

Prompt $\Lambda_c^+ \rightarrow p^+ h^+ h^-$ BF Update



Stephen Ogilvy

University of Glasgow



Paul Soler, Patrick Spradlin

- Performing relative measurements of Λ_c^+ BFs, hoping to make first observation of $\Lambda_c^+ \rightarrow p^+ \pi^- K^+$.
- Making independent measurements in prompt and semileptonic streams.
- Selection finalised, mass fits complete.
- Phase-space averaged efficiency calculations underway. Will eventually be replaced with event-by-event weightings for acceptance variations across phase space.

Efficiencies to be determined:

$$\frac{BF_{phh}}{BF_{pK\pi}} = \frac{N_{phh_{measured}}}{N_{pK\pi_{measured}}} \times \frac{\epsilon_{trig|phh}}{\epsilon_{trig|pK\pi}} \times \frac{\epsilon_{strip|phh}}{\epsilon_{strip|pK\pi}} \times \frac{\epsilon_{offline|phh}}{\epsilon_{offline|pK\pi}} \times \frac{\epsilon_{PID|phh}}{\epsilon_{PID|pK\pi}} \times \frac{\epsilon_{acc|phh}}{\epsilon_{acc|pK\pi}}$$

- Trigger and stripping efficiencies taken from MC.
- Offline (BDT in prompt, cut based in SL) efficiency taken from data.
- PID efficiency derived using Andy Powell's data-driven method.
- Acceptance efficiency from differing MC generator level cuts between SL modes (=1 for prompt).

Stripping Efficiencies

- Attain efficiencies of stripping (without PID requirements) from MC. Require reconstructed mass is Λ_c^+ mass $\pm 20\text{MeV}/c^2$.
- Revised since last presented with higher statistics.

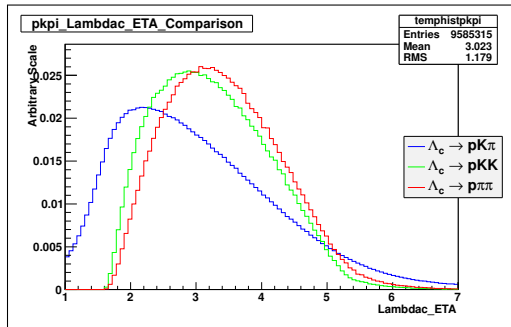
Stream	Mode	Generated	Stripped	$\epsilon_{strip acc}$ (%)
Prompt	$\Lambda_c^+ \rightarrow p^+ K^- \pi^+$	2,308,801	12,172	0.527 ± 0.009
	$\Lambda_c^+ \rightarrow p^+ K^- K^+$	2,289,265	8,966	0.392 ± 0.008
	$\Lambda_c^+ \rightarrow p^+ \pi^- \pi^+$	2,305,682	13,955	0.605 ± 0.010
	$\Lambda_c^+ \rightarrow p^+ \pi^- K^+$	2,321,303	12,018	0.518 ± 0.009
Semileptonic	$\Lambda_c^+ \rightarrow p^+ K^- \pi^+$	9,585,315	238774	2.491 ± 0.005
	$\Lambda_c^+ \rightarrow p^+ K^- K^+$	1,014,944	50,188	4.934 ± 0.022
	$\Lambda_c^+ \rightarrow p^+ \pi^- \pi^+$	1,017,068	55,626	5.480 ± 0.023

- Problem with SL MC generator level cuts: CF uses LHCbAcceptance, CS uses DaughtersinLHCb.
- Necessitates inclusion of further gen-level acceptance efficiency.

Gen-Level Efficiencies

- Proper treatment requires generation of new MC without gen-level cuts.
- As a first attempt at a correction apply both sets of generator level cuts to existing MC and calculate new effective efficiencies.
- Not perfect due to differing PDFs used in generation of kinematics in the η/θ range of interest depending on gen-level cut used.

- LHCbAcceptance: signal produced in $\theta = 0 - 400$ mrad.
- DaughtersInLHCb: charged daughters produced in $\theta = 10 - 400$ mrad.



- Incorporate the correction in stripping efficiencies, taken from MC.

Mode	$\epsilon_{strip acc}$ (%)	
	Before	After
$\Lambda_c^+ \rightarrow p^+ K^- \pi^+$	2.491 ± 0.005	4.957 ± 0.010
$\Lambda_c^+ \rightarrow p^+ K^- K^+$	4.934 ± 0.022	4.995 ± 0.022
$\Lambda_c^+ \rightarrow p^+ \pi^- \pi^+$	5.480 ± 0.023	5.604 ± 0.024

- Would naively expect the CF efficiency to be between the pKK and p $\pi\pi$ with an accurate correction.
- Currently generating MC without generator cuts to evaluate absolute efficiencies for LHCbAcceptance and DaughtersInLHCb.

Prompt Trigger Efficiencies

- Semileptonic chain:
 - L0Muon TOS
 - Hlt1TrackMuon TOS
 - Hlt2TopoMuNBodyBBDT TOS
- Prompt Chain:
 - L0Global TIS
 - Hlt1TrackAllL0 TIS
 - Hlt2Phys TIS
- No TOS prompt data in 2011 for CS/DCS modes.
- Take TIS efficiencies from MC. But MC has very low TIS efficiency...
- Efficiencies of entire chain:

Mode	$N_{\text{TIS sel}}$	$\epsilon_{\text{TIS sel}}(\%)$
$\Lambda_c^+ \rightarrow p^+ K^- \pi^+$	65 12301	0.53 ± 0.13
$\Lambda_c^+ \rightarrow p^+ K^- K^+$	34 6401	0.53 ± 0.18
$\Lambda_c^+ \rightarrow p^+ \pi^- \pi^+$	52 10720	0.49 ± 0.13

- No evidence of differing TIS efficiencies but test is very imprecise.

Prompt Trigger Efficiencies

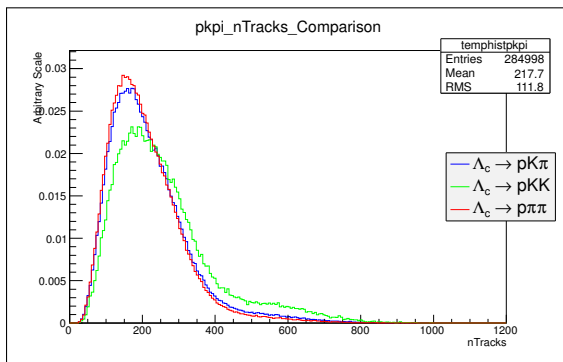
- Checking each level of the trigger individually is more precise but less comprehensive than checking the full chain.

Mode	N_{sel}	L0Global TIS		Hlt1TrackAllL0 TIS		Hlt2Phys TIS	
		$N_{\text{L0 sel}}$	$\epsilon_{\text{L0 sel}}$	$N_{\text{Hlt1 sel}}$	$\epsilon_{\text{Hlt1 sel}}$	$N_{\text{Hlt2 sel}}$	$\epsilon_{\text{Hlt2 sel}}$
kpi	12301	3124	0.2540 ± 0.0078	276	0.0224 ± 0.0027	468	0.0380 ± 0.0034
kk	6401	1667	0.2604 ± 0.0110	161	0.0252 ± 0.0039	254	0.0397 ± 0.0049
pipi	10720	2775	0.2589 ± 0.0085	266	0.0248 ± 0.0030	406	0.0379 ± 0.0037

- Again no evidence of differing TIS efficiencies.
- Will take semileptonic efficiencies from MC as use exclusive TOS chain here.

PIDCalib Update

- Have previously presented a PID calibration using daughter P and PT.
- Have new processing including event nTracks. Unfortunately distributions between modes are significantly different.



- Will necessitate a new calibration, coming soon.

- Generation of MC without cuts for gen-level effs.
- New PIDCalib with nTracks.
- Will present phase-space averaged results for relative \mathcal{BF} s at next meeting.
- Then incorporate event-by-event weighting to treat variations in acceptance across phase space.