Analysis of the photoproduced $2\pi^0$ system

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Figure 1: Aerial image taken of the Thomas Jefferson national accelerator facility. It was taken in 2012 and shows the aerial view of the facility with Hall D circled in blue [1].

The GlueX Collaboration

The Hall D GlueX experiment at the Thomas Jefferson national accelerator facility specialises in finding light exotic mesons. An electron is accelerated to 12 GeV before being converted to a photon via coherent bremsstrahlung, providing a linearly polarised 8-8.6 GeV photon to the hall. This photon collides with a stationary hydrogen target, producing final state particles which are reconstructed using the detector setup.

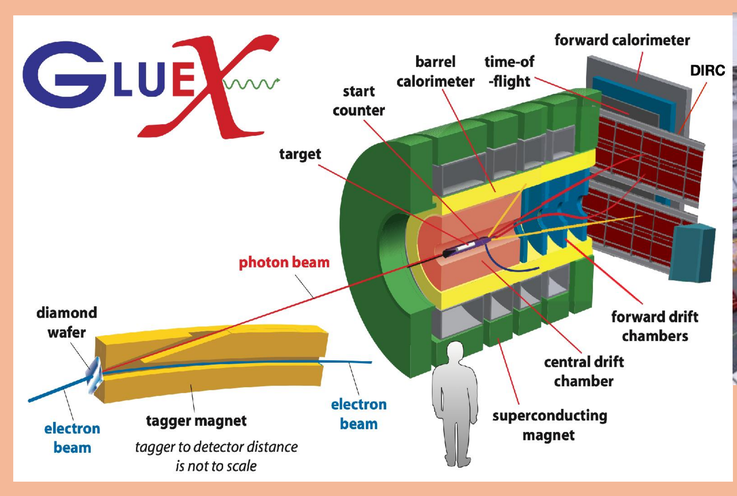
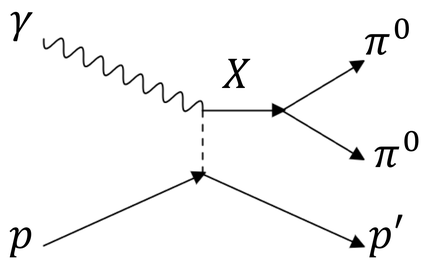


Figure 2: (Left) A diagram of the experimental setup in Hall D [2]. (Above) Image of the detector in Hall D as taken in 2024 [3]. Tracks measured by the detectors are used in decay reconstruction.

The analysis channel:

$$\gamma p \rightarrow p\pi^0\pi^0$$
$$\pi^0 \rightarrow \gamma\gamma$$



Aside: First Measurement of $a_2^0(1320)$ Polarized Photoproduction Cross Section [4]

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First measurement of the differential photoproduction cross section of $a_2^0(1320)$ in the $\mu\pi^0$ channel

First separation of the contributions of natural- and unnatural-parity exchanges

The same methodology can be used to extract related novel information from the photoproduced $\pi^0\pi^0$ channel

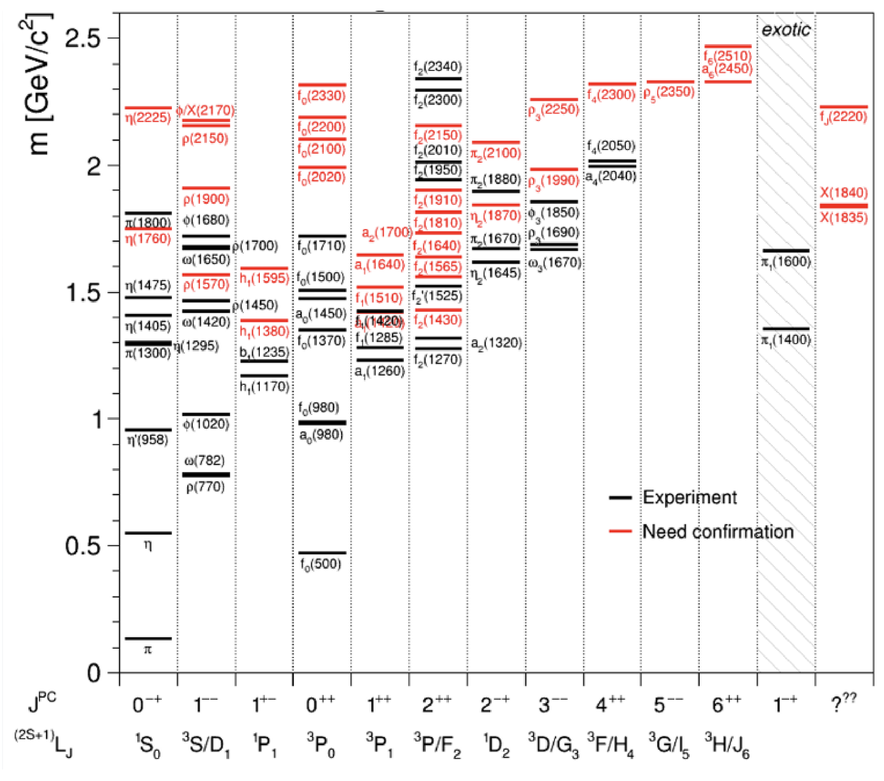
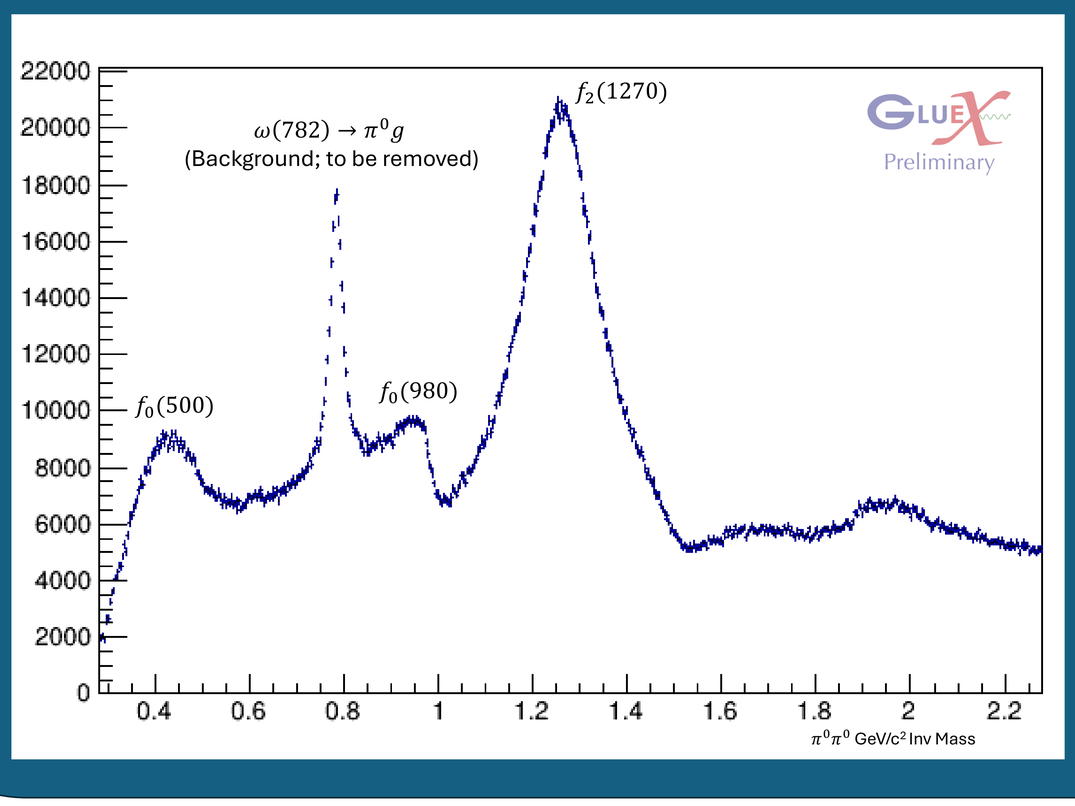


Figure 3: The quantum numbers and associated particle masses which make up the light meson spectrum [5]. Goal of this type of hadron spectroscopy is to confirm excited states (seen in red), complete the SU(3) nonets, and search for exotic states.

Motivation

- Some f_0 resonances available to this channel still require confirmation
- The first cross section analysis of photoproduced $f_2(1270)$
- Analysis of photoproduced resonances can be used to test theoretical models
- Provides a reference state on which to build the partial wave analysis of exotic particles that have these established states as background



$0^+(J^{++})$

f_J

Selection criteria:

Not π^0 mass constrained
Beam energy between 8 and 8.6 GeV
Confidence level above 1e-5
Missing mass between 0.2 and -0.2

The Next Steps

1) Use weights to remove background under the π^0
2) Add additional cuts if needed to get data as pure as possible
3) Perform a partial wave analysis to extract quantum numbers
4) Measure and extract relevant photoproduced cross sections

References:
[1] *Aerial view of JLab taken 2012/04/03*, *Aerial view of JLab*. Available at: https://gluexweb.jlab.org/content/photo/aerial-view-jlab-taken-20120403 (Accessed: 07 April 2025).
[2] Naomi Jarvis (2013) *Pre-DIRC GlueX detector and photon source with labels (pdf)* . GlueX. Available at: https://gluexweb.jlab.org/content/drawing/pre-dirc-gluex-detector-and-photon-source-labels-pdf (Accessed: 07 April 2025).
[3] Austregesilo , A. and Devlin , A. (2024) *Hall D 2024 Open House Poster*, *GlueX*. Available at: https://gluexweb.jlab.org/content/photo/hall-d-2024-open-house-poster (Accessed: 07 April 2025).
[4] al., F. Afzal et (May 2025) *First measurement of $a_2^0(1320)$ polarized photoproduction cross section* .DOI: 10.1103/jfzb-rfl4.
[5] K.Goetzen, GSI