CB-Note 296
Addendum

Addendum to Technical report: Antiproton-proton annihilation at rest into $K_L K_S \pi^0 \pi^0$

Kersten Braune and Christian Felix
Ludwig-Maximilians-Universität München

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PWA Fits

This note describes additional fits done since the publication of the technical report last April. The large width of the h_1' always bothered me since it seemed to take care of some background or an altogether forgotten amplitude. This amplitude is the $\phi(1680)$ which was introduced in Fit 8 and subsequently discarded. It should have been part of the fits hunting for a $J^{PC}= 1^{+-}$ contribution. Following the numbering of the technical report, this is now done in Fit 12.

Fit 12 amplitudes: (vb-fith1masswidthphi1680) The amplitudes for this fit are the *basic amplitudes* (Fit 3) plus an amplitude with the PDG parameters for the $\phi(1680)$. An additional $J^{PC}= 1^{+-}$ amplitude, representing the h_1', is given to the fit with free mass and width. This fit has the same likelihood and $\langle\chi^2\rangle$ as Fit 11, $\log\mathcal{L} = 3186$ and $\langle\chi^2\rangle = 1.68$, i.e. it is a very good fit. The h_1' mass comes out to be the same as before, $m_{h_1'} = (1430 \pm 60)\,\mathrm{MeV/c^2}$, but the new width is much narrower, $\Gamma = (133 \pm 50)\,\mathrm{MeV/c^2}$, due to the introduction of a $\phi(1680)$ amplitude.

This result leads to the final fit, where other decay modes of $h_1'(1430)$ and $K_1(1270)$ and $K_1(1400)$ are allowed.

Fit 13 amplitudes: (plusk1amp) Having found a very good description of the data, we now try some fine tuning by considering additional decay amplitudes for the particles in the last fit. First the decay $h_1'(1430)\rightarrow(K\pi)_S K$ is added(best-h1kpis). The likelihood does not increase and the intensity of this decay is negligible (smaller than 0.5%). The next fit contains all decay modes of $K_1(1270)$ and $K_1(1400)$, which are: $K_1\rightarrow K^*\pi$ with $L(K^*\pi)$=0,2, $K_1\rightarrow(K\pi)_S\pi$ and $K_1\rightarrow K(\pi\pi)_S$. The fit shows that these decays do not contribute for the $K_1(1270)$, but they are accepted for the $K_1(1400)$ (plusallk1s). I consider this fit to be the final answer to this analysis of the $K_L K_S \pi^0\pi^0$ final state. The final fit parameters are shown in Table 11 and the experimental projections are compared to the fit in Fig. 20.

Fit 13 final	$\log \mathcal{L} = 3222$	$\langle \chi^2 \rangle = 1.7$
Amplitude	Intensity [%]	Phase [deg]
$(K\pi)_S K^*$ S-wave	3.3 ± 6	0 fixed
$K^*\bar{K}^*$ S-wave	3.7 ± 2	152 ± 5
$K^*\bar{K}^*$ D-wave	2.1 ± 1	349 ± 6
$K_1(1270) \to K^*\pi^0$ S-wave	2.4 ± 3	130 ± 5
$K_1(1400) \to K^*\pi^0$ S-wave	53.6 ± 13	71 ± 5
$K_1(1400) \to K^*\pi^0$ D-wave	1.2 ± 8	49 ± 39
$K_1(1400) \to (K\pi)_S\pi^0$ P-wave	5.9 ± 5	38 ± 6
$K_1(1400) \to K(\pi\pi)_S$ P-wave	3.3 ± 4	36 ± 5
$\phi(\pi\pi)_S$ S-wave	2.1 ± 3	34 ± 12
$\phi(1680) \to K^*\bar{K}^*$ P-wave	1.0 ± 0.6	33 ± 7
$X(1^{+-}) \to K^*K$ S-wave	9.0 ± 4	322 ± 5
Incoherent background	12.4 ± 27	

Table 11: Amplitudes and phases for fit 12.

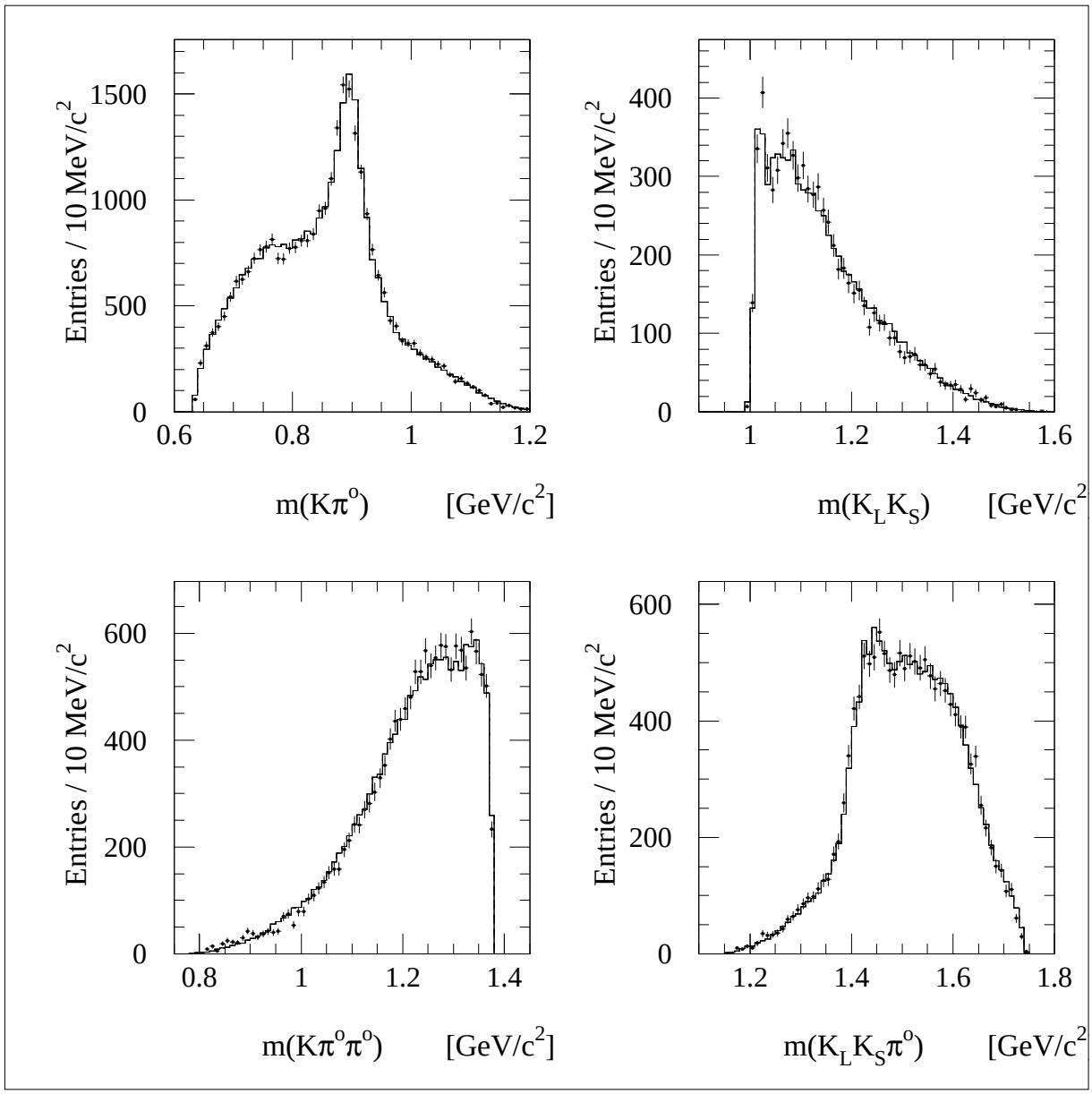

Figure 20: Comparison of data (points with error bars) and fit 12 (solid line). Two- and three-particle invariant mass distributions.