Study of the J/ψ photoproduction with tagged forward proton in $p+p$ collisions at $\sqrt{s} = 510$ GeV

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The STAR Collaboration https://drupal.star.bnl.gov/ STAR/presentations

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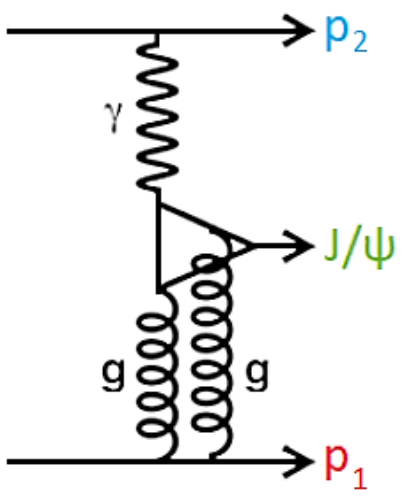
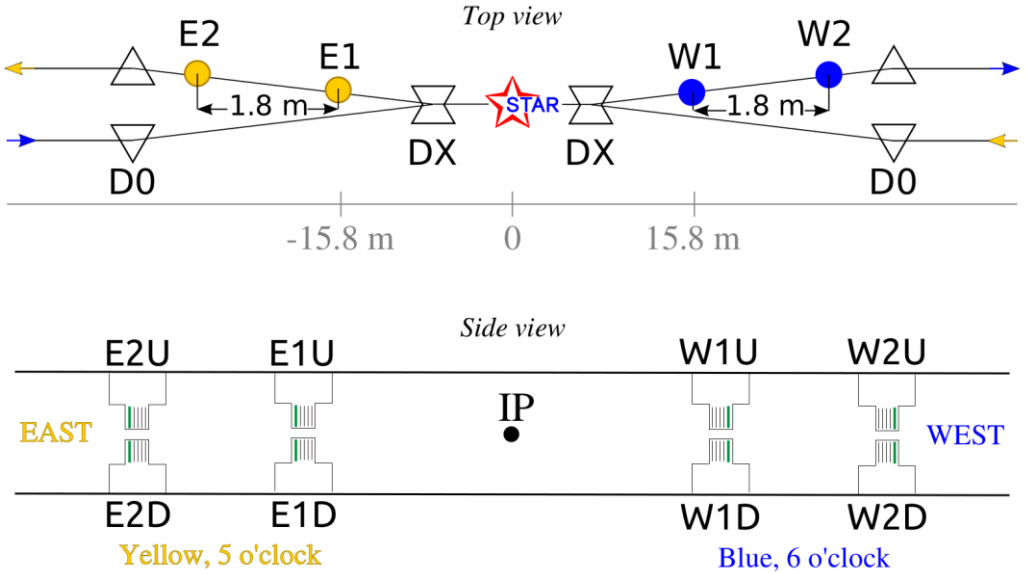
Exclusive measurement of J/ψ photoproduction



- p + p → p_1 + J/ψ + p_2
- J/ψ → e^++ e^- decay channel
- Interactions of proton's (p_1) electromagnetic fields, which are taken as fluxes of photons, with the other proton (p_2)
- Photons can fluctuate to a virtual hadronic state ($q\bar{q}$) which scatters of other proton and turns into a real vector meson (J/ψ)
- Interaction of $q\bar{q}$ pair with target proton through Pomeron exchange

Diffractive process

- Presence of one or both incoming particles that remain intact after a collision detected by special forward detectors - Roman Pots
- Produced central system of particles X separated by large rapidity gaps (LRG) from the forward protons



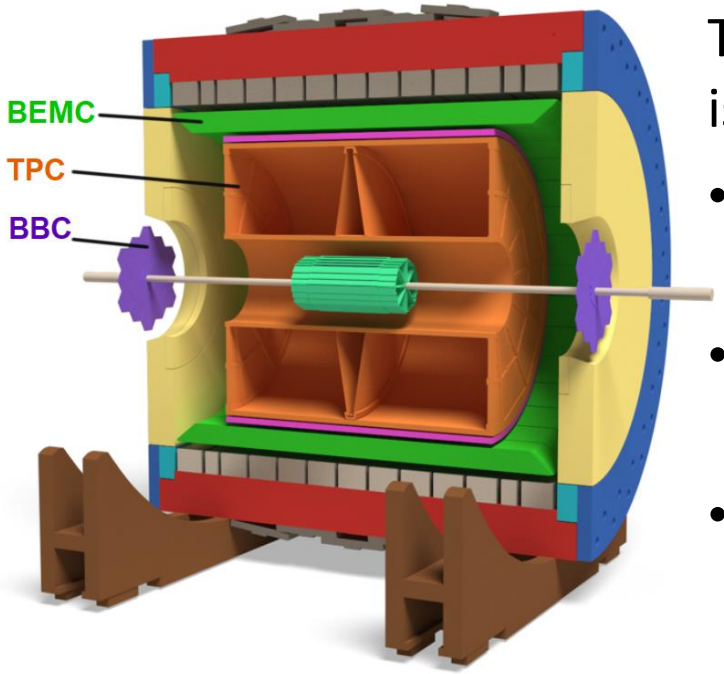
Goals of the analysis

J/ψ photoproduction in p+p collisions at $\sqrt{s}$ = 510 GeV

Data from 2017 collected at the STAR experiment

A) Cross-section of J/ψ photoproduction as a function of transferred momentum $|-t|$

B) Possibility to have a precise measurement of the p_T of the virtual photon thanks to the measurement of forward proton in Roman Pot detectors: $-\mathbf{p}_{2,T} = (\mathbf{p}_{J/\psi} + \mathbf{p}_1)_T$

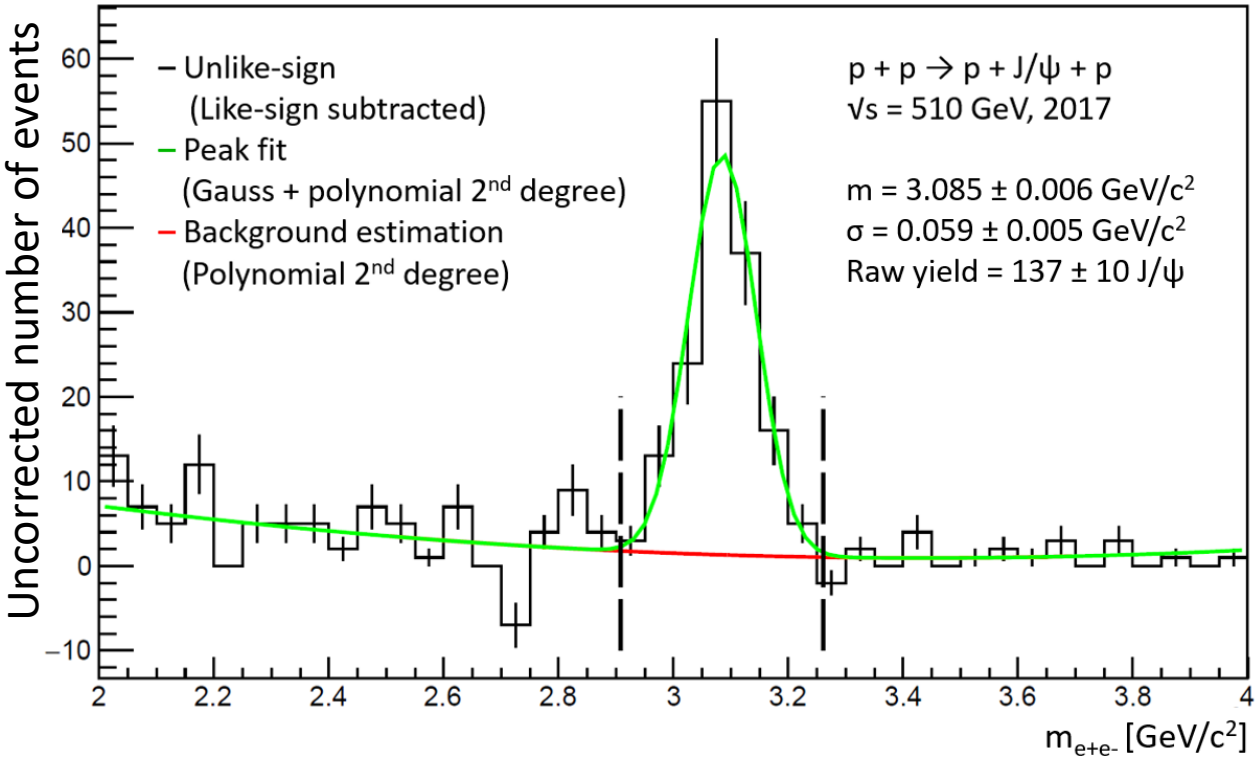


This analysis utilizes the unique ability of the STAR experiment, which is the detection of forward-going protons using Roman Pot detectors

- Proton p_1 from Pomeron vertex (high p_T) detected in Roman Pot detectors
- Proton p_2 from photon vertex (low p_T) scatters at a small angle, not measured in Roman Pots
- The electron and positron tracks ($J/\psi \rightarrow e^+ + e^-$) are detected in the Time Projection Chamber and Barrel Electromagnetic Calorimeter

Results

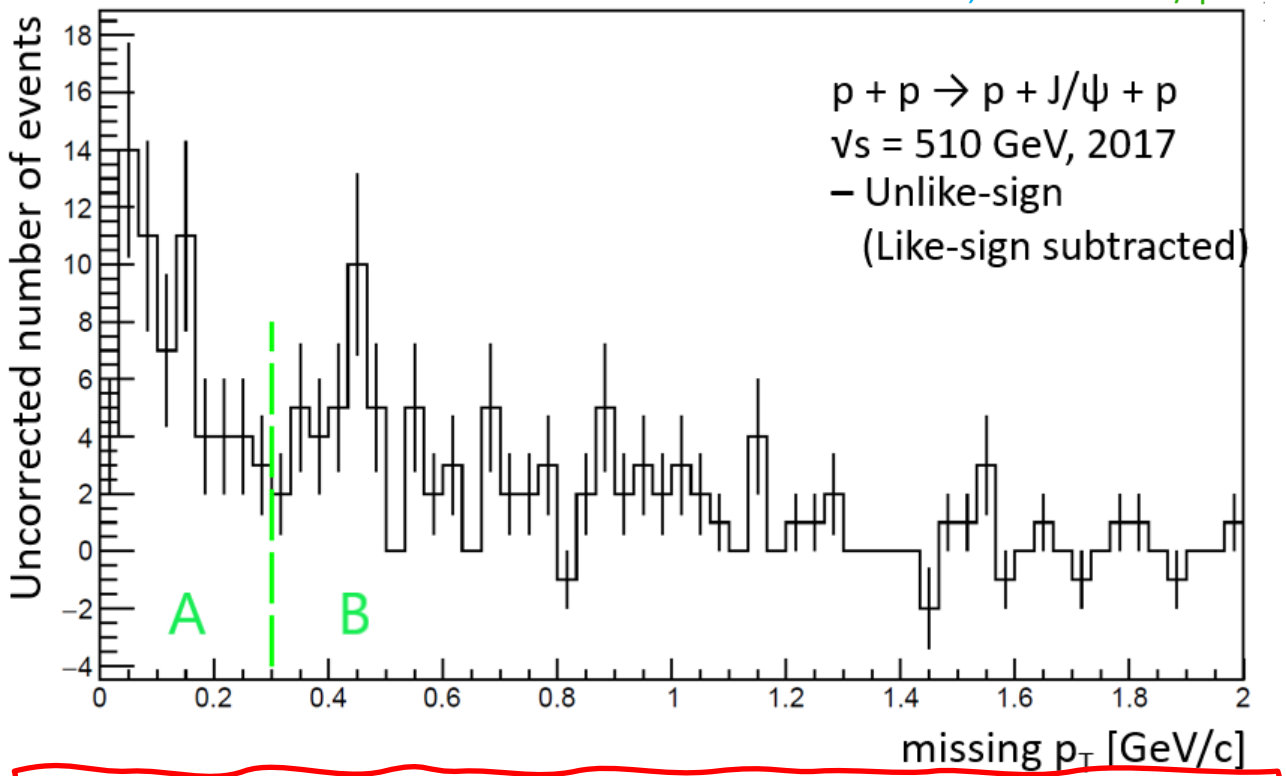
UNCORRECTED INVARIANT MASS AND RAW YIELD



- Prominent peak visible in the uncorrected invariant mass distribution
- Raw yield of J/ψ → e^++ e^- in *p*+*p* collisions with RP proton tagging extracted for the first time

MISSING p_T

- Momentum conserved in a collision $(\mathbf{p}_1 + \mathbf{p}_2 + \mathbf{p}_{J/\psi})_T = 0$
- J/ψ and proton measured
- p_T of virtual photon is the missing p_T : $-\mathbf{p}_{2,T} = (\mathbf{p}_1+\mathbf{p}_{J/\psi})_T$



A: Peak at zero consistent with the exclusive process

B: Broad structure from 0.3 GeV/c is consistent with non-exclusive processes