Plan for measuring c_i and s_i for 4Pi

15/02/2016 Claire Prouve

Event selection

Standard event selection for tags: see Chris' thesis/ F_+ paper

KsPiPi veto for the 4Pi side from F_+ paper (?)

Decay mode	DTag		Cuts		K_S^0 veto	On m_{BC} plane					B_{flat}
	Cands.	Events	Cands.	Events	and MCS	S	A	B	C	D	
K^+K^-	751	751	175	175	106	34	4	0	36	0	23.7 ± 3.7
$\pi^+\pi^-$	2833	2813	581	579	490	83	0	0	204	10	120.1 ± 9.0
$K^\pm\pi^\mp$	1776	1764	1357	1355	659	600	0	3	6	1	4.4 ± 1.7
$K_S^0\pi^0$	533	509	236	231	132	120	1	0	1	0	1.0 ± 0.6
$K_S^0\eta(\gamma\gamma)$	246	234	50	48	25	20	1	0	0	0	0.4 ± 0.4
$K_S^0\omega$	19129	8631	101	101	51	44	0	0	1	0	0.6 ± 0.6
$K_S^0\eta(\pi^+\pi^-\pi^0)$	19129	8631	18	17	9	7	0	0	0	0	0.0
$K_S^0\eta'(\pi^+\pi^-\eta)$	53	40	19	18	12	10	0	1	0	0	0.4 ± 0.4
$K_S^0\pi^0\pi^0$	3290	2632	97	87	49	23	1	0	5	2	2.4 ± 1.6
$K^\pm\pi^\mp\pi^0$	6226	4691	3556	3116	1488	1223	20	7	34	12	25.4 ± 4.6
$\pi^+\pi^-\pi^0$	5670	4691	1111	1004	738	188	10	8	208	37	115.5 ± 9.6
$K_S^0\pi^+\pi^-$	12370	6978	637	550	297	248	0	1	20	2	11.6 ± 2.9
$4\pi^\pm$ (K_S^0 FS < 0)	16737	9729	3176	2679	1937	344	2	1	814	44	478.2 ± 18.0
$4\pi^\pm$ (K_S^0 FS < -2)	16737	9729	3176	2679	1493	257	2	1	623	34	366.1 ± 15.6
$4\pi^\pm$ (K_S^0 mass veto)	16737	9729	3176	2679	2197	386	3	1	917	44	541.9 ± 19.1

Table 3: Candidate and event yields in data at various stages: 'DTag' is number from DTag software, 'Cuts' is number after selection cuts, 'K_S^0 veto and MCS' is number after K_S^0 veto and multiple candidate selection have been applied. 'On m_{BC} plane' indicates number of candidates in each region on the m_{BC} plane. B_{flat} is the flat background estimate from the sidebands. For $4\pi^\pm$ against itself the K_S^0 veto is applied to both sides.

Backgrounds

Peaking backgrounds *are those that lie predominantly in the signal region. They often have the same final-state particle content as the signal decay.*

Flat backgrounds *are distributed across the signal region and sidebands without any significant peaking structures. The quantity of flat background in the signal region can be estimated using the sideband populations in data.*

Phase-space backgrounds: evenly distributed in phase-space, meaning each bin 'gets' the a number of events proportional to its area in the Dalitz-plot.

Resonant background: 'unevenly' distributed in phase-space, meaning distribution of events over the bins has to be found differently

➔ The categories peaking bkg/flat bkg are used to find the total number of events while the phase-space/resonant category is used to find the distribution over the bins.

1. **Find peaking/resonant bkgs! (KsPiPi reconstructed as 4Pi is one)**
2. **How to define and determine the 'area of a bin in phase-space'?**

Backgrounds

We consider the following phase-space backgrounds:
• Signal-side background to KS0K+K,
The following backgrounds are assumed to be resonant:
• KS0,LK+K against opposite-side background,

We use a signal MC sample of KS0,LK+K tagged with KPi to estimate the bin-by-bin yield of resonant backgrounds…
➔ Not sure this is optimal (but the errors are probably so big that it doesn't matter?)

- KsPiPi reconstructed as 4Pi: find distribution from data with reversed Ks-Veto

Kinematic fitting

The final state tracks are refitted to the D^0 mass.

1. Chris validates this technique on MC, do we need to do that too?

2. Treating of events that leave the signal region due to the fit: *Occasionally an event is reconstructed outside the physical region. A vector from this point to the Dalitz plane boundary is determined such that the vector is perpendicular to the tangent to the boundary at the point of intersection between the vector and the boundary. There is one unique vector that satisfies this condition, denoted the vector of closest approach.*

   ➔ How to do that for 4Pi?

Flavour tag correction factors

Correction factor to be multiplied to the number of flavour tagged events:

$$f_F^{DCS} = \frac{\int_{\mathcal{D}_i} |\mathcal{A}(D^0 \to K_S^0 K^+ K^-)(x,y)|^2 \, \mathrm{d}x \, \mathrm{d}y}{\int_{\mathcal{D}_i} |\mathcal{A}(D^0 \to K_S^0 K^+ K^-)(x,y) + R_F r_D^F e^{i\delta_D^F} \mathcal{A}(\overline{D}^0 \to K_S^0 K^+ K^-)(x,y)|^2 \, \mathrm{d}x \, \mathrm{d}y}, \quad (3$$

Final state F	$r_D^F(\%)$	$\delta_D^F(^\circ)$	R_F
$K^\pm\pi^\mp$	0.580 ± 0.008	202 ± 10	1
$K^\pm\pi^\mp\pi^0$	0.48 ± 0.02	227 ± 17	0.84 ± 0.07
$K^\pm\pi^\mp\pi^+\pi^-$	0.57 ± 0.02	114 ± 26	0.33 ± 0.26

To do

- Finish getting K3Pi and Kenu events (data, genMC, continuum MC, Signal MC)
  - What bkgs would we expect here?
  - Include Chris' BkgCat
- Apply selection and make table like Chris to compare
- Handle events that the kinematic fit kicked out the physical region
- Peaking and flat bkgs for total signal region
- Get "area" of bins in phasespace
- Flavour-tag correction factors
- Bin migration
- Selection and reconstruction efficiencies
- Amplitude model MC from CLEO? (for bin migration and efficiencies)
- Model predictions for number of signal events in bins (both flavour and CP tags)
- Model predictions for c_i, s_i
- How many bins do we want to try?