

# FCNF and L/BNV in $\Lambda_C$ decays

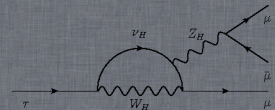
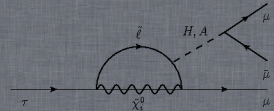
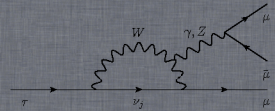
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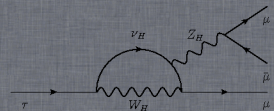
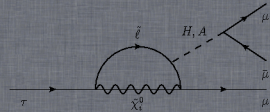
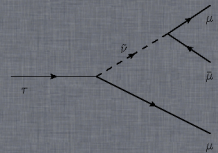
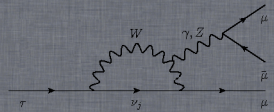


Motivation

Strategy

Comparison  $\Lambda_C$  vs  $\tau$

Work done so far



# Motivation

Following the success of  $\tau \rightarrow 3\mu$  and  $\tau \rightarrow p\mu\mu$  (published 2 weeks ago) we decided to go one step further and analyse analogous channels for  $\Lambda_c$ .

- Decays have different physics motivations:

$$\begin{array}{l} \tau \rightarrow 3\mu \text{ LFV} \\ \tau^+ \rightarrow p\mu^-\mu^+ |B-L|=0 \\ \tau^+ \rightarrow \bar{p}\mu^+\mu^+ |B-L|=0 \end{array} \left| \begin{array}{l} \Lambda_c \rightarrow 3\mu |B-L|=0 \\ \Lambda_c^+ \rightarrow p\mu^-\mu^+ \text{ FCNC} \\ \Lambda_c^+ \rightarrow \bar{p}\mu^+\mu^+ |B-L|=0 \end{array} \right.$$

- The current limits (@ 90% CL):

$$\mathcal{B}(\Lambda_c^+ \rightarrow p\mu^-\mu^+) < 4.4 \times 10^{-5}, \text{ arXiv:1107.4465}$$

$$\mathcal{B}(\Lambda_c^+ \rightarrow \bar{p}\mu^+\mu^+) < 9.4 \times 10^{-6}$$

$$\mathcal{B}(\Lambda_c^+ \rightarrow 3\mu) \text{ No constraints!}$$

# Strategy

Follow the strategy of  $\tau$  analysis:

- Take prompt  $\Lambda_c$ , separate approach to SL.
- Loose cut preselection.
- Train MVA on MC prompt signal and recalibrate on data.
- Mass resolution we expect similar to  $\tau$ .  $15\text{MeV}$  for  $3\mu$  and  $9\text{MeV}$  for  $p\mu\mu$ . Mean recalibrated from data.
- Normalize to  $\Lambda_c^+ \rightarrow pK^-\pi^+$ , or  $\Lambda_c^+ \rightarrow p\pi^-\pi^+$ .
- Optimise the binning in MVA.
- CLs method for limit.

# Comparison $\Lambda_c$ vs $\tau$

## Strong sides of $\Lambda_c$ :

- No SM background in  $3\mu$  case ( $D_s \rightarrow \eta(\mu\mu\gamma)\mu\nu$ )
- Smaller combinatorial background than in  $\tau$  decays. 😊

## Weaker sides of $\Lambda_c$ :

- Smaller no. of  $\Lambda_c$  than  $\tau$  to begin with.
- Need to study very carefully  $\Lambda_c$  production and backgrounds. 😞

# Work done so far

- $\Lambda_c \rightarrow p\mu\mu$  is already stripped (line was with  $\tau$  line all along).
- $\Lambda_c \rightarrow 3\mu$  is being stripped in incremental stripping.
- Requested 1M signal samples. Production will today most likely.
- Background studies.

# Possible background

<b>Resonance</b>	$\mathcal{B}(\lambda_c \rightarrow pX)$	$\mathcal{B}(X \rightarrow \mu\mu)$
$\eta$	UNKNOWN	$(5.8 \pm 0.6) \times 10^{-6}$
$\rho^0$	UNKNOWN	$(4.55 \pm 0.28) \times 10^{-5}$
$\omega$	UNKNOWN	$(9.1 \pm 3.0) \times 10^{-5}$
$f(980)$	$(2.8 \pm 1.9) \times 10^{-3}$	UNKNOWN
$\phi$	$(8.2 \pm 2.7) \times 10^{-4}$	$(2.89 \pm 0.19) \times 10^{-4}$
<b>Resonance</b>	$\mathcal{B}(\lambda_c \rightarrow pX)$	$\mathcal{B}(X \rightarrow \mu\mu\gamma)$
$\eta$	UNKNOWN	$(3.1 \pm 0.4) \times 10^{-4}$

# $\Lambda_c$ production mechanism

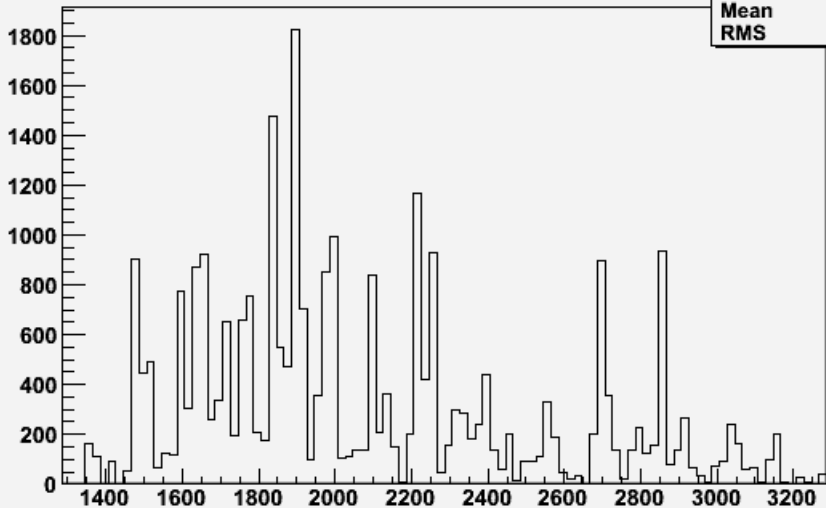
Process	$\mathcal{B}(X \rightarrow \lambda_c Y)$
$\Lambda_B \rightarrow \Lambda_c^+ \pi^-$	$0.0088 \pm 0.0032$
$\Lambda_B \rightarrow \Lambda_c^+ \ell \nu$	$0.05 \pm 0.014$
$\Lambda_B \rightarrow \Lambda_c^+ \ell \nu \pi \pi$	$0.056 \pm 0.031$
$B \rightarrow \Lambda_c^+ p \pi \pi^0$	$(1.8 \pm 0.6) \times 10^{-3}$
$B \rightarrow \Lambda_c^+ p \pi \pi \pi$	$(2.3 \pm 0.7) \times 10^{-3}$
$B \rightarrow \Lambda_c^+ \Lambda_c^- K^+$	$(8.7 \pm 3.5) \times 10^{-4}$
$B \rightarrow \Sigma(2455) p \pi^0$	$(4.4 \pm 1.8) \times 10^{-4}$
$B \rightarrow \Sigma(2455) p \pi \pi$	$(4.4 \pm 1.7) \times 10^{-4}$
$B \rightarrow \Sigma(2455)^- p \pi \pi$	$(2.8 \pm 1.2) \times 10^{-4}$



# Backup Slides

Mass Lc

mylc_h	
Entries	28615
Mean	2084
RMS	442.8



From two B trees and other

hcat0

Entries 23241

Mean 2055

RMS 406.4

