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The Monte Carlo for the 3π analysis *

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Abstract

A description of the Monte Carlo used for the Partial Wave Analysis (PWA) is given. This note describes the creation of various input files needed by the PWA. The use of these files is discussed elsewhere. [1]

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1 Introduction

To take into account the finite acceptance of the apparatus, a Monte Carlo acceptance calculation is used. This calculation proceeds in three steps, each discussed separately below. Three simulated data sets are produced by these steps, the "Raw Monte Carlo" data set, the "Reconstructed Monte Carlo" data set and the "Accepted Monte Carlo" data set. The Monte Carlo analysis chain is depicted schematically in figure 1.

2 Raw Monte Carlo

The first step of the calculation is production of the "Raw Monte Carlo" event sample. Pseudo-events distributed uniformly over the Dalitz plot and over solid angles in the center of mass are generated. The 3π effective mass is chosen to be uniform between 0.8 and 2.8 GeV/c^2. These limits are selectable at run time but contain the range of all analyses done to date. The t (momentum transfer squared) distribution is chosen according to

$$\frac{dN}{dt} \propto te^{bt} \tag{1}$$

with b equal to ten by default. Beam particle position and momentum is drawn from a model based on the observed distributions of these quantities. Correlations between beam position and momentum are fully accounted for in this model. The output of this calculation are the 4-vectors of the 3 pions, the beam, the recoiling proton and the location of the primary vertex.

3 Reconstructed Monte Carlo

The effect on the acceptance of the apparatus on reconstruction is taken into account by passing the raw pseudo-events through an analysis chain identical to that used during data analysis. To do this, the 4-vectors generated in the previous step are tracked through magnetic field of the MPS. The positions determined are transformed into "hits" in the drift and proportional chambers and stored in a form that simulates the data taken by the experiment. The response of the Lead Glass Detector (LGD) is determined for photons that are tracked into it. The response of the cells around the location of the photon impact are drawn from tables derived from the data.

The effect of reconstruction is simulated by passing the events through the analysis chain. This series of programs is identical to the series used during the analysis of the data. In particular, the reconstruction program $a2$ † performs pattern recognition and geometric fitting to reconstruct tracks and verticies from the hits. Photon momenta are reconstructed from the LGD simulated response.

† For those familiar with the programs of E852, $a2$ was derived from $a1$, the standard analyzer, by removing much of the diagnostic printout.

The reconstructed events are passed through $sq97$, a constrained fitting program based on $SQUAW$. The event topology is specified at this stage.

Acceptance effects accounted for at this stage are listed below.

Apertures: If a particle strikes an absorber or leaves the active area of the tracking chambers, hit generation ends.

The trigger: The hits generated in the Target Cylindrical chamber (TCYL) and trigger PWCs are counted and compared to the trigger requirement. The efficiency of the trigger PWCs is position dependent and based on a map derived from the illumination observed in the experiment. If charged pions strike the Elastic Veto/Beam Veto (EV/BV) the event is rejected. If a charged particle strikes the photomultipliers of EV/BV the event is vetoed. The simulated response of the LGD cells was used as input to a routine that duplicated the trigger processor algorithm.

Reconstruction: Events containing tracks without sufficient hits to be reconstructed are rejected at this stage. Events with photons that miss the LGD are rejected as are events that reconstruct to a hypothesis other than 3π.

The output of this program chain at this point is a data summary tape (DST) containing information identical to that contained on the data DSTs. The original, generated event is also included on the Monte Carlo DSTs.

4 Accepted Monte Carlo

The data used for the Partial Wave Analyses (PWA) is subjected to further selection criteria (cuts) to improve the signal to noise ratio and limit the effects of partially understood acceptance. Since the output of the Monte Carlo chain is identical to the data analysis chain, identical selection programs can be (and are) used to simulate the effect of these final selection criteria. The data selection cuts are discussed elsewhere. [2]

References

[1] M. Swat and S. Teige, Analysis Note-006

[2] R. Mitchell, Analysis Note-001

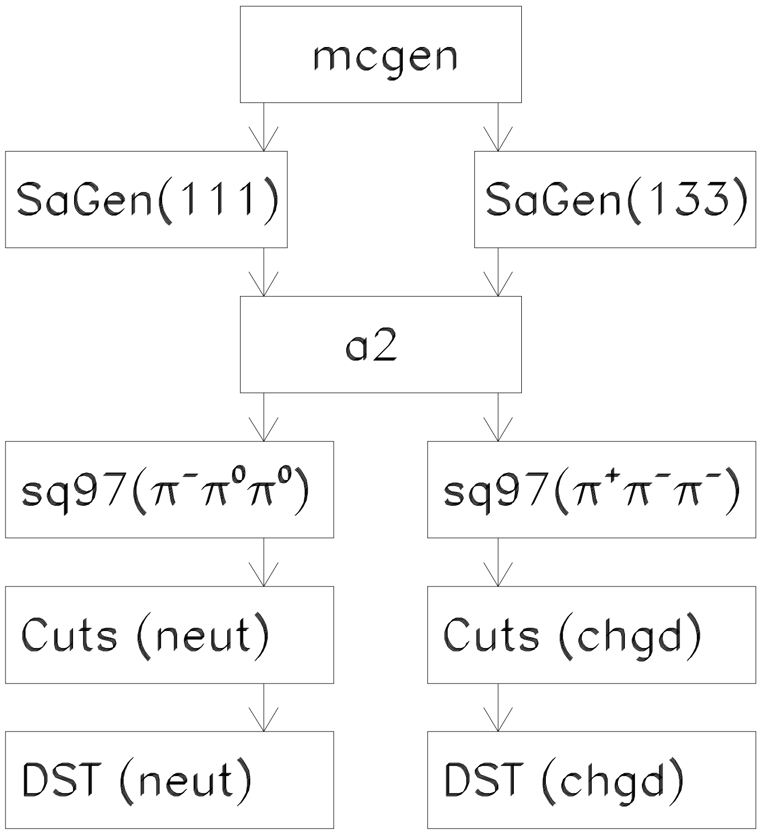

Figure 1: The Monte Carlo analysis chain. *mcgen* populates phase space, generates event 4-vectors and writes the RawMC DST. SaGen generates simulated hits in the apparatus, simulates the trigger, apertures and effciencies. $a2$ reconstructs momenta and verticies from the hits and $sq97$ performs constrained fits to the hypotheses. The output of $sq97$ is saved as the Reconstructed MC DST. Finally, *slicer* is used to perform final event selections (Cuts) and produce the Accepted MC DSTs.