Time dependent Dalitz analysis of $B^0 \rightarrow D^{\pm} K_s^0 \pi^{\mp}$ decays.

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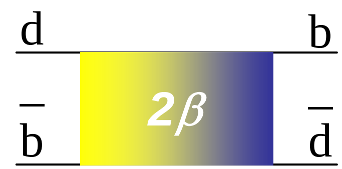
LAL - Orsay

$2\beta+\gamma$ IN $B^0 \rightarrow D^- K^0 \pi^+$ DECAYS

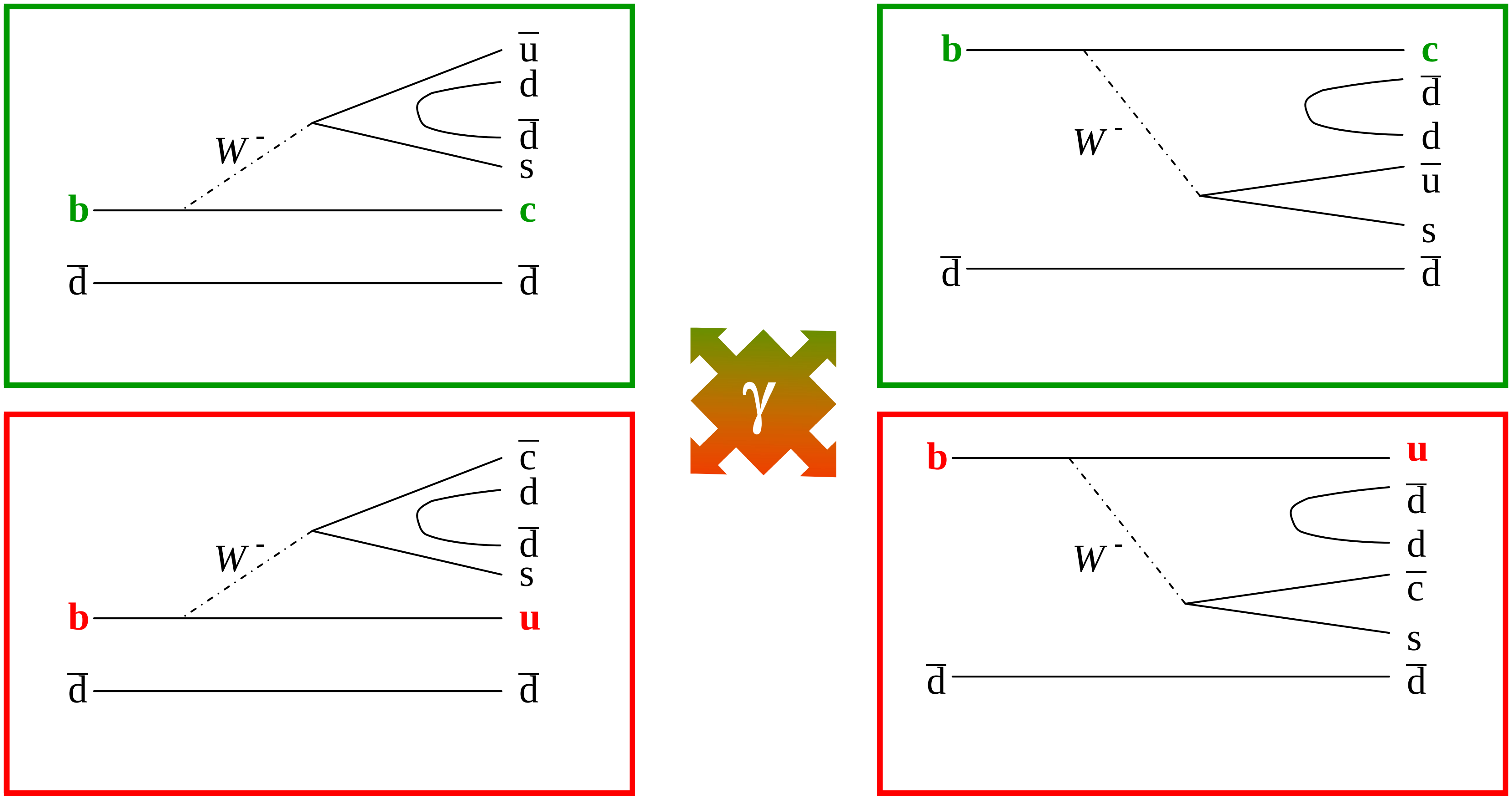
Interference of V_{cb} e V_{ub} amplitudes to the same final state ➔ **sensitivity to γ**

Mixing $\overline{B^0}B^0$ ➔ **sensitivity to 2β**



(see: R. Aleksan, T. C. Petersen, A. Soffer, *Phys. Rev. D67 (2003) 096002*

R. Aleksan, T. C. Petersen, *hep-ph/0307371* (CKM workshop 2003, numerical analysis))



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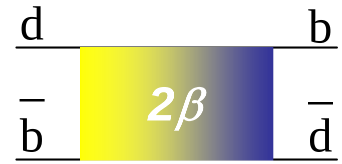

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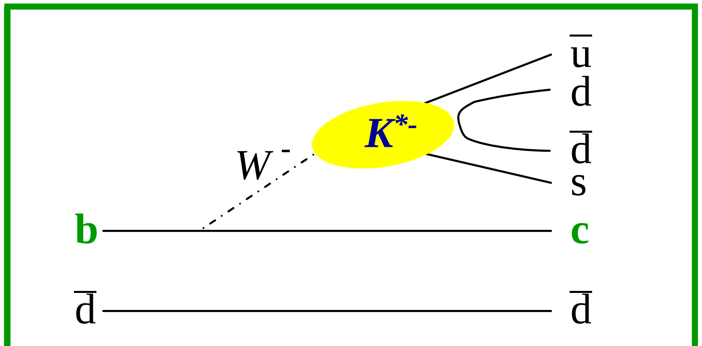
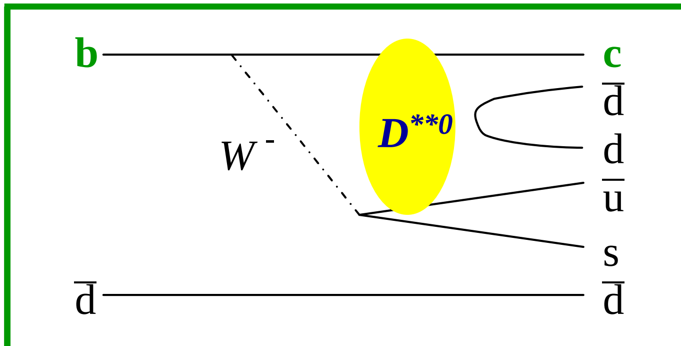
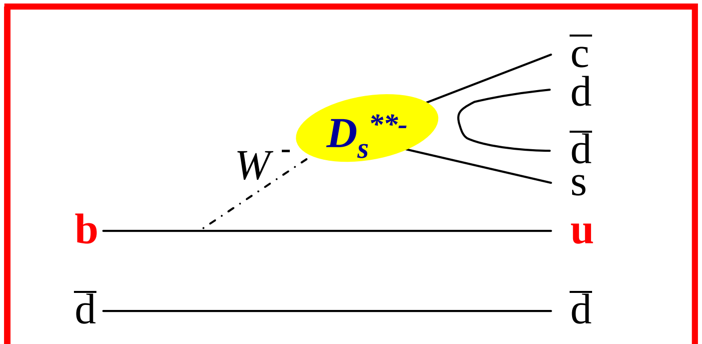


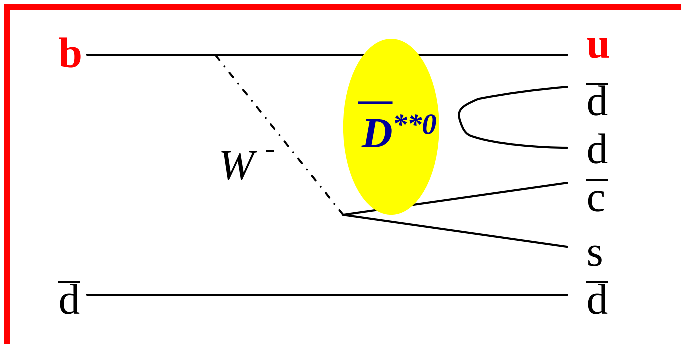
$\overline{B^0} \to D^+ K^{*-}$ $(K^{*-} \to K^0 \pi^-)$



$\overline{B^0} \to D^{**0} K^0$ $(D^{**0} \to D^+ \pi^-)$



$\overline{B^0} \to D_s^{**-} \pi^+$ $(D_s^{**-} \to D^- K^0)$



$\overline{B^0} \to \overline{D}^{**0} K^0$ $(\overline{D}^{**0} \to D^- \pi^+)$

3-body decay* ➔ *Intermediate resonances* ➔ *Dalitz analysis

DALITZ MODEL

Isobar model is assumed.

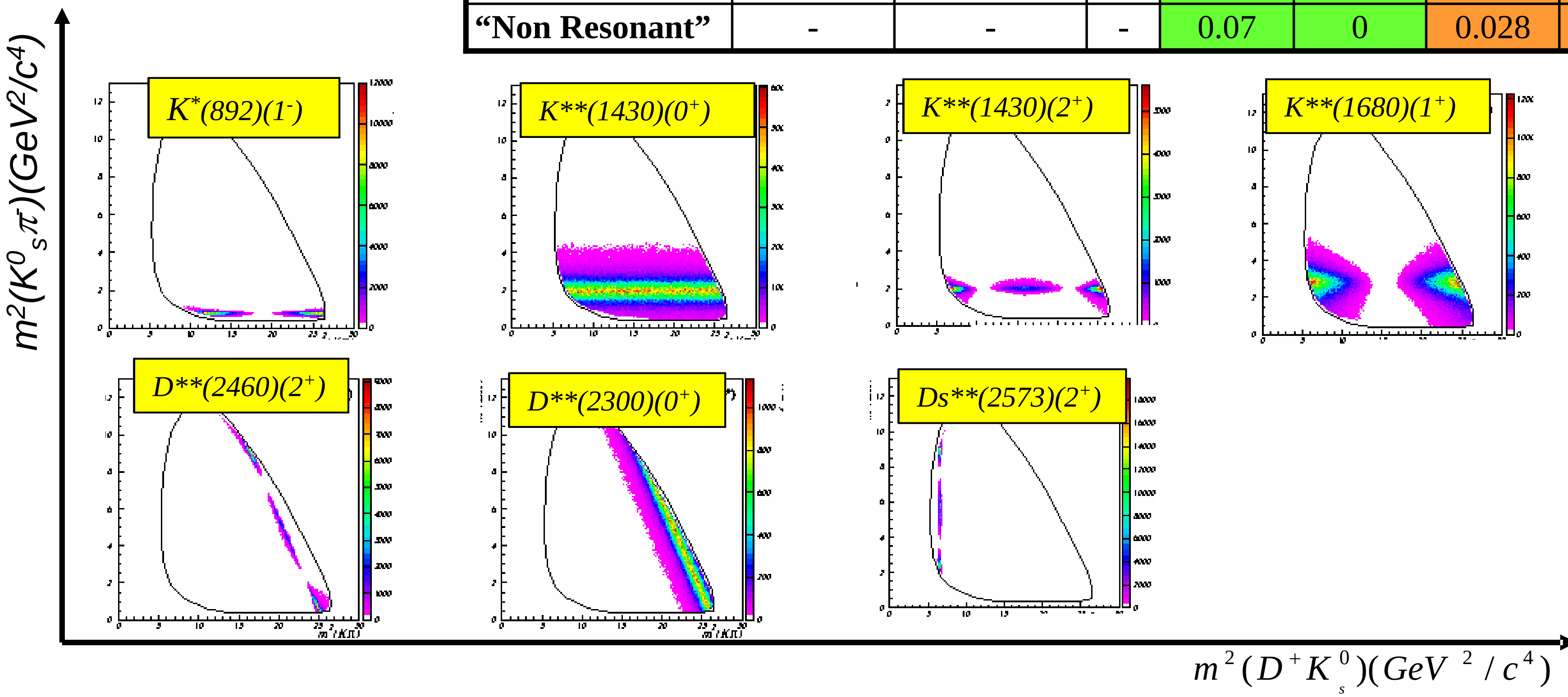
$$A_{c_k(u_k)} e^{i\delta_{c_k(u_k)}} = \sum_j a_j \cdot e^{i\cdot\delta_j} \cdot BW_{jk}(m,\Gamma,s)$$

Strong phase

Amplitude

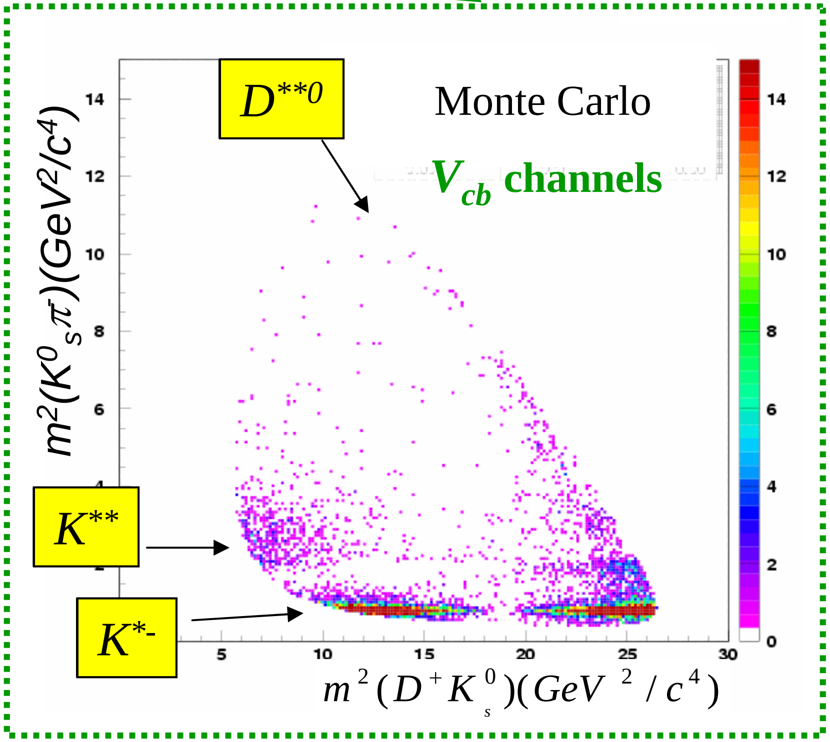
Breit Wigner

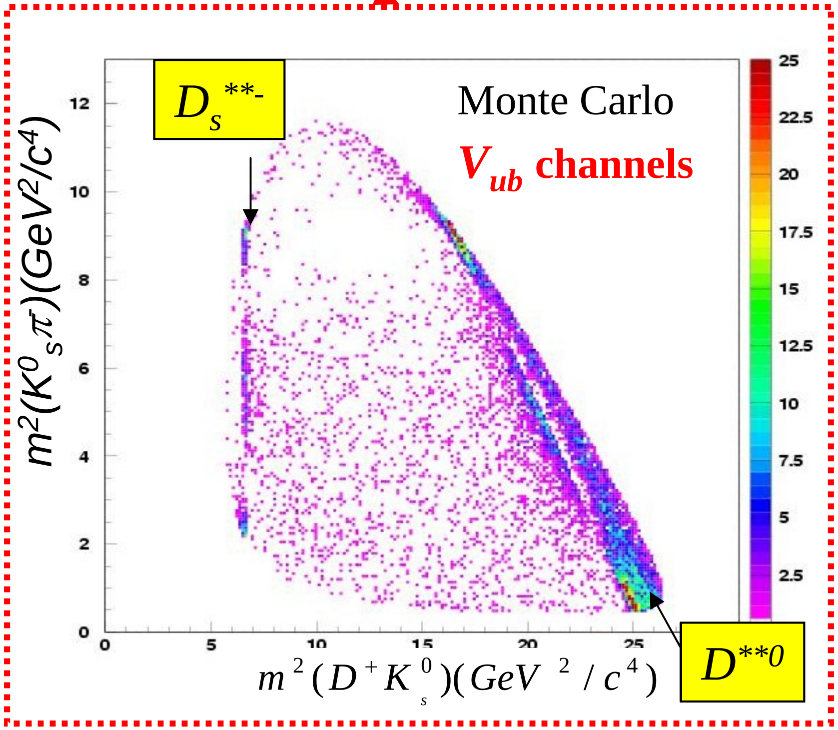
	Mass (GeV/c^2)	*Width (Gev/c^2)*	J^P	$a(V_{cb})$	$\phi(V_{cb})^o$	$a(V_{ub})$	$\phi(V_{ub})^o$
$D_{s2}(2573)^{\pm}$	2.572	0.015	2+	-	-	0.02	
$D_2^*(2460)^0$	2.461	0.046	2+	0.12	30	0.048	30
$D_0(2308)^0$	2.308	0.276	0+	0.12	70	0.048	90
$K^*(892)^{\pm}$	0.89166	0.0508	1-	1	0	-	-
$K_0^*(1430)^{\pm}$	1.412	0.294	0+	0.6	80	-	-
$K_2^*(1430)^{\pm}$	1.4256	0.0985	2+	0.2	0	-	-
$K^*(1680)^{\pm}$	1.717	0.322	1-	0.3	30	-	-
"Non Resonant"	-	-	-	0.07	0	0.028	30



INTERFERENCE IN THE DALITZ

INTERFERENCE





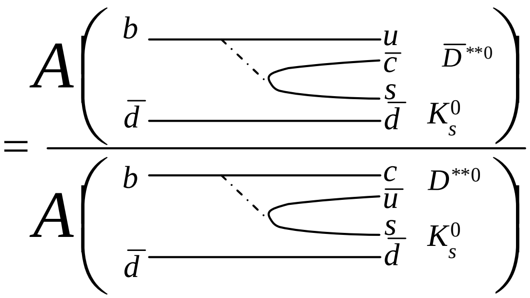
ADVANTAGES OF THE METHOD

- **Theoretically clean (no need of assuming SU(3) or neglect diagrams as in $D^{(*)}\pi(\rho)$)**

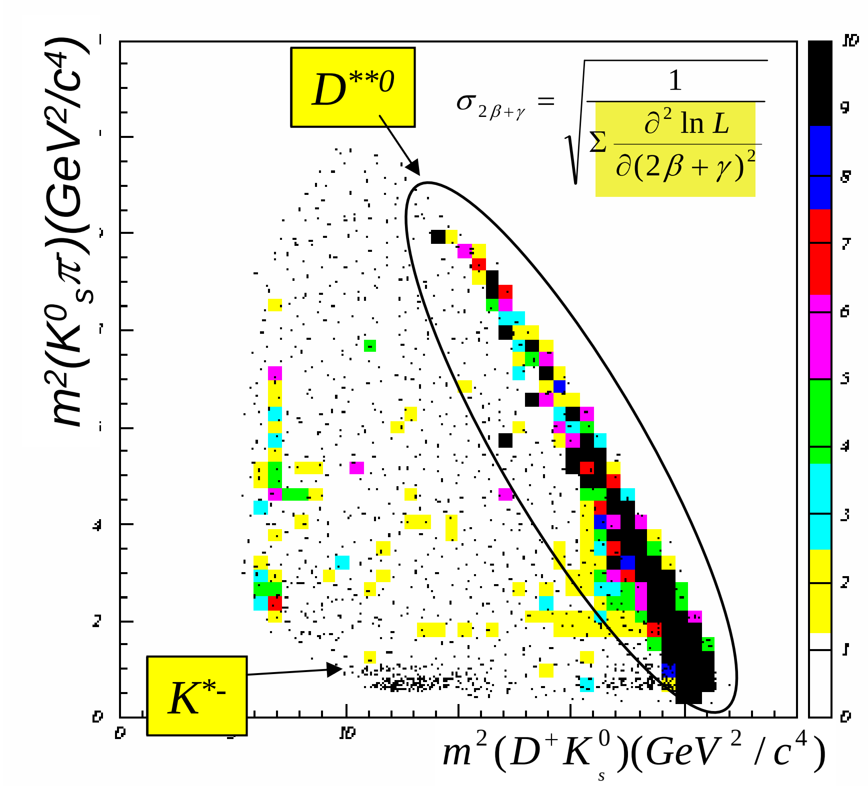
- ***r_i* varies on the Dalitz plot, no need to determine it** if all the V_{ub} e V_{cb} amplitudes and phases are determined;

Simulated distribution of the events in the Dalitz plot is weighted by a factor

- in some regions **r is expected to be high (*)**:



$$r_B = \frac{A(b\to u\bar{c}s\,\bar{d})}{A(b\to c\bar{u}s\,\bar{d})} \approx \frac{1}{\lambda}\left|\frac{V_{ub}}{V_{cb}}\right| \approx 0.4$$



- The presence of some wide resonances ensures **only 2 ambiguities (due to the irreducible S_π) !**
(In $D^{(*)}\pi(\rho)$ there are 4 ambiguities…)

$$S_{\pi/2}: \; 2\beta+\gamma \to \pi/2-\Delta\delta, \quad \Delta\delta \to \pi/2-(2\beta+\gamma)$$
$$S_{-} \;: \; 2\beta+\gamma \to -(2\beta+\gamma), \quad \Delta\delta \to \pi-\Delta\delta$$
$$S_{\pi} \;: \; 2\beta+\gamma \to 2\beta+\gamma+\pi, \quad \Delta\delta \to \Delta\delta+\pi$$

(*): see also B.Aubert et al., [BABAR Collaboration], Phys.Rev. D74, 031101, (2006) http://ckm2005.ucsd.edu/WG/WG5/thu2/Sordini-WG5-S3.pdf

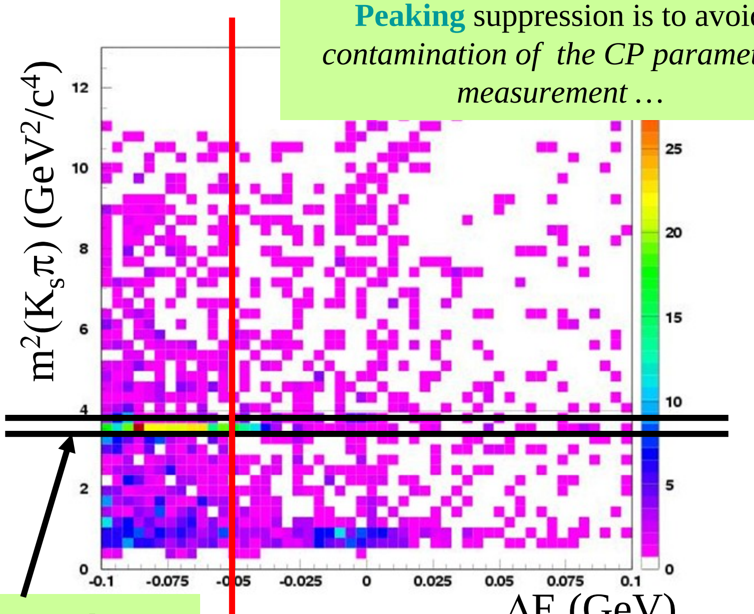
SELECTION

Use BRecoToDKPi skim with analysis-31	
Bachelor track	No VeryTightElectron No TightKaon
L2/sigma(L2)	>4
Pvtx(Ks)	>0.001
M(Ks)	+-7MeV
KaonID (K fromD) LHKaon selector	K not Pion
mD	Inside 2 sigma window
Pvtx(D)	>0.001
$\sigma(\Delta t)<2.5$ ps and $\lvert\Delta t\rvert<20$ps	
$\lvert m^2(K_S\pi)\rvert$	>(3.4:3.95) GeV^2/c^4
$\lvert\cos\theta_B\rvert$	<0.85MeV
Pvtx(B)	>0.001
Best candidate based on D mass and Pvtx(B)	
m_{es}	(5.24:5.29) GeV/c^2
$\lvert\Delta E\rvert$	<100 MeV
Fisher (5 variables)	(-3:3)

$$B^0 \to D^{\pm} K^0_S \pi^{\mp}$$
$$K^0_S \to \pi^{\mp}\pi^{\pm}$$
$$D^{\pm} \to K^{\pm}\pi^{\mp}\pi^{\pm}$$

Selection efficiency ~10%

- ✓ **On Peak Data *Moderato* (316 fb^{-1})**
- ✓ **Off Peak Data *Moderato* (28 fb^{-1})**
- ✓ **Signal Monte Carlo (53k events)**
- ✓ **Generic BB Monte Carlo**
- ✓ **Control Sample: $B^0 \to Da_1$**



Peaking suppression is to avoid *contamination of the CP parameters measurement …*

$B \to DD_{(s)}$ decays

THE LIKELIHOOD

$$L_{\pm}^{i} = N_{sig}^{i} (TD)_{\pm,sig}^{i} Y_{sig}^{i} + N_{Back}^{i} T_{\pm,Back}^{i} D_{Back} Y_{Back}^{i}$$

- **Signal likelihood.**

$$(TD)_{\pm,Sig}^{i} = (TD)_{\eta,k}(\Delta t, m^2(D^+K_s^0), m^2(K_s^0\pi^-)) = \frac{e^{-\frac{|\Delta t|}{\tau}}}{4\tau} \frac{A_{c_k}^2 + A_{u_k}^2}{2} \left\{1 - \eta S_f^k \sin(\Delta m \Delta t) + \eta C^k \cos(\Delta m \Delta t)\right\}$$

$$C^k = \frac{A_{c_k}^2 - A_{u_k}^2}{A_{c_k}^2 + A_{u_k}^2} \qquad S^k_{D^+K_S^0\pi^-} = \frac{2\,\mathrm{Im}(A_{c_k} A_{u_k} e^{i(2\beta+\gamma)+i(\delta_{c_k}-\delta_{u_k})})}{A_{c_k}^2 + A_{u_k}^2}$$

Note: untagged events (η=0) play a role since they help in the amplitudes and phases determination.

- **Background likelihood.**

$$Y_{Back}^{i} = Y_{Back}^{i}(m_{ES}, \Delta E, Fisher) = f_{Cont}^{i} Y_{\pm,Cont}^{i} + f_{BB}^{i} Y_{\pm,BB}^{i} + f_{Peak}^{i} Y_{\pm,Peak}^{i}$$

$$T_{\pm,Back}^{i} = T_{\pm,Back}^{i}(\Delta t, \sigma(\Delta t)) = f_{Cont}^{i} T_{\pm,Cont}^{i} + f_{BB}^{i} T_{\pm,BB}^{i} + f_{Peak}^{i} T_{\pm,Peak}^{i}$$

$$D_{Back} = D_{Back}(m^2(D^+K_s^0), m^2(K_s^0\pi^-))$$

THE FIT STRATEGY

Step1 : Yields fit on data (making use of control samples)

Step2 : Dalitz background parameterization

Step3 : Time parameterization on control samples

Step4 : Complete CP fit

(With additional cuts: $m_{ES} > 5.27\ GeV/c^2$, $|\Delta E| < 50 MeV$, *Fisher > -2)*

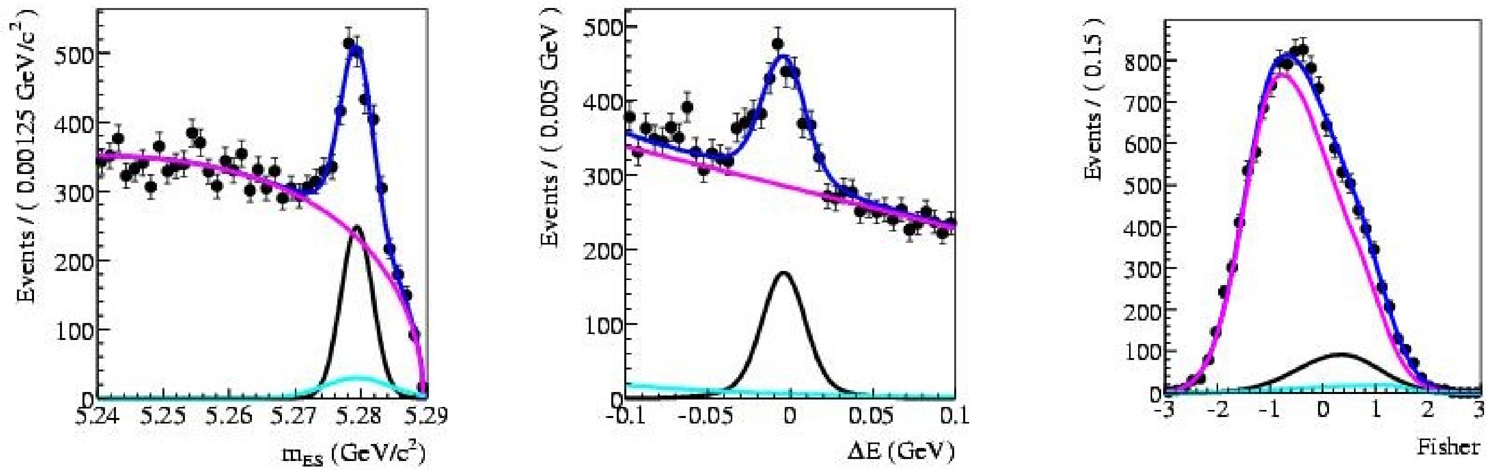
Control samples:

- **Signal**: $B^0 \to D^+ a_1^-$ with $a_1^- \to \rho^0 \pi$ and $\rho^0 \to \pi^+ \pi^-$ has the same final state but is much more abundant: $Br(B^0 \to D^+ K^0 \pi^-) = (4.9 \pm 0.9) \bullet 10^{-4}$ vs $Br(B^0 \to D^+ a_1^-) = (6.0 \pm 3.3) \bullet 10^{-3}$
- **Continuum** : Off-resonance data
- **Combinatorial BB and Peaking** : Monte Carlo simulation.

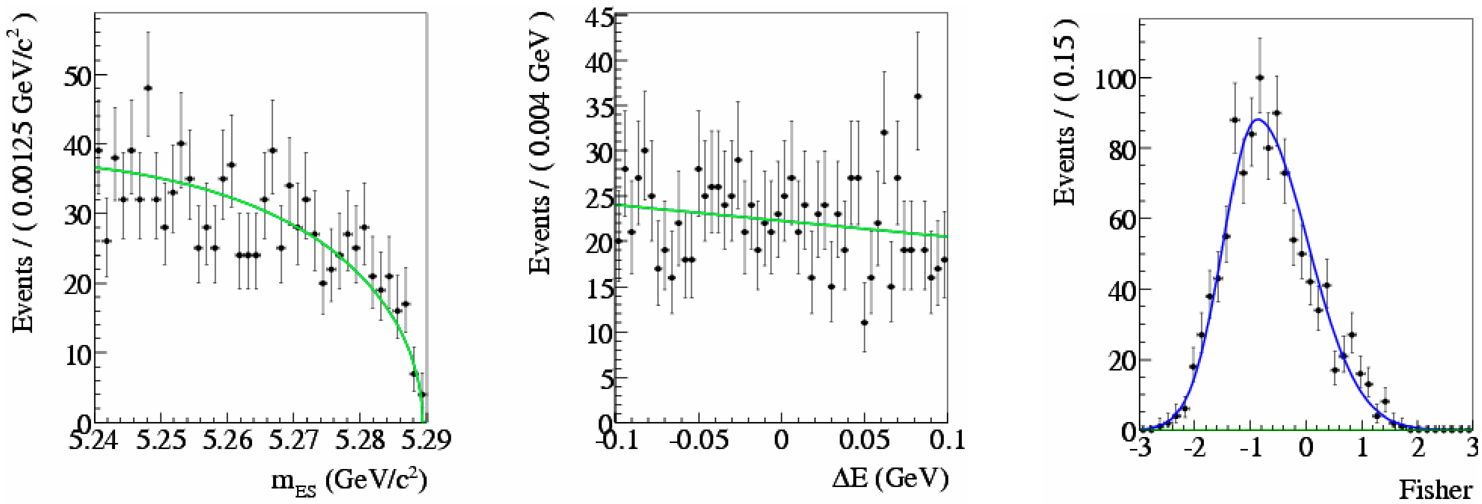
STEP 1A: FIT SHAPES ON CONTROL SAMPLES

Da_1 control sample → signal shapes

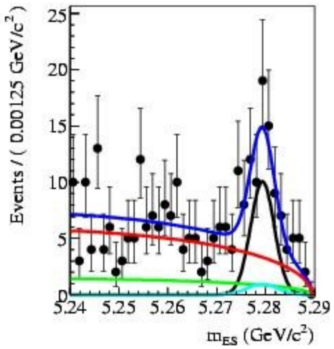
Combinatorial
Peaking
Signal
Global

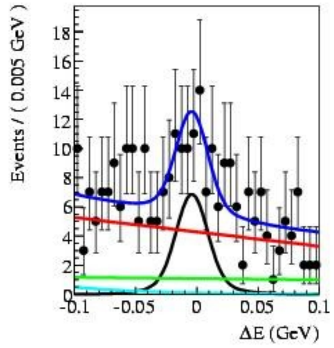


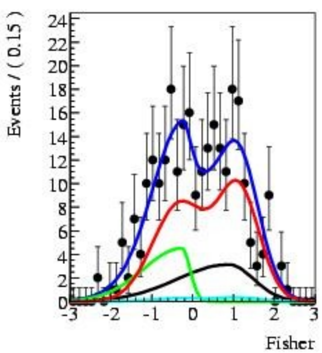
Off-resonance control sample → continuum background shapes



STEP 1B: YIELD FIT ON DATA SAMPLE

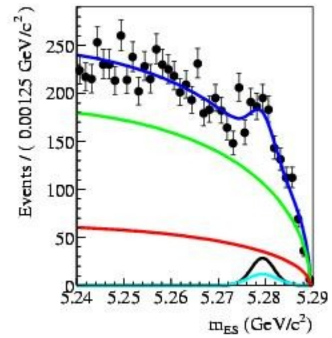


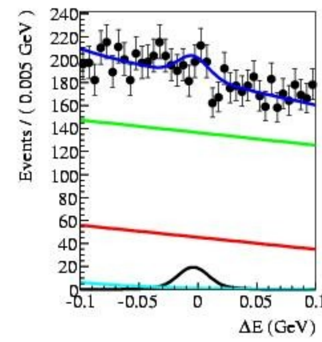


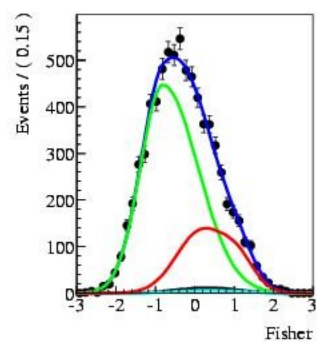


Lepton category

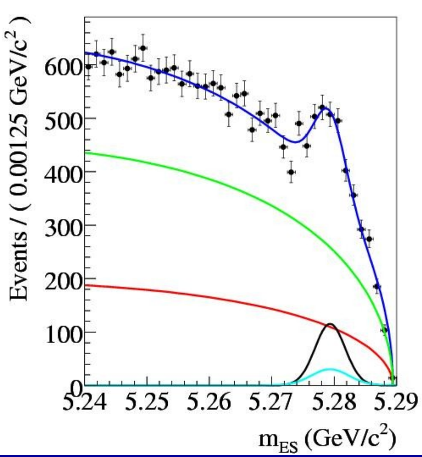
The Fisher parameters shapes are split by tagging categories.

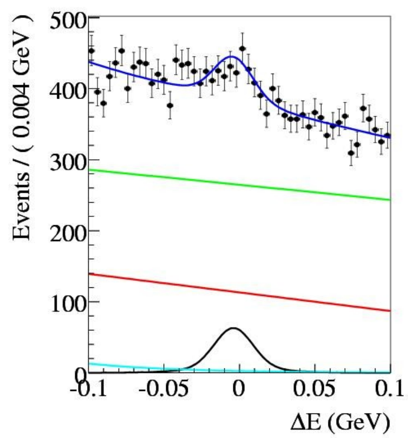


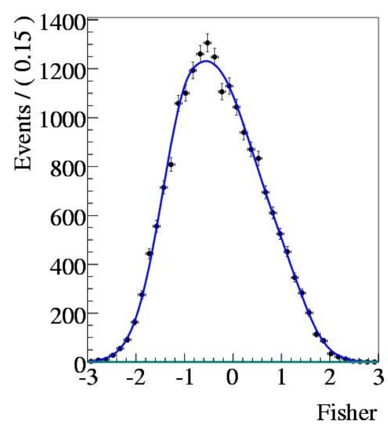




Untag Category







Nsig = 558+/- 34
Ncont = 13222 +/- 226
NBB = 5647 +/- 213
NPeak = 183 +/- 41

THE $_s$Plots TECHNIQUE

sPlots recipe to check the distribution of a discriminating variable used in the Likelihood.

- Repeat the fit without the discriminating variable with all parameters fixed except the yields
- Extract the covariance matrix V
- Compute the weight W for the specie you want to check
- Fill an histogram of the variable for all events in the sample with a weight =sWeight

For mD check, would be $P_{ij}(mD,\Delta E,FI)$ for m_{ES} check

$$W^i_{sig} \equiv \frac{\sum_j \mathbf{V}_{sig,j} P_{ij}(m_{ES},\Delta E,\mathcal{F})}{\sum_j N_j P_{ij}(m_{ES},\Delta E,\mathcal{F})},$$

j = signal, qq, BB, peaking

i = event

For signal Pdfs check, can be done for BB, peaking, qq species

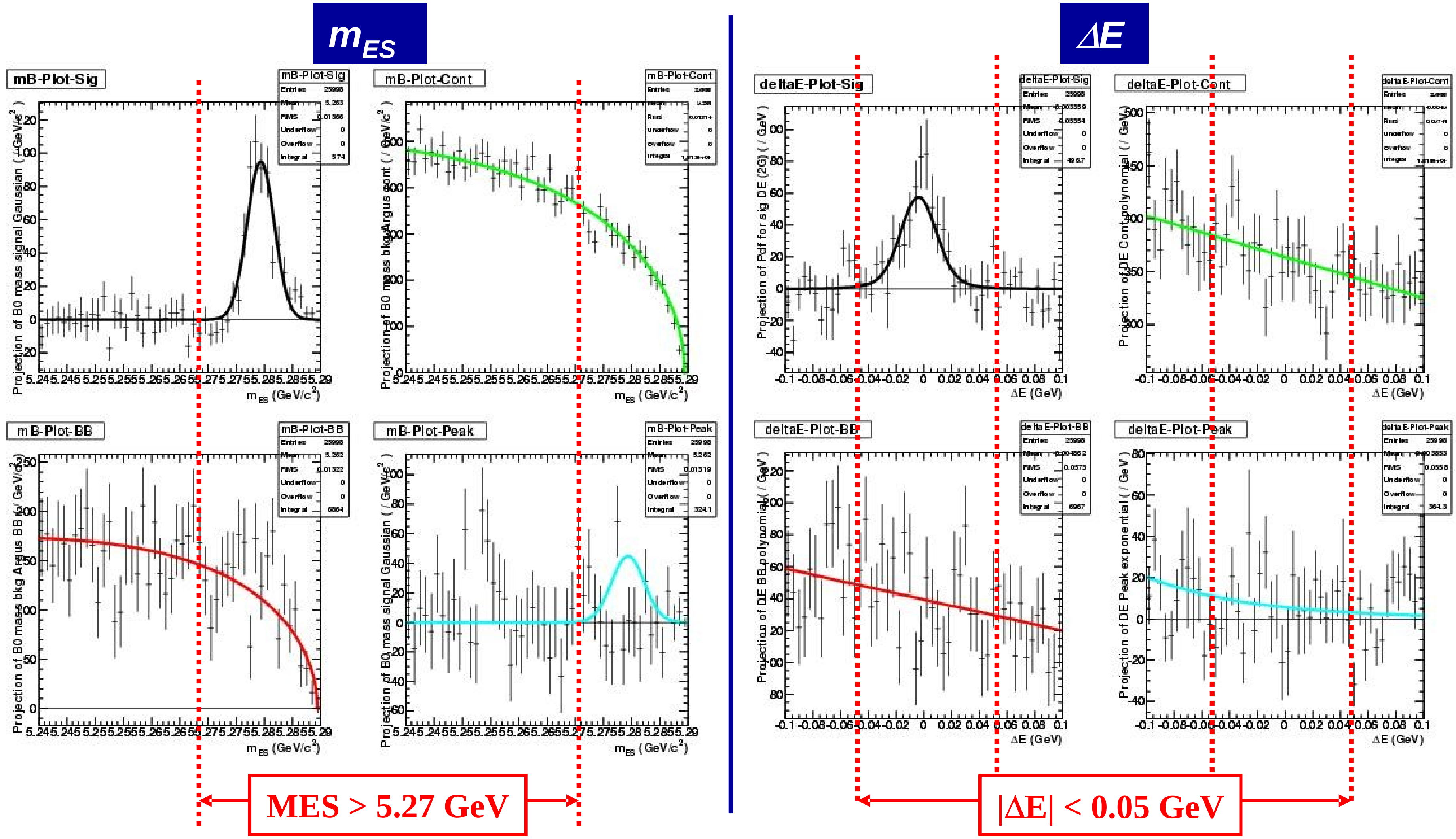
M. Pivk, F. Le Diberder

NIM A 555 (2005) 356-369

NB : To check a variable which is not in the Likelihood (*eg* the Ks mass)

one just has to rerun the yields-only fit without changing the L description

$_s$*Plots*: MES & ΔE



Continuum pdf
BB pdf
Peaking pdf
Signal pdf

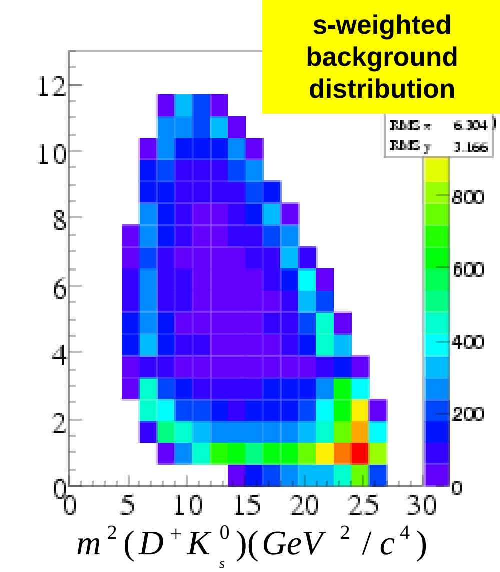
These are not fits!

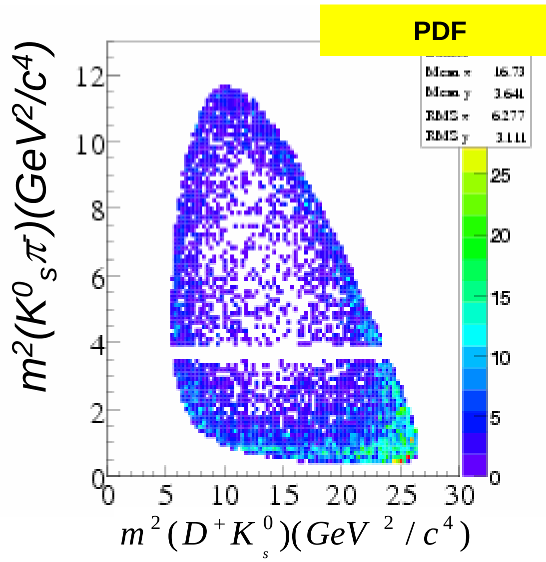
The PDF used in the likelihood is superimposed to the sPlots.

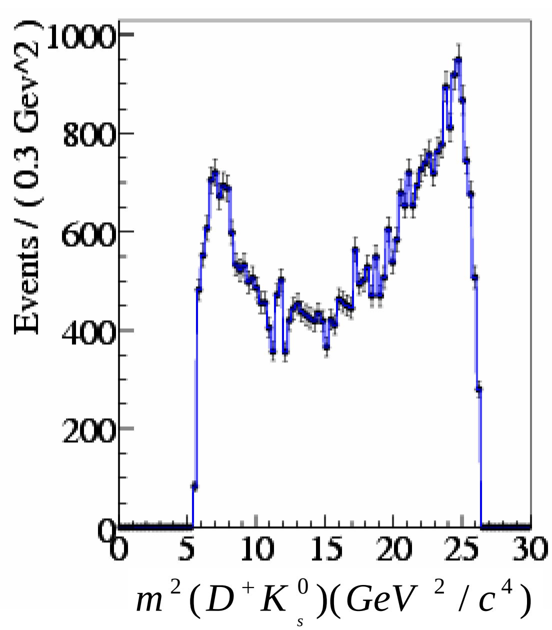
STEP 2: DALITZ PARAMETERIZATION

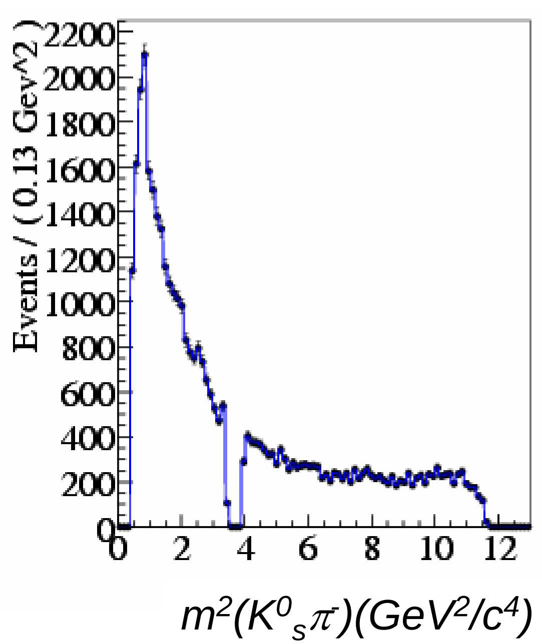
Dalitz background parameterization is a RooHistPdf of the s-weighted distributions on data of the background:

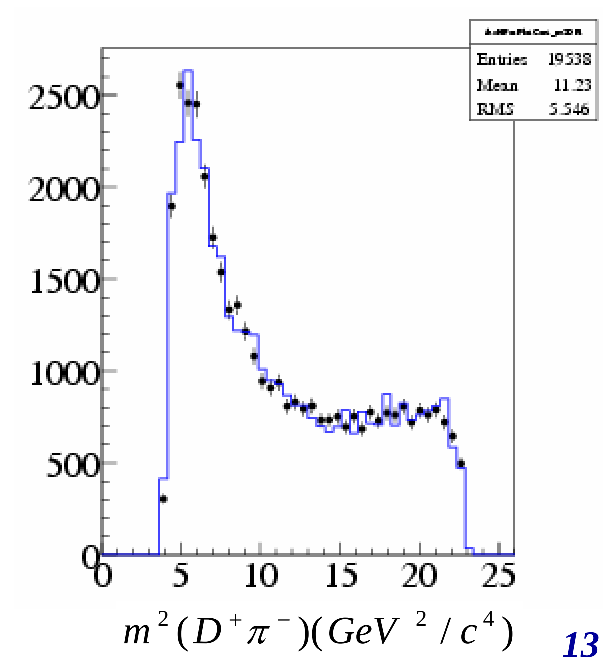
$$W_{back}^{i} = 1 - W_{sig}^{i} = 1 - \frac{\sum_j V_{sig,j} Y_j^i(m_{ES}, \Delta E, F)}{\sum_j N_j Y_j^i(m_{ES}, \Delta E, F)}$$





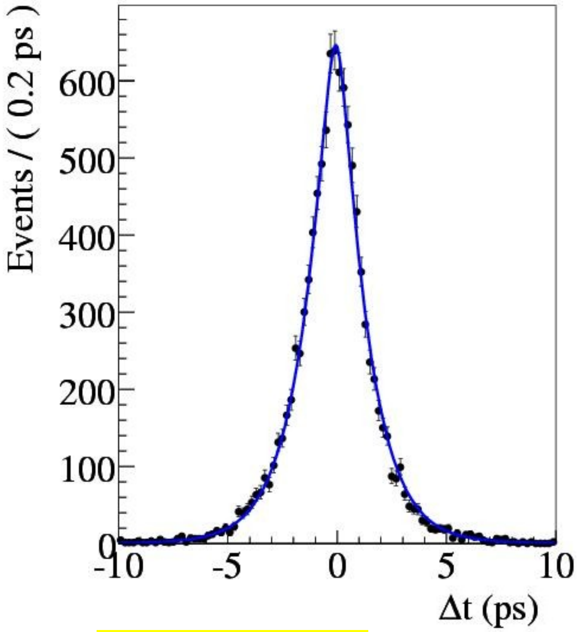






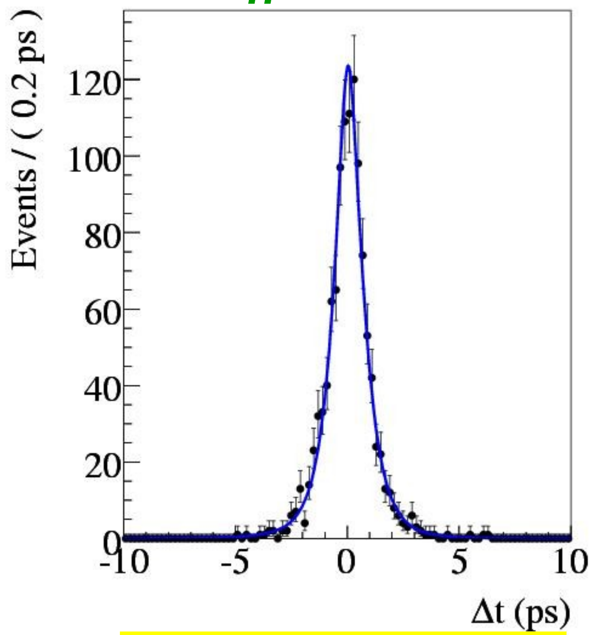
STEP 3: TIME PARAMETERIZATIONS

Monte Carlo



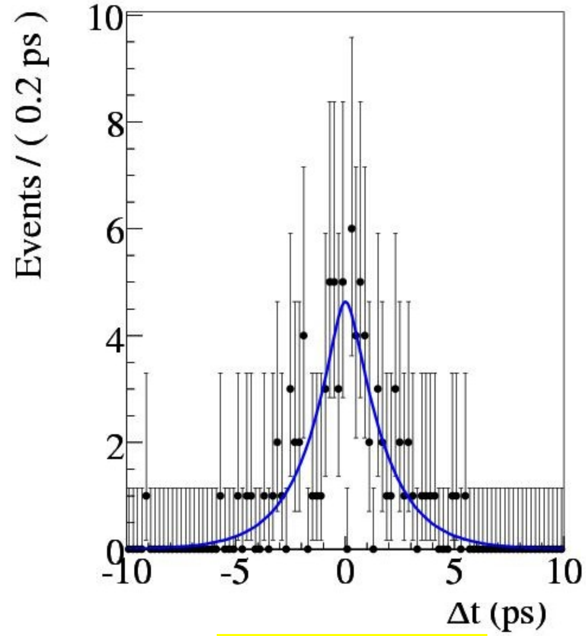
$\tau_{BB} = (1.20 \pm 0.02)\,ps$

Off-resonance



$\tau_{Cont} = (0.45 \pm 0.03)\,ps$

Monte Carlo



$\tau_B = 1.542\,ps$

$$\frac{e^{-\frac{\Delta t}{\tau}}}{4\tau} \otimes \underbrace{\{(1 - f_2 - f_3)G_1(\Delta t, \mu_1, \sigma_1) + f_2 G_2(\Delta t, \mu_2, \sigma_2) + f_3 G_3(\Delta t, \mu_3, \sigma_3)\}}_{\text{Resolution function.}}$$

Resolution function.

STEP 4: CP FIT

Monte Carlo simulations show that *the statistic is not yet sufficient* to extract all amplitudes and phases from the fit.

The fit can be performed in the following configuration:

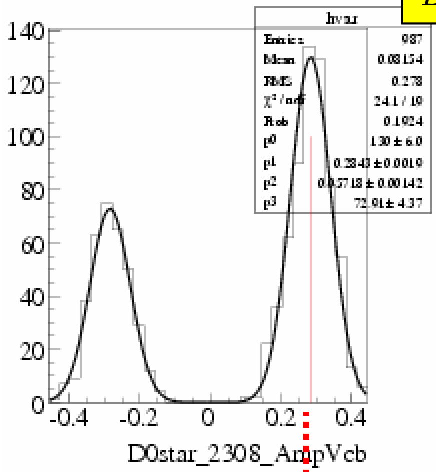
- A parameter ***r = 0.3*** is defined as the ratio between the V_{ub} and V_{cb} amplitudes.
- The D^{**}_s amplitude and phase are fixed to the model values.

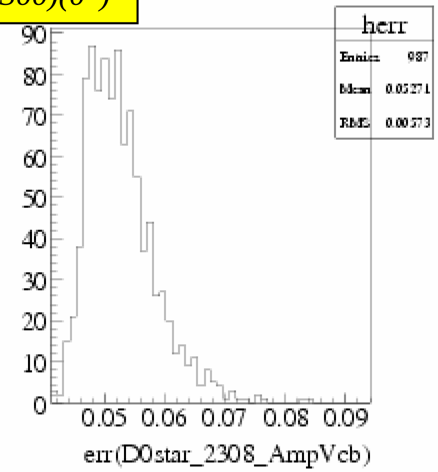
Note:

- We fix the non resonant contribution at 0 (most conservative hypothesis).
- We would present the result on $2\beta+\gamma$ as a function of r

BIASES IN TOY MONTECARLO @ 316 fb^{-1}

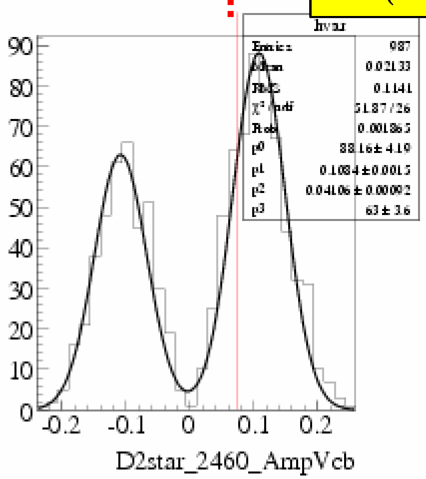
*D**(2300)(0^+)*

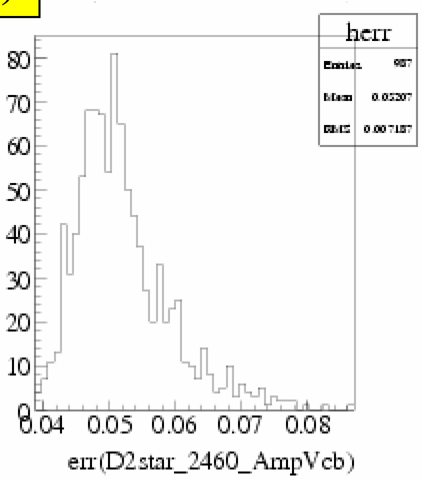




Generated value

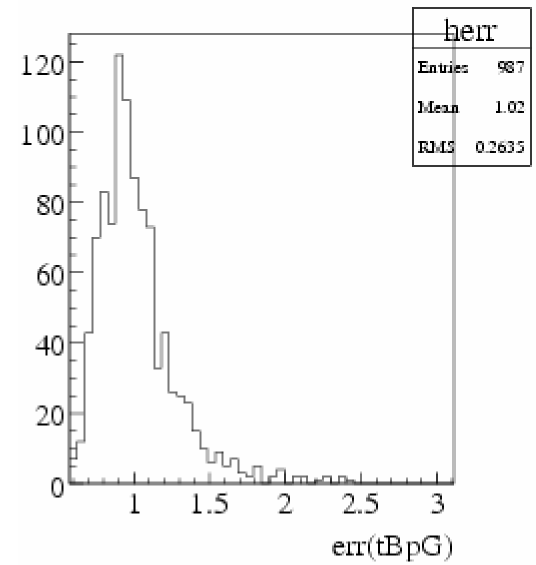
*D**(2460)(2^+)*





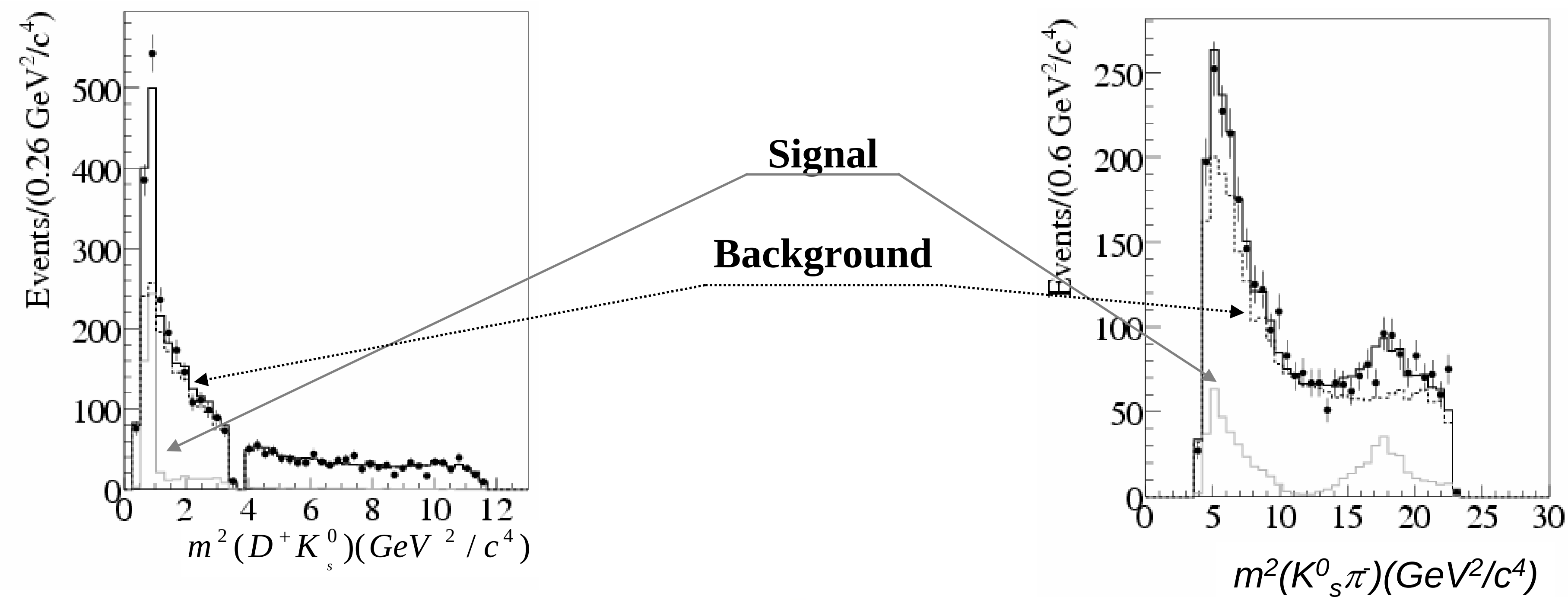
We will correct for the biases, generating toys with amplitudes and phases fitted values.

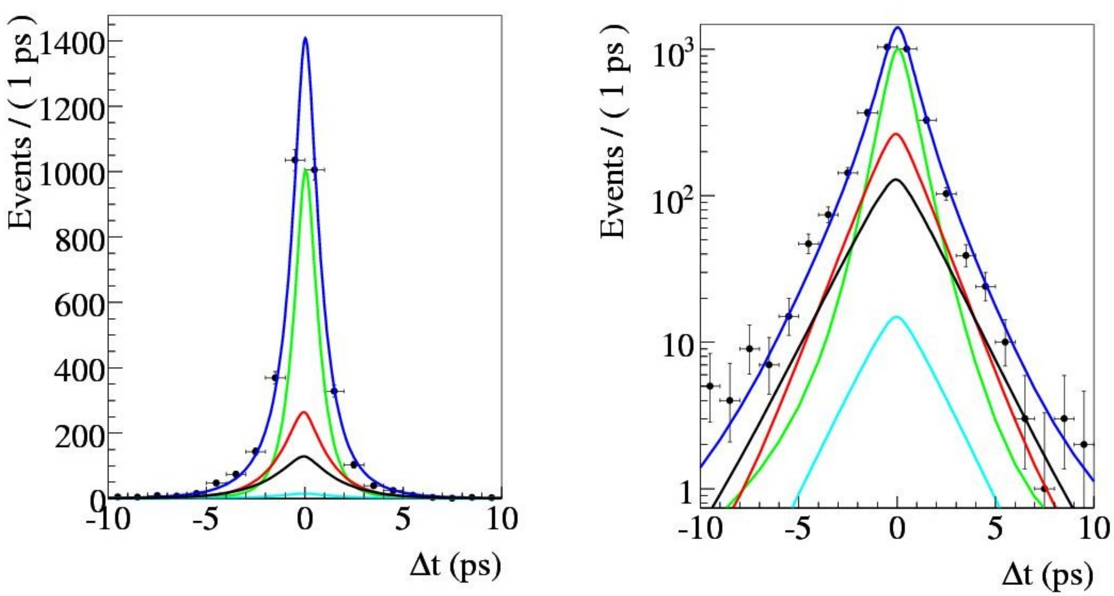
Error distribution on 2β+γ: Mean=1.02 rad



RESULTS

INVARIANT MASSES AND TIME





Continuum
Combinatorial BB
Peaking
Signal
Global

AMPLITUDES, PHASES AND $2\beta+\gamma$

First measurements of amplitudes and phases of the resonances populating the V_{cb} part of the Dalitz plot for $B^0 \to D^- K^0 \pi^+$ decays.

First measurement of $2\beta+\gamma$ in these decays.

Resonance	Bias correction for the amplitude	Amplitude after bias correction	Phase
$K^*(892)$	–	1.	0.
$D_0^{**}(2308)$	$+0.0027$	0.290 ± 0.048	267.3 ± 21.8
$D_2^{**}(2460)$	-0.0334	0.042 ± 0.050	325.1 ± 46.0
$K_0^{**}(1430)$	-0.0249	0.135 ± 0.058	283.9 ± 29.6
$K_2^{**}(1430)$	-0.0169	0.108 ± 0.056	220.8 ± 29.9
$K^{**}(1680)$	-0.0107	0.404 ± 0.047	128.3 ± 22.2
$2\beta+\gamma$		82.8 ± 53.5	

The likelihood has local maxima.

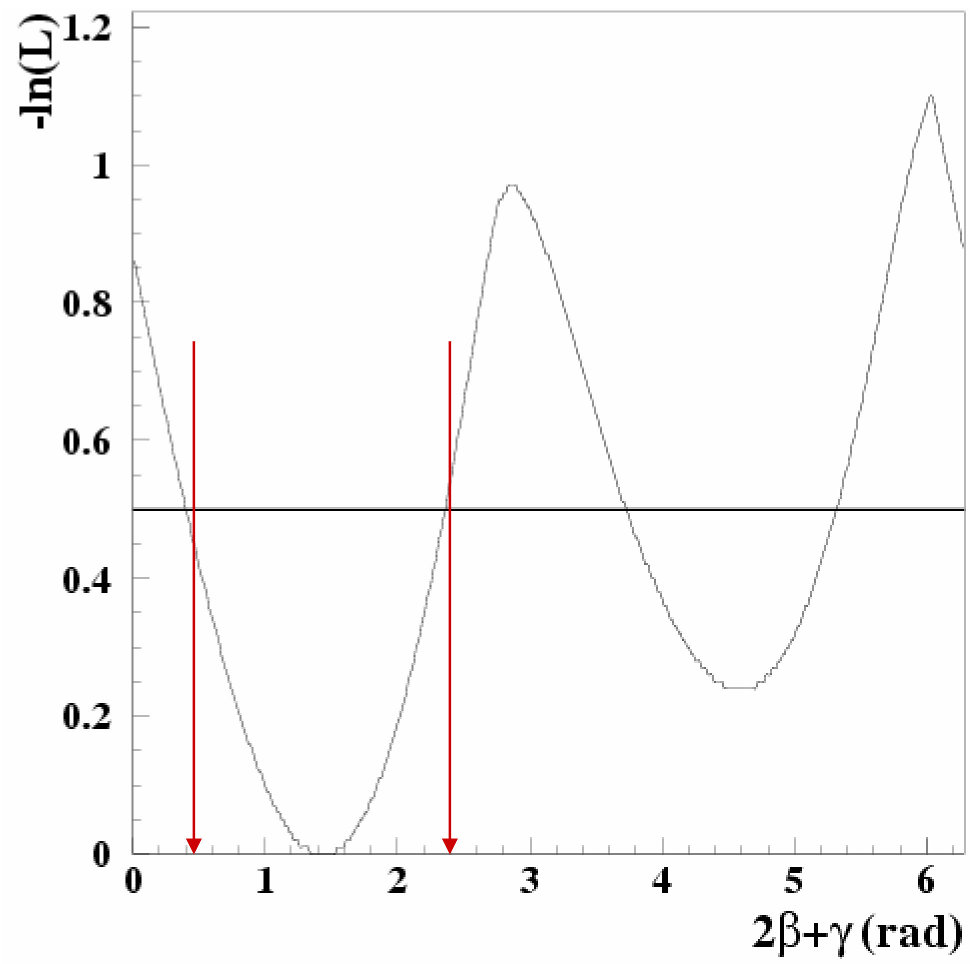
To find the real maximum, the fit is repeated 20 times with different initial values.

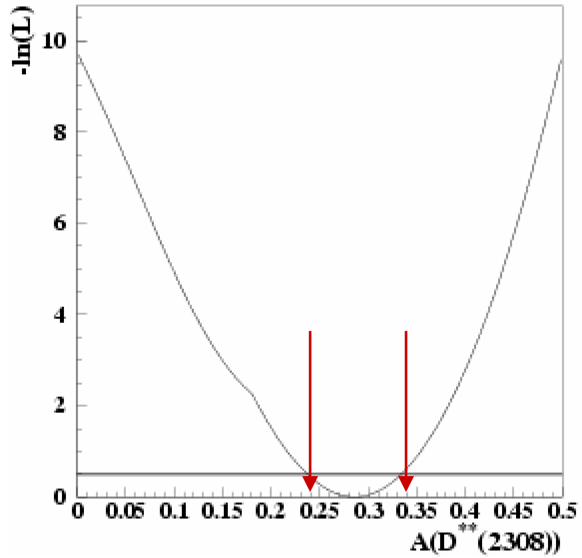
The results chosen correspond to the best likelihood value.

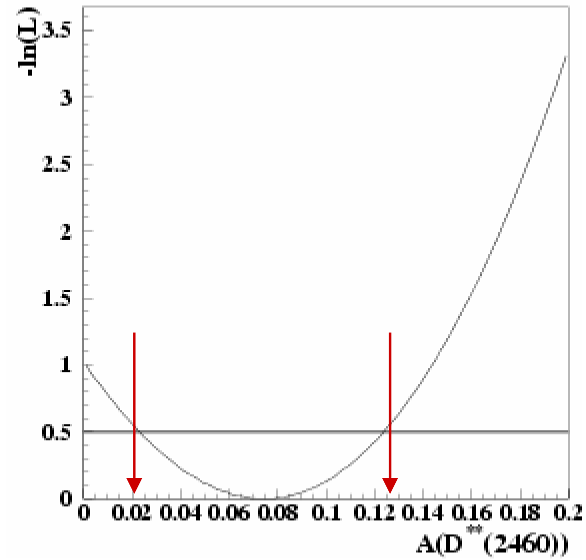
LIKELIHOOD SCANS

As a check, perform a scan to obtain the projected likelihood for each parameter.

For each fixed value, 20 fits are performed, the lowest –log(L) is choses and plotted







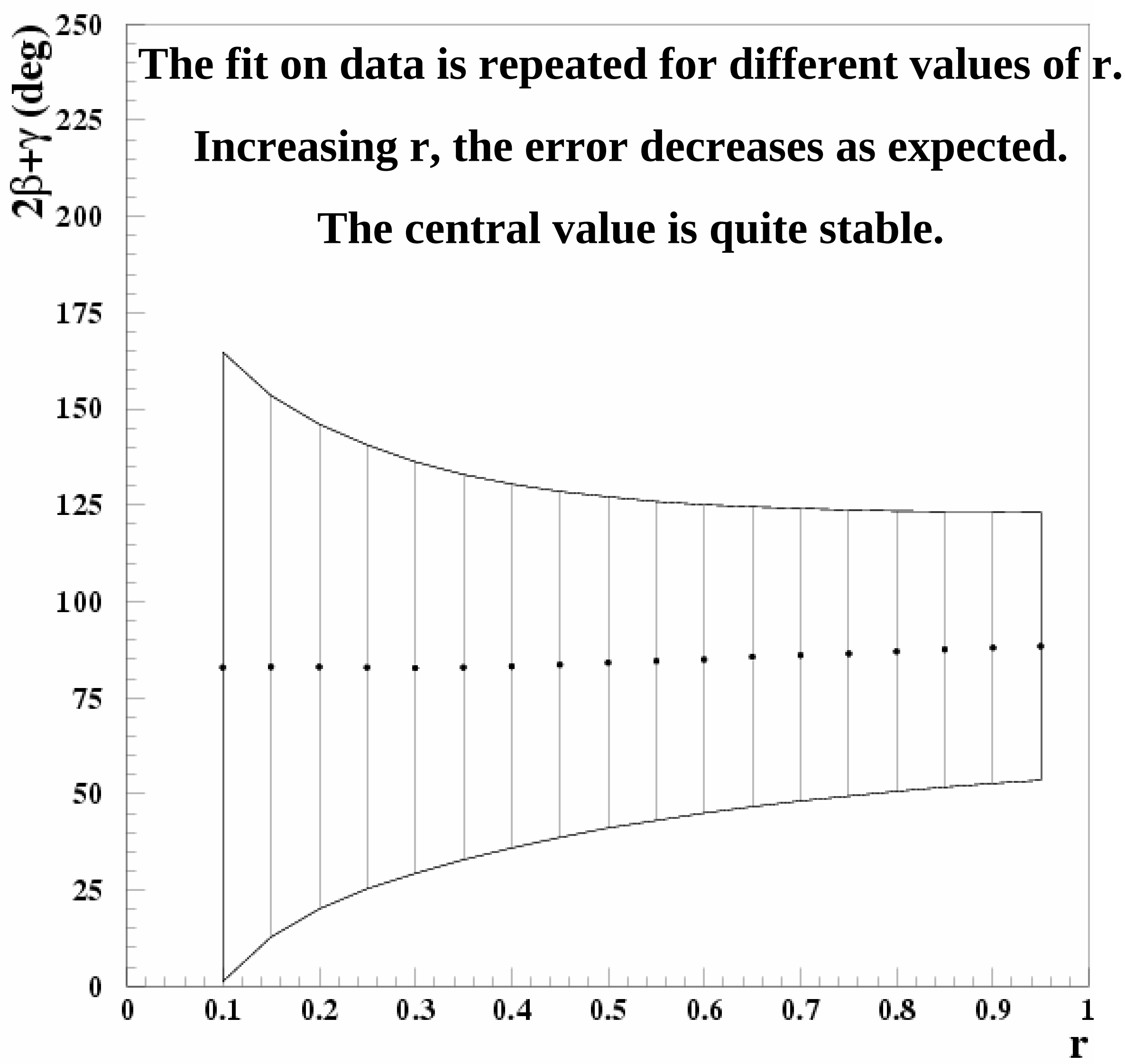
Errors are compatible with those determined by Minuit.

SYSTEMATICS

Most of systematics are the shift between the fitted value in the new configuration and the default value at 100 ab-1, to avoid statistical fluctuations.

Systematic	$2\beta+\gamma$	$D_0^{**}(2308)$ a_c	$D_0^{**}(2308)$ δ_c	$D_2^{**}(2460)$ a_c	$D_2^{**}(2460)$ δ_c	$K_0^{**}(1430)$ a_c	$K_0^{**}(1430)$ δ_c	$K_2^{**}(1430)$ a_c	$K_2^{**}(1430)$ δ_c	$K^{**}(1680)$ a_c	$K^{**}(1680)$ δ_c
Bkgd Dalitz param.	16.0	0.058	3.2	0.034	12.1	0.088	9.5	0.005	12.0	0.015	10.3
Efficiency over the Dalitz plot	5.8	0.014	17.5	0.028	10.8	0.005	1.9	0.036	0.8	0.017	19.4
CP content of bkgd	1.0	0.021	6.9	0.003	8.4	0.005	1.4	0.007	3.9	0.003	1.0
r	1.0	0.013	8.6	0.013	2.2	0.039	3.0	0.012	0.7	0.016	0.3
$a(D_s^{**+}(2503))$	0.7	-	-	-	-	-	-	-	-	-	-
m, Γ	9.5	0.012	28.0	0.011	6.9	0.018	2.8	0.032	5.9	0.036	9.3
$\mathcal{Y}$ PDF param.	3.0	0.005	1.4	0.002	0.4	0.007	0.6	0.003	0.1	0.002	0.5
Signal and bkgd fractions	1.4	0.012	2.9	0.004	1.2	0.013	1.4	0.008	0.7	0.004	1.4
Yields	0.1	0.003	1.3	0.001	0.3	0.005	0.4	0.002	0.1	0.002	0.1
Tagging and time param.	2.6	0.003	1.4	0.001	0.3	0.004	0.4	0.002	0.2	0.002	0.2
Combined error	20.0	0.067	35.2	0.048	19.7	0.099	10.7	0.051	14.0	0.046	24.0

r SCAN



The fit on data is repeated for different values of r.
Increasing r, the error decreases as expected.
The central value is quite stable.
2β+γ (deg)
250
225
200
175
150
125
100
75
50
25
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
r

TOY MONTECARLO @ ~10 ab^{-1} !!!

All amplitudes and phases, both Vcb and Vub are correctly determined.

	Fitted values				*Generation values*			
	$a(V_{cb})$	$\phi(V_{cb})^o$	$a(V_{ub})$	$\phi(V_{ub})^o$	$a(V_{cb})$	$\phi(V_{cb})^o$	$a(V_{ub})$	$\phi(V_{ub})^o$
$D_{s2}(2573)^{\pm}$	-	-	0.002 ± 0.011	0. ± 155	-	-	0.02	0
$D_2^*(2460)^0$	-0.111 ± 0.010	207 ± 7	0.046 ± 0.019	46 ± 26	0.12	30	0.048	30
$D_0(2308)^0$	-0.128 ± 0.017	252 ± 11	0.047±0.023	38 ± 31	0.12	70	0.048	90
$K^*(892)^{\pm}$	fixed	fixed	-	-	1	0	-	-
$K_0^*(1430)^{\pm}$	0.602 ± 0.024	81 ± 2.2	-	-	0.6	80	-	-
$K_2^*(1430)^{\pm}$	0.197 ± 0.035	0. ± 2	-	-	0.2	0	-	-
$K^*(1680)^{\pm}$	0.301 ± 0.011	28 ± 3.6	-	-	0.3	30	-	-
"Non Resonant"	0.093 ± 0.019	357 ± 13	0.070 ± 0.030	48 ± 24	0.07	0	0.028	30

$2\beta+\gamma = (1.93 \pm 0.25)$ rad $= (111 \pm 14)^o$

(generation value was 2 rad)

CONCLUSIONS

The time dependent Dalitz analysis of the $B^0 \to D^- K^0 \pi^+$:

- does not rely, at high statistic, on any theoretical assumption;
- determines $2\beta+\gamma$ with only 2 fold ambiguities;
- benefits of large interference in some regions of the Dalitz plot;
- gives the knowledge of the V_{cb} and V_{ub} parts of the Dalitz plot.

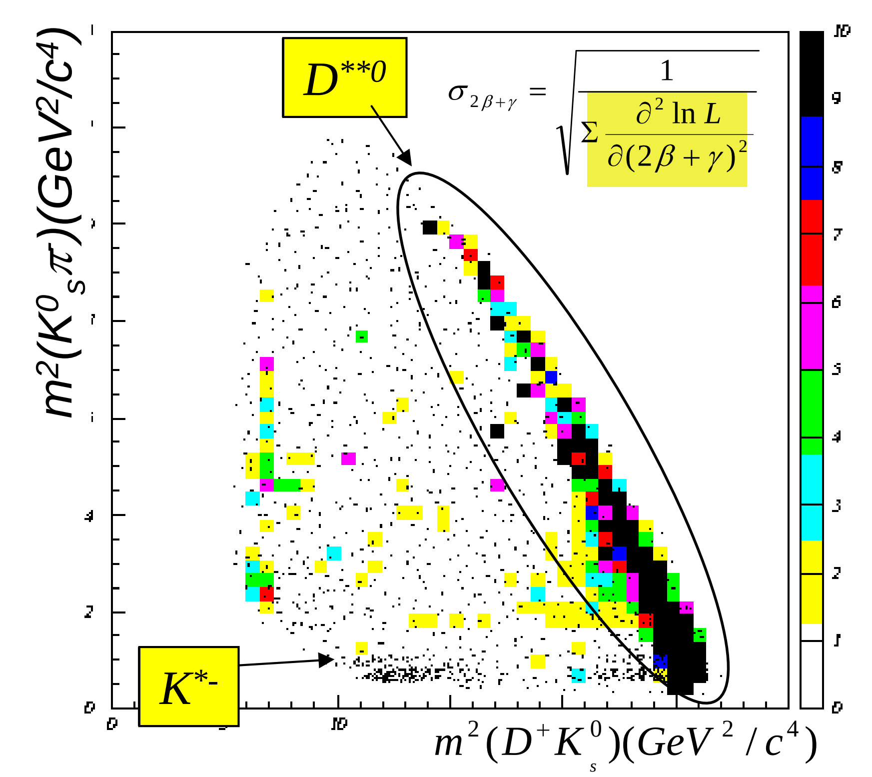
- We unblinded amplitudes, phases and $2\beta+\gamma$: $(82.8 \pm 53.5 \pm 20.0)$

  (actual result from UTFit is 90 ± 33)
- Systematics are done.
- The analysis is documented in BAD1201
- A first version of the paper is available (BAD 1812)
- We are interacting with our RC: Chih-hsiang Cheng, David N. Brown, Guglielmo De Nardo (replacing Fred Blanc).

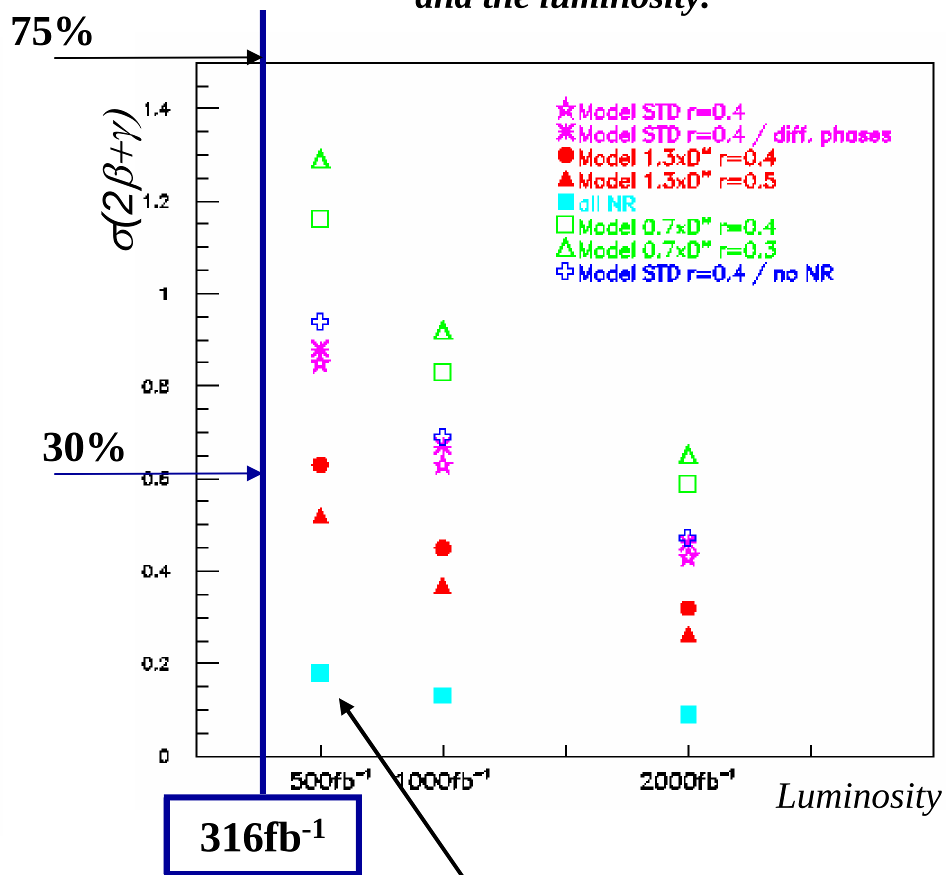
BACKUP

SENSITIVITY

Simulated distribution of the events in the Dalitz plot is weighted by a factor



Variations as a function of the model and the luminosity.

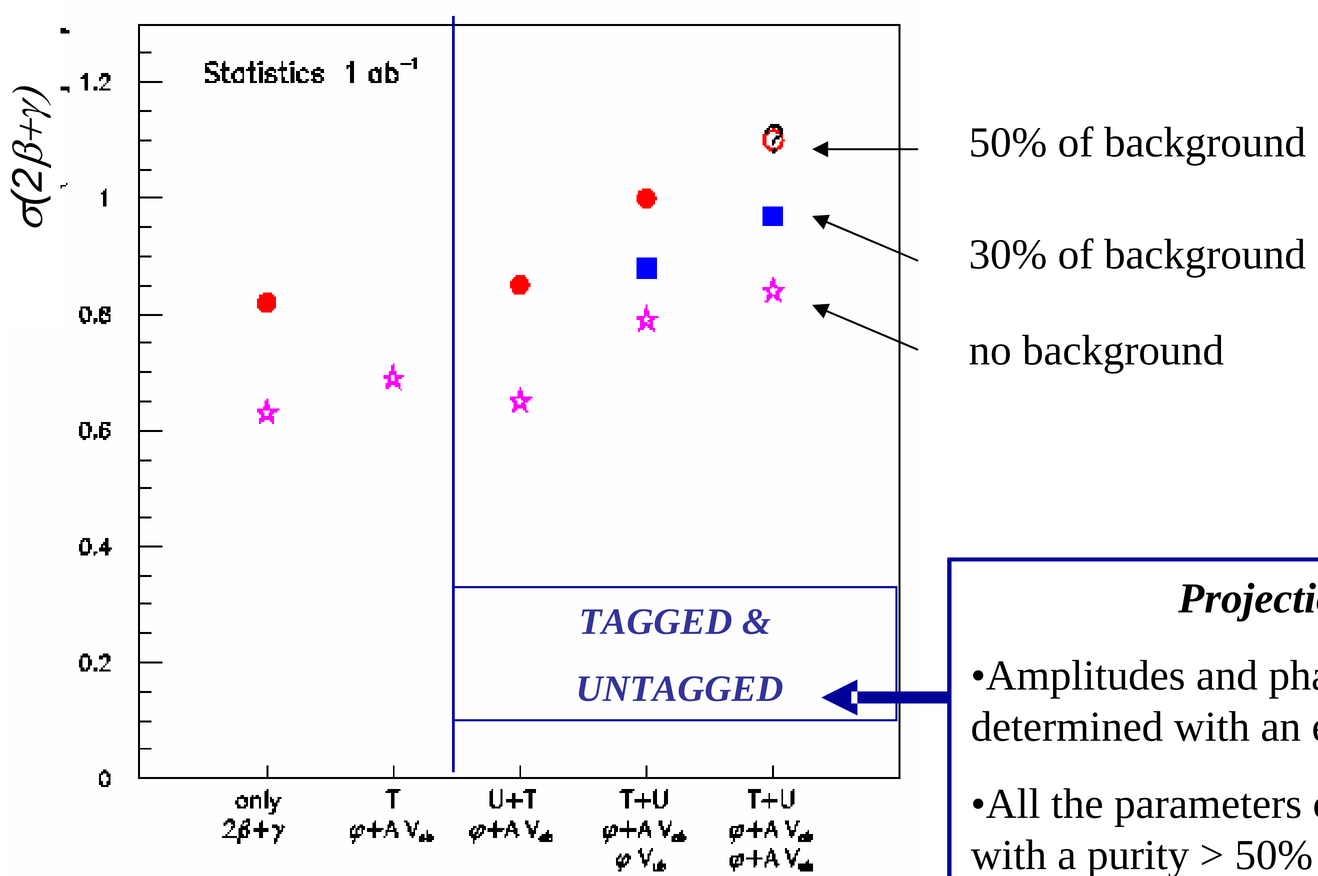


Previous feasibility study had an optimistic assumption on the Dalitz model, thus underestimating the error.

F.Polci, M.H.Schune, A.Stocchi
hep/ph 0605129

BACKGROUND EFFECT

- *The effect of a BACKGROUND uniform in the Dalitz plot has been evaluated.*
- *The use of untagged events helps.*



Projection at 1ab⁻¹

•Amplitudes and phases V_{cb} are determined with an error of 20%-30%

•All the parameters can be determined with a purity > 50%

TIME DEPENDENT DALITZ PDF

In the case of $B^0 \rightarrow D^+\pi^-$:

$$B_{tag} = \begin{cases} B^0 \Rightarrow (\eta = -1) \\ \overline{B}^0 \Rightarrow (\eta = +1) \end{cases}$$

$$P_\eta^{TAG}(\Delta t) = \frac{e^{-\frac{|\Delta t|}{\tau}}}{4\tau}\left\{1 - \eta S_f \sin(\Delta m \cdot \Delta t) + \eta C \ \cos(\Delta m \cdot \Delta t)\right\}$$

$$r_{D+\pi-} \equiv \frac{q}{p}\frac{\overline{A}_{D+\pi-}}{A_{D+\pi-}} = |r_{D+\pi-}| e^{-i(2\beta+\gamma+\Delta\delta)}$$

$$\begin{cases} C_{D^+\pi^-} = \dfrac{1-|r_{D^+\pi^-}|^2}{1+|r_{D^+\pi^-}|^2} \\ S_{D^+\pi^-} = \dfrac{2\,\mathrm{Im}(r_{D^+\pi^-})}{1+|r_{D^+\pi^-}|^2} \end{cases}$$

In the case of $B^0 \rightarrow D^+K_s\pi^-$:

$$P_{\eta,k}^{TAG}(\Delta t) = \frac{e^{-\frac{|\Delta t|}{\tau}}}{4\tau}\frac{A_{c_k}^2 + A_{u_k}^2}{2}\left\{1 - \eta S_f^k \sin(\Delta m \cdot \Delta t) + \eta C^k \cos(\Delta m \cdot \Delta t)\right\}$$

$$C^k = \frac{A_{c_k}^2 - A_{u_k}^2}{A_{c_k}^2 + A_{u_k}^2} \qquad S^k_{D^+K_S^0\pi^-} = \frac{2\,\mathrm{Im}(A_{c_k} A_{u_k} e^{i(2\beta+\gamma)+i(\delta_{c_k}-\delta_{u_k})})}{A_{c_k}^2 + A_{u_k}^2}$$

Note: untagged events (η=0) play a role since they help in the amplitudes and phases determination.

SIGNAL TIME-DALITZ LIKELIHOOD

	$D^- K^0 \pi^+$ final state	$D^+ K^0 \pi^-$ final state
V_{cb} contribution	$< D^- K^0 \pi^+ \vert T \vert B^0 >= A_{c_i} e^{i\delta_{c_i}}$	$< D^+ K^0 \pi^- \vert T \vert \overline{B}^0 >= A_{c_i} e^{i\delta_{c_i}}$
V_{ub} contribution	$< D^- K^0 \pi^+ \vert T \vert \overline{B}^0 >= A_{u_i} e^{i\delta_{u_i} - i\gamma}$	$< D^+ K^0 \pi^- \vert T \vert B^0 >= A_{u_i} e^{i\delta_{u_i} + i\gamma}$

Amplitude — strong phase — Breit Wigner of resonance

$$A_{c_i(u_i)} e^{i\delta_{c_i(u_i)}} = \sum_j a_j \cdot e^{i \cdot \delta_j} \cdot BW_j(m, \Gamma, s)$$

$$\Pr\left(B^0 \to D^+ K_s^0 \pi^- \right) = \frac{|A_{c_i}|^2 + |A_{u_i}|^2}{2} e^{-\Gamma t} \left\{ 1 + C_i \cos(\Delta m \cdot t) + S_i^+ \sin(\Delta m \cdot t) \right\}$$

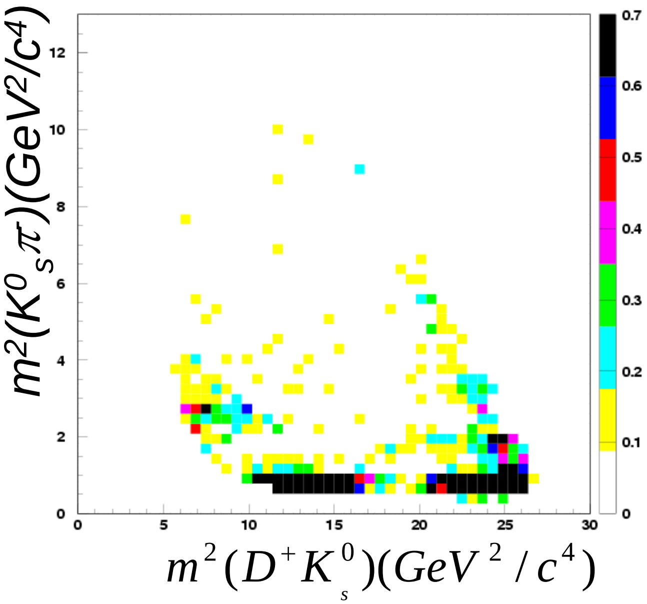
$$\Pr\left(\bar{B}^0 \to D^+ K_s^0 \pi^- \right) = \frac{|A_{c_i}|^2 + |A_{u_i}|^2}{2} e^{-\Gamma t} \left\{ 1 - C_i \cos(\Delta m \cdot t) - S_i^+ \sin(\Delta m \cdot t) \right\}$$

$$\Pr\left(B^0 \to D^- K_s^0 \pi^+ \right) = \frac{|A_{c_i}|^2 + |A_{u_i}|^2}{2} e^{-\Gamma t} \left\{ 1 - C_i \cos(\Delta m \cdot t) + S_i^- \sin(\Delta m \cdot t) \right\}$$

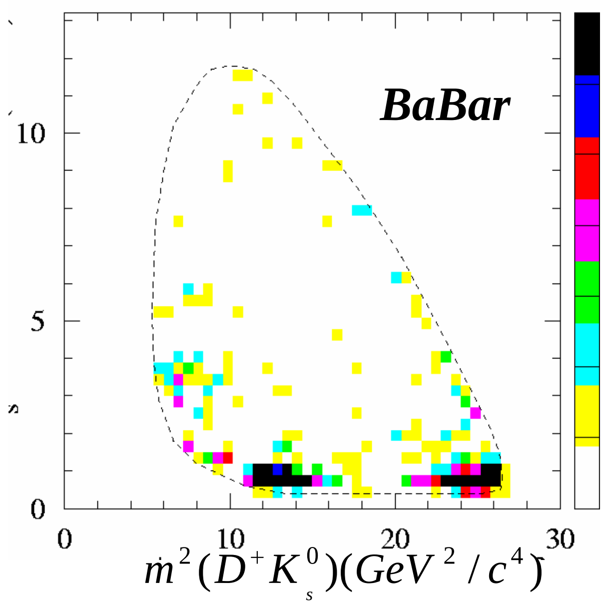
$$\Pr\left(\bar{B}^0 \to D^- K_s^0 \pi^+ \right) = \frac{|A_{c_i}|^2 + |A_{u_i}|^2}{2} e^{-\Gamma t} \left\{ 1 + C_i \cos(\Delta m \cdot t) - S_i^- \sin(\Delta m \cdot t) \right\}$$

$$C_i = \frac{|A_{c_i}|^2 - |A_{u_i}|^2}{|A_{c_i}|^2 + |A_{u_i}|^2} \qquad S_i^+ = \frac{2\,\mathrm{Im}(A_{c_i} A_{u_i}^* e^{i(2\beta+\gamma)})}{|A_{c_i}|^2 + |A_{u_i}|^2} \qquad S_i^- = \frac{2\,\mathrm{Im}(A_{c_i}^* A_{u_i} e^{i(2\beta+\gamma)})}{|A_{c_i}|^2 + |A_{u_i}|^2}$$

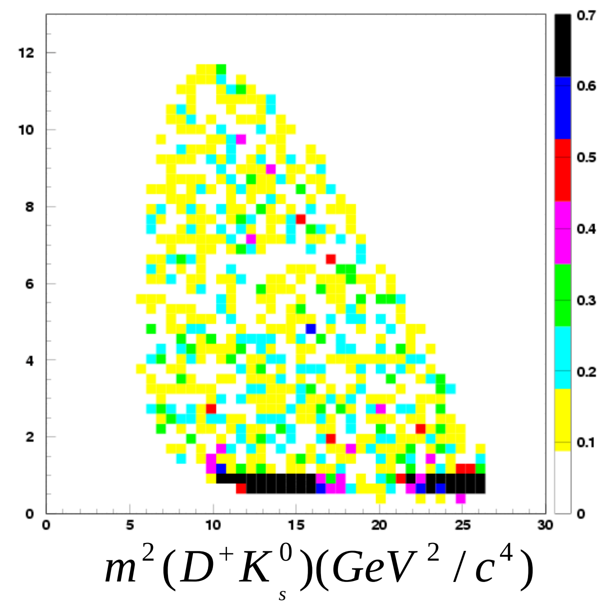
THEORETICAL MODELS *vs* DATA



Theoretical model used in the simulation.



Experimental Dalitz plot (background subtracted).



Theoretical model used in the previous simulation.

The model assuming **only non resonant** for the V_{ub} amplitude

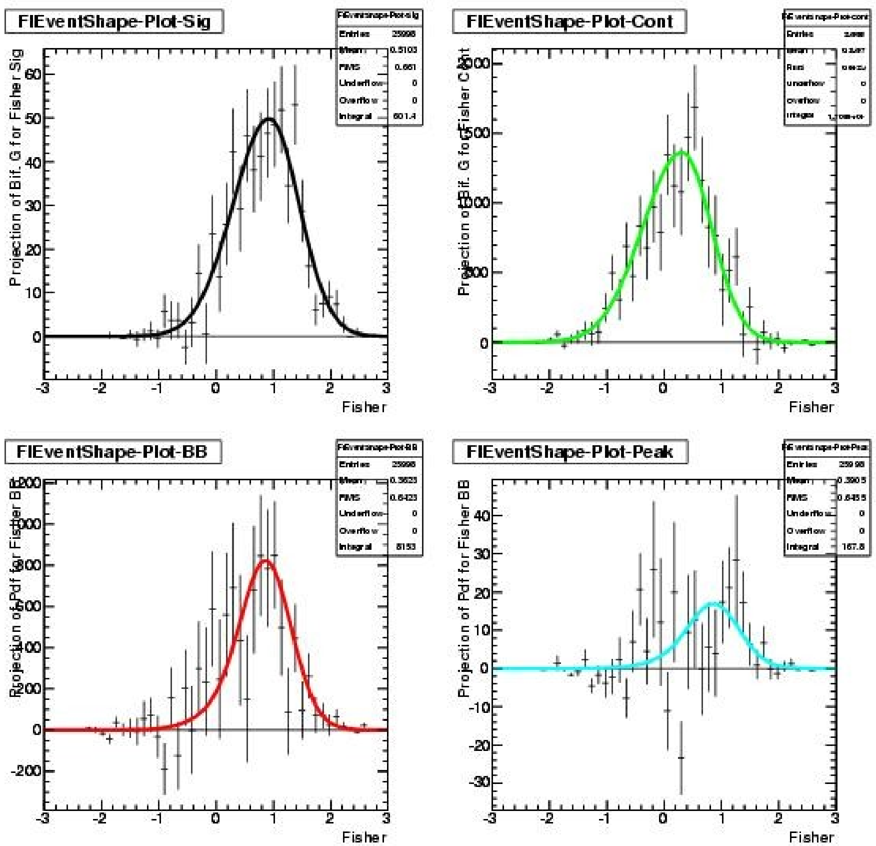
(suggested in: R. Aleksan, T. C. Petersen, *hep-ph/0307371* (CKM workshop 2003, numerical analysis))

does not reproduce the experimental data!

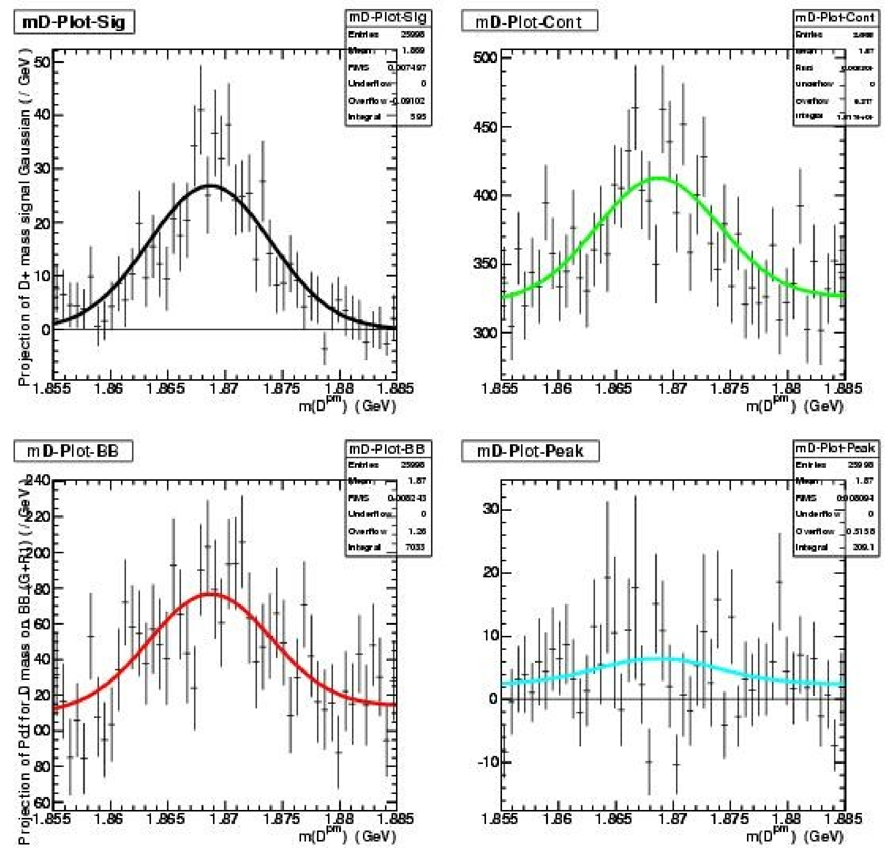
Implying interference all over the phase space, **overestimates the sensitivity!**

sPlots – Fisher & D mass

Fisher

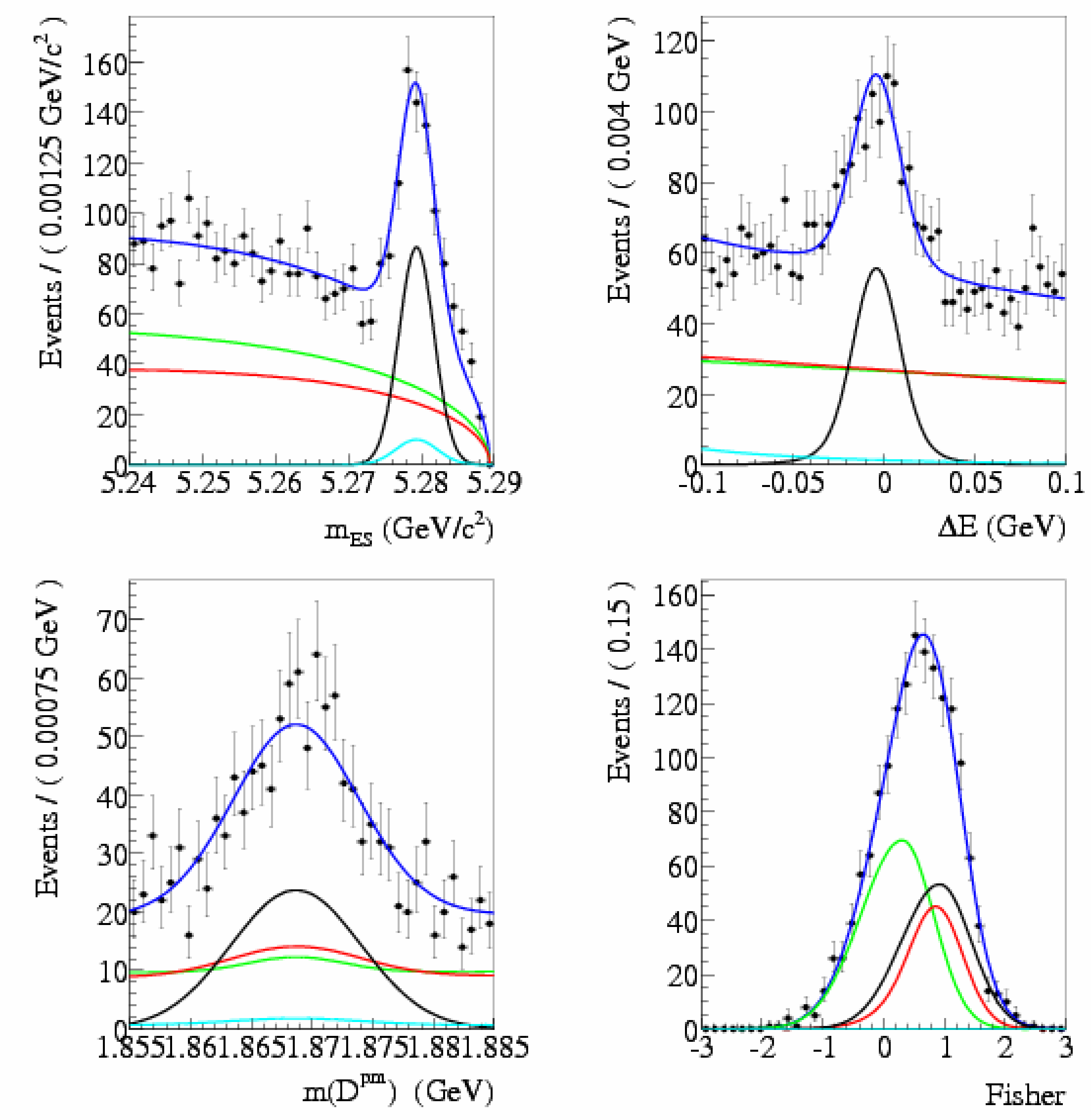


mD



It is not a fit , Pdfs used in the likelihood are superimposed.

TO VISUALIZE SIGNAL LEVEL…

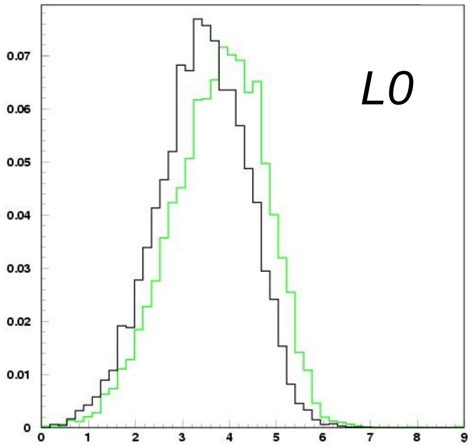


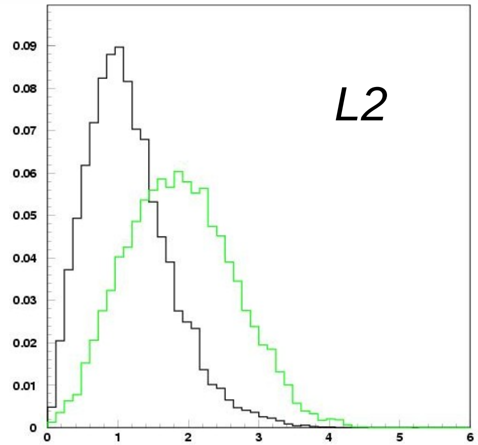
Plot cutting on the other three variables:
5.2725<mes<5.2875 GeV/c^2
|ΔE|<0.1 GeV
M(D) inside 2σ window
Fisher>0.2

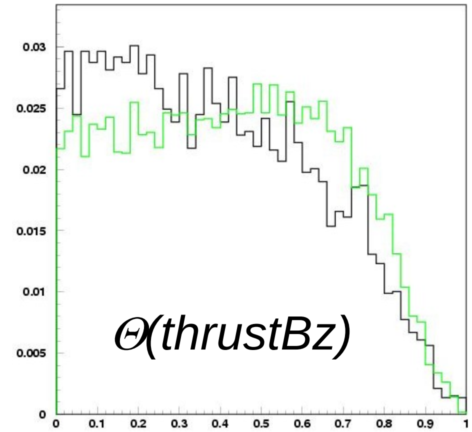
Continuum pdf
BB pdf
Peaking pdf
Signal pdf
Overall pdf

NEW VARIABLES IN THE FISHER

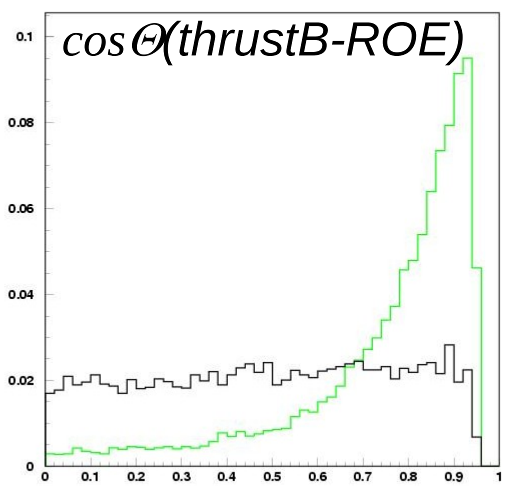
$$FI \equiv c_0 + c_1 L_0 + c_2 L_2 + c_3 |\cos\theta_{(\vec{p}_{T_B},\vec{z})}| + c_4 T + c_5 |\cos\theta_{(\vec{T}_B,\vec{T}_{ROE})}|$$

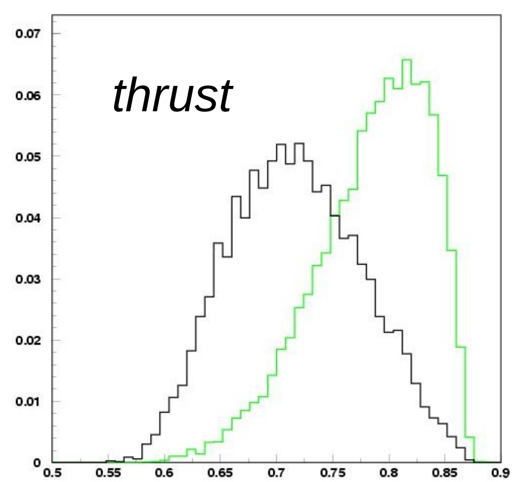






Continuum pdf
Signal pdf





Fisher shape correlation with tagging categories is taken into account.