SPRINGZ: A New Program for Reduction of INGA Data in Zls Format

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Introduction

The use of large detector arrays in nuclear spectroscopy has ushered a sequence of juxtaposed developments of efficient software for reduction of data acquired from these facilities. Consequent to the advent of the Indian National Gamma Array (INGA), an array of Comton suppressed Clover detectors, there have been several allied programming developments in around two decades of operation of the facility [1–5].

The present work, inspired by the aforementioned contributions, reports the development of a new program for sorting of data from a multi-Clover array such as INGA. It endeavours to introduce certain convenience and vantage in the required inputs from the user as well as provide an elaborate diagnosis of the data from multiplicity calculations based on varied criteria. The latter is expected to aid in the understanding and troubleshooting of the pulse processing and data acquisition system used in the experimental setup. The code is named Sorting PRogram for INGa data in Zls format (SPRINGZ). It works on listmode data files in the zls [7] format. The data acquired from the INGA facility, when operated with analog electronics based pulse processing setups, is typically either in the zls (lamps) [3, 7] format or in the freedom (candle) [2] format. The latter can be converted to the zls format, using the LAMPS [7] program, for application of the SPRINGZ code. Obviously the INGA facility is being mentioned in a generic sense and the program is applicable for reduction of data acquired with any γ-ray detector array.

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Programming and I/O Features

The SPRINGZ program reads the listmode data event-by-event, block-by-block from the specified list of data files and subjects the same to the customary reduction procedures applied to γ-ray spectroscopy data from multi-Clover array. These include gain scaling, addback and generation of 64 MB γ-γ matrices wherein the assignment of detectors to the axes, symmetric or angle / orientation dependent, are made as per the specification provided by the user. Conveniently, these specifications are communicated to the program in terms of actual detector / parameter numbers. The conditions, if any, on these input parameter numbers are internally worked out by the program. For instance, the conditions between the input parameters of a polarization matrix or an angular matrix are all automated. The coefficients of calibration, supporting a fifth order polynomial, are read-in from a separate file. Similarly a lower threshold on individual parameters are also provided through a file input and can be conveniently used to address (noise) issues specific to a particular channel.

Very importantly, the SPRINGZ program can generate time-difference (tac) spectra for all detector combinations (Fig. 1) and, to a considerable extent, extract the centroids from the same in an automated way. The latter step replaces the inconvenience of manually determining the centroids for the large number of combinations, such as 153 for 18 detectors. These centroids can be then used as inputs to the TDCCAL (Bhowmik et al.) program to extract the TDC offsets

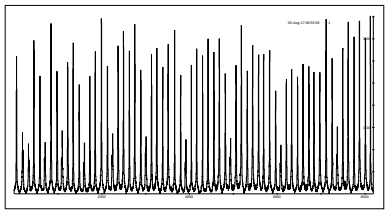

FIG. 1: TAC spectra, generated using SPRINGZ, corresponding to individual combination of detectors from a data acquired at the present INGA campaign in IUAC, New Delhi.

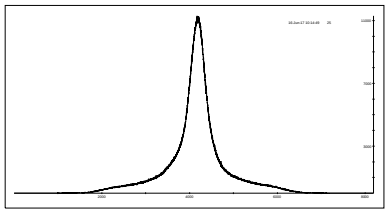

FIG. 2: Total γ-γ TAC spectrum, generated using SPRINGZ, from a recent experiment at the INGA facility in IUAC, New Delhi.

and eventually generate the γ-γ tac spectrum (Fig. 2). The energy and timing spectra generated by the SPRINGZ program can be read out by the RADWARE [6] package.

One of the salient utility features of the SPRINGZ program is that it outputs a detailed event profile based on varied criteria. These criteria are set on raw energy and raw timing parameters as well as on the calibrated and processed ones that actually make it to the reduced data (matrices and cubes). The evolution in the profile accompanying the changing criterion provides an insight into the data as well as in the pulse processing and acquisition systems. The code can be conveniently modified further for specific probes, as per the requirements of the user.

Validation and Outlook

The SPRINGZ program is presently being applied for reduction of data acquired from the INGA campaigns (2007-2009, 2016-) at the IUAC, New Delhi. It is being validated

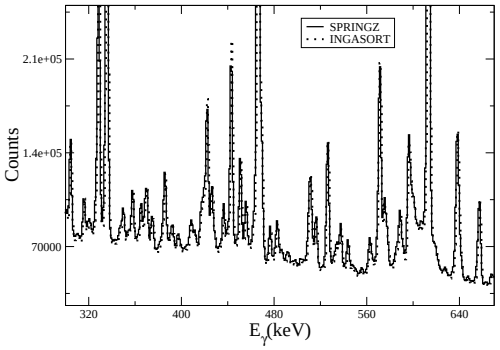

FIG. 3: Comparison between the full projections of symmetric matrices constructed using SPRINGZ and INGASORT.

with respect to the end results obtained from the existing programs such as INGASORT [1]. Fig. 3 depicts a comparison between the full projection spectra of the matrices generated using SPRINGZ and INGASORT. The overlap between the two provides a benchmark for the present efforts. Further developments are in progress to expand the applicability of the SPRINGZ code and the same is available for users.

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