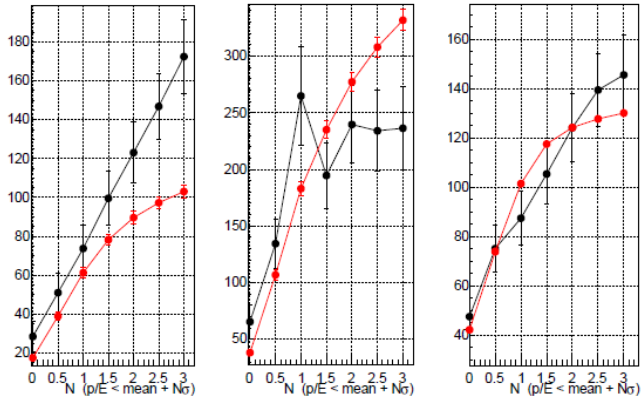
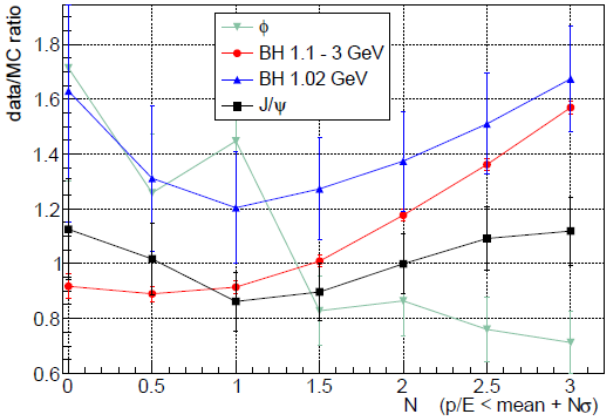
First measurement of near threshold J/ψ photoproduction

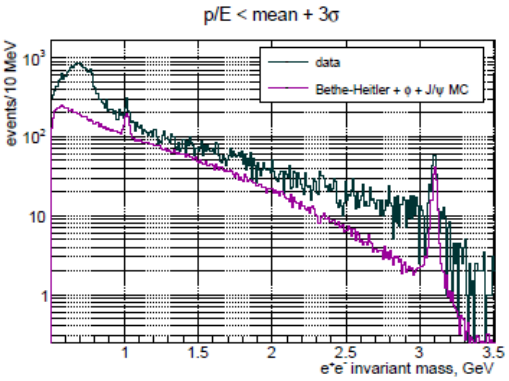
- Reaction: $\gamma p \to p e^+ e^-$ for M(e^+e^-)>0.9 GeV
- Use ϕ photoproduction and, possibly, BH x-section to normalize the J/ψ x-section
- Aim to describe the x-section in 1-3 GeV region with MC to make sure relative normalization is under control
- The idea to correctly estimate BH continuum: vary E/p cuts and compare with MC



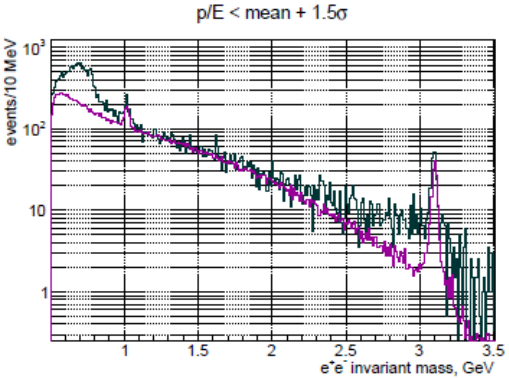
(a) Data (black) and MC (red) results for yields of BH at 1.02 GeV (left), ϕ (middle), and J/ψ (right) vs p/E cut values for both calorimeters.



(b) ratios



(a) Di-electron invariant mass distribution with 3σ p/E cuts on both calorimeters: green – data, magenta – simulations.



(a) Di-electron invariant mass distribution with 1.5σ p/E cuts on both calorimeters: green – data, magenta – simulations.

Plan for the analysis

- Data from both 2016 and 2017 spring runs analyzed with the same (insignificantly different) software version
- MC for J/ψ, ϕ, and BH for the different run periods and different beam intensities
- Extract E/p distributions for electrons from data
- Smear calorimeter energy E in MC to match the E/p distribution from data, or, if possible, smear some lower level quantities in MC to match data
- Apply same E/p cuts on data and MC and compare the peaks and continuum, decide about the cut values at which the pion background is small
- In addition apply pre-shower, dE/dx cuts, and some geometrical ($\theta > 2^0$) and kinematical (exclude Δ) cuts to reduce the pion background
- In slices of beam energy estimate yields and then relative ϕ and BH x-sections using relative MC efficiencies and beam flux
- Extract relative J/ψ x-section and normalize it using ϕ and BH x-sections
- Extract yields in slices of t and estimate t-dependence

The goals of the paper

- J/ψ x-section as function of beam energy (5-6 points in the 8.2 – 12 GeV interval)
- t-dependence of J/ϕ photoproduction averaged over the whole energy range
- Possibly, J/ψ x-section as function of beam energy, but with a cut on t to demonstrate possible change in the production mechanism
- Comparison to SLAC and Cornell data
- Comparison/fits with theoretical curves (Brodsky and other) for the t-channel and physical interpretation of the results
- Comparing with predictions for pentaquark production in the s-channel
- Setting limits on the branching fractions of the pentaquarks decaying in p+J/ψ – this requires additional statistical analysis, models for both the t-channel "background" and the pentaquarks (JPAC people could help us)