Basic software suite for nuclear data sorting and automatic calibration

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Introduction

A software suite called BINDAS (BasIc Nuclear Data Analysis Software) has been developed primarily for sorting and calibration of gamma-ray spectroscopic data. It includes the programs PDE200, BINDAS and AUTOCAL. The program PDE200 is used for time merging and sorting the raw data acquired from the DAQ. BINDAS is a command line based program with an integrated help module and is used to create spectra, matrices and HMEVENT files. The HMEVENT files are then used for creating $\gamma-\gamma-\gamma$ coincidence cube and $\gamma-\gamma-\gamma-\gamma$ coincidence hypercube in RADWARE.

Features of BINDAS

The MAP file

The MAP file contains all the information about the detectors in the array and their connections to the DAQ. This separation of the array configuration from the program allows the same program to be used for multiple configurations. If the observed data is different from the expected configuration defined in the MAP file, then the program warns the user of this issue while stopping its execution.

Converting RAW data to EVENT format

The data from the DAQ has a lot of information on CFD trigger time, trace, etc,. At the end, one only requires the energy, timing and the crystal information out of all of these. This data simplification, followed by time sorting is performed by PDE200. It utilizes Radix sort with K-way merge sort algorithm for this purpose. Use of these algorithms allows PDE200 to be significantly faster (up to $\sim$ 20 times) than the presently available such programs [1, 2] while requiring very less working space. The output is in a custom EVENT format. As various DAQs have different RAW data format, the EVENT format was created so that each of these data format could be converted to the EVENT format thus removing the need for modifying BINDAS for each new DAQ.

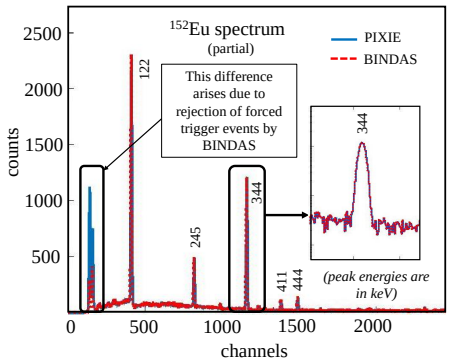

FIG. 1: Comparison of MCA spectra stored by PIXIE based DAQ and the same reconstructed from list mode data by BINDAS while rejecting events for which the CFD did not trigger

Creating spectra and matrices

The single crystal and addback spectra can easily be created by BINDAS because of the MAP file. The program also allows for a single detector to be divided into sub-detector groups with lesser crystals therefore allowing for multiple use-case scenarios. The spectrum from the PIXIE based DAQ's software and one reconstructed from list mode data by BINDAS

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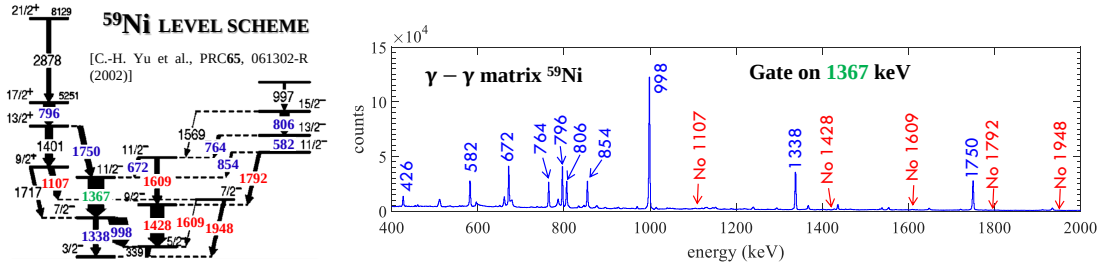

FIG. 2: (left) Partial level scheme of ^{59}Ni and (right) 1367-keV gated spectrum from $\gamma-\gamma$ coincidence matrix analysed using BINDAS. Blue (Red) lines are in coincidence (parallel) with 1367 keV.

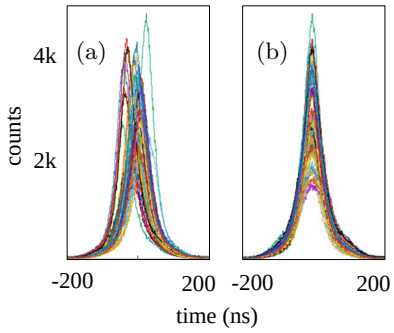

FIG. 3: (a) unaligned and (b) aligned time spectra between different clover detector pairs

are compared in fig. 1. The spectra created by BINDAS are saved in ORNL SPK format and are easily readable in RADWARE.

Matrices are created in BINDAS using the matrix module. And as the angular positions of the crystals are stored in the MAP file, creating asymmetric matrices for DCO and polarization measurements is greatly simplified. A gated spectra obtained from an *all vs all* symmetric matrix for ^{59}Ni is shown in fig. 2.

Automatic calibration

The spectra files in ORNL SPK format can be calibrated using a software in the suite called AutoCAL. The user needs to manually calibrate one file following which, the program automatically finds the peaks and assigns their energies based on the manual calibration.

Time spectra alignment

BINDAS also creates time spectrum between the detectors and automatically aligns them, as shown in fig. 3. This allows BINDAS to use narrow coincidence time window to create cleaner matrices and HMEVENT file.

Creating HMEVENT file

HMEVENT file contains calibrated γ coincidence data which are of three or higher fold coincidences. BINDAS suite provides header files that allow RADWARE to read these files and create cube and hypercube using programs in RADWARE.

Conclusion

A software suite for sorting and calibration of nuclear data has been developed at VECC. It has been created keeping in mind the various arrays and Data Acquisition Systems and future requirements. This suite has been used in the analysis of ^{115}Sb [3] and ^{59}Ni [4] data.

Acknowledgment

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References

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