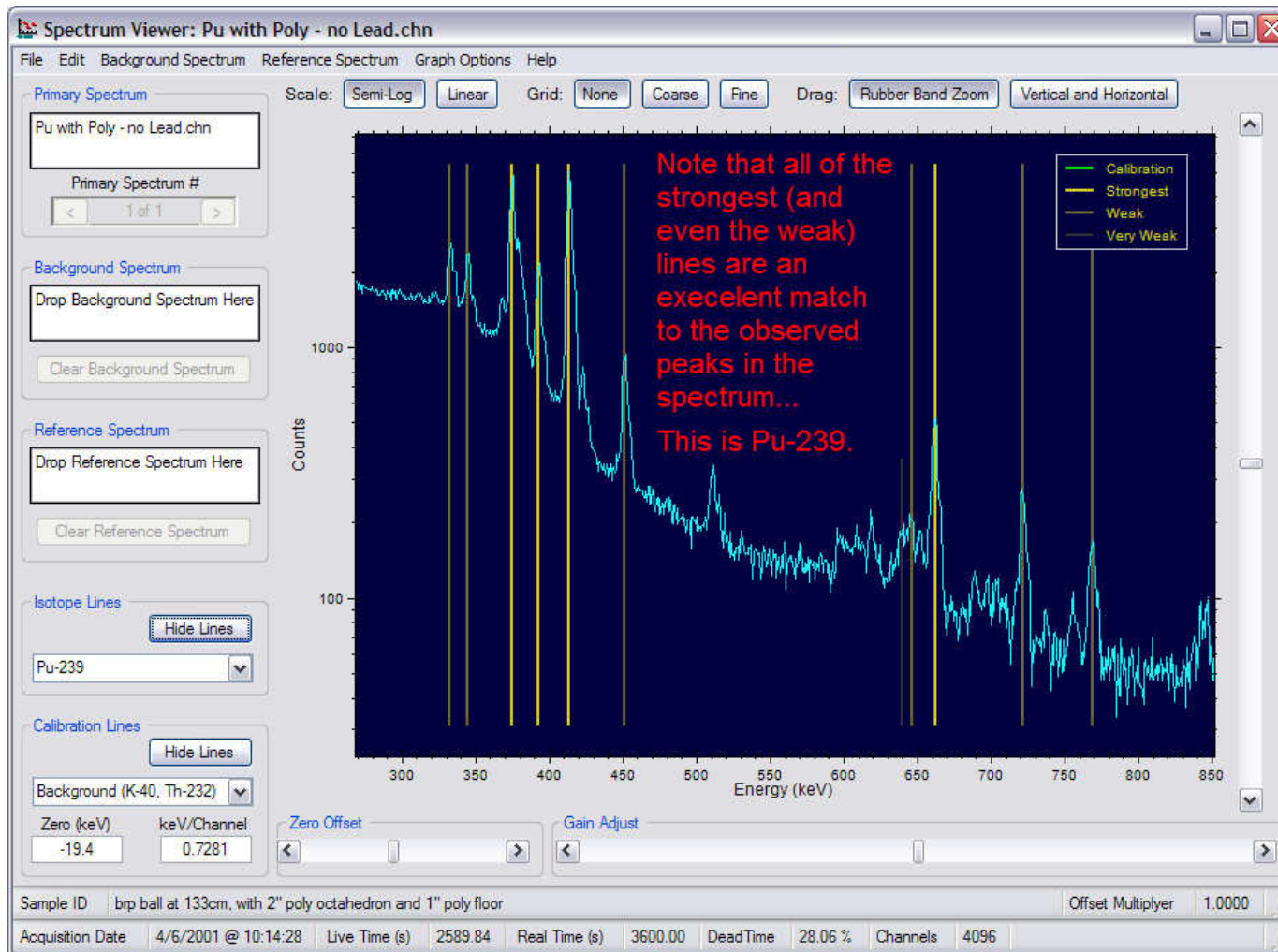




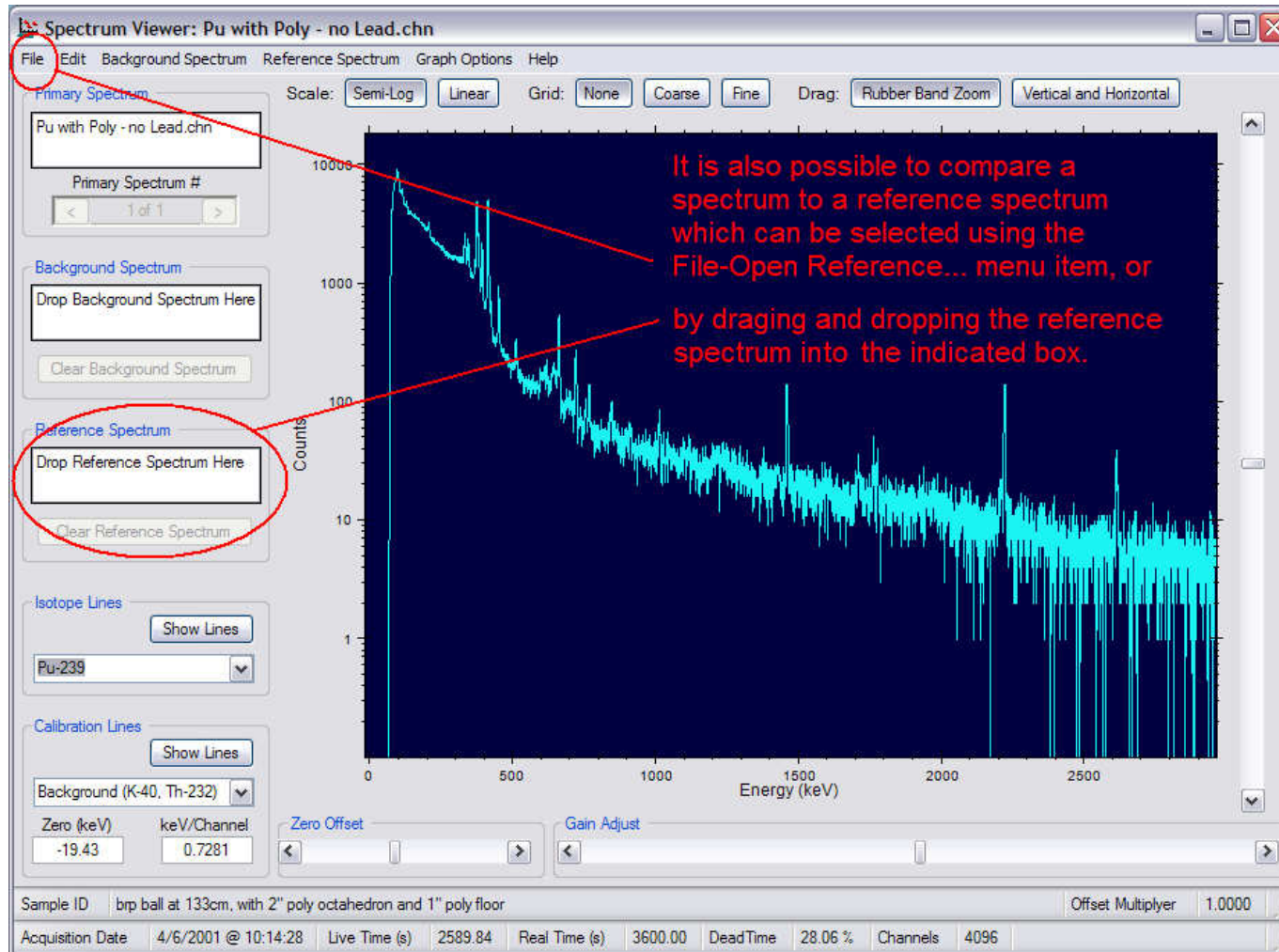
# Comparison to known energy lines...



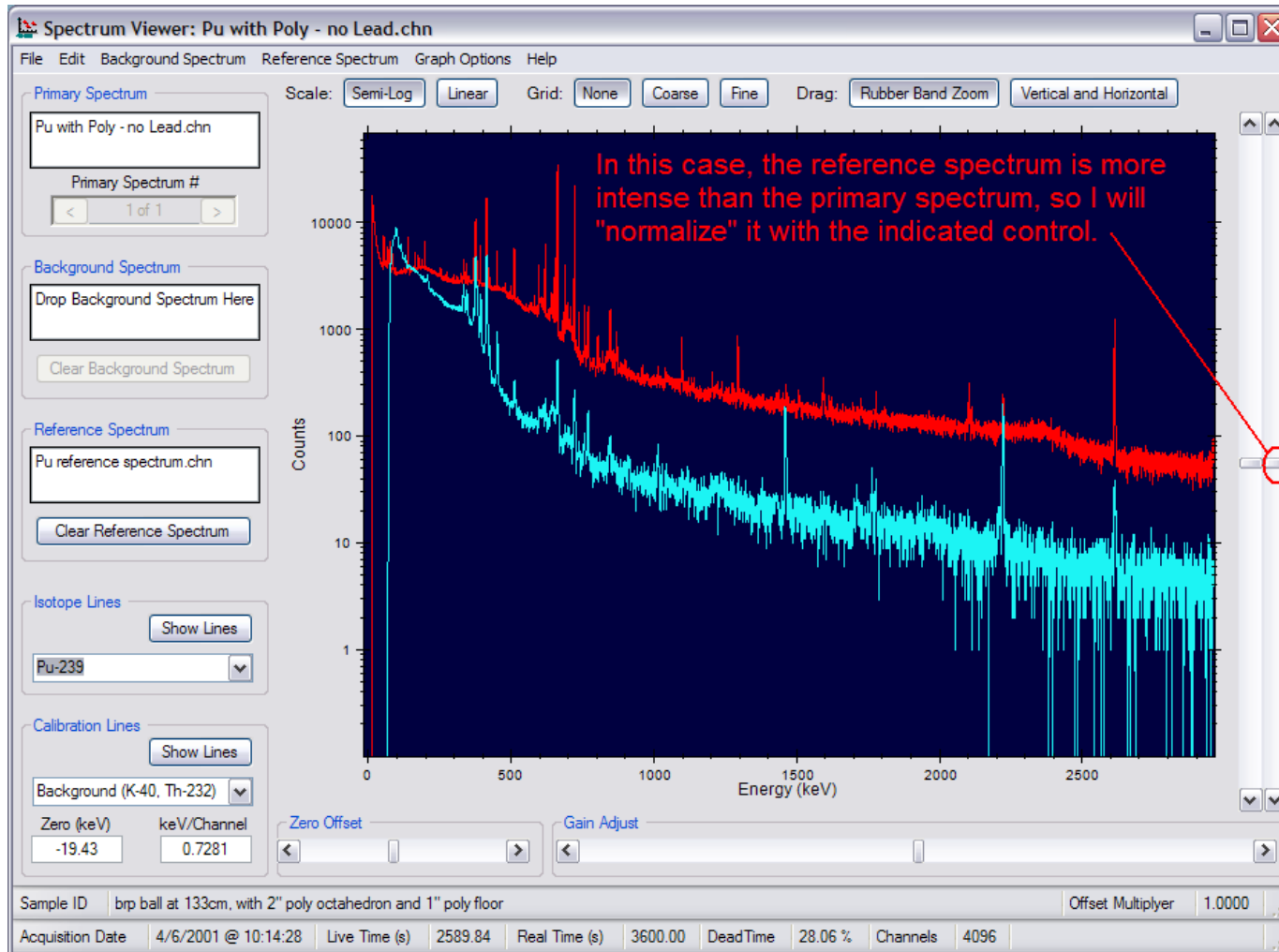
# Comparison to known energy lines...



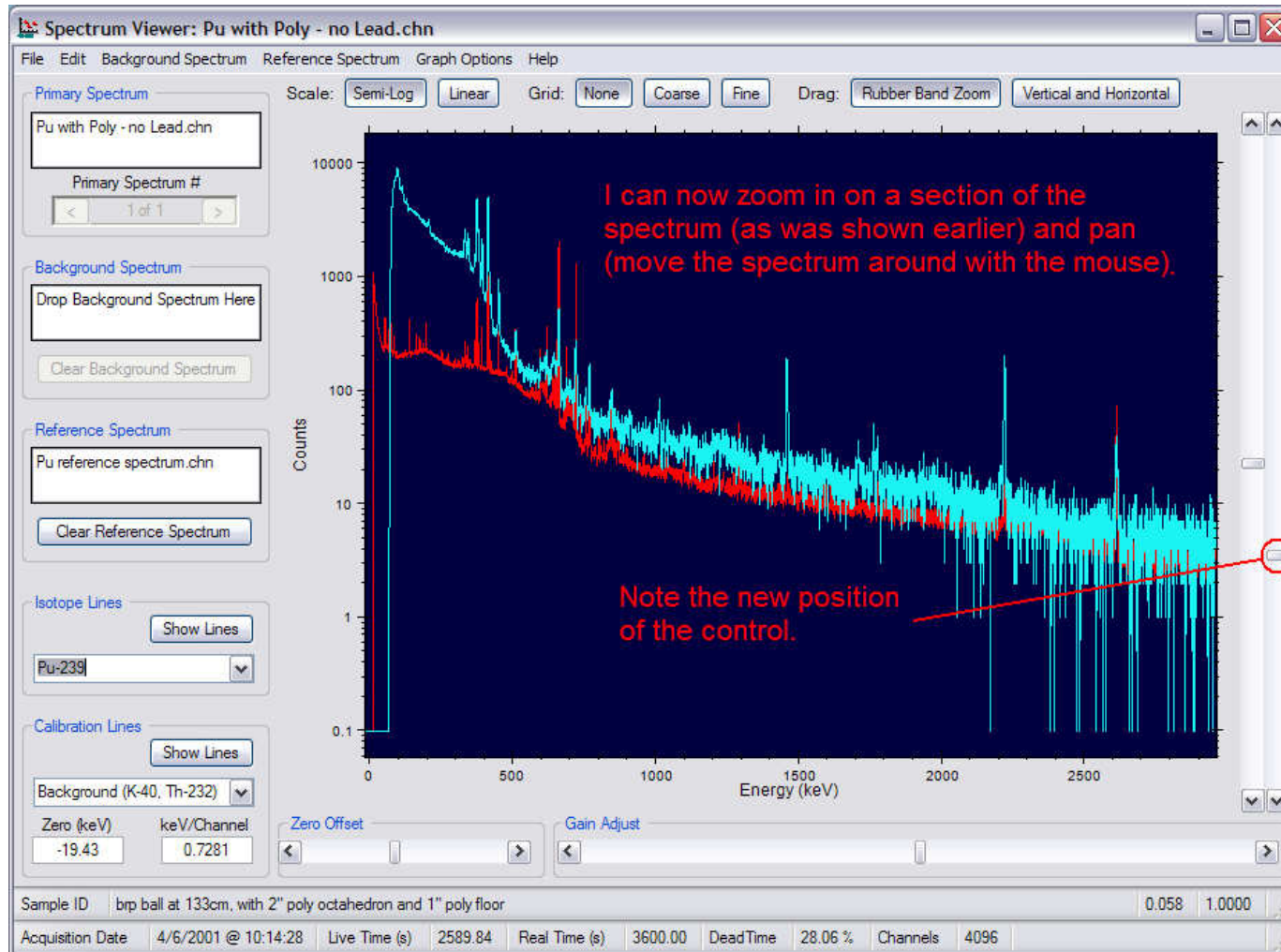
# Comparison to a reference spectrum...



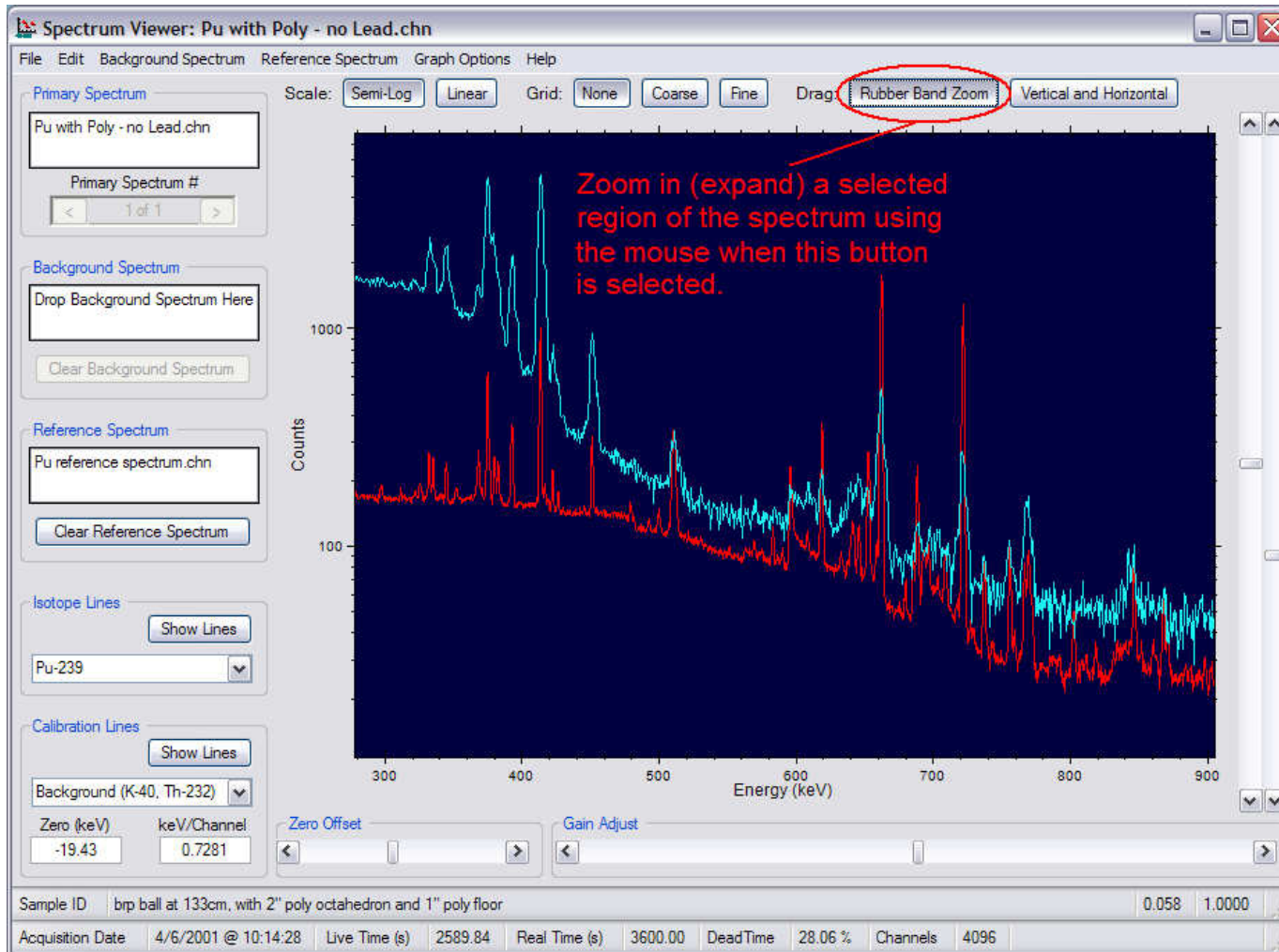
# Comparison to a reference spectrum...



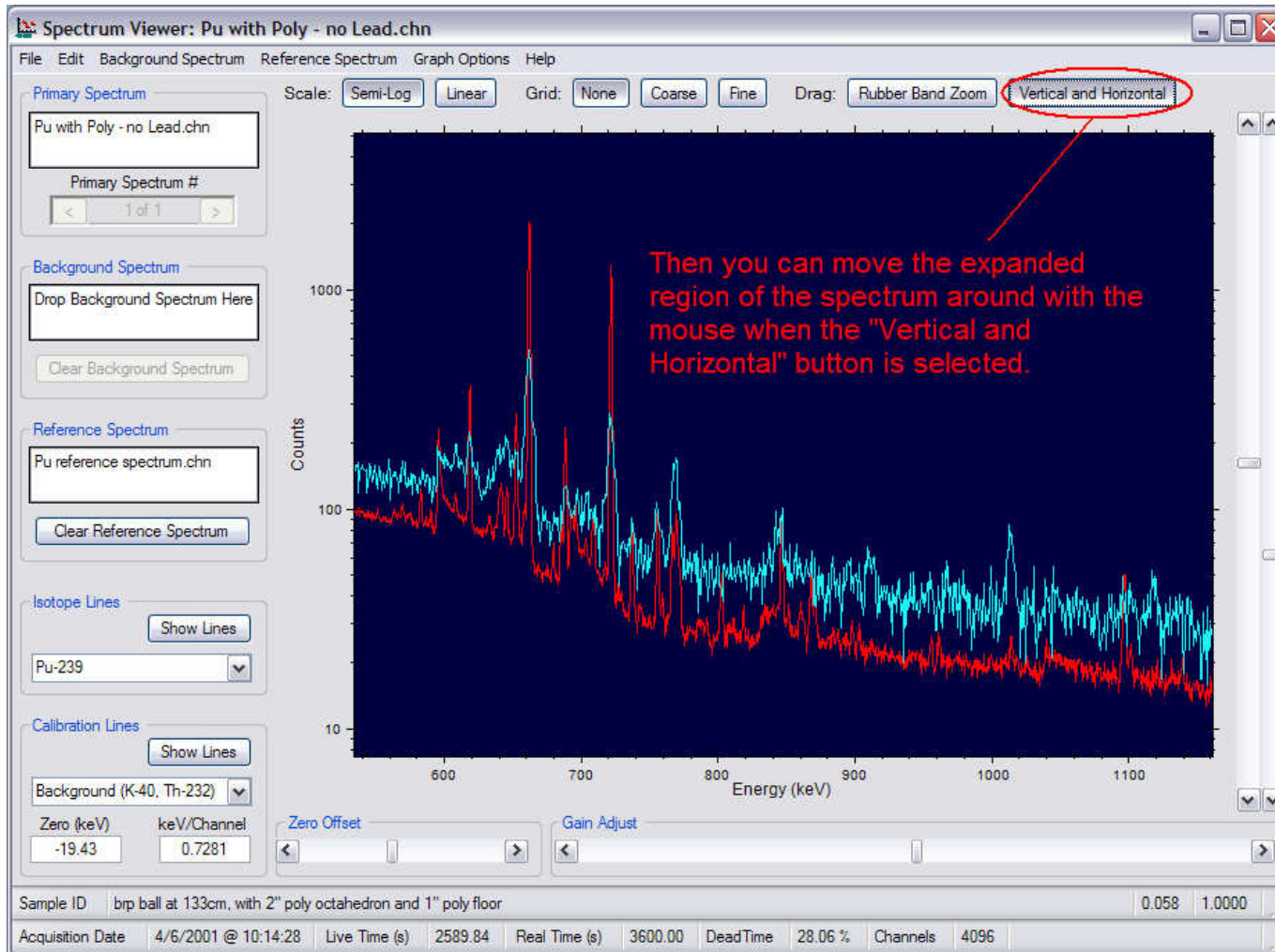
# Comparison to a reference spectrum...



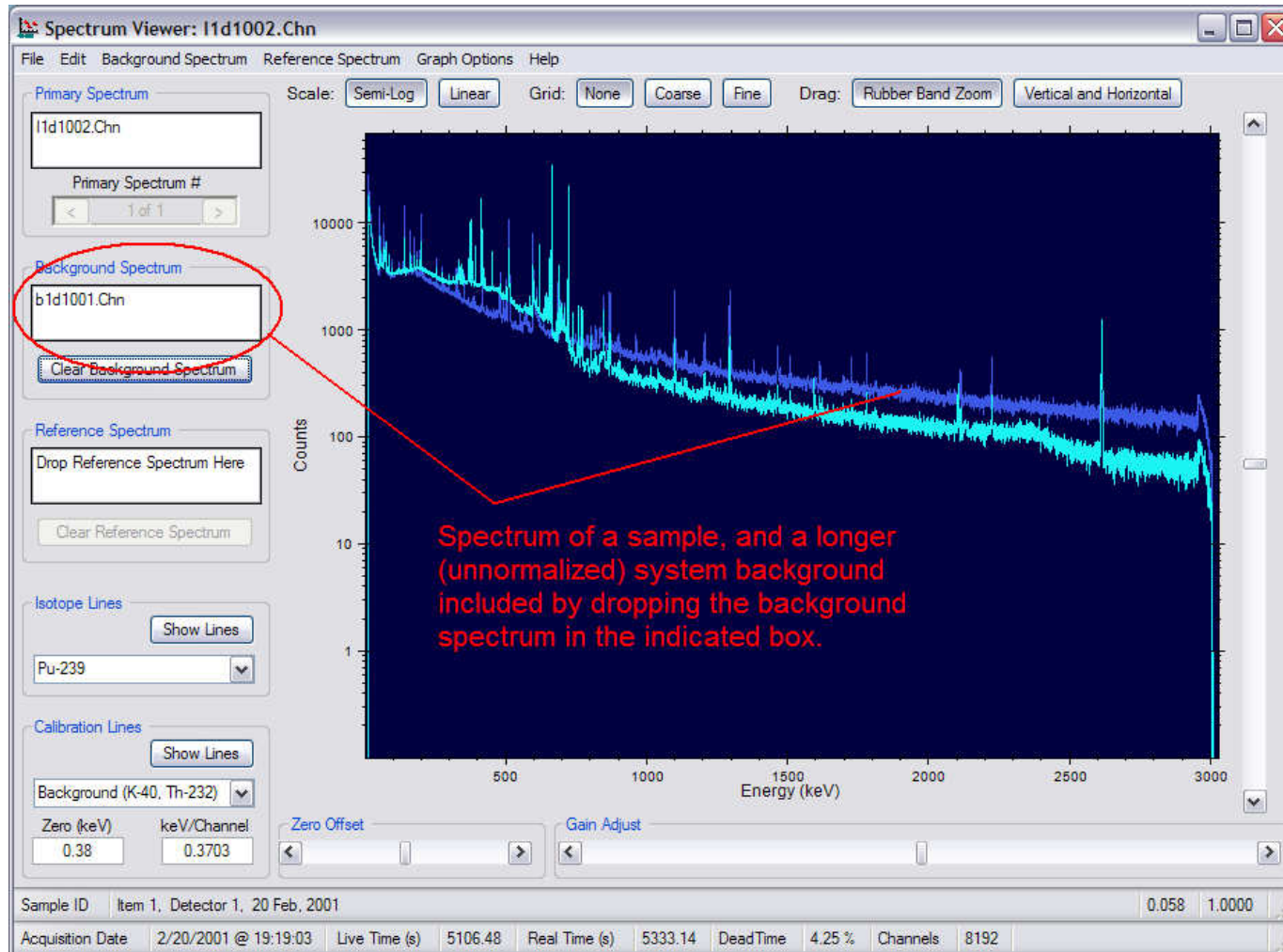
# Comparison to a reference spectrum...



# Comparison to a reference spectrum...

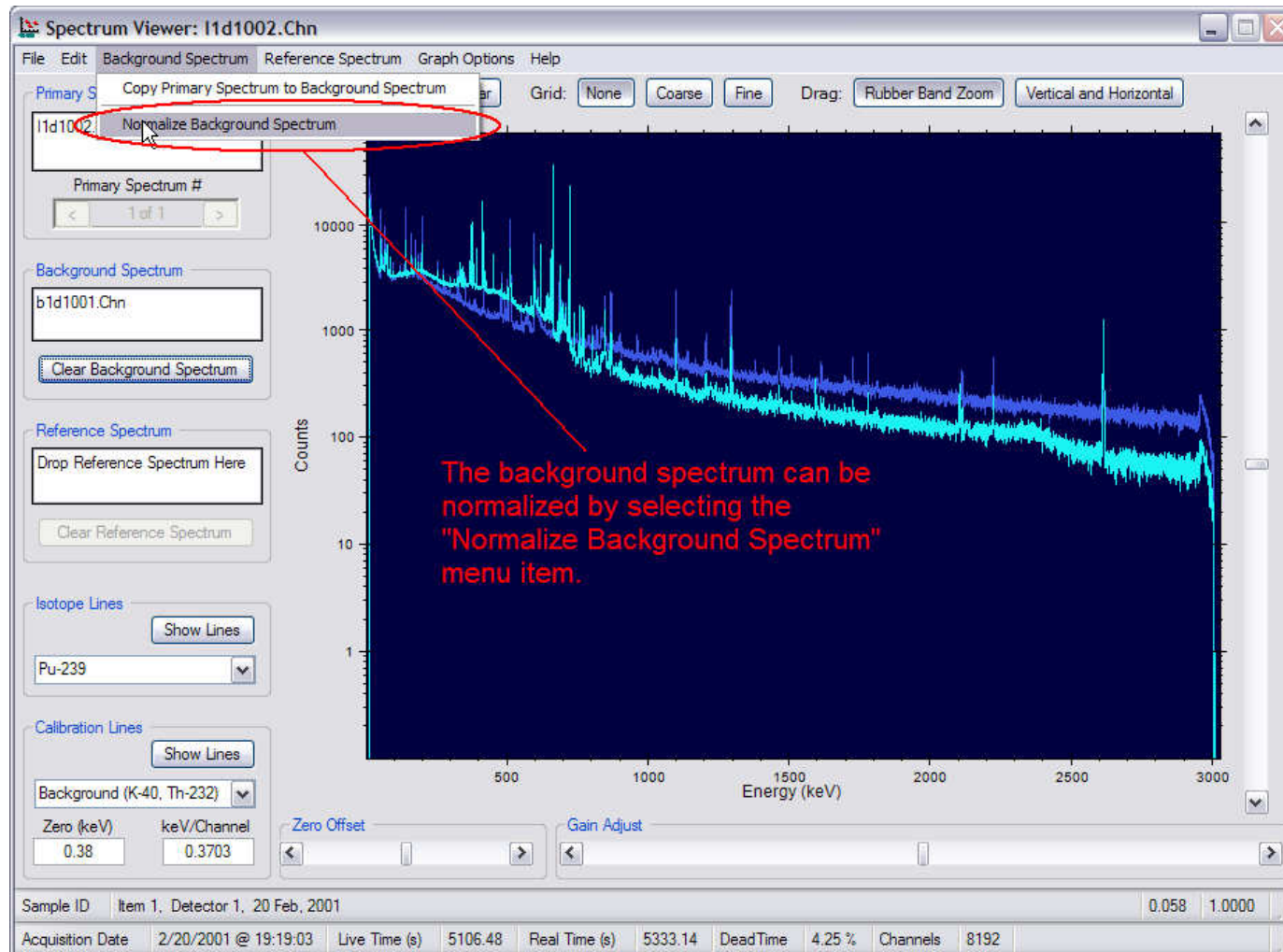


# Comparison to a background spectrum...

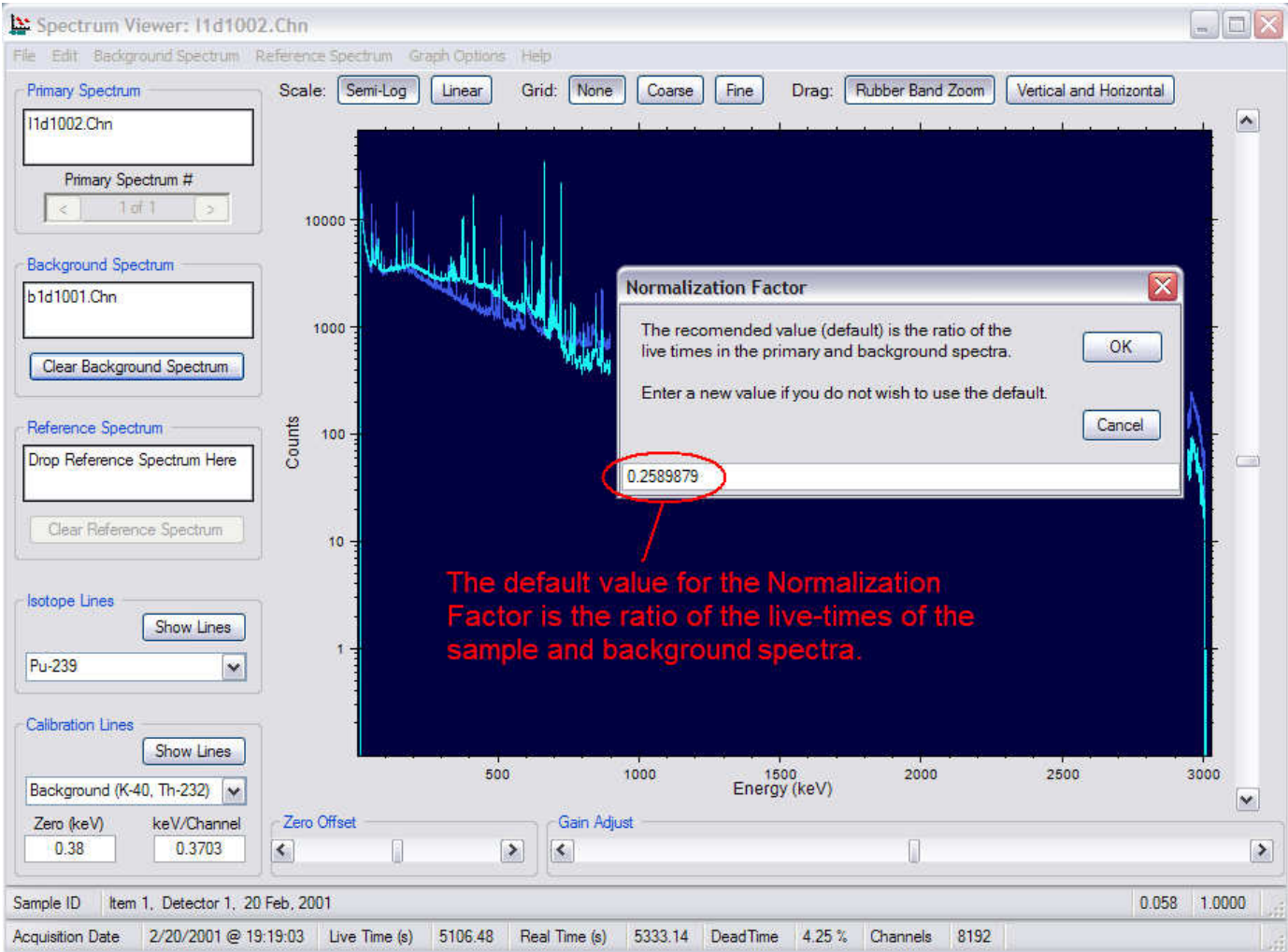




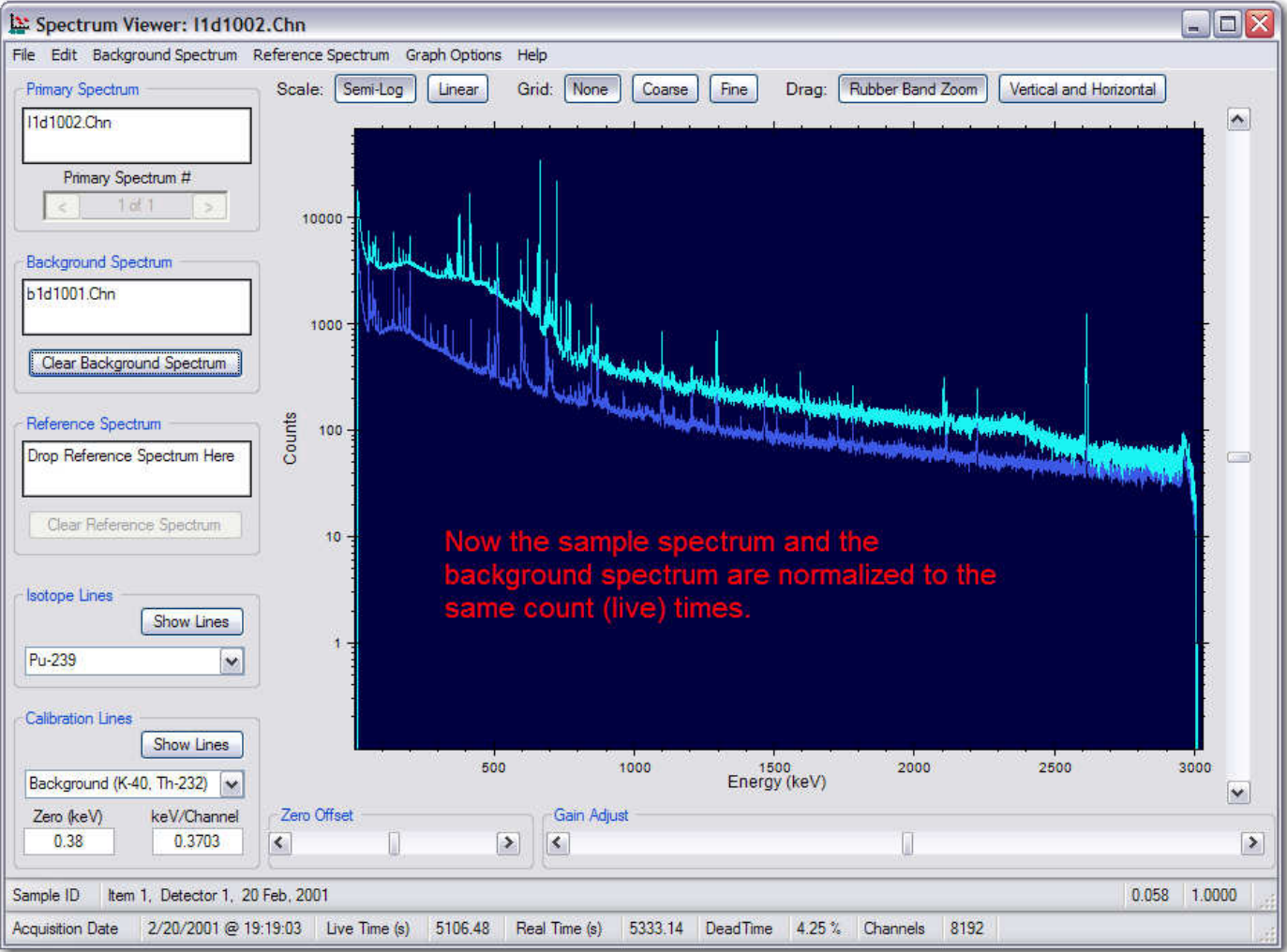
# Comparison to a background spectrum...



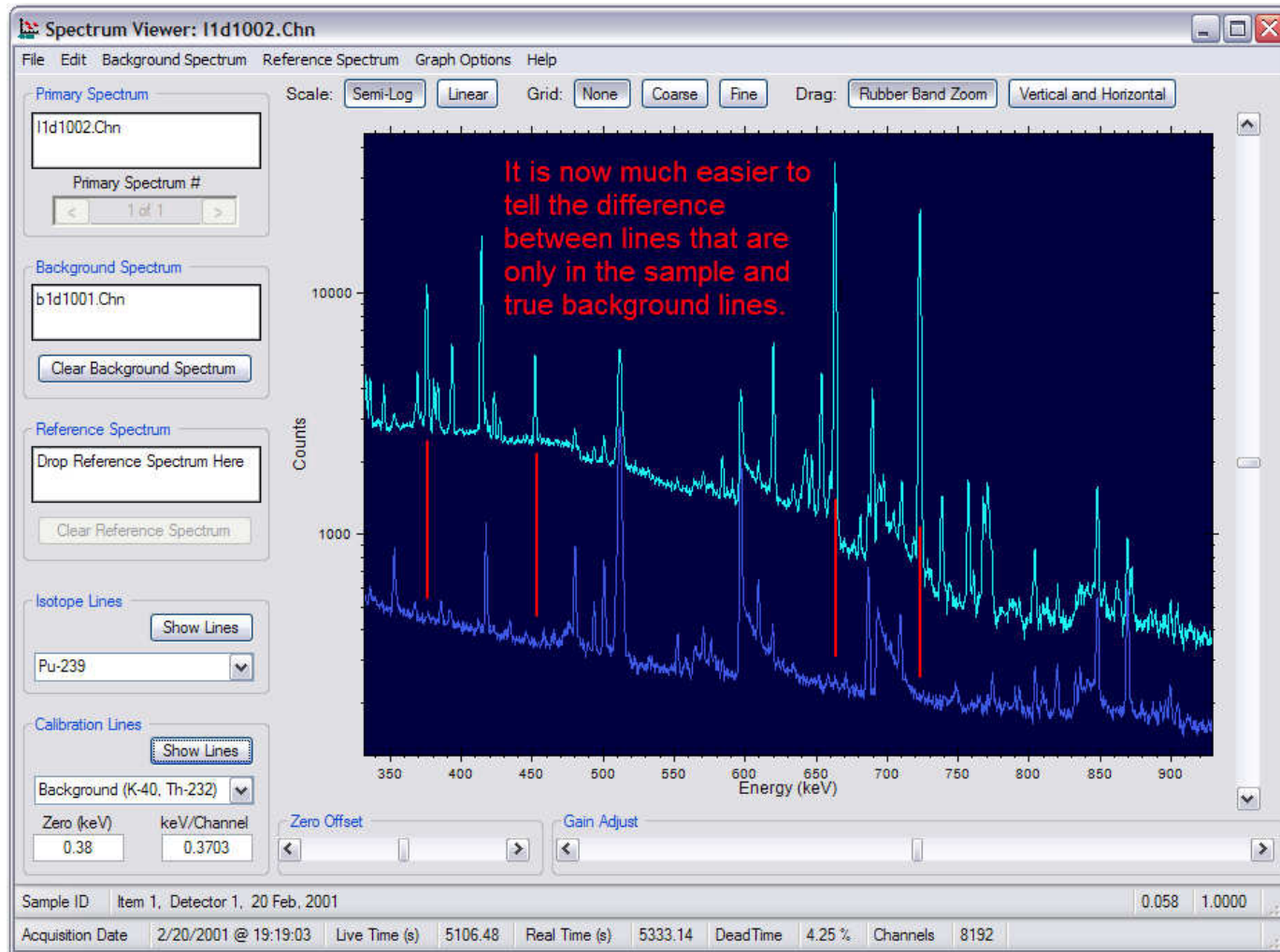
# Comparison to a background spectrum...



# Comparison to a background spectrum...



# Comparison to a background spectrum...



# Analysis Strategy

- Check the energy calibration.
- Look for neutron features in the spectrum:
  - Neutron capture lines
    - H
    - Cd
  - “Shark Fin” features.
- Compare the primary spectrum with the known isotope lines of SNM and other materials of interest (Pu-239, U-235, U-233, and Np-237).
- If you get a match, compare with applicable reference spectrum.

# Summary

- Basic controls and operations of the Spectrum Viewer software
- Three types of spectra
  - Primary
  - Background
  - Reference
- Check the energy calibration
- Comparison of primary spectrum to ...
  - Known isotope lines
  - Reference spectra
- Analysis strategy