$\gamma p \longrightarrow p \phi \eta U p date$

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Outline

- Motivation
- Cuts
- Selecting φη Events
- Preliminary Results

Search for New and Unusual Strangeonia States Using $\gamma p \longrightarrow p \varphi \eta$

• $\gamma p \rightarrow p \varphi \eta$ is expected to be dominated by an ss parent state



 Observation of a state with a large branching fraction to φη and small branches to non strange final states would establish an ss̄ state.

Cuts for $\gamma p \longrightarrow p \Phi \eta$

Beam Photon:

• RF Timing (3 beam bunches)

Target:

- 51 cm < Vertex Z < 79 cm
- Vertex R <= 1 cm

Recoil Proton:

- dE/dX in CDC for proton
- PID Timing Cuts
- K+ / K-:
 - PID Timing Cuts
 - Good Kaon Selection
 - <u>Time of Flight Only</u>

- PID Timing Cuts
- <u>FCAL E < 500 MeV</u>
- Unused Shower Energy < 50 MeV

Exclusivity:

• |MM²| < 0.02

Other:

- K⁺K⁻ Invariant Mass < 1.055
- $0.3 < \gamma\gamma$ Invariant Mass < 0.8
- Beam Photon With Best MM²

Data Set:

• Spring 2017



Good Kaon Selection







Good Kaon Selection



Before Good Kaon Selection

After Kaon Selection

φ Only Seen in TOF



Selecting $\phi\eta$ Events



How to remove additional yy/K+K- Backgrounds:

φ Only QValue

Joint φη QValue

Elliptical

• η Only QValue

φ×η QValue

Example of Nearest Neighbors Fit



Example of Nearest Neighbors Fit







Preliminary Results Joint on QValue: $K^+K^-\gamma\gamma$ Mass : Q₀ Weighted $\frac{10}{40} \frac{10}{40} \frac{$





Preliminary Results

φ Only QValue:





Joint on QValue Fit



Events / 0.020 GeV/c²

N* Background

N* Background

Summary

Work in progress:

- Reduce N* Background
- Acceptance Corrections

<u>We observe two structures in the φη Invariant Mass</u>

- Structures in φη have never been seen before in photoproduction
- The first structure is consistent with the $\phi(1680)$, or the radially excited $\phi(1020)$. This has only been observed in e⁻e⁺ experiments
- The second structure is consistent with the $\phi_3(1850)$. This has only been observed in K⁻p \longrightarrow K \overline{K} , K \overline{K}^* experiments