

$\Lambda_b^0 \rightarrow \Lambda_c^+ \pi^-$ Lifetime Measurement

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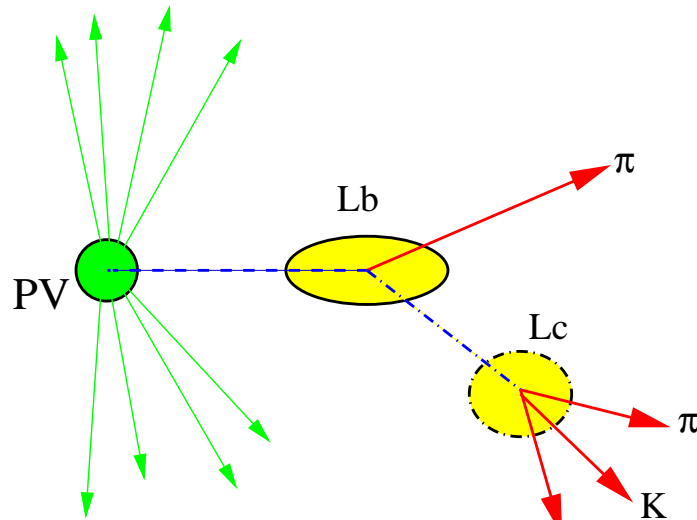
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Outline

- B^0 cross-check mode
- SVT efficiency function studies
- Conclusion and Plan

One-Slide Analysis Overview

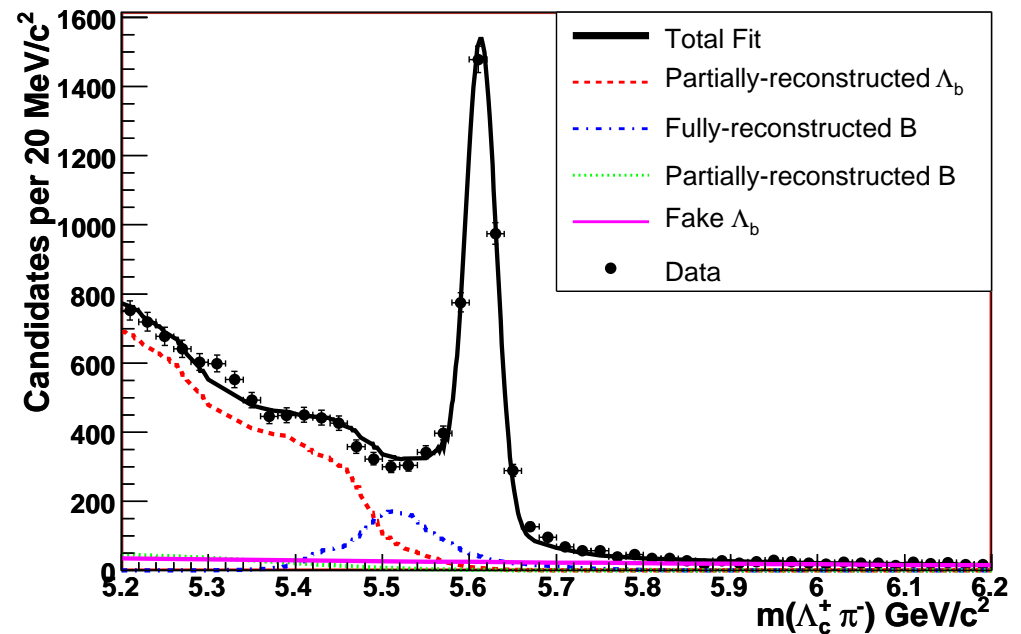


Measure lifetime in fully-reconstructed $\Lambda_b^0 \rightarrow \Lambda_c^+ \pi^-$ decays using SCENA trigger
 $\sim 3000 \Lambda_b^0 \rightarrow \Lambda_c^+ \pi^-$ decays in $\sim 1 fb^{-1}$

- The same mass fit as used in Σ_b analysis

\Rightarrow [cdfnote 8395](#) describes mass fit and sample selection

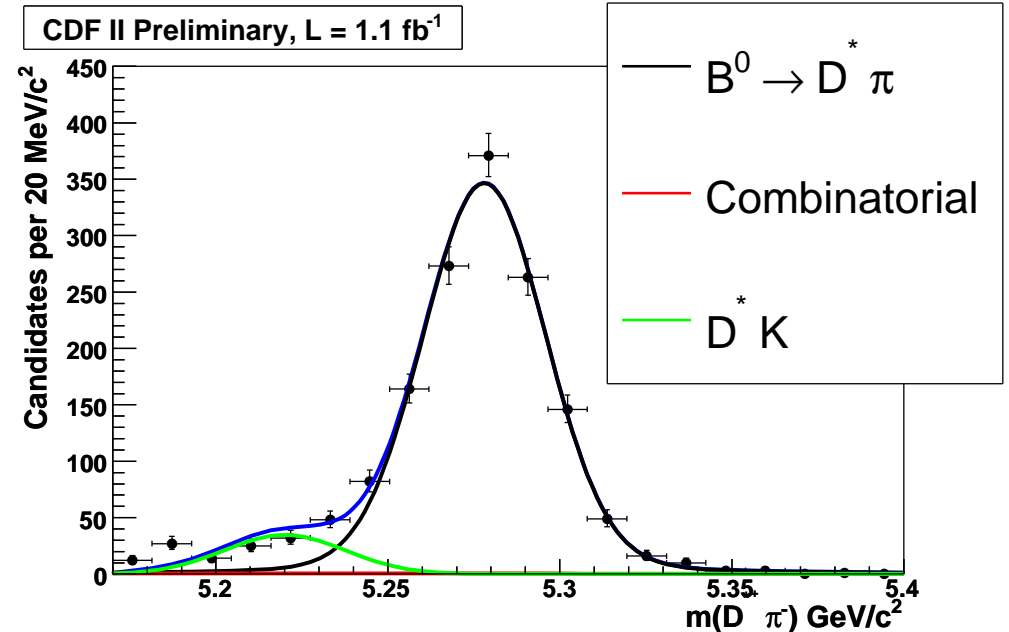
\Rightarrow [cdfnote 8578](#) describes Λ_b^0 lifetime fit



$B^0 \rightarrow D^{*+} \pi^-$ Cross-Check I

Thank you to Amanda and LBL people for their data, MC, and help.

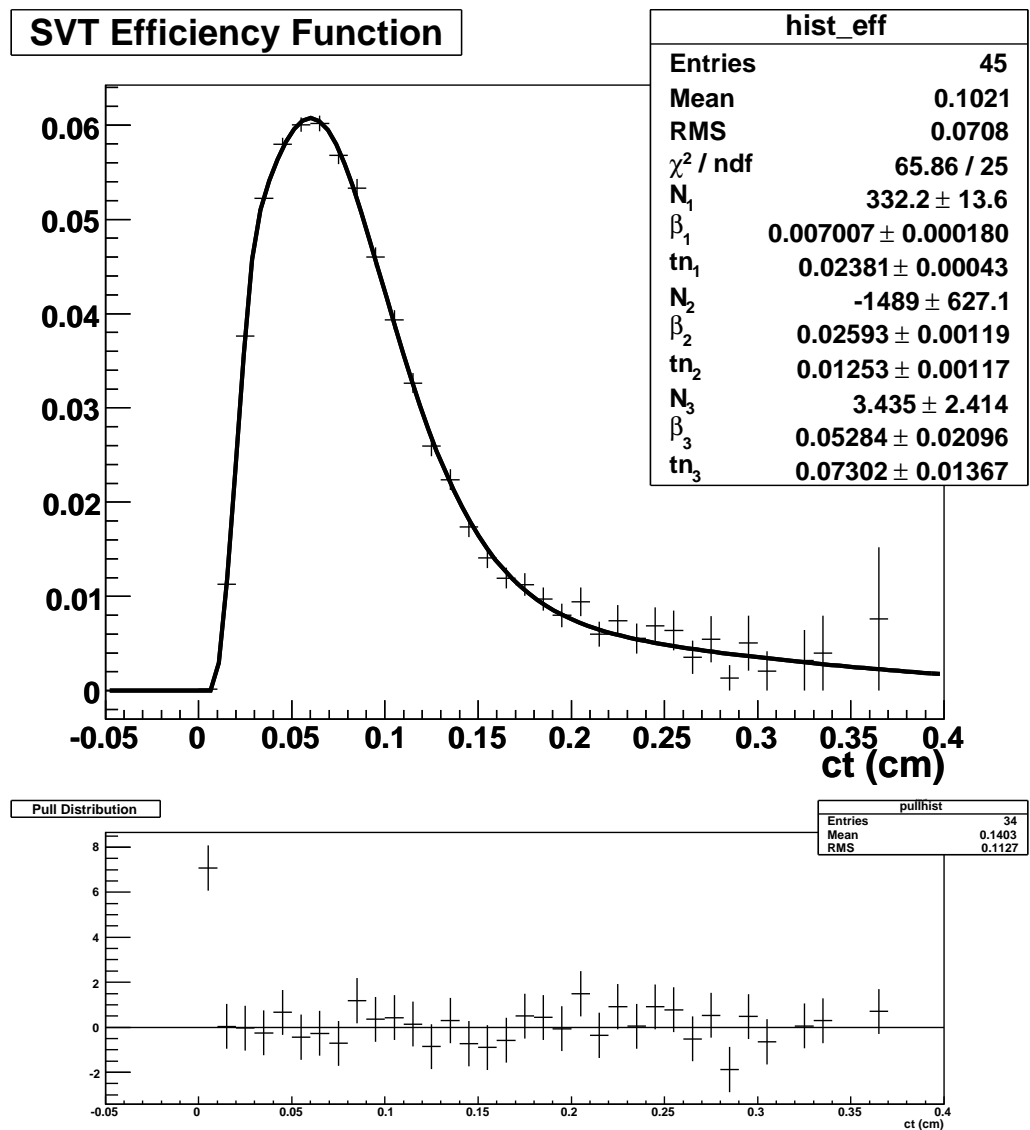
- Run on Amanda's 0h Data.
- 3 component fit.
- Use our own, simple mass fit.
- $m(D^{*+} \pi^-) \in [5.17, 5.35]$



Yield	JHU	LBL
$N(B^0 \rightarrow D^{*+} \pi^-)$	1399 ± 39	1336.4
$N(B^0 \rightarrow D^{*+} K^-)$	132.9 ± 15.1	102.6
N(Combinatorial)	31.9 ± 6.8	18.9

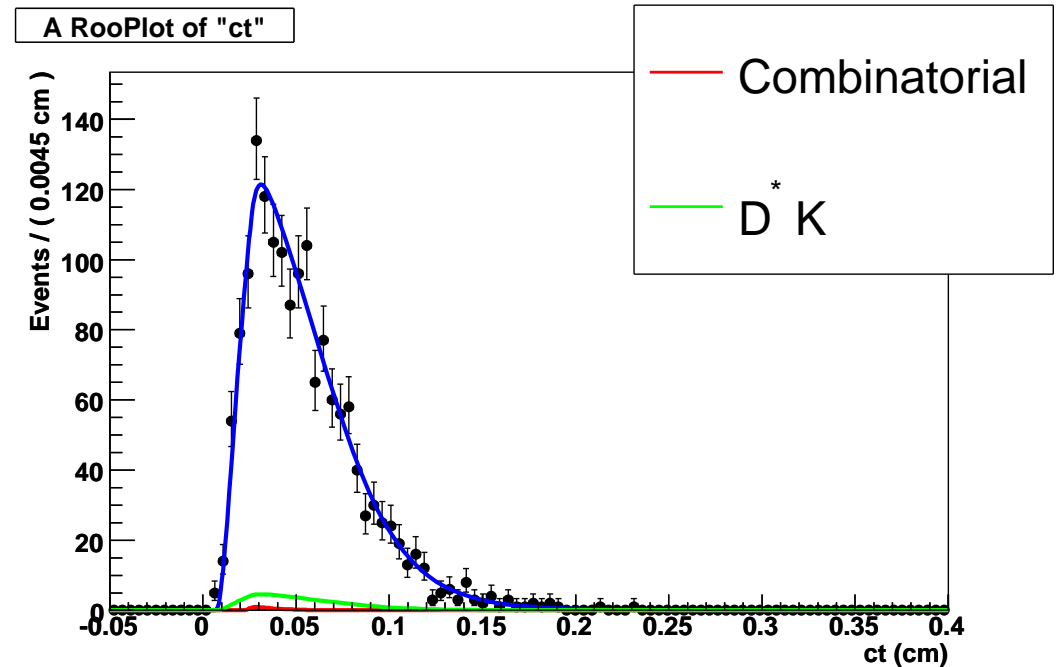
$B^0 \rightarrow D^{*+} \pi^-$ Cross-Check II

- LBL Signal Monte Carlo Sample
- SVT efficiency distribution created and fit w/ standard, JHU, Λ_b^0 code.



$B^0 \rightarrow D^{*+} \pi^-$ Cross-Check III

- Same functional form for both B^0 and Λ_b^0 lifetimes.
- 3 component fit
- $m(D^{*+} \pi^-) \in [5.225, 5.331]$
- Signal ct and σ_{ct} from sideband-subtracted data
- Comb. Bkg. ct and σ_{ct} from upper sideband



Lifetime	JHU (μm)	PDG (μm)
$c\tau(B^0 \rightarrow D^{*+} \pi^-)$	452.1 ± 17.81	458.7 ± 2.7

$B^0 \rightarrow D^{*+} \pi^-$ lifetime agrees well with PDG

SVT Efficiency Distribution I

SVT efficiency fn. corrects for lifetime bias introduced by TTT.
We use the techniques described in cdfnote 7386

The distribution is defined by:

$$\epsilon(ct) = \frac{Histo^{TTT}(ct)}{\sum_i exp(ct_i, c\tau^{MC}) \otimes Gauss(\sigma_{ct}^i)}$$

The standard SVT distribution is fit with:

$$\epsilon_{TTT}(ct) = \sum_{i=1}^{i=3} N_i \cdot (x - \beta_i)^2 \cdot e^{-x/\tau_i} \cdot (x > \beta_i)$$

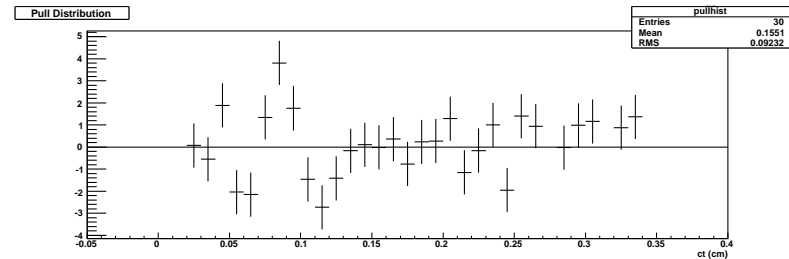
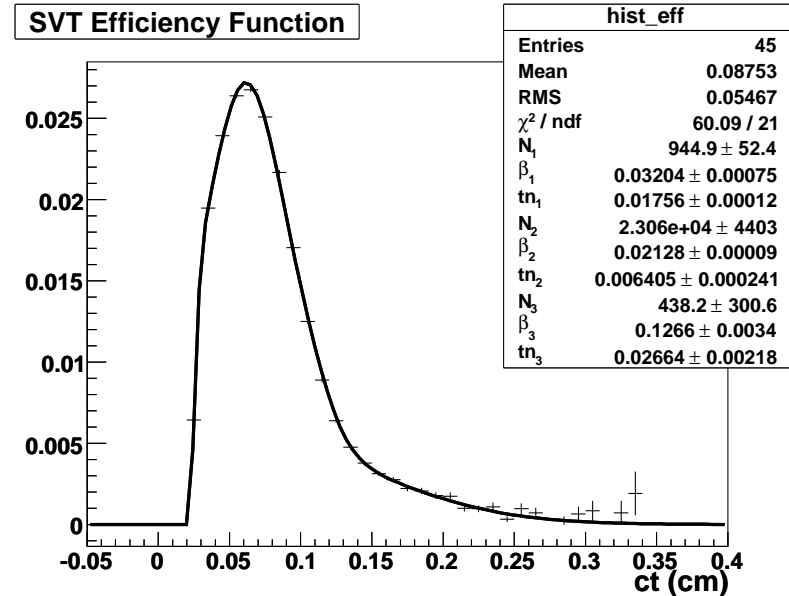
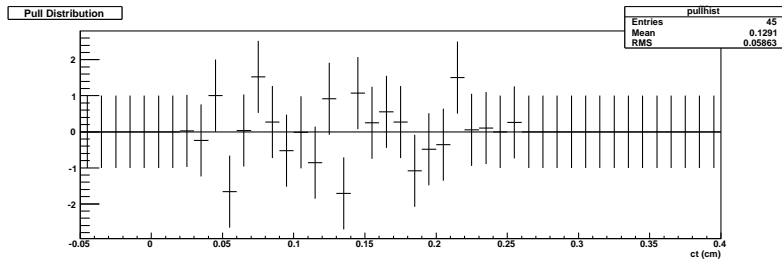
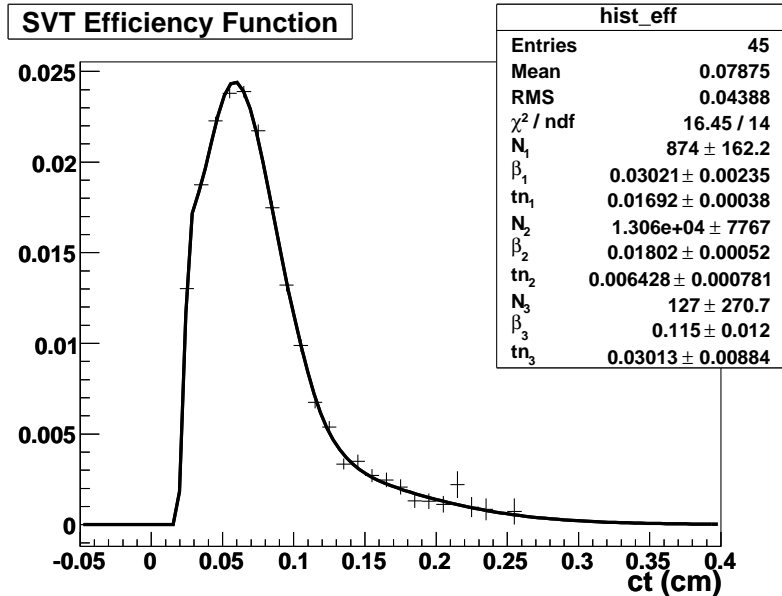
Or, alternatively, is fit with:

$$\epsilon_{TTT}(ct) = \frac{(a_0 \cdot ct + a_1 \cdot (ct)^2 + a_2 \cdot (ct)^3)^2}{(a_3 + a_4 \cdot ct + a_5 \cdot (ct)^2 + a_6 \cdot (ct)^3 + a_6 \cdot (ct)^4)^2}$$

SVT Efficiency Distribution II

New Monte Carlo generated over the Holidays!

Now have $\sim 350k$, $\Lambda_b^0 \rightarrow \Lambda_c^+ \pi^-$ signal events (SAM z35b80)

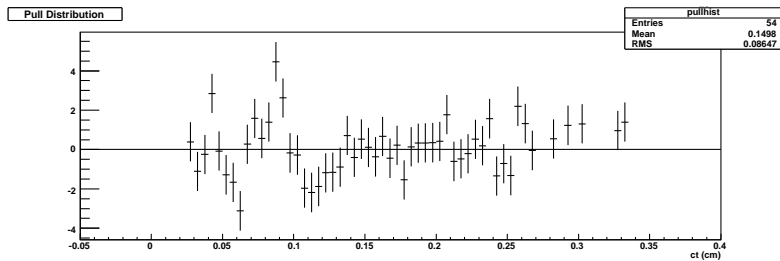
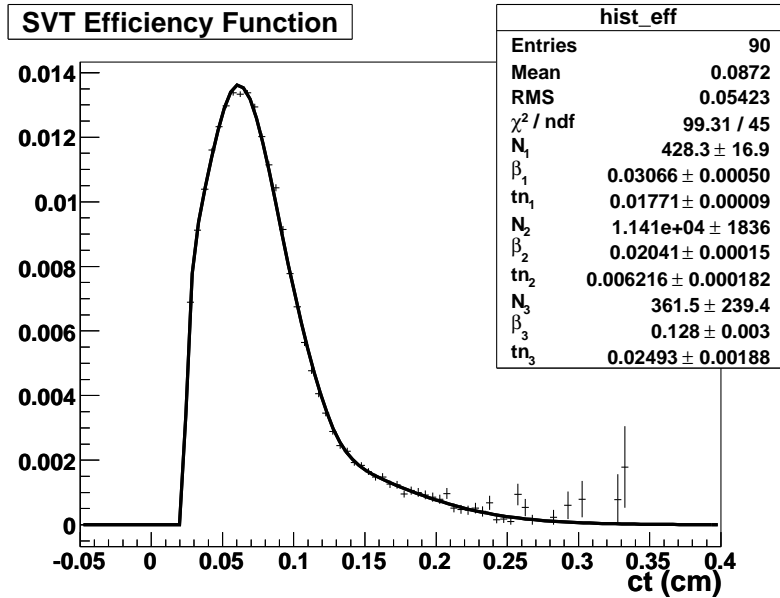


old (45 bins) blind $ct = 386.4 \pm 10.4$

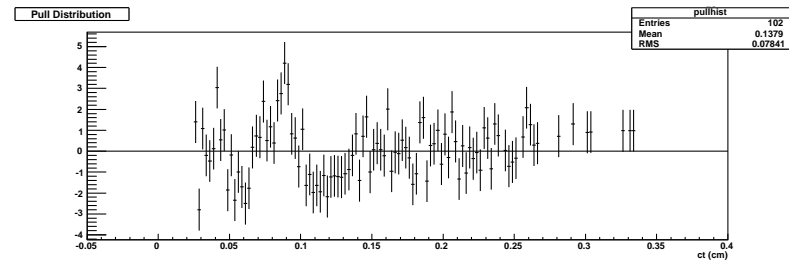
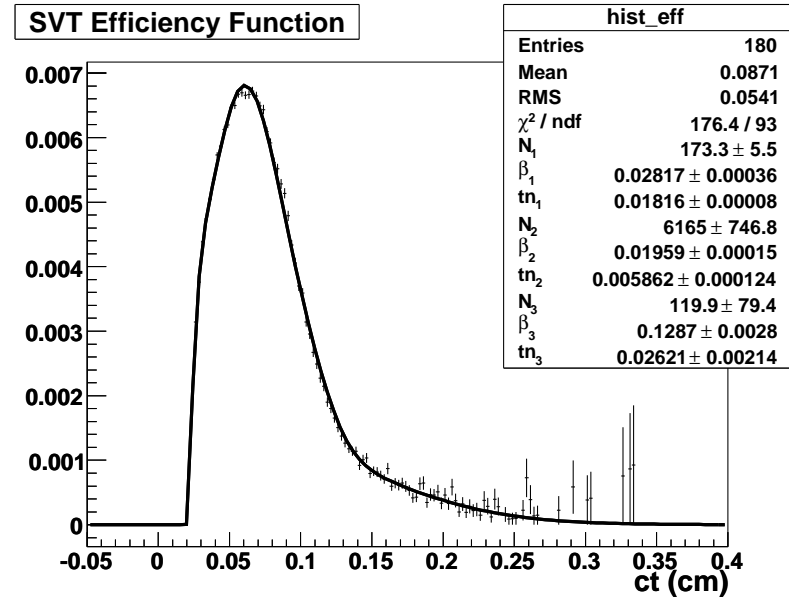
new (45 bins) blind $ct = 385.6 \pm 10.4$

SVT Efficiency Distribution III

Big changes in lifetime w/ different binning for SVT eff. fn!



90 bins; blind $ct = 404.0 \pm 11.1$

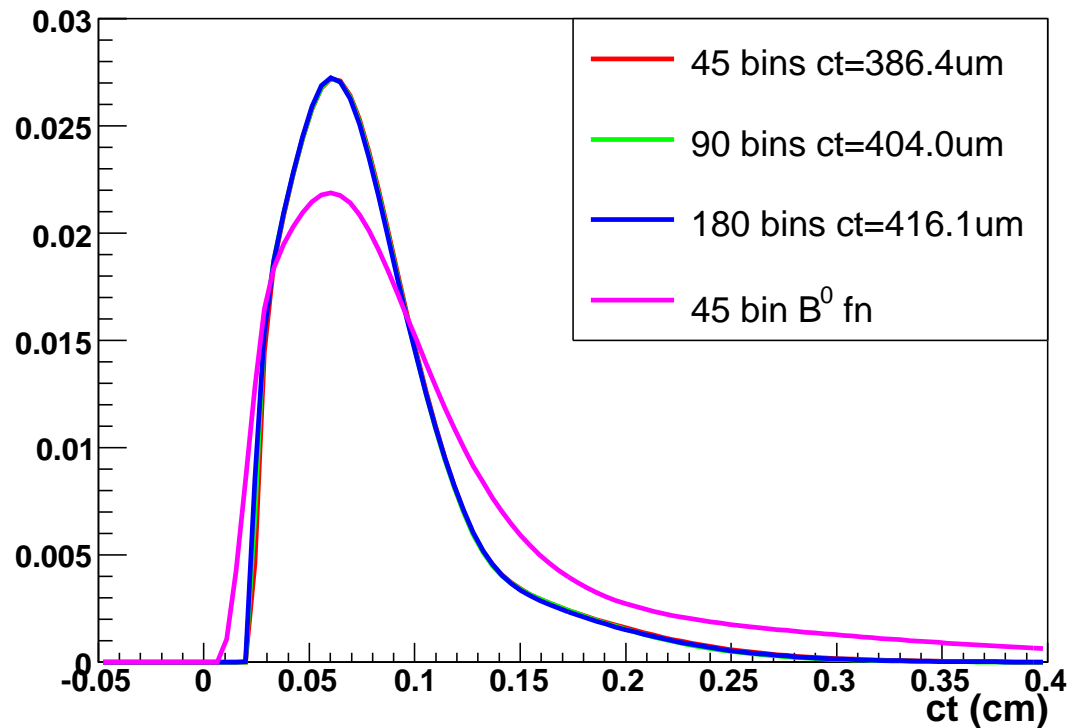


180 bins; blind $ct = 416.1 \pm 11.6$

SVT Efficiency Distribution IV

Very small differences in Λ_b^0 SVT eff. fn. \rightarrow big lifetime differences

SVT Efficiency Function



bins	blinded Λ_b^0 lifetime
45	$385.6 \pm 10.4\mu\text{m}$
90	$404.0 \pm 11.1\mu\text{m}$
180	$416.1 \pm 11.6\mu\text{m}$
bins	B^0 lifetime
45	$452.1 \pm 17.81\mu\text{m}$
90	$455.8 \pm 18.09\mu\text{m}$
180	$456.7 \pm 18.15\mu\text{m}$

Efficiency Function Checks

1. Signal MC Checks

- Simple, unblinded, signal-only MC fit
- See the same lifetime dependence on SVT binning

2. Fit for SVT parameters in signal-only MC

- Fix lifetime in Fit
- Float the 9 SVT parameters in the fit
- Fit is unstable

3. Alternative SVT parameterization

- Similar exercises as above w/ alternate SVT parameterization
- Seems more stable

4. Replace SVT parameterization w/ histogram

- Bypass SVT fitting by feeding histogram directly

Conclusions & Plan

- B^0 cross-check mode is done and the results agree well with PDG
- Discovered that Λ_b^0 lifetime fit is very sensitive to small changes in the SVT efficiency function
- We will keep pushing on the SVT efficiency function studies

In parallel...

- We continue to revise the documentation.
→ Look for an update to cdfnote 8578 soon.
- We're wrapping up the remaining systematics.