SpiRITROOT: an analysis framework for the SπRIT experiment

G. Jhang,[*1,*2] J. W. Lee,[*1,*2] G. Cerizza,[*2] T. Isobe,[*3] and M. B. Tsang[*2] for the SπRIT collaboration

The main detector in the SπRIT(SAMURAI pion Reconstruction and Ion Tracker) experiment is the SπRIT-TPC (time projection chamber)[1]. The GET electronics[2] as front-end readout electronics reads the charge and time with 12,096 pad electrodes of the TPC and stores structured binary-encoded data. To decode and analyze this data in a consistent and systematic manner, we provide a software framework to the collaborators that accounts for both simulation and data analysis.

SpiRITROOT is the analysis framework for the SπRIT experiment developed on the structure of FairRoot[4]. FairRoot provides a highly modulized programming environment that allows developers to maintain the code in an organized manner and to simplify the analysis process for users. SpiRITROOT has two parts: the simulation and the experimental data flow. A Schematic of these parts is shown in Fig. 1. Each rectangle indicates a stage inside the software framework. Each stage has entries (blue text) corresponding to tasks.

In the *simulation data flow*, collision events generated by external programs such as PHITS[5] and pBUU[6] are fed to SpiRITROOT to simulate the detector response through the GEANT4 package. After simulating the events, the digitization stage takes over with its three tasks: drift task, pad response task, and electronics task. The drift task calculates the number of ionized electrons, their drift time, and their dispersion from the ionized point. The pad response task calculates the amplification and dispersion by the anode wires. Finally, the electronics task simulates the response pulse from the electronics using a reference pulse measured from the cosmic data.

In the *experimental data flow*, the data are read by the unpacker stage. The GETDecoder task unpacks the binary data, while the STConverter task maps the signals of each channel to each pad. In addition, the ANAROOT task has been added to unpack and decode data from RIBFDAQ, which contains information from the KATANA and multiplicity trigger arrays[7].

The reconstruction stage is common to both data flows. The pulse shape analysis task analyzes the shaped pulse from the electronics to find the hit position and energy loss. The hit clustering task collects groups of hits satisfying certain criteria, such as proximity between hits, into clusters to determine the closest position to the ionized point. The linear tracking task, developed mainly to identify tracks and analyze the commissioning experiment data, is used to fit the straight tracks and determine the reaction vertices. The Riemann tracking task identifies and separates the tracks in the event and provides approximate track parameters, such as the curvature and dip angle, using a simple helix fit. Finally, the GENFIT[9] task analyzes the tracks using a Kalman filtering algorithm and provides information on physical observables such as momentum, mass, and charge to perform particle identification taking into account the energy loss.

SpiRITROOT is working successfully in analyzing the experimental data. One of the useful tools provided to the users for online analysis is the event display, which allows to visualize the reconstructed events in 3D. The brief report on commisssioning experiment and one example of 3D-reconstructed collision event are presented in Ref.[8]

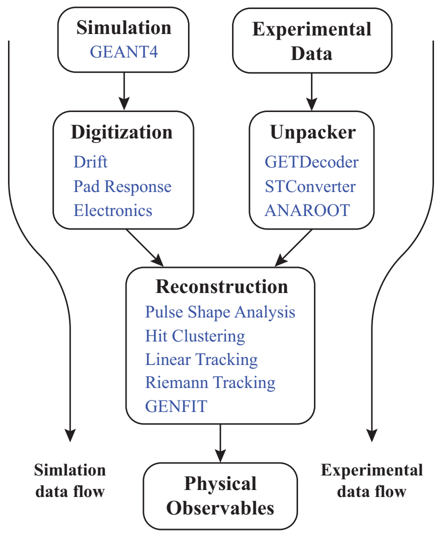

Fig. 1. Simple description of the data flow in SpiRIT-ROOT. Both the simulation and experimental data are analyzed in the single framework.

*1 Department of Physics, Korea University
*2 NSCL, Michigan State University
*3 RIKEN Nishina Center

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