The Importance of J/ψ

- J/ψ is a charm-anti-charm meson
- Discovered simultaneously by experimentalists at BNL and SLAC
- Significant discovery because it confirmed the Glashow-Iliopoulos-Maiani (GIM) mechanism, which explained the suppression of flavor transitions
- Over the years, J/ψ production has been used as a mechanism for studying QCD

**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
- Study the forward-backward asymmetry to access the real part of the Compton scattering amplitude
- J/ψ photoproduction on the nucleon proceeds via gluon exchange since the charm content of the nucleon is negligible

**Physics Motivation**

**J/ψ Photoproduction With CLAS12**

- Close to the production threshold energies, the electron-positron pair from J/ψ decay and the recoil proton scatter into the CLAS12 forward detector. The CLAS12 FD can detect and identify the particles in the full kinematical range of the reaction.
- Kinematical constraints on an-un-detected scattered electron allows study quasi-real photoproduction
- This analysis uses part of the CLAS12 Run Group A data

**Particle Identification & Event Selection**

For e+e− detection (p < 5 GeV)…
- Energy and time information from calorimeters and the threshold Čerenkov counter are analyzed
- For proton detection…
- Time-of-flight from the scintillator counters and the momentum from the tracking are used
- For e+e− detection (p > 5 GeV) …
- Utilize additional cuts related to pion rejection, including the addition of machine learning. This was based on the ROOT Multi-Variate Analysis package. The Boosted Decision Tree (BDT) was selected as a viable algorithm.

- Events are selected by measuring physical quantities related to the un-detected scattered electron
- Low values of the square of the missing mass and transverse momentum components show evidence of quasi-real photoproduction

**Fall 2018 Run Conditions**

<table>
<thead>
<tr>
<th>Beam Energy</th>
<th>10.6 GeV</th>
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<tbody>
<tr>
<td>Target</td>
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<tr>
<td>Beam Current</td>
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<td>Time Period</td>
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**References**


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