$\Lambda_b^0 \to \Lambda_c^+ \pi^-$ Lifetime Update

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February 20, 2007

Talk Outline

- SVT Efficiency Function Redux
- Smoothed SVT Eff. Histogram
- Pursing a Consistent Signal MC Fit

SVT Efficiency Function Review

SVT eff. fn. accounts for bias introduced by TTT and selection cuts.
Technique used is described in `cdfnote 7386`

SVT efficiency histogram defined by:

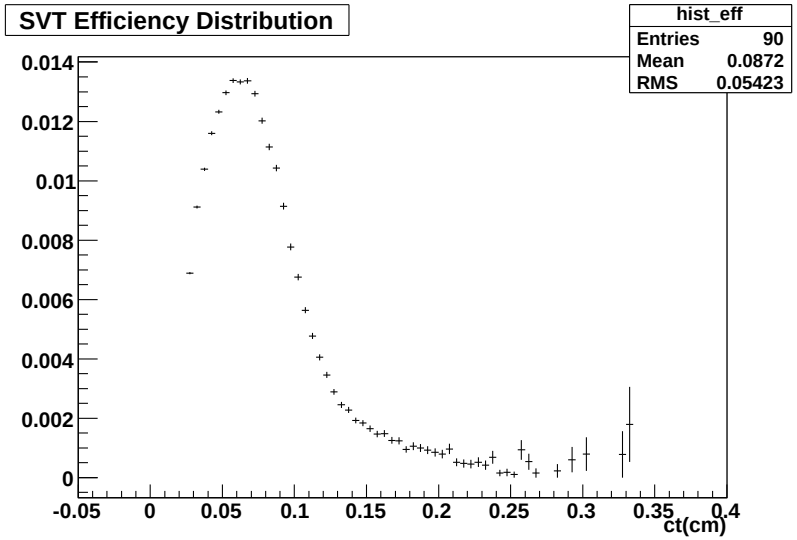
$$\epsilon(ct) = \frac{Histo^{TTT}(ct)}{\sum_i exp(ct_i, c\tau^{MC}) \otimes Gauss(\sigma^i_{ct})}$$

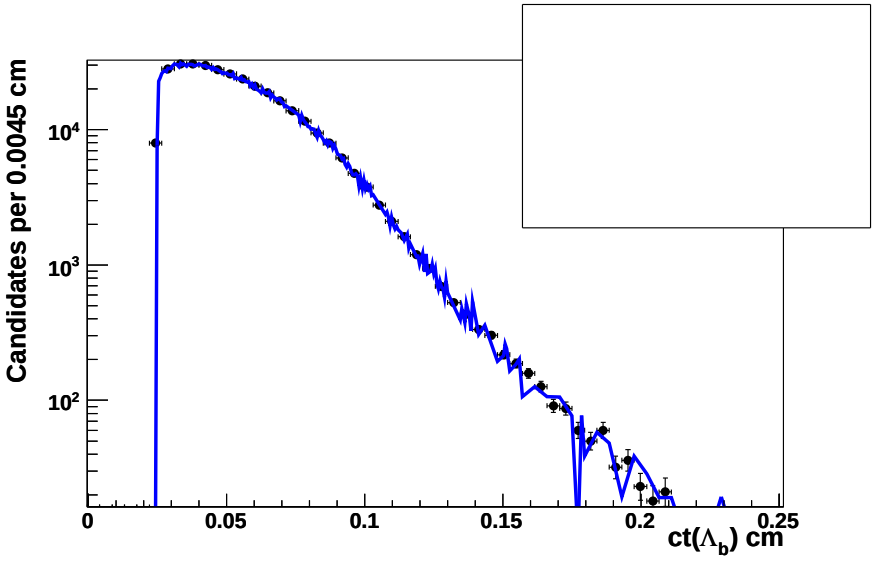
that is fit to get "efficiency function";

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

This parameterization does not describe our SVT shape very well.
Unstable lifetime fit results.

Lifetime Fit Review





Instead of fitting, we tried using the raw Histogram

bins	Λ_b^0 lifetime
45	$369.6 \pm 1.0 \mu m$
90	$361.6 \pm 1.0 \mu m$
180	$361.5 \pm 1.0 \mu m$

ct Result depends on binning

Lack of continuous shape also gives poor lifetime fit projection

Planned to create a smoothed histogram to approximate a continuous SVT eff. function

Smoothed SVT Efficiency Histogram

SVT efficiency histogram originally defined by:

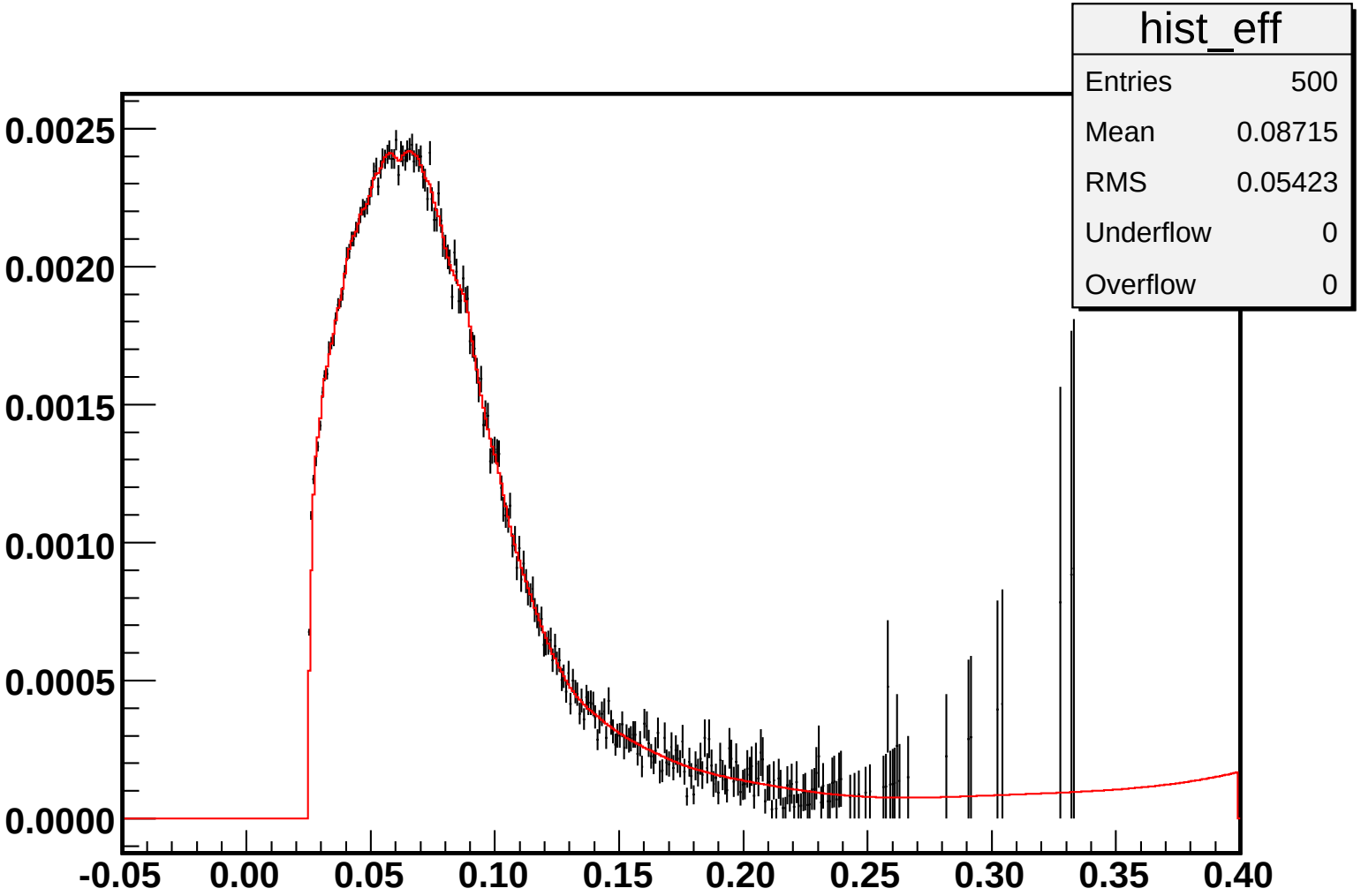
$$\epsilon(ct) = \frac{Histo^{TTT}(ct)}{\sum_i exp(ct_i, c\tau^{MC}) \otimes Gauss(\sigma^i_{ct})}$$

We replace the numerator with a smoothed distribution

$$\epsilon(ct) = \frac{RooKeysPdf^{TTT}_{histo}(ct)}{\sum_i exp(ct_i, c\tau^{MC}) \otimes Gauss(\sigma^i_{ct})}$$

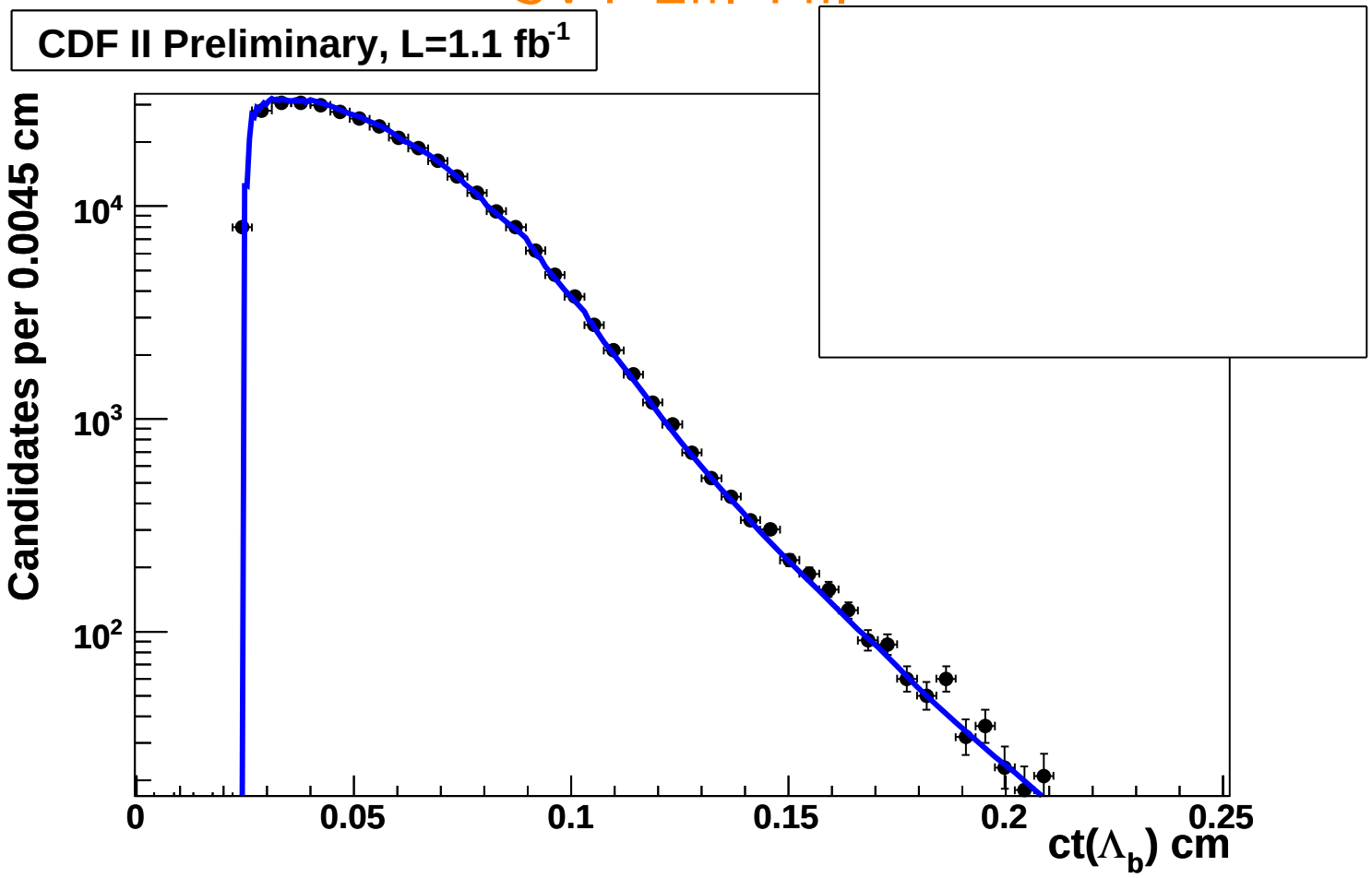
RooKeysPdf makes a smoothed distribution from the $ct(\Lambda^0_b)$ data.
This "function" is used to fill a finely binned histogram which is then used as the numerator

SVT Efficiency Smoothed Histogram II



Lifetime Fit and Projection

MC fit (input $c\tau(\Lambda_b^0) = 369\mu m$): $c\tau$ projection looks good w/ RooKeys SVT Eff. Fn.



However, Λ_b^0 Lifetime fit result is $\sim 10\mu m$ low $(358.9 \pm 1\mu m)$!

Circular Sanity Check

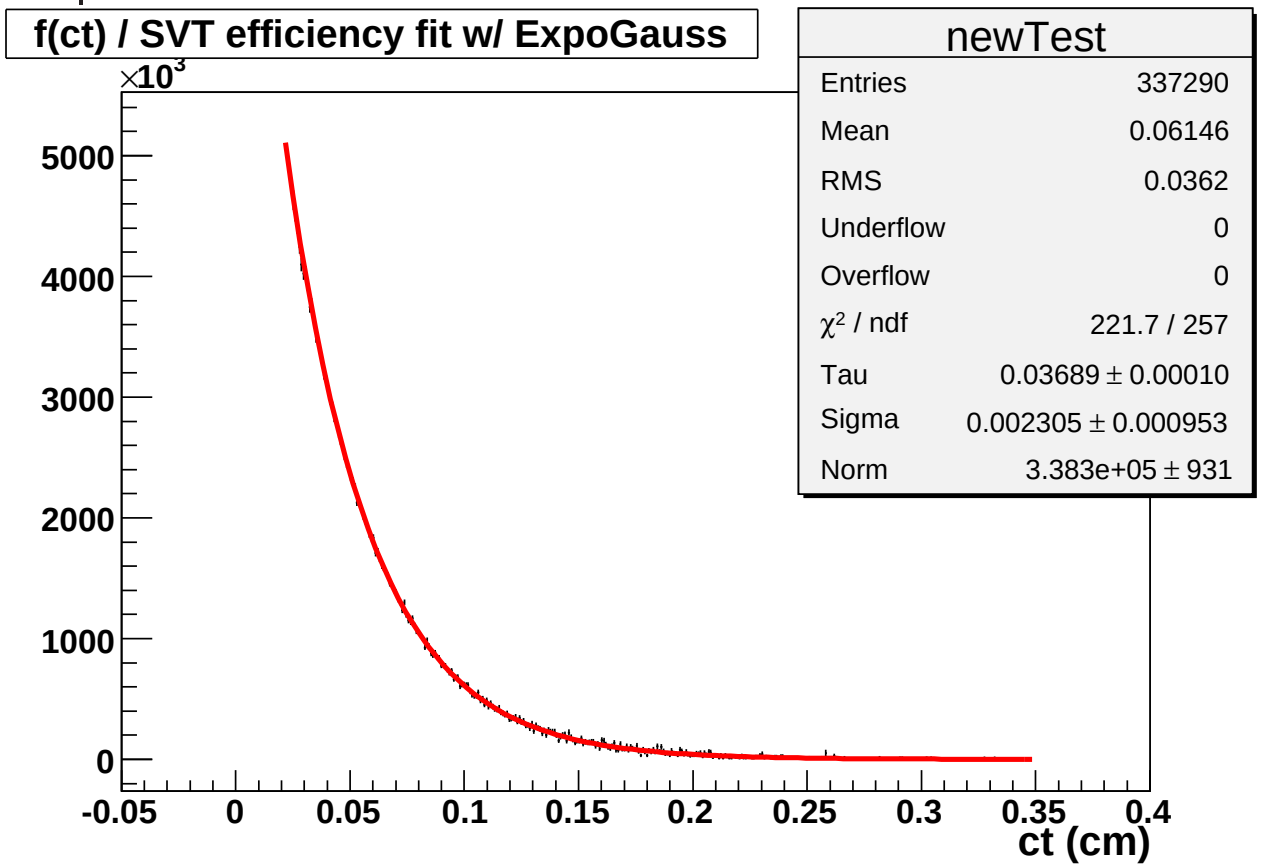
$$f(ct) = \frac{1}{c\tau} e^{-ct'/\tau} \otimes R(ct, ct') \epsilon_{TTT}(ct)$$

$$\frac{f(ct)}{\epsilon_{TTT}(ct)} = \frac{1}{c\tau} e^{-ct'/\tau} \otimes R(ct, ct')$$

$\Leftarrow$Expected Λ_b^0 lifetime distribution

Fit Monte Carlo using same ExpoGauss code as our standard fit framework $\Rightarrow$ $ct(\Lambda_b^0)$ and σ_{ct} from fit agree well w/ MC input lifetime $(ct(\Lambda_b^0) = 369\mu m)$ and lifetime error.

No $10\mu m$ offset here...



Conclusion and Outlook

- Have developed a method for dealing with SVT efficiency instability.
- SVT efficiency function issues are solved.
- Lifetime fit projection also looks good.
- Now hunting down sources of $\sim 10\mu m$ offset in the fitted lifetime of our MC sample.
  - Problem is suspected in our fit framework.
- Once the issue is solved, we'll...
  - move ahead w/ fit in data.
  - recalculate the systematics.
  - update the documentation (`cdfnote 8578`).