Lifetime &Mixing with D*l ν

News:

- Fit Convergence Strategy
- Study of the Analysis Bias

Martino, 6/5/2004

Fit Convergence Strategy

"Old" Problem:
Difficulty in reaching the convergence using Migrad+Minos.
Sometimes Migrad fails, sometimes Minos does not compute 1 (or both) the asimmetric parameter errors...
Behaviour strongly correlated with parameter starting point.

→ Delay in Systematics/ Checks computation
(not possible to disentangle between systematic effects/Fit instability)

New Approach:
1) Perform a scan over the (τ, Δm) plane leaving free all the other parameters in order to find a minimum "by−hands" (using the Italian Analysis Farm and the Padova Reprocessing Farm);
2) Use the previous result as a starting point for the "standard fit"

Procedure applied on all the MC "Signal" Fits (see note tables 12, 13);
MC total Fit (Signal+Background) under way...

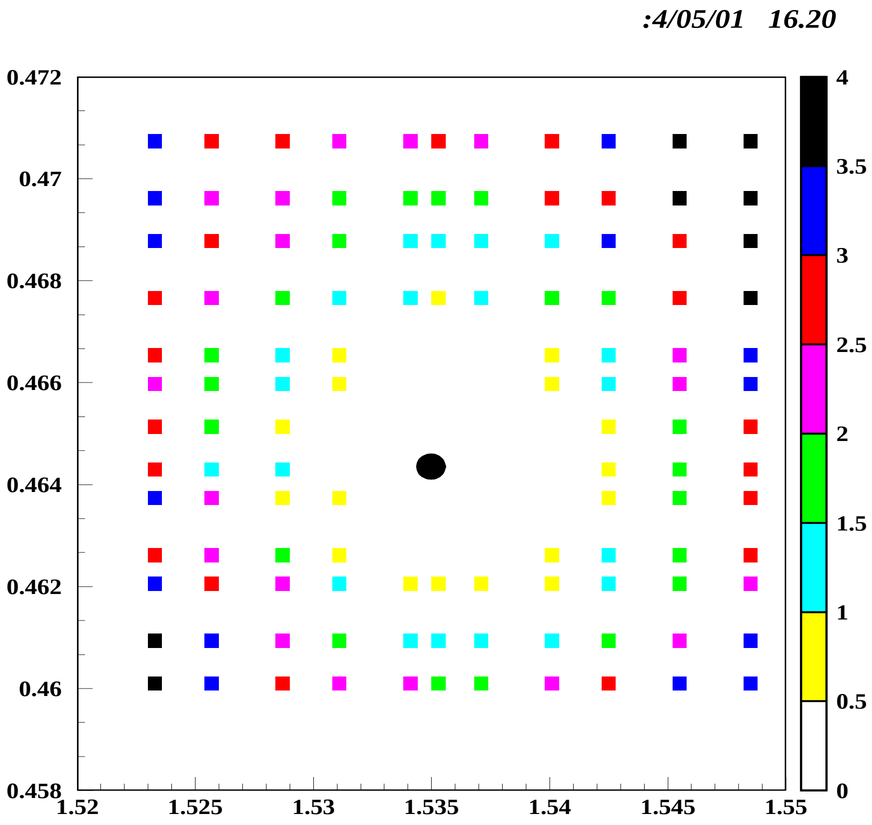
Advantages:

1) Convergence of the fit;

2) Check of the likelihood behaviour in the region around the minimum.

Example:

MC Pure Signal (B^0 Signal+Resonant B^+):



143 fits performed in the region (1.52 ps $< \tau <$ 1.55 ps; 0.455 ps$^{-1} < \Delta m <$ 0.475 ps^{-1})

~ 1 night

$\Delta \mathrm{Log}\mathcal{L} = \mathrm{Log}\mathcal{L} - \min(\mathrm{Log}\mathcal{L})$

Min(Log$\mathcal{L}$)=332532.7 at (τ, Δm)= (1.5342, 0.46425)

(1.5356, 0.46425)

(1.5356, 0.46500)

(1.5370, 0.46425)

(1.5370, 0.46500)

"Standard Fit" results obtained starting from the two "extreme" points:

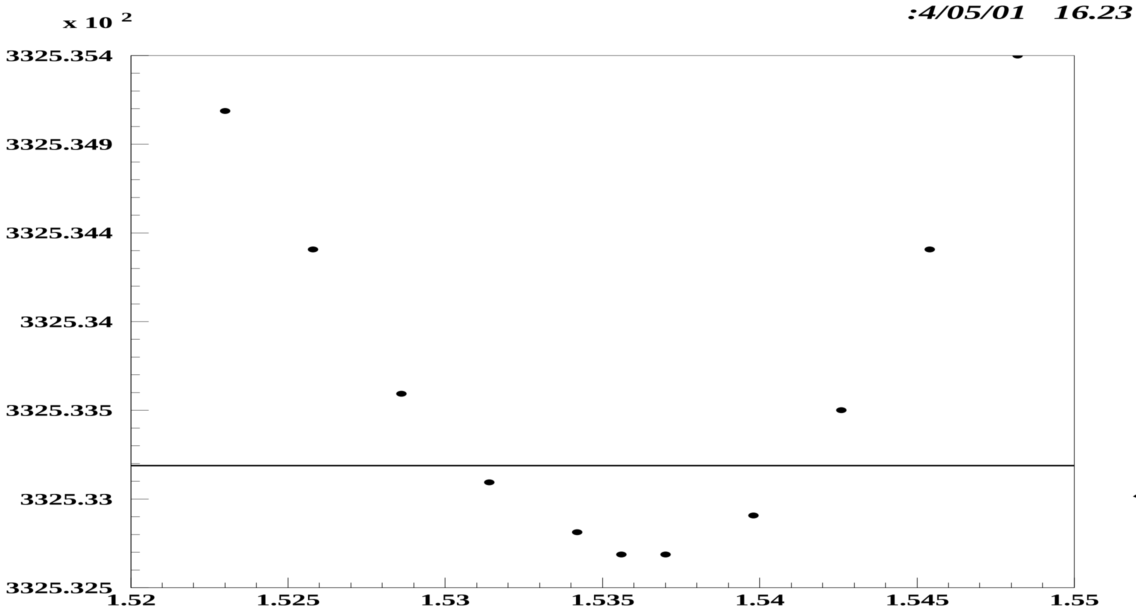
(τ, Δm)=(1.5370, 0.46500)

$\longrightarrow$ (1.5368 $\pm$ 0.0049; 0.4648 $\pm$ 0.0021) Log$\mathcal{L}$=332532.66

(τ, Δm)=(1.5342, 0.46425)

$\longrightarrow$ (1.5342 $\pm$ 0.0039; 0.4642 $\pm$ 0.0024) Log$\mathcal{L}$=332532.71

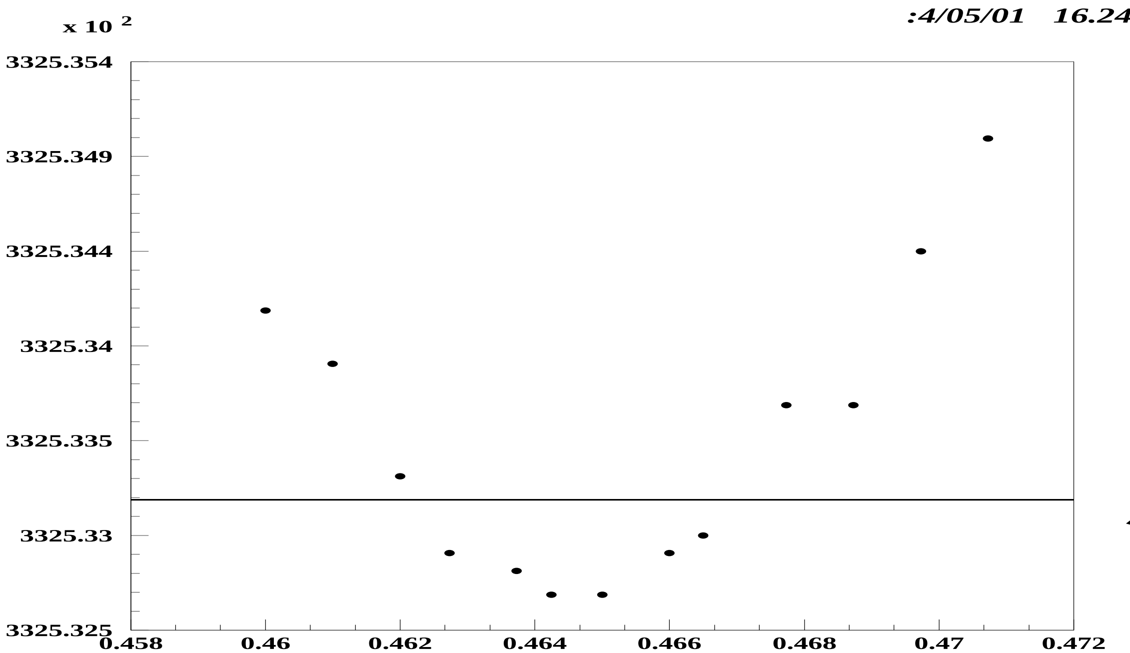
To be chosen according to Log$\mathcal{L}$ value (...and maybe assuming a fit systematic according to $\delta\Delta$m, $\delta\tau$)



Fit Statistical Errors in agreement with Log$\mathscr{L}$ behaviour around the minimum

τ=1.5368 ± 0.0049 ps

Min(Log$\mathscr{L}$)+ 0.5



Δm=0.4648 ± 0.0021 ps^{-1}

Min(Log$\mathscr{L}$)+0.5

Study of the Analysis Bias

"Old" Problem:
From the fit to the MC Pure Signal we observe a bias (BAD 287, v11):

$\delta\Delta m = -0.006 \pm 0.001$ ps^{-1}

→ The mixed event fraction is underestimated:

$$\delta\chi_d = -0.003 \pm 0.001$$

But...

...The fraction of MC truly mixed events when just a single π^*l pair/event is reconstructed is correct!

$$\chi_d = 0.1744 \pm 0.0005 \text{ (w.r.t. 0.174 MC truth)}$$

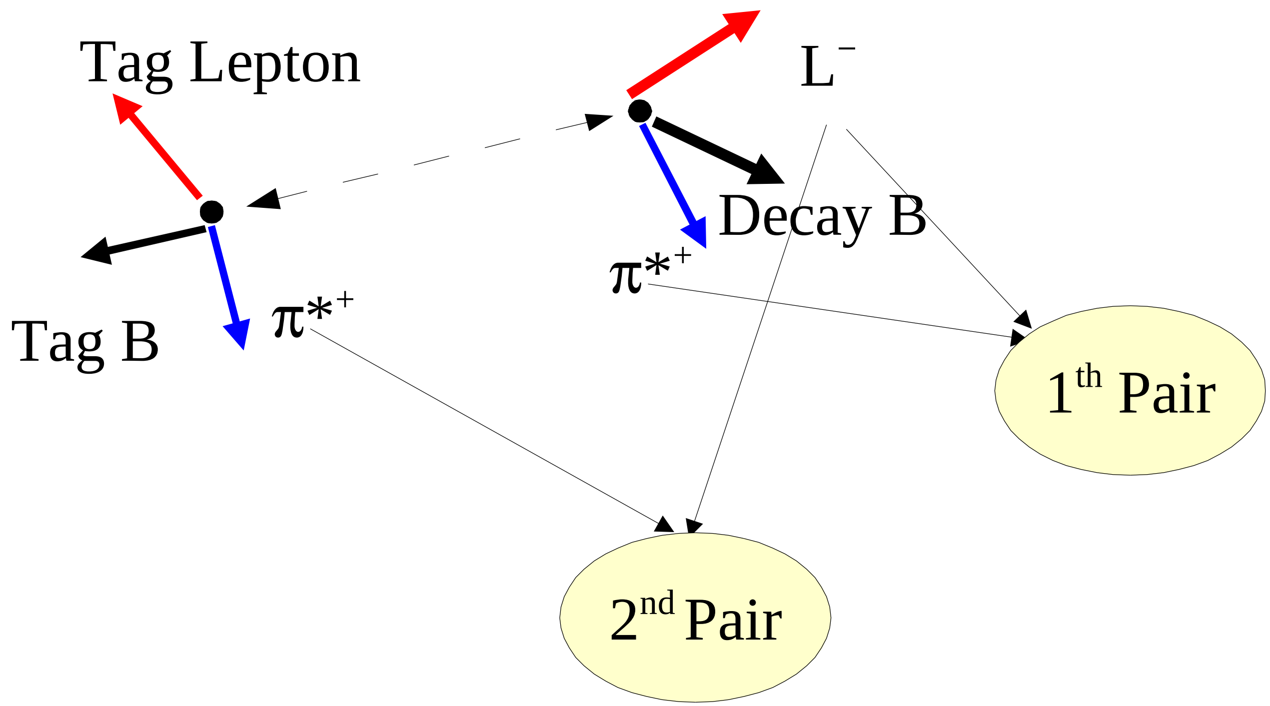
→ Bias induced by the events with more than one π^*l pair...

...Why?

In the case of mixed events with two D* from different Bs, a second π^* l "true" pair can be reconstructed with the Right Charge Correlation.

If the 2nd pair is chosen by the selection algorithm, the event can fall in the Side Band region or it can be classified as "Combinatorial Background"

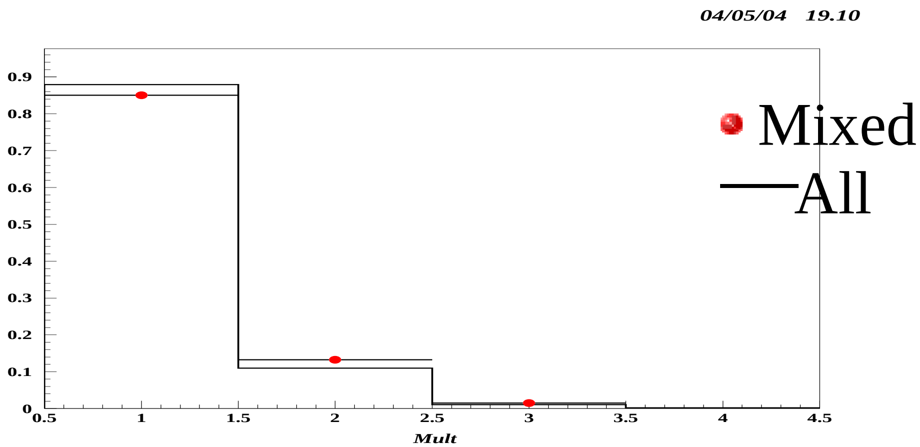
→ Reduction of the measured mixed event fraction.

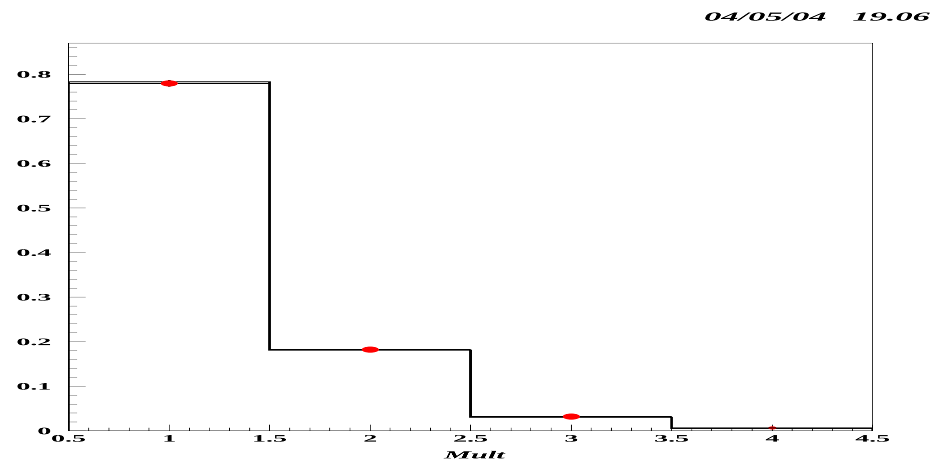


• Number of π*l candidates / event (Signal MC)

Right Charge Correlation

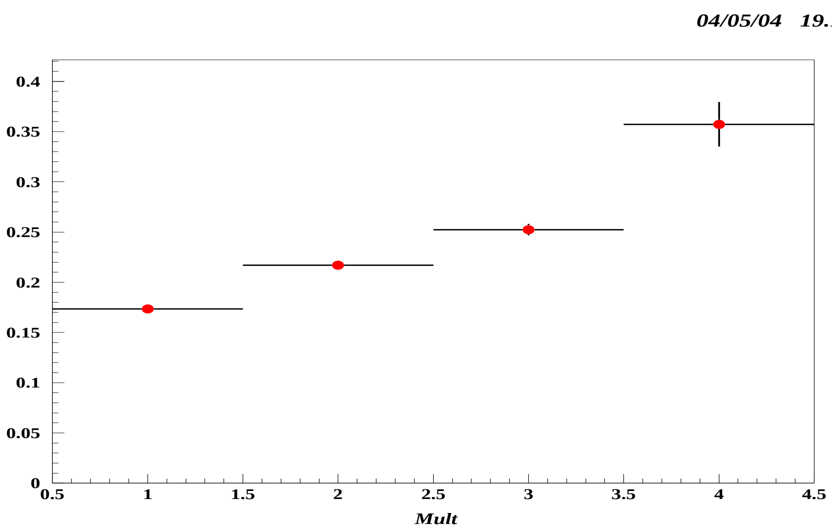
R.C + Wrong Charge Correlation

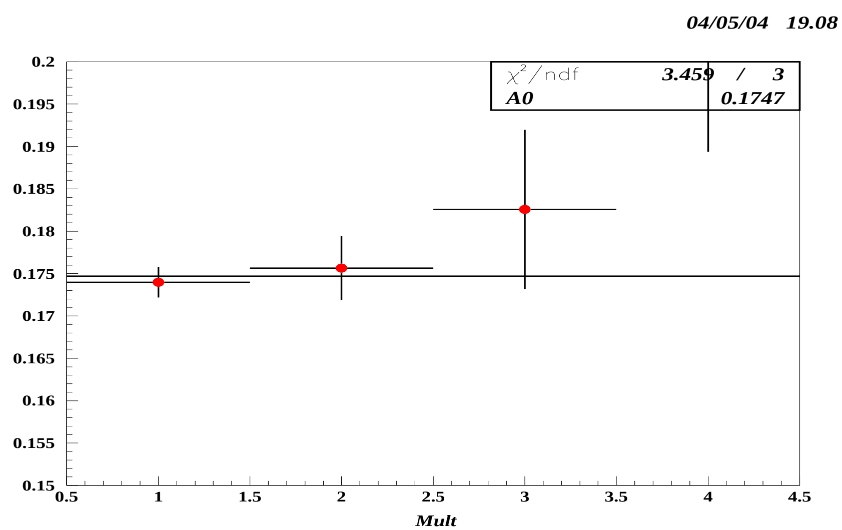




- R. C. Mixed event sample shows higher fraction of multiple candidates
- Fraction of Mixed Events:

Strong χ_d dependence vs number of reconstructed candidates





Mixed Event Fraction χ_d vs Event Tag

Event Tag:

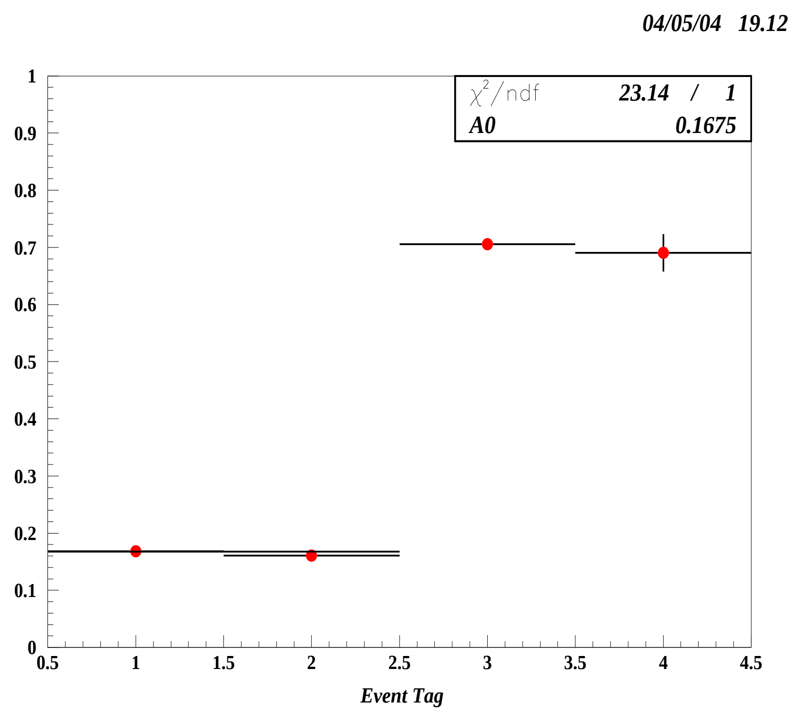
1: just one π^* l candidate;

2: one additional π^* l candidate (π^* not from D*);

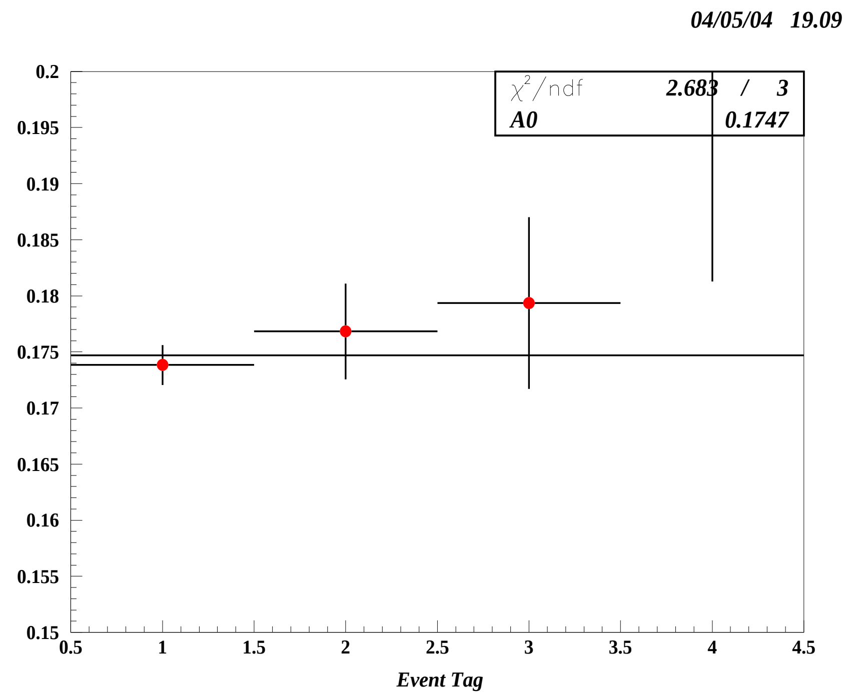
3: one additional π^*l candidate (π^* from D*);

4: two or more π^* l candidates (at least one from D*)

Right Charge Correlation



R.C + Wrong Charge Correlation



How to manage this effect on the data? Three possible strategies:

1) Use only the event sample with just one π^*l candidate,
(ε~80% for R.C+W.C);

2) Determine the fraction of events with more then one D* in Data and MC,
tune the simulation and compute the expected bias;

3) Use two separate analysis streams for the two subsamples:
−single candidate;
−two candidates from D* from different Bs :
"golden events" with two $B \rightarrow D^* l \nu$ and lowest dilution

... Approach to be chosen...

Strategy n. 2:
Determination of the Fraction of Events with more then one D* (Data vs MC)

1) Compute the ratio

$R=N(D^* \rightarrow (K\pi)\pi^*)_{\text{Side Band, Wrong Charge}} / N(D^* \rightarrow (K\pi)\pi^*)_{\text{Mass Band, Right Charge}}$

independent from efficiency/ mixing effects

2) Rescale the MC to the DATA result
3) Compute the expected bias.

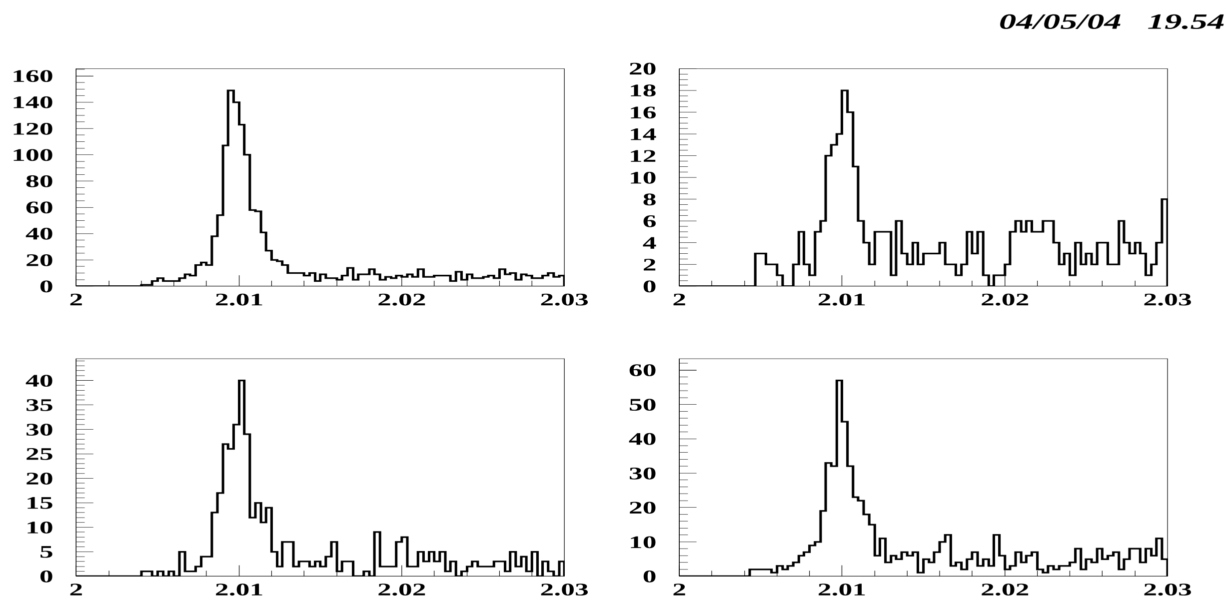
$$\mathbf{D^* \rightarrow (K\pi)\pi^*}$$

Mass Band
Right Charge

Side Band
Right Charge

Mass Band
Wrong Charge

Side Band
Wrong Charge



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Work going on...(Franco)

Still missing items:

- Use Gexp model for cascade decays
- Alignment, boost, beam spot (Michele at work)
- Different cut in the likelihood−identification variable
- Toy (Marcello already started)
- Bad 287 updated in ~1 week