The Photoproduction of Strangeness in $\gamma p \rightarrow \Lambda K^+ \pi^+ \pi^-$ with CLAS at Jefferson Lab

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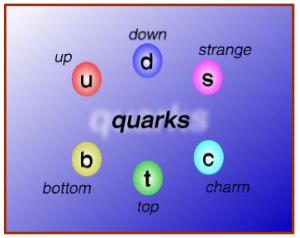
Overview

- Motivation
- CLAS g12 Experiment
- Analysis
- Summary

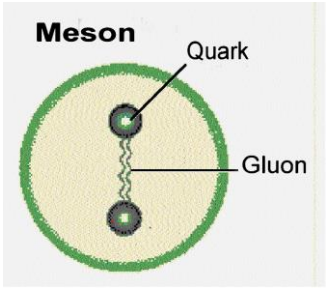
Motivation

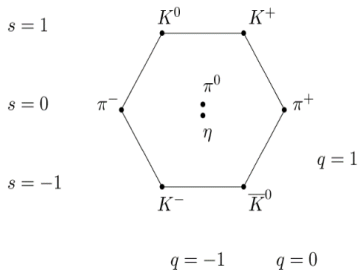
➢ **Quantum Chromodynamics is the theory of strong interactions mediated by the "color" force.**

- Baryons are half integer spin particles (fermions)
- Mesons are integer spin particles (bosons).
- In the constituent Quark Model, a meson is made up of a quark-antiquark pair. A baryon is made up of three quarks.

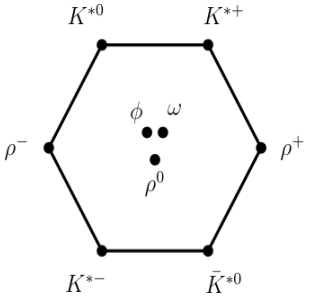


➢ **In this research, we are looking for excited strange mesons and strange gluonic hybrids through photoproduction.**

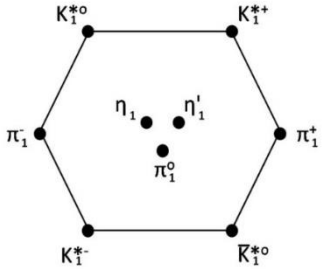




$J^{PC} = 0^{-+}$



$J^{PC} = 1^{--}$



$J^{PC} = 1^{-+}$

CLAS g12 Experiment

- Jefferson Lab hosts CEBAF (Continuous Electron Beam Accelerator Facility) that delivers up to a 6 GeV electron beam to three halls: A, B and C.

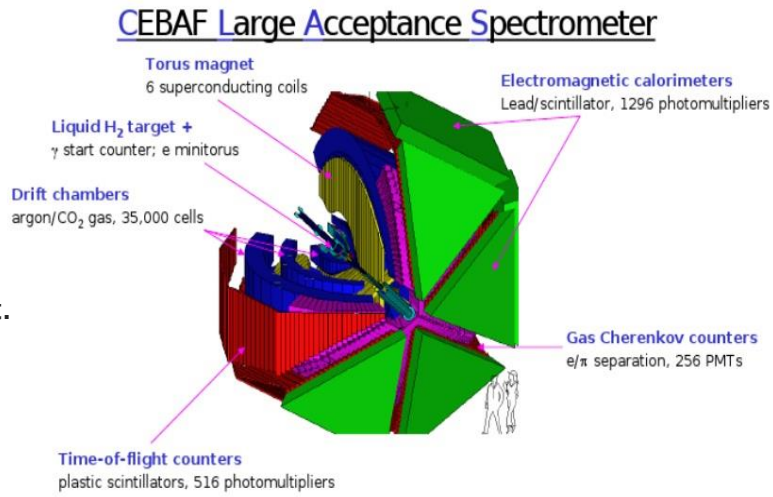
- Hall B hosts the CEBAF Large Acceptance Spectrometer (CLAS).

- The g12 experiment was primarily approved for exotic mesons and excited cascade states studies.

- Up to a 5.5 GeV photon beam incident on a LH_2 target.

- 26.2 billion triggers (68 Pb^{-1}, 126 TB) of various topologies.

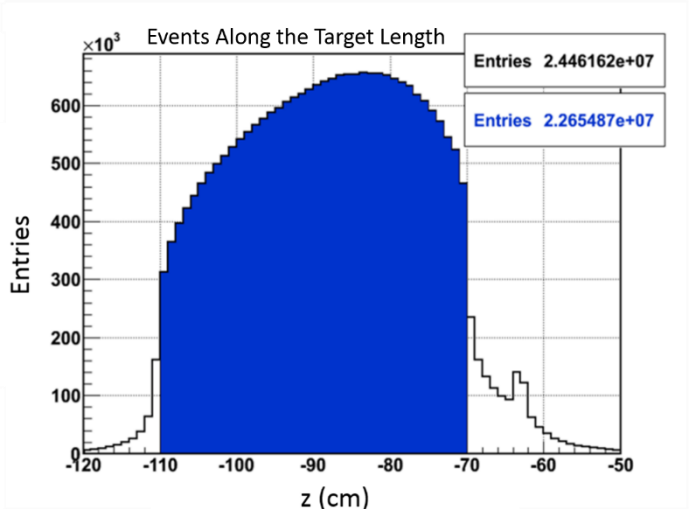
- About 25M $\gamma p \rightarrow p\, K^+ \pi^+ \pi^- [\pi^-]$ events from the g12 Dataset.

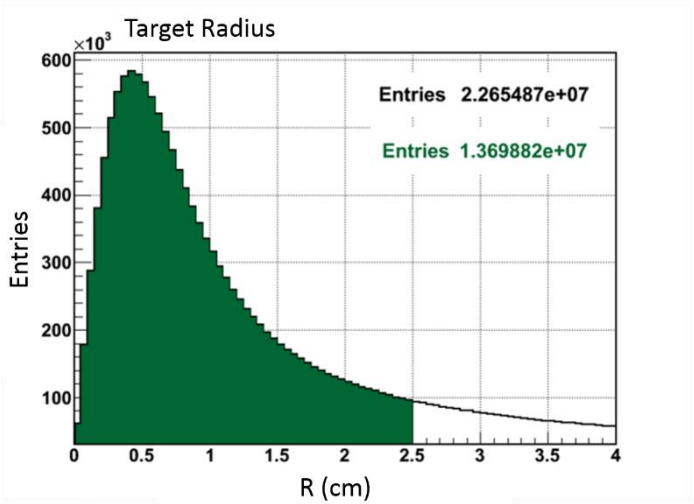


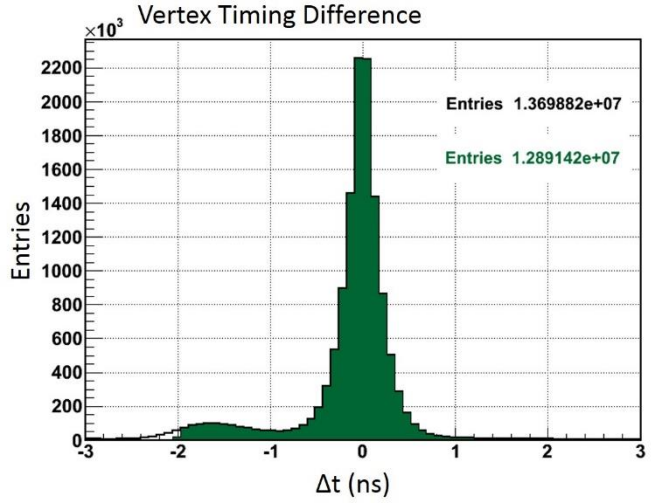
Analysis

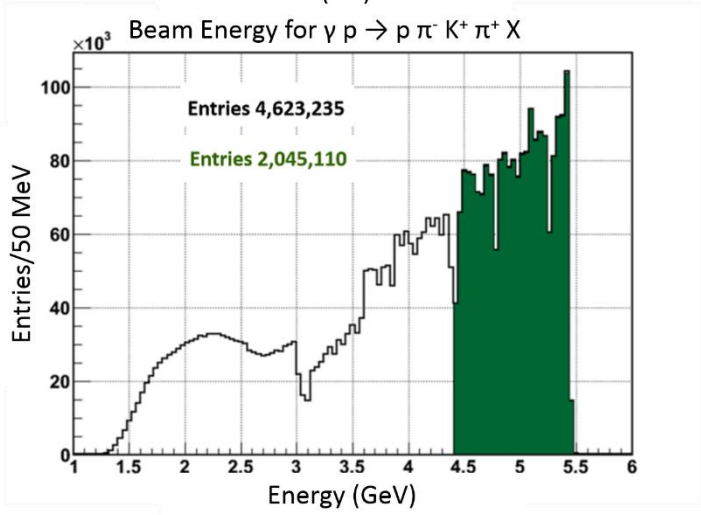
Vertex and Beam Energy Selection For $\gamma p \rightarrow p \pi^- K^+ \pi^+ X$

-Corrections applied in this part include: beam energy loss, particle energy loss and momentum corrections.





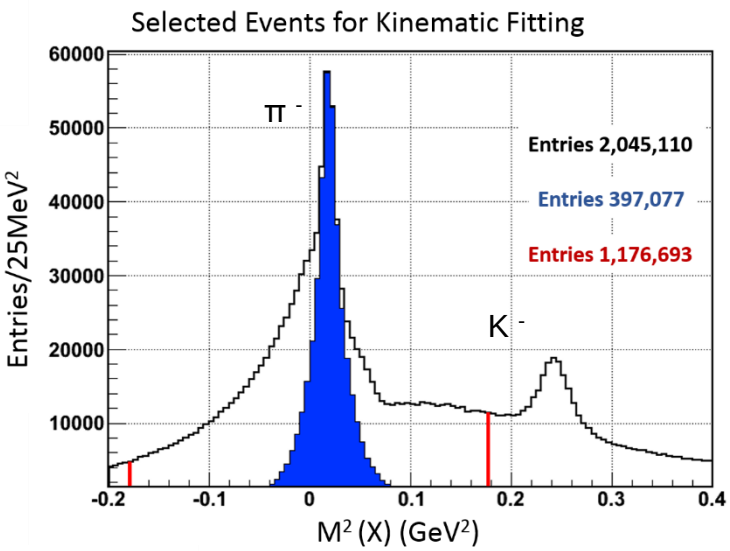


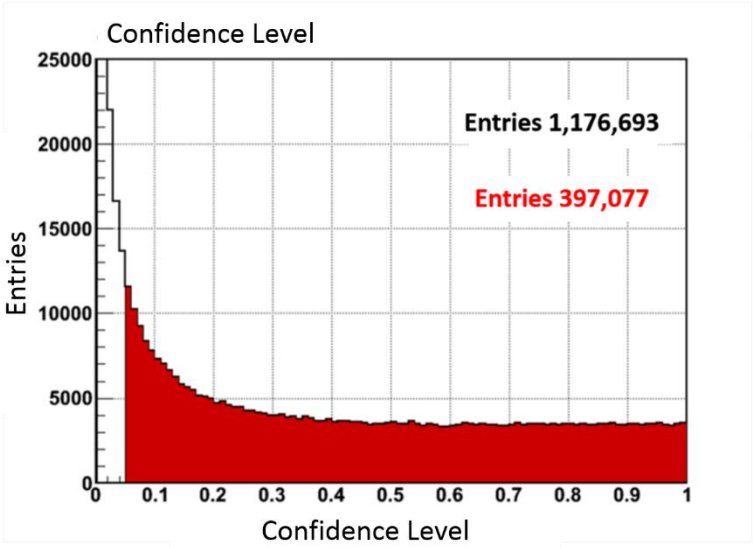


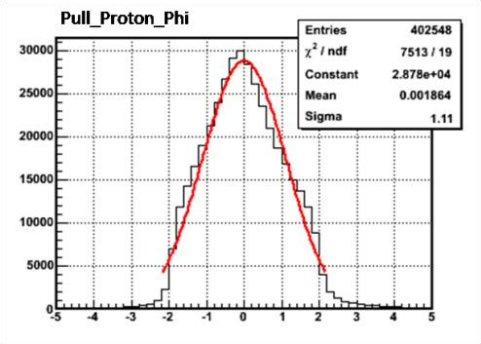
Analysis

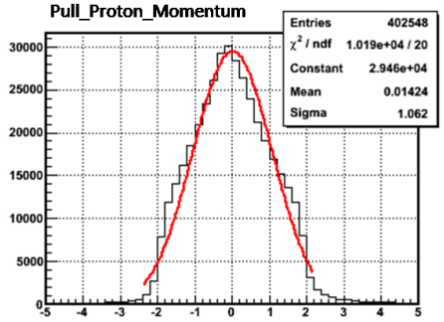
Missing Pion Selection

- The missing mass is fit to a pion.
- 5% confidence level cut is applied on the data.





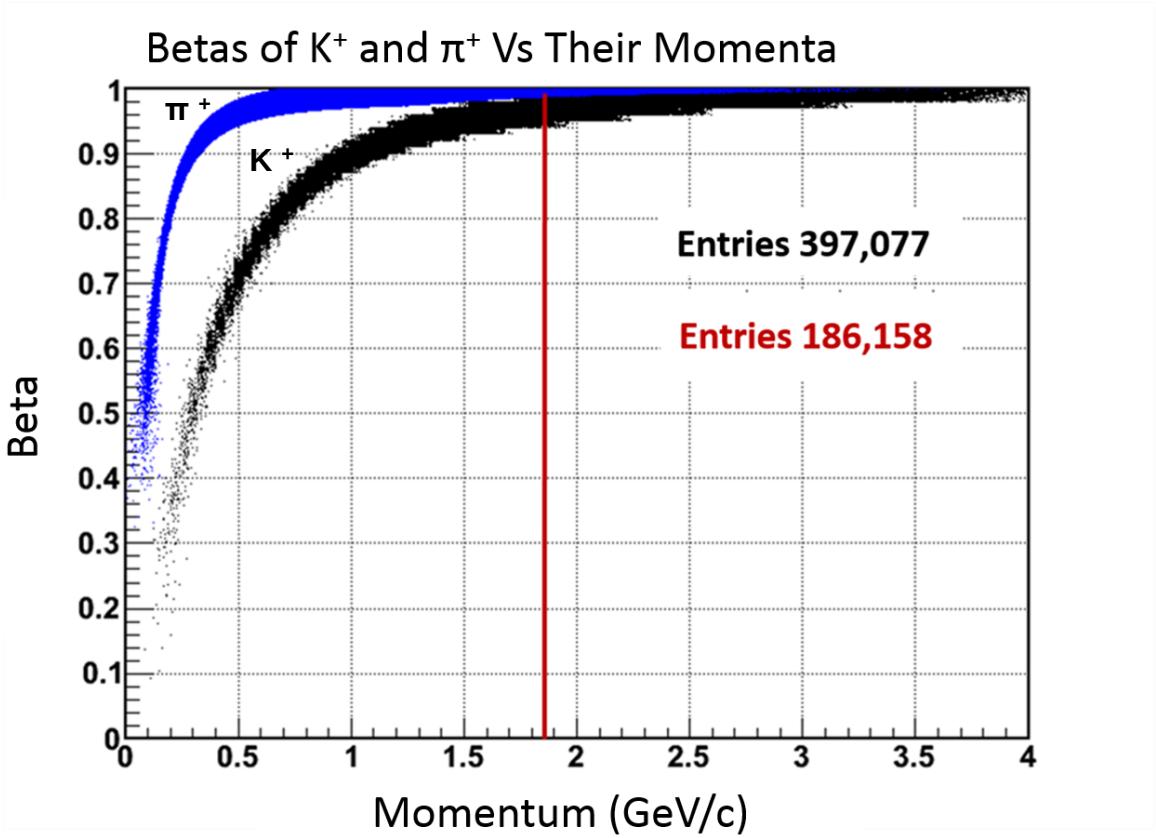




Analysis

Pion and Kaon Identification

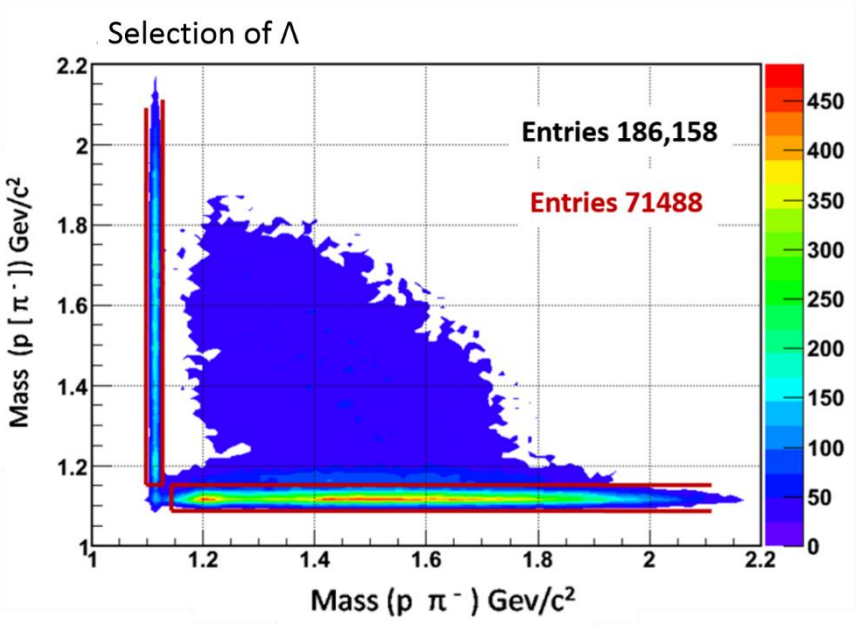
$\beta = P/E$



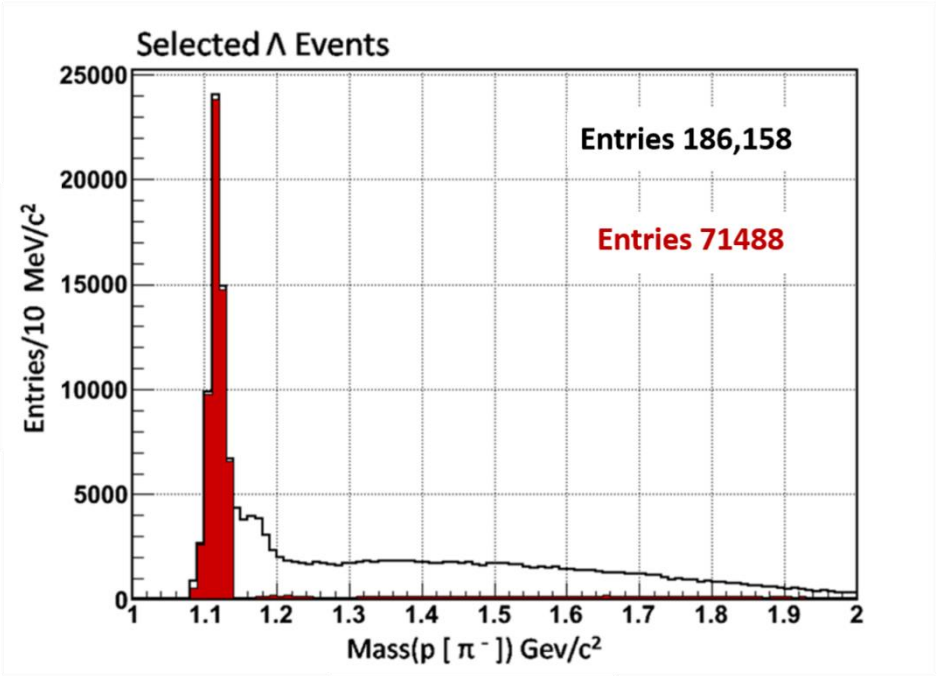
Analysis

Identification of Λ

$\gamma p \rightarrow \Lambda K^+ \pi^+ \pi^-$

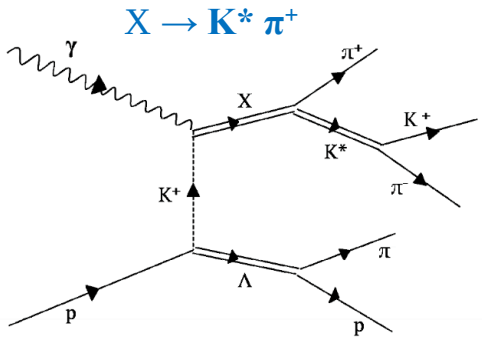


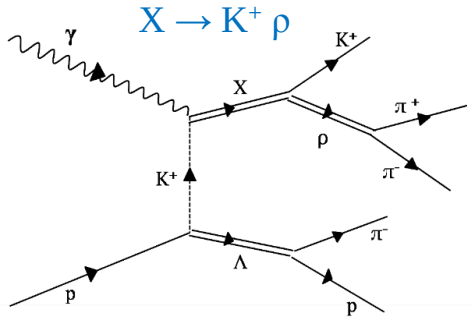
- Λ is selected through its $p\pi^-$ decay
- Some of the missing pions come from a lambda decay, however they only make 15% of the total lambda events.

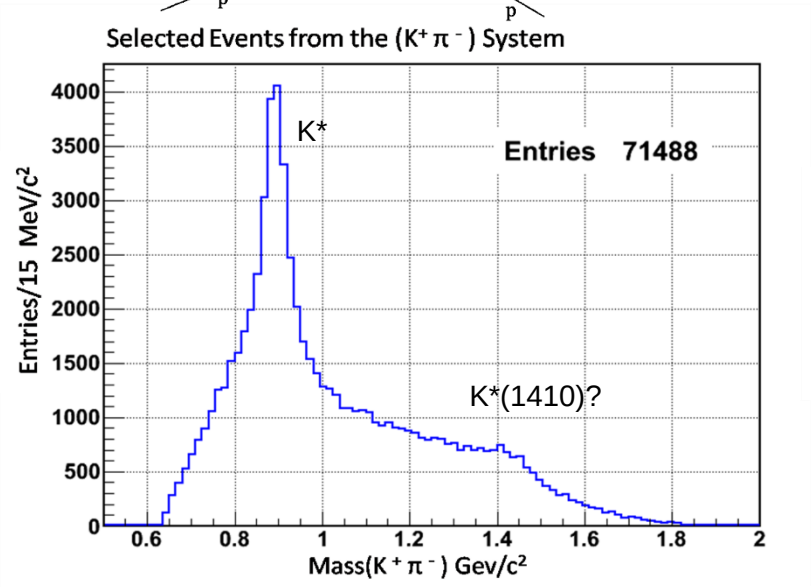


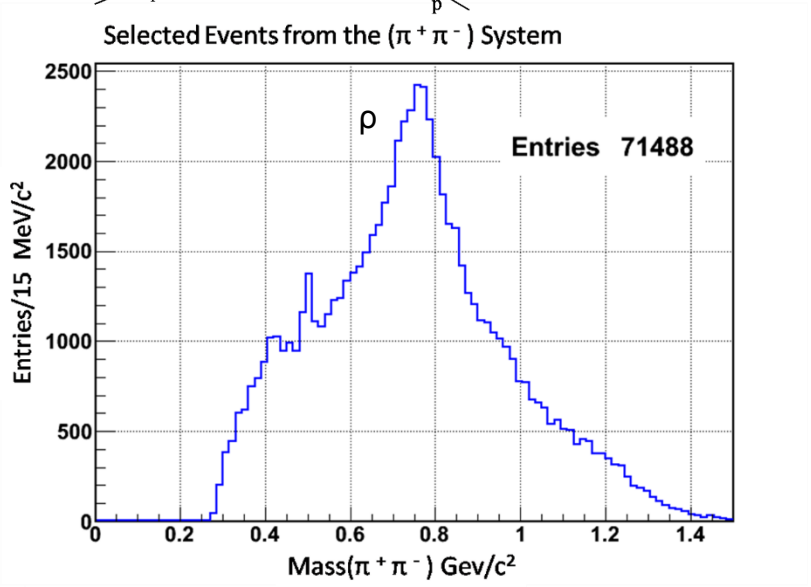
Analysis

Intermediate States in ($K^+ \pi^+ \pi^-$)







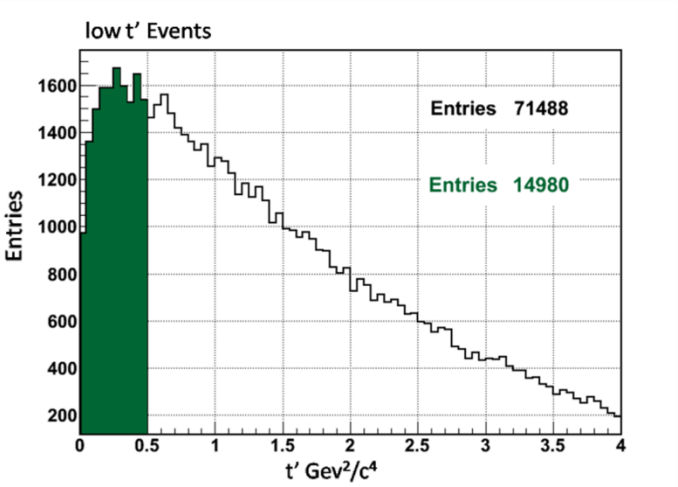


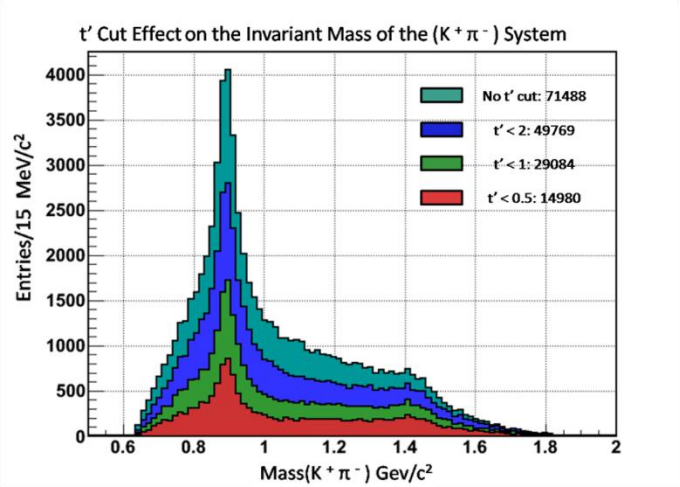
Analysis

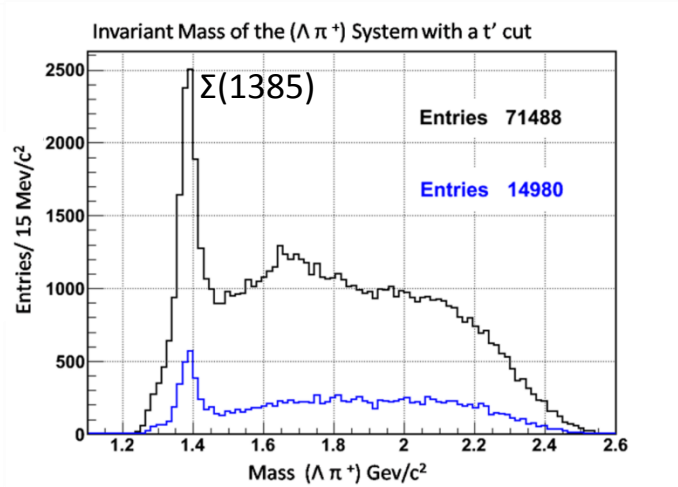
Enhancement of the Meson Production with a t' cut

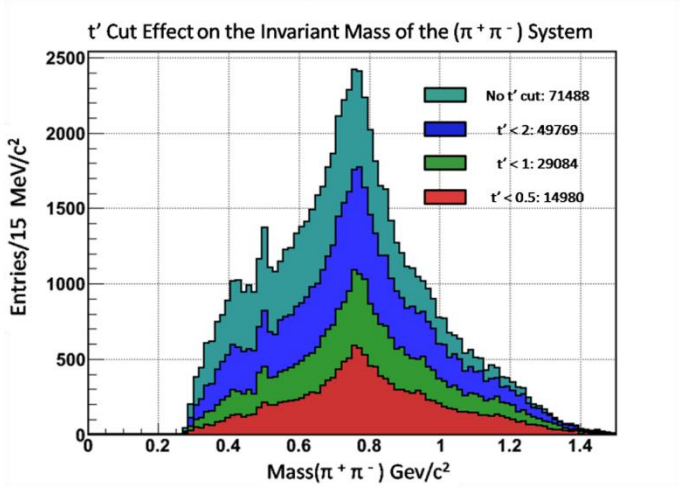
Select events of $t' < 0.5\ GeV^2/c^4$

$t' = t - t_0$



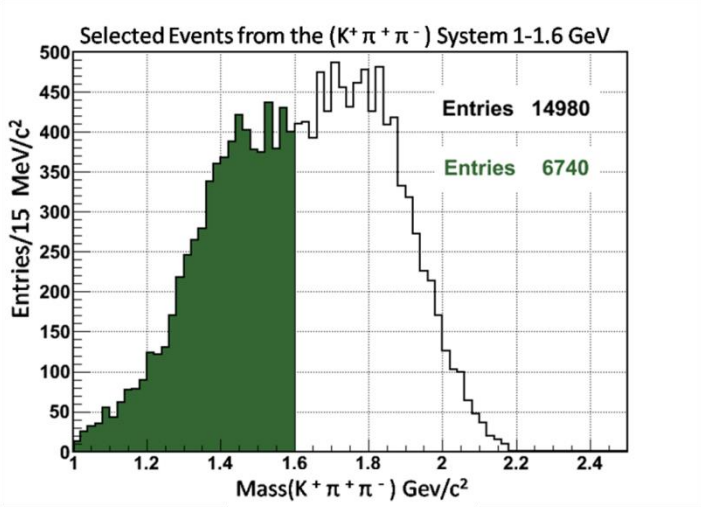


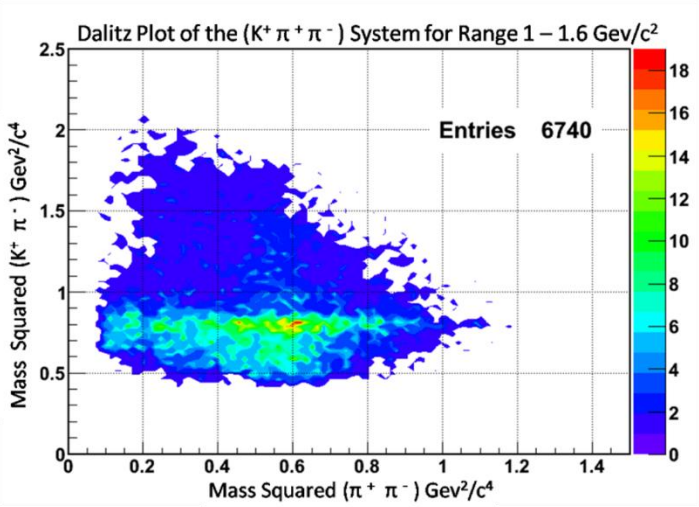


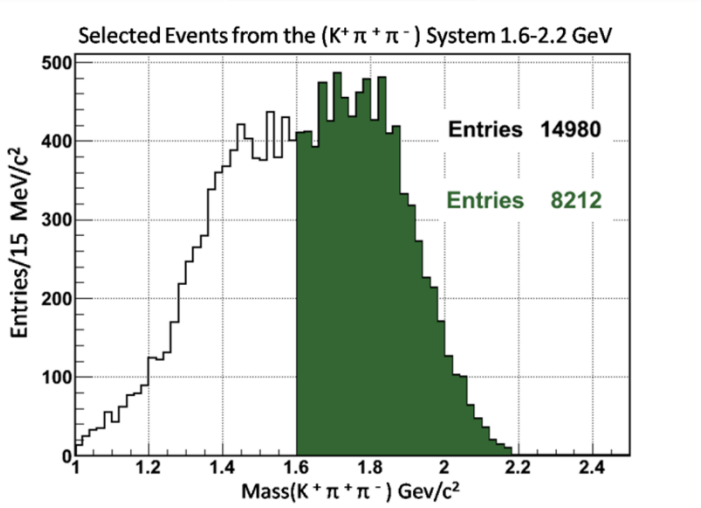


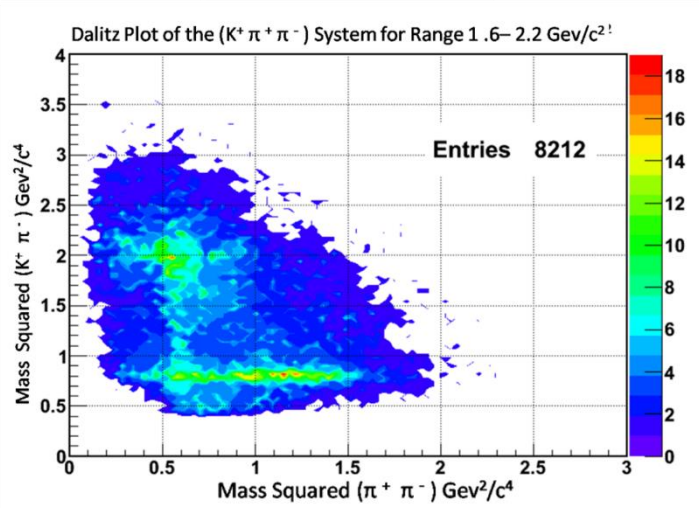
Analysis

Expected Decay Modes of ($K^+ \pi^+ \pi^-$)









Summary & Future Plans

- There are about 15K events being used for studying the photoproduction of strange mesons.
- The final decay modes of the ($K^+ \pi^+ \pi^-$) system include the ($K^* \pi^+$) and the (ρK^+).
- Partial Wave Analysis is in progress.
- Effect of the Baryon background on PWA will be studied.
- Study the Cross Section of the ($\Lambda K^+ \pi^+ \pi^-$) System.

Thank you!