More on Wrong Sign D^0 Decays

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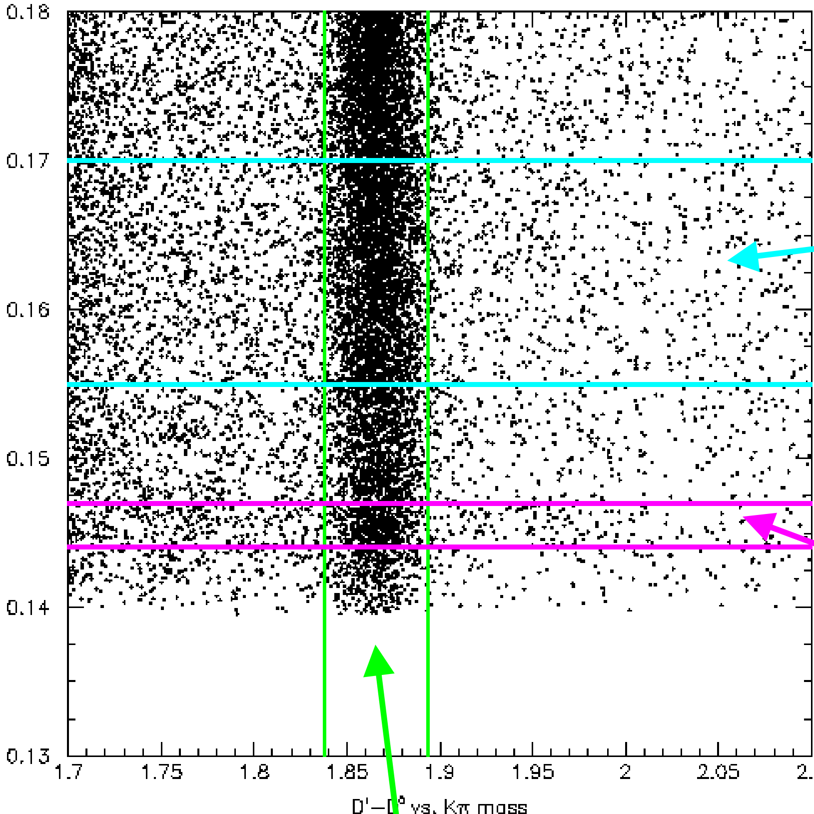
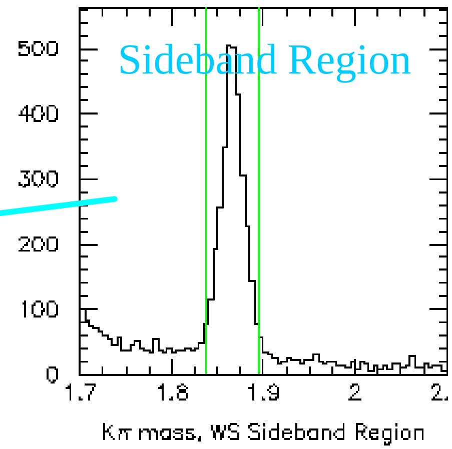
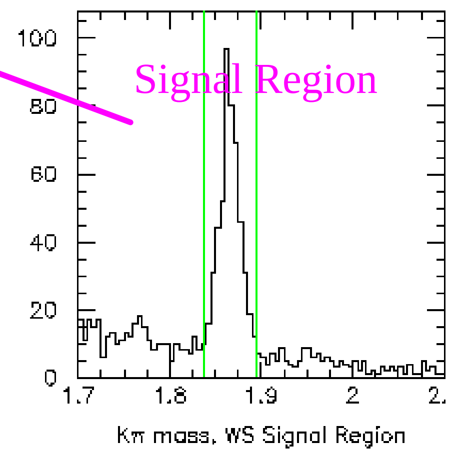
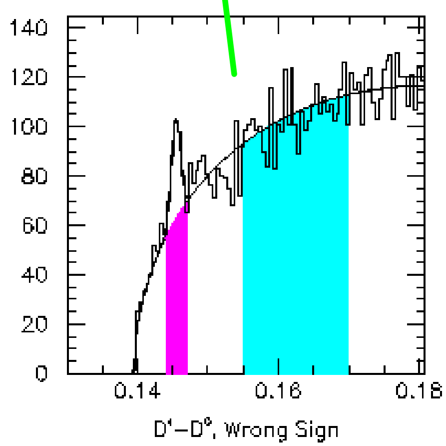
From Last Time: A Sideband Subtraction Method







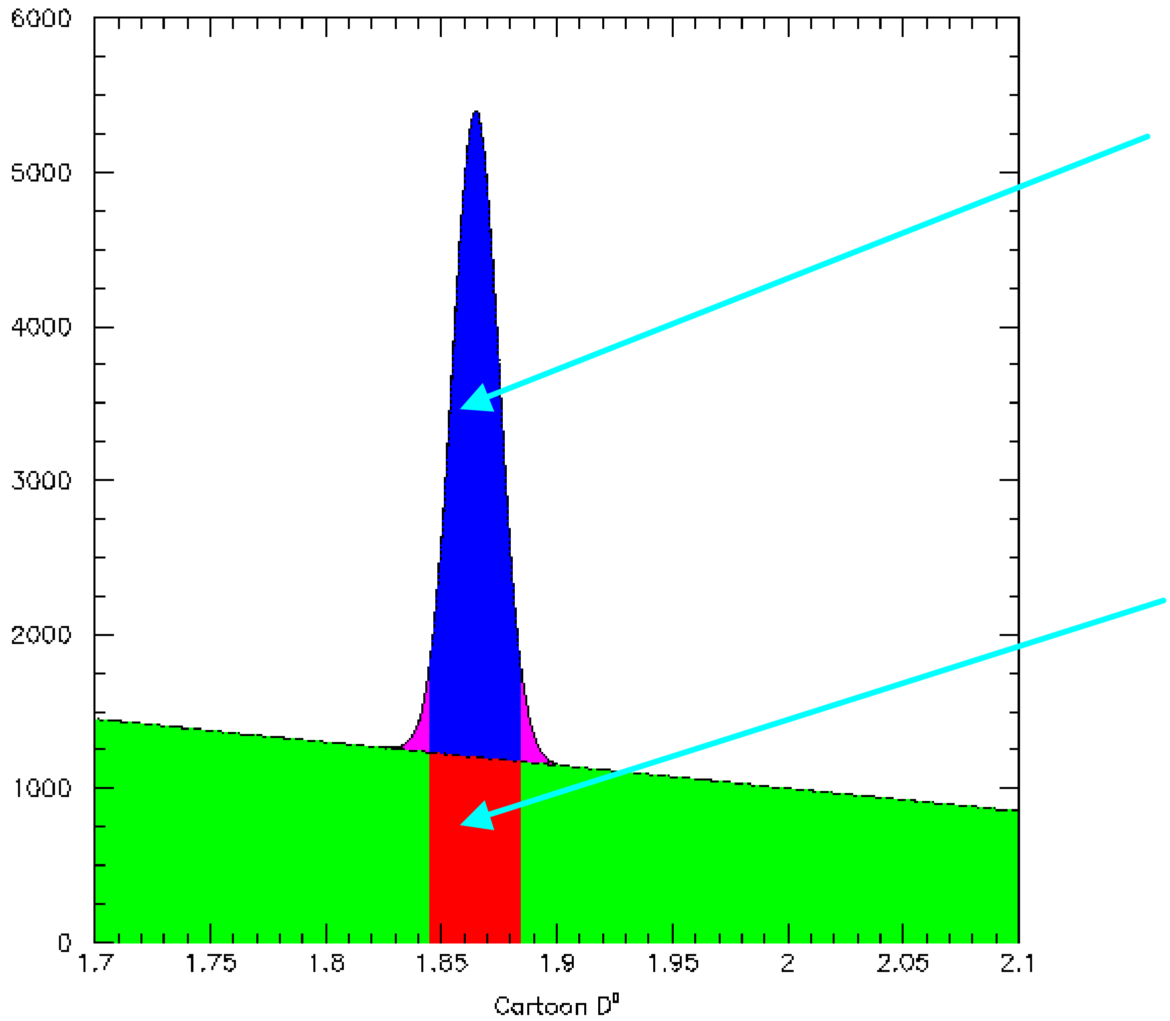


Use a sideband from the D*-D^0 mass difference plot…

to subtract off the background D^0 from the signal region.

$$Yield_{WS} = Yield_{SR} - Yield_{SB} \times Ratio_{BGs}$$

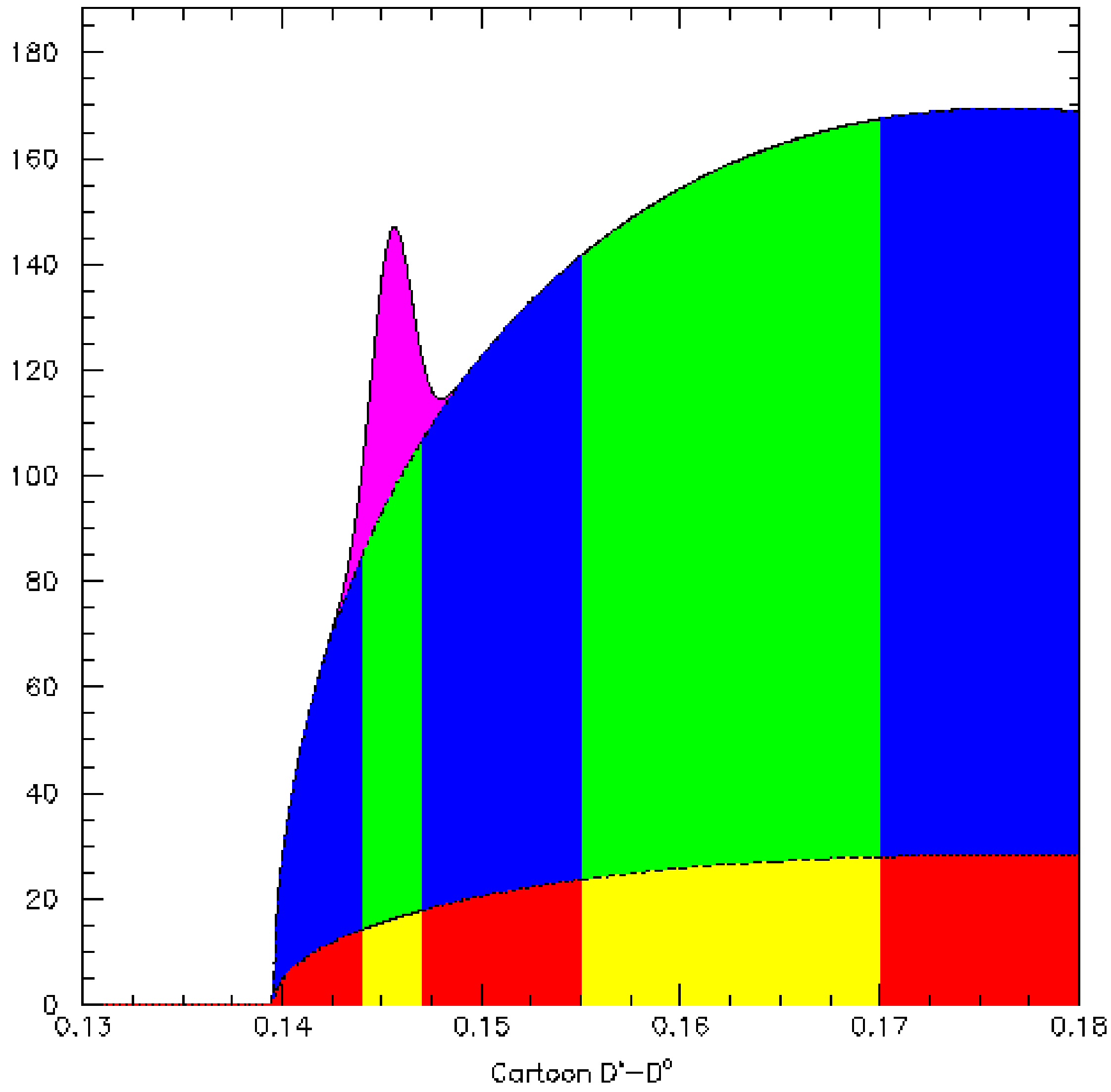
Remember: There are Two Types of Background Under D*



Real D^0 **g** $K\pi$

Background
Under D^0

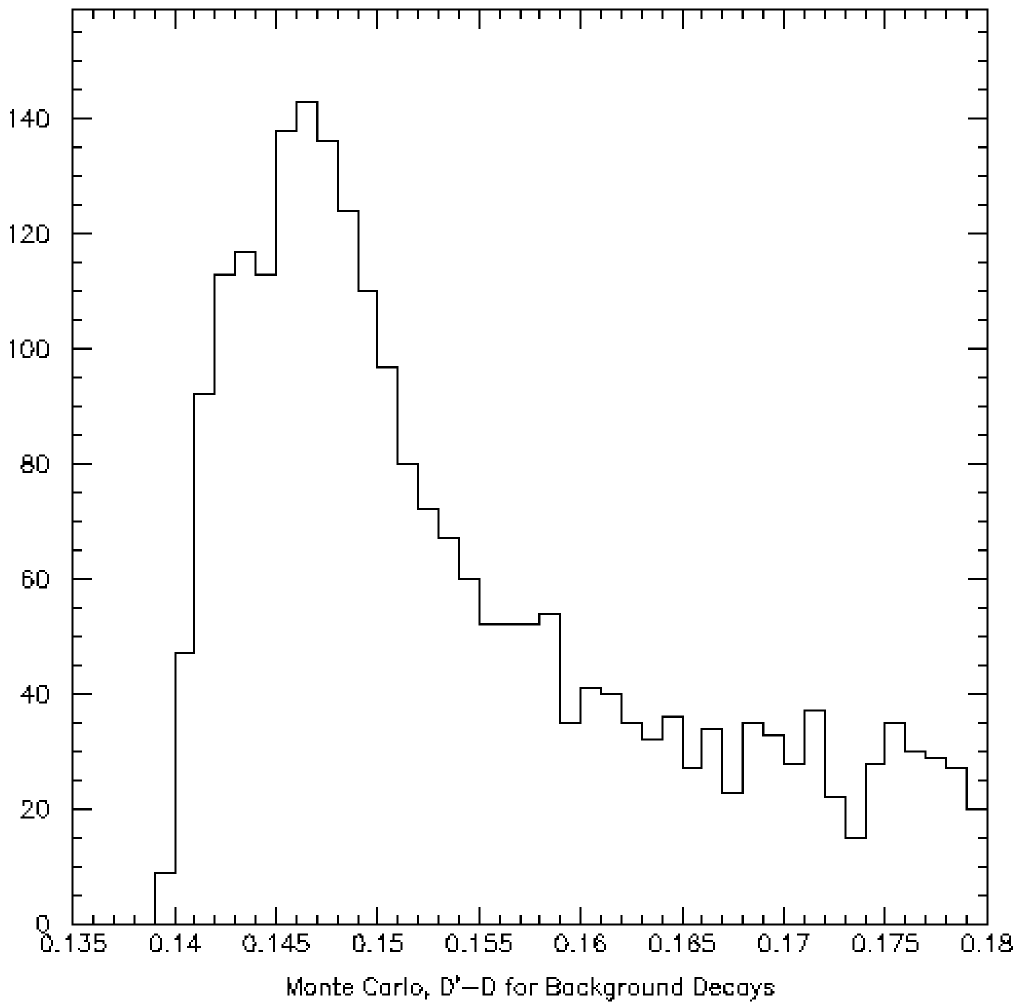
Sideband Subtraction Hinges on the Ratio of Background Types



If the ratio of background types is the same in the sideband region as it is in the background portion of the signal region then the D^0 yield subtraction is safe.

But, it turns out that the ratio is not the same under the signal!

D* Backgrounds are Enhanced in Signal Region

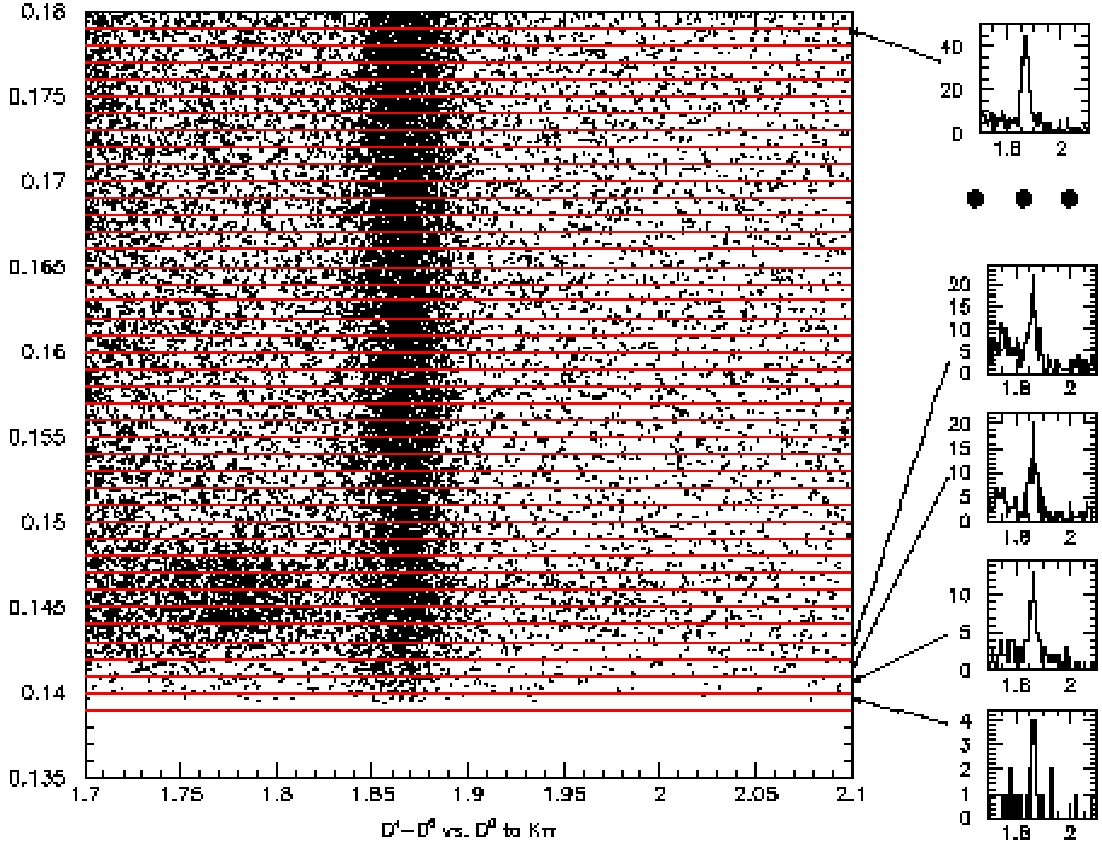


Look at D*'s from a monte carlo simulation of D^0 decays with $K\pi$, KK and $\pi\pi$ modes excluded

The dominate modes are doubly mis-IDed:

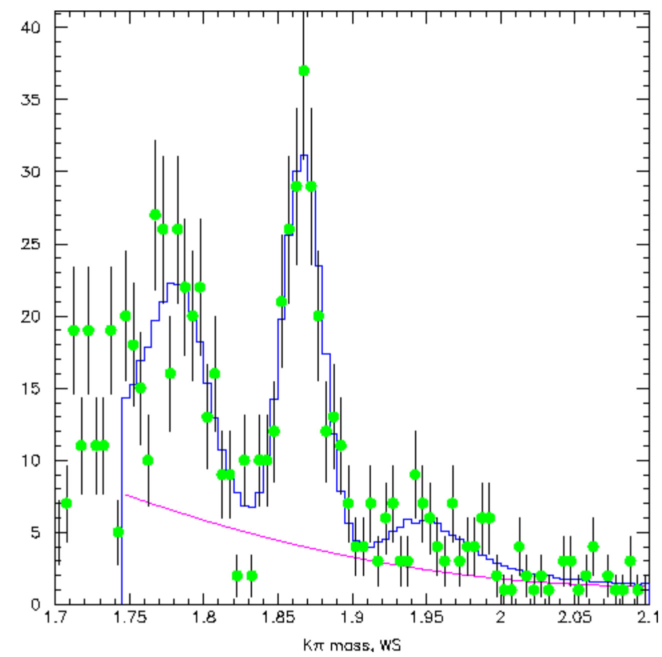
- D^0 **g** $K^-\pi^+\pi^0$
- D^0 **g** $K^-\mu^+\nu$
- D^0 **g** $K^-e^+\nu^0$

The Modified New Method



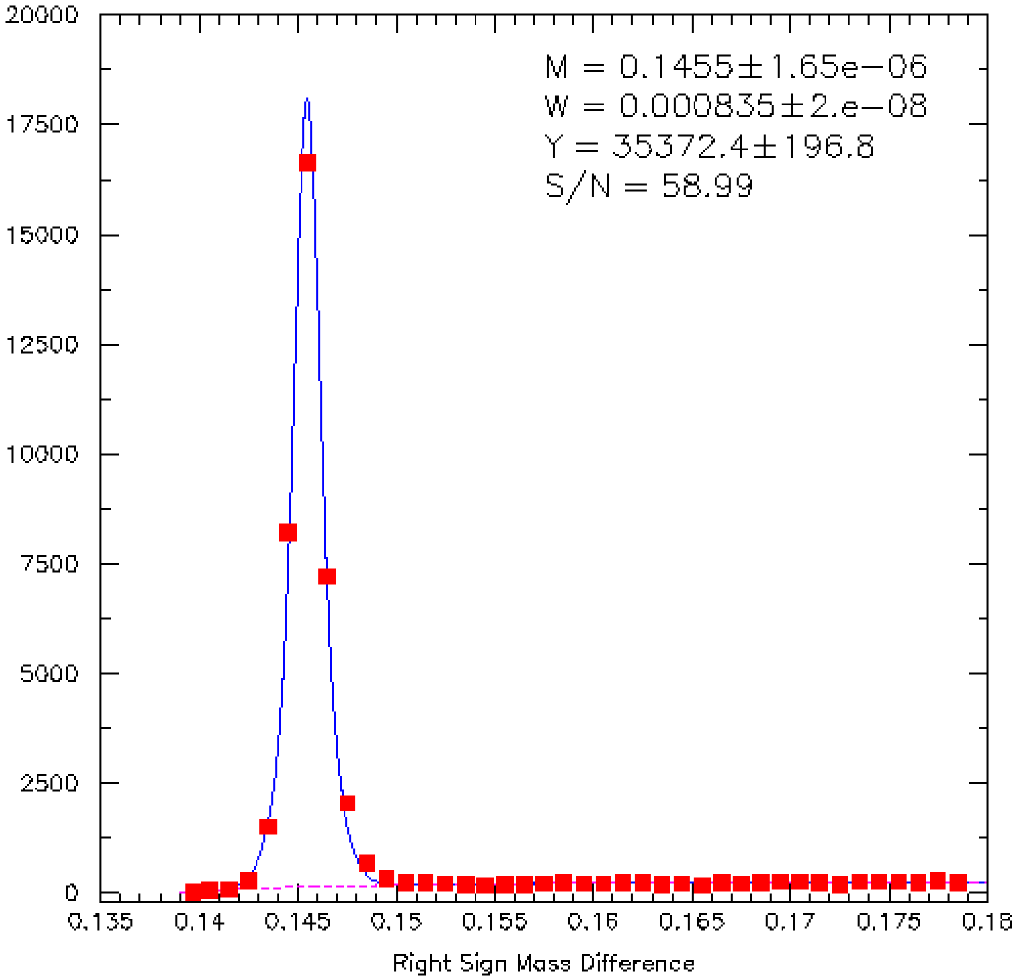
Fit D^0 in bins of mass difference and replot fitted yields against mass difference.

An Example D^0 Plot Fit



Fit using monte carlo reflection shapes for KK and ππ, a degree 2 polynomial background and a gaussian for the D.

And the Mass Difference Plot Looks Like…



Here all the background is due to D g Kπ with a random soft π tag.

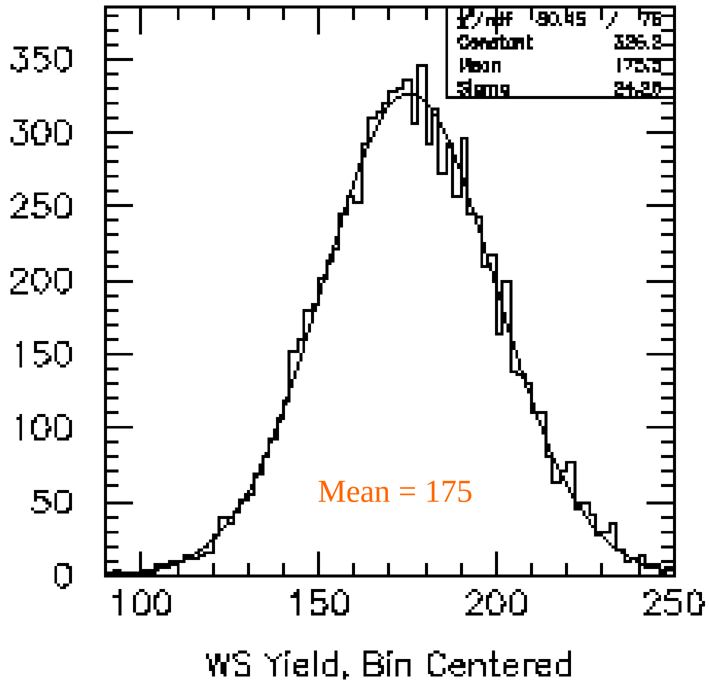
You get an second plot for the wrong sign.

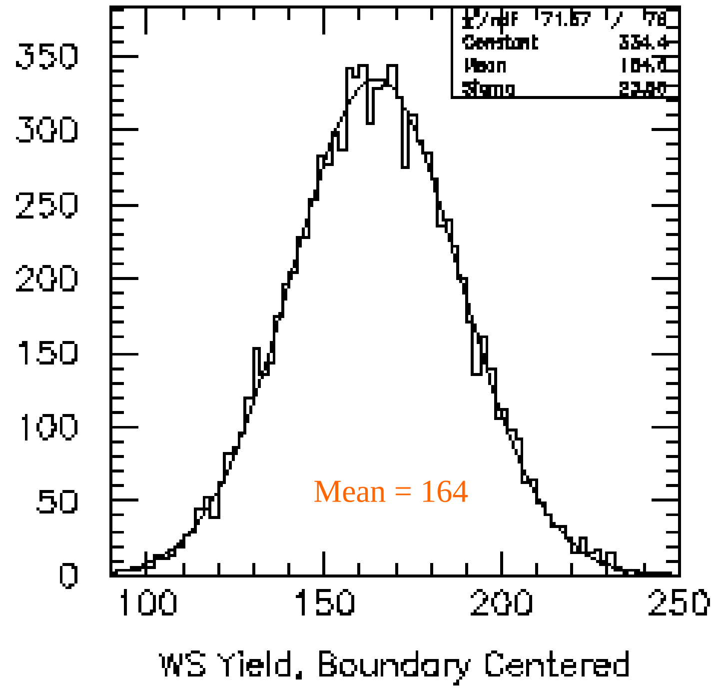
The signal is fit to two gaussians and the background is fit to:

$$A(x-m_p)^{1/2}+B(x-m_p)^{3/2}$$

A Subtlety of the Fit

I found a large systematic dependence of the yield to the binning. (Yikes!)





Mini monte carlo with 10,000 throws and 163 WS events generated.

Solution: Integrate fit function over the bin instead of calculating the function at the bin center.

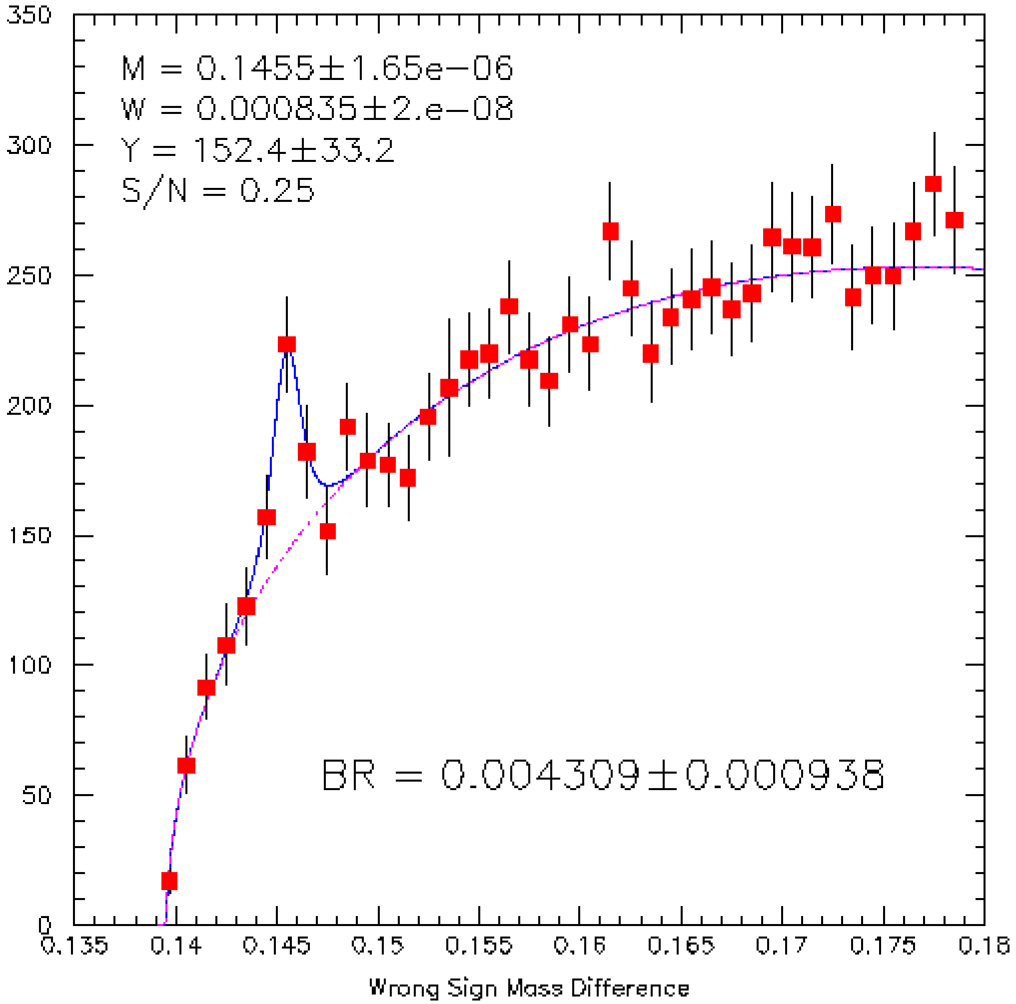
Baseline Cuts

- $L/\sigma > 5$
- Isolation of the Primary (Iso1) < 10%
- Multiplicity of Primary > 2
- Primary Vertex in Target > -1σ
- Confidence Level of π or K as μ < 1%
- Functional Kπ Asymmetry:

$$p_D > -160. + 280 \times Asym$$

- Pionicity > -2.
- Kaonicity > 0.5
- Pionicity+Kaonicity > 8, in a 4σ window about πK mass

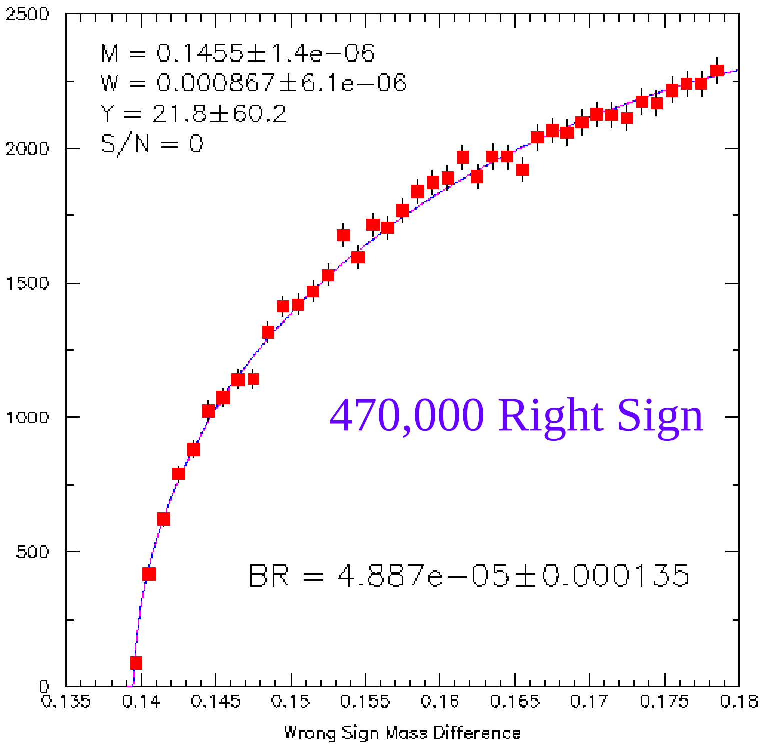
And The Branching Ratio is…



A measurement of the branching ratio 4.6σ from zero.

Is this Method Double Mis-ID Proof?

From the monte carlo…



The monte carlo indicates that we expect fewer than 2 Double mis-ID events to feed through.

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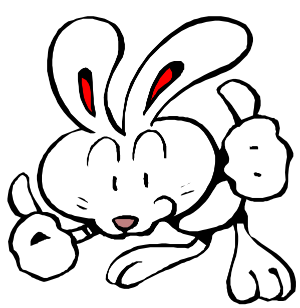
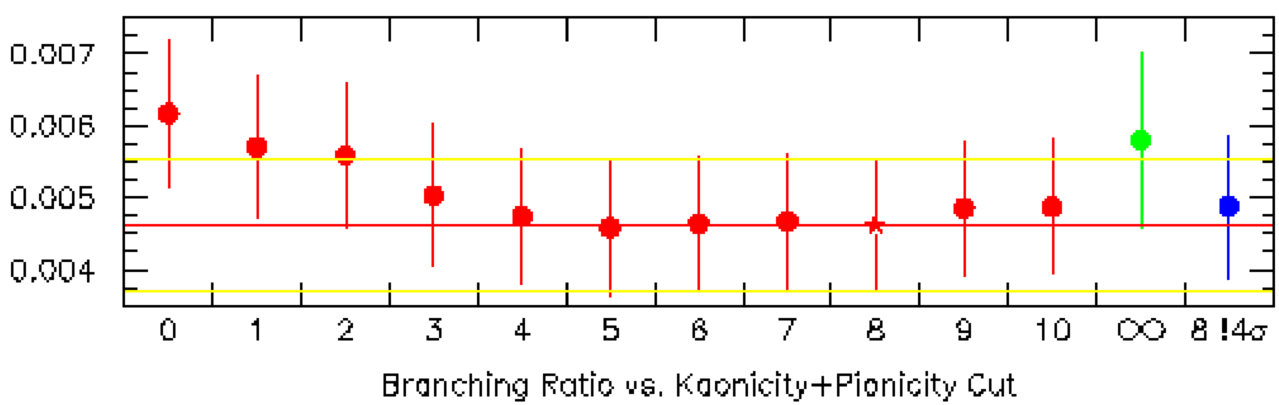
The branching ratio is stable as the double mis-ID cut is evolved.



Yes!



Preliminary Systematic Studies

Fit Variants:

Variant	Yield RS	Yield WS	BR (10^{-2})	Error (10^{-2})
Nominal	35452.9	154.4	0.4355	0.0917
Count D's	35363.0	156.6	0.4428	0.0887
P1 BG	35542.4	155.9	0.4369	0.1040
Shift Bins	35542.4	141.5	0.3980	0.0948
Shift Refects	35482.2	153.3	0.4321	0.0903
No $\pi\pi$	35583.3	139.9	0.3933	0.0909
No KK	35475.6	5.8	0.0165	0.0870

The total fit variant systematic is 0.022x10^{-2}

The systematic from just shifted bins is 0.027x10^{-2}

Conclusion

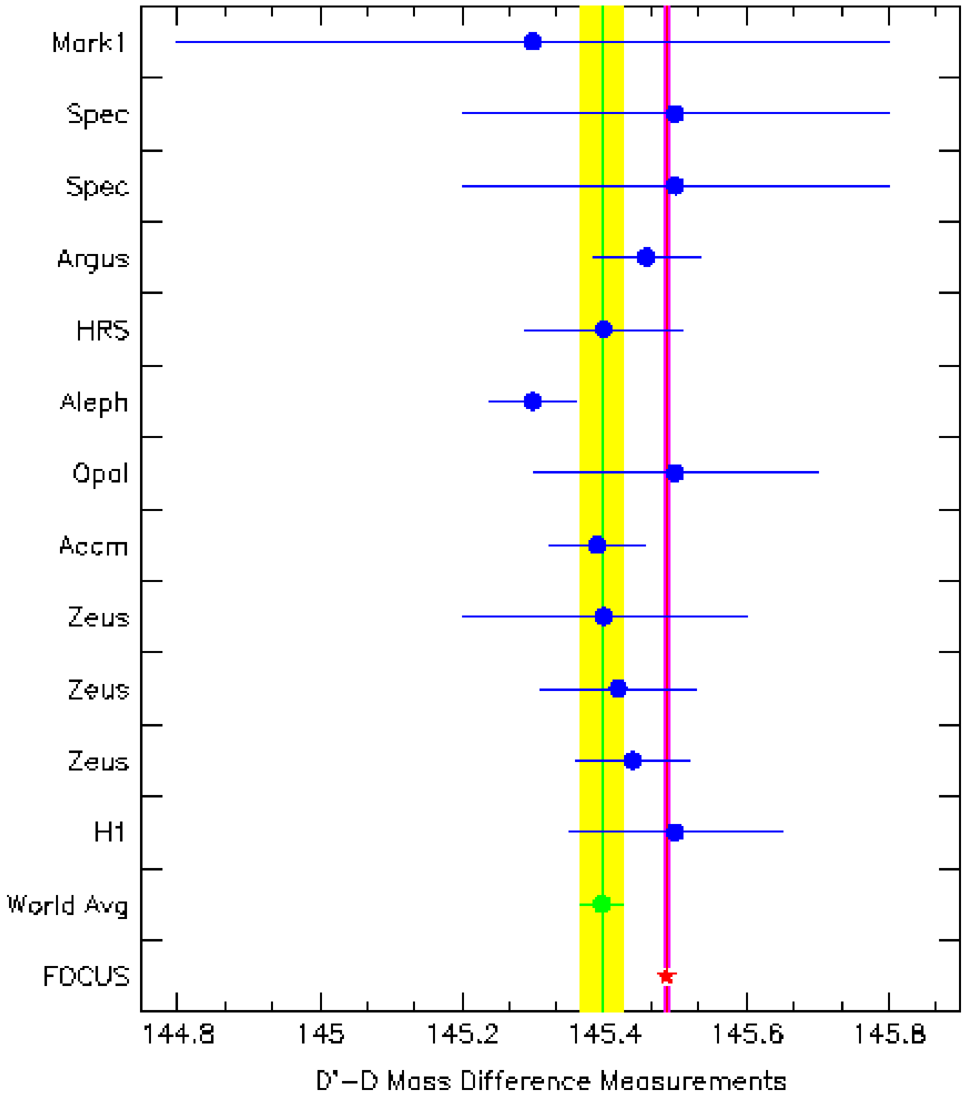
I measure the branching ratio:

$$\frac{D^0 \rightarrow K^+ p^-}{D^0 \rightarrow K^- p^+} = 0.00431 \pm 0.00094 \pm (\geq 0.0005)$$

I expect the systematic errors to be small.

But what does this number mean?

A Little "Go FOCUS!" Pep Talk!



We should not be ashamed to show our D*-D mass difference value.

The PDG98 world average is clearly too low and our value is in good agreement with the spread of existing measurements.