1 Hard and Intermediate Interactions

One of the positron interaction systematic errors has to do with how well we can validate the simulation of hard and intermediate interactions. Hard interaction events are arbitrarily defined here to be events in which the decay positron loses more than $1MeV/c$ of momentum from were it is generated to where it goes through the last DC. Intermediate interactions are those events whose decay positrons have lost less than $1MeV/c$.

In our simulation we can look at the reconstructed decay positron distribution over the thrown distribution to see how large a correction is needed to account for hard and intermediate interactions. The ratio of of reconstructed over thrown distributions in $\cos\theta$ for all events, events that lose $< 1MeV/c$, and those events that lose $> 1MeV/c$ is shown in Figure 1.

The size of the correction is estimated using the asymmetry in the fiducial of the thrown, A_t, minus reconstructed, A_r, over thrown times the relative fraction of the events that are hard f_h or intermediate $f_i = 1 - f_h$. The size of the correction $\Delta\ P_\mu\xi$ depends on the location of the muon stopping Bragg peak in the stopping target. The size of the corrections are summarized in Table 1.

μ Location in Target	$\Delta\ P_\mu\xi$ Inter.	$\Delta\ P_\mu\xi$ Hard	Systematic Error
PC 5 stops (upstream)	-0.0112	0.0017	$\pm$0.0008
centered ($\frac{1}{2}$)	-0.0048	-0.0056	$\pm$0.0010
$\frac{3}{4}$	-0.0067	-0.0100	$\pm$0.0017

Table 1: $\Delta\ P_\mu\xi$ corrections due to intermediate and hard interactions for each of the three different muon stopping locations of data. The systematic error is based on 14% validation of hard interactions and 5% validation of intermediate interactions.

Given that we trust our simulation of hard interactions to 14% and intermediate interactions to 5%, the resulting systematic error for centered stops for example is estimated as $0.00483 * 0.05 + 0.00561 * 0.14 =$ *0.000103*.

Note: This number will be smaller now since we can reduce the 14% and 5% numbers based on Rob's analysis of upstream stops.

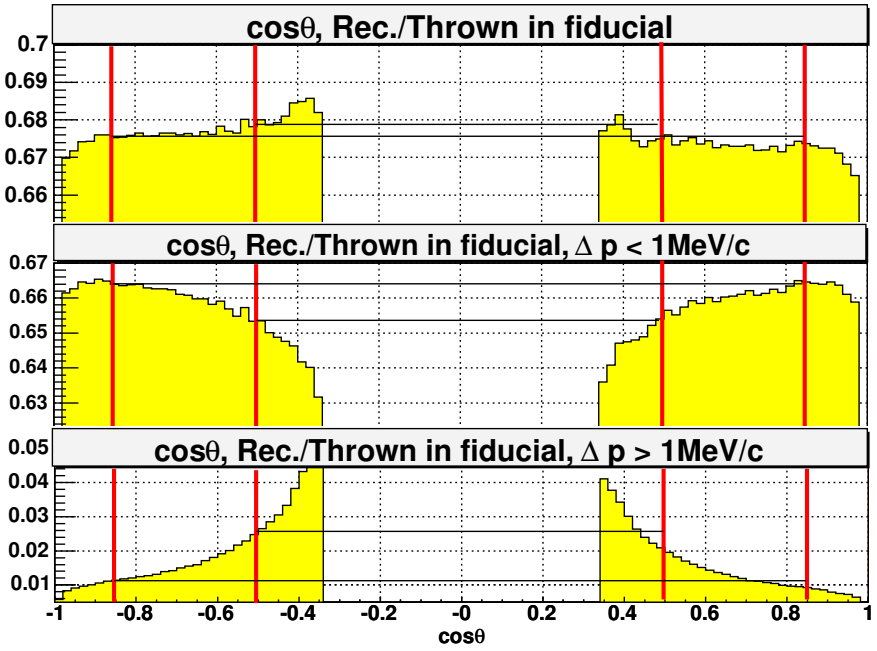

Figure 1: Reconstructed over thrown yield versus $\cos\theta$ for events in the fiducial $p_{total} < 50.0 MeV/c$, $p_{trans} < 38.6 MeV/c$, and $p_{long} > 13.7 MeV/c$. The top plot is for all events, the middle plot is for events where the decay positron loses less than 1MeV/c, and the bottom plot is for positron energy loss greater than 1 MeV/c. The plots are for a muon stopping distribution centered in the target.