University of Cincinnati QuarkNet Center

Improving the significance of Ξ^0 signal by making quality cuts to π^- daughters

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The purpose of our research was to study XiC0 ($\Xi_c^0 \to \Xi^-\pi^+; \Xi^- \to \Lambda\pi^-; \Lambda \to \pi^- p$) using the data from LHCb experiment at CERN. The first thing we did was to add cuts to the daughter particles. After the signal was improved slightly with the first daughters, the other daughters were added one by one as well as other cuts. This process was repeated until reaching the parent particle. While adding cuts to the daughters, we had a pass graph, which represents the entries that passed the cuts stated, and a fail graph, for the entries that failed one or more of the cuts. After improving the signal, we tried a single Gaussian fit. Once the residuals of the fit were reasonable, we inserted a table that represented the sigma value, which was 8.4 ± 0.7 for the XiC0. We repeated this process with the OmegaC0 ($\Omega_c^0 \to \Omega^-\pi^+; \Omega^- \to \Lambda K^-; \Lambda \to \pi^- p$), and got a reasonable signal. We then attempted the decay chain of OmegaC+ ($\Omega_c^+ \to \Omega^- K^+\pi^+; \Omega^- \to \Lambda K^-; \Lambda \to \pi^- p$), but there was no noticeable peak and the cuts used did not help to reveal one.

Improving the significance of Ξ^- mass plot by making quality cuts to π^- daughters

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The purpose of our research is to improve the signal to background ratio of the $\Xi_c^+ \to \Xi^-\pi\pi; \Xi^- \to \Lambda\pi^-; \Lambda \to p\pi^-$. All of the data is from experiments conducted at the LHCb in CERN. The procedure in use to achieve this goal, starting from the last decay in the cascade, is to make selection on the mass distribution entries until the signal is visible above the background. Then move to the parent particle and repeat up the decay chain. Selections used in the study include probabilities that a track is electronic noise, lifetime, particle identification, position, mass, and corrected mass. Certain selections are used at different stages in the decay chain resulting in an Ξ_c^+ mass measurement of 2468.84 ± 0.12 MeV / c^2, a sigma of 6.3 ± 0.1 $/c^2$ and signal entries of 7181 ± 129. Results of the Ξ_c^+ are used to look at the Ξ_c^0 particle; this is inconclusive, as there is not a signal in the analyzed data. A further study on the Ξ_c^+ would include analysis on the systematics that are involved with this mass study. A further study involving the Ξ_c^0 would be useful given that more data is used in the mass study.

Improving the significance of Ξ^+ mass plot by making quality cuts to π^- daughters

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The purpose of our research was to study Ξ_c^+ ($\Xi_c^+ \to \Xi^- \pi^+\pi^+; \Xi^- \to \Lambda\pi^-; \Lambda \to \pi^- p$) using the data from LHCb experiment at CERN. Our first action was to find and apply appropriate cuts to the first daughter particles. After we improved the signal peak and eliminated portions of the background, we repeated the process to the other daughter particles. Each time we repeated this process further up the decay chain, the signal improved more and more. In addition to having a histogram of the data that passed the cuts, we also had one containing all of the failed entries.

When our signal was improved and all of our cuts were made, we fitted the histogram with a single Gaussian fit. When the fit and its residuals were reasonable, we inserted a table with the sigma value, which was 6.4 ± 0.2 for the Ξ^+. Our next step was to look up the decay chain one more step, and study Ξ^0 ($\Xi^0 \rightarrow \Xi^+\pi^-$; $\Xi^+ \rightarrow \Xi^-\pi^+\pi^+$; $\Xi^- \rightarrow \Lambda\pi^-$; $\Lambda \rightarrow \pi^- p$), but there was no peak and our cuts did not reveal one.