Post CKM School

Sensitivity Study For NP Search using D_s Decay at Belle.

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Charm Meson (D)

- Lightest Particle with charm quark .
- $c\underline{q}$ or $\underline{c}q$ (where q = u,d,s)

Particle	Symbol	Anti-particle	Makeup	Rest mass MeV/c^2	S	C	Lifetime
D	D^+	D^-	$c\underline{d}$	1869.4	0	+1	10.6 x10^{-13}
D	D^0	D^0	$c\underline{u}$	1864.6	0	+1	4.2 x10^{-13}
D	D_s^+	D_s^-	$c\underline{s}$	1969	+1	+1	4.7 x10^{-13}

Motivation to use D_s

- Investigate cabibbo supressed D^0,D^+,D_s^+ decays. ($c \longrightarrow u\gamma$)
- Use some approches to find decay width of this decay
- Contribution comes from Non-Minimial Supersymmetry
- NP can generate transition leading to a deviation from SM
- Using D_0: How much contribution is from NP and SM?
- Using D_s : Contributions were very “Precise”
- D_s is more sensitive towards NP contributions

$$R_{\rho/\omega} \equiv \frac{\Gamma(D^0 \to \rho^0/\omega\gamma)}{\Gamma(D^0 \to \bar{K}^{*0}\gamma)}$$

$$R_K \equiv \frac{\Gamma(D_s^+ \to K^{*+}\gamma)}{\Gamma(D_s^+ \to \rho^+\gamma)}$$

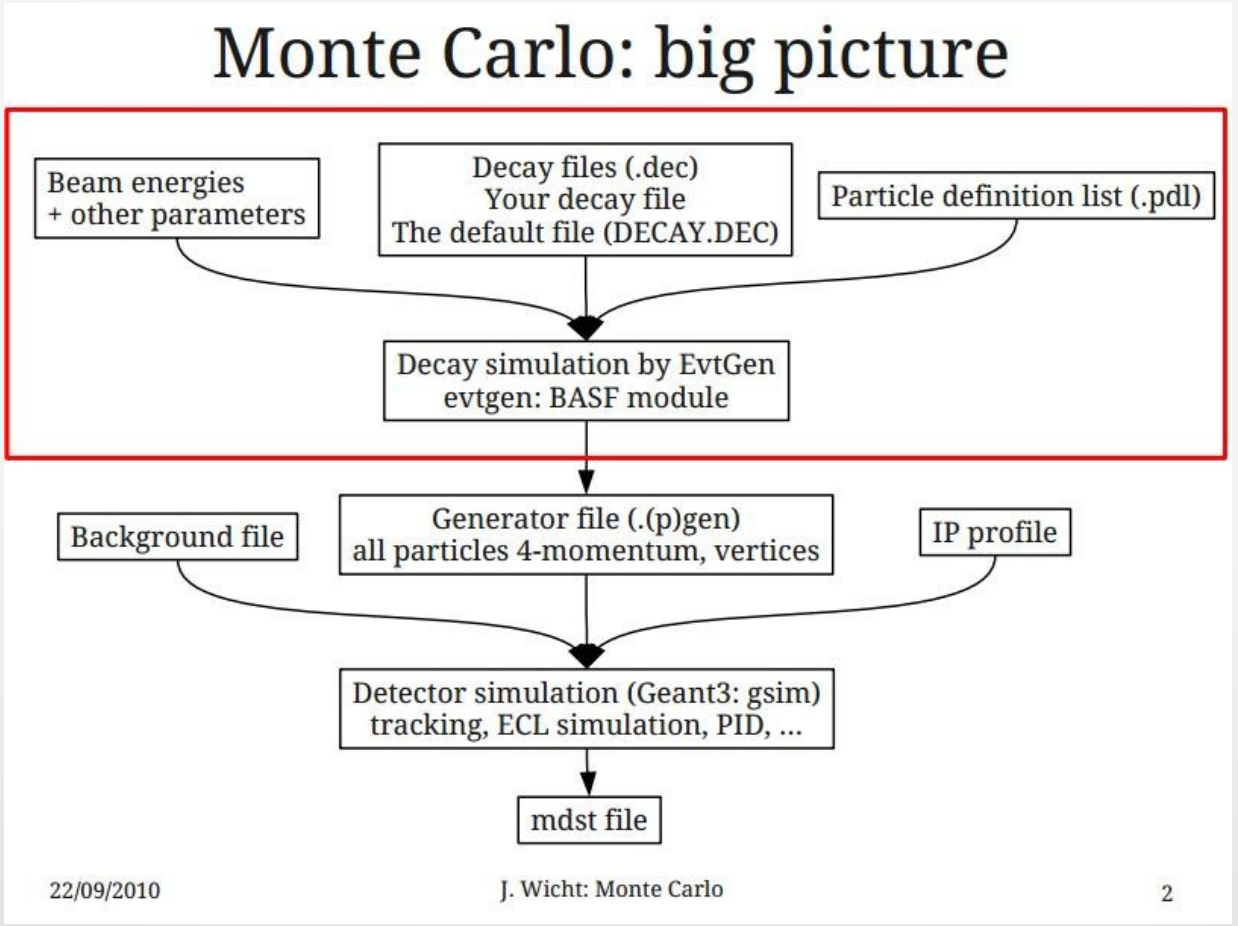
- B.Bajc et al, PRD 54, 1996

How we identify a Particle?

Particle	Energy	Momentum	Position	Particle Identification
e^- (e^+)	ECL	CDC	SVD, CDC	ECL, ACC ,TOF, CDC
μ^- (μ^+)		CDC	SVD, CDC	KLM,ACC,TOF,CDC
π^- (π^+)		CDC	SVD , CDC	ACC,TOF,CDC
K^- (K^+)		CDC	SVD , CDC	ACC,TOF,CDC
p		CDC	SVD,CDC	ACC,TOF,CDC
γ	ECL		ECL	ECL,CDC
K_L			KLM	KLM

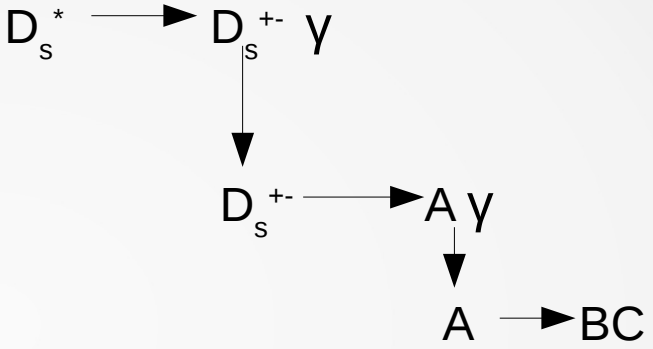
BASF

- In Belle : $e^+ e^- \longrightarrow$ upsilon(4S) i.e $b\underline{b}$
- Assume upsilon(4S) : Virtual Photon $\longrightarrow c\underline{c}$ i.e $D_s^{*} \longrightarrow D_s^+ / D_s^-$



Decay Modes

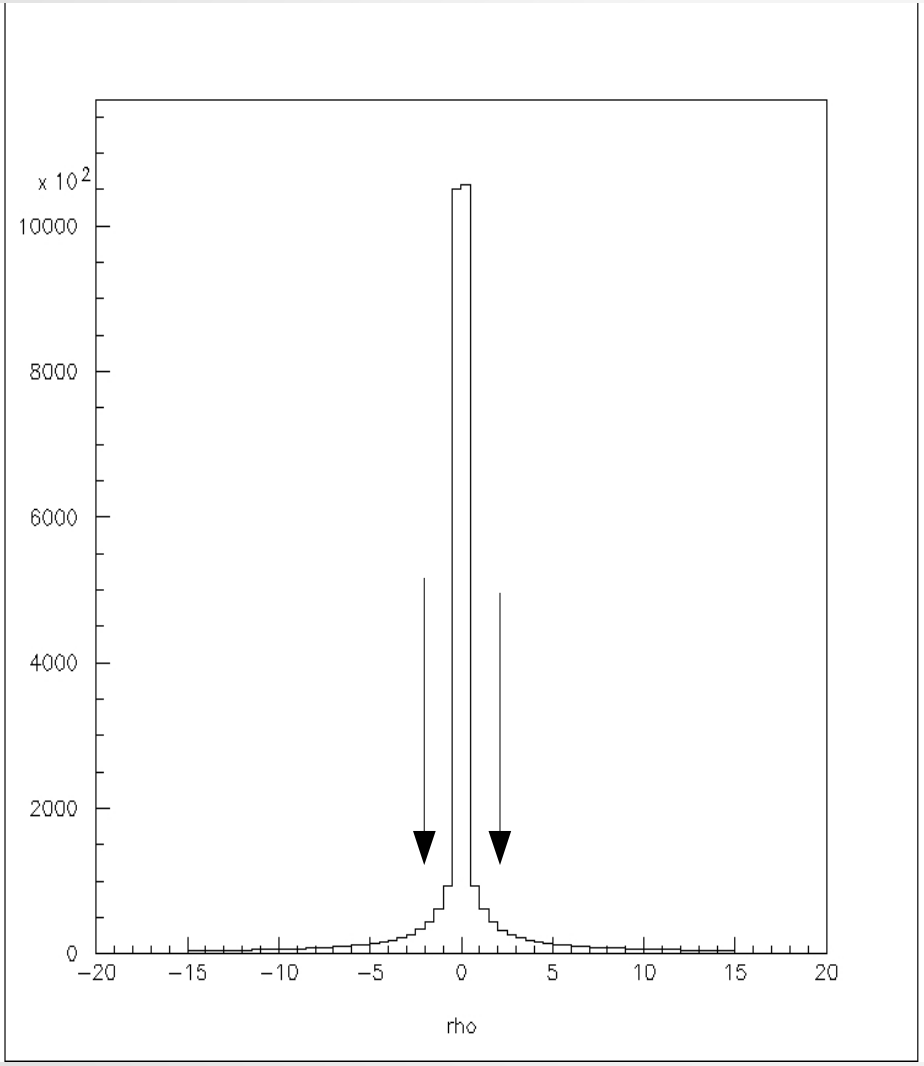
- $D_s^+ \rightarrow \rho^+ \gamma$ $\quad \pi^+ \pi^0$
- $D_s^- \rightarrow \rho^- \gamma$ $\quad \pi^- \pi^0$
- $D_s^+ \rightarrow K^{*+} \gamma$ $\quad \pi^+ K_s$
- $D_s^- \rightarrow K^{*-} \gamma$ $\quad \pi^- K_s$
- $D_s^+ \rightarrow K^{*+} \gamma$ $\quad K^+ \pi^0$
- $D_s^- \rightarrow K^{*-} \gamma$ $\quad K^- \pi^0$



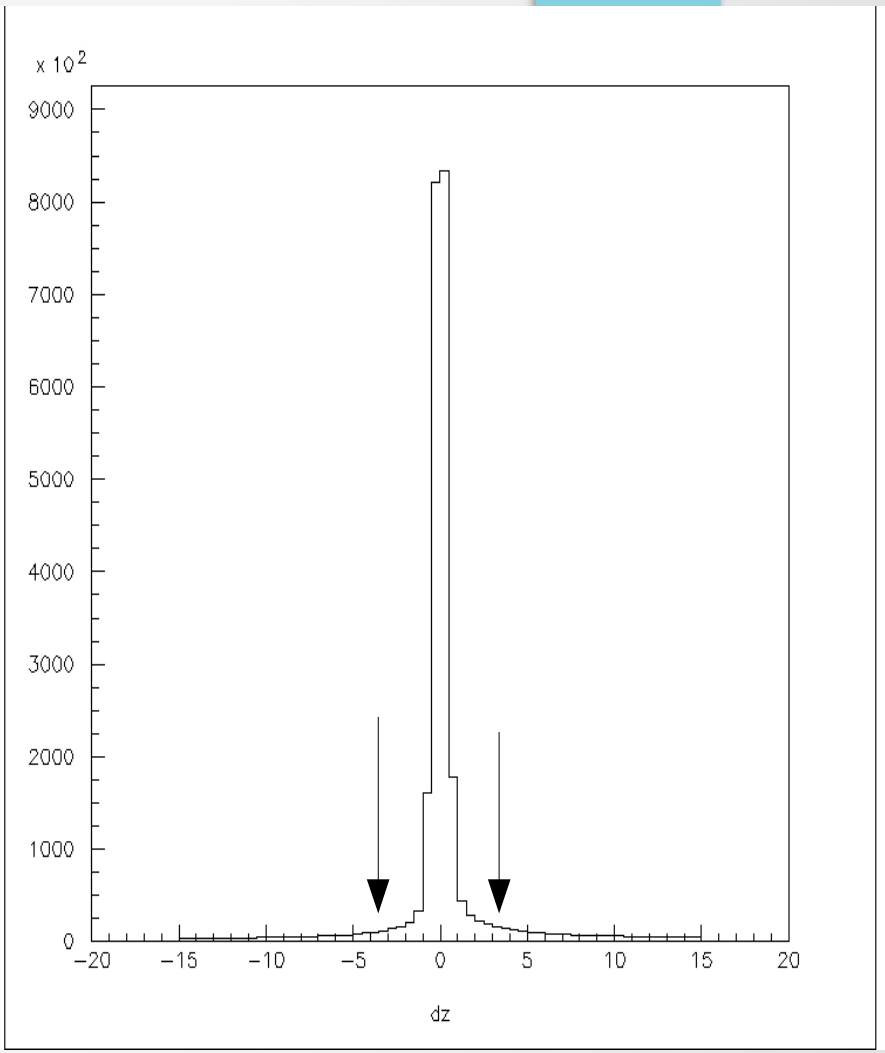
Generated Signal MC to 1 Million entries for each mode

$\rho^+ \rightarrow \pi^+ \pi^0$ B.F. = 100%
$K^{*+} \rightarrow \pi^+ K_s$ B.F. = 33.3%
$K^{*+} \rightarrow \pi^0 K^+$ B.F. = 33.3%

dr and dz

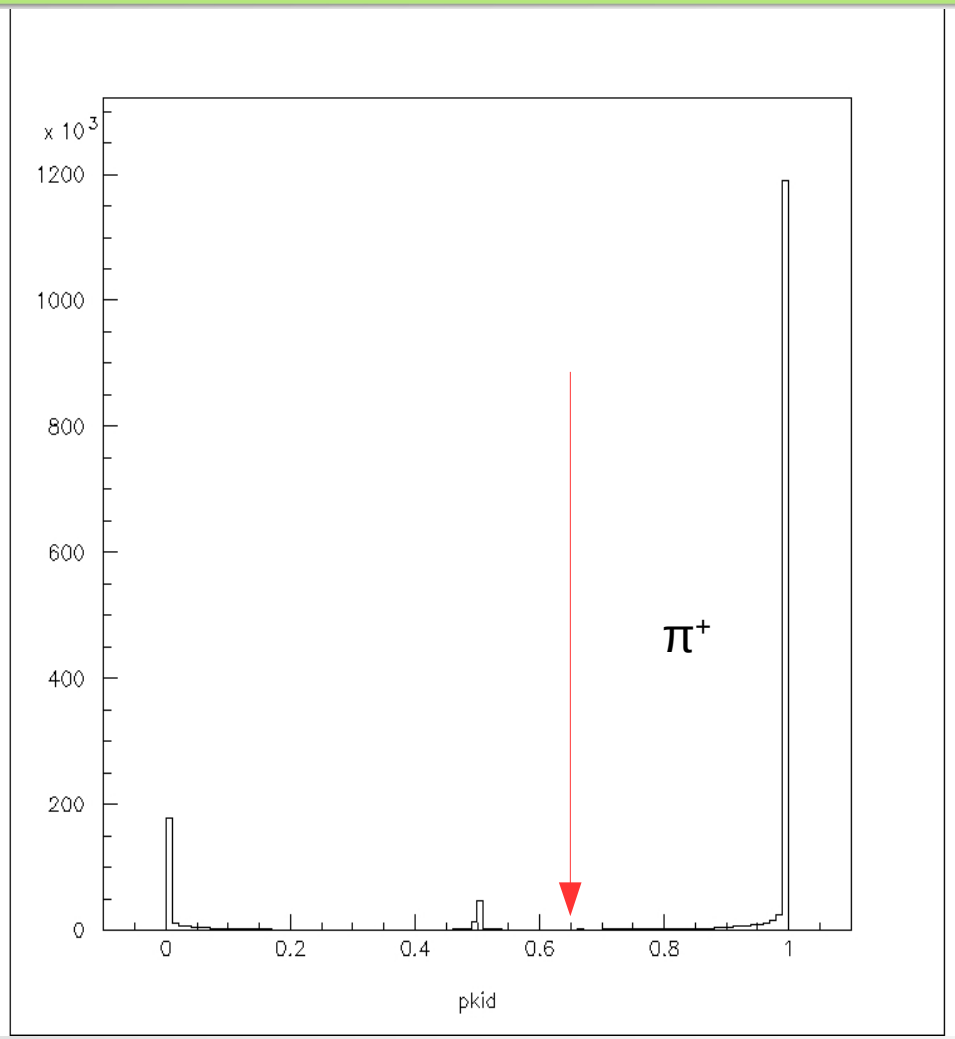


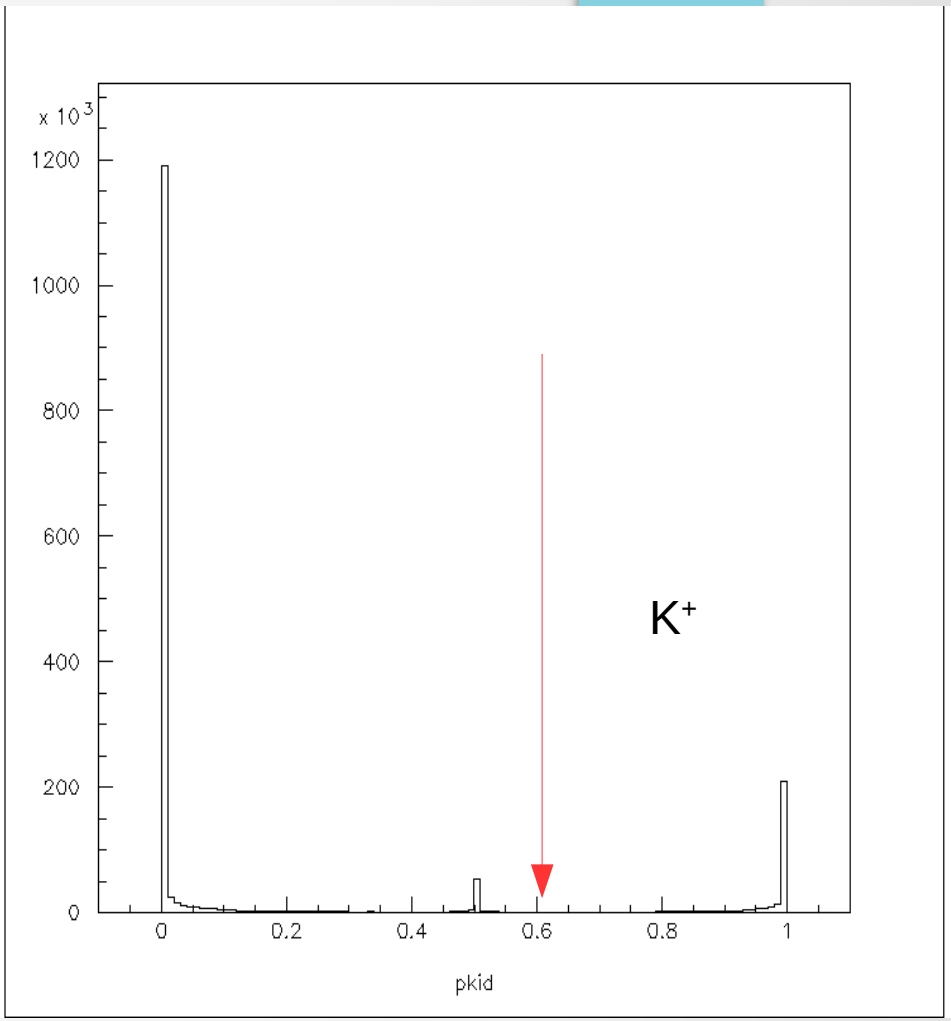
-1.5<|dr|<1.5 cm



-3.5<|dz|<3.5cm

Pion / Kaon Selection

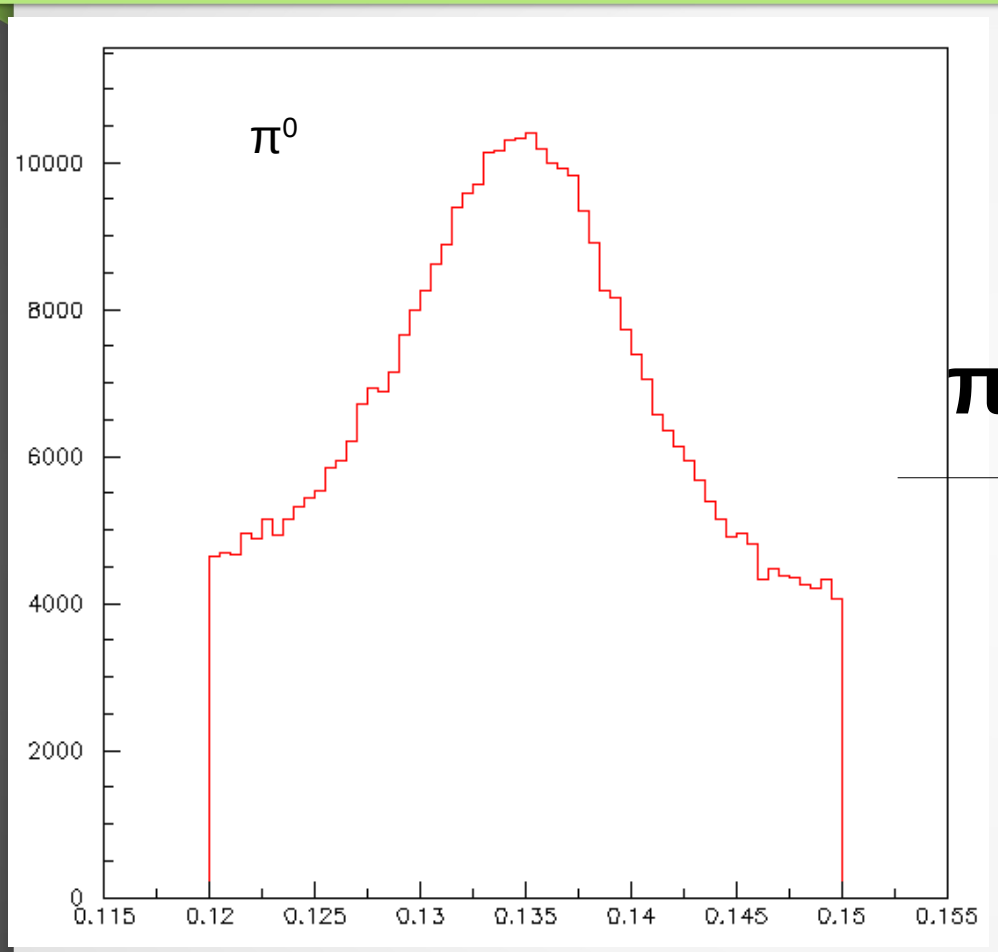




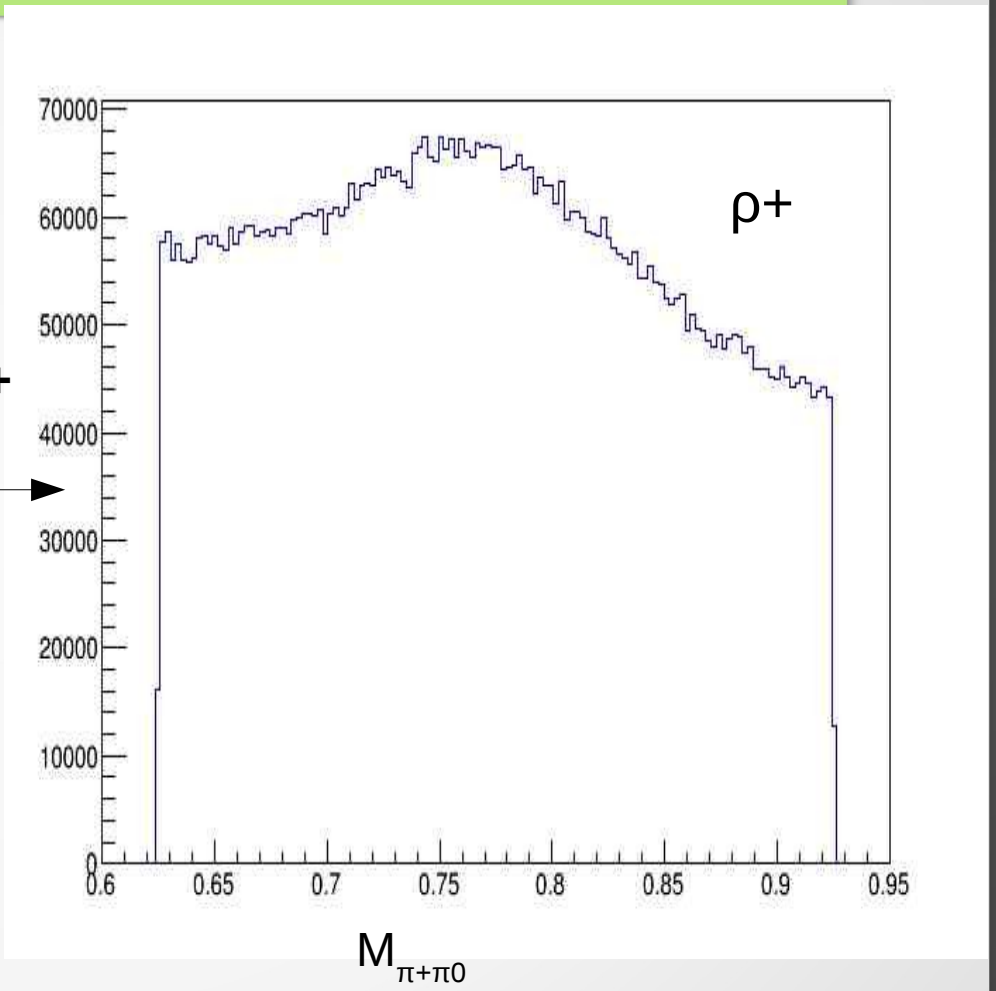
$L_\pi = (L_\pi) / (L_\pi + L_k)$

$L_k = 1 - L_\pi$

Reconstruction of rho

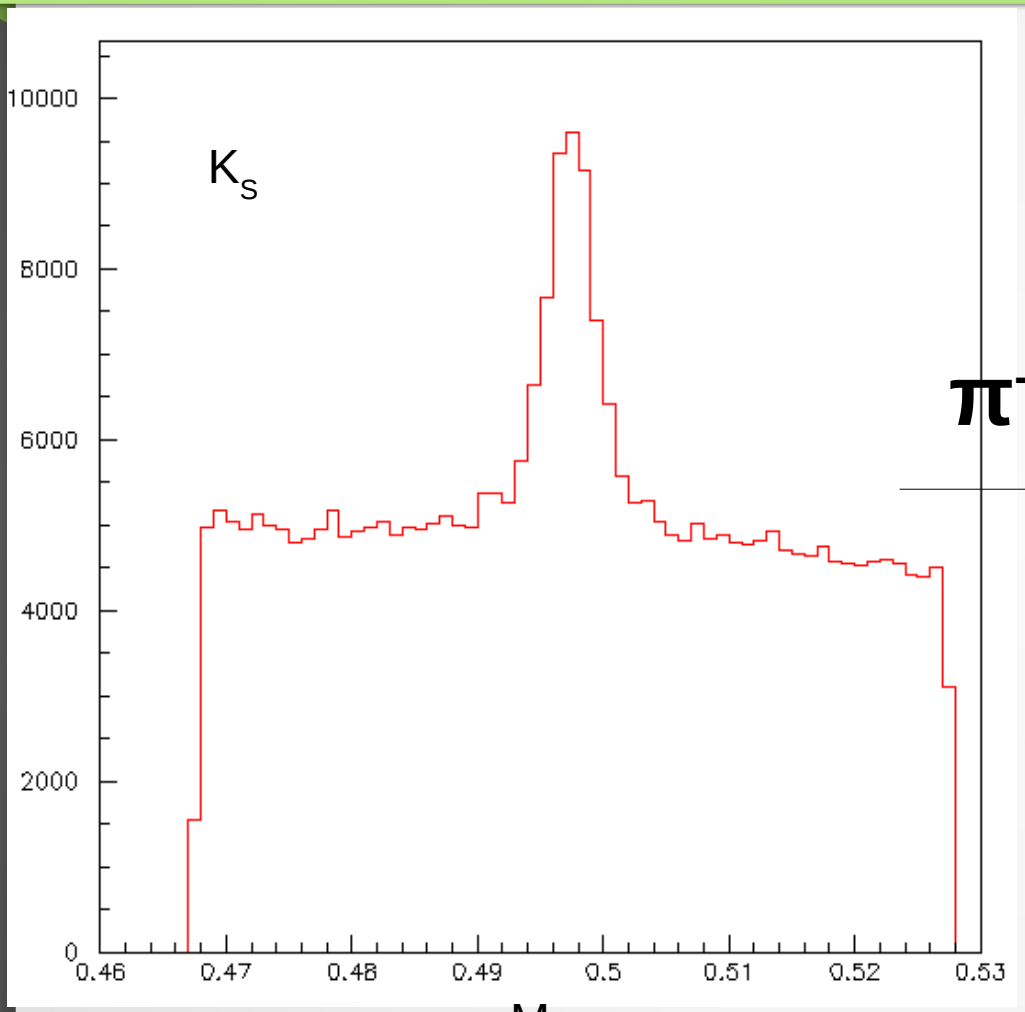


π+

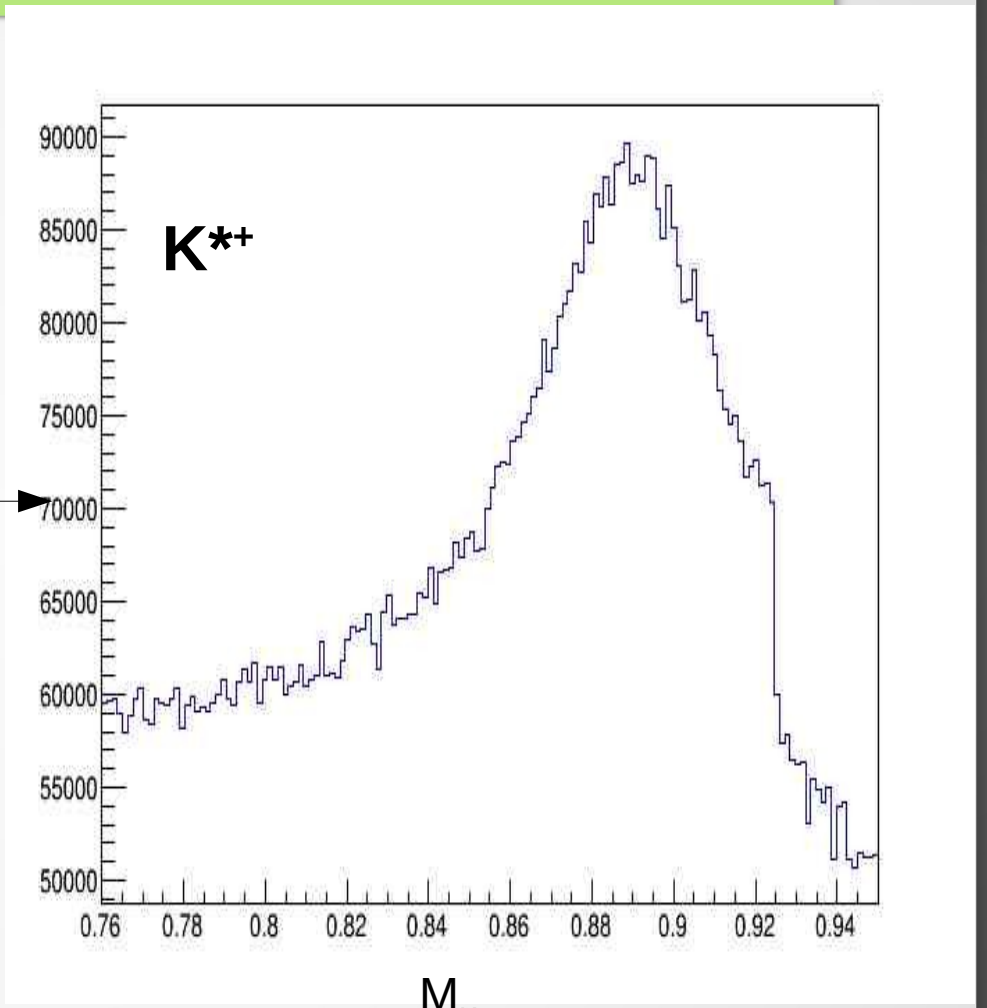


$\pi^0 \rightarrow \gamma\gamma$ 98.8 %

Reconstruction of K*

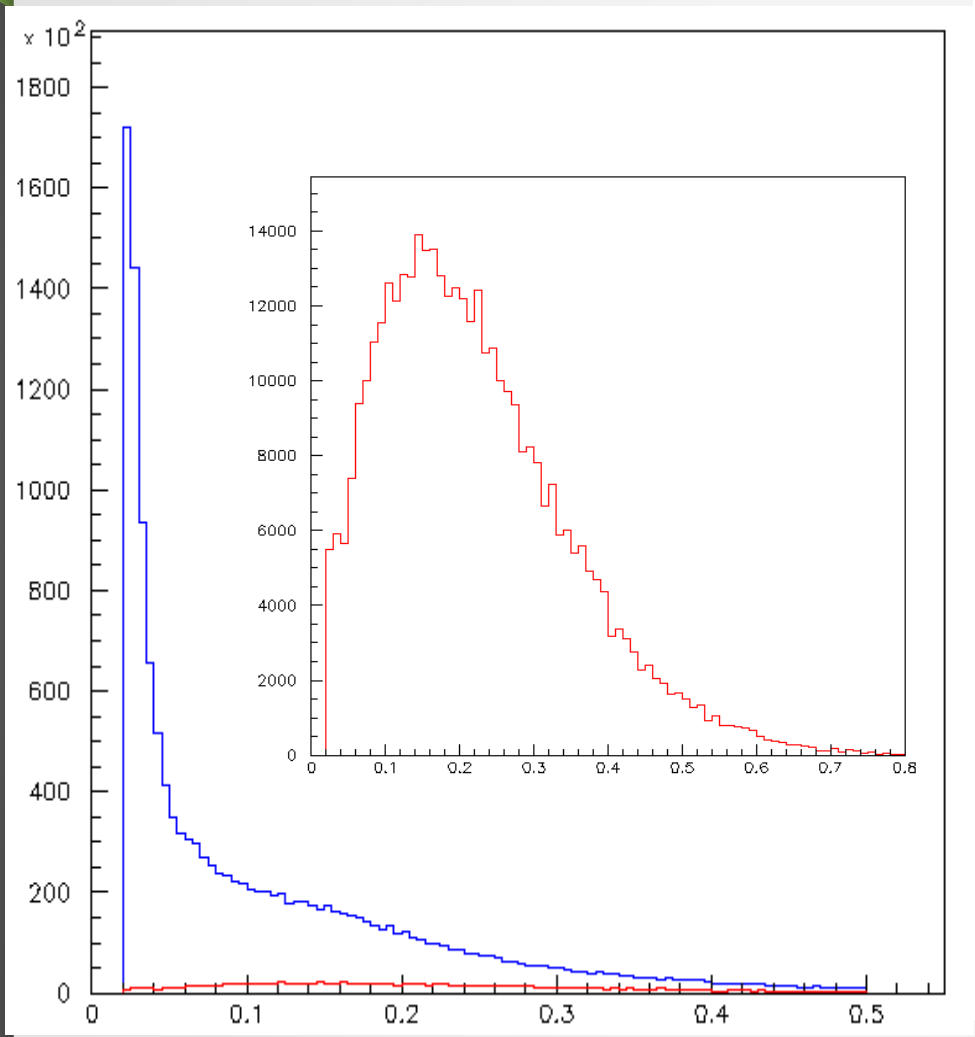


π^+

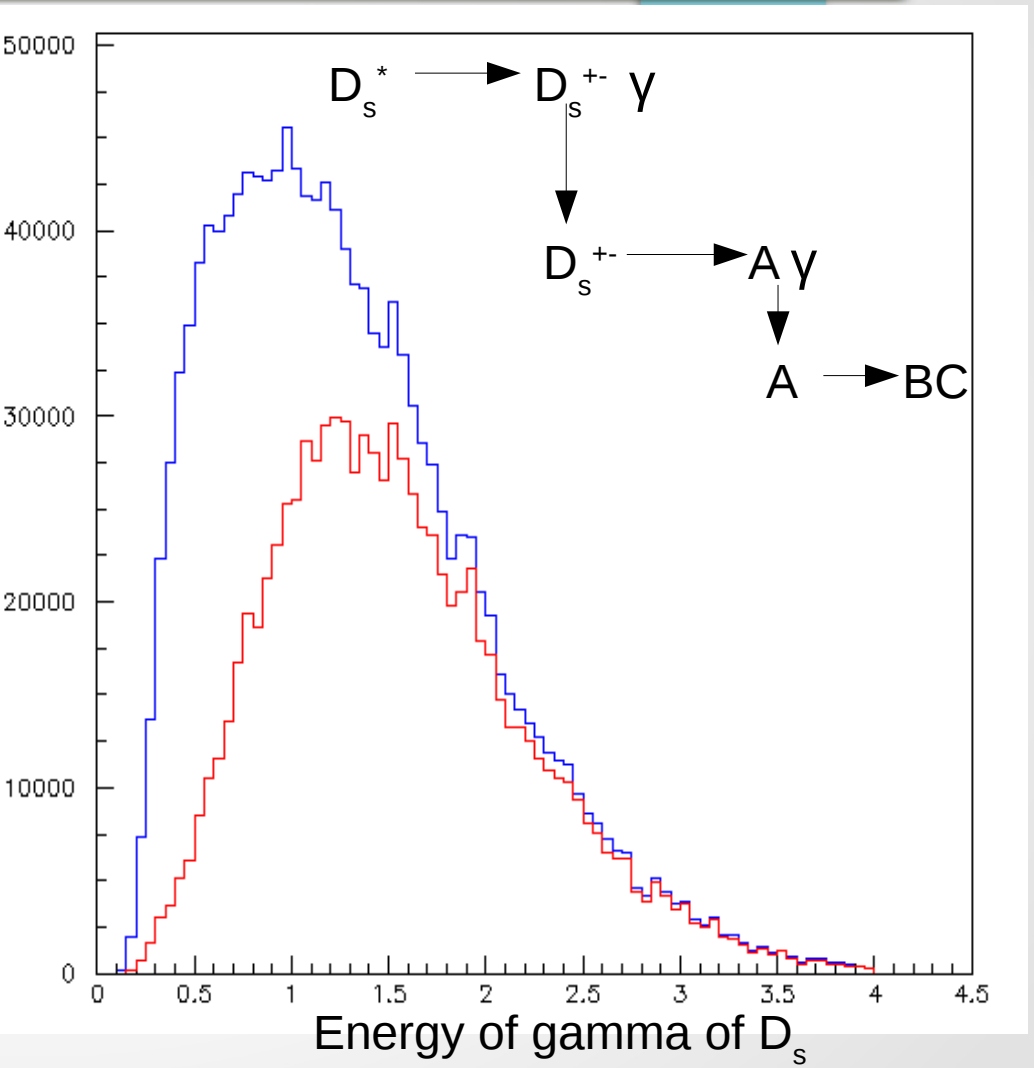


$K_s \rightarrow \pi^+\pi^-$ 69.2 %

Energy of Photons



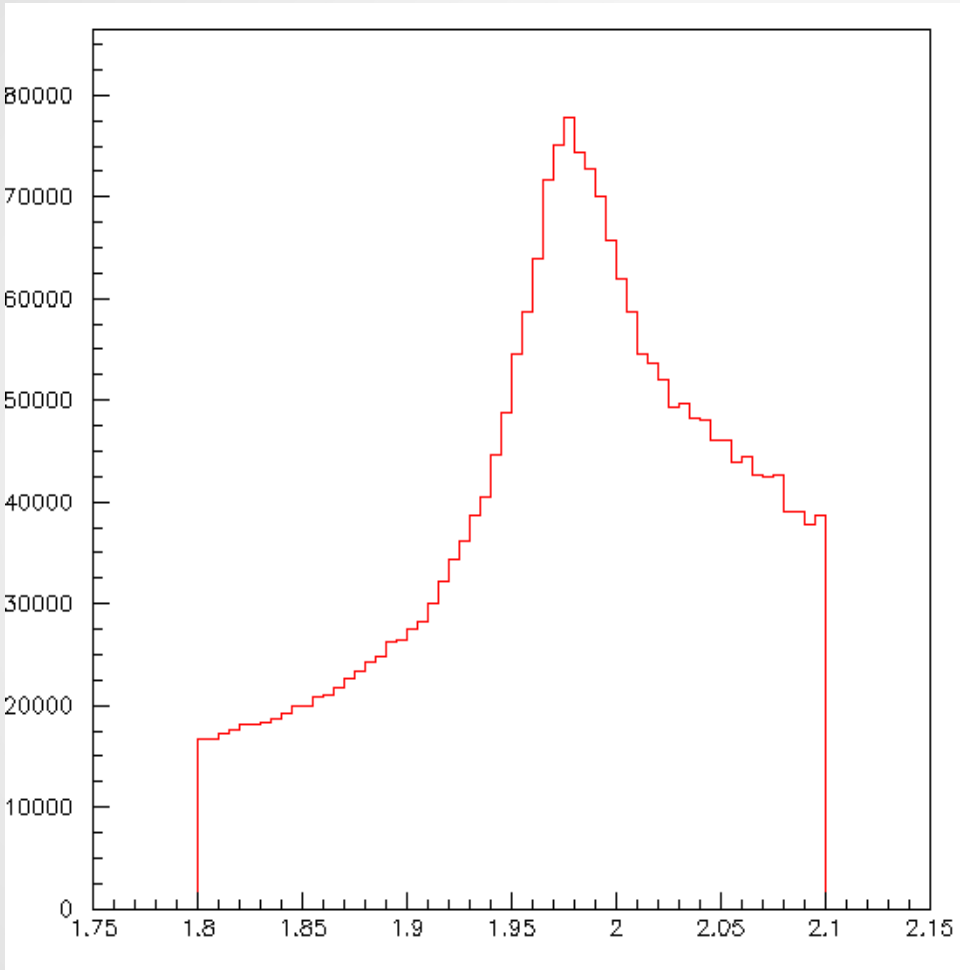
Energy of gamma of Ds*

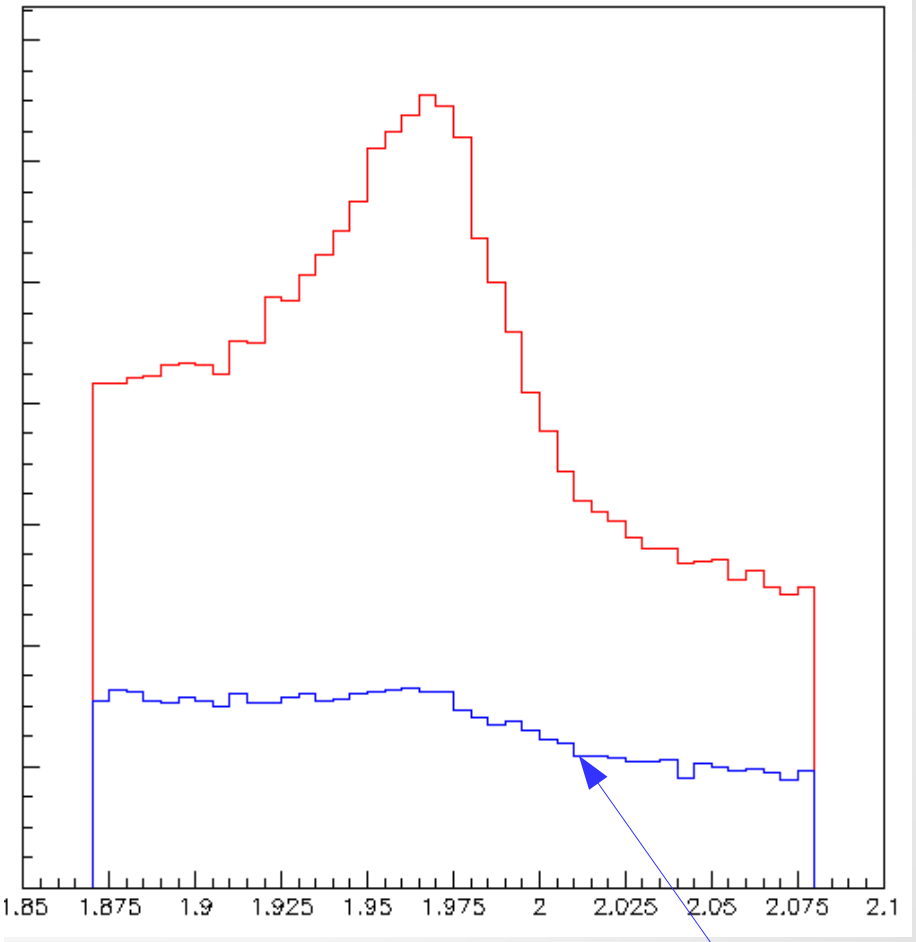


Energy of gamma of D_s

Red :Energy of pure signal
Blue: Energy of all combinations

Mass D_s



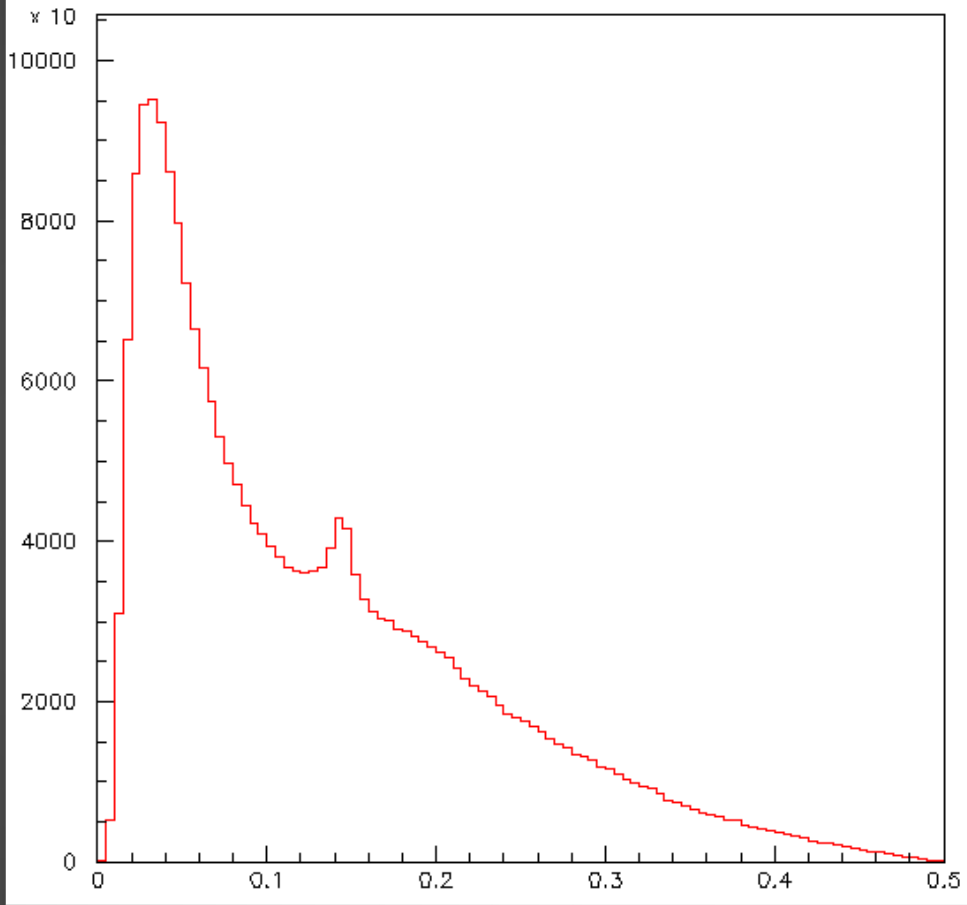


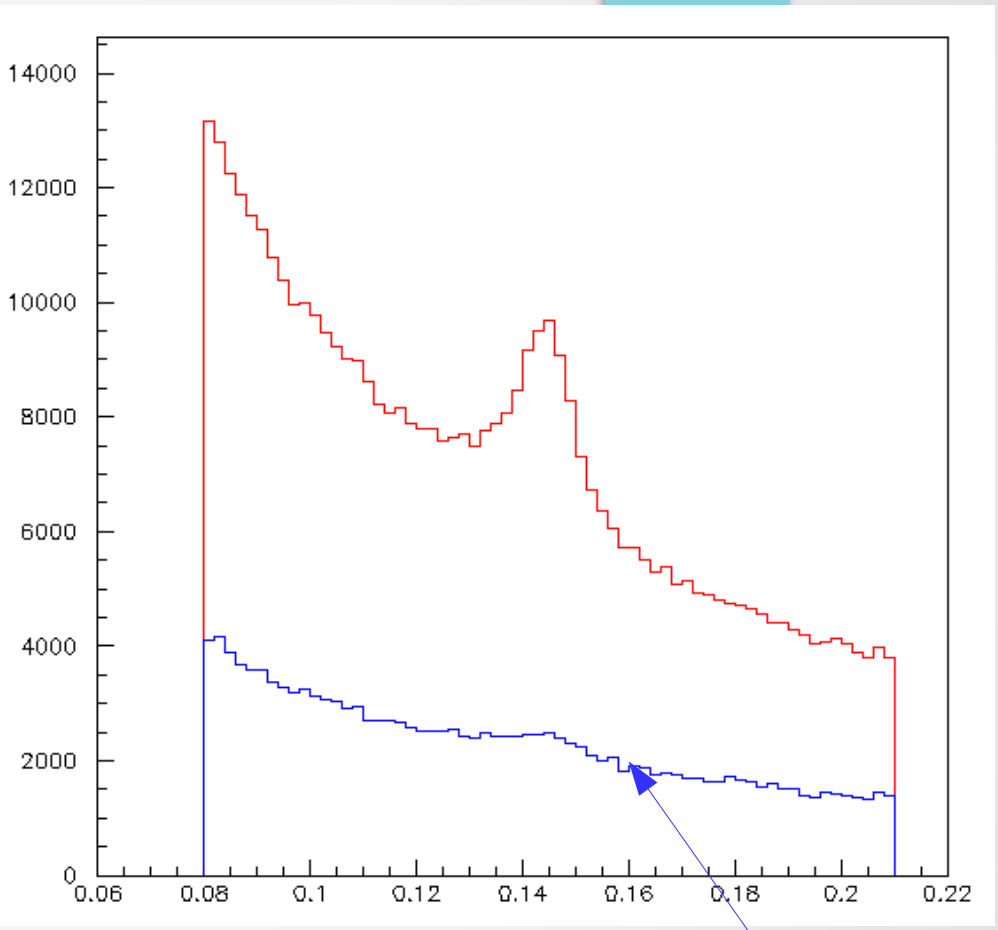
Cuts : 1.925<masd< 2.03GeV

Gammas coming from π^0

0.125<DeltaM<0.155 GeV

Signal identification



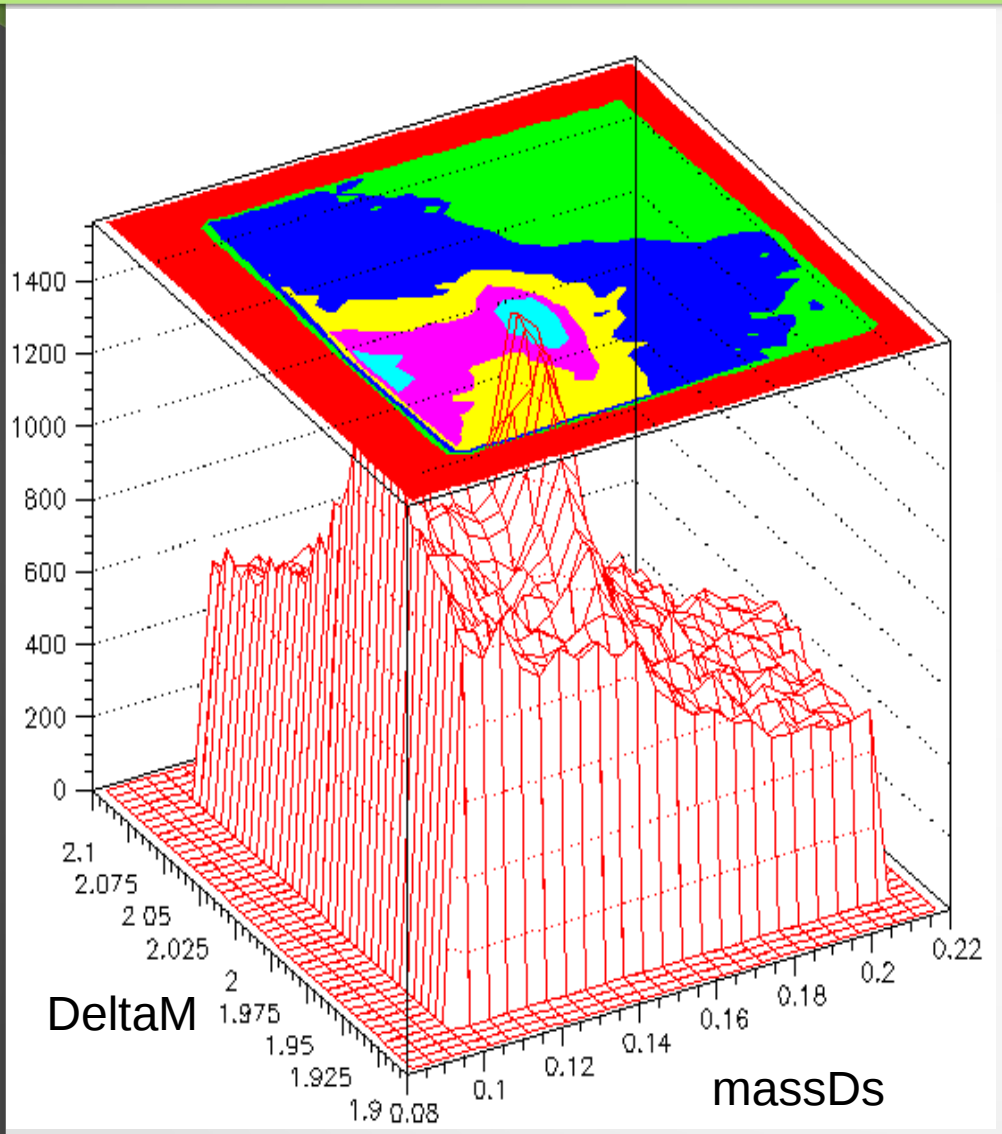


Cuts : 0.08<delm<0.2GeV

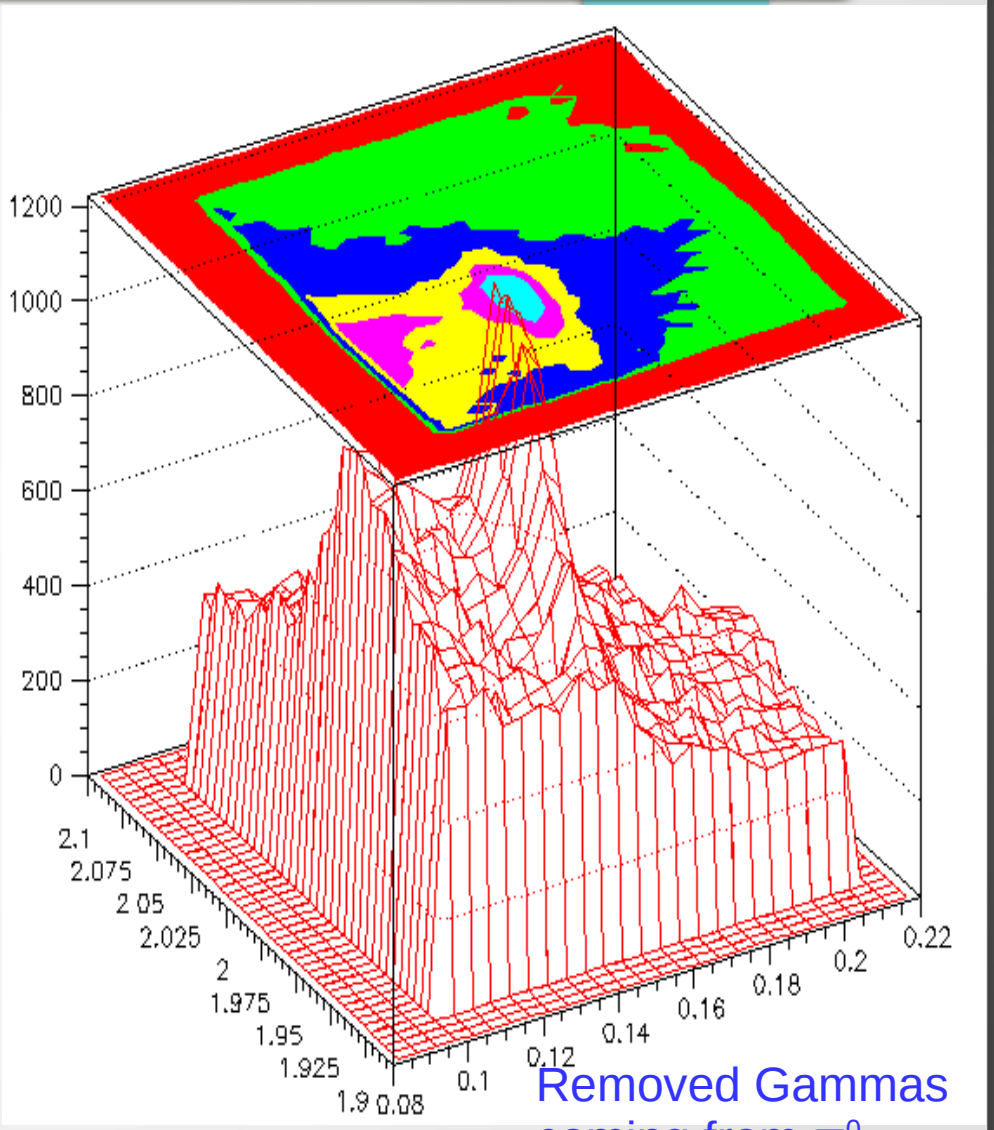
Gammas coming from π^0

$1.925 < M_{Ds} < 2.03$ GeV

Masd vs delm



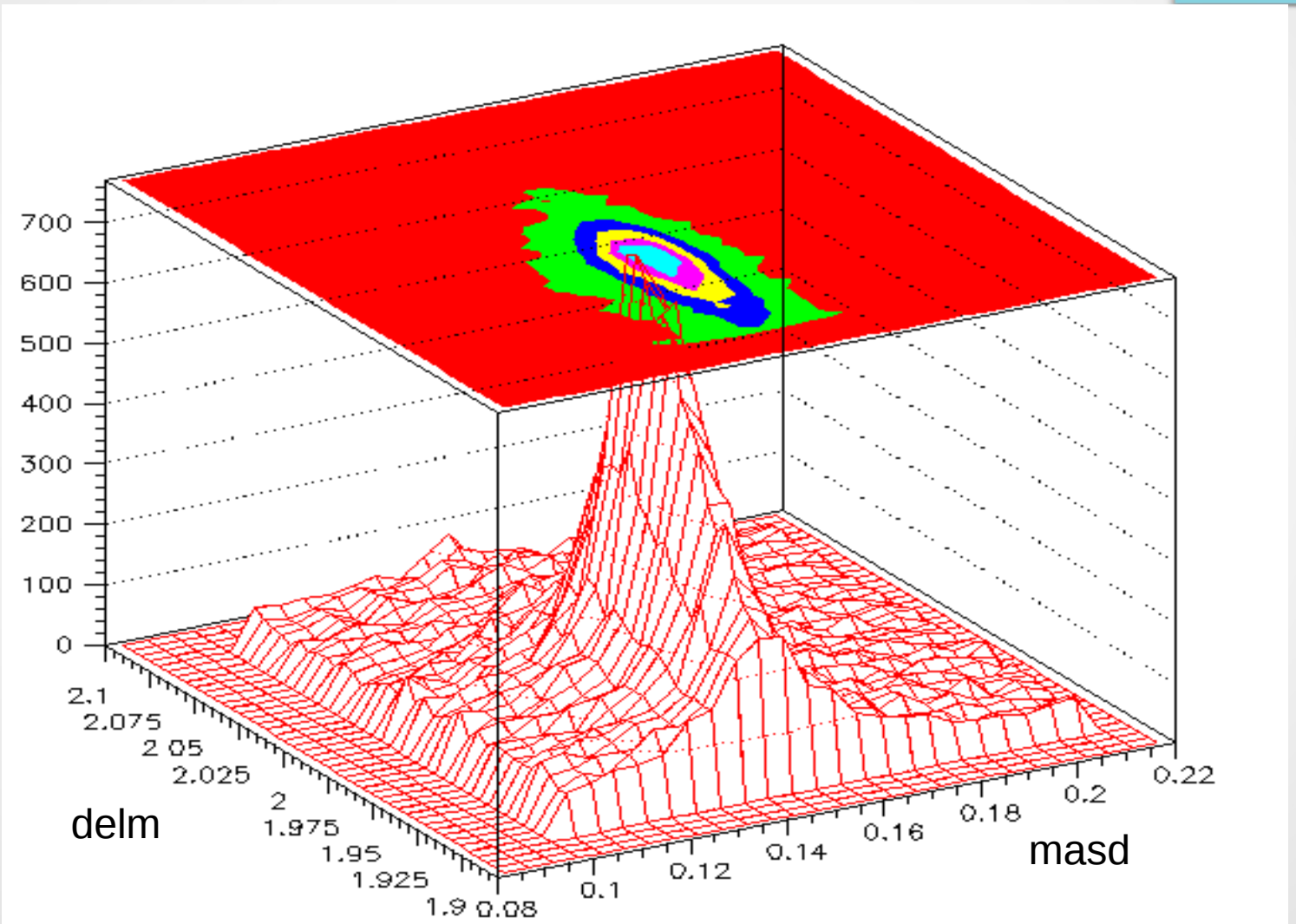
masDs vs DeltaM : all



Removed Gammas coming from π^0

Masd vs delm : after π^0 veto

MC truth matched signal



masd vs delm : pure signal

Summary

- Learned about Belle and the BASF software.
- Signal MC is generated and reconstruction code is prepared.

To Do:

- Optimize the cuts to remove the non true combinations.
- Singal truth matching to measure the feedback.
- Best candidate selection will be done.
- Perform background study using generic MC.
- Parameterize the signal and the background.
- Estimate the significance of the signal.

Thank you