Event generator for the $\gamma\, p \rightarrow p\, K^{+}\, K^{-}$ events

Rebecca Osar and Michael Dugger
College of Integrative Sciences and Arts, Arizona State University, Polytechnic

Introduction

GlueX detector

- photon beam and proton target

Three decay models of $\gamma\, p \rightarrow p\, K^{+}\, K^{-}$ interaction:

$\gamma\, p \rightarrow p\, K^{+}K^{-}$

$\gamma\, p \rightarrow K^{+}\Lambda^{*}_{1520}$ $\hookrightarrow K^{-}\, p$

$\gamma\, p \rightarrow p\, \varphi$ $\hookrightarrow K^{+}K^{-}$

Programs and Methods

C++

- event generator
- ROOT scripts

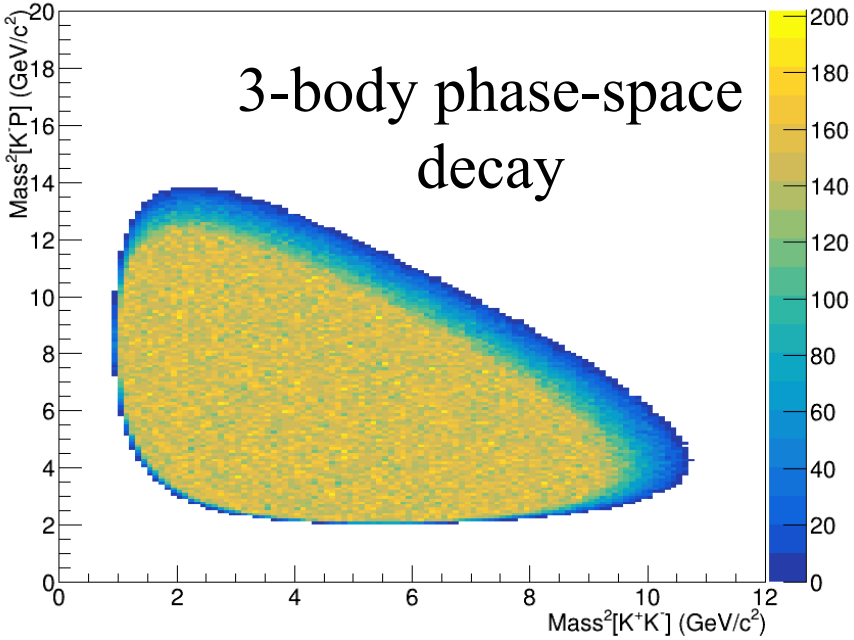
ROOT

- histograms
  - Dalitz plots
  - mass plots

Results

Dalitz plots

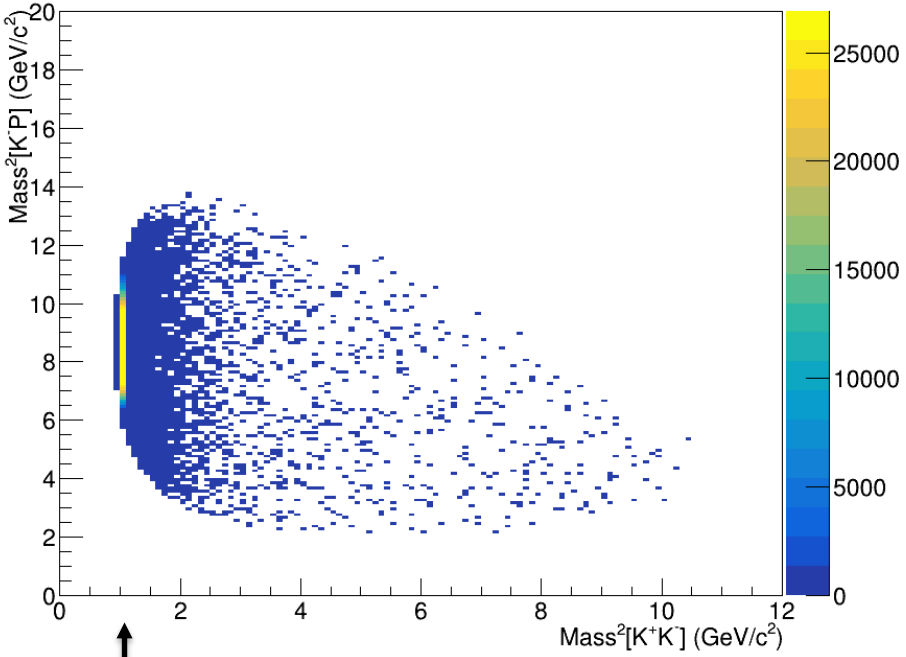
- Decay to particles x_1 x_2 x_3 (pK^+K^-)
- Dalitz plot: $Mass^2(x_1\ x_2$ system) versus $Mass^2(x_2\ x_3$ system)
- A pure 3-body phase-space decay produces flat distribution over allowed range for fixed energy



Results

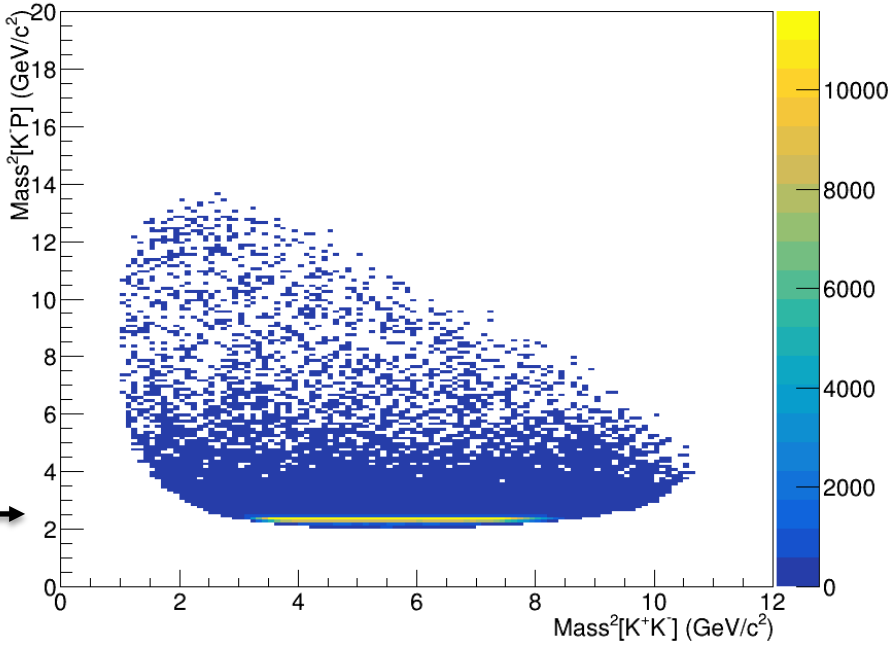
Dalitz plots

Phi Decay $\varphi\, p \rightarrow K^+\, K^-\, p$



Mass^2 of φ = 1 GeV/c^2

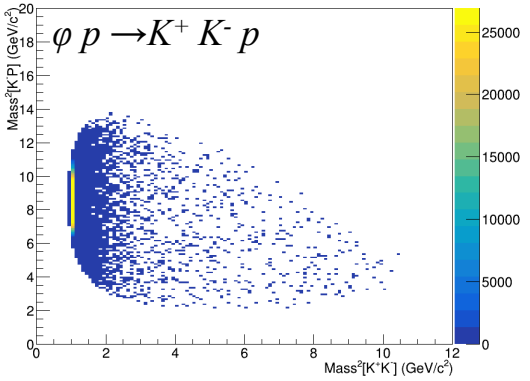
Lambda Decay $K^+\, \Lambda_{1520} \rightarrow K^+\, K^-\, p$

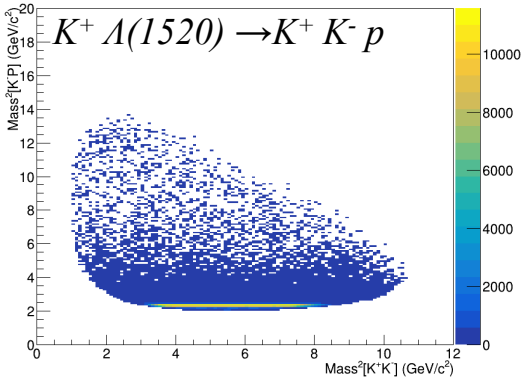


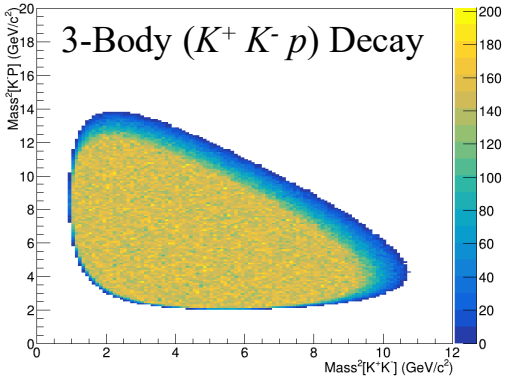
Mass^2 of Λ^*_{1520} = 2.31 GeV/c^2 →

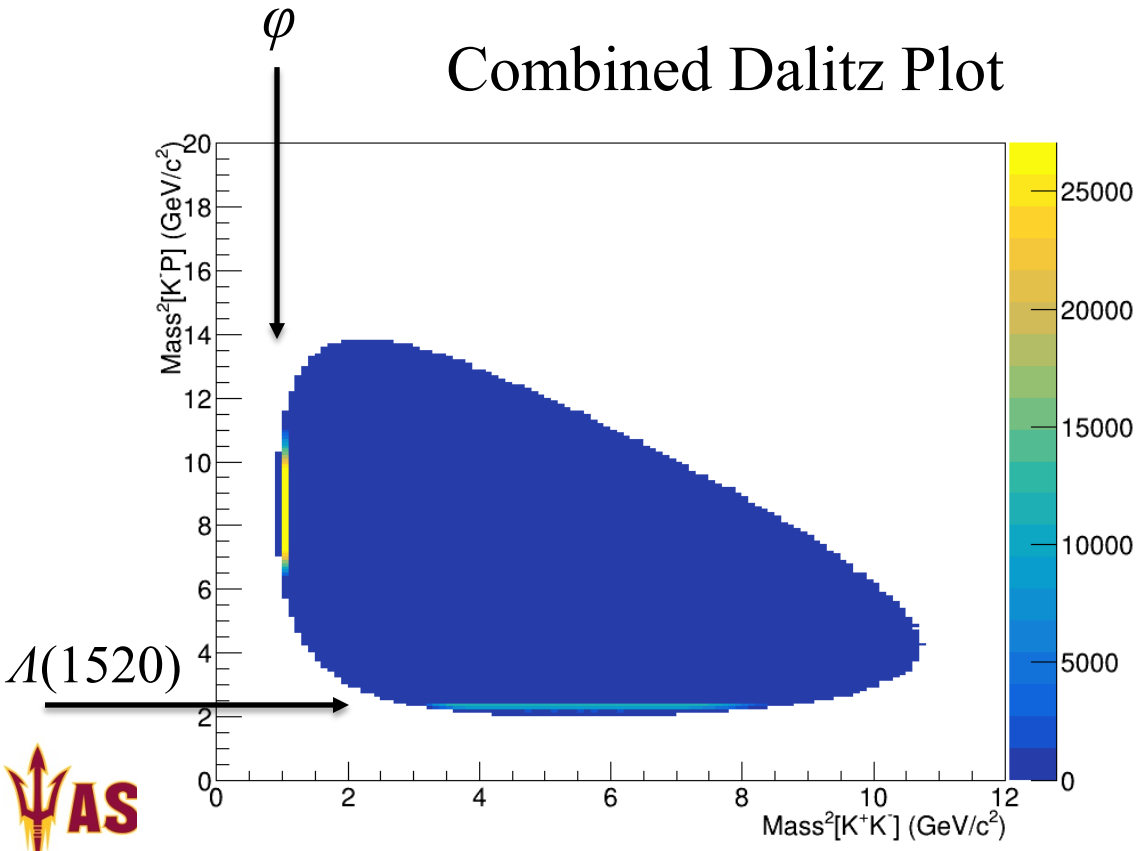
Results

Dalitz plots





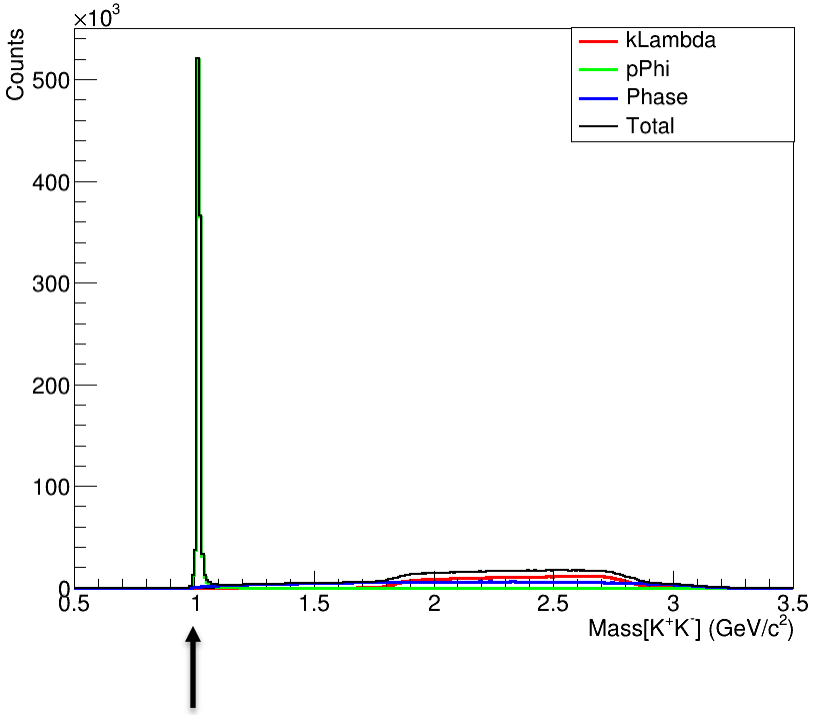




Results

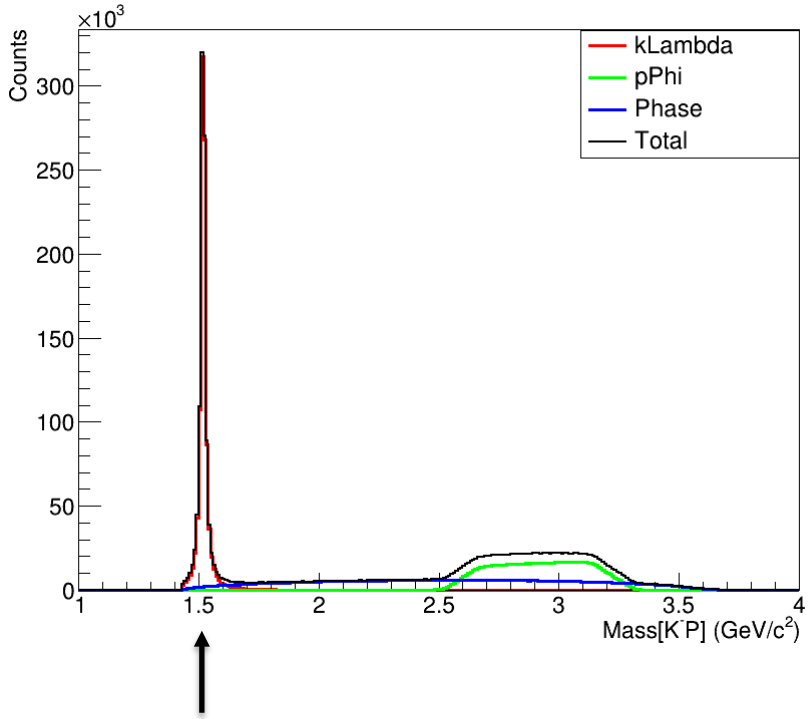
Mass plots

Counts vs Mass of $K^+ K^-$



Mass of φ = 1.02 GeV/c²

Counts vs Mass of $K^- p$



Mass of $\Lambda(1520)$ = 1.52 GeV/c²

Notes:

- Relative intensities of the Λ and φ are not expected to be as dominate in real data
- Momentum smearing due to the detector response will cause the widths to be considerably larger when run through detector simulation

Uses and Possible Future Directions

Expand code to model other interactions:

- Include the excited Λ states near 1.8 GeV/c^2
- Model $\gamma\, p \rightarrow K^+\, K^+\, \Xi^-$,where $\Xi^- \rightarrow \pi^-\, \Lambda$
- Include virtual photon (for CLAS12 detector studies)

Use output files as input for detector simulation studies

- Determine detector efficiencies for various final states
- Study energy loss corrections for CLAS12 detector

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