Extraction of Time and energy data from a digital pulse processor

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Technologies

Introduction

Detectors

- Particle detectors are instruments used to measure the kinematic properties of quanta.
- Particles may be subatomic such as photons bosons, all the way to atomic nuclei such as α-particles

Data Acquisition (DAQ)

- Used to record events occurring at detectors
- This records the time and energy of an event very precisely.

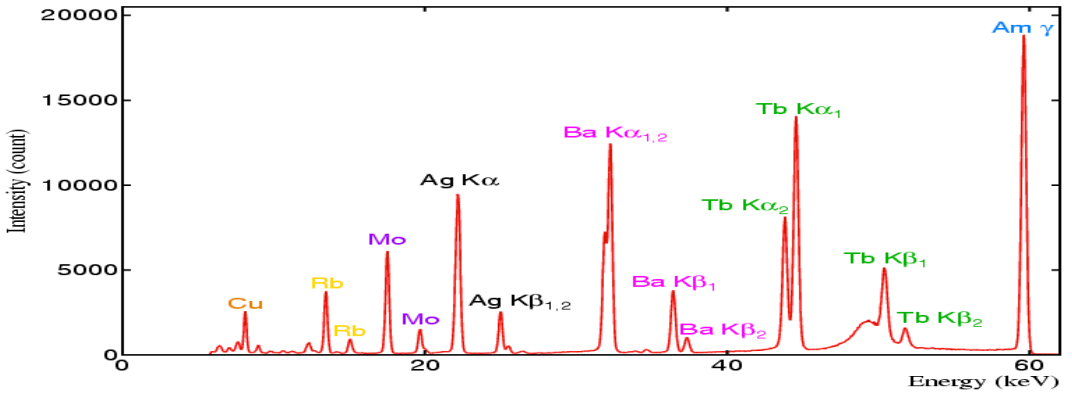
Calibration

Time

- Recorded precisely from the DAQ
- For this specific experiment the time signatures of events at opposite detectors needs to be synchronised
- A windowing technique will be used to discriminate between events

Energy

- Recorded precisely at a specific channel number
- These channels need to be calibrated using a well known energy spectrum



Calibration - energy

Optimization function

- Plot channel number vs Energy
- Model the curve using a Polynomial Equation
- Judge the correctness of the model using Chi-squared

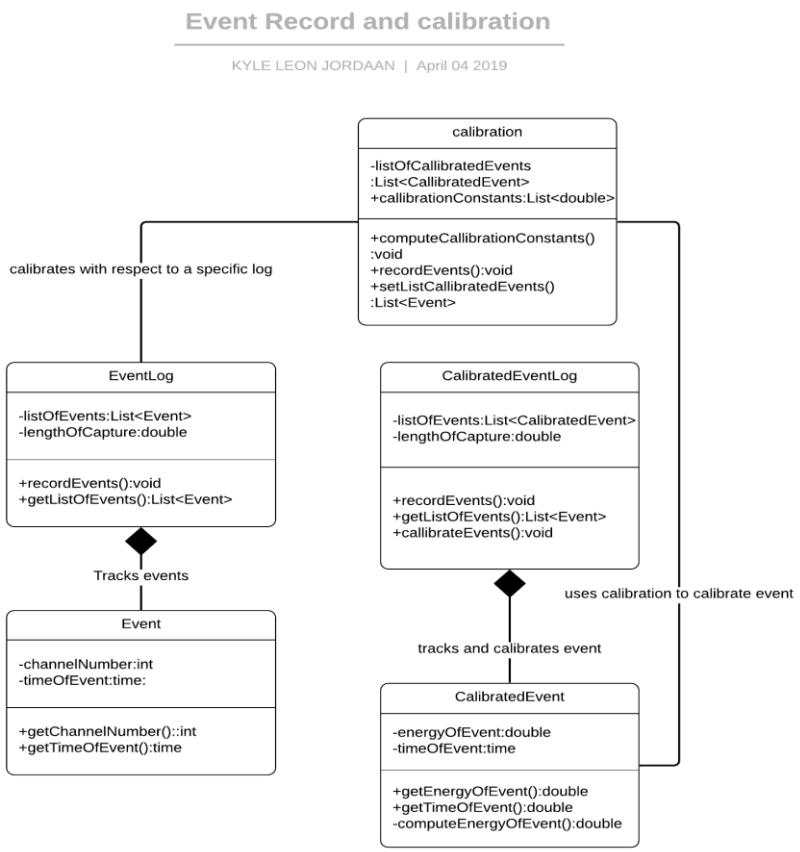
Search algorithm

- The model is defined by the Calibration constants, the coefficients of the Polynomial Equation
- These constants are found using:
  - Global Search
  - Multi Start Search
  - Pattern Search

Tool Being built

- The system will be a C++ library that interfaces with the DAQ to record Events. Which will be extended with a python wrapper.
- The system will also need to calibrate this data.
- As well as use time windowing for gamma events to remove background radiation and synchronise events in time.
- This system will use the Paass-lc framework as a starting point and extend the framework to accomplish this task.

Tool – UML



UML diagram describing the objects used for the process of recording events and calibrating them

Application and Conclusion

Application

- The time windowing technique is used very effectively for the removal of background radiation for gamma events
- The time signatures are used in modern PET scanners to locate radioactive dye’s injected into a patient

Conclusion

- The tool that will be developed currently has applications in the fields of nuclear medicine and experimental particle physics.
- It covers a wide area of study:
  - Computer algorithms
  - Reverse engineering
  - Nuclear Physics