

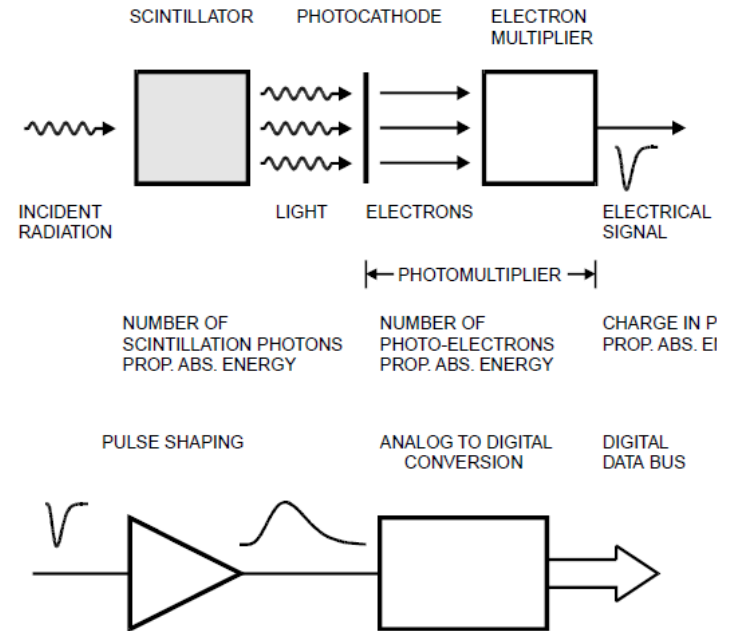
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Pulse Shape and Signal Processing for Neutron and Gamma Energy Sources



Neutron Spectroscopy Using CLYC

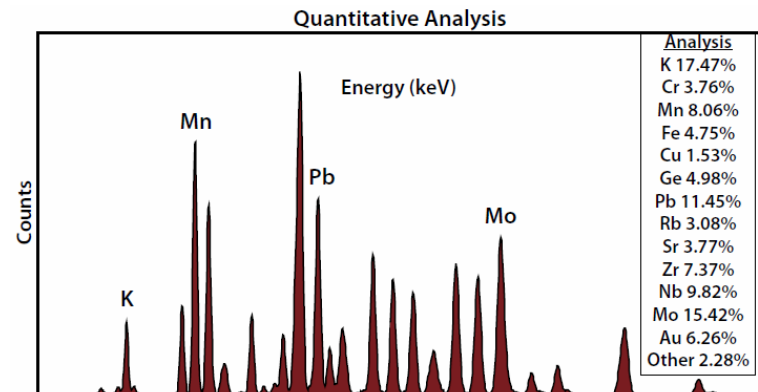
- $\text{Cs}_2\text{LiYCl}_6:\text{Ce}$ (CLYC) is an inorganic scintillator that has dual sensitivity to neutron and gamma rays.
- Scintillation detectors produce light when exposed radiation.
- The light generated is converted to electrical energy using a photomultiplier tube (PMT). The waveform signals that are output from the PMT are called pulses.
- The signal from the pulses can be pre-processed using analog and/or digital electronics.



Source: Spieler, H., Front-End Electronics and Signal Processing

Applications

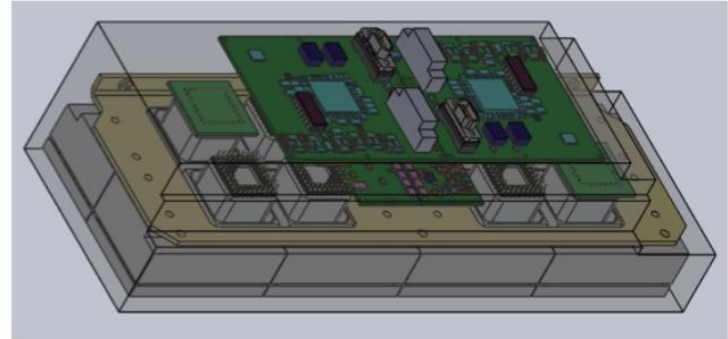
- Radioactive Material Detection
- Quantitative Analysis
- Soil composition
 - Oil and Gas
- Hydrogen Detection
 - Space applications



Source: Amptek

Space Based Neutron Detectors

- LunaH-Map
 - MiniNS Detector
- Mars Science Laboratory (Curiosity)
 - Dynamic Albedo of Neutrons (DAN)
- DAWN Mission
 - Gamma Ray and Neutron Detector (GRaND)

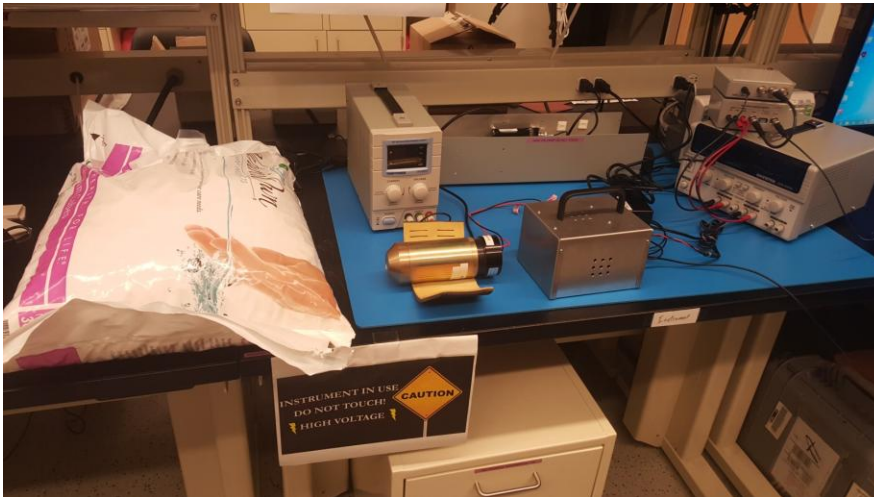


MiniNS Source: Hardgrove Labs



DAN Instrument Source: ROSCOSMOS

CLYC Laboratory Setup



Hardgrove Lab

- Analog Electronics
- Digital FPGA
- Source: Potassium

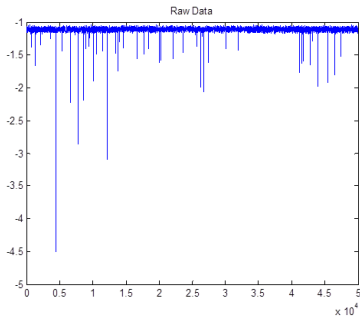
- Holbert Lab
- Analog Electronics
 - Digital FPGA
 - Source: Cesium



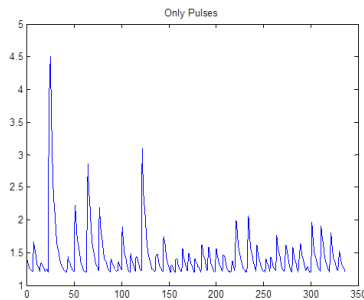
Signal Processing Hardware

- Analog
 - Charge Sensitive Preamplifier
 - Gaussian Shaper
 - Analog/Digital Converter (MCA)
- Outputs:
 - Histogram
- Digital
 - Analog/Digital Converter (MCA)
 - FPGA and Software Processing
- Outputs:
 - Raw Waveform
 - Integrals
 - Histogram
 - Pulse Shape Discrimination

Neutron Pulse Processing Software

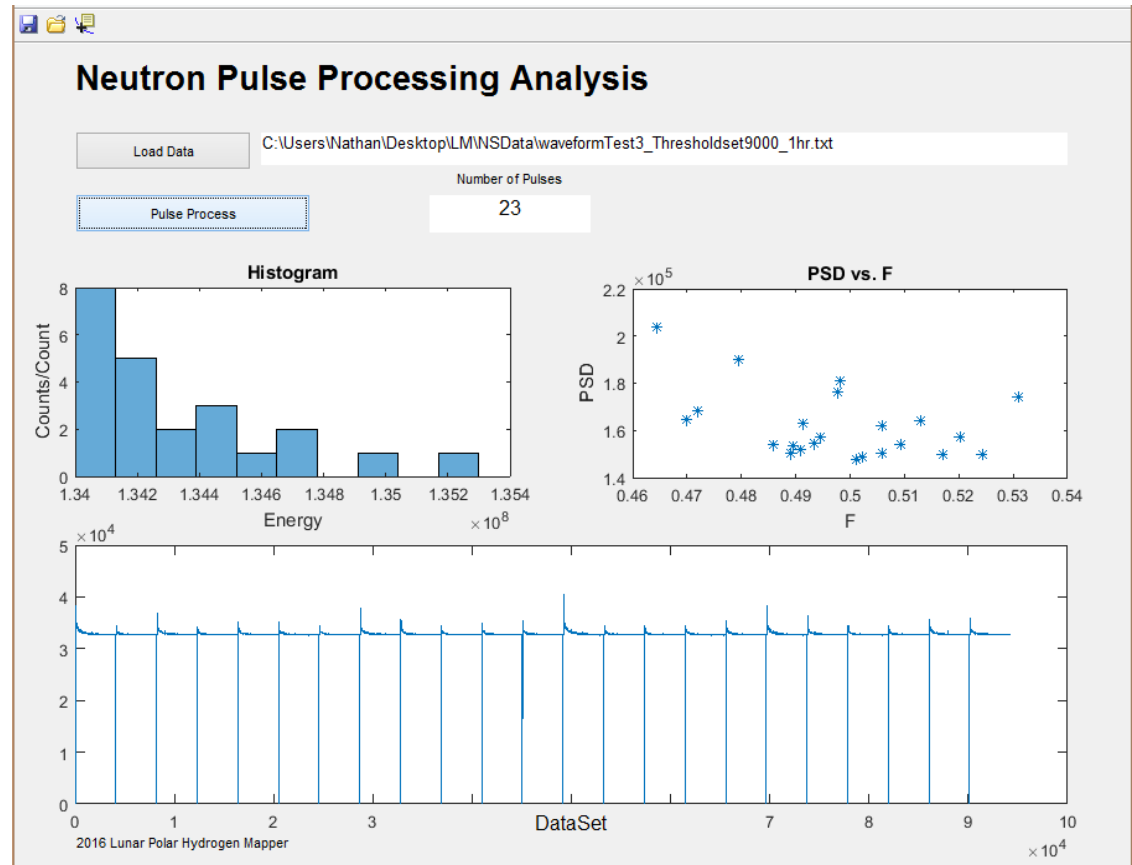
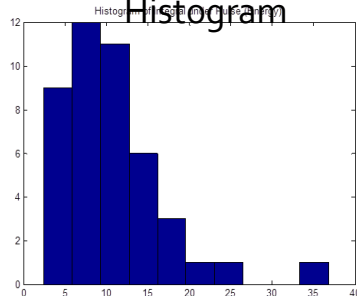


Convert to Integrals

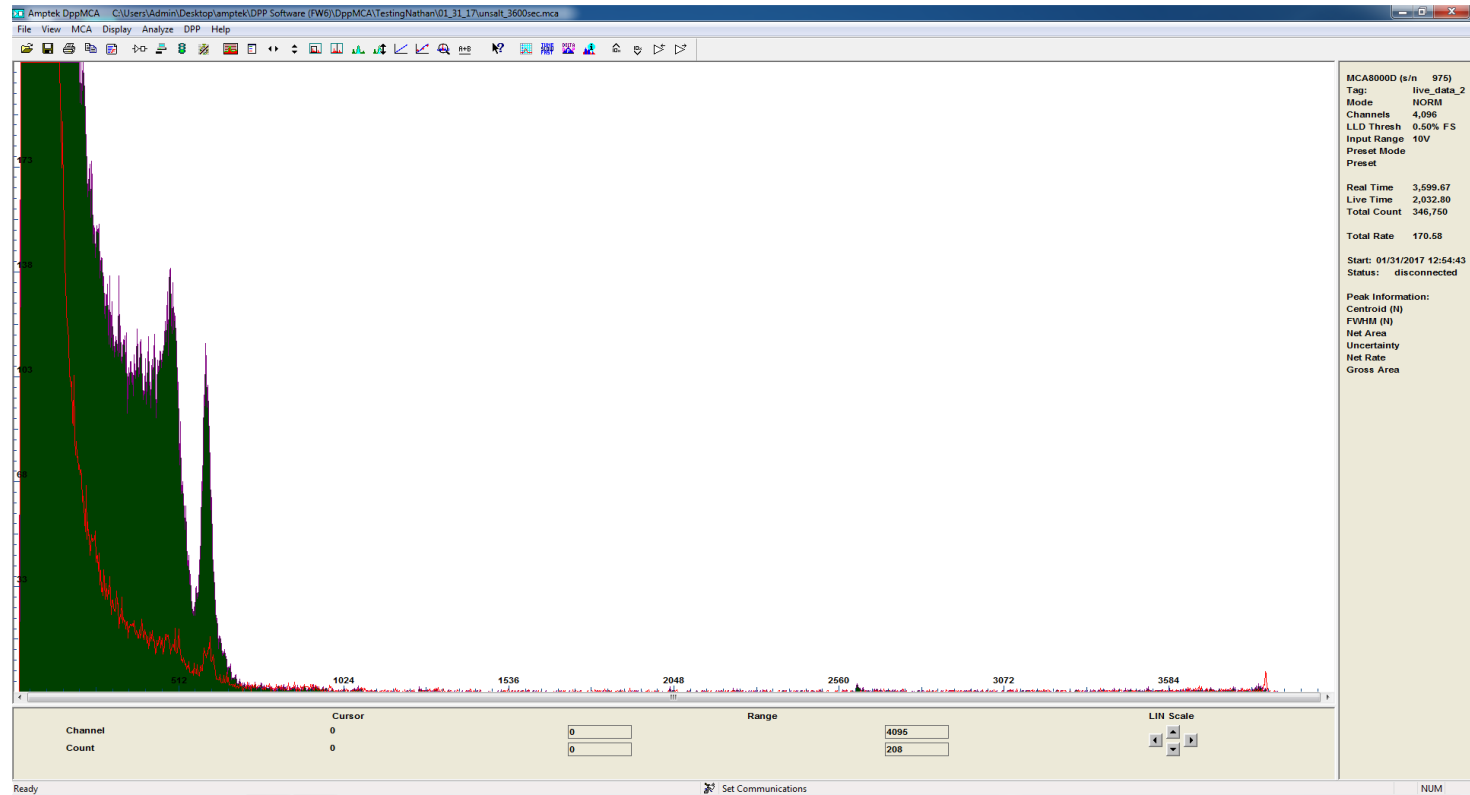


Generate

Histogram



Pulse Processing Results



3600 sec experiment control versus potassium chloride salt pellets
Green: Potassium (K-40) Red: Background radiation

Acknowledgements

Thank you to:

Dr. Craig Hardgrove

Dr. Tom Sharp and Desiree Crawl

Arizona Space Grant Consortium

NASA

Erik Johnson - Radiation Monitoring Devices
(RMD)

Dr. Keith Holbert - ASU

Thank you!

Questions??

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