

$D^0 \rightarrow (K_L/K_S) \pi^0$ Progress report

Charm studies group meeting,

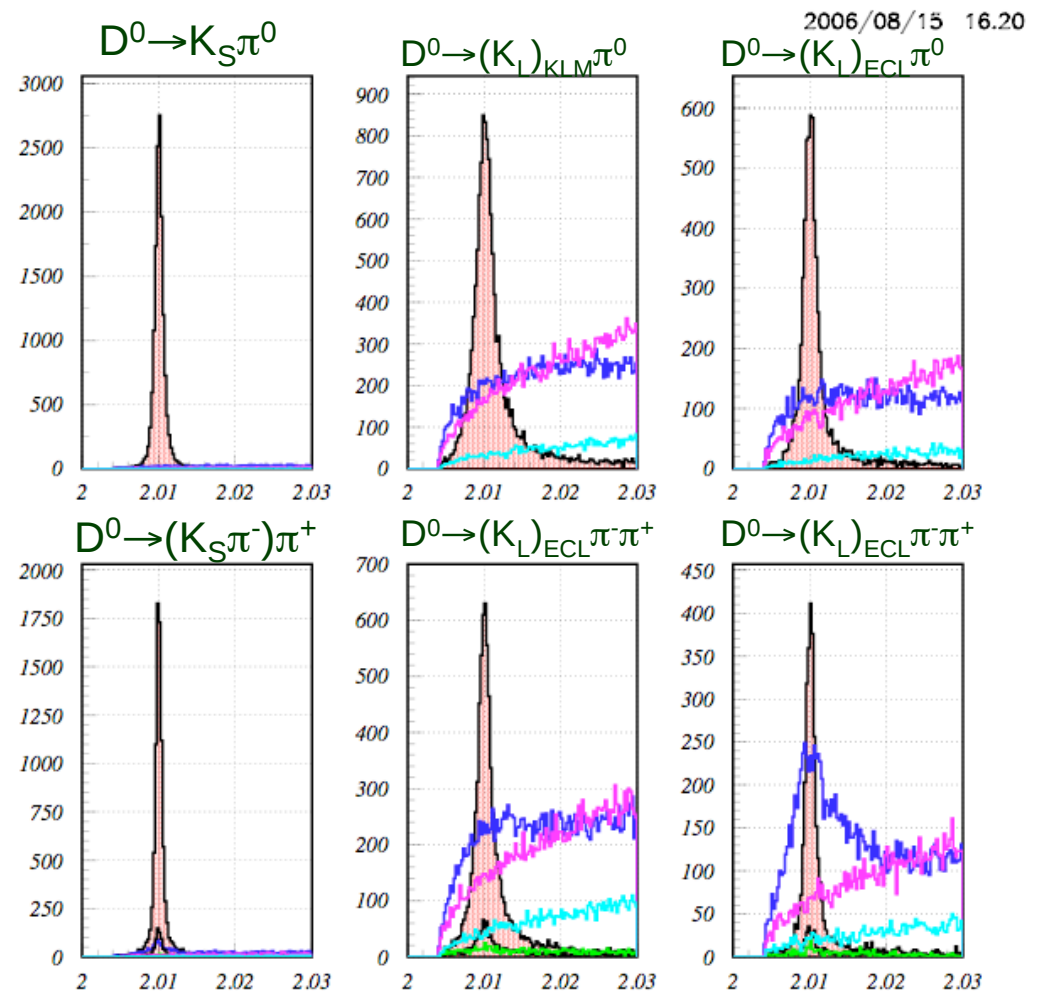
05 Sept 2006

Manmohan Dash, Virginia Tech

Introduction

- * A detailed study of the source of backgrounds is presented.
- * 3 streams of Experiment 7, 9, 11, 13 MC data used.
- * A small amount of data might have been excluded as jobs didn't produce correct output, will be included later.

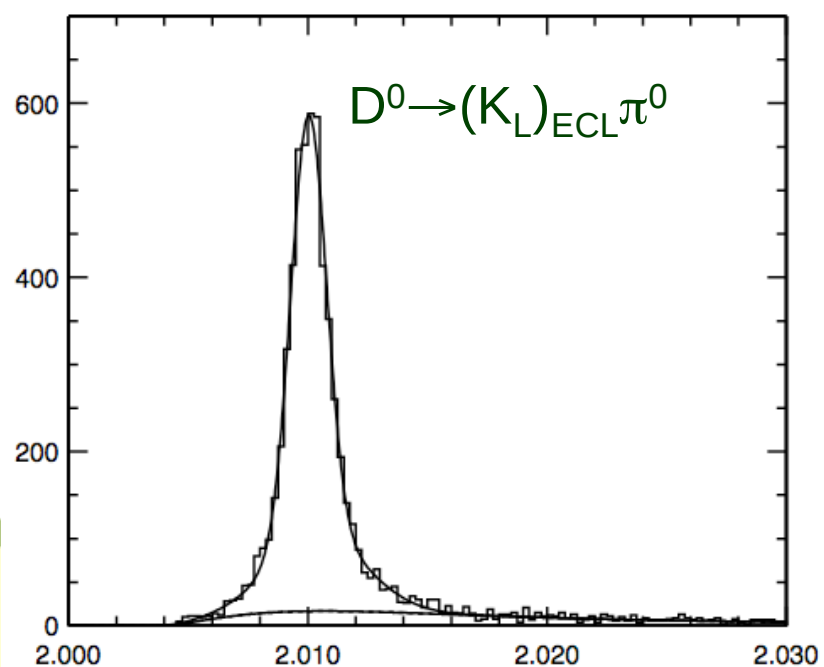
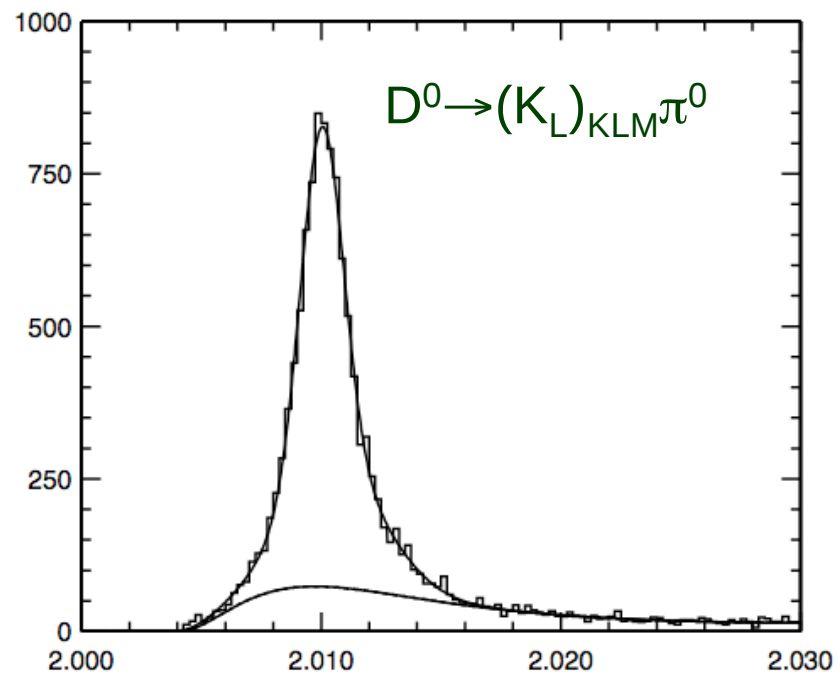
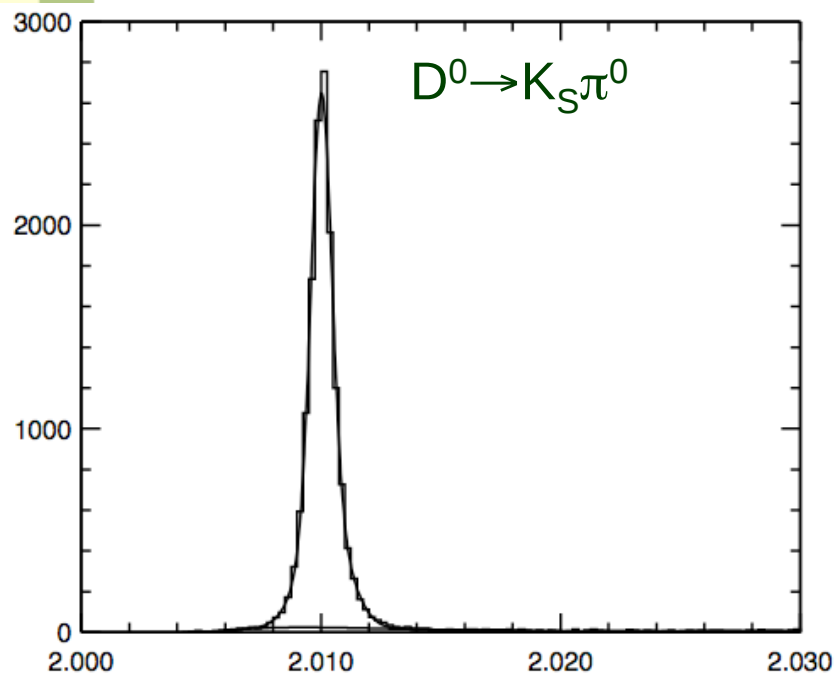
- * Signal Hatched in Red
 - * Peaking background from $\bar{K}^0/K^0 \rho^0$
 - * Background from broad resonances
 - * Unknown peaking
- +
- rest of c cbar background
 - * uds background
 - * mixed + charged background



Fit procedure for true signal.

- * True signal, shown in next 2 sets of plots → Everything except the signal is vetoed.
- * Signal → double Gaussian.
- * Background → threshold function,
$$\text{NORM} * (\text{X-OFFSET})^{**\text{POWER}} * \text{EXP}(\text{COEFF1} * (\text{X-OFFSET}) + \text{COEFF2} * (\text{X-OFFSET})^{**2})$$
- * Offset of threshold fixed to 2.04 GeV.

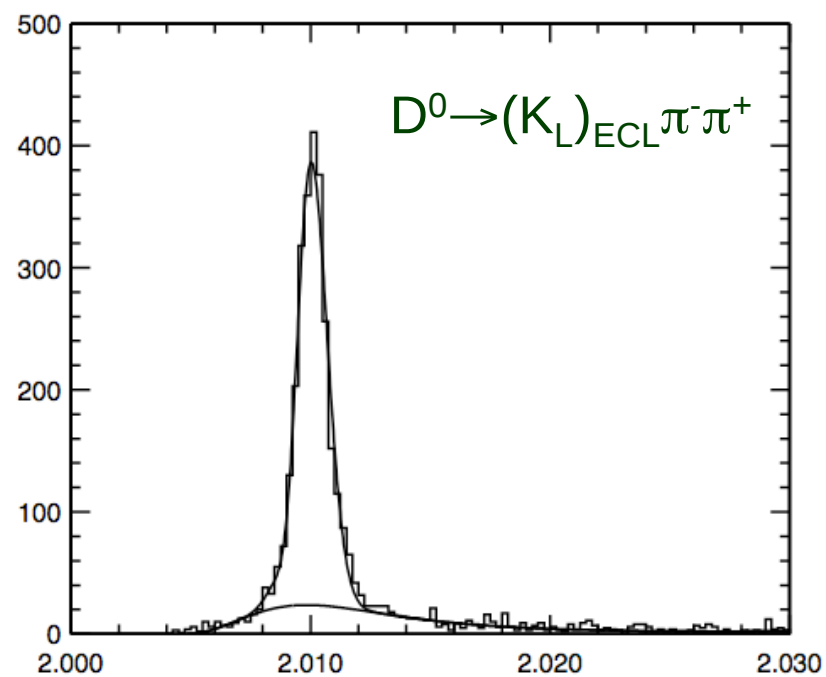
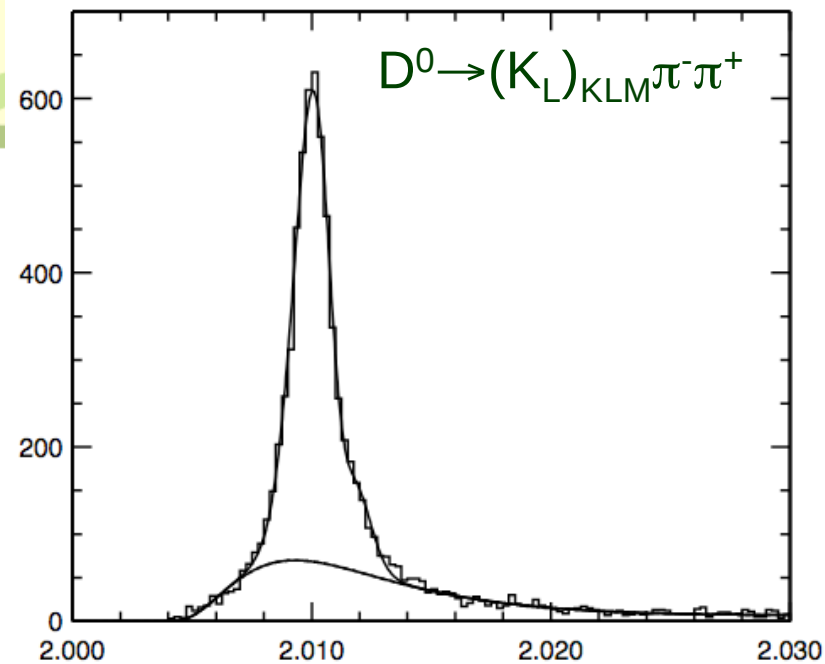
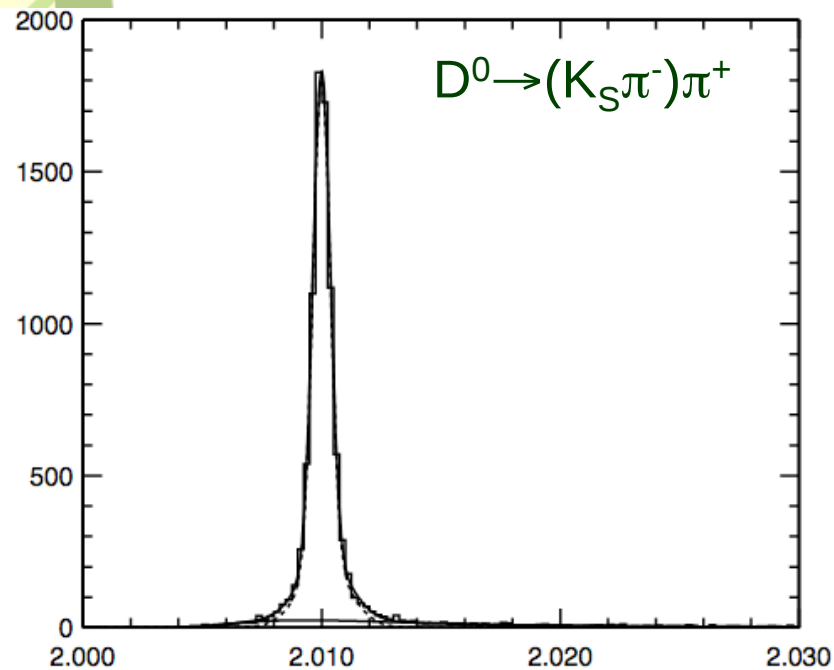
True signal, obtained
by vetoing everything
else except signal,
shown for signal
modes.



Fit statistics

	Fit quality	Area	Mean	Sigma1	Ar2/ Area	Delm	Sig2/ sig1
$D^0 \rightarrow K_S \pi^0$	Chi**2 = 175.7 for 120 - 10 d.o.f. C.L. = 7.016E-03% Fit Status 3	13959. +/- 133.06	2.0100 +/- 6.99060 E-06	4.24522 E-04 +/- 1.44522 E-05	0.36612 +/- 3.87280 E-02	1.38276 E-04 +/- 2.68030 E-05	2.1835 +/- 5.91587 E-02
$D^0 \rightarrow (K_L)_{KLM} \pi^0$	Chi**2 = 130.1 for 120 - 10 d.o.f. C.L. = 9.25 % Fit Status 3	8957.6 +/- 302.57	2.0100 +/- 2.26763 E-05	8.86282 E-04 +/- 3.75094 E-05	0.42950 +/- 5.15889 E-02	5.56479 E-04 +/- 1.48053 E-04	2.3419 +/- 9.47979 E-02
$D^0 \rightarrow (K_L)_{ECL} \pi^0$	Chi**2 = 150.5 for 120 - 10 d.o.f. C.L. = 0.623 % Fit Status 3	5313.6 +/- 320.34	2.0100 +/- 1.82792 E-05	7.43846 E-04 +/- 2.60778 E-05	0.31627 +/- 5.36479 E-02	3.84660 E-04 +/- 1.80601 E-04	2.6962 +/- 0.26556

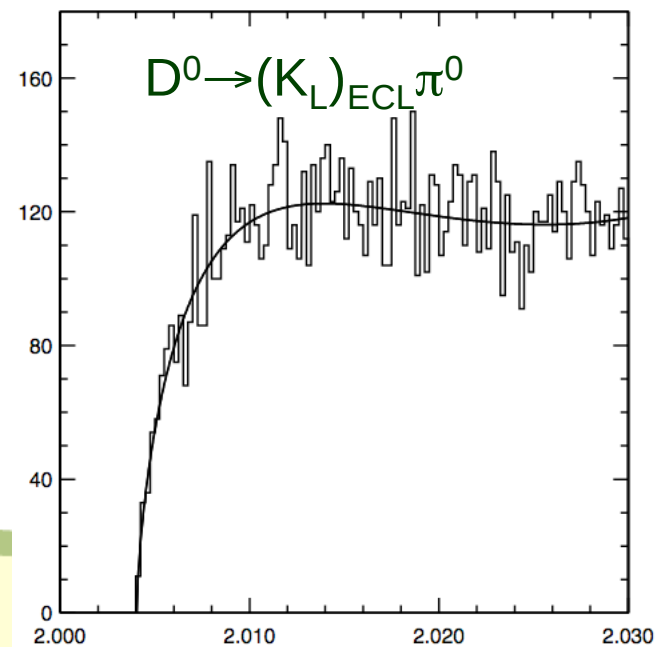
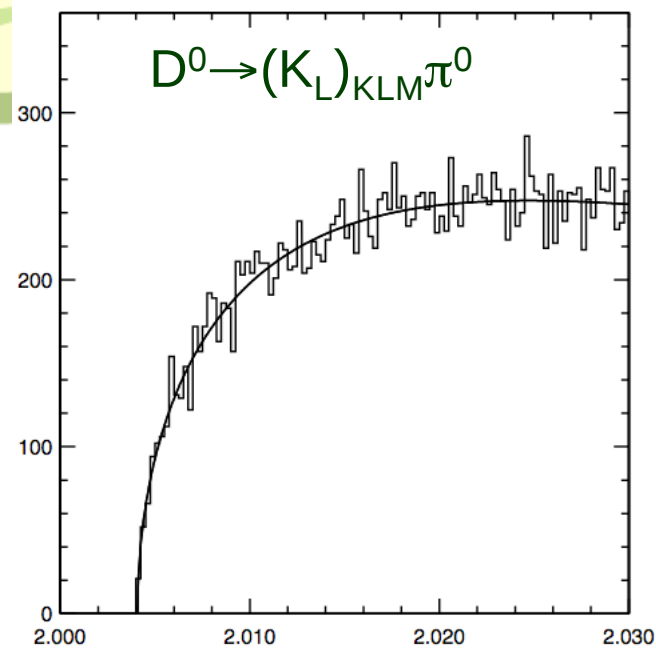
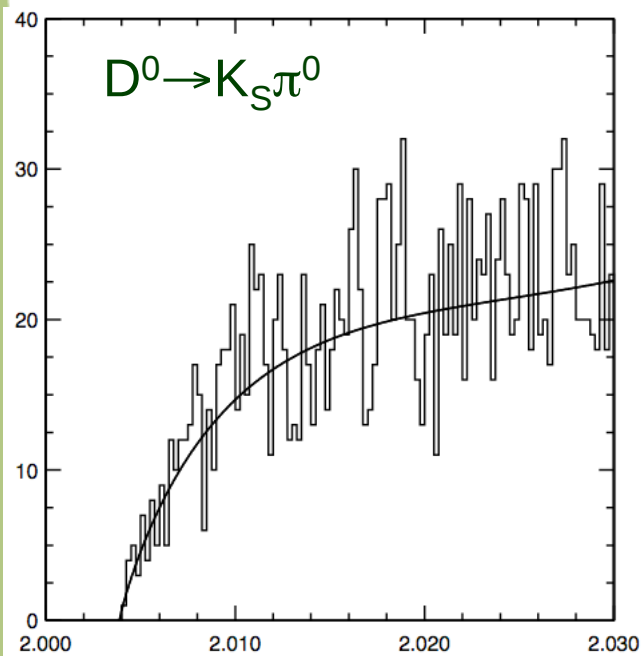
True Signal,
calibration modes.



Fit statistics.

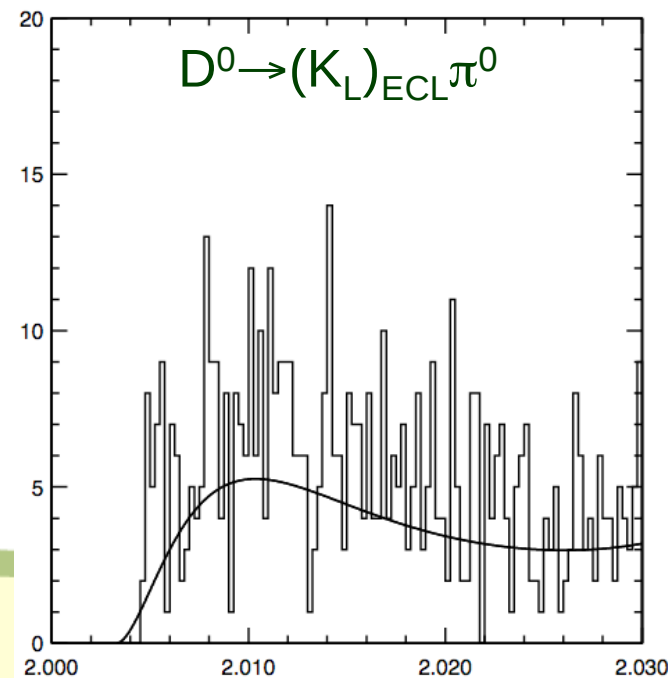
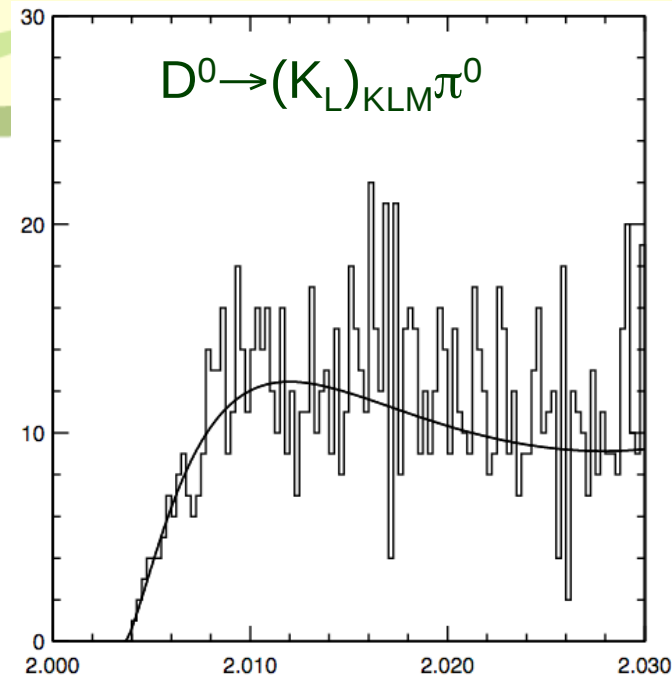
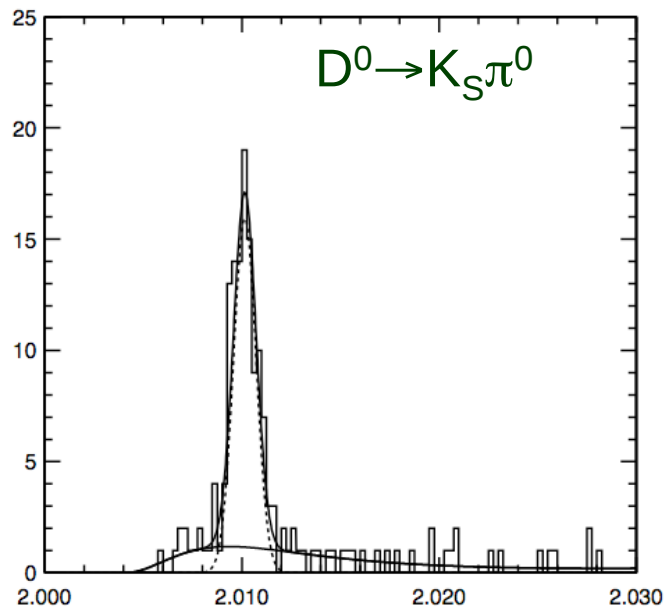
	Fit quality	Area	Mean	Sigma1	Ar2/ Area	Delm	Sig2/ sig1
$D^0 \rightarrow (K_S \pi^-) \pi^+$	Chi**2 = 117.8 for 120 - 10 d.o.f. C.L. = 28.9 % Fit Status 3	7937.6 +/- 101.70	2.0100 +/- 6.23044 E-06	3.63407 E-04 +/- 9.03141 E-06	0.26271 +/- 2.21035 E-02	1.23193 E-04 +/- 3.77835 E-05	2.8365 +/- 0.13506
$D^0 \rightarrow (K_L)_{KLM} \pi^- \pi^+$	Chi**2 = 112.5 for 120 - 10 d.o.f. C.L. = 41.6 % Fit Status 3	4665.5 +/- 121.76	2.0104 +/- 6.66557 E-05	9.87733 E-04 +/- 2.76225 E-05	- 0.42984 +/- 0.14311	6.14977 E-04 +/- 9.02022 E-05	0.61106 +/- 6.94434 E-02
$D^0 \rightarrow (K_L)_{ECL} \pi^- \pi^+$	Chi**2 = 182.1 for 120 - 10 d.o.f. C.L. =1.878E- 03% Fit Status 3	2334.3 +/- 62.805	2.0099 +/- 6.41349 E-05	7.35126 E-04 +/- 3.06261 E-05	- 0.22303 +/- 0.10692	- 7.36366 E-04 +/- 1.09378 E-04	0.62292 +/- 8.19874 E-02

c cbar background for signal
modes, Broad resonance
modes excluded, fitted to
threshold function.



Broad resonance decays:

$D \rightarrow \bar{K}^0/K^0 R$, $R = \rho^0, \omega, f, \eta$
etc, peak fitted to single
Gaussian, background
fitted to threshold function.
Offset fixed when there is
a peak.



Fit statistics for the peak.

	Fit quality	Area	Mean	Sigma
$D^0 \rightarrow K_S \pi^0$	Chi**2 =32.0 for 120 - 7 d.o.f. C.L. = 100.% Fit Status 3	91.492 +/- 11.071	2.0101 +/- 7.72776 E-05	5.72500 E-04 +/- 5.95267 E-05

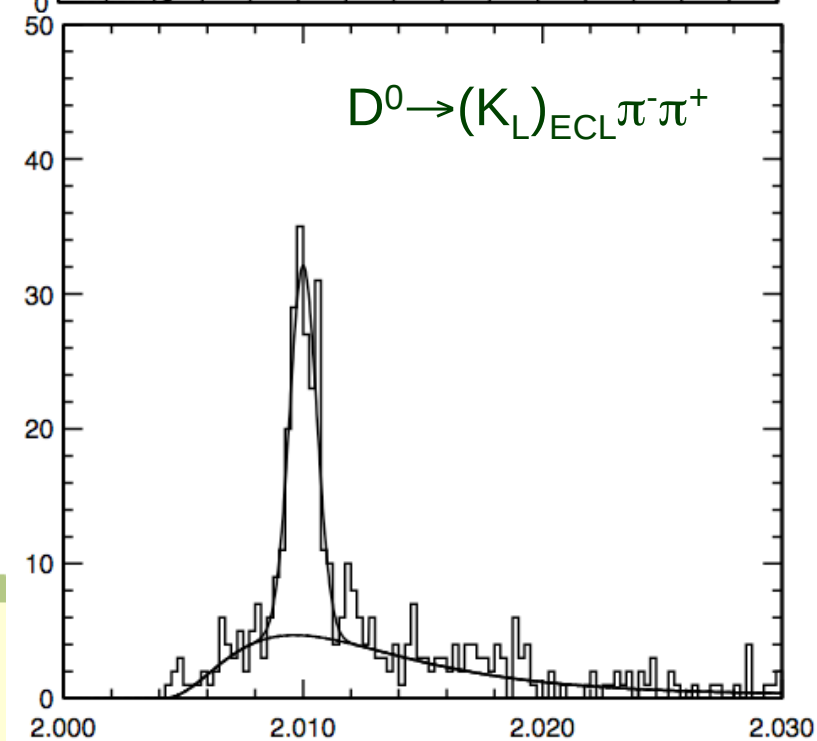
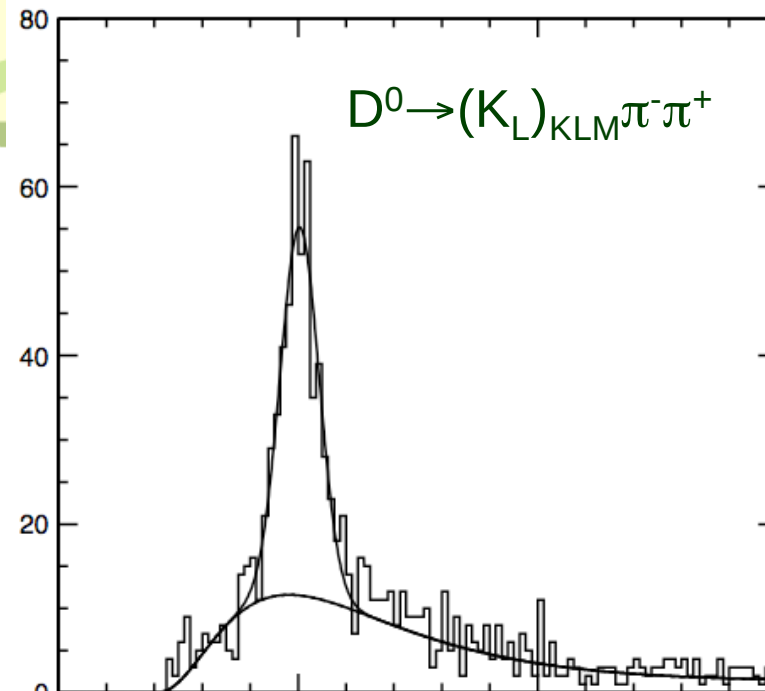
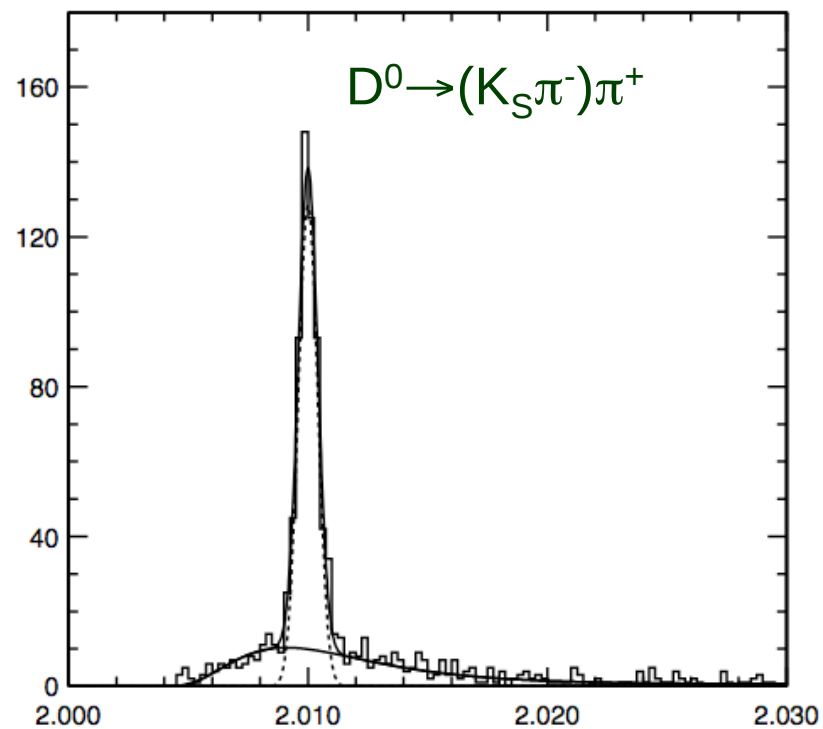
Known peaking background

$D^0 \rightarrow \bar{K}^0/K^0 \rho^0$

Peak: single Gaussian,

Background: threshold

Offset: fixed

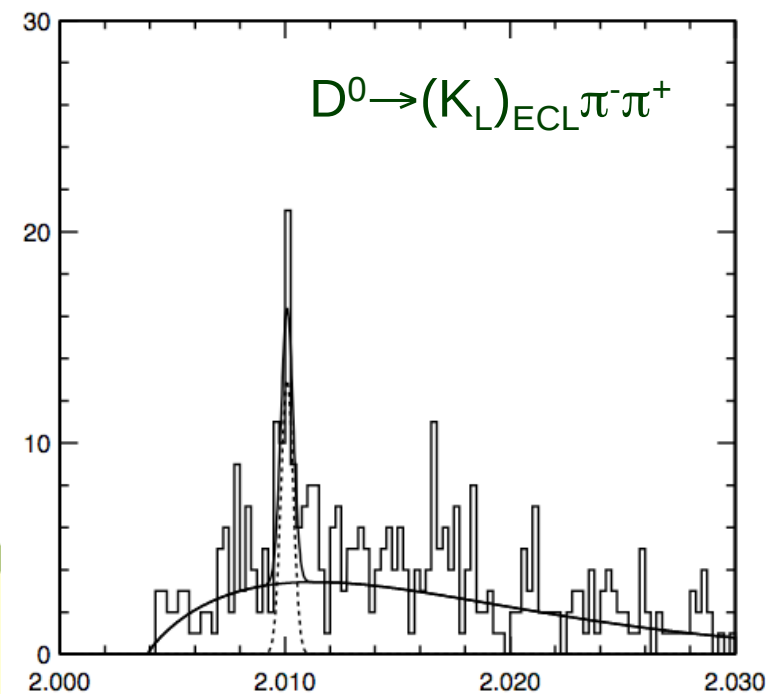
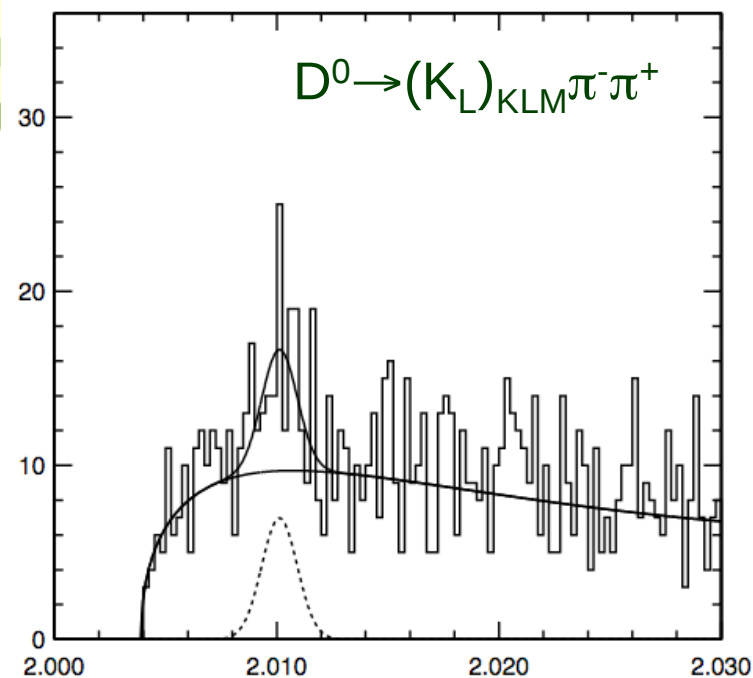
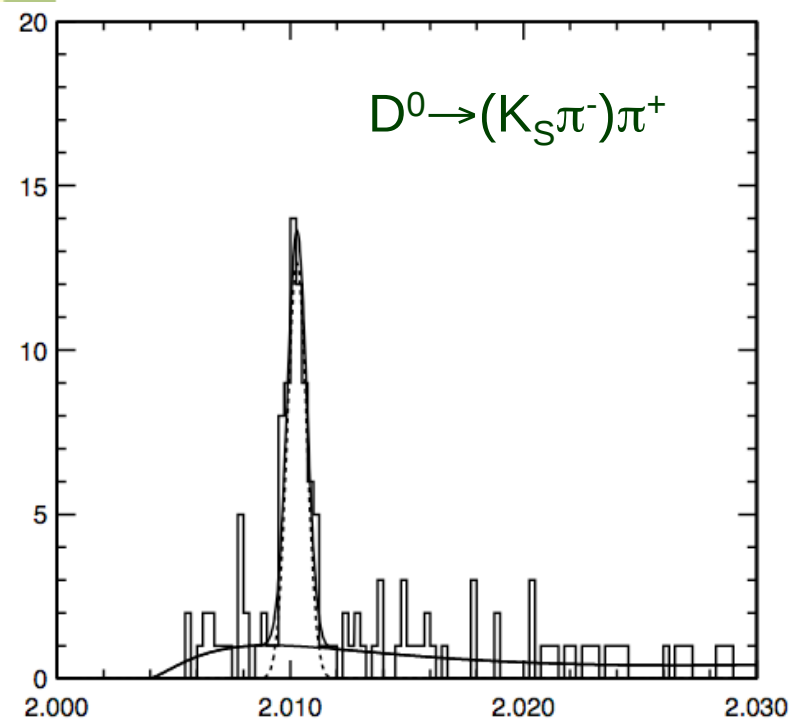


Fit statistics.

	Fit quality	Area	Mean	Sigma1
$D^0 \rightarrow (K_S \pi^-) \pi^+$	Chi**2 = 88.6 for 120 - 7 d.o.f. C.L. = 95.7 % Fit Status 3	521.96 +/- 26.492	2.0100 +/- 2.12158E-05	4.05314E-04 +/- 2.05148E-05
$D^0 \rightarrow (K_L)_{KLM} \pi^- \pi^+$	Chi**2 = 106.1 for 120 - 7 d.o.f. C.L. = 66.3 % Fit Status 3	354.22 +/- 37.890	2.0101 +/- 6.23321E-05	8.09196E-04 +/- 7.65446E-05
$D^0 \rightarrow (K_L)_{ECL} \pi^- \pi^+$	Chi**2 = 75.2 for 120 - 7 d.o.f. C.L. = 99.8 % Fit Status 3	155.43 +/- 16.051	2.0100 +/- 6.06920E-05	5.65296E-04 +/- 5.25233E-05

Other broad resonance modes. i.e. $D^0 \rightarrow \bar{K}^0/K^0 \rho^0$ excluded.

Peak: single Gaussian,
Background: threshold
Offset: fixed

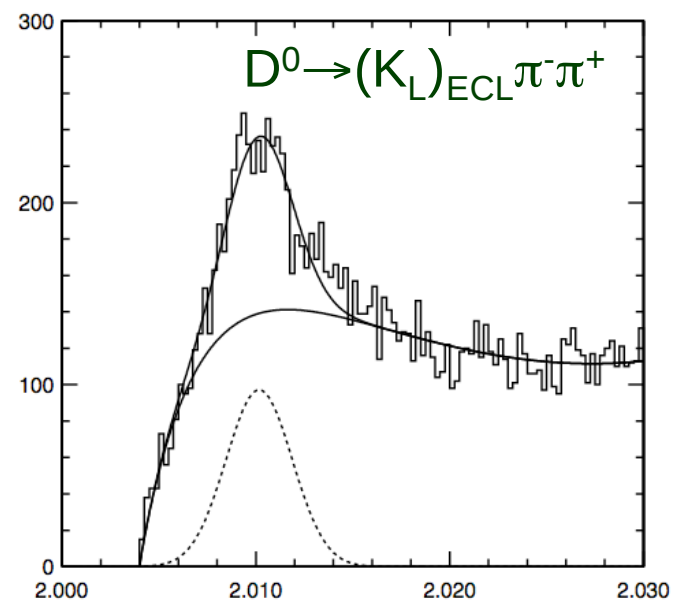
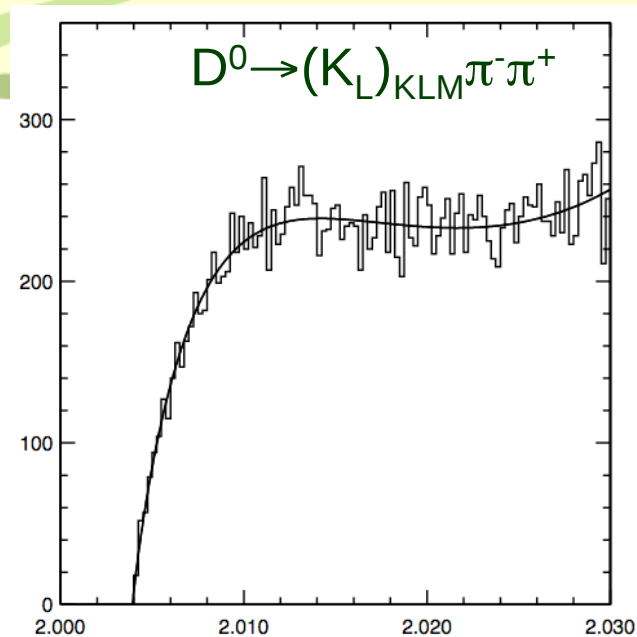
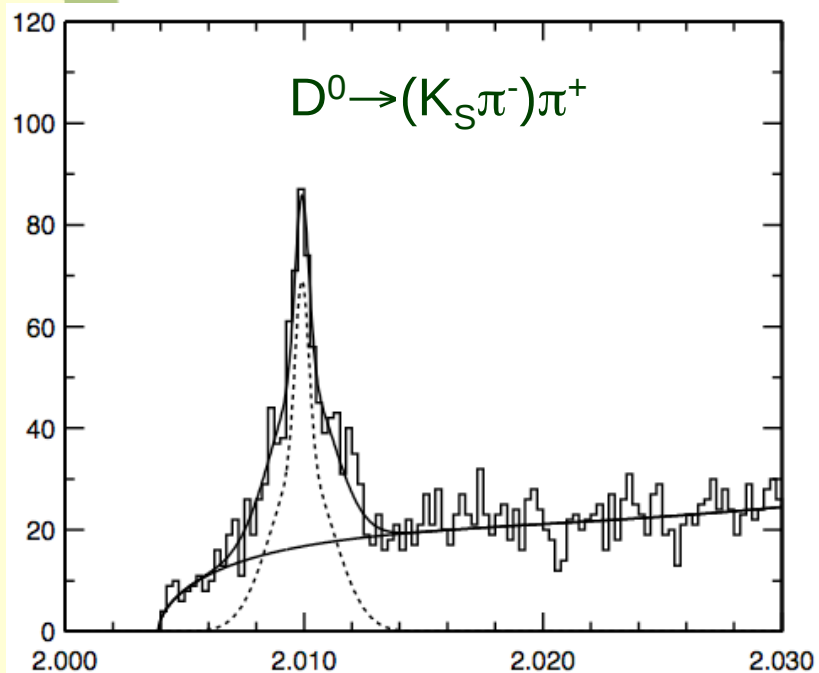


Fit statistics.

	Fit quality	Area	Mean	Sigma1
$D^0 \rightarrow (K_S \pi^-) \pi^+$	Chi**2 = 41.9 for 120 - 7 d.o.f. C.L. = 100. % Fit Status 3	52.591 +/- 8.2325	2.0103 +/- 7.38818E- 05	4.15008E- 04 +/- 5.41869E- 05
$D^0 \rightarrow (K_L)_{KLM} \pi^- \pi^+$	Chi**2 = 111.2 for 120 - 7 d.o.f. C.L. = 53.1 % Fit Status 3	55.878 +/- 19.937	2.0101 +/- 2.82844E- 04	8.00030E- 04 +/- 2.48342E- 04
$D^0 \rightarrow (K_L)_{ECL} \pi^- \pi^+$	Chi**2 = 109.3 for 120 - 7 d.o.f. C.L. = 58.0 % Fit Status 3	35.147 +/- 8.0766	2.0101 +/- 6.40576E- 05	2.69650E- 04 +/- 7.96740E- 05

Unknown peaks in $c\bar{c}$ background, Peaks: double
Gaussian for $D^0 \rightarrow (K_S \pi^-) \pi^+$

Gaussian for $D^0 \rightarrow (K_L)_{ECL} \pi^- \pi^+$



Fit statistics for unknown peaks.

	Fit quality	Area	Mean	Sigma1	Ar2/ Area	Delm fixed	Sig2/ sig1
$D^0 \rightarrow (K_S \pi^-) \pi^+$	Chi**2 = 89.4 for 120 - 9 d.o.f. C.L. = 93.5 % Fit Status 3	532.59 +/- 60.667	2.0099 +/- 5.17193 E-05	2.8839 4E-04 +/- 6.7586 6E-05	0.8029 1 +/- 5.9603 5E-02	0.0000 +/- 0.0000	4.5193 +/- 1.0142
$D^0 \rightarrow (K_L)_{ECL} \pi^- \pi^+$	Chi**2 = 134.5 for 120 - 7 d.o.f. C.L. = 8.21 % Fit Status 3	1662.3 +/- 356.25	2.0102 +/- 1.13445 E-04	1.7076 8E-03 +/- 2.4330 1E-04	--	--	--

What could be the peaks?

- * The strange bump in calibration mode appears for ECL type K_L only.
- * A quick scan in ECL variables showed no strange behavior.
- * BFs in PDG 2006(given for K_S modes only as DCS/CF interference can't be ruled out)

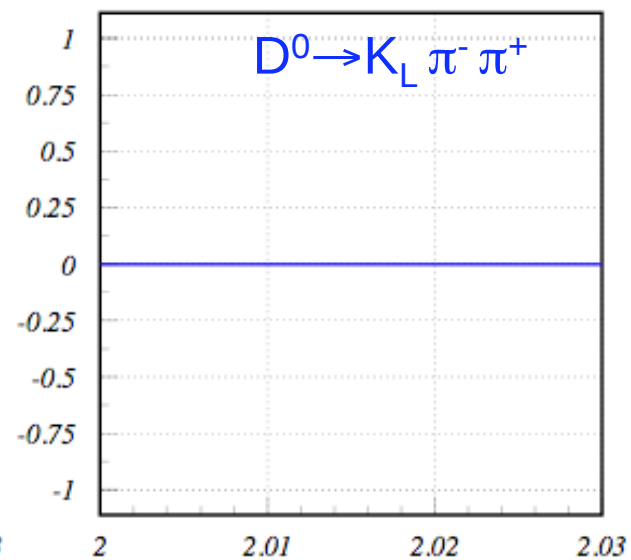
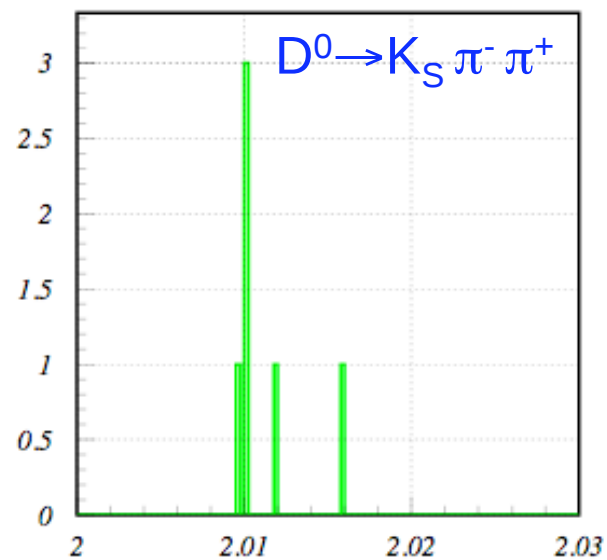
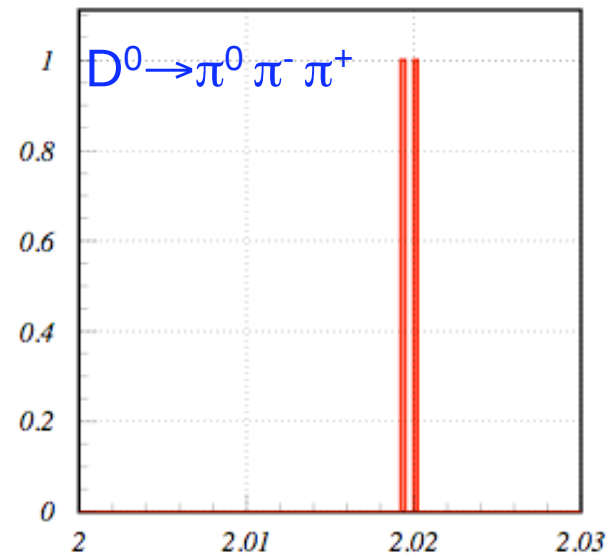
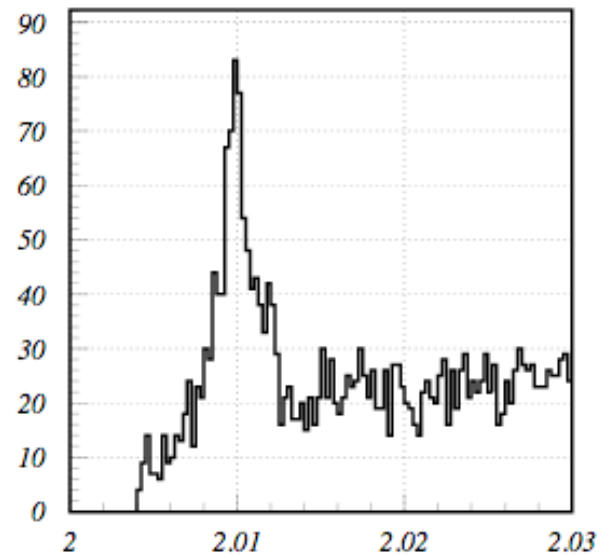
$K^*(892)^- \pi^+, K^*(892)^- \rightarrow K_S \pi^- \quad (1.91 \pm 0.14) \%$

$\pi^+ \pi^- \pi^0 \quad \text{evtgen } 1.33\% \quad \text{PDG } (1.31 \pm 0.06) \%$

$\pi^+ \pi^- K_S \quad \text{evtgen(Kbar)} 1.03\% \quad \text{PDG, non-resonant} (2.6 + 5.9 - 1.6) \times 10^{-4}$

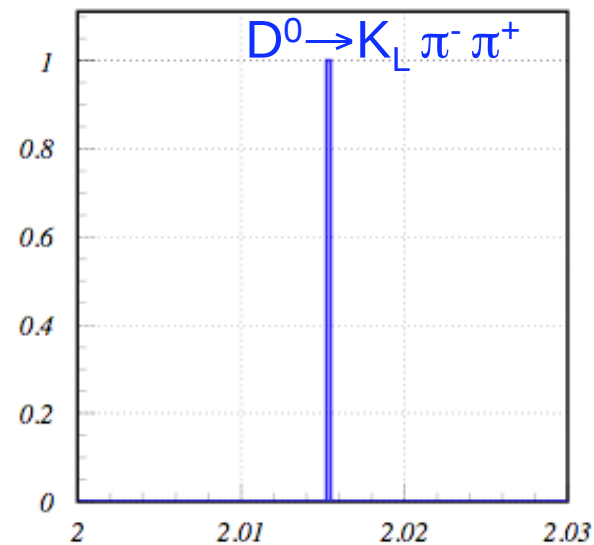
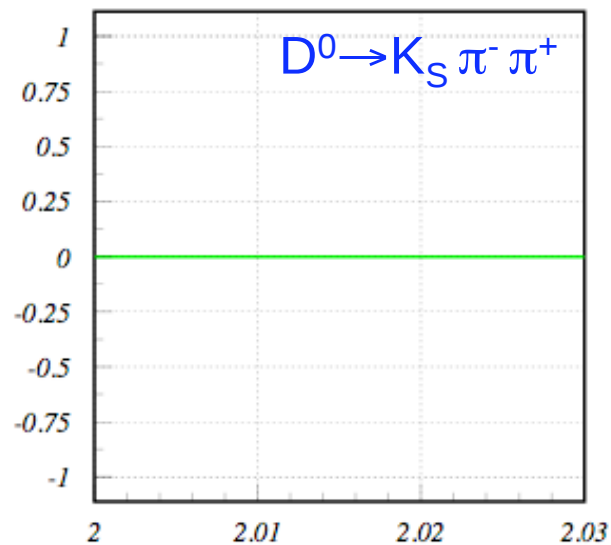
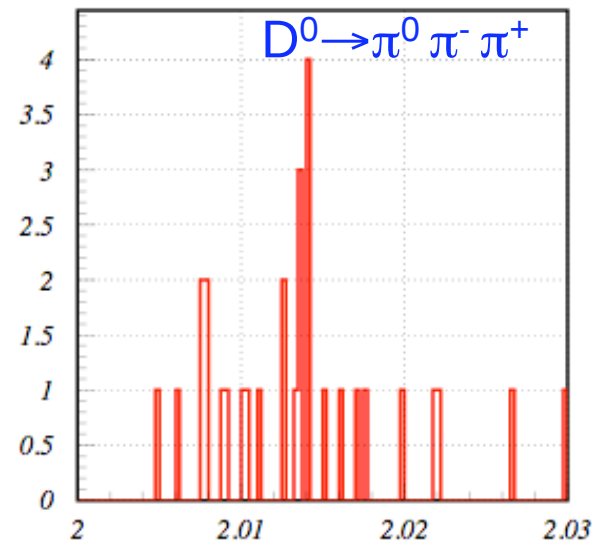
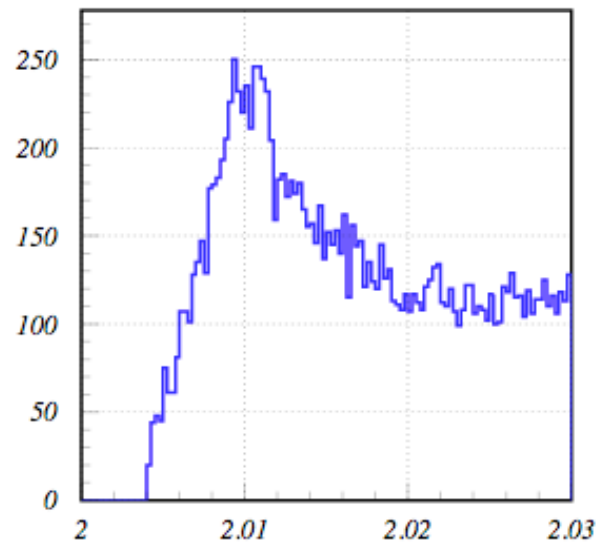
Unknown peak in $D^0 \rightarrow (K_S \pi^-) \pi^+$

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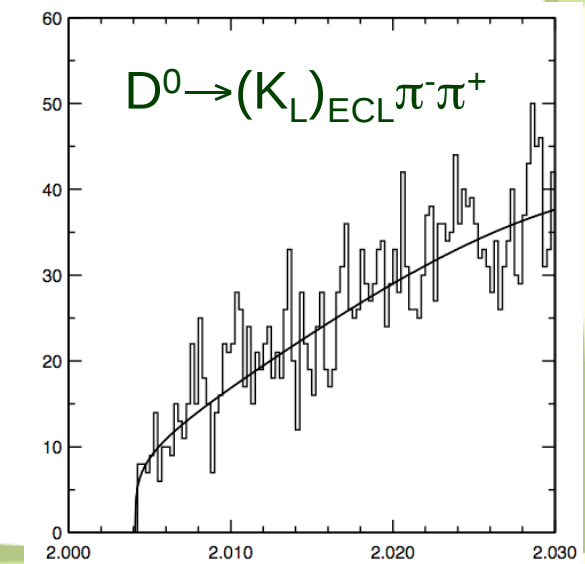
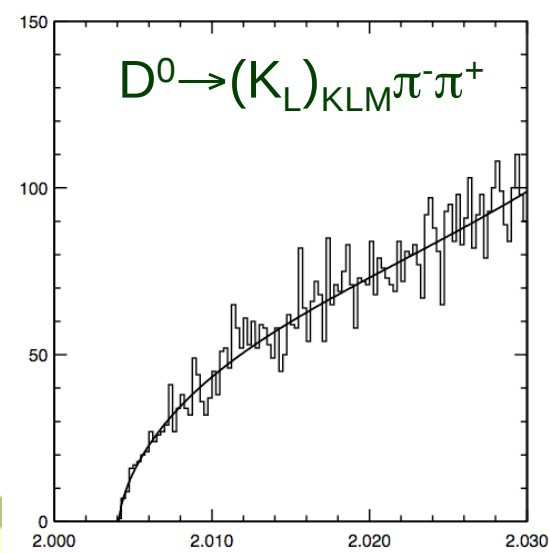
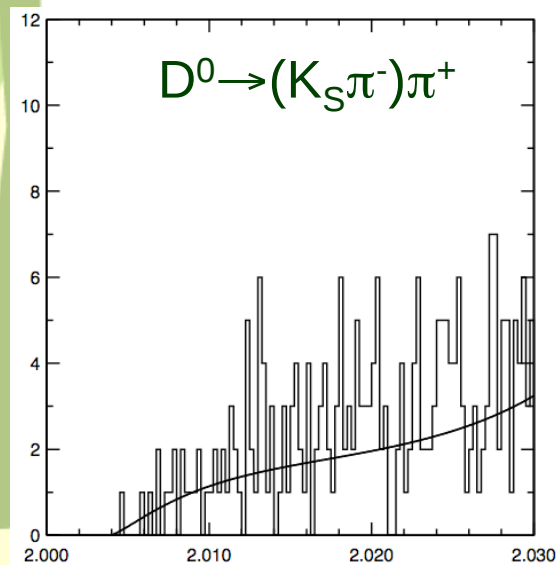
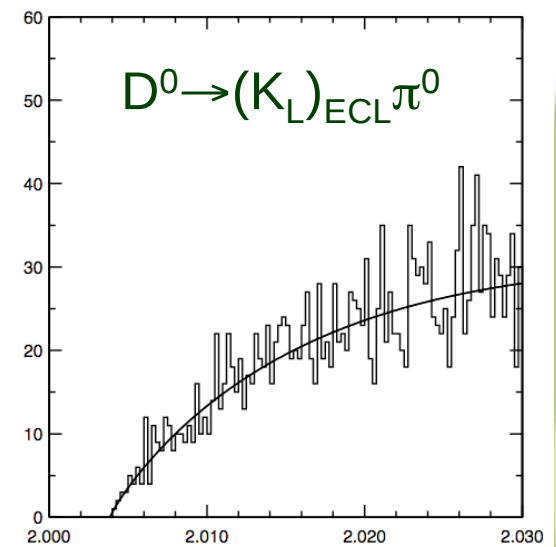
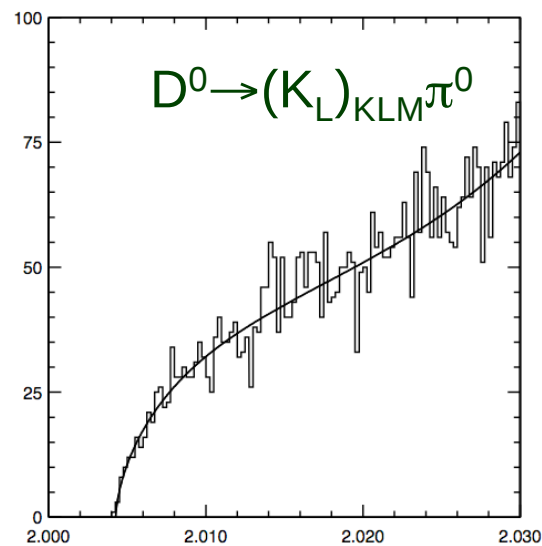
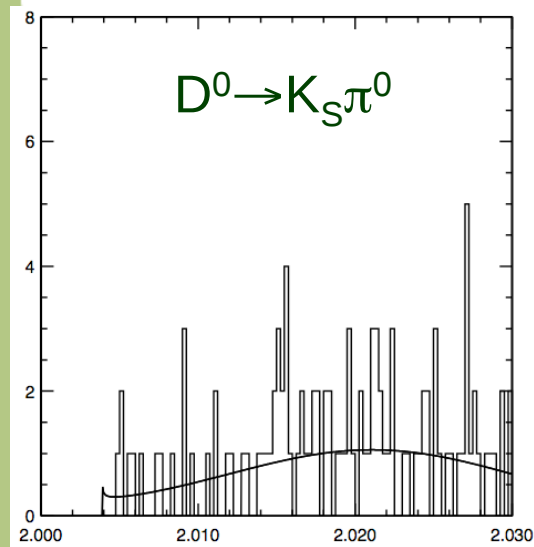


Unknown peak in $D^0 \rightarrow (K_L)_{ECL} \pi^- \pi^+$

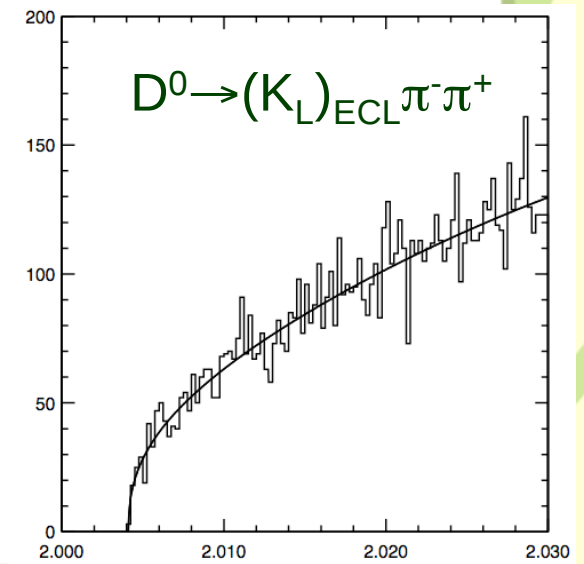
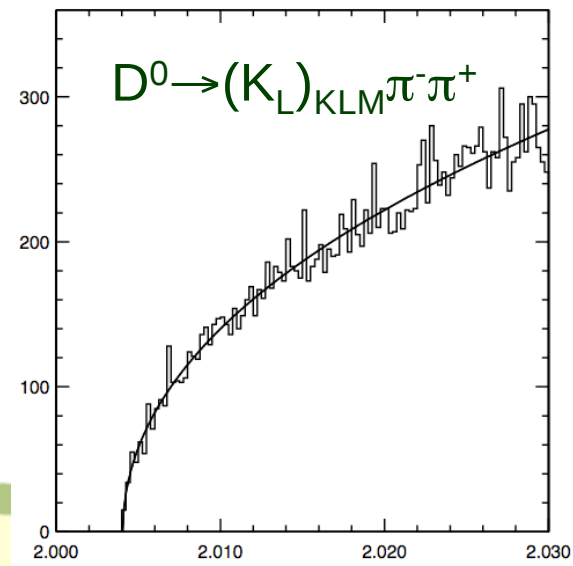
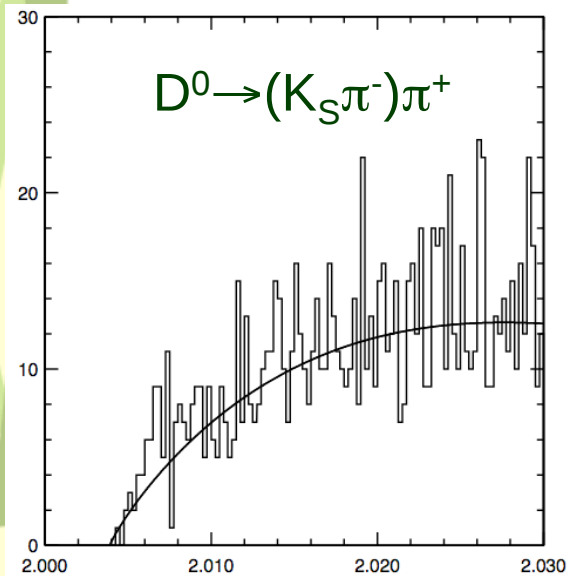
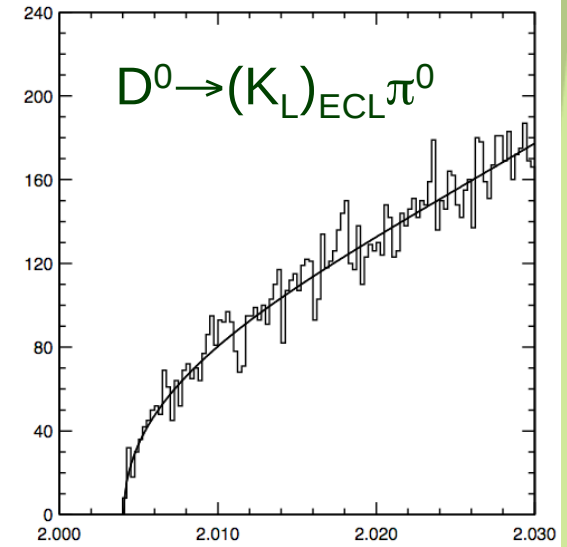
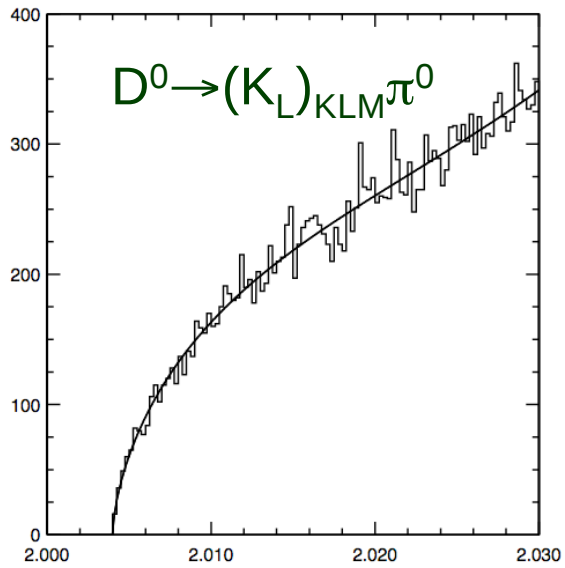
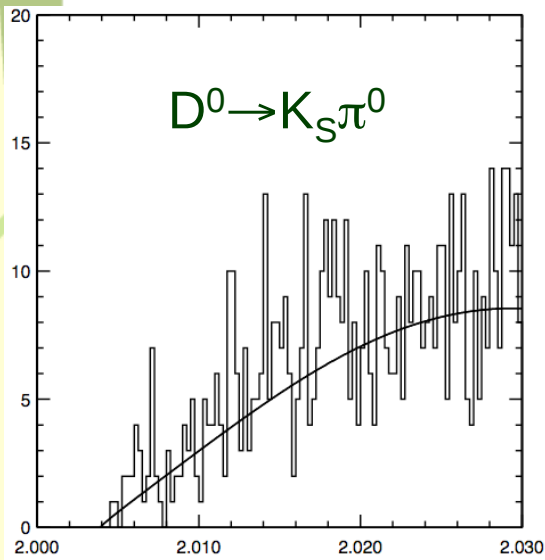
2006/08/30 22.38



$\bar{b}$ background



uds background



Unfinished business.

- * Writing a preliminary Belle Note.
- * Should I increase MC stat to say 100/fb for BAM? (Skim + analysis jobs)
 - i. Smearing Pseudo K_L for fit study.
 - ii. Multiple candidates with error.
 - iii. Bias, asymmetry study in fit in MC/data
 - iv. Unknown peaks??