Identifying Reactions in $\gamma p \rightarrow \pi^- \pi^+ \pi^0 p$

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FSU

GlueX

Introduction to GlueX & Data

- GlueX's goal is to learn about **light mesons** and search for **hybrid mesons**.
- The GlueX detector allows the reconstruction of **exclusive final states**.
- The data analyzed consists of a **photon** and **proton** producing $\pi^-\pi^+\pi^0$ p. Different intermediate states are present in the data, but we'll look at ω specifically.
- We are interested in 2 different arrangements produced from interaction: **Type 1 & Type 2**
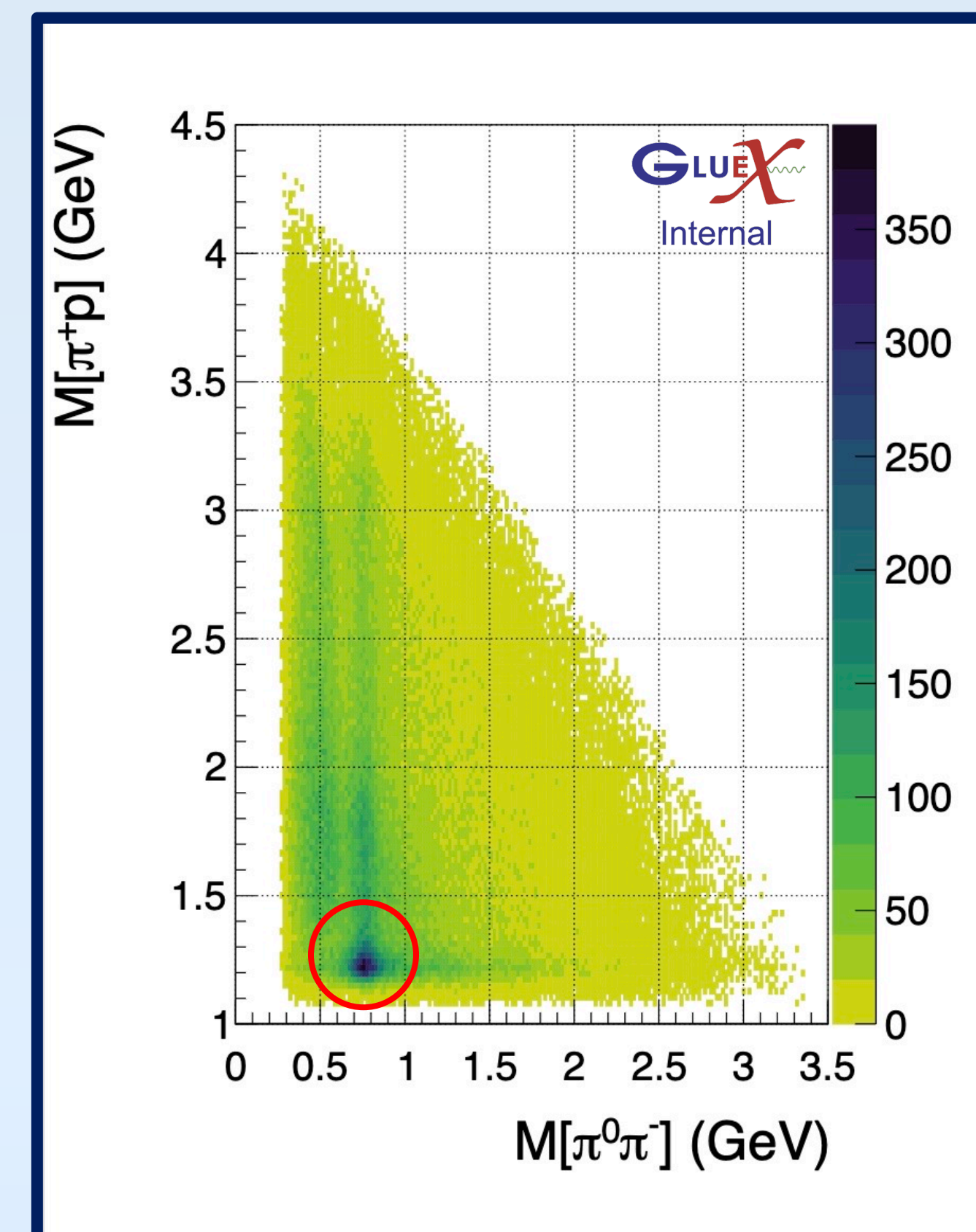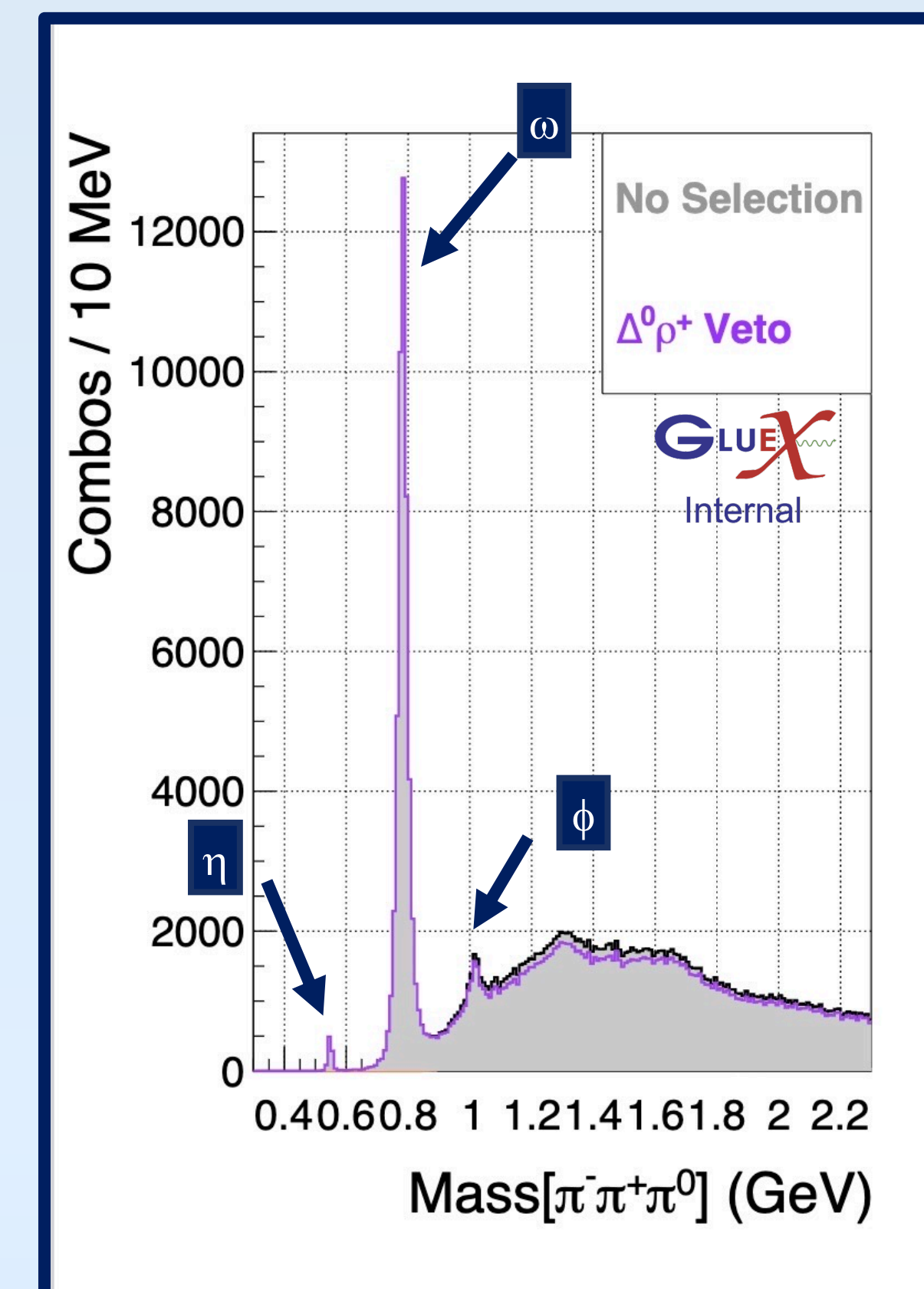
First Reaction Type
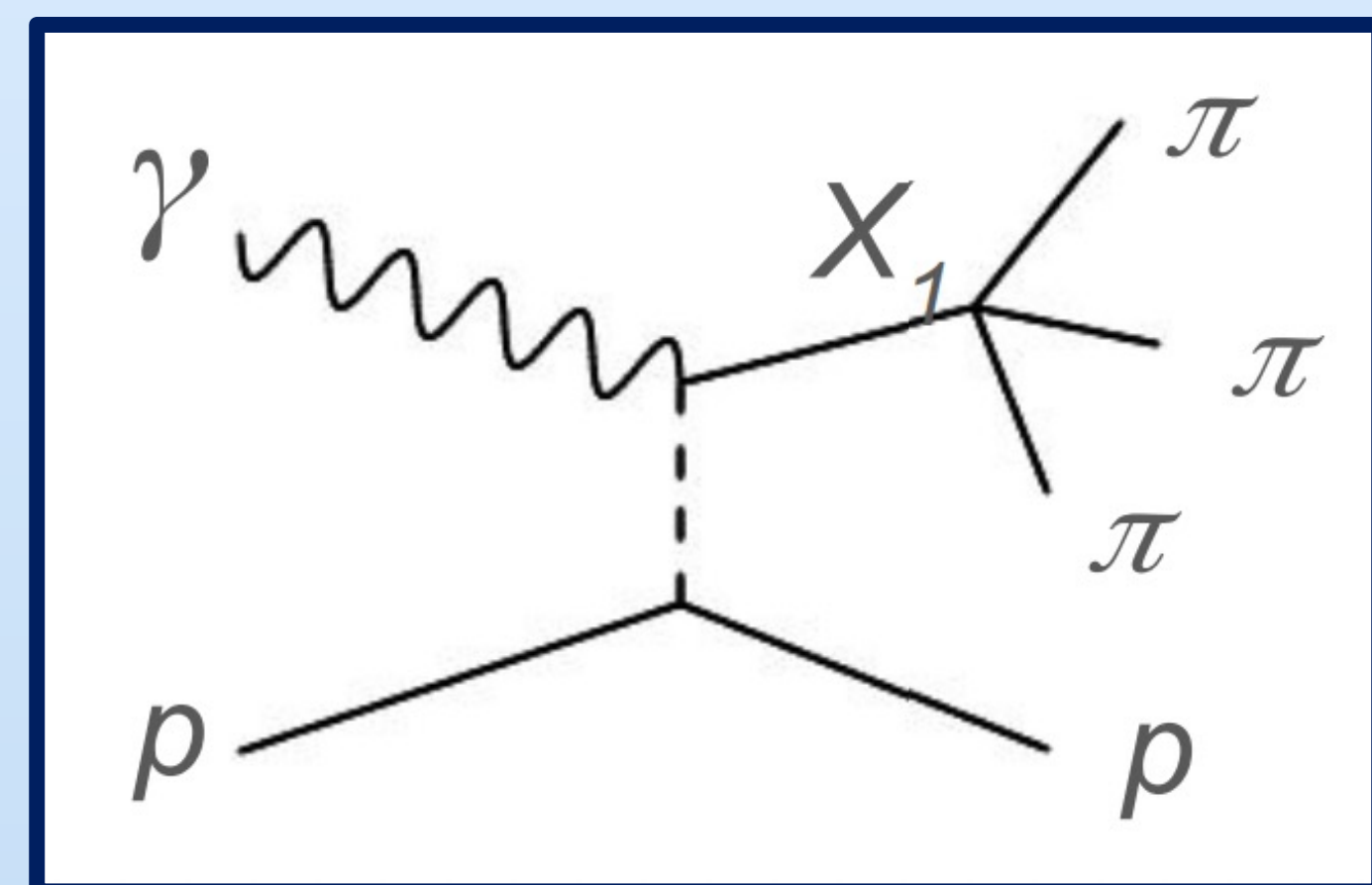
Second Reaction Type
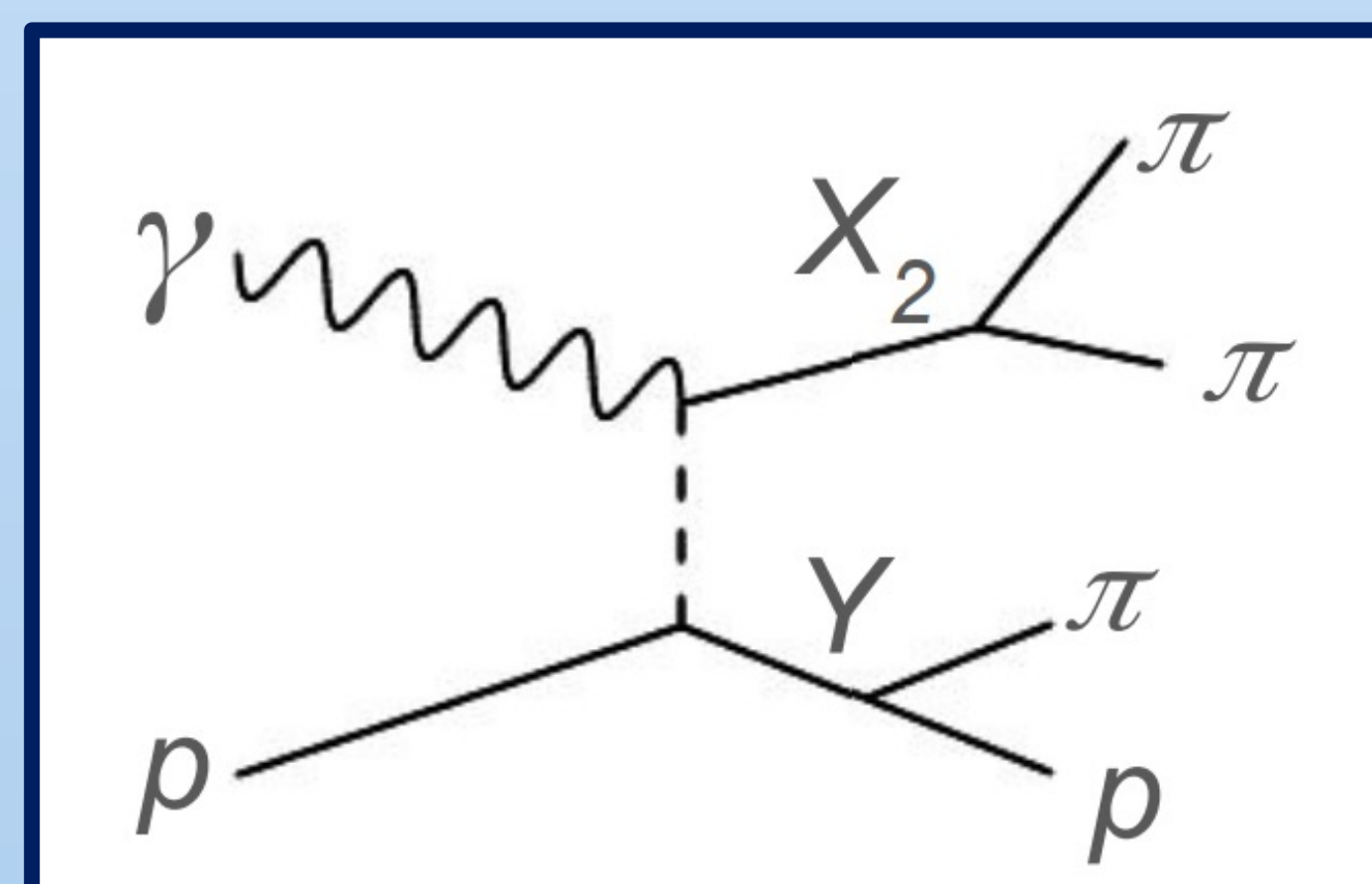
Analysis

Do these reactions affect the signal region for the ω?

ω, η, & ϕ examples of **resonance**

- $\pi^0\pi^-$ **vs** π^+p **plot**: The correlation between Mass[π^+p] and Mass[$\pi^0\pi^-$] allows us to identify if **meson (X₂)** was produced at same time as **baryon (Y)**

- $\pi^0\pi^-$ π^+ **plot**: To answer this, we plot the **Mass[3π]** with the events from **Type 2** reaction removed. These reactions **do not** affect the signal region for the ω
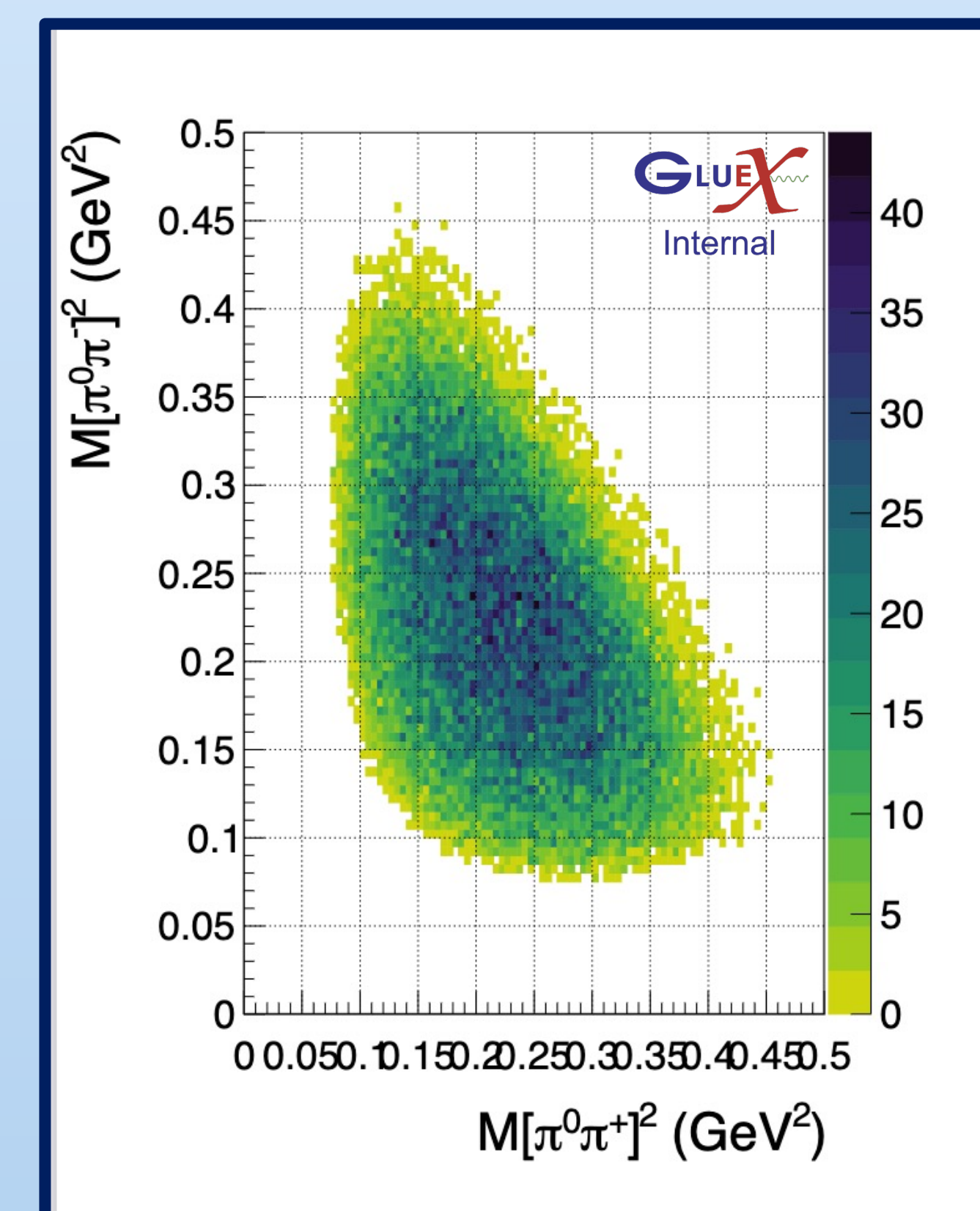
Plotting the λ
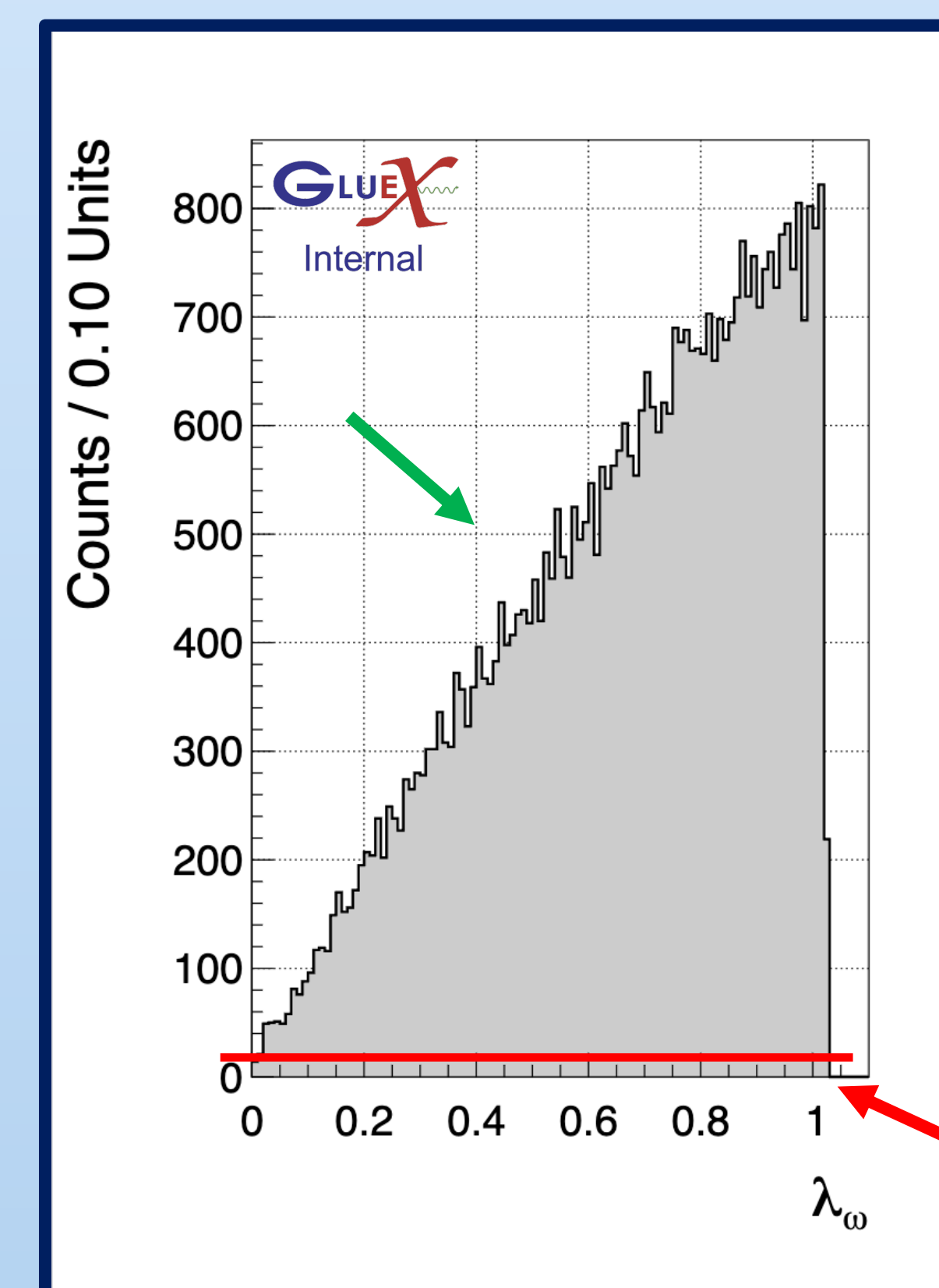
- **Dalitz plot** $\pi^0\pi^+$ **vs** $\pi^0\pi^-$: ω is a **vector meson** that decays into 3 particles. The **events clustering in the center** prove this to be true.

- λ **plot:** estimates the number of **signal** and **background** events in the ω region.

Summary

- We identified and isolated different types of reactions for the final state $\pi^-\pi^+\pi^0 p$
- Through different plotting methods, we were able to study their effects on the data.
- We kept in mind the primary goal of **selecting** the ω meson and **removing background.**

Future Analysis

- The lambda plot only allows us to calculate the number of signal events.
- To expand our analysis, we can perform a fit using a **Breit-Wigner distribution**, to further analyze and extract properties for the ω.
- The next step would be to fit the ω signal with this distribution to study how the **measured width** and **mass changes** as we alter the values for the timing that is used to identify the pions.

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References