KOPIO TN0XX

KOPIO MC and analysis plan

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Abstract

A plan for producing Monte Carlo data for KOPIO analysis is described.

A diagram of the plan is shown in Figure 1. The arrows show the flow of data. The dashed line indicates how we can circumvent some eventually necessary steps in order to produce Monte Carlo (MC) output for analysis in a timely fashion. The large text describes the data at each stage; the small text are effects or factors that need to be taken into account at each step.

It is assumed that software associated with each item in the diagram will be as independent of the other items as possible in order to facilitate interchange, development and modification. For example, we should be able to easily switch between different response functions of photomultiplier tubes and avalanche photodiodes to assess their effect on background and signal rates.

Here is a description of all terms in the diagram.

- **JHITS** For each MC track and sensitive detector element, we store the average position, deposited energy and average time of the energy deposit. For wire chambers (WC) we store the distance of closest approach to the wire. For the beam catcher (BCAT), we store the number of photoelectrons. A sensitive detector element in the MC is a single piece of scintillator, single wire or BCAT module.

- **PREDIGI** For each sensitive detector element, the observed energy is accumulated in bins of time based on the JHITS information. For WC (BCAT), the distance of closest approach (number of photoelectrons) is stored instead of the energy. Attenuation and propagation are currently taken into account with a simple model. Effects of broken fibers and photo- or ion-statistics are currently ignored. See [1] for details.

- **CONSOLIDATION** The predigitized information does not take into account the summing of sensitive detector elements into a single readout channel. For example, each scintillator tile in a shashlyk detector is considered to be a sensitive detector element, but all tiles in a module will be summed (or consolidated) to form the input observed by the readout of a single module. The form of the consolidated information should be the same as that of the predigitized information. Indeed, for some detector elements such as BCAT, the predigitized and consolidated information will be identical.

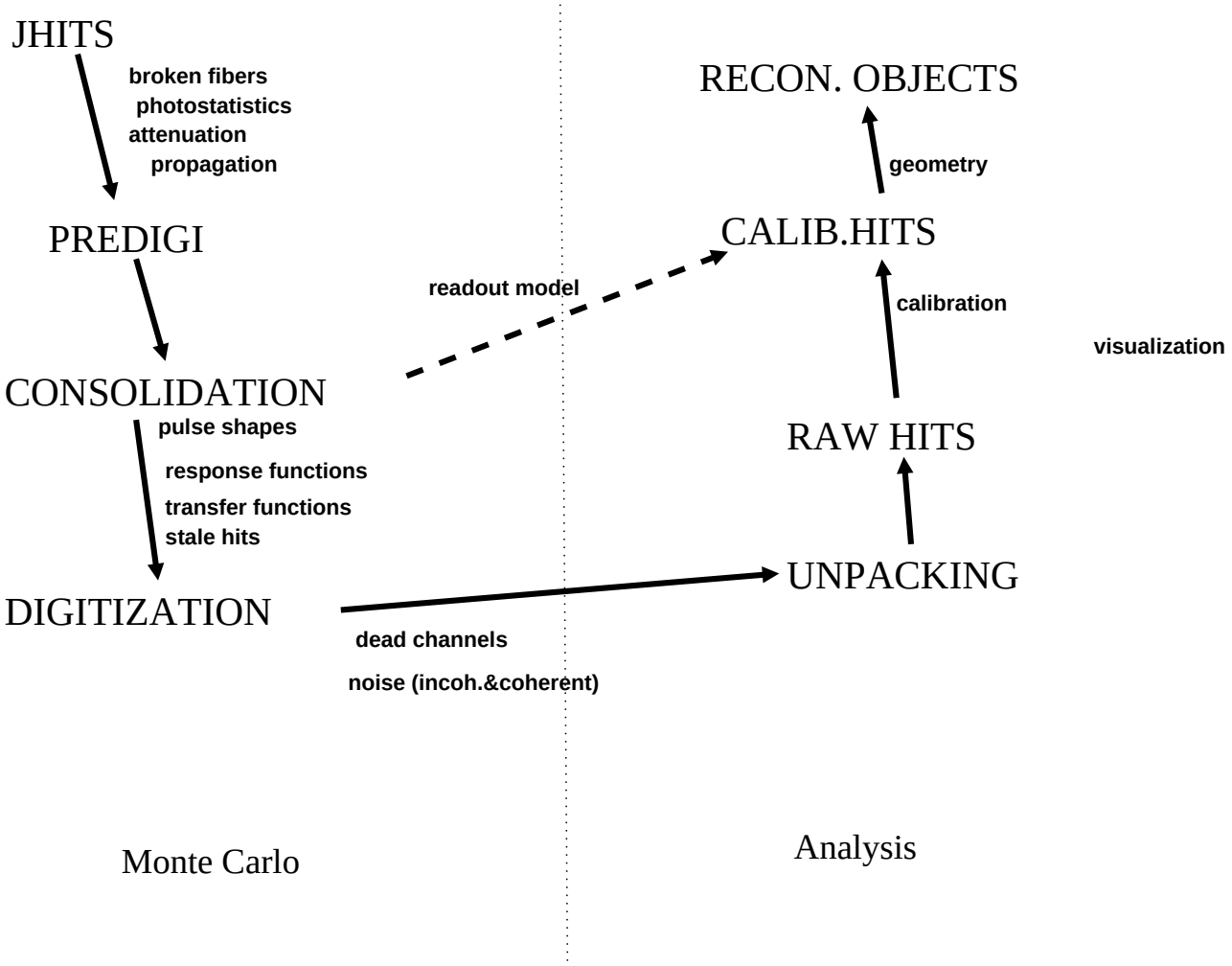

Figure 1: Diagram of the plan for producing KOPIO Monte Carlo data for analysis. See text for details.

- **DIGITIZATION** Reduction of the consolidated information to digital form to mock up the actual detector readout taking into account pulse shapes, response and transfer functions, ADC gates, WaveForm Digitizer (WFD) timing, etc. and adding in stale hits. Stale hits are hits in the detector from photons and tracks in a microbunch other than the microbunch responsible for the trigger.
- **UNPACKING** Transformation of the digitized information to analog information. The effects of dead channels and electronic noise should be simulated before this step.
- **RAW HITS** May be the same as the unpacked information.
- **CALIBRATED HITS** The raw hit information with calibration constants applied to render them in the form of energy and time. To mock up calibrated hits directly from the **CONSOLIDATION** step, readout models of ADCs, TDCs, WFDs need to be applied.
- **RECONSTRUCTED OBJECTS** Objects to be used as input for analysis.

May be as complex as a preradiator-calorimeter cluster with position, time and energy information or as simple as a single calibrated hit and its position. The key point is that each calibrated hit must be associated with a detector element position using the known geometry.

The items on the left hand side of the figure (labelled "Monte Carlo") are assumed to be done entirely inside the GEANT MC software. The items on the right hand side ("Analysis") should be done external to the MC.

The **JHITS** and **PREDIGI** items are largely complete although modification will probably be necessary to accomodate WC cathode strip hits.

The high priority items are **CONSOLIDATION**, readout model(s) to produce the **CALIBRATED HITS** and the use of the geometry information to produce the**RECONSTRUCTED OBJECTS**. We currently assume that the latter step can be done using ROOT with the geometry file produced by the MC.

References

[1] D.E. Jaffe, *Predigitization in KOPIO GEANT MC*, October 2003.