

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

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Talk Outline

- Updated Systematic Error Results
- Schedule and Outlook

New Fit Configuration

- 2-step fit: Mass fit followed by the Lifetime fit.
- Same binned Mass fit.
- Simplified Un-binned, maximum-likelihood, 2-D (ct, σ_{ct}) Lifetime fit.
- RooFit 2.31.

The general form of the lifetime likelihood;

$$\mathcal{L}(ct, \sigma_{ct}) = \sum_{i=7} P_{ct, \sigma_{ct}}^i(ct, \sigma_{ct}; S_{ct}).$$

i	7 Fit components
$P_{ct, \sigma_{ct}}^i(ct, \sigma_{ct})$	Joint ct and σ_{ct} probability distribution.
S_{ct}	Global scale factor

Signal Normalizations

i	Component	Norm [μm]
1	N_LbLcPi	2904.9 ± 57.9
2	N_B4Track	250.5 ± 15.4
3	N_LbLcK	138.6 ± 15.9
4	N_CmbBkg	116.2 ± 5.0
5	N_Lb4Track	113.7 ± 15.9
6	N_LbSemi	27.0 ± 7.8
7	N_BOther	7.2 ± 6.8
8	N_LbOther	3.5 ± 0.3
9	N_LbSigcPi	0.76 ± 0.11
10	N_BSemi	0.64 ± 0.28
11	N_LbBump	0.098 ± 0.02
12	N_LbLcRho	0.027 ± 0.004

Systematics: Toy MC Setup

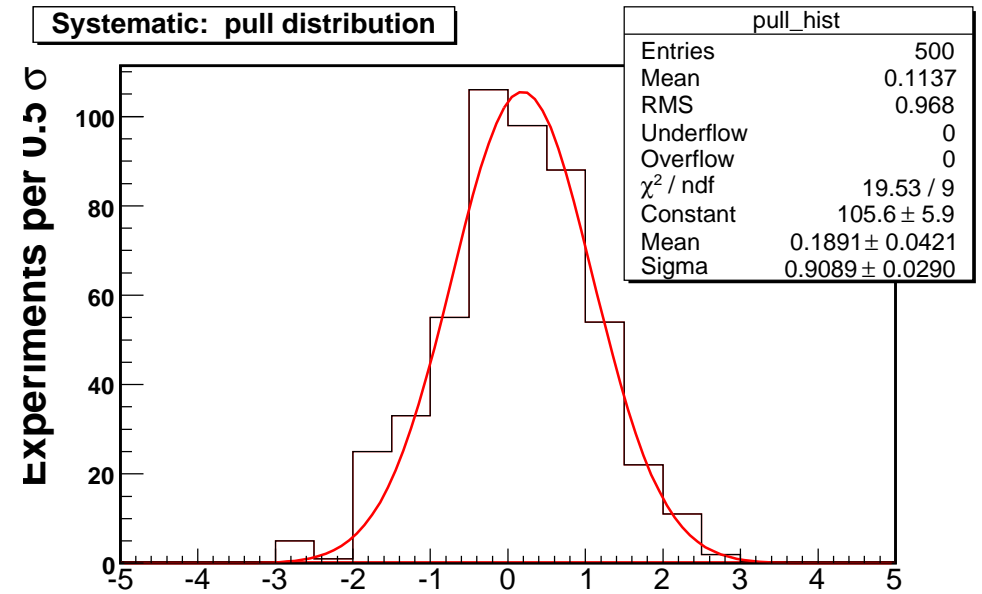
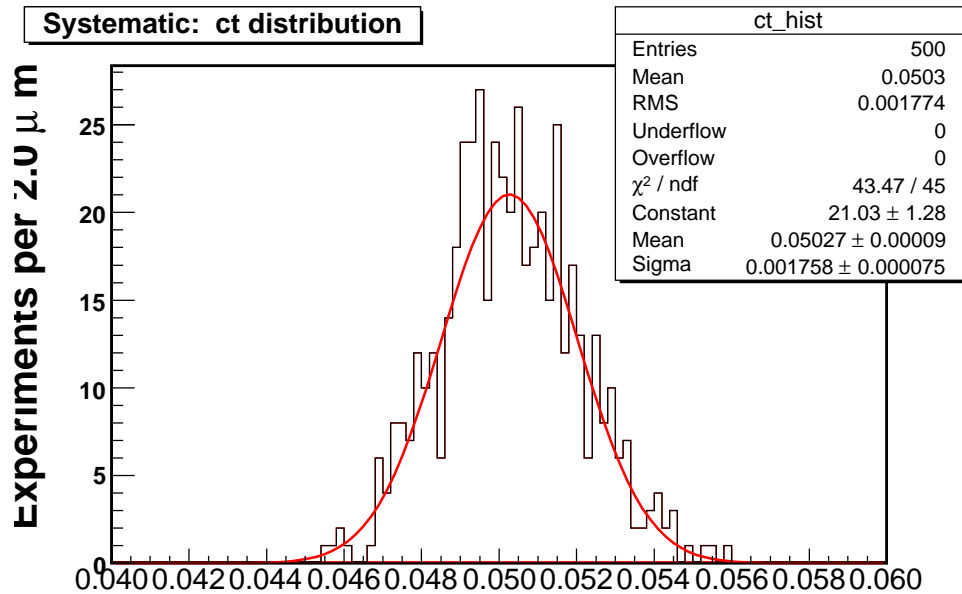
1. Fit the Blinded Data sample w/ the “Rigged” PDF.
2. Using the Rigged Fit result, generate the Rigged Toy Dataset.
3. Fit the Rigged Toy Dataset w/ the Baseline Fit.
4. Systematic is difference between; the Rigged Fit and the average Baseline fit to Rigged Data.

Generate Toy MC samples with statistics similar to data sample (~ 3700)

Run 500 pseudo-experiments per systematic.

Systematics: Fitter Bias

Sample	Rigged ct	Result	Diff
Fitter Bias	$350.0\mu m$	$350.5 \pm 10.0\mu m$	$+0.5\mu m$
Fitter Bias	$400.0\mu m$	$400.8 \pm 11.6\mu m$	$+0.8\mu m$
Fitter Bias	$450.0\mu m$	$449.5 \pm 13.7\mu m$	$-0.5\mu m$
Fitter Bias	$500.0\mu m$	$502.7 \pm 17.6\mu m$	$+2.7\mu m$
Quoted Systematic			negligible



Systematics: Λ_c Dalitz Fractions

Mode	PDG Fraction
$\Lambda_c \rightarrow pK^*$	22.7 \pm 7.1%
$\Lambda_c \rightarrow \Delta^{++}K$	12.2 \pm 4.3%
$\Lambda_c \rightarrow \Lambda(1520)\pi$	25.5 \pm 8.5%
$\Lambda_c \rightarrow pK\pi$	39.7 \pm 11.3%

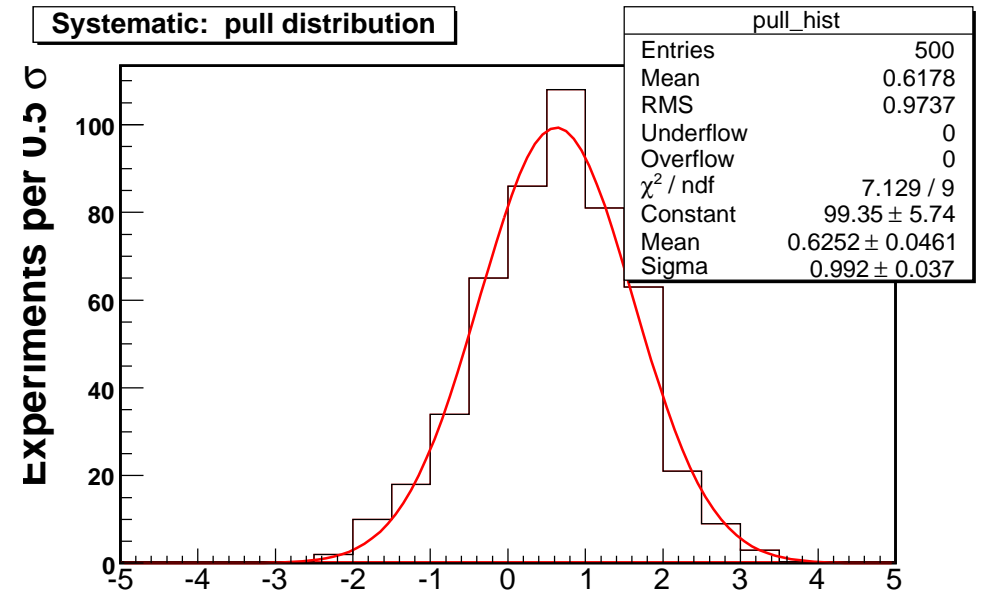
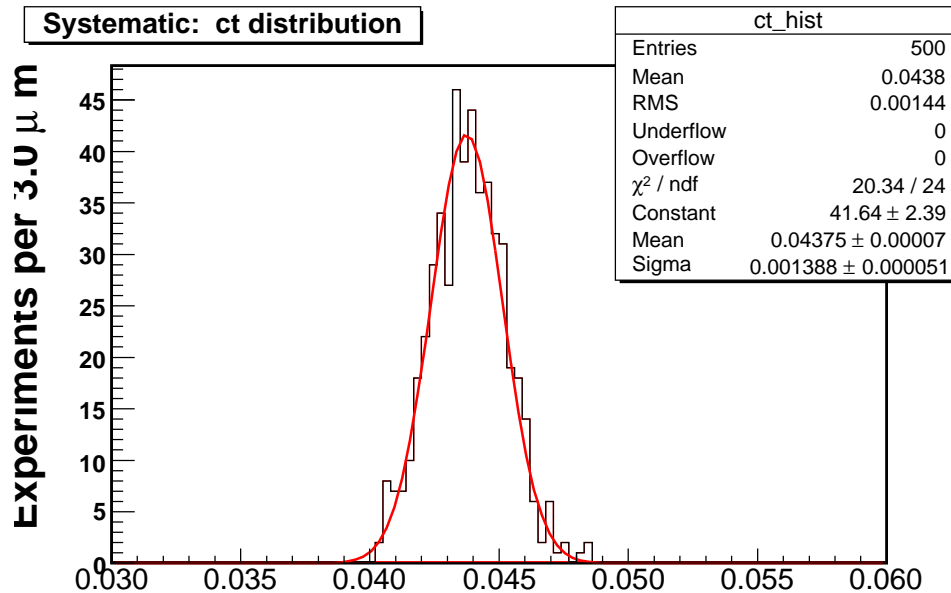
Because the Monte Carlo doesn't include Λ_c Dalitz information, we've adopted an aggressive approach for evaluating this systematic.

Currently, we evaluate this systematic by fluctuating each mode between $\pm 3\sigma$ with a flat distribution.

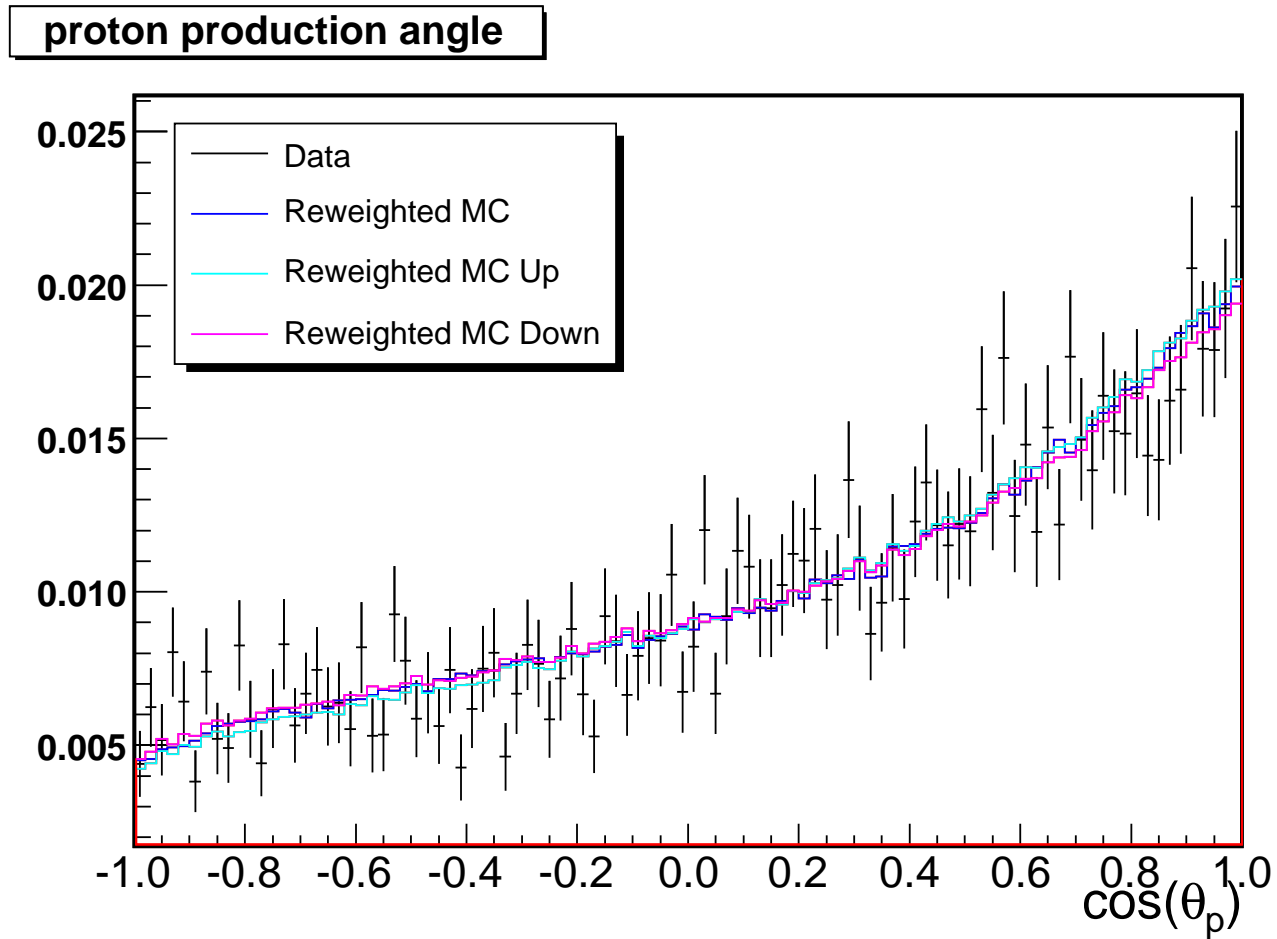
This approach may need to be revised.

Systematics: Λ_c Dalitz Fractions

Sample	pK^*	$\Delta^{++}K$	$\Lambda(1520)\pi$	$pK\pi$	Rigged	Result	Δ	old Δ
Baseline	0.227	0.122	0.255	0.397	NA	$437.0\mu m$	NA	NA
Dalitz_1	0.190	0.174	0.331	0.305	$441.1\mu m$	$438.0\mu m$	$3.1\mu m$	$2.2\mu m$
Dalitz_2	0.252	0.430	0.163	0.154	$438.8\mu m$	$438.4\mu m$	$-0.2\mu m$	$5.9\mu m$
Dalitz_3	0.383	0.143	0.234	0.240	$428.4\mu m$	$437.5\mu m$	$-9.1\mu m$	$5.5\mu m$
Dalitz_4	0.297	0.145	0.100	0.458	$438.4\mu m$	$437.5\mu m$	$0.9\mu m$	$4.8\mu m$
Dalitz_5	0.441	0.120	0.267	0.171	$431.9\mu m$	$438.9\mu m$	$-7.0\mu m$	$6.4\mu m$
Quoted Systematic							$9\mu m$	

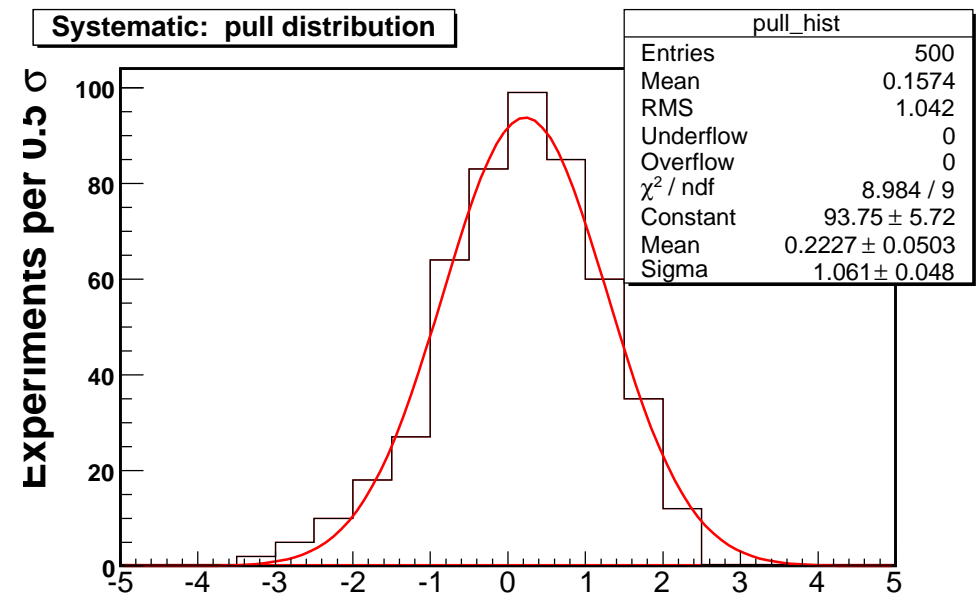
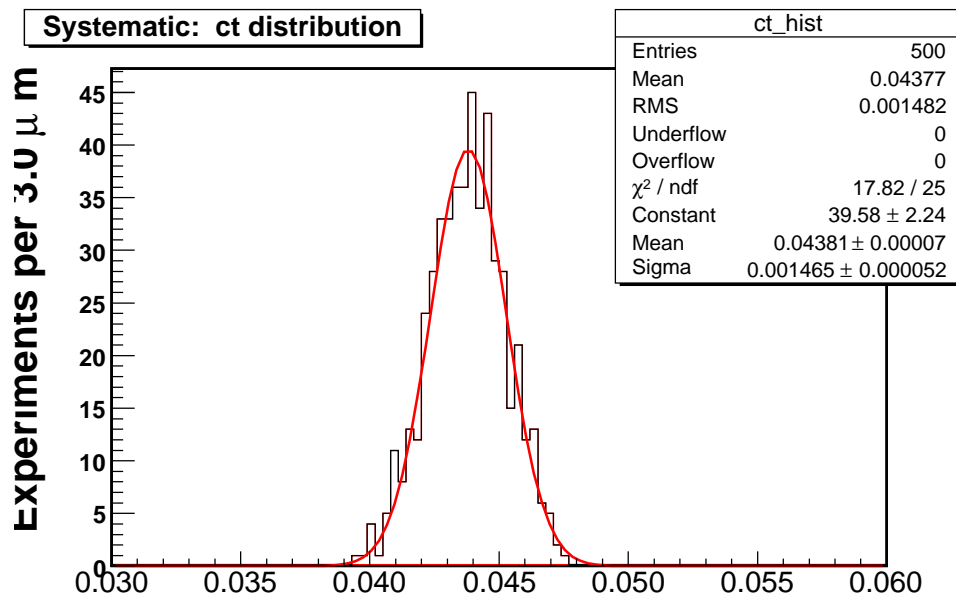


Systematics: Λ_b^0 Polarization Re-weighting

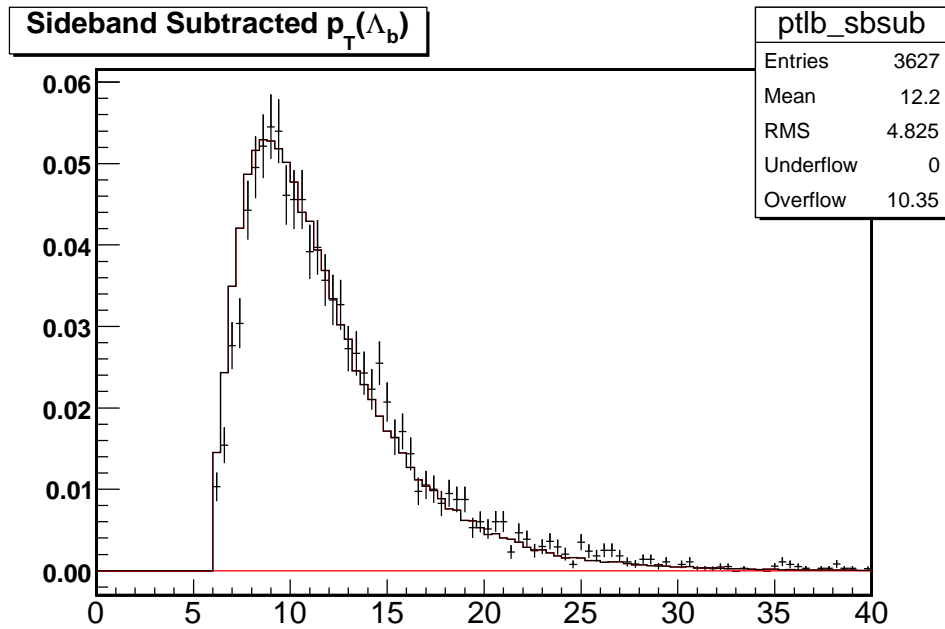


Systematics: Λ_b^0 Polarization Re-weighting

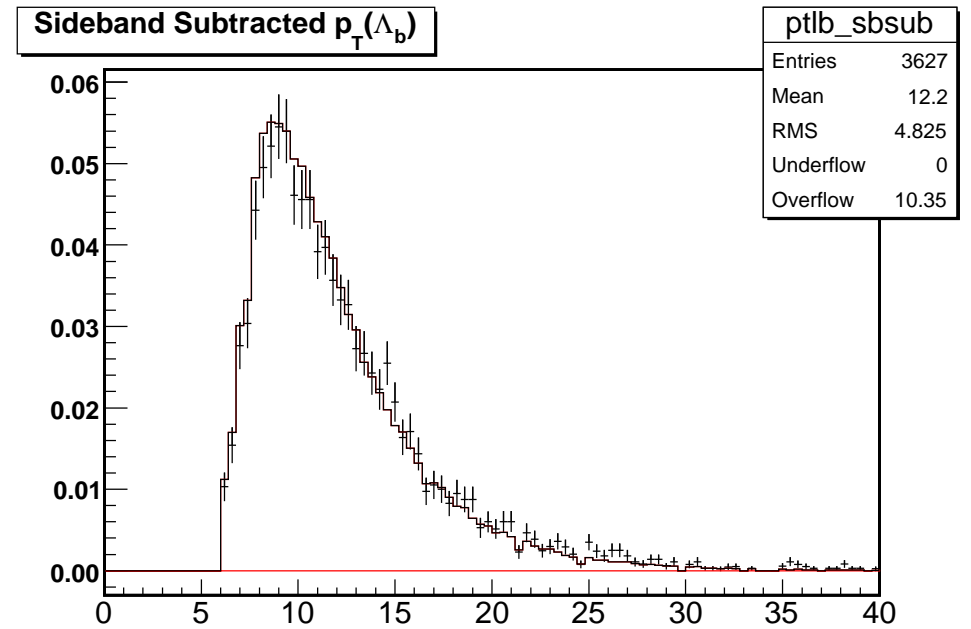
Sample	Rigged ct	Result	Δ	old Δ
Polarization +	$434.7\mu m$	$437.3\mu m$	$-2.6\mu m$	$0.3\mu m$
Polarization -	$434.7\mu m$	$438.1\mu m$	$-3.4\mu m$	$1.6\mu m$
Quoted Systematic:			$3.4\mu m$	



Systematics: $p_T(\Lambda_b^0)$ Re-weighting



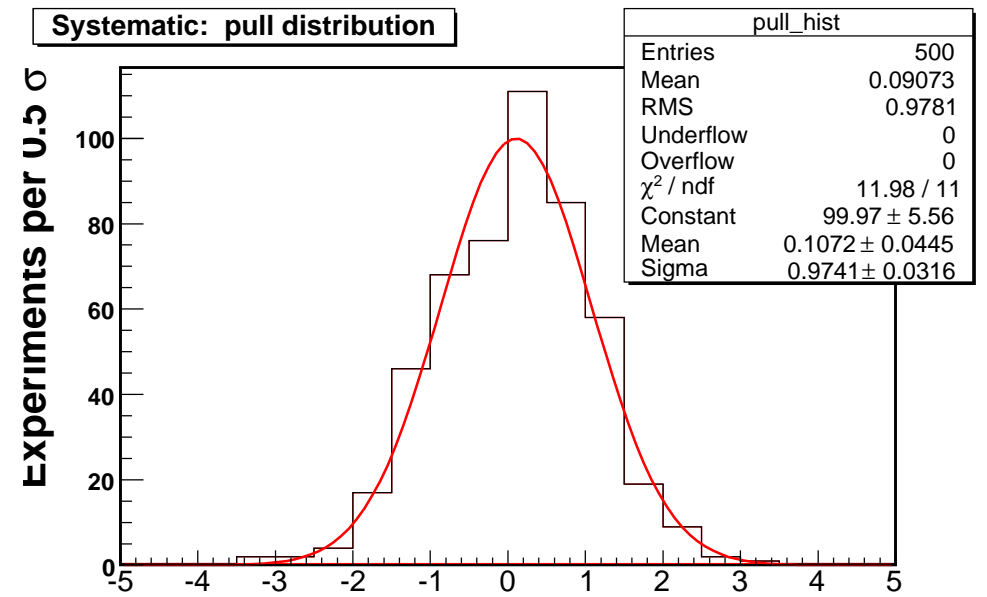
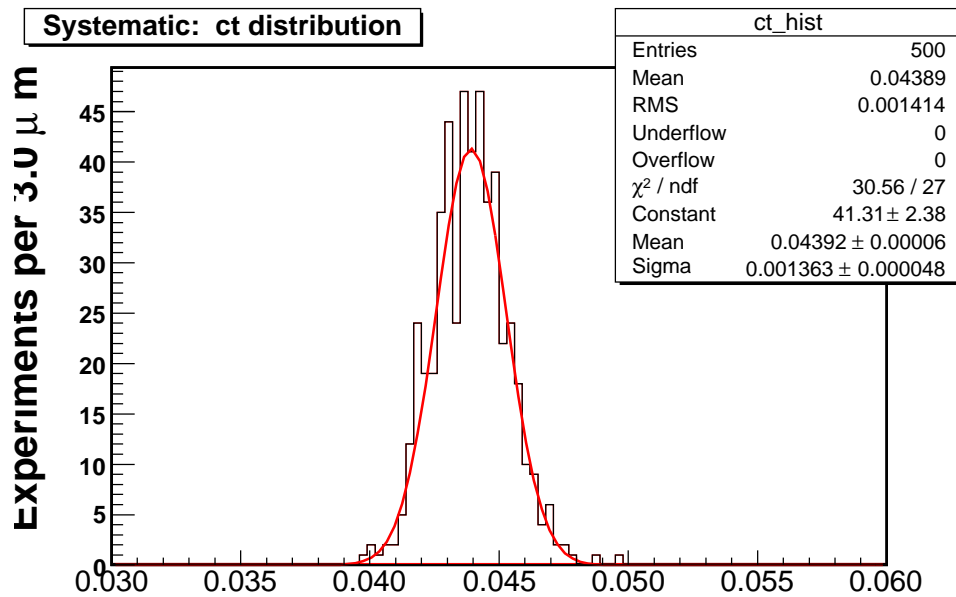
Before Re-Weighting



After Re-Weighting

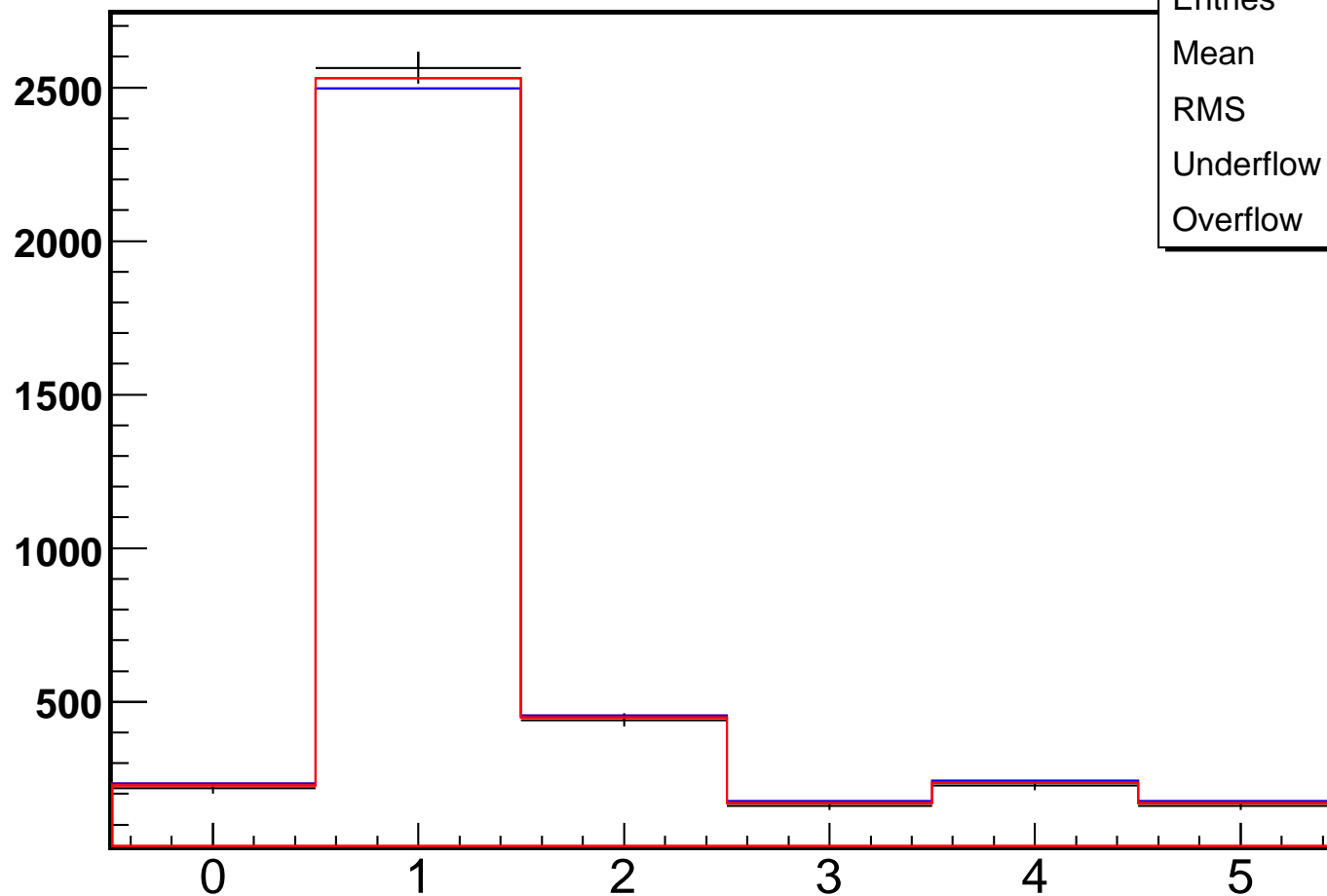
Systematics: $p_T(\Lambda_b^0)$ Re-weighting

Sample	Rigged ct	Result	Δ	old Δ
$p_T(\Lambda_b^0) +$	$436.1\mu m$	$437.2\mu m$	$-1.1\mu m$	$1.0\mu m$
$p_T(\Lambda_b^0) -$	$436.9\mu m$	$439.2\mu m$	$-2.3\mu m$	$0.8\mu m$
Quoted Systematic:			$2.3\mu m$	



Systematics: TrigCode Re-weighting

Signal by Trigger Category



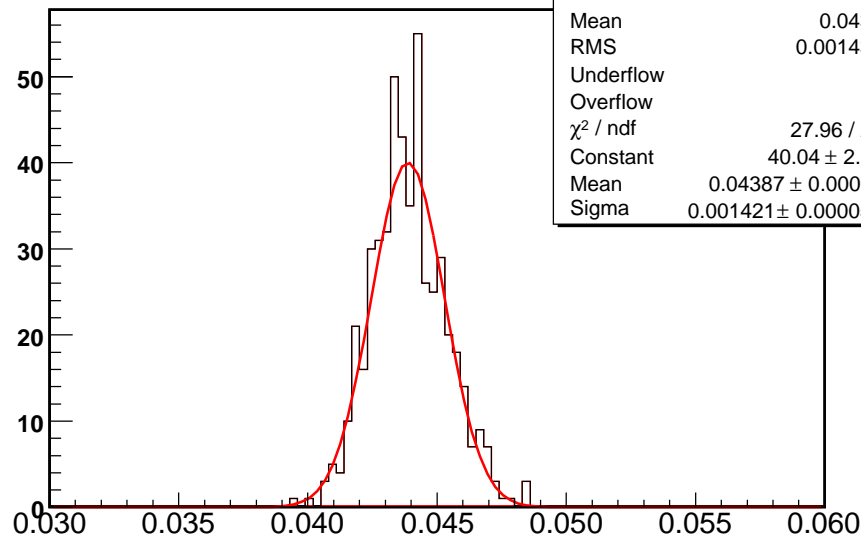
syst_data_hist	
Entries	3782
Mean	1.509
RMS	1.171
Underflow	0
Overflow	0

Systematics: TrigCode Re-weighting

Sample	Rigged ct	Result	Δ	old Δ
TrigCode_1	$435.0\mu m$	$438.0\mu m$	$-3.0\mu m$	$2.2\mu m$
TrigCode_2	$439.7\mu m$	$438.2\mu m$	$1.5\mu m$	$-1.8\mu m$
TrigCode_3	$434.4\mu m$	$438.7\mu m$	$-4.3\mu m$	NA
TrigCode_4	$436.1\mu m$	$437.5\mu m$	$-1.4\mu m$	NA
TrigCode_5	$435.3\mu m$	$438.8\mu m$	$-3.5\mu m$	NA
Quoted Systematic:			$4.3\mu m$	

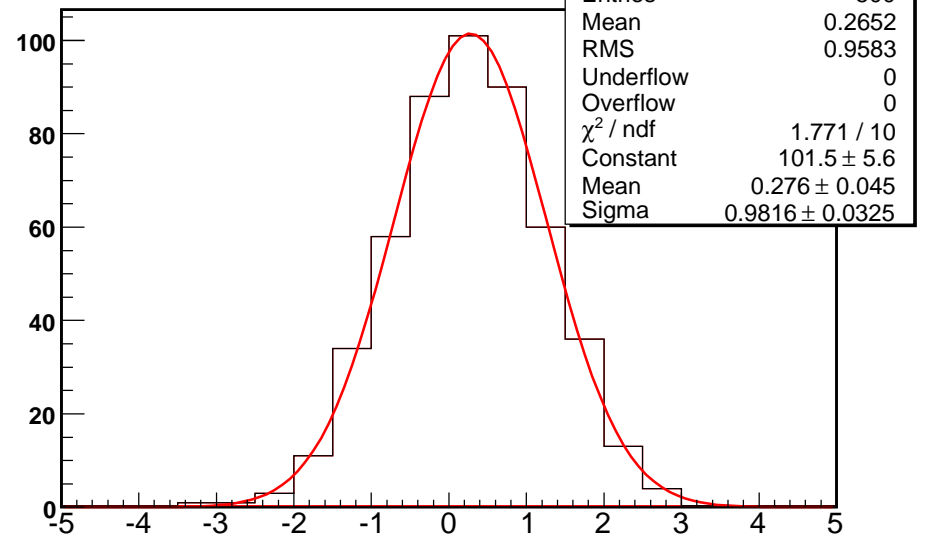
Systematic: ct distribution

Experiments per $3.0\mu m$



Systematic: pull distribution

Experiments per 0.5σ

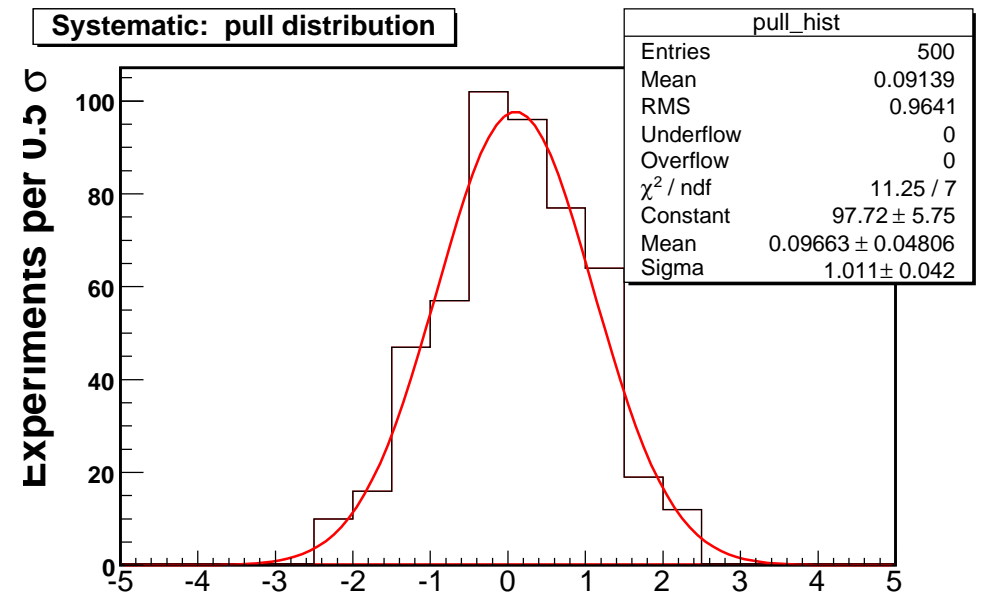
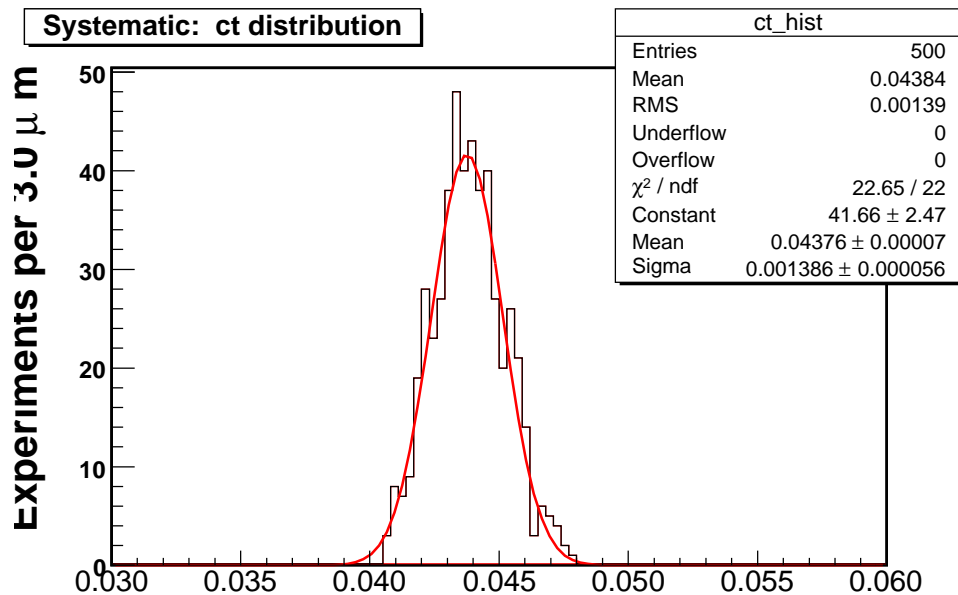


Systematics: B^0 τ Parameter

PDG lists $c\tau(B^0) = 460 \pm 10 \mu m$

We use $c\tau(B^0)_+ = 470 \mu m$ and $c\tau(B^0)_- = 450 \mu m$ to evaluate our systematics.

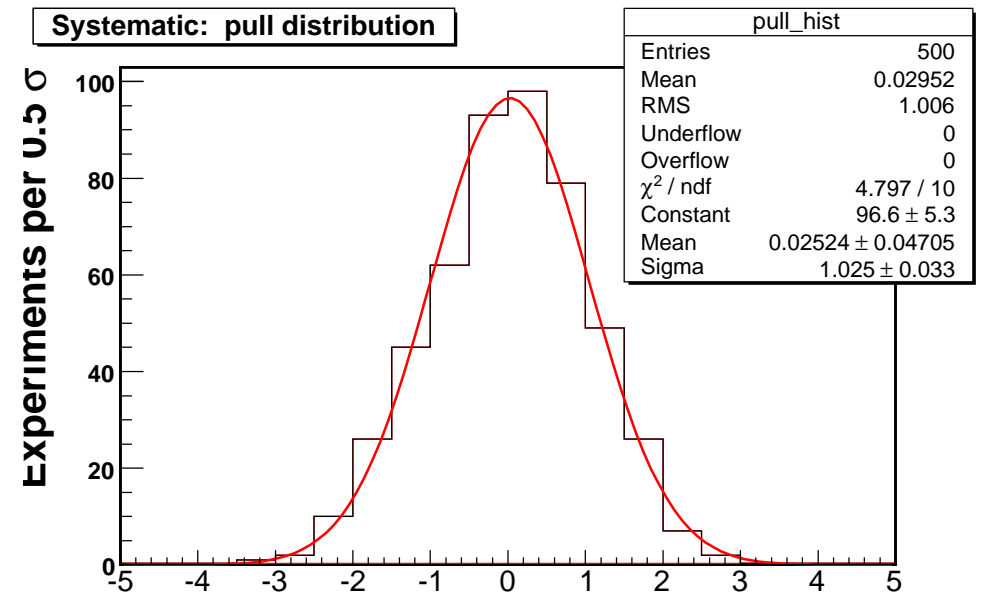
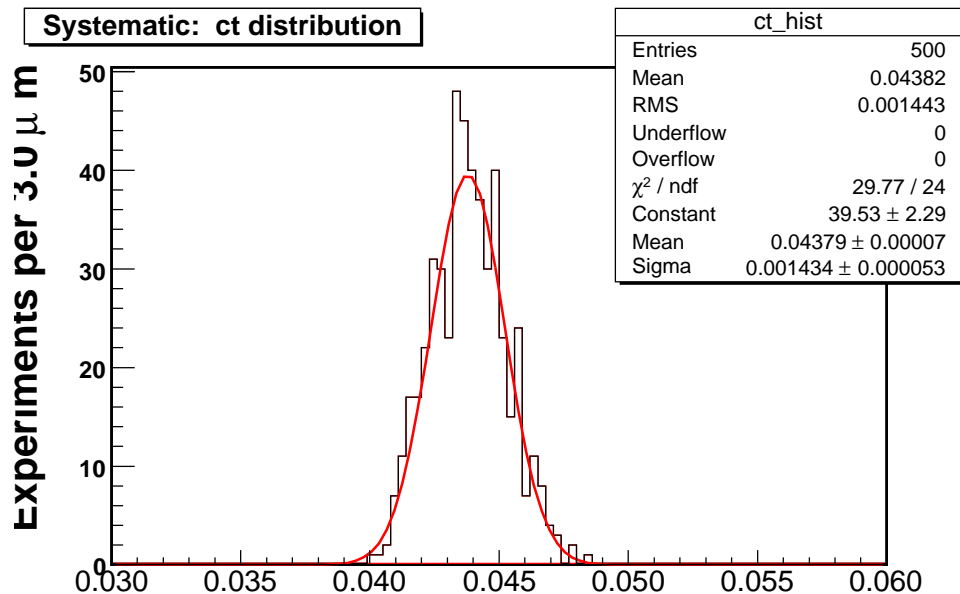
Sample	Rigged ct	Result	Δ	old Δ
$c\tau(B^0)_+$	$436.4 \mu m$	$437.6 \mu m$	$-1.2 \mu m$	$0.2 \mu m$
$c\tau(B^0)_-$	$437.8 \mu m$	$438.9 \mu m$	$-1.1 \mu m$	$-0.1 \mu m$
Quoted Systematic:			$1.2 \mu m$	



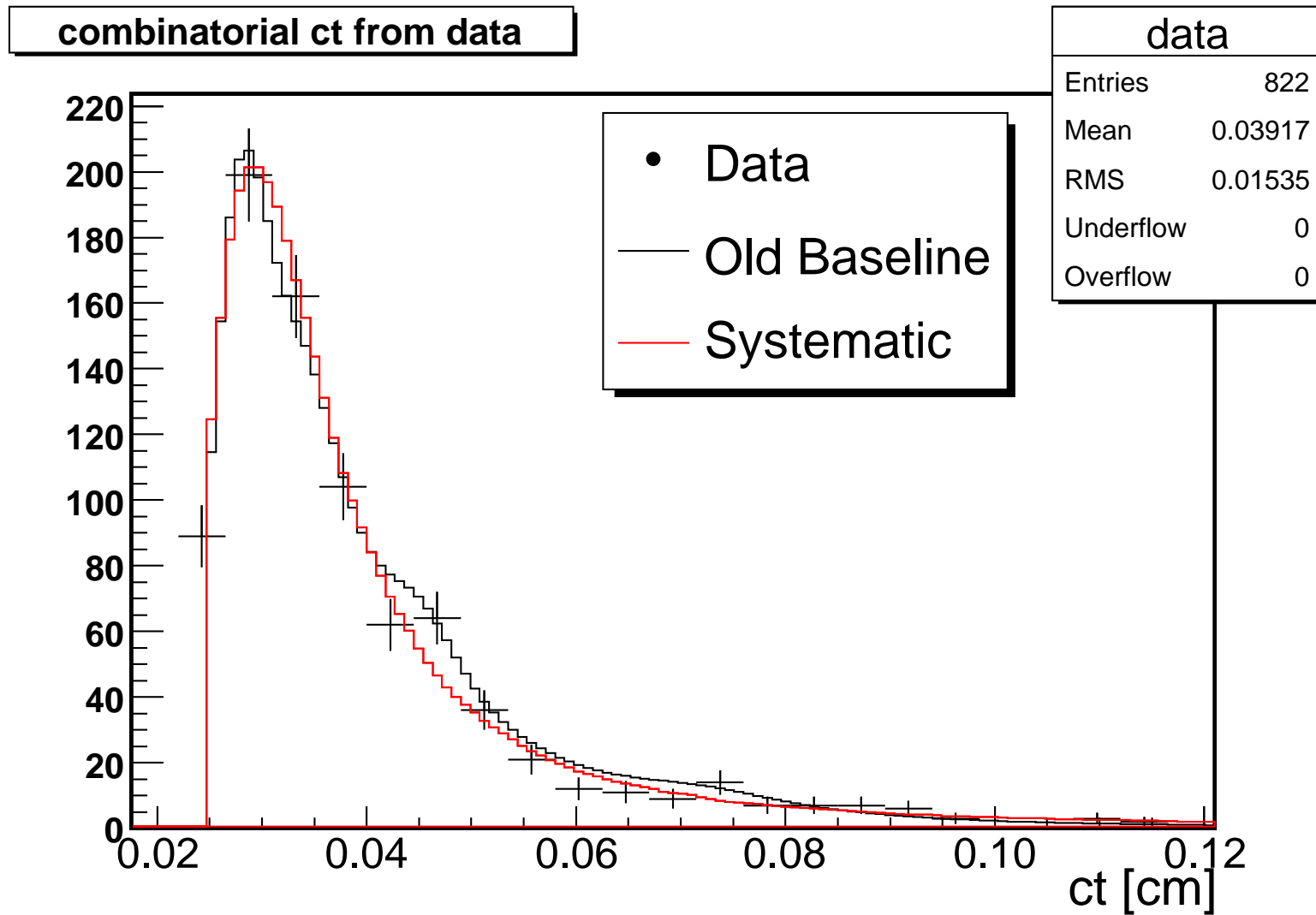
Systematics: Global σ_{ct} Scale Factor

We use a double Gaussian resolution function for σ_{ct} . We weight both Gaussians up and down by 20% for this systematic.

Sample	Rigged ct	Result	Δ	old Δ
$S_{\sigma_{ct}} + 20\%$	$437.0\mu\text{m}$	$437.7\mu\text{m}$	$-0.7\mu\text{m}$	$-0.3\mu\text{m}$
$S_{\sigma_{ct}} - 20\%$	$437.0\mu\text{m}$	$437.9\mu\text{m}$	$-0.9\mu\text{m}$	$-0.2\mu\text{m}$
Quoted Systematic:			$1\mu\text{m}$	

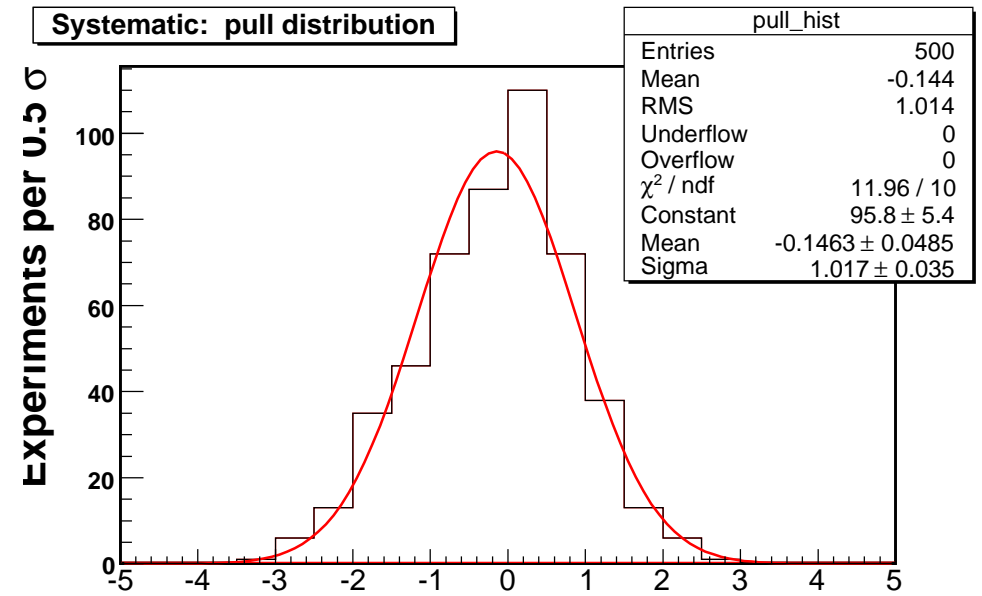
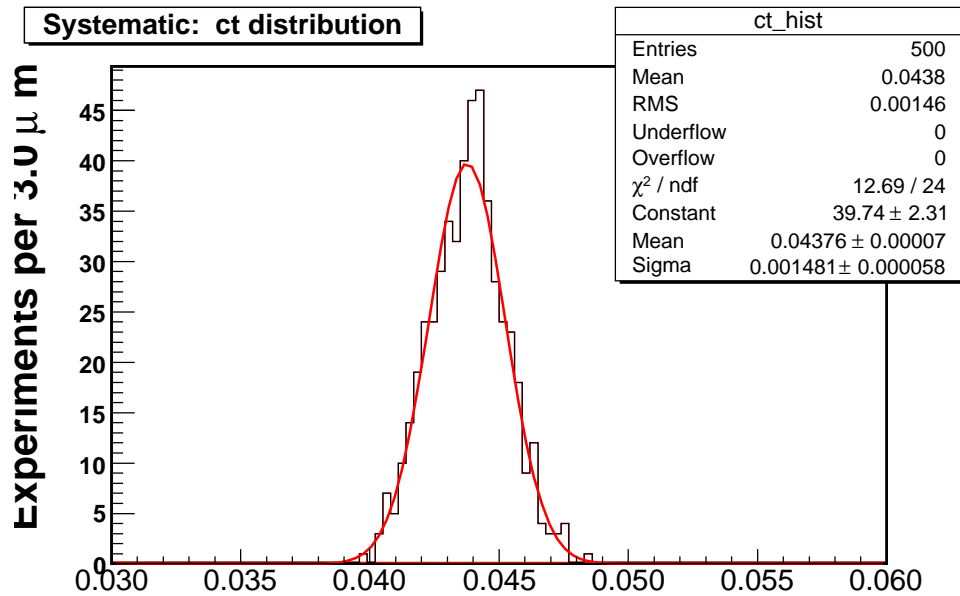


Systematics: Combinatorial ct Distribution



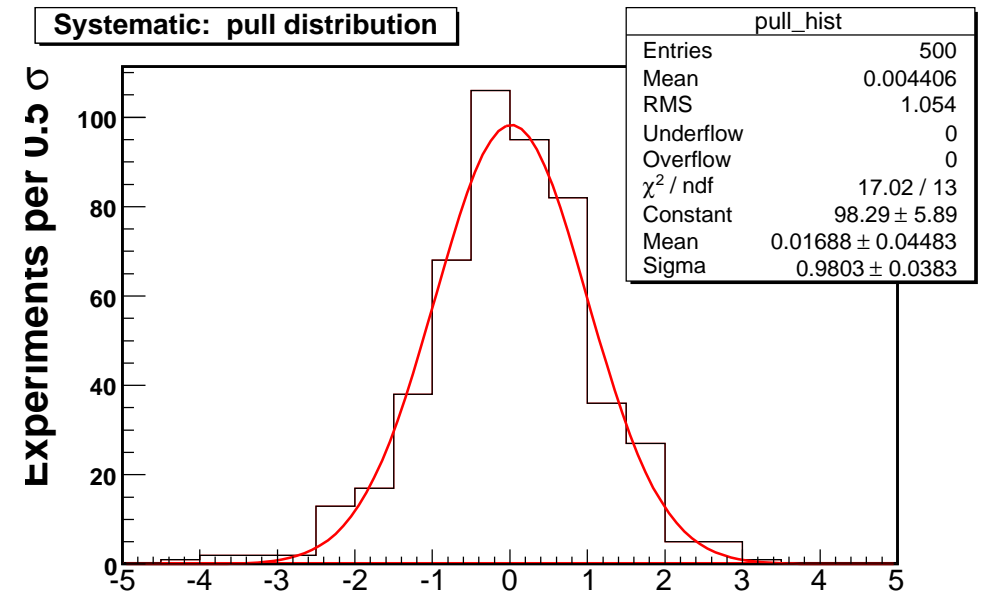
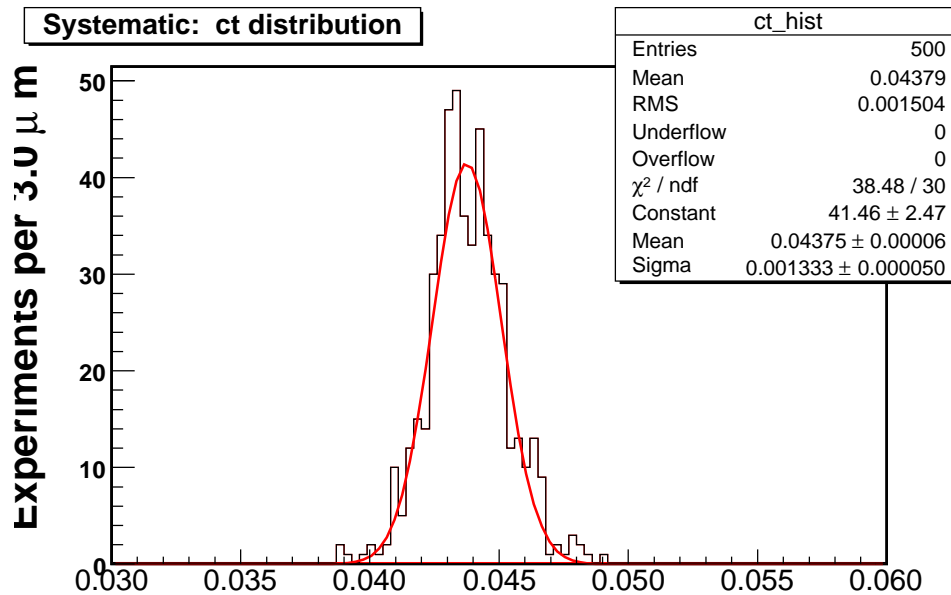
Systematics: Combinatorial ct Distribution

Sample	Rigged ct	Result	Δ	old Δ
Parameterized	$439.3\mu m$	$437.6\mu m$	$1.7\mu m$	$0.0\mu m$
Quoted Systematic:			$1.7\mu m$	



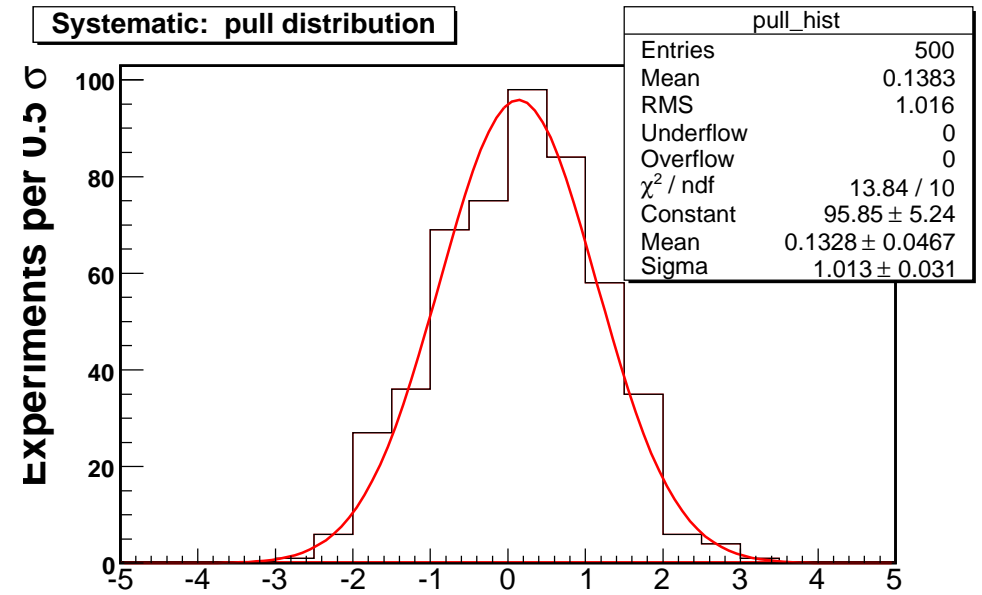
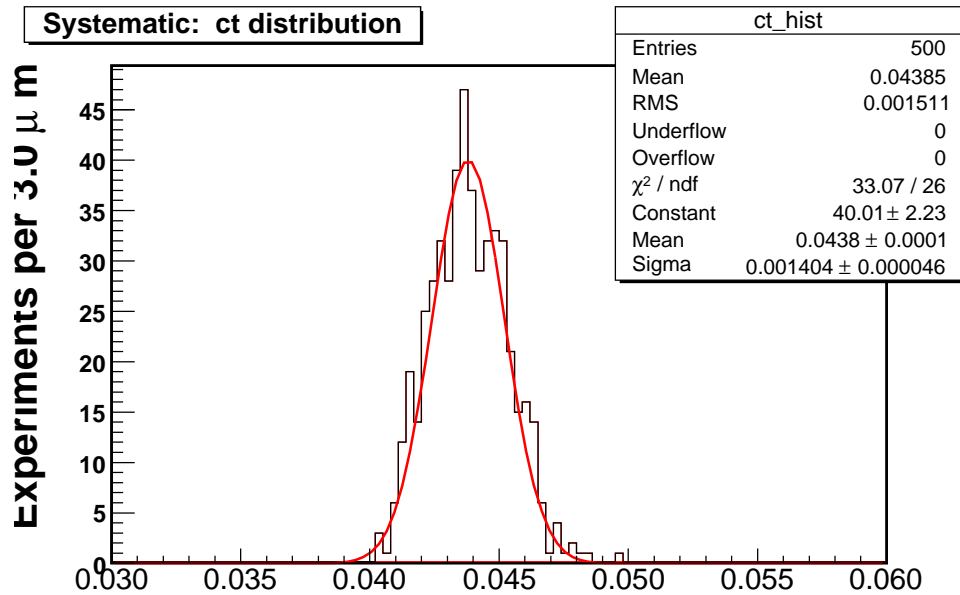
Systematics: σ_{ct} Binning

Sample	Rigged ct	Result	Δ
Rebin by 2	$437.0\mu m$	$437.5\mu m$	$-0.5\mu m$
Rebin by 3	$437.0\mu m$	$437.6\mu m$	$-0.6\mu m$
Quoted Systematic:			negligible



Systematics: Mass Normalizations

Sample	Rigged ct	Result	Δ
SignalNorms_1	$436.2\mu m$	$437.9\mu m$	$-1.7\mu m$
SignalNorms_2	$435.7\mu m$	$438.0\mu m$	$-2.3\mu m$
SignalNorms_3	$436.8\mu m$	$437.3\mu m$	$-0.5\mu m$
SignalNorms_4	$437.5\mu m$	$438.4\mu m$	$-0.9\mu m$
SignalNorms_5	$437.4\mu m$	$438.0\mu m$	$-0.6\mu m$
Quoted Systematic:			$2.3\mu m$



Systematics: Summary Table

Systematic	Status
Alignment	$2.0\mu m$ (cdfnote 8524)
SVT-SVX d0 correlation	$1.0\mu m$ (cdfnote 7386)
Λ_c Dalitz structure	$9.0\mu m$
Data-MC comparison: TrigCode re-weighting	$4.3\mu m$
Λ_b^0 polarization	$3.4\mu m$
Data-MC comparison: $pt(\Lambda_b^0)$ spectrum	$2.3\mu m$
Sample Composition	$2.3\mu m$
Combinatorial ct distribution	$1.7\mu m$
ct background (B τ -parameter)	$1.2\mu m$
Global scale factor	$1.0\mu m$
Fitter bias	negligible
σ_{ct} binning	negligible

$$ct(\Lambda_b^0) = XXX.X \pm 14.0(stat.) \pm 11.5(syst.)\mu m$$

Schedule and Outlook

- We have nearly all of the systematics now in hand.
- Need to settle on how to deal w/ Dalitz.
- We are working on two additional requested systematics;
 - Λ_c lifetime
 - separate efficiency for B^0 background.
- Last “big ticket” item is to run our new fit on Amanda’s $B^0 \rightarrow D^* \pi$ sample.
- Working on these items and hope to show soon.
- Addressing specific questions raised at Blind Preblessing.
- Note (8578) will be updated by next Monday.