Instructions on how to use the WaveDump Wrapper:

Please contact Tomi Akindele (akindele1@llnl.gov) with any questions.

Environment:

WaveDump is used to record the waveforms for all test. All WaveDump runs should be taken while in the ~/Data directory. Due to the size of these files, it is impractical to store individual waveforms for each PMT and test. The digitizer will be in different configurations for the tests. **See WaveDump Documentation**.

The high voltage for the PMTs are controlled using Geaco or through the front face of the HV control. **See Geaco Documentation**.

The CAEN desktop digitizer is used for the dark noise, the 10^7 gain test, relative quantum efficiency, and peak to valley test. A 2 Channel PICO-Scope is used for the after pulsing tests.

The Software written for these tests utilize C++ and ROOT. Each test is contained in a separate folder specified by the name of the test under the Wrapper directory found in one layer below the home directory. In general each test contains an SPE_Gen that generates the SPE, and SPE_Fit which performs the fits for the SPE.

Important File Locations:

Configuration Files: /etc/wavedump/WaveDumpConfig_X742.txt Waveforms and working directory for running WaveDump: ~/Data Analysis Software for Tests: ~/Wrapper

10^7 Gain Test

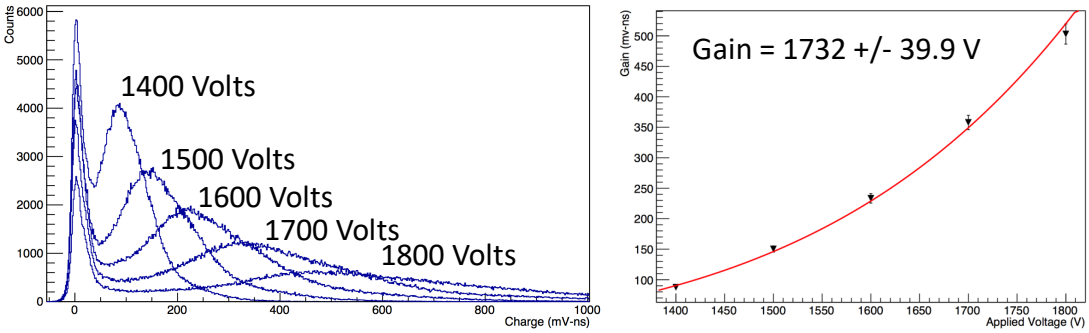
For this test 5 pre-determined HV scans found in the ~/Wrapper/HVScan.txt file will be tested for each

1. Change the sampling rate in the digitizer through the configuration file to 5 GH
2. Turn on the LED.
3. Go to the HVScan.txt file in ~/Wrapper/ you will see 7 columns of text. The first corresponds to the PMT number, 2-6 corresponds to the HV setting, and the last to the Hamamatsu 10^7 gain. 4. Set each PMT to the HV corresponding to the round of the test you are on, and close the file. 5. cd ~/Data folder. Run Wavedump: wavedump /etc/wavedump/WaveDumpConfig_X742.txt

    a. Enter s
    b. Enter c
    c. Enter W

d. Allow for writing for 15 min e. Enter s

4. Go to ~/Wrapper/Gain_Test/
5. Execute the SPE Generator
    a. ./SPE_Gen
    b. Enter the PMT serial number and round of test that you are on. c. This should create and save an SPE spectra in a .root format
6. Continue steps 3-7 for the remaining 4 tests.
7. Execute the spe analyzer. a. ./SPE_Fit
8. This should perform a series of fits to determine the relative quantum efficiency and peak to valley from the previously generated spectra.
9. In the case that the fits do not converge, you may need to manually change the initial parameters in the SPE_Fit.cpp file
10. The tabulated gain for 10^7 should print to screen: record this value.



Example output from the Gain tests. The SPE_Gen code will specifically generate SPE spectra. While the SPE_Fit will fit individual histograms as well as the gain curve.

Dark Counts:

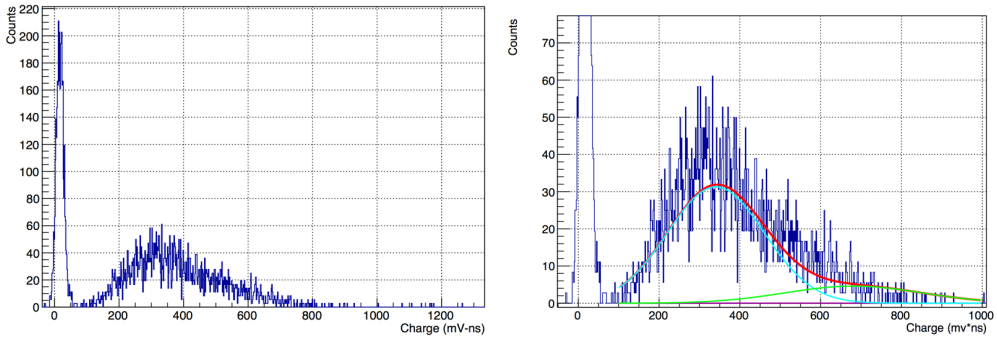
1. Change the sampling rate in the digitizer through the configuration file to 1 GHz.
2. Turn off the LED but continue to allow the pulse generator to trigger the digitizer.
3. Ensure the PMTs are set to 10^7 gain
4. Run Wavedump: wavedump /etc/wavedump/WaveDumpConfig_X742.txt

    a. Enter s
    b. Enter c
    c. Enter W
    d. Allow for writing for 15 min e. Enter s

5. Go to ~/Wrapper/Darknoise/
6. Execute the SPE Generator

a. ./SPE_Gen
b. Enter the PMT serial number and voltage as set by the
c. This should create and save an SPE spectra in a .root format

7. Execute the Dark noise analyzer. a. ./SPE_DarkNoise
    2. This should perform a series of fits to determine the dark counts from the previously generated fits.
    3. In the case that the fits do not converge, you may need to manually change the initial parameters in the DarkNoise.cpp file
    4. Go to line ***** and change the initial fit
    5. The tabulated dark noise should print to screen: record this value.



Example output from the dark noise tests.

Single Photo-Electron Analysis (Relative Quantum Efficiency + Peak to Valley):

1. Change the sampling rate in the digitizer through the configuration file to 5 GHz.
2. Turn on the LED.
3. Ensure the PMTs are set to 10^7 gain
4. Run Wavedump: wavedump /etc/wavedump/WaveDumpConfig_X742.txt

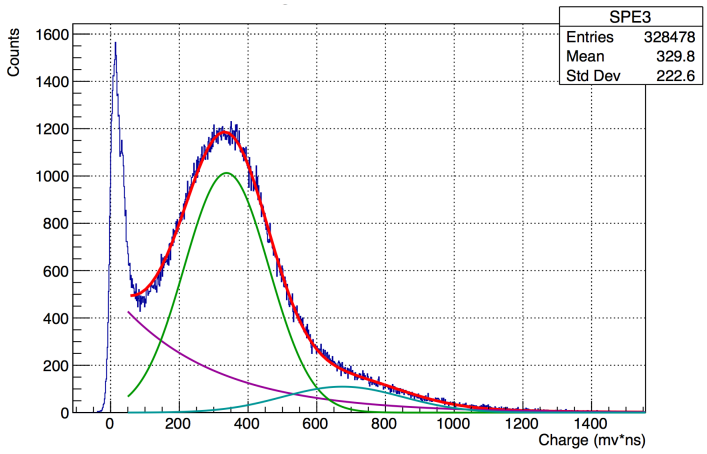
    a. Enter s
    b. Enter c
    c. Enter W
    d. Allow for writing for 15 min

    e. Enter s

5. Go to ~/Wrapper/SPE_Analysis/
6. Execute the SPE Generator

    a. ./SPE_Gen
    b. Enter the PMT serial number and voltage as set by the
    c. This should create and save an SPE spectra in a .root format

7. Execute the spe analyzer. a. ./SPE_Analyzer
    a. This should perform a series of fits to determine the relative quantum efficiency and peak to valley from the previously generated spectra.
    b. In the case that the fits do not converge, you may need to manually change the initial parameters in the SPE_Analyzer.cpp file
    c. Go to line ***** and change the initial fit
    d. The tabulated quantum efficiency and peak to valley should print to screen: record these two values.



Example output from the SPE Analysis Test.

After-Pulsing

1. Move the signal input from the desktop digitizer to the VME digitizer

5. Run wavedump: wavedump

    a. Enter s
    b. Enter c
    c. Enter W
    d. Allow for writing for 15 min

    e. Enter s

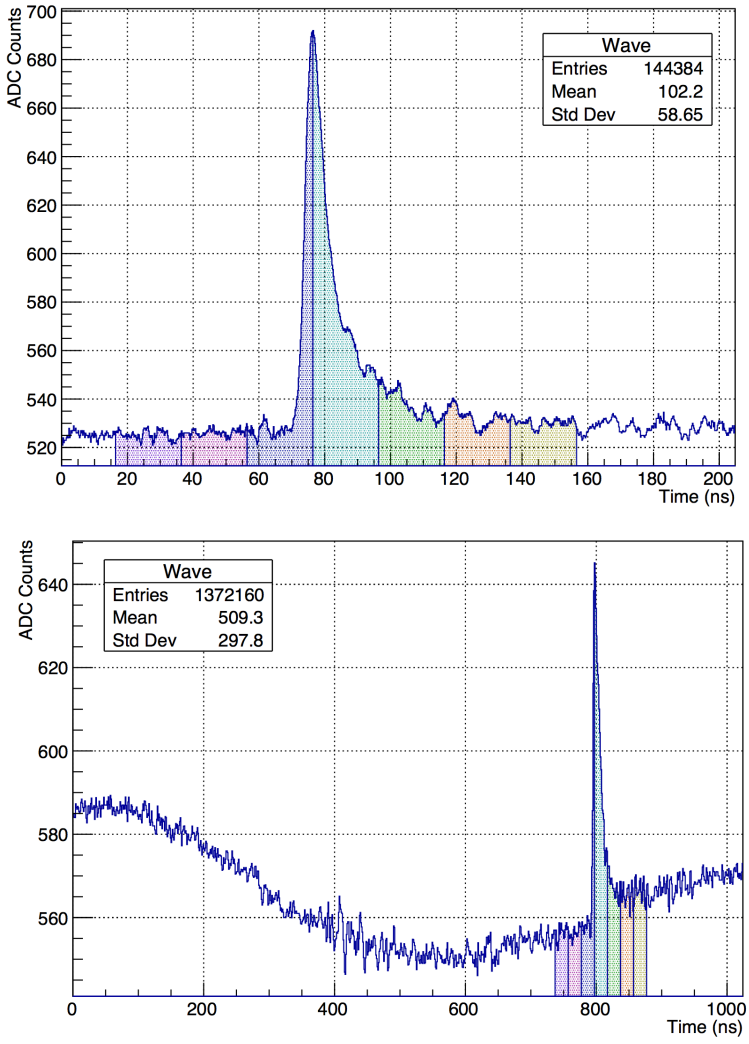
8. Go to ~/Wrapper/After_Pulses/
9. Execute the SPE Generator

    a. ./SPE_Gen
    b. Enter the PMT serial number and voltage as set by the
    c. This should create and save an SPE spectra in a .root format

10. Execute the fitter: ./Time_Fit
    a. This should list the time of the four most prominent after pulses and their relative intensities. record these values.

Wave Fitter

In the ~/ Wrapper/After_Pulsing, ~/ Wrapper/Dark_Rate, and the ~/Wrapper (used for the SPE_Analysis and the Gain_Test) a waveform visualizer/peak finder is in the wave_fitter.cpp executable.



Examples of the wave_fitter visualization