Charming Searches for the Origin of Matter

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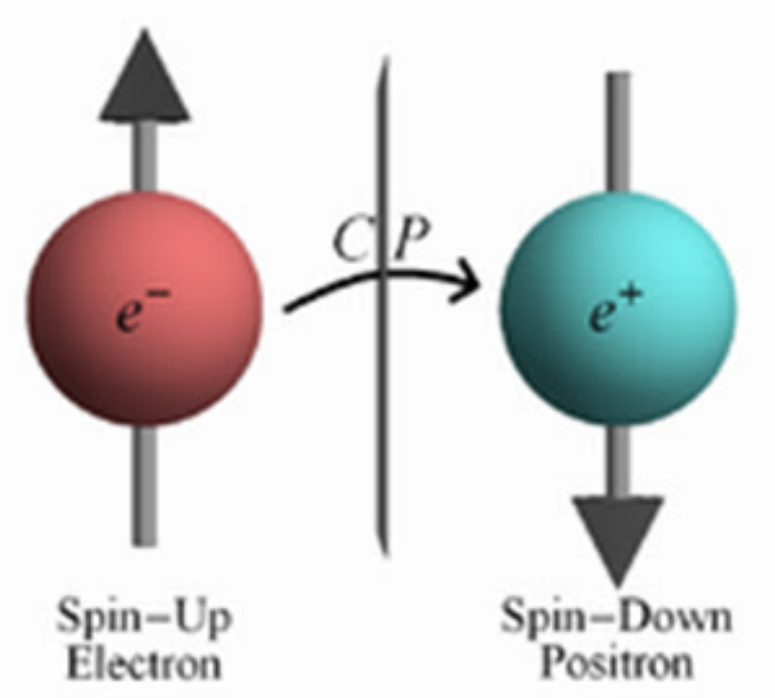
Some Important Terms

- Baryogenesis- production of an excess of matter over anti-matter in the early universe
- CP Asymmetry- a difference in the behavior of a matter particle and it's antimatter partner

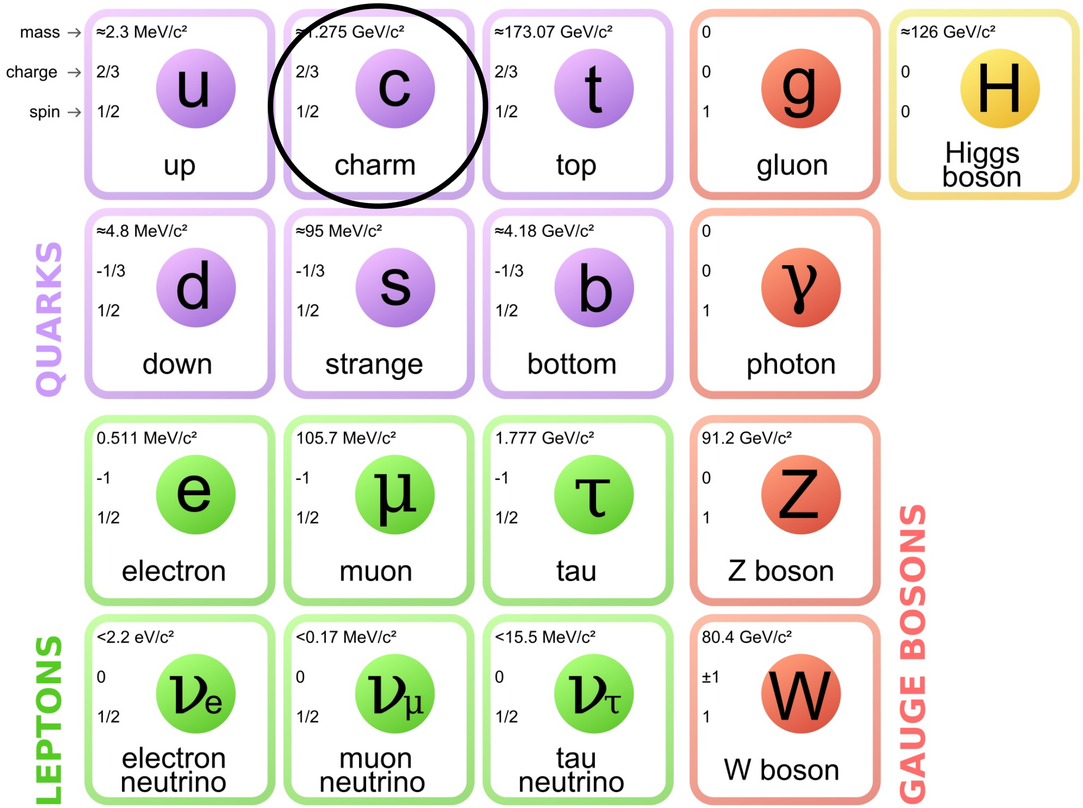


What happened to the antimatter?

- The Standard Model (SM) predicts that there should be roughly the same amount of matter and antimatter, which would then annihilate, leaving behind a bunch of light
- We exist and are made of things other than light, so clearly this is an incomplete picture
- There must be some source of CP violation that is not predicted by the SM

Why charm particles?

- SM predicts that CP asymmetries in charm particles should be very small (~10^{-3}-10^{-4})
- So, if you see any asymmetry it is significant
- Charm baryons in particular don't have many CP asymmetry measurements, so lots of room for new results
- This is the main focus of the Mississippi Belle II group



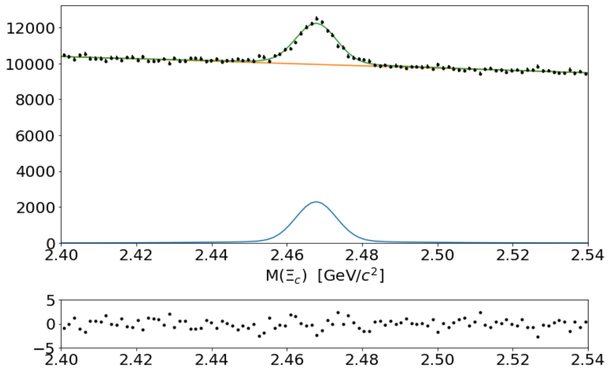
Results for $\Xi_c^+ \to \Sigma^+ h^+ h^-$ using MC15rd default MC

- Truth-matching was used to extract the raw asymmetries and compare them with results from the invariant mass fits.
- $\Xi_c^+ \to \Sigma^+ \pi^+ \pi^-$

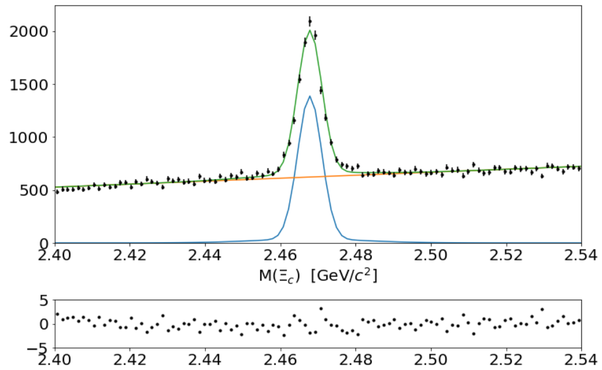
MC (~1680 /fb)	A_{raw} % ($\Xi_c^+ \to \Sigma^+ \pi^+ \pi^-$)	A_{raw} % ($\Lambda_c^+ \to \Sigma^+ \pi^+ \pi^-$)	A_{cp} % ($\Xi_c^+ \to \Sigma^+ \pi^+ \pi^-$)
Truth-matched	6.27 ± 0.59	6.33 ± 0.15	-0.05 ± 0.61
Fitted	6.22 ± 2.08	6.60 ± 0.44	-0.38 ± 2.13

- $\Xi_c^+ \to \Sigma^+ K^+ K^-$

MC (~1680 /fb)	A_{raw} % ($\Xi_c^+ \to \Sigma^+ K^+ K^-$)	A_{raw} % ($\Lambda_c^+ \to \Sigma^+ K^+ K^-$)	A_{cp} % ($\Xi_c^+ \to \Sigma^+ K^+ K^-$)
Truth-matched	5.46 ± 1.08	6.07 ± 0.79	-0.61 ± 1.34
Fitted	5.91 ± 1.68	6.46 ± 0.73	-0.55 ± 1.83



$\Xi_c^+ \to \Sigma^+ \pi^+ \pi^-$



$\Xi_c^+ \to \Sigma^+ K^+ K^-$

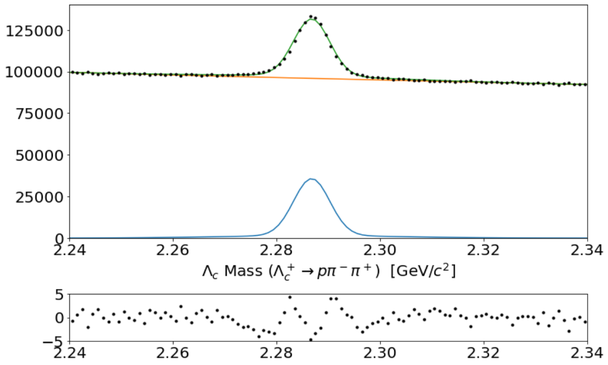
Results for $\Lambda_c^+ \to p^+h^+h^-$ using MC15rd default MC

- Truth-matching was used to extract the raw asymmetries and compare them with results from the invariant mass fits.
- *Subset of the full MC sample corresponding to 105 /fb was used for $D^0 \to K^-\pi^+\pi^+\pi^-$ mode.
- $\Lambda_c^+ \to \mathrm{p}^+\pi^+\pi^-$

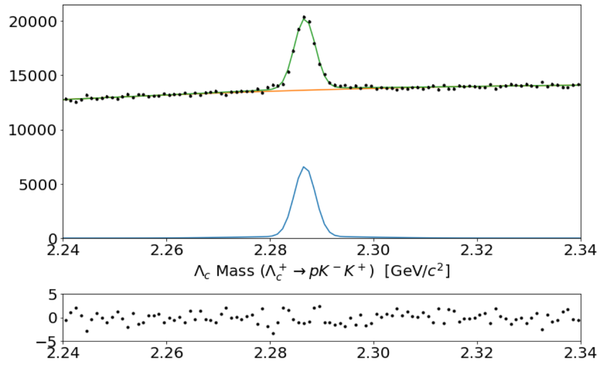
MC (~1680 /fb)	A_{raw} % ($\Lambda_c^+ \to \mathrm{p}^+\pi^+\pi^-$)	A_{raw} % ($\Lambda_c^+ \to \mathrm{p}^+\pi^+K^-$)	A_{raw}% ($D^0 \to K^-\pi^+\pi^+\pi^-$)*	A_{cp} % ($\Lambda_c^+ \to \mathrm{p}^+\pi^+\pi^-$)
Truth-matched	3.23 ± 0.17	2.80 ± 0.07	-0.86 ± 0.07	-0.39 ± 0.20
Fitted	3.79 ±0.53	2.82 ± 0.11	-0.95 ± 0.19	0.02 ± 0.57

- $\Lambda_c^+ \to \mathrm{p}^+K^+K^-$

MC (~1680 /fb)	A_{raw} % ($\Lambda_c^+ \to \mathrm{p}^+K^+K^-$)	A_{raw} % ($\Lambda_c^+ \to \mathrm{p}^+\pi^+K^-$)	A_{raw}% ($D^0 \to K^-\pi^+\pi^+\pi^-$)*	A_{cp} % ($\Lambda_c^+ \to \mathrm{p}^+K^+K^-$)
Truth-matched	3.69 ± 0.52	3.22 ± 0.06	-0.63 ± 0.05	-0.16 ± 0.53
Fitted	3.33 ± 1.20	3.19 ± 0.13	-0.74 ± 0.19	0.60± 1.22



$\Lambda_c^+ \to p^+\pi^+\pi^-$



$\Lambda_c^+ \to p^+K^+K^-$

Questions?