

# $\Lambda_b$ Lifetime Measurement: Mass Fit Update

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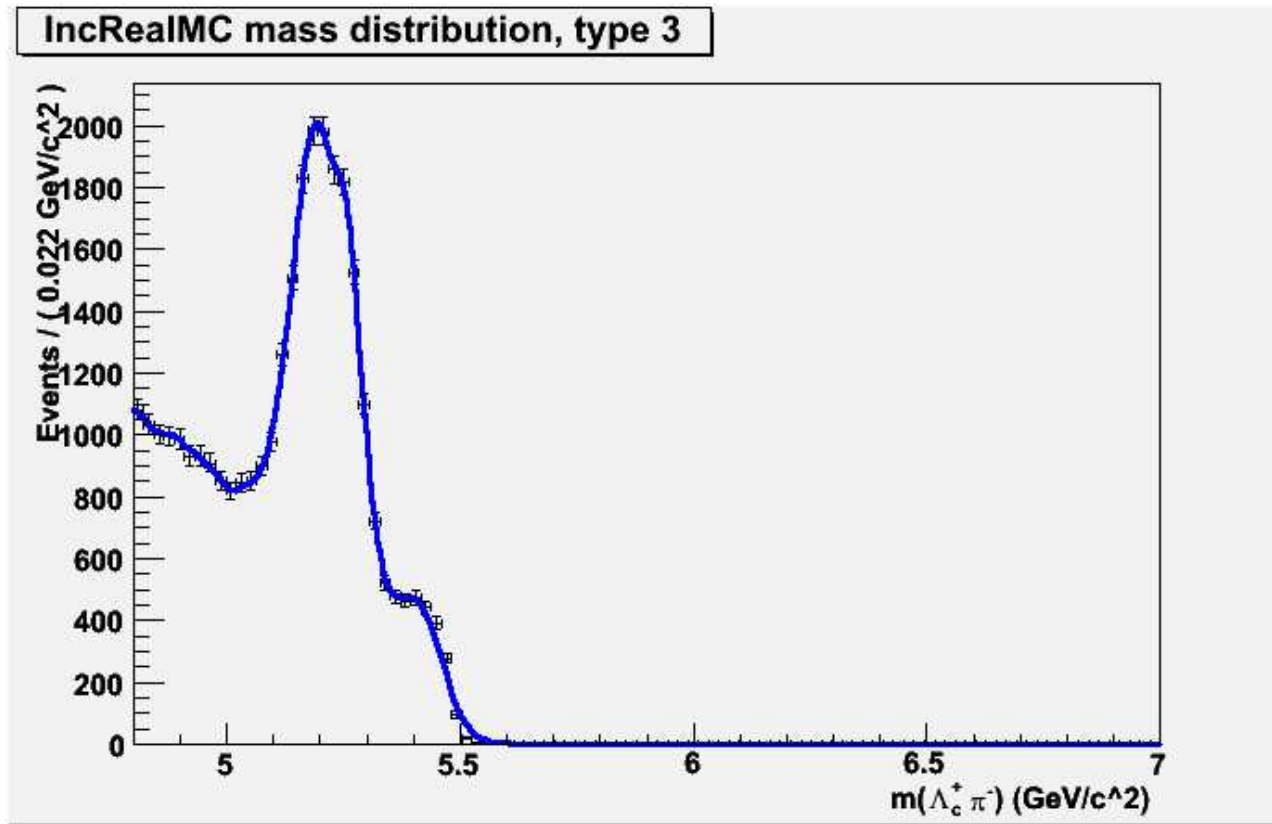
# Introduction

Review: Oct 10, I gave a brief,  $\Lambda_b$  mass fit update.

⇒ Today, I'll show the *final* (at least for now)  $\Lambda_b$  mass fit.

- New  $\Lambda_b$  shape added: (Decouples  $\Lambda_c^{+*}$  decays from  $\Lambda_b$ -other shape)
- Revisit the fit constraints
- The mass fit today
- Plan for  $\Lambda_b$  lifetime measurement

# Old $\Lambda_b$ -Other Template

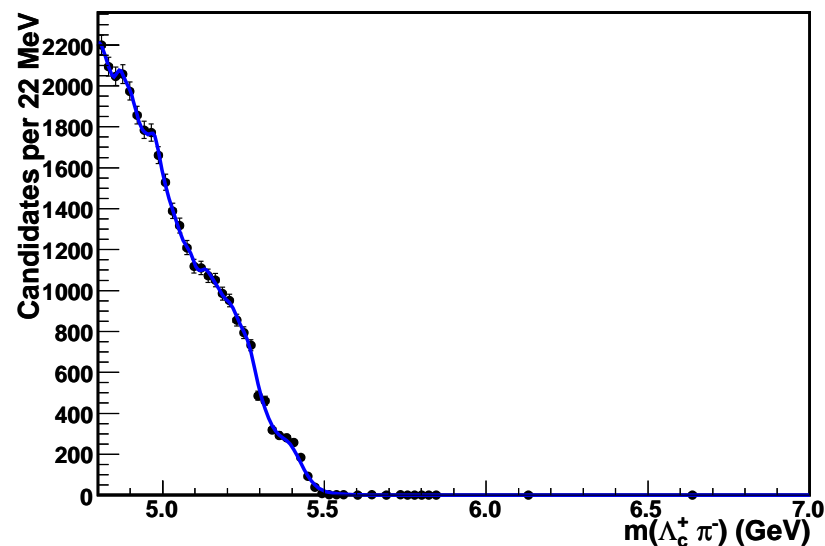
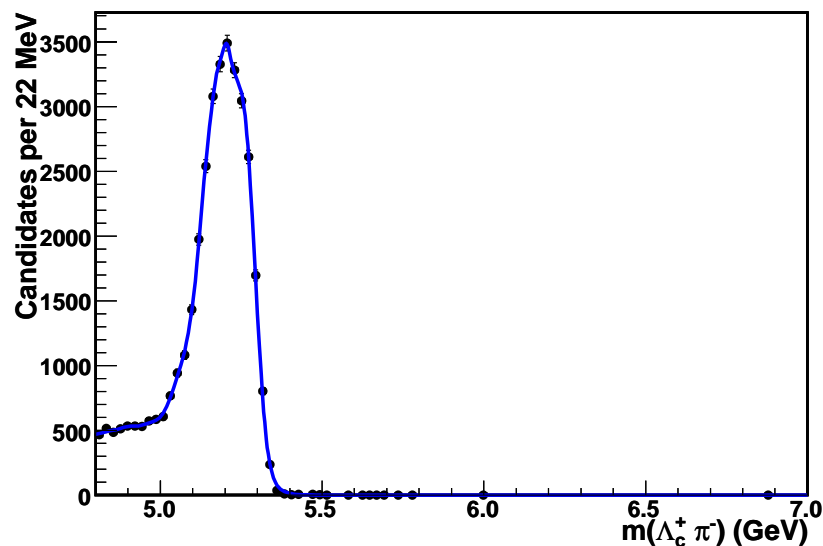


- Separated significant decay modes from the soup

- $\Lambda_b \rightarrow \Lambda_c \pi$
- $\Lambda_b$  four-track
- $\Lambda_b \rightarrow l \bar{\nu}_l X$
- $\Lambda_b \rightarrow \Lambda_c K$
- $\Lambda_b \rightarrow \Lambda_c \rho$
- $\Lambda_b \rightarrow \Sigma_c \pi, \Sigma_c^* \pi$

⇒  $\Lambda_b$ -other template still has some structure  
⇒ Add yet another shape...

# New $\Lambda_b$ -Other Template!



$\Rightarrow \Lambda_b$ -bump consists mostly of  $\Lambda_b \rightarrow \Lambda_c^* \pi$  decays.

many hadronic branching ratios are basically educated guesses

we have a \*reconstructed\*  $\Lambda_b \rightarrow \Lambda_c^* \pi$  peak

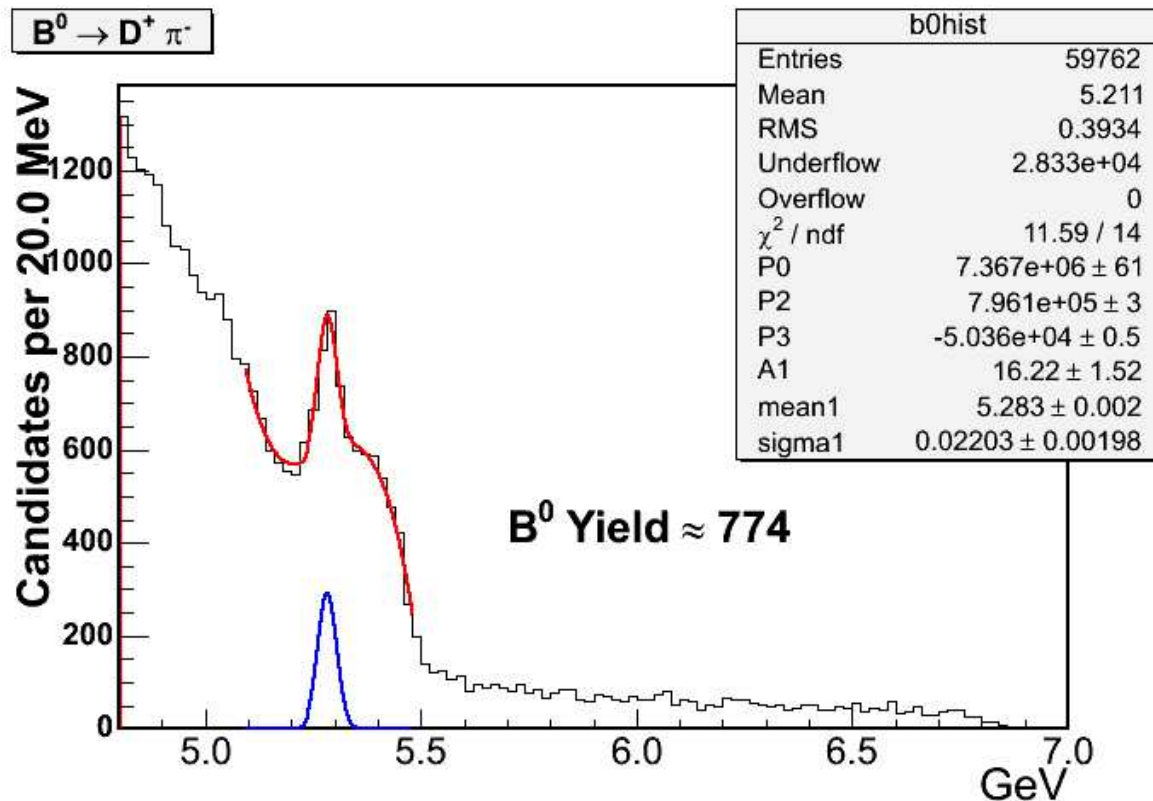
$\Rightarrow \Lambda_b$ -other now allowed more flexibility in the fit

# Mass Fit Constraints

- All shapes floating in fit - Constraints needed for fit stability.
- Constraints also reflect the underlying physics.
- Two significantly improved/changed constraints are:
  - Number of  $B$  four-track events.
  - Total number of baryons.

# Counting $B^0$ candidates in the data

Exchange  $\pi$  for  $p$  mass in  $\Lambda_c \rightarrow pK\pi$  decay: Reconstruct  $B^0$  decays in data.



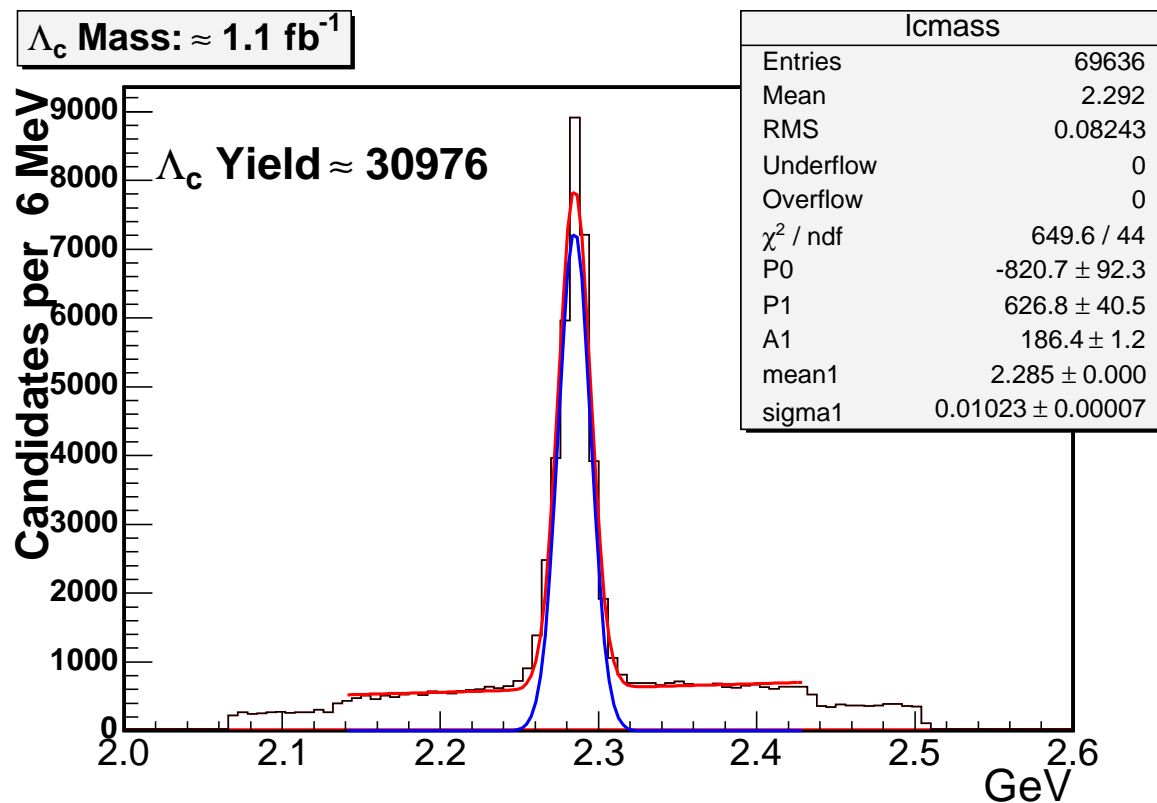
- From Inclusive MC:  $B^0 \rightarrow K\pi\pi\pi$  content of B4prong  $\sim 0.57$

$$\text{Constrain: } N_{B\text{four-track}} = 1356 \pm 125$$

# Constraining Baryons I

- Total contributions from  $B$  mesons relatively well known.
- Total contributions from  $\Lambda_b$  decays is less understood.

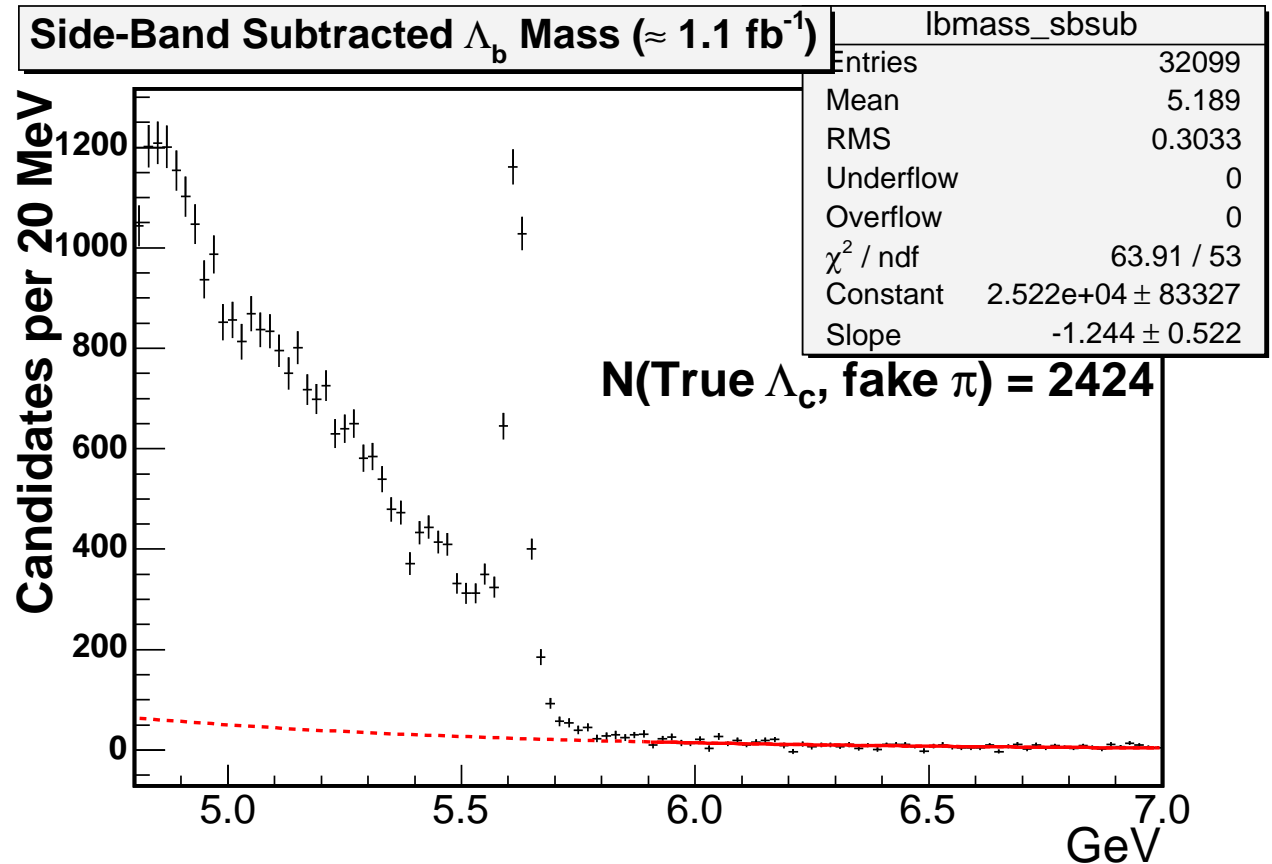
⇒ First, subtract the  $\Lambda_c$  sidebands



# Constraining Baryons II

Next, subtract true- $\Lambda_c$  but fake- $\pi$  combinatorial background.

$\Lambda_b \rightarrow \Lambda_c X; \Lambda_c \rightarrow pK\pi$  remain.



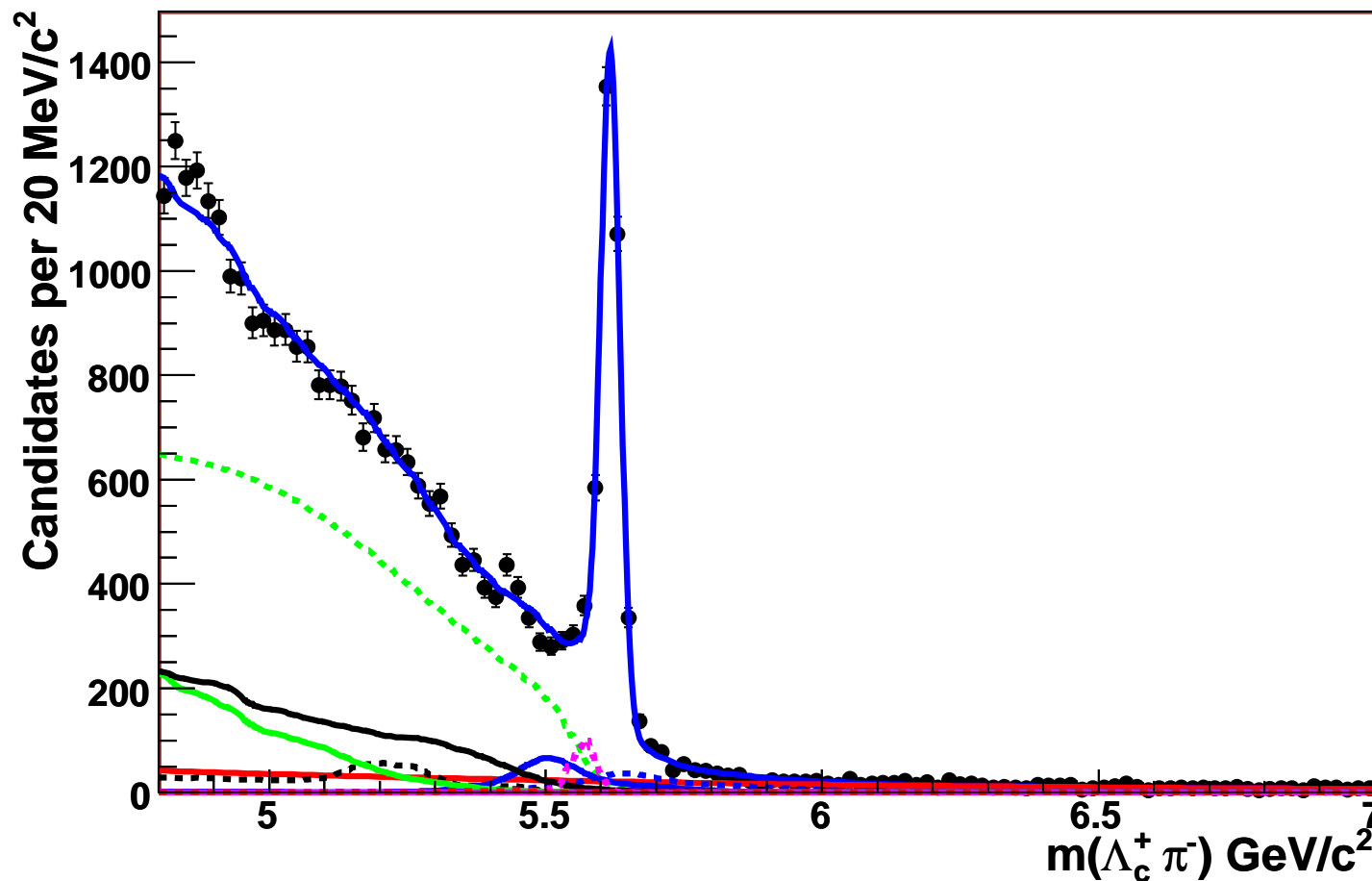
We correct for the  $\Lambda_c$  that do not decay to  $pK\pi$  ( $\sim 4\%$ )  
Assign 5% uncertainty - motivated by unknown  $\Lambda_b$  branching fractions

$$\text{Constrain: } N_{baryons} = 28,272 \pm 1,414$$

# Old Mass Fit

Reminder of what the mass fit looked like last time

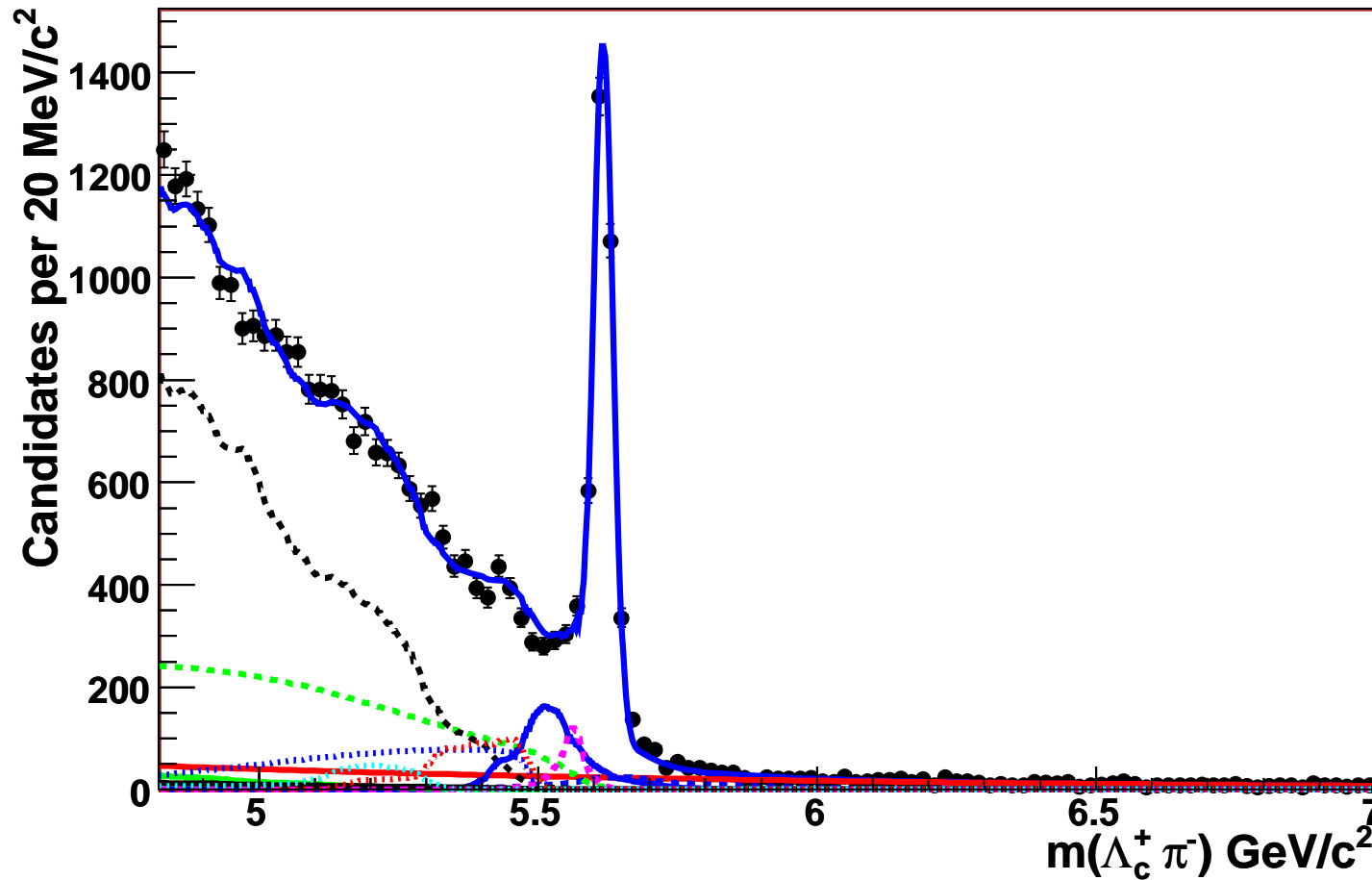
CDF II Preliminary,  $L = 1.1 \text{ fb}^{-1}$



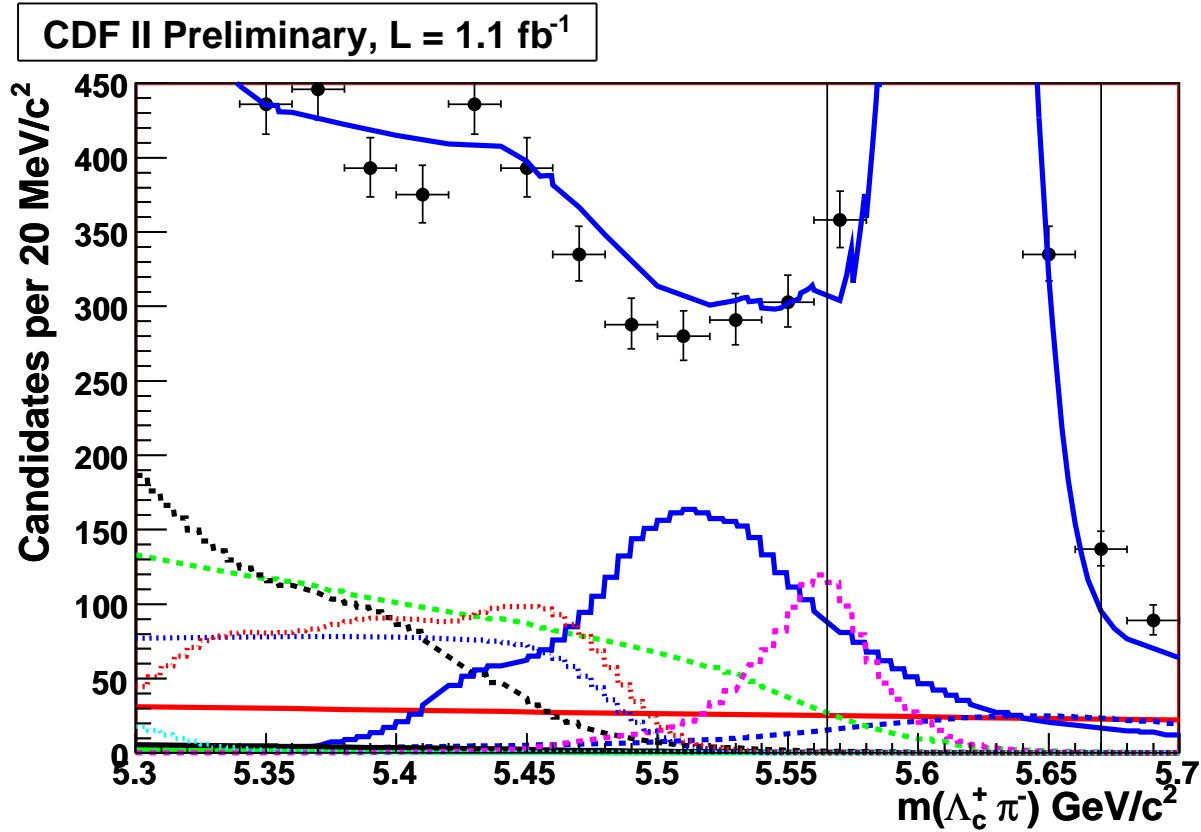
# New Mass Fit

Improved Constraints and new  $\Lambda_b$ -other template.

CDF II Preliminary,  $L = 1.1 \text{ fb}^{-1}$

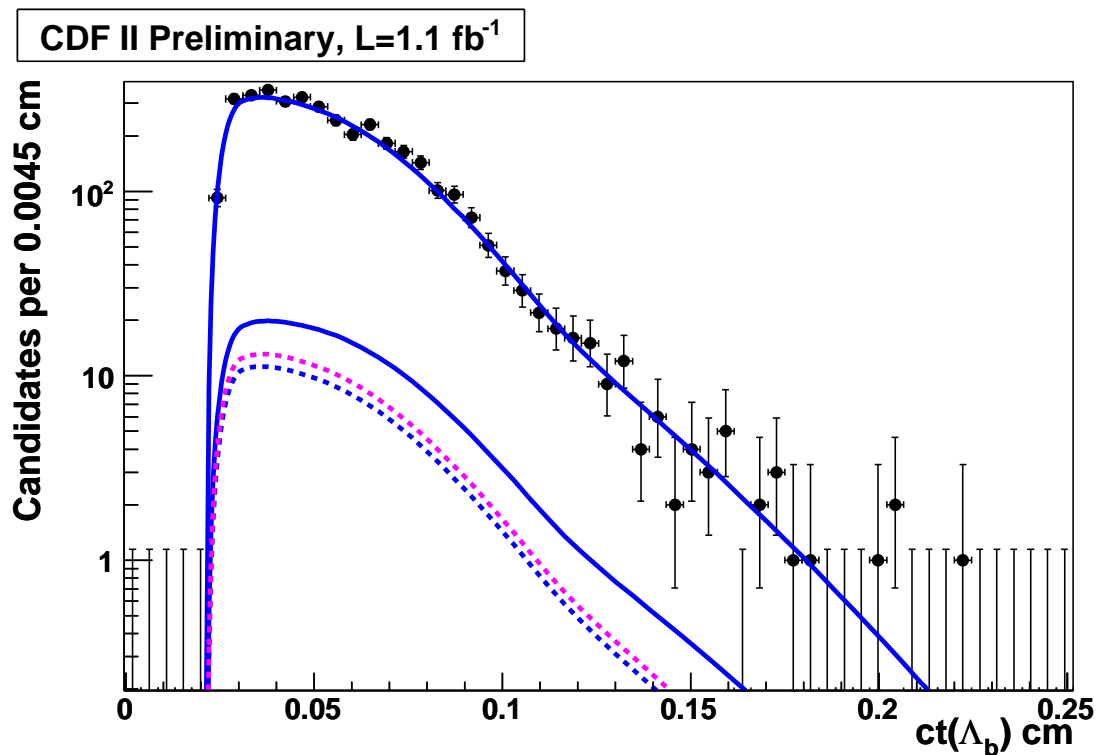


# Mass Fit Details



Normalization	Value
$N_{\Lambda_b \rightarrow \Lambda_c^+ \pi^-}$	2883
$N_{\Lambda_b \rightarrow \Lambda_c^+ K^-}$	135.6
$N_{Combinatorial}$	126.3
$N_{\Lambda_b \text{ Four-Track}}$	116.2
$N_{\Lambda_b \rightarrow l \bar{\nu}_l X}$	45.22
$N_{\Lambda_b \text{ 'misc'}}$	20.5953
$N_{B \text{ Four-Track}}$	220.6
$N_{B \rightarrow l \bar{\nu}_l X}$	0.39
$N_{B \text{ 'Other'}}$	1.78

# A Peek at Blinded $\Lambda_b$ Lifetime Fit



⇒ Still don't quite understand this plot...  
Where is the combinatorial contribution?

# Conclusions

- ⇒ We now have a stable mass fit.
- ⇒ Constraints more firmly based on the physics
- ⇒ Gory details can be found in cdfnote 8395  
(update will be posted this evening)
- ⇒ Lifetime fit looks okay-ish... Still a little debugging to be done.

## Plan and To-Do

- ⇒ Systematics are already underway.
- ⇒ New  $\Lambda_b$  lifetime note is underway cdfnote 8578.
- ⇒ Plan on posting the new lifetime note by the end of the week.
- ⇒ Start (pre) blessing next week.
- ⇒ Hope to wrap-up in time for CKM-workshop (12-16 December).
- ⇒ Need to work on the calendar with the convenors.