J/ψ Photoproduction Near Threshold With CLAS12

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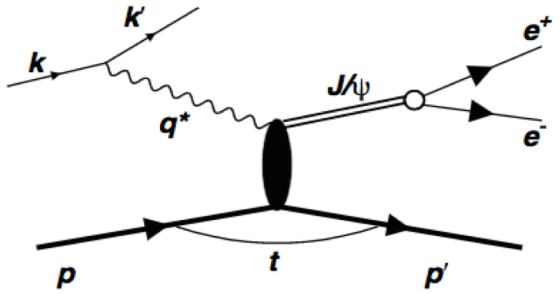
Experiment Overview

Description

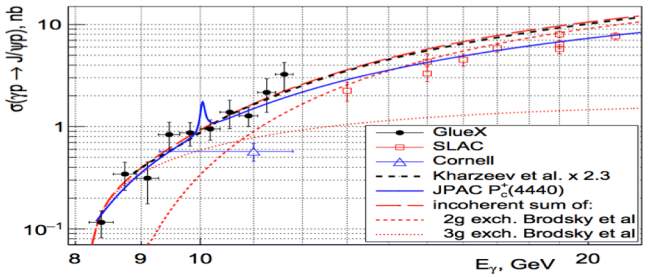
- Electrons accelerated by CEBAF scatter off a liquid Hydrogen target at low scattering angles through the exchange of a quasi-real photon at $Q^2 \sim 0$
- Detect the recoil proton and the e^+e^- from the decay of J/ψ
- Experiment 12-12-001 was approved for 120 days of beamtime on CLAS12 at a luminosity of 10^{35} cm^{-2} s^{-1} . Approximately 40% of data has been collected.

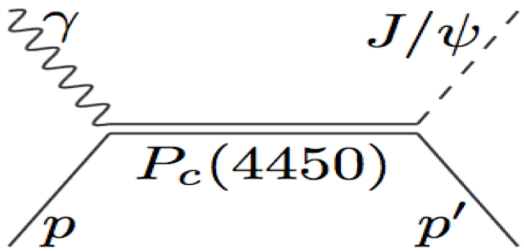
Physics Goals

- Probe the distribution of color charge in the nucleon
  - Measure the t-dependence of the differential cross section of J/ψ photoproduction
- Study the production mechanism of J/ψ near threshold
  - Measure the total cross section as a function of photon energy
- Verify the existence of LHCb pentaquark through s-channel J/ψ production



GlueX Published Cross Sections of J/ψ Photoproduction (arXiv:1905.10811)





Particle Identification and Event Selection

Particle Identification

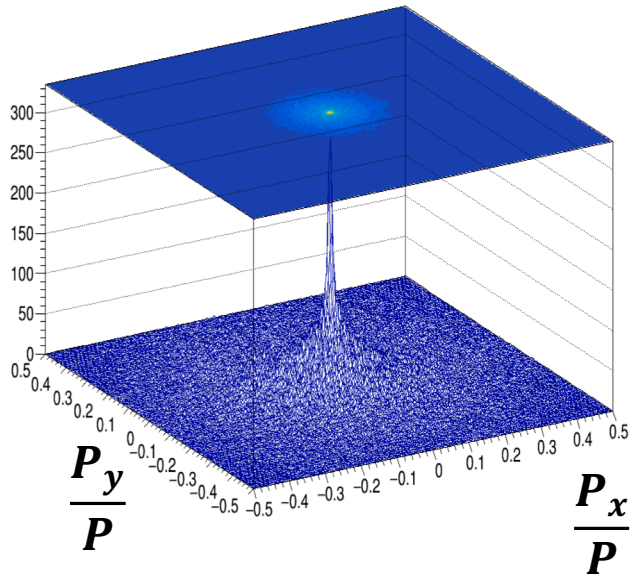
- Protons: comparing measured β with expected proton β using Time-Of-Flight detector
- For e+e- with p < 4.9 GeV/c: Cuts on E/p in Electromagnetic Calorimeter and photoelectrons in the High-Threshold Cherenkov Counter
- For e+e- with p > 4.9 GeV/c: same cuts, but with additional shower profile analysis

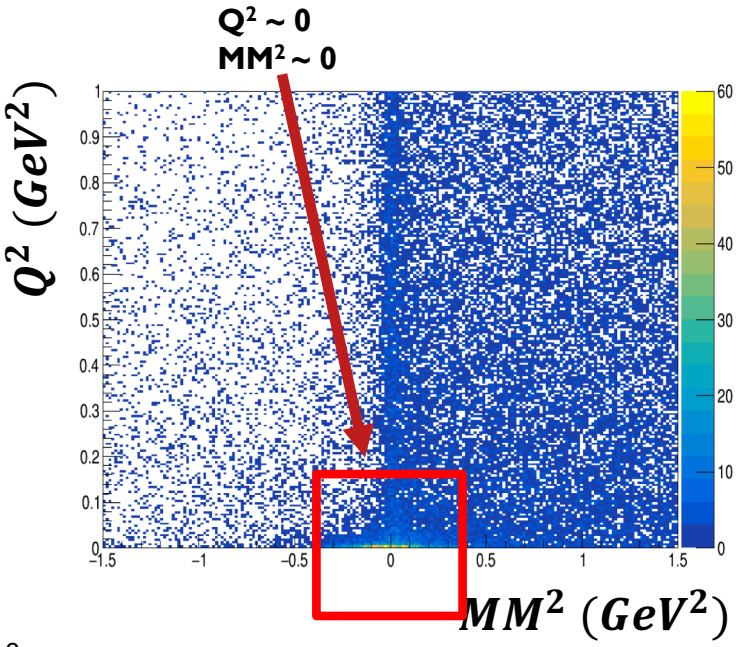
Event Selection

- Transverse missing momentum
- Q^2 and missing mass

$$ep \rightarrow e^+e^-p'X \qquad X = e^-$$

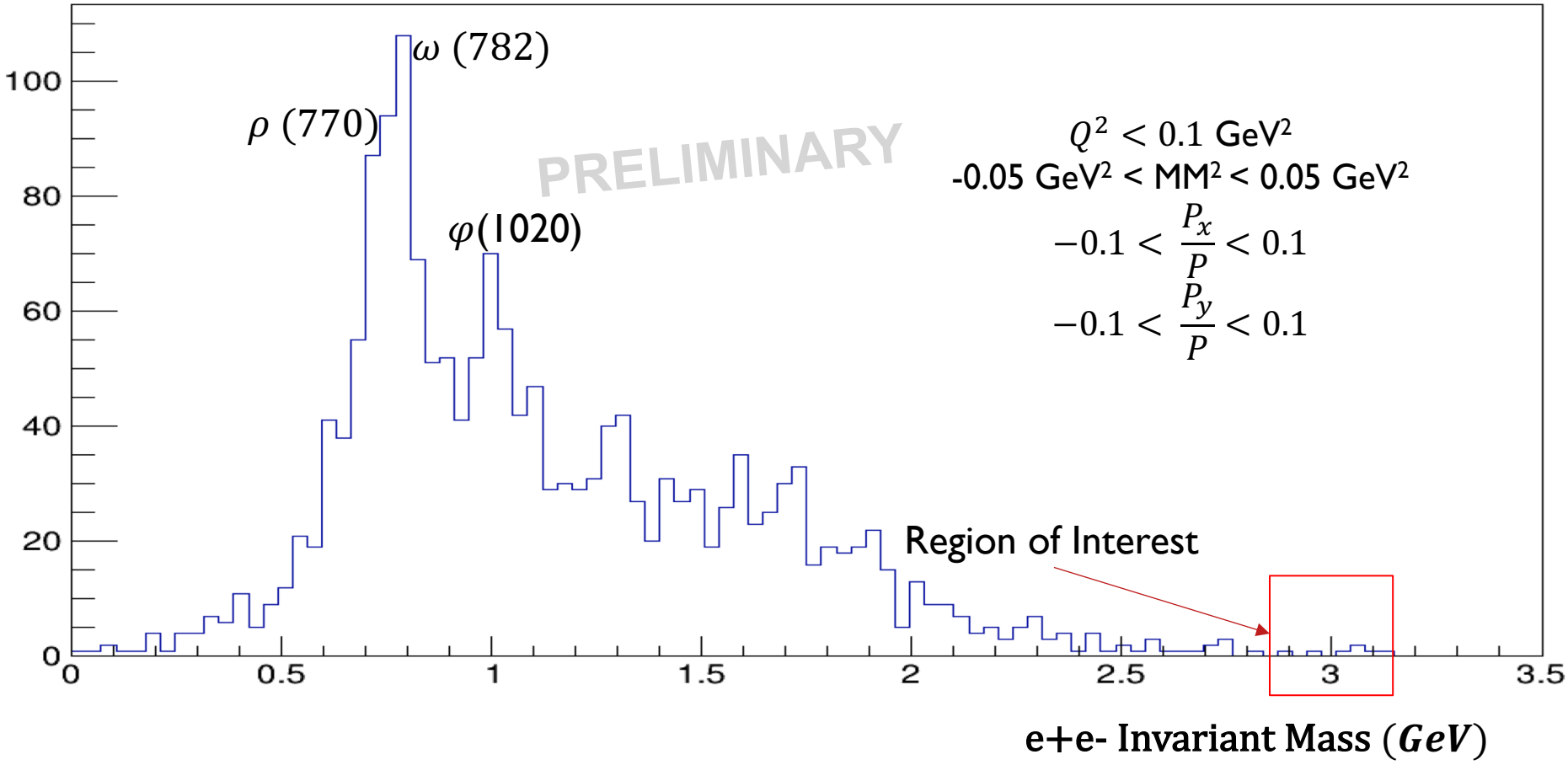
Small Fractional Momenta of the Scattered Electron





Invariant Mass Distributions From Available Data

- Vector mesons are clearly visible in the invariant mass distribution of e+e- pairs after selecting quasi-real photoproduction events.
- The data sample accounts for **~ 1%** projected total data.



Current and Future Analysis

- Improve particle identification, especially for positrons and electrons with $p > 4.9$ GeV/c
- Study fiducial cuts and momentum corrections
- Refine event selection criteria
- Study kinematic fitting approach
- Study acceptances and efficiencies using simulated data merged with background
- Develop fitting procedure to the invariant mass distribution to extract number of J/ψ events in each kinematic bin
- The goal for the next year is to analyze the full statistics and measure cross sections