WORK PLAN IN PROGRESS

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OUTLINE

1. What Are We Trying To Measure?

2. Physics Analysis
   Calculating $N(K_L\pi)$
   Calculating $N(K_S\pi)$

3. Calibration Analysis
   Calculating $N(K_L\pi\pi)$
   Calculating $N(K_S\pi\pi)$
What Are We Trying To Measure?

- We are measuring the following asymmetry in the decay of $D^0$

$$ A = \frac{\Delta \Gamma}{2 \Gamma_{av}} $$

$$ = \frac{(\Gamma_{D^0 \rightarrow K_S^0 \pi^0}) - (\Gamma_{D^0 \rightarrow K_L^0 \pi^0})}{(\Gamma_{D^0 \rightarrow K_S^0 \pi^0}) + (\Gamma_{D^0 \rightarrow K_L^0 \pi^0})} $$

$$ = \frac{\Delta B}{2 B_{av}} \text{ as branching fraction } B_{K_L \pi} \propto \Gamma_{K_L \pi} \text{ and so on} $$

$$ = \frac{N(K_L \pi) - N(K_S \pi)}{N(K_L \pi) + N(K_S \pi)} $$

- detector efficiency corrected by using decay $D^0 \rightarrow (\bar{K}^0 \pi)\pi$ via $K^*-\pi$

$$ A = \frac{\frac{N(K_L \pi)}{\epsilon_{K_L}} - \frac{N(K_S \pi)}{\epsilon_{K_S}}}{\frac{N(K_L \pi)}{\epsilon_{K_L}} + \frac{N(K_S \pi)}{\epsilon_{K_S}}} $$

$$ = \frac{N(K_L \pi) / N(K_L \pi \pi) - N(K_S \pi) / N(K_S \pi \pi)}{N(K_L \pi) / N(K_L \pi \pi) + N(K_S \pi) / N(K_S \pi \pi)} $$

- So we have the following numbers to calculate for this analysis

$N(K_L \pi), N(K_S \pi), N(K_L \pi \pi), N(K_S \pi \pi)$
Physics Analysis, calculating $N(K_L\pi)$

- Create MC samples for $D^0 \rightarrow K_L^0\pi^0$ and $D^0 \rightarrow K_S^0\pi^0$
  - Signal MC
    
    \[
e^+e^- \rightarrow c\bar{c} \rightarrow \text{charm fragmentation} \rightarrow \text{single } D^{*+} \text{ selection} \rightarrow \text{decay table}
    \]
  - Generic MC
    
    \[
e^+e^- \rightarrow c\bar{c} \rightarrow \text{charm fragmentation} \rightarrow \text{allow generic decay ? ? ?}
    \]

- Reconstruct $D^0 \rightarrow K_L^0\pi^0$ (Signal MC)
  
  $K_L^0$by $D^0$ mass constraint, $E_{ECL} > 300$MeV
  - for excluding $K$ and $\pi$ decays in flight
  $D^0$by $x_p > 0.6, -0.95 < \cos(\angle D^0k^0) < 0.2$
  - for excluding combinatorics, random pion backgrounds
  
  tag by $D^{*+} \rightarrow D^0\pi^+$ look at $D^{*+}$ mass distribution
  
  fit signal and background (to be crosschecked with data later)

- Reconstruct $D^0 \rightarrow (\text{pseudo } K_L^0)\pi^0$ for control
  
  Signal MC of $D^0 \rightarrow K_S^0\pi^0$ is used here
  do a resolution study of $K_S^0$and$K_L^0$
  
  reconstruct $K_S^0$ by $D^0$ mass constraint
  $K_S^0$ direction resolution smeared to match $K_S^0$ resolution
Physics Analysis, calculating $N(K_L \pi)$

- Analyse generic MC sample to study the backgrounds
  - reconstruct $D^0 \to K_L^0 \pi^0$
  - tag decays present in sample by evtgen, plot their mass distribution
  - (to get no of background events for each decay and their spectrum)
  - ??? is it correct/useful ???
  - study the event topology to get the potential background sources
  - ??? device cuts and optimise ???

- Skim data for $D^0 \to K_L^0 \pi^0$
  - reconstruct $D^0 \to K_L^0 \pi^0$, fit signal, background in $D^*$ mass
  - obtain $N(K_L \pi)$ and cross-check with signal MC
Physics Analysis, calculating $N(K_S\pi)$

- Reconstruct $D^0 \to K_S^0\pi^0$ (Signal MC)
  $K_S^0$ from mdst-vee2, apply track quality cuts
  same cuts on $D^0$ etc as in case of $D^0 \to K_L^0\pi^0$
  fit signal and background for crosschecking with data later

- Analyse generic MC sample to study the backgrounds
  same procedure as in case of $D^0 \to K_L^0\pi^0$

- Skim data for $D^0 \to K_S^0\pi^0$
  reconstruct $D^0 \to K_S^0\pi^0$, fit signal, background in $D^{*+}$ mass
  obtain $N(K_S\pi)$ and cross-check with signal MC
Calibration Analysis, calculating $N(K_L\pi\pi)$

- Signal and Generic MC for $D^0 \to K_L\pi\pi$ and $D^0 \to K_S\pi\pi$ via $K^{*-}$ reconstruct $D^{*+} \to D^0\pi^+, D^0 \to K^{*-}\pi^+, K^{*-} \to K_L\pi^-$ (signal MC) apart from cuts for $D^0$ and $K_L$ etc invariant mass cut on $K^{*-}$ tag by $D^{*+} \to D^0\pi^+$ look at $D^{*+}$ mass distribution fit signal and background (to be crosschecked with data later)

- Reconstruct $D^0 \to (\text{pseudo } K_L^0\pi)\pi$ for control use results from resolution study as earlier

- Do a background study in the generic MC sample as earlier device and optimise cuts

- Skim data for $D^0 \to K_L\pi\pi$
  reconstruct $D^0 \to K_L\pi\pi$, fit signal, background in $D^{*+}$ mass obtain $N(K_L\pi\pi)$ and cross-check with signal MC
Calibration Analysis, calculating $N(K_S\pi\pi)$

- Reconstruct $D^{*+} \rightarrow D^0\pi^+$, $D^0 \rightarrow K^{*-}\pi^+$, $K^{*-} \rightarrow K_S\pi^-$ (signal MC)
  invariant mass cut on $K^{*-}$
tag by $D^{*+} \rightarrow D^0\pi^+$ look at $D^{*+}$ mass distribution
  fit signal and background and crosscheck with data later

- Do a background study in the generic MC sample as earlier device and optimise cuts

- Skim data for $D^0 \rightarrow K_S\pi\pi$
  reconstruct $D^0 \rightarrow K_S\pi\pi$ , fit signal, background in $D^{*+}$ mass
  obtain $N(K_S\pi\pi)$ and cross-check with signal MC