

Analysis Report

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Charm Studies Meeting, Belle

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Highlights

- Skimmed and analyzed data
 - HadronB skim of exp 07, exp 09, exp 11, exp 13 (4s + continuum) $[29.369(4s) + 3.004(cont) = 32.373]fb^{-1}$
- Results from $[21.328(4s) + 2.320(cont) = 23.648]fb^{-1}$ shown in this report
 - Corresponds to (exp 07 to exp 13-run 531) data
 - To compare with previous analysis done by Roman Kagan($23.6fb^{-1}$)
 - All procedure and cuts same except slight difference in Reconstruction and fitting
 - Significant improvement in signal yield

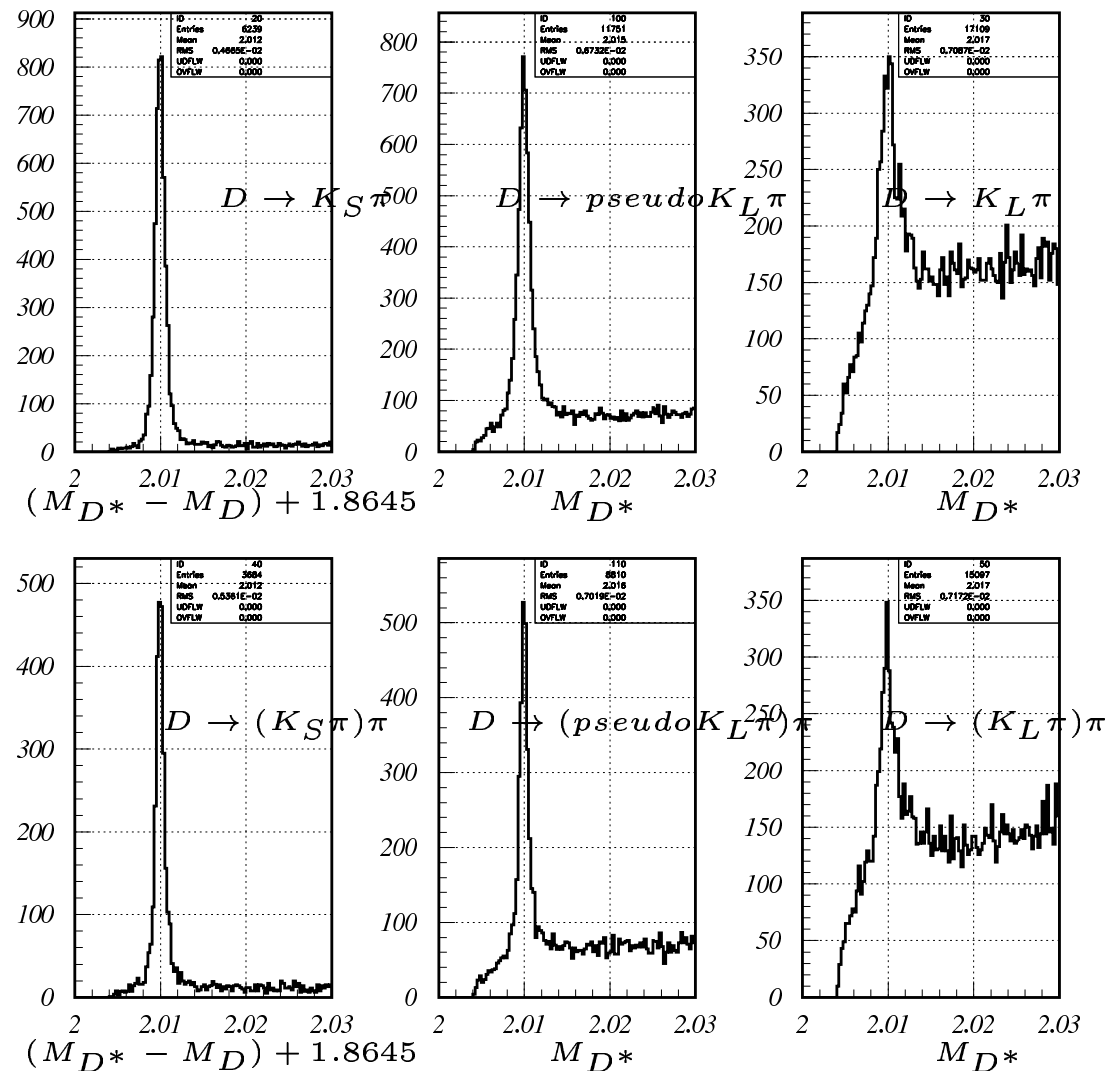
Reconstruction and Event Selection

- π^0 from mdst-pi0
 - $E_\gamma \leq .05 \text{ GeV}/c^2$
- $\pi^\pm$ good charged
- K_S good K_S
 - Tighter cuts by Roman on K_S vertex parameters
- K_L from mdst-klong
 - Detector gives only K_L direction
 - M_{D^0} and M_{K_L} is fixed to PDG value and kinematics is solved for p_{K_L}

- Quadratic equation, $\frac{-b - (\sqrt{b^2 - 4ac})}{2a}$ currently chosen solution
- $K^{*\pm}$ mass cuts
 - within 50 MeV of nominal $K^{*\mp}(892)$ mass
- D^0 mass window cuts and constraints
 - within 100 MeV of nominal D^0 mass for K_S modes
- $D^{*\pm}$
 - $M_{D^{*\pm}} \leq 2.03 \text{ GeV}$ for K_L modes
 - $(\delta M + 1.8645) \leq 2.03 \text{ GeV}$ for K_S modes
where $\delta M = M_{D^{*\pm}} - M_{D^0}$
- Veto on unreconstructed charged particles

- ECL K_L s with energy range 0.15 to 0.3 GeV is rejected
- Cosine of K^0 flight angle wrt D^0 boost (Θ_{DK})
 - $-0.95 \leq \Theta_{DK} \leq 0.2$ for all modes
- Invariant mass of $\pi^+ \pi^-$ pair
 - $M_{\pi^+ \pi^-} \leq 0.7$
- Reconstructed scaled momentum of D^* , x_p
 - $0.6 \leq x_p \leq 1.0$
- pseudo K_L
 - $K_S(\pi^+ \pi^-)$ reconstructed the same way as K_L

Signal for the 4-modes in data



Fitting Procedure

- Roman's Method

- for K_S modes signal is double gaussian
- for K_L modes signal is single gaussian
- central value of all gaussians fixed to nominal $D^{*\pm}$ mass
- background for all modes, first order polynomial $\times$ square root threshold factor

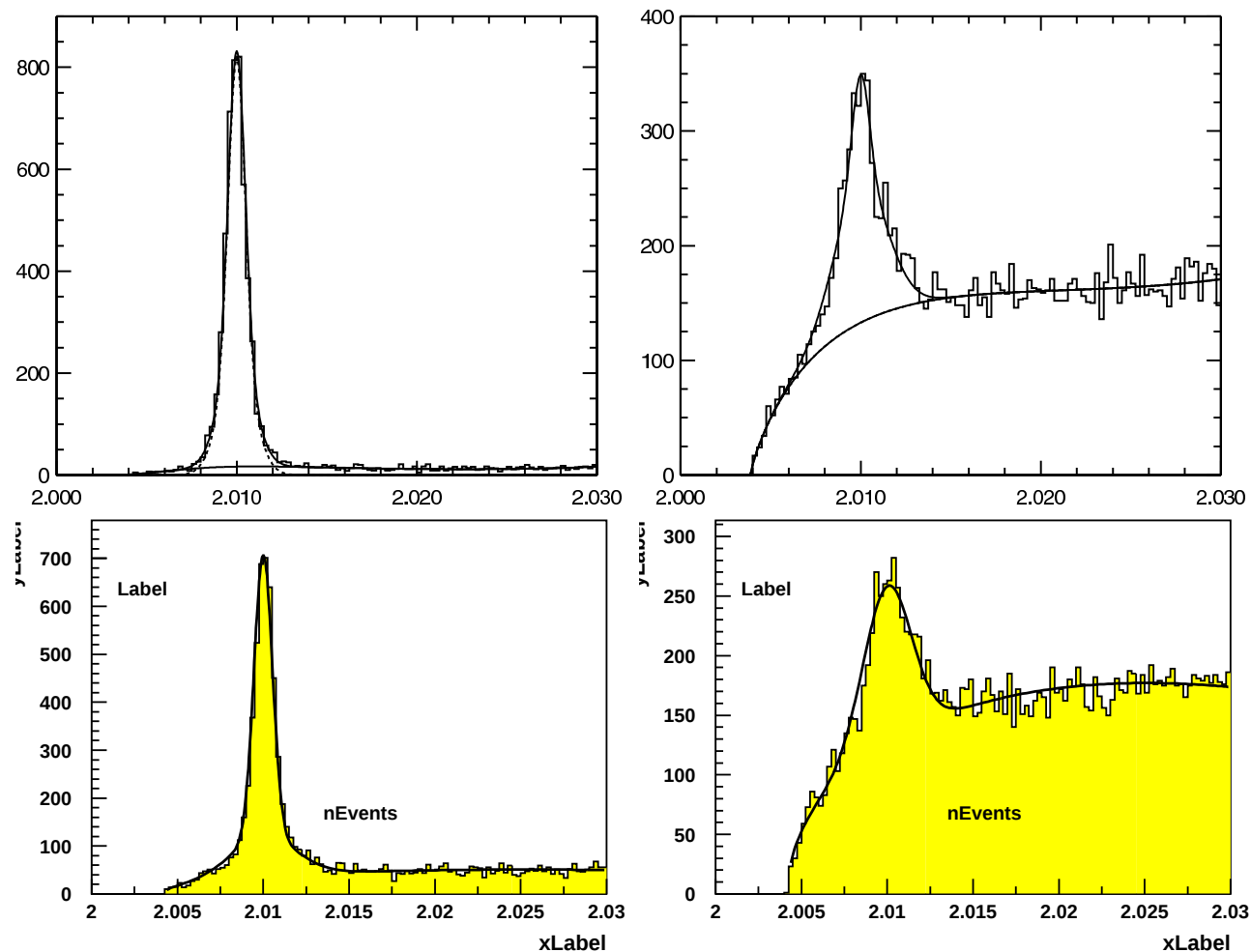
- My Method

- signal double gaussian(all modes) with mean fixed to nominal $D^{*\pm}$ mass

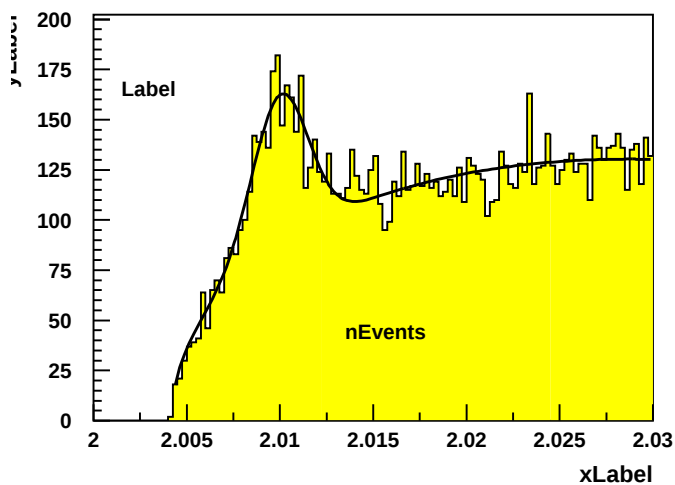
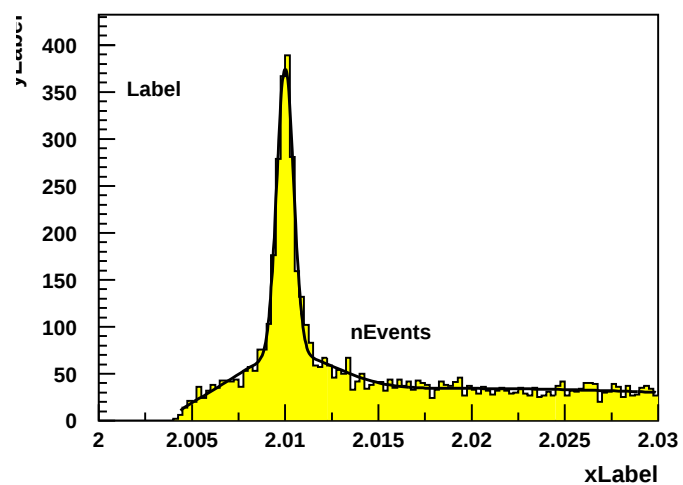
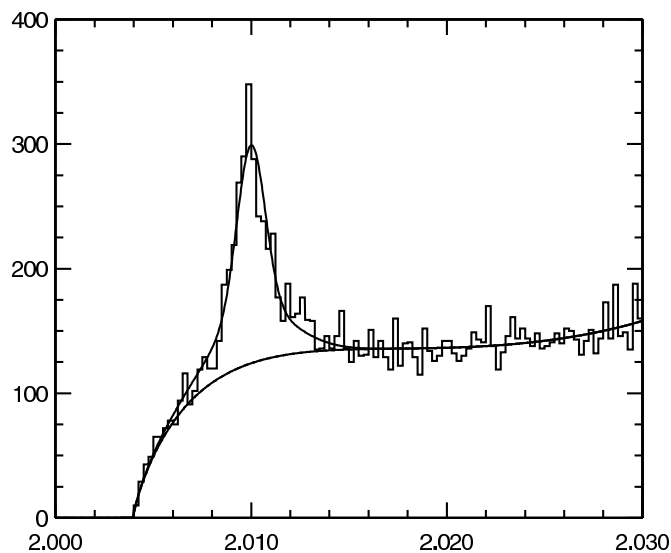
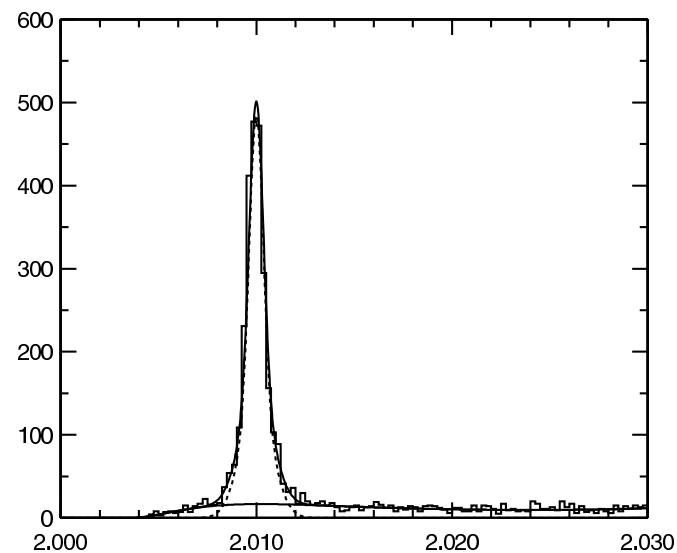
– background for all modes, Threshold function :

$$\text{NORM} * (\text{X-OFFSET}) ** \text{POWER} * \text{EXP}(\text{COEFF1} * (\text{X-OFFSET}) + \text{COEFF2} * (\text{X-OFFSET}) ** 2)$$

Comparison with Roman's result $D \rightarrow K_S \pi$ Vs $D \rightarrow K_L \pi$



$D \rightarrow K_S \pi \pi$ Vs $D \rightarrow K_L \pi \pi$



Comparison of Yields

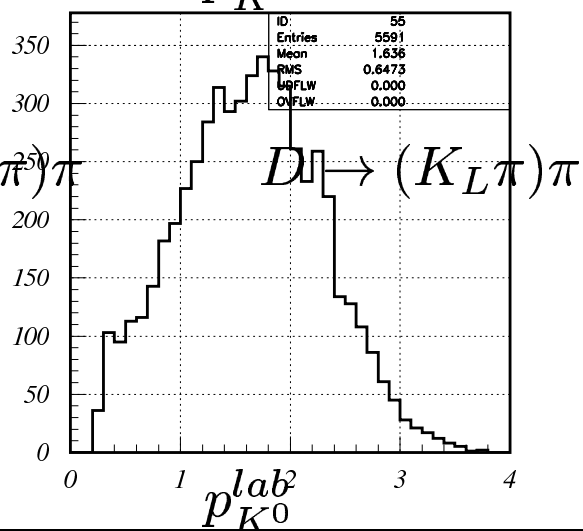
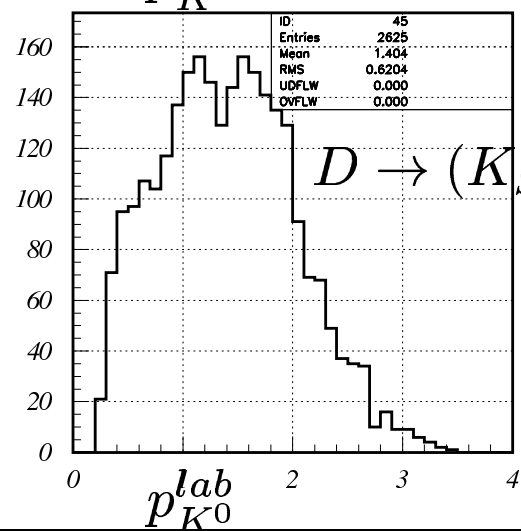
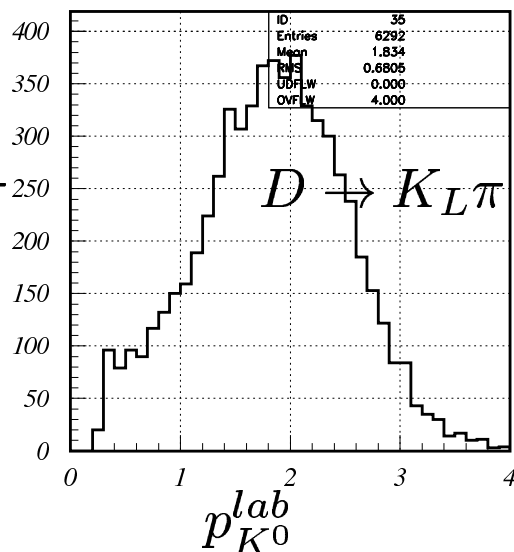
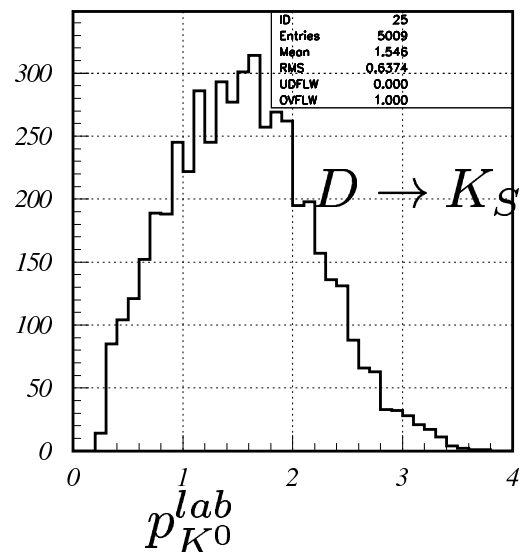
- Roman's result

- $N(K_S \pi^0) = 4715 \pm 91$
- $N(K_L \pi^0) = 1839 \pm 101$
- $N(K_S \pi \pi) = 2524 \pm 77$
- $N(K_L \pi \pi) = 1119 \pm 84$

- My result

- $N(K_S \pi^0) = 6739$
- $N(K_L \pi^0) = 3943$
- $N(K_S \pi \pi) = 3432$
- $N(K_L \pi \pi) = 2617$

K^0 momentum spectra in Lab, from data under peak



Next

- Skim and analyze generic MC
- Efficiency and MC truth
- Optimization of cuts
- Best candidate selection

back up slide1, fit results

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*****
D0 to Ks Pi0
*****
FCN=   134.1745      FROM MINOS      STATUS=PROBLEMS      36314 CALLS      49359 TOTAL
                        EDM=   0.82E-05      STRATEGY= 1      ERROR MATRIX ACCURATE

Results of Fit to Plot(s):          20  0;
Chi**2 =   134.2 for 120 - 9 d.o.f.          C.L. = 6.65  %
Plot Area Total/Fit  6239.00 / 6239.00      Fit Status 3
Func Area Total/Fit  6105.83 / 6105.83      E.D.M. 8.235E-06

      Name      Value      Errors
      Name      Value      Parabolic      Minos
Function 1: Threshold
1( 1) 1 NORM      3.84856E+13 +/- 4.02250E+13 - 0.0000 + 0.0000
1( 2) 2 OFFSET      2.0027 +/- 3.57398E-04 - 3.78483E-04 + 3.54221E-04
1( 3) 3 POWER      3.3629 +/- 0.18483 - 0.0000 + 2.3067
1( 4) 4 COEFF1     -571.58 +/- 42.495 - 278.70 + 0.0000
1( 5) 5 COEFF2      10109. +/- 1144.5 - 3187.0 + 0.0000
Function 2: Two Gaussians (sigma)
2( 1) 6 AREA      4769.6 +/- 79.380 - 0.0000 + 0.0000
* 2( 2) 7 MEAN      2.0100 +/- 0.0000 - 0.0000 + 0.0000
2( 3) 8 SIGMA1     4.62957E-04 +/- 2.54287E-05 - 2.63585E-05 + 2.46451E-05
2( 4) 9 AR2/AREA    0.41327 +/- 7.06260E-02 - 6.78059E-02 + 7.32673E-02
* 2( 5) 10 DELM      0.0000 +/- 0.0000 - 0.0000 + 0.0000
2( 6) 11 SIG2/SIG1  1.9995 +/- 9.32731E-02 - 9.19518E-02 + 9.53709E-02

*****
D0 to Kl Pi0
*****
FCN=   105.8381      FROM MINOS      STATUS=PROBLEMS      11384 CALLS      19114 TOTAL
                        EDM=   0.23E-02      STRATEGY= 1      ERROR MATRIX ACCURATE

Results of Fit to Plot(s):          30  0;
Chi**2 =   105.8 for 120 - 9 d.o.f.          C.L. = 62.1  %
Plot Area Total/Fit  17109.0 / 17109.0      Fit Status 3
Func Area Total/Fit  17004.2 / 17004.2      E.D.M. 2.319E-03

      Name      Value      Errors
      Name      Value      Parabolic      Minos
Function 1: Threshold
1( 1) 1 NORM      5.80753E+07 +/- 3.23793E+07 - 3.31007E+07 + 5.12834E+07
1( 2) 2 OFFSET      2.0039 +/- 1.08437E-05 - 1.05668E-05 + 9.95403E-05
1( 3) 3 POWER      0.82159 +/- 7.83142E-02 - 0.12689 + 9.09799E-02
1( 4) 4 COEFF1     -91.193 +/- 23.512 - 25.336 + 31.307
1( 5) 5 COEFF2      1368.7 +/- 528.32 - 665.31 + 556.61
Function 2: Two Gaussians (sigma)
2( 1) 6 AREA      2203.4 +/- 203.64 - 191.71 + 0.0000
* 2( 2) 7 MEAN      2.0100 +/- 0.0000 - 0.0000 + 0.0000
2( 3) 8 SIGMA1     4.80251E-04 +/- 1.23619E-04 - 0.0000 + 0.0000
2( 4) 9 AR2/AREA    0.79067 +/- 8.83186E-02 - 0.12012 + 0.0000
* 2( 5) 10 DELM      0.0000 +/- 0.0000 - 0.0000 + 0.0000
2( 6) 11 SIG2/SIG1  3.0101 +/- 0.56273 - 0.0000 + 0.0000
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backup slide2, fit results

```
*****
D0 to Kl Pi0
*****
FCN=   105.8381      FROM MINOS      STATUS=PROBLEMS      11384 CALLS      19114 TOTAL
                        EDM=   0.23E-02      STRATEGY= 1      ERROR MATRIX ACCURATE

Results of Fit to Plot(s):          30  0;
Chi**2 =   105.8 for 120 - 9 d.o.f.          C.L. = 62.1 %
Plot Area Total/Fit 17109.0 / 17109.0          Fit Status 3
Func Area Total/Fit 17004.2 / 17004.2          E.D.M. 2.319E-03

      Name      Value      Errors
      Name      Value      Parabolic      Minos
Function 1: Threshold
1( 1) 1 NORM      5.80753E+07 +/- 3.23793E+07 - 3.31007E+07 + 5.12834E+07
1( 2) 2 OFFSET      2.0039 +/- 1.08437E-05 - 1.05668E-05 + 9.95403E-05
1( 3) 3 POWER      0.82159 +/- 7.83142E-02 - 0.12689 + 9.09799E-02
1( 4) 4 COEFF1     -91.193 +/- 23.512 - 25.336 + 31.307
1( 5) 5 COEFF2     1368.7 +/- 528.32 - 665.31 + 556.61
Function 2: Two Gaussians (sigma)
2( 1) 6 AREA      2203.4 +/- 203.64 - 191.71 + 0.0000
* 2( 2) 7 MEAN      2.0100 +/- 0.0000 - 0.0000 + 0.0000
2( 3) 8 SIGMA1     4.80251E-04 +/- 1.23619E-04 - 0.0000 + 0.0000
2( 4) 9 AR2/AREA   0.79067 +/- 8.83186E-02 - 0.12012 + 0.0000
* 2( 5) 10 DELM     0.0000 +/- 0.0000 - 0.0000 + 0.0000
2( 6) 11 SIG2/SIG1 3.0101 +/- 0.56273 - 0.0000 + 0.0000
*****
D0 to (Kl Pi) Pi
*****
FCN=   119.2885      FROM MINOS      STATUS=SUCCESSFUL 25534 CALLS      29622 TOTAL
                        EDM=   0.15E+00      STRATEGY= 1      ERROR MATRIX ACCURATE

Results of Fit to Plot(s):          50  0;
Chi**2 =   119.3 for 120 - 9 d.o.f.          C.L. = 27.8 %
Plot Area Total/Fit 15097.0 / 15097.0          Fit Status 3
Func Area Total/Fit 14954.2 / 14954.2          E.D.M. 0.152

      Name      Value      Errors
      Name      Value      Parabolic      Minos
Function 1: Threshold
1( 1) 1 NORM      6.31882E+07 +/- 1.32621E+07 - 5.36843E+07 + 5.26542E+07
1( 2) 2 OFFSET      2.0040 +/- 6.38992E-05 - 7.77374E-05 + 1.37100E-04
1( 3) 3 POWER      0.82177 +/- 3.41283E-02 - 0.28170 + 9.30466E-02
1( 4) 4 COEFF1     -120.98 +/- 10.170 - 21.452 + 70.329
1( 5) 5 COEFF2     2276.6 +/- 273.64 - 1479.6 + 453.93
Function 2: Two Gaussians (sigma)
2( 1) 6 AREA      1788.3 +/- 176.54 - 188.87 + 394.71
* 2( 2) 7 MEAN      2.0100 +/- 0.0000 - 0.0000 + 0.0000
2( 3) 8 SIGMA1     7.13733E-04 +/- 7.71413E-05 - 1.11153E-04 + 9.37094E-05
2( 4) 9 AR2/AREA   0.46350 +/- 0.11166 - 0.13265 + 0.17232
* 2( 5) 10 DELM     0.0000 +/- 0.0000 - 0.0000 + 0.0000
2( 6) 11 SIG2/SIG1 2.8350 +/- 0.40736 - 0.55509 + 0.52442
*****
*
```