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

R. Mumford, S. Behari, P. Maksimovic, M. Martin, J. Pursley, M. Schmidt
Johns Hopkins University
D. Litvintsev
FNAL

May 27, 2008

Talk Outline

- Updated Systematic Errors
- Dalitz Question

Updating Systematic Errors

Q: Why do most of the rigged systematic errors go low?

A: A mistake was found in the way that the systematic errors were computed.

- Previously, $\sim 9\%$ of systematic experiments showed positive offsets.
- The $rigged$ MC samples, **were not updated** after we found an error in the σ_{PV} from the old MC sample.
- Result is systematic errors that are significantly over-estimated and predominantly lower than the baseline fit.
- After the fix, $\sim 18\%$ of experiments show positive offsets.
- The systematic errors make much more sense.

Systematic: $ct(B^0)$

- B^0 is the largest background.
- Default value: $ct(B^0) = 460\mu m$.
- We expect that by changing the B^0 lifetime we soak up more or less of the long-lived candidates.
- $ct(\Lambda_b^0)$ should also change accordingly.

Name	**Old** $\Delta(Rig - \overline{Toy})[\mu m]$	**New** $\Delta(Rig - \overline{Toy})[\mu m]$
$ct(B^0) = 470\mu m$	-1.2	-1.8
$ct(B^0) = 450\mu m$	-1.1	$+0.3$

Systematic: Λ_b^0 Polarization

- Changes to polarization shape between Data and MC are very small.
- Old systematic error was too large.
- Fluctuation between $\pm\sigma$ were also very large.

Name	**Old** $\Delta(Rig - \overline{Toy})[\mu m]$	**New** $\Delta(Rig - \overline{Toy})[\mu m]$
Polarization $+\sigma$	-2.6	-1.3
Polarization $-\sigma$	-3.4	-1.8

Systematic: $p_T(\Lambda_b^0)$

- Fluctuations in p_T re-weighting produced large systematic error.
- Fluctuation between $\pm\sigma$ were also very large.

Name	**Old** $\Delta(Rig - \overline{Toy})[\mu m]$	**New** $\Delta(Rig - \overline{Toy})[\mu m]$
$p_T(\Lambda_b^0) + \sigma$	-1.1	-1.1
$p_T(\Lambda_b^0) - \sigma$	-2.3	-1.1

Systematic: Trigger Code

Name	**Old** $\Delta(Rig - \overline{Toy})[\mu m]$	**New** $\Delta(Rig - \overline{Toy})[\mu m]$
TrigCode_1	-3.0	-2.9
TrigCode_2	$+1.5$	$+4.0$
TrigCode_3	-4.3	-0.3
TrigCode_4	-1.4	-1.8
TrigCode_5	-3.5	-1.4
Quoted error	4.3	4.0
RMS	2.3	2.7

- Similar systematic errors between old and new cases.
- May be a good idea to use RMS of shifts here as the error.

Systematic: Dalitz Fractions

Name	**Old** $\Delta(Rig - \overline{Toy})[\mu m]$	**New** $\Delta(Rig - \overline{Toy})[\mu m]$
Dalitz_1	$+3.1$	$+1.0$
Dalitz_2	-0.2	$+1.4$
Dalitz_3	-9.1	-1.6
Dalitz_4	-0.9	$+0.9$
Dalitz_5	-7.0	-3.3
Dalitz_6	$+0.5$	-0.2
Dalitz_7	-3.5	-1.3
Dalitz_8	-5.0	-3.7
Dalitz_9	-5.6	-7.1
Dalitz_10	-5.7	-6.8
Quoted Error (RMS)	5.0	3.1

- One more positive shift than we had before.
- Spread looks more reasonable now too.

Summary of Systematic Errors

Description	**Old Value** $[\mu m]$	**New Value** $[\mu m]$
Alignment	2.0	2.0
SVT-SVX d0 correlation	1.0	1.0
Data-MC Agreement: TrigCode re-weighting	4.3	4.0
Data-MC Agreement: Λ_c Dalitz structure	5.0	3.1
Background Normalizations	3.0	3.0
B^0 Efficiency	2.7	2.7
Data-MC Agreement: Primary Vertex Position	2.6	2.6
Data-MC Agreement: Λ_b^0 polarization	3.4	1.8
B^0 Lifetime	1.2	1.8
Combinatorial ct Template	1.7	1.4
Data-MC Agreement: $pt(\Lambda_b^0)$ spectrum	2.3	1.1
Global Scale Factor	1.0	1.0
Fitter Bias	negligible	negligible
σ_{ct} Binning	negligible	negligible
Λ_c Lifetime	negligible	negligible
Data-MC Agreement: Primary Vertex Error	negligible	negligible
Total Systematic Uncertainty	9.7	8.0

Dalitz Question

Q (Elliot Lipeles): Excess at high $m(p, K)$. One resonance that is right there is $\Lambda_c \to \Lambda\pi$.

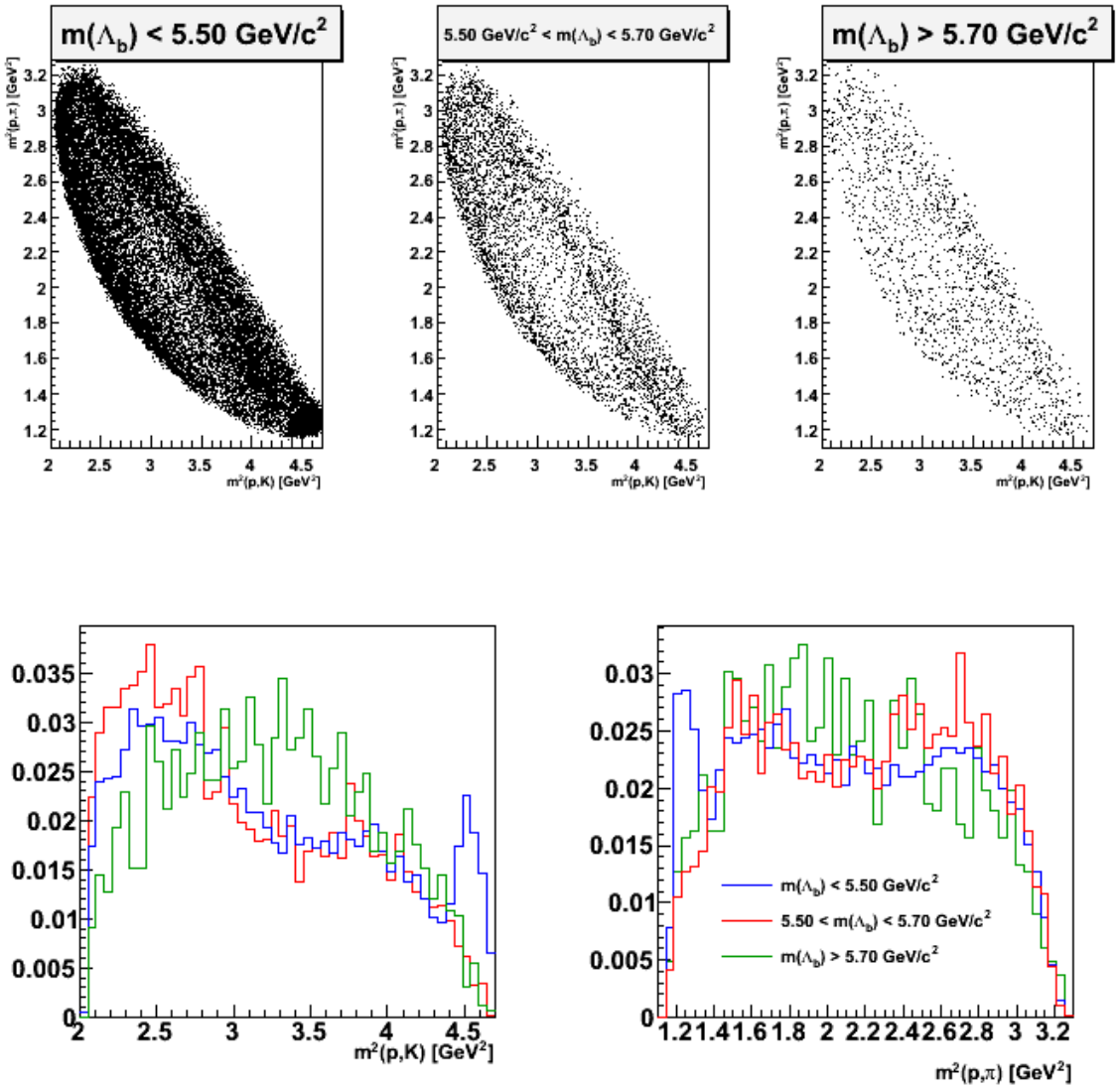
You might want to look at the Λ_b^0 and Λ_c masses for those events to make sure that they are really Λ_b^0 and Λ_c events.

A: For the Dalitz studies shown in the note, we have considered not only Λ_c from Λ_b^0 but also from the Λ_b^0 sidebands (to preserve statistics). The excess at high $m(p, K)$ comes from Λ_c decays in the lower Λ_b^0 sideband.

The Λ_b^0 signal region has only 5000 events to play with the Dalitz fractions.

Much more physics to look at in the Λ_c Dalitz decays that will not be a part of the Λ_b^0 lifetime analysis.

Dalitz Question



Conclusion

- Mistake in systematic error evaluation has been found and fixed.
- All systematic numbers have been updated. Changes total systematic error from $9.7\mu m$ to $8.0\mu m$.
- There is much more physics in Λ_c Dalitz decays than we can include in the Λ_b^0 lifetime analysis. We think that our Dalitz systematic error is sufficient.
- Progress is being made by LBL/JHU on the MC trigger modelling study. These plots will be shown soon.