

XYZ spectroscopy

Justin Stevens



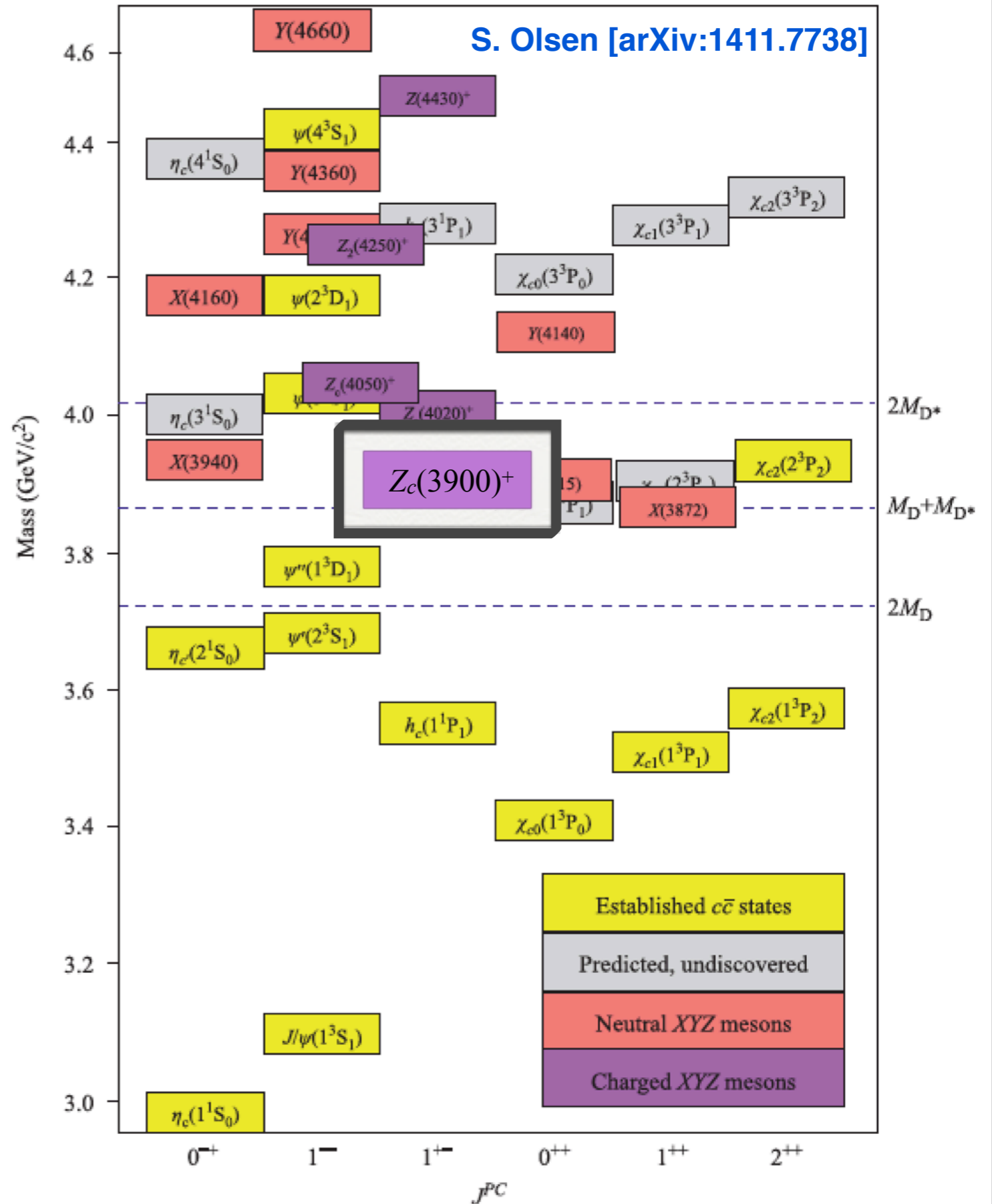
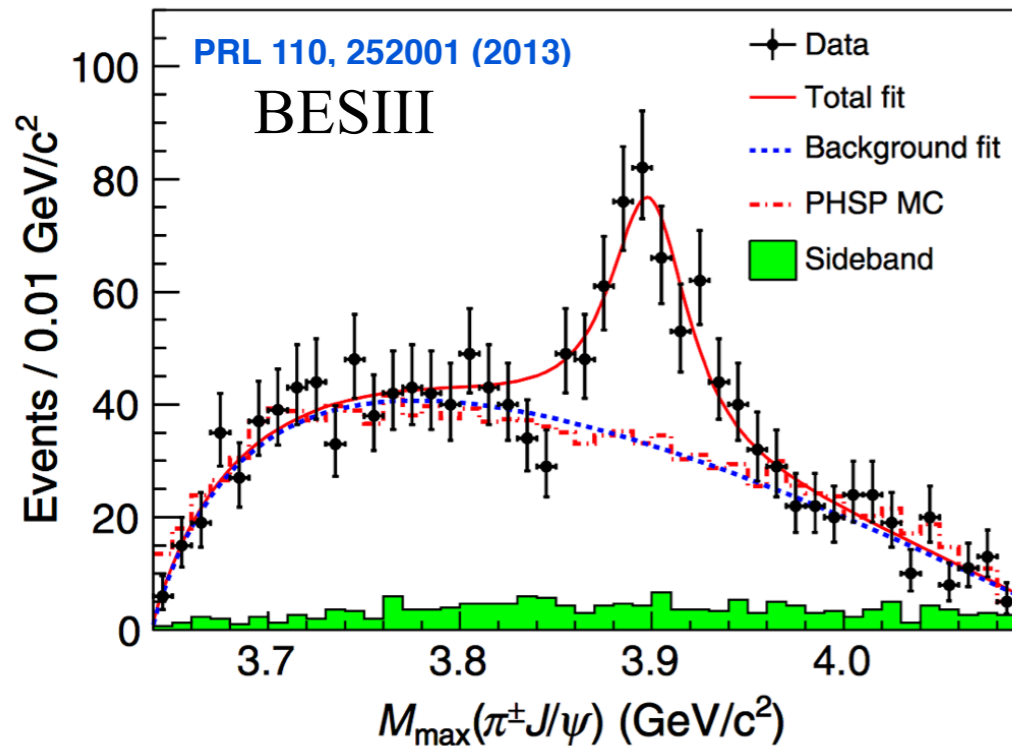
WILLIAM & MARY

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XYZ states

- * Many new states observed in the last ~decade
- * Not predicted by the standard charmonium models
- * Many models for interpretation: resonant states, meson molecules, re-scattering effects, etc.

$$e^+e^- \rightarrow \pi^+\pi^- J/\psi \quad (4260 \text{ MeV})$$

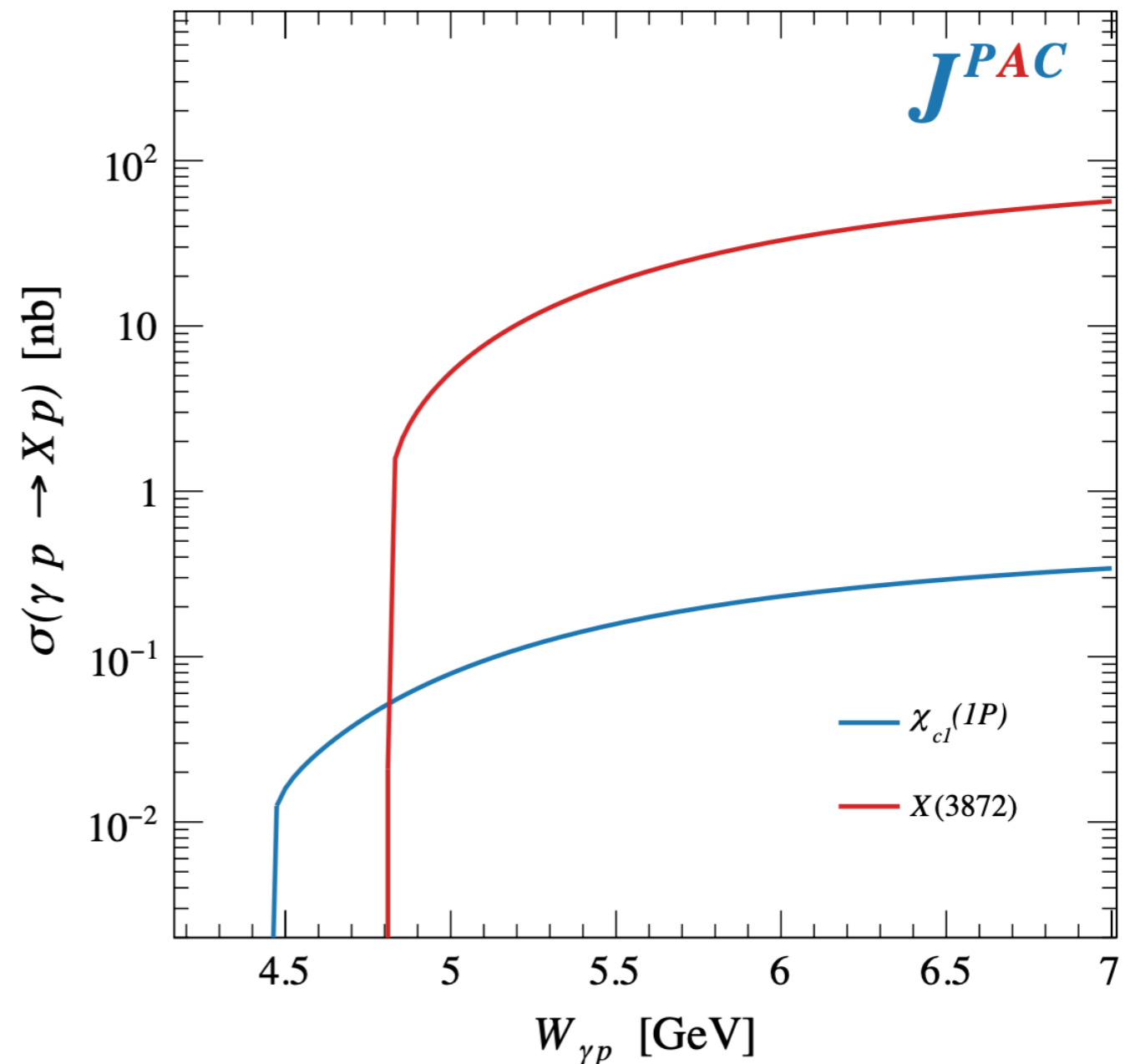
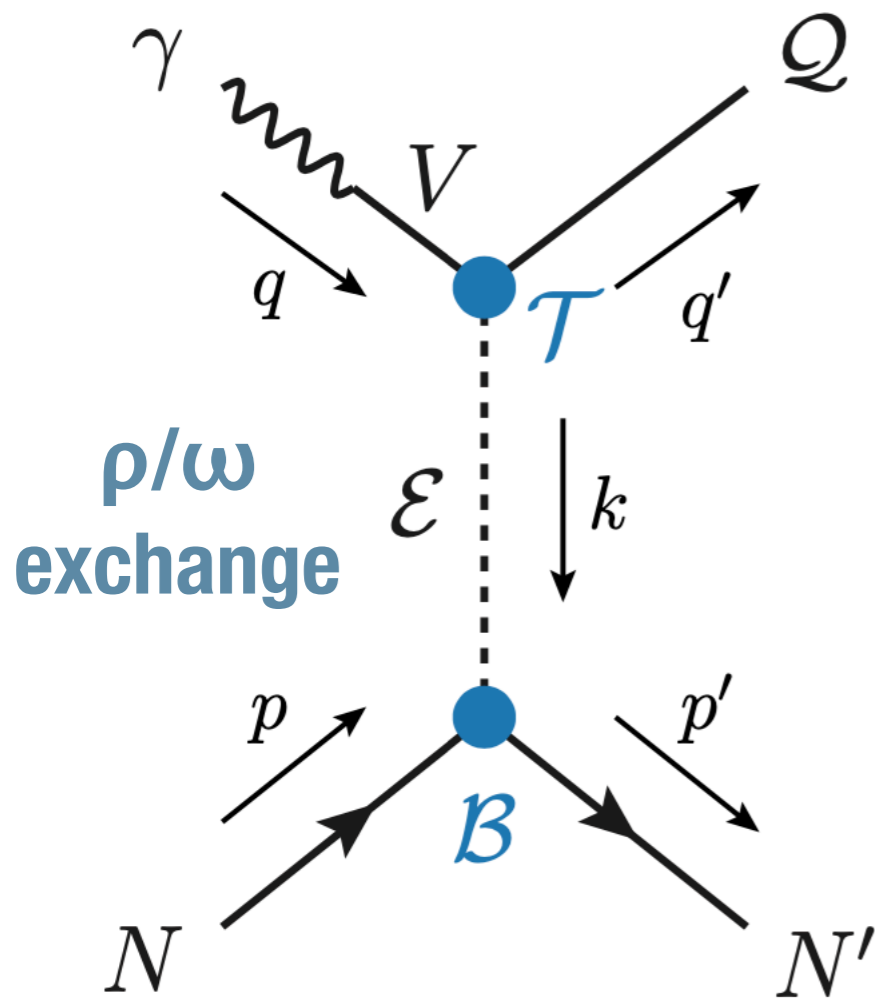


Theory predictions for XYZ states

XYZ spectroscopy at electron-hadron facilities: Exclusive processes

M. Albaladejo,^{1,*} A. N. Hiller Blin,^{1,†} A. Pilloni,^{2,3,‡} D. Winney,^{4,5,§}
 C. Fernández-Ramírez,⁶ V. Mathieu,⁷ and A. Szczepaniak^{1,4,5}
 (Joint Physics Analysis Center)

JPAC arXiv:2008.01001



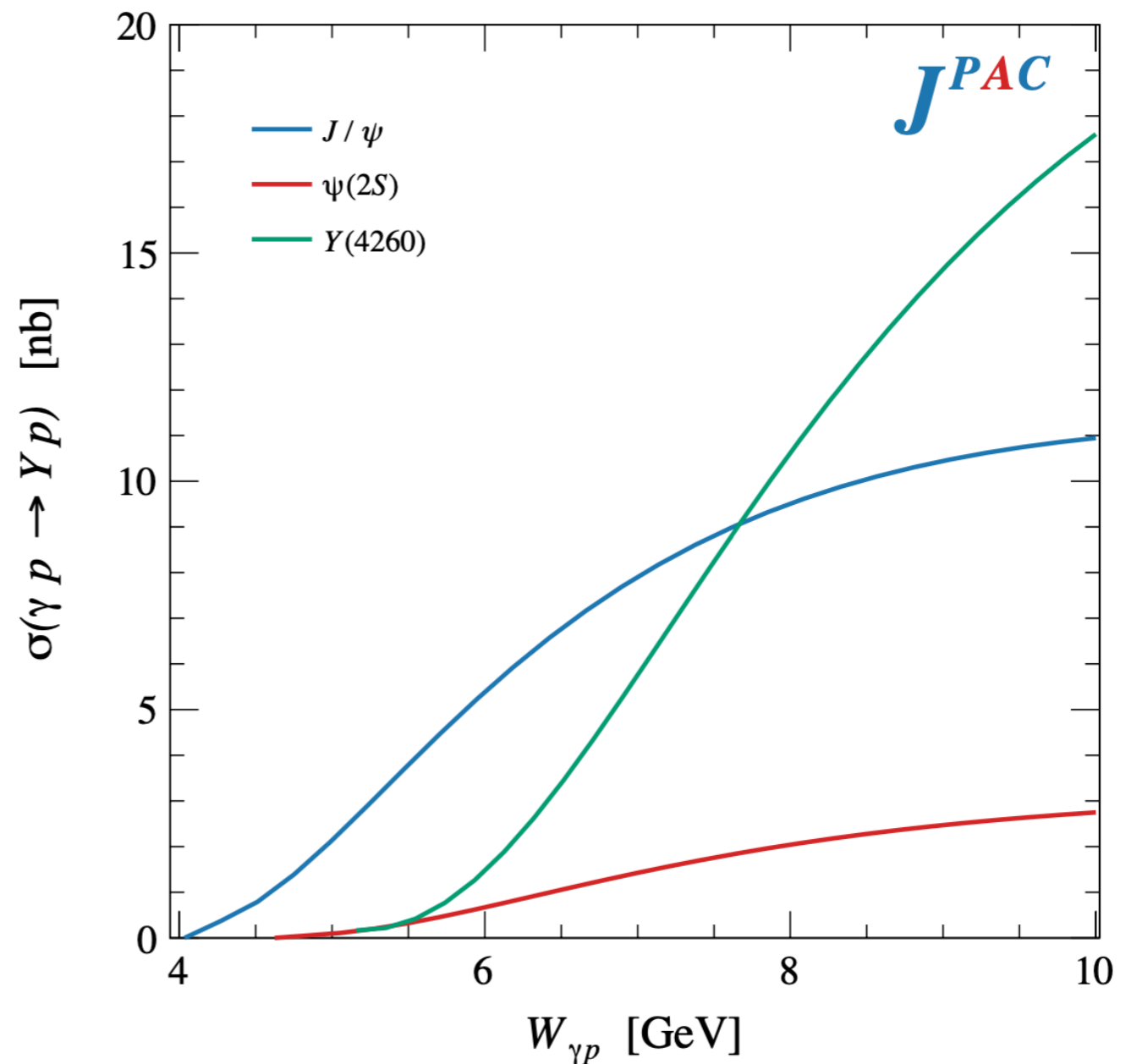
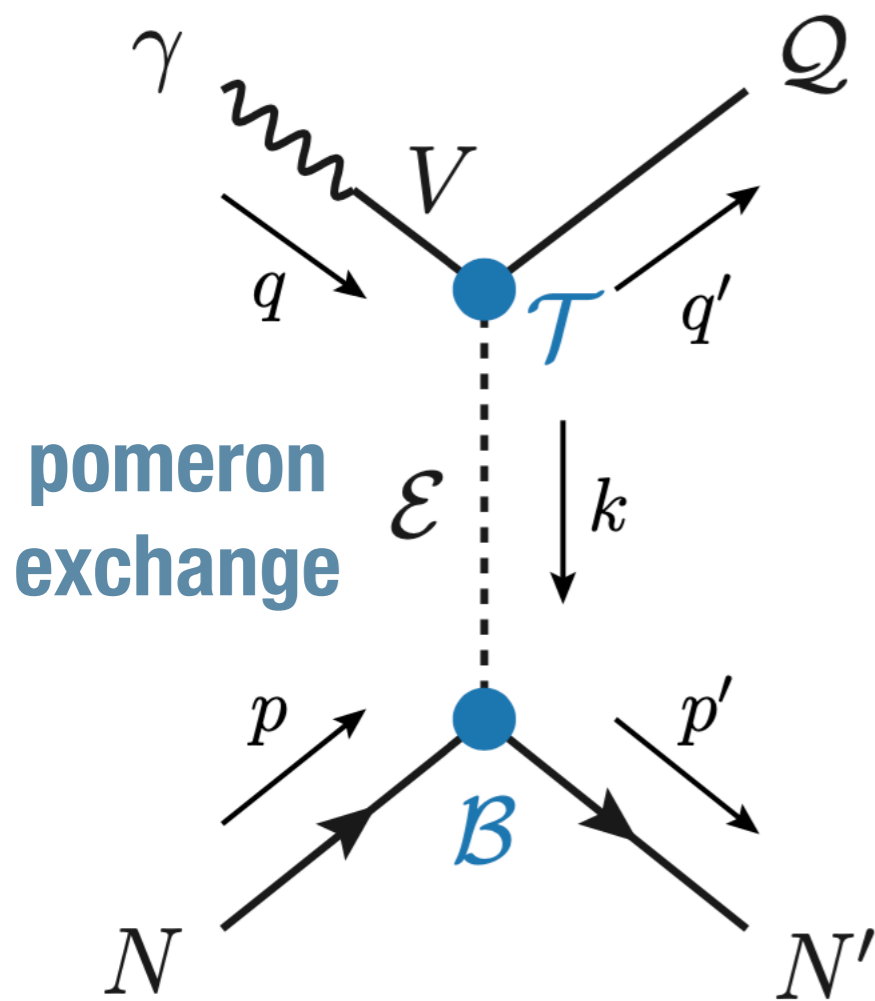
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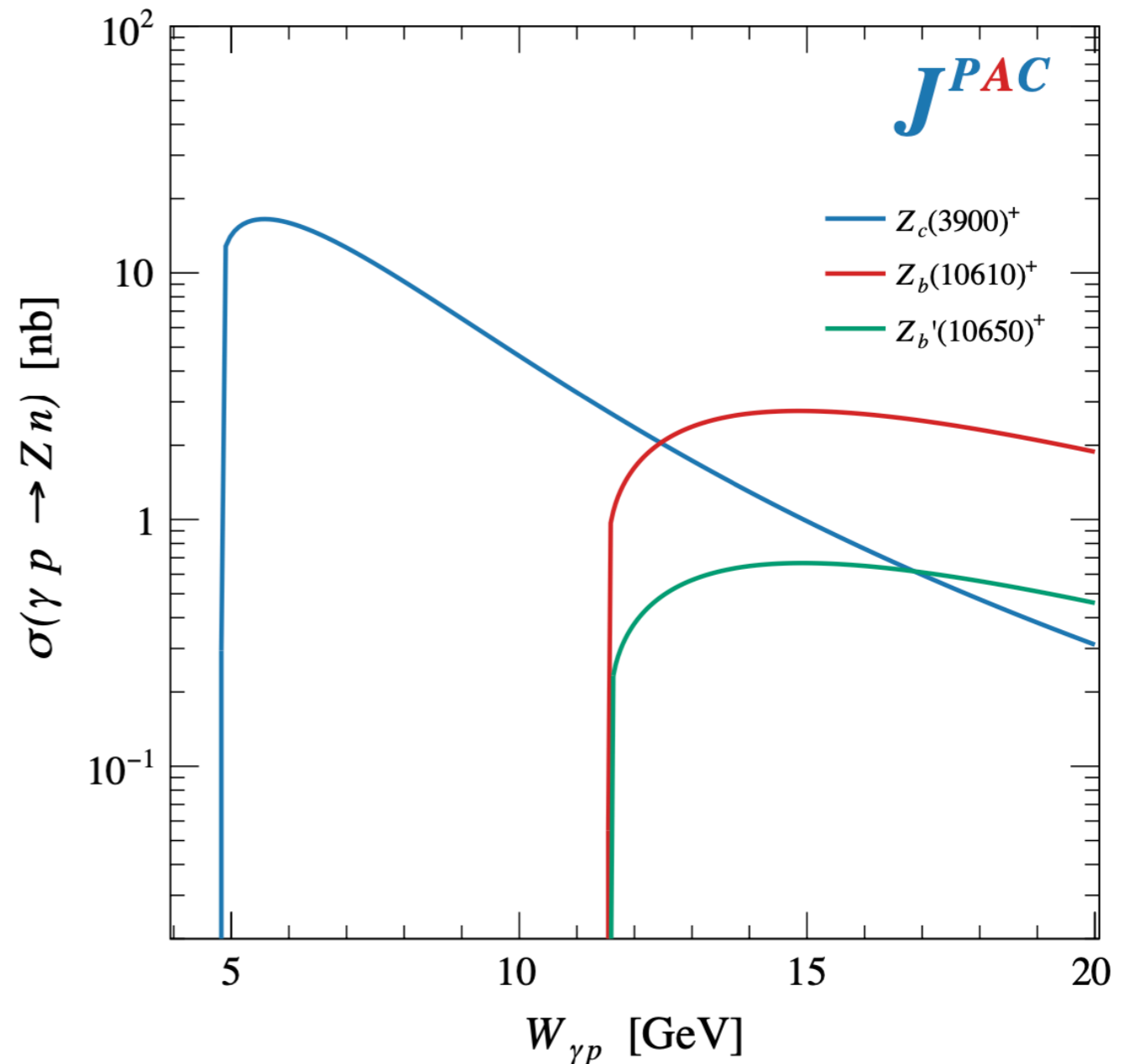
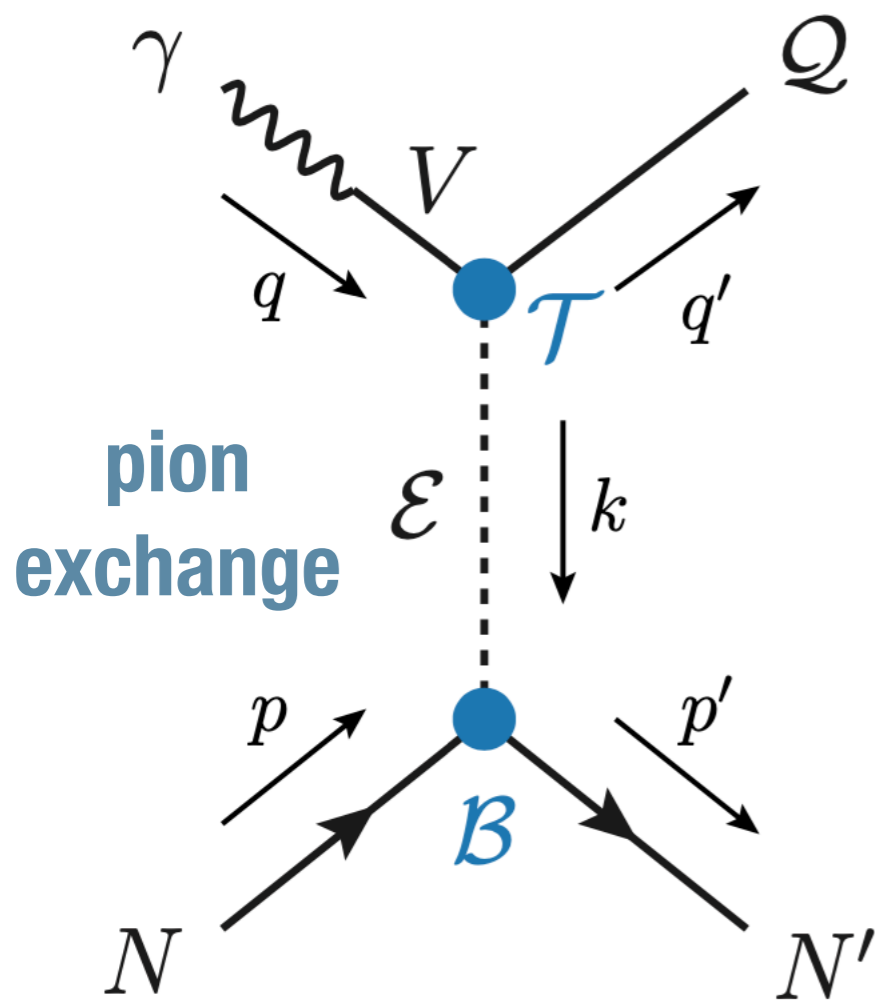


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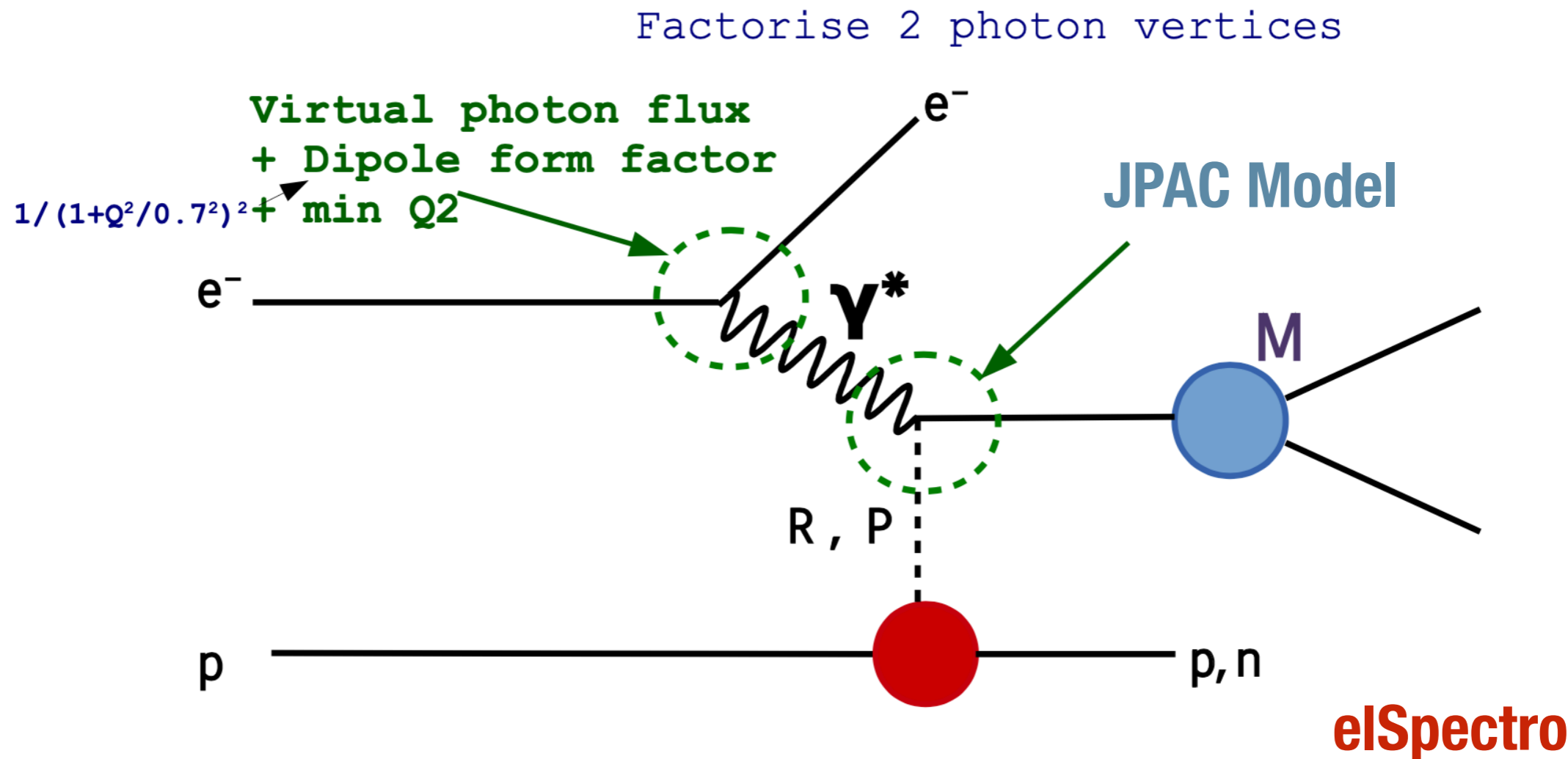
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Event generator development

Derek Glazier (Glasgow)



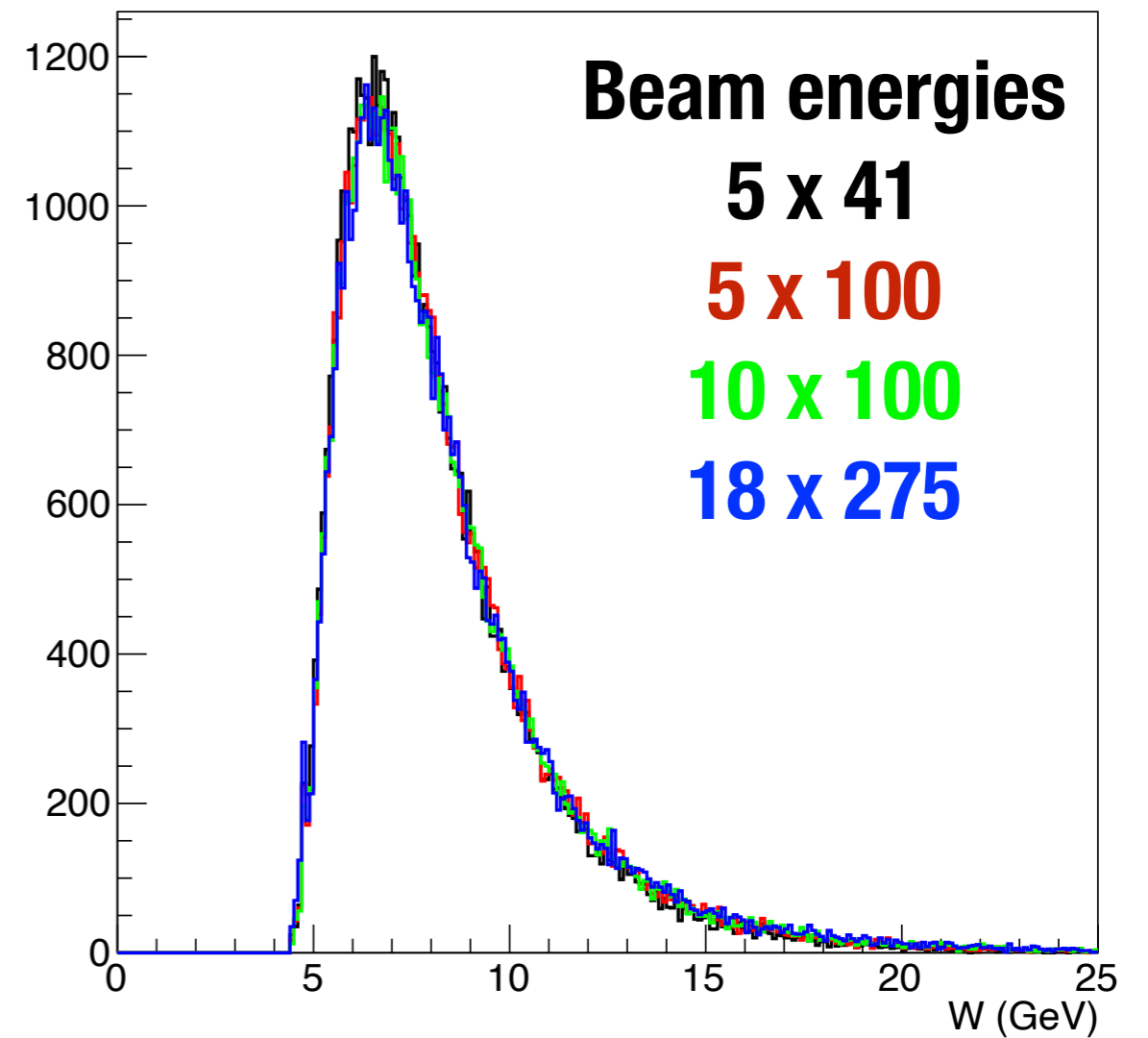
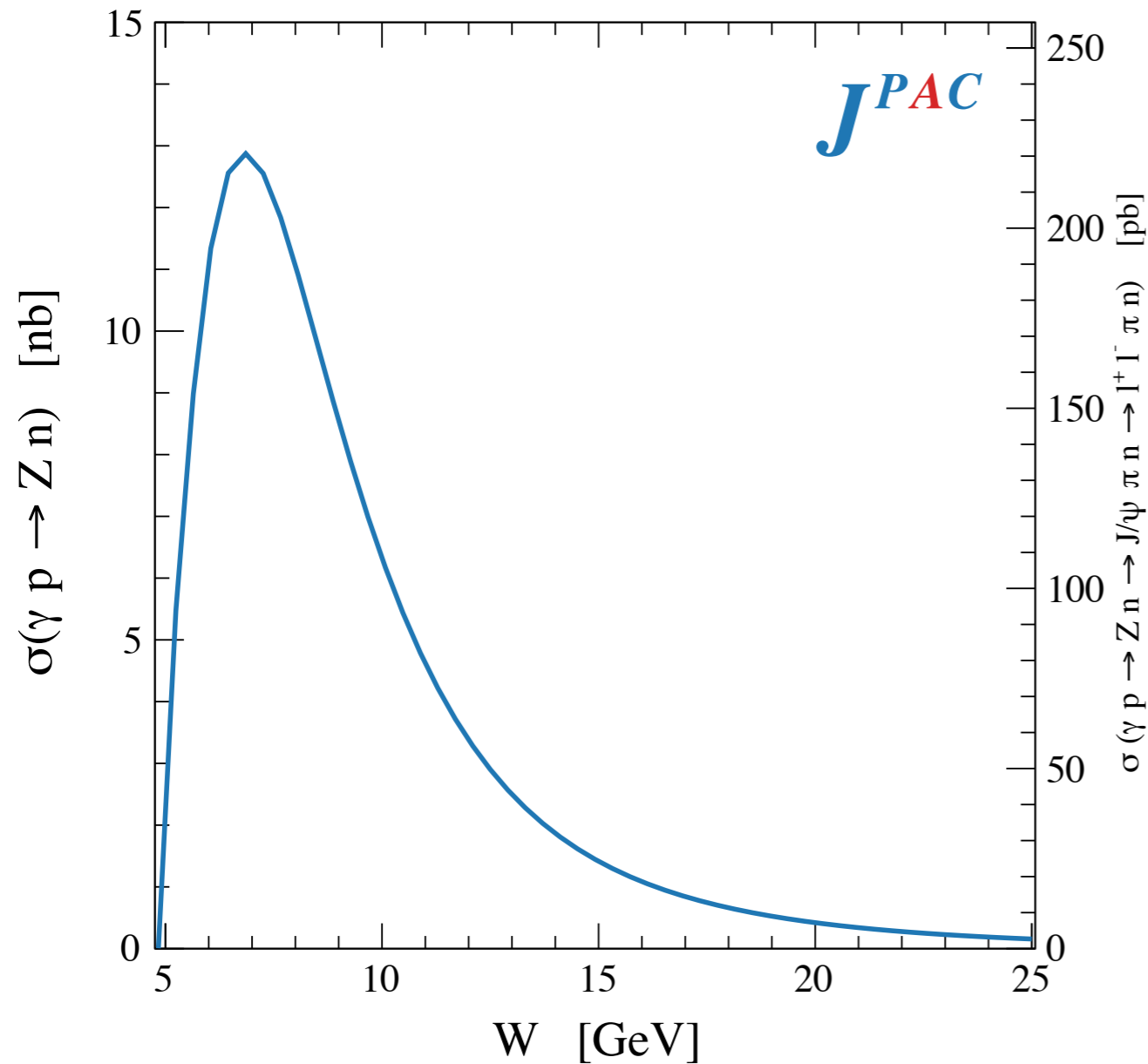
- * Event generators need a virtual photon flux to convolute with photoproduction cross sections

<https://github.com/dglazier/elSpectro>

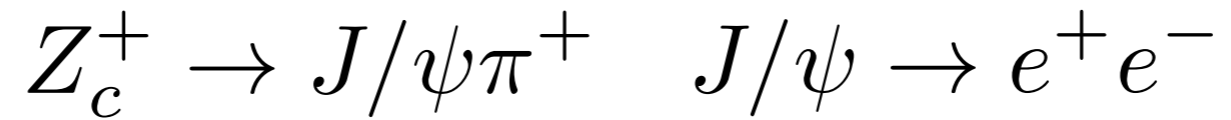


elSpectro generator: Z_c , π exchange

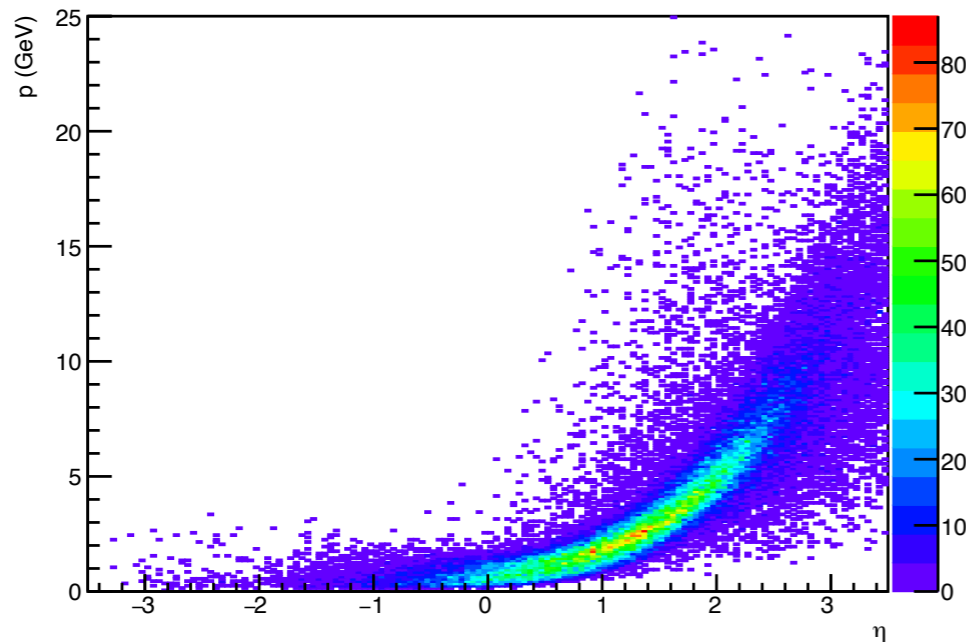
Both cross section and virtual photon flux dominated at threshold



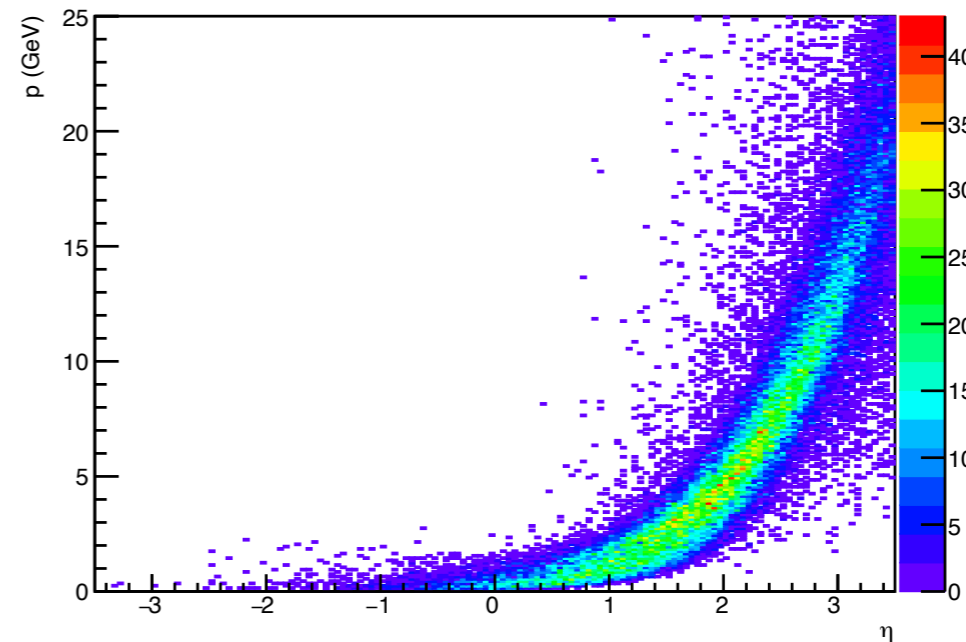
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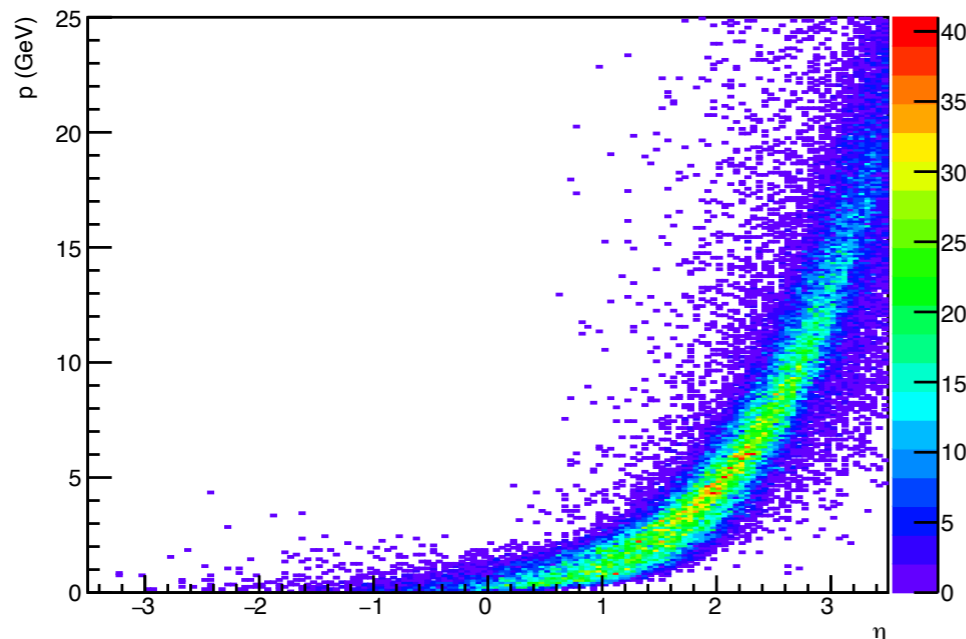
Beam energies: 5_41



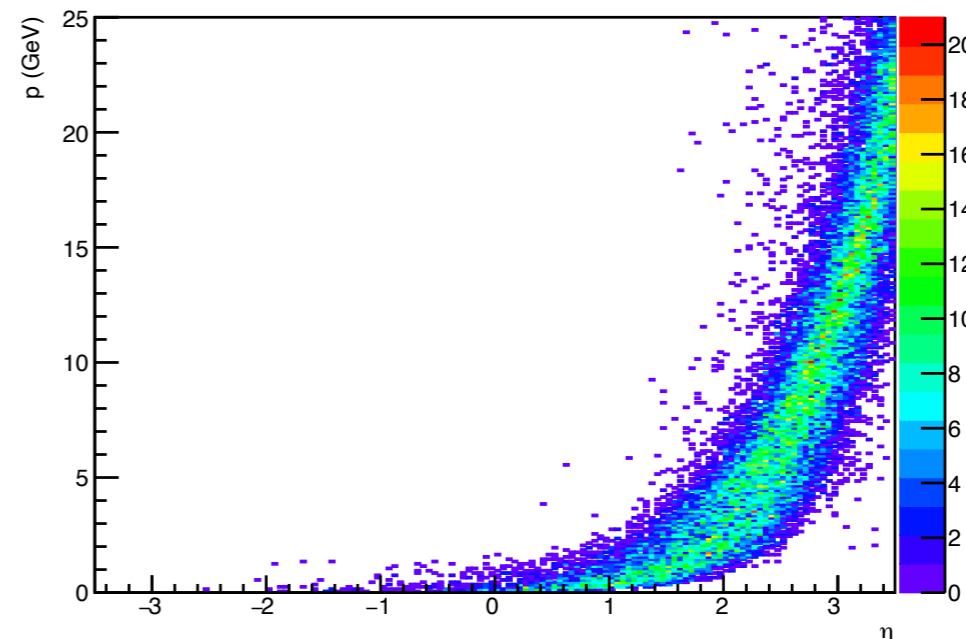
Beam energies: 5_100



Beam energies: 10_100



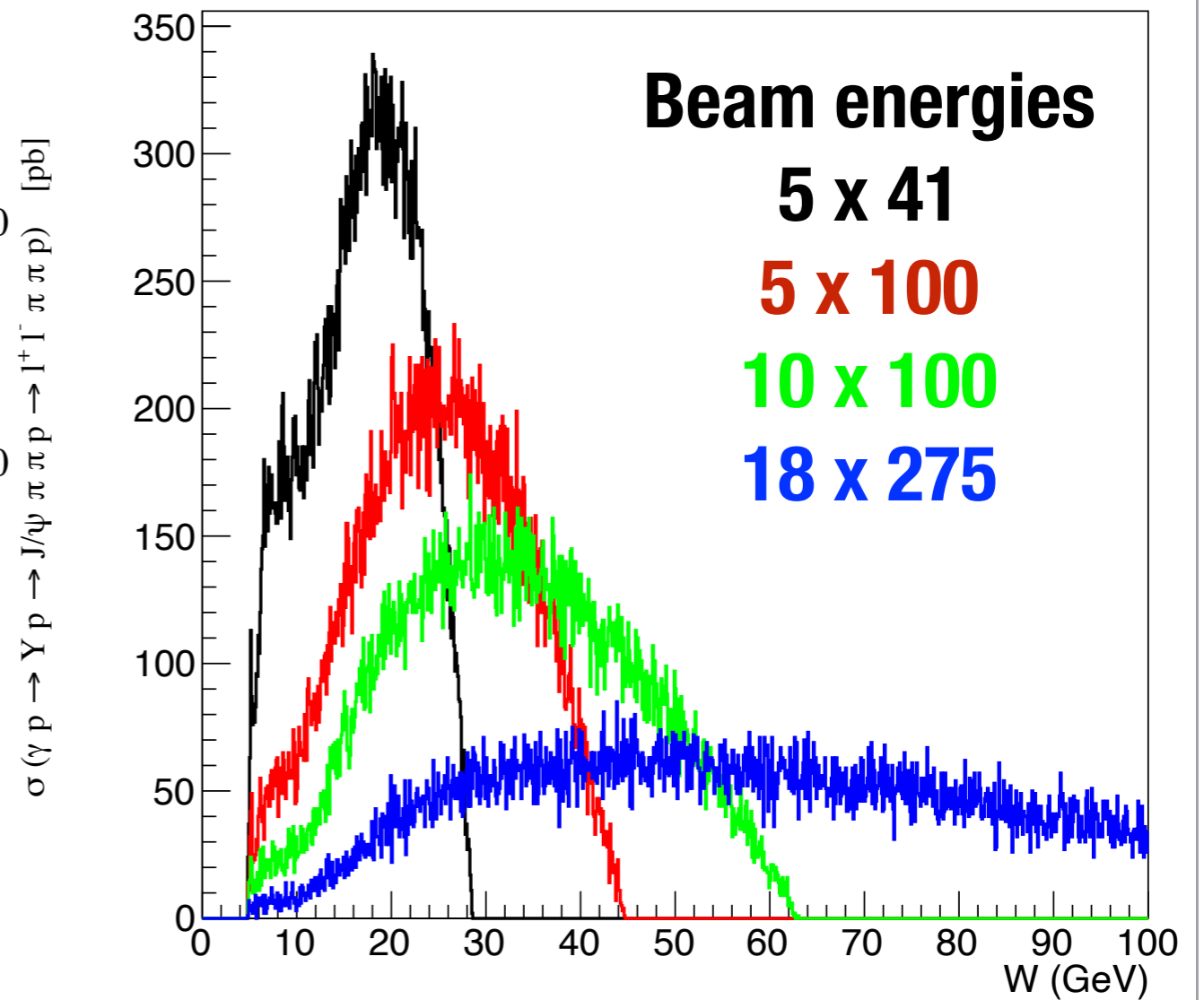
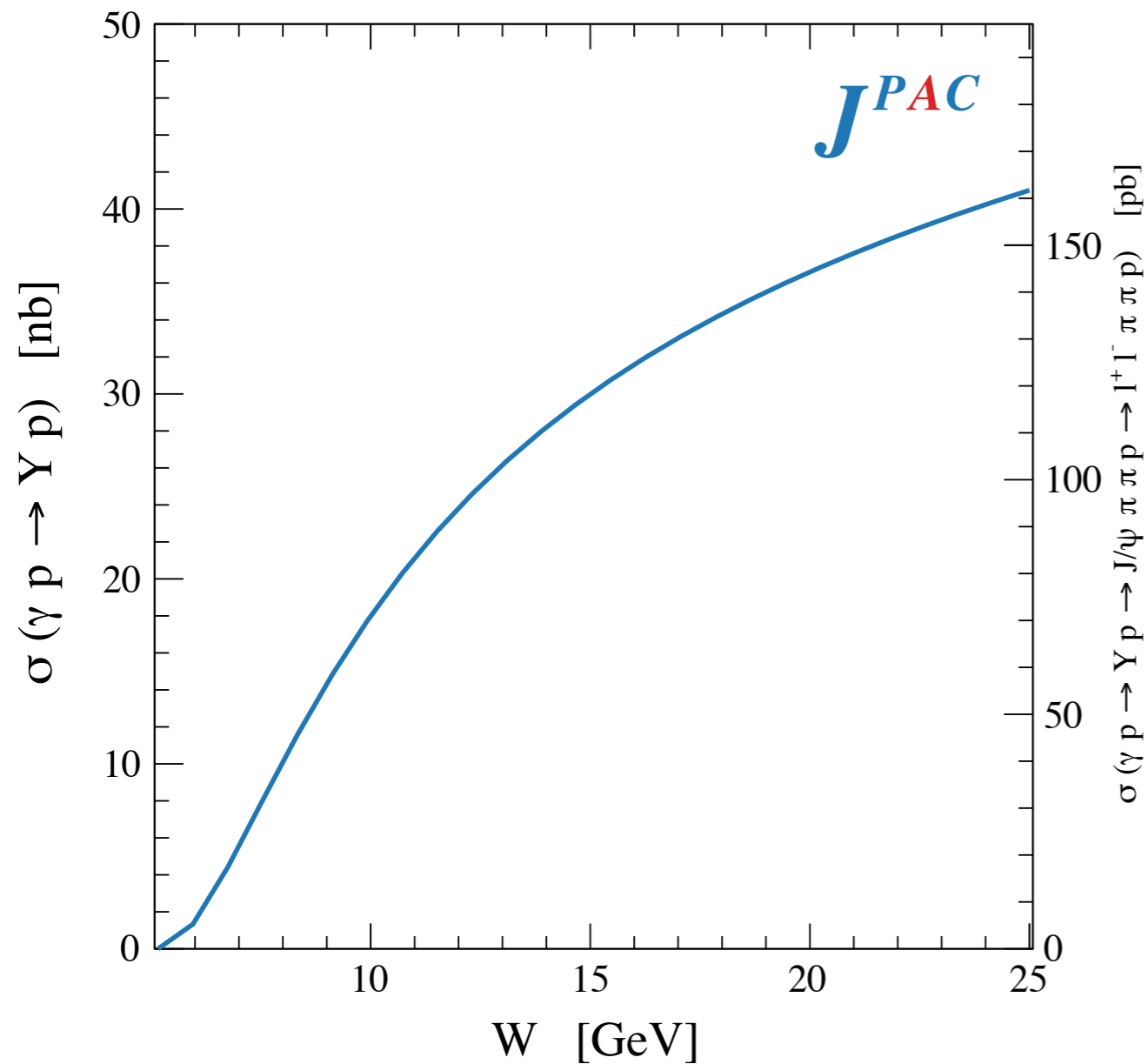
Beam energies: 18_275



Decay e^\pm boosted to forward η for all beam energies

elSpectro generator: $Y(4220)$

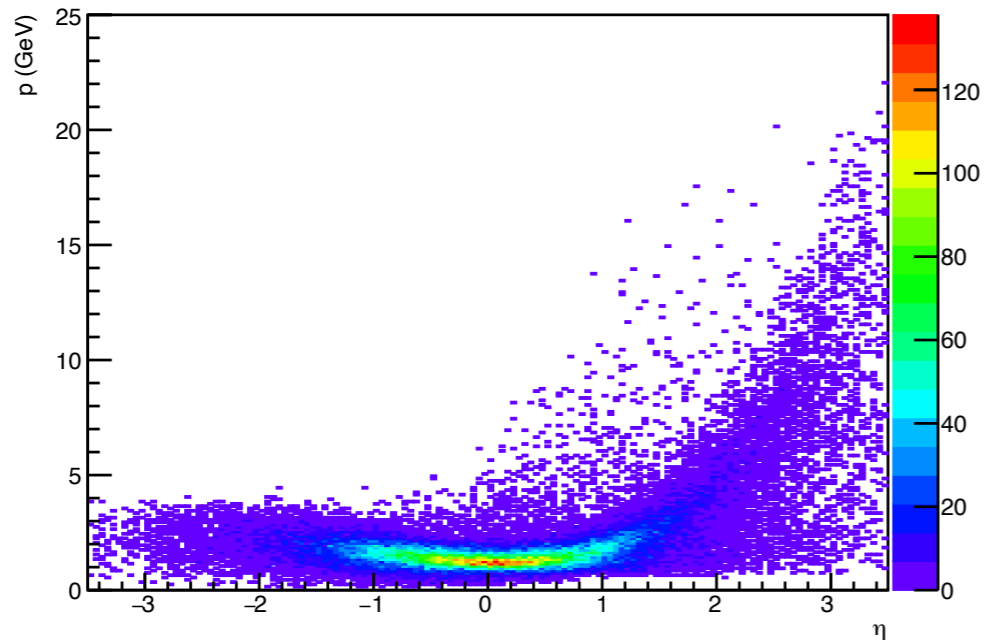
Cross section increases with W ,
while virtual photon flux largest at threshold



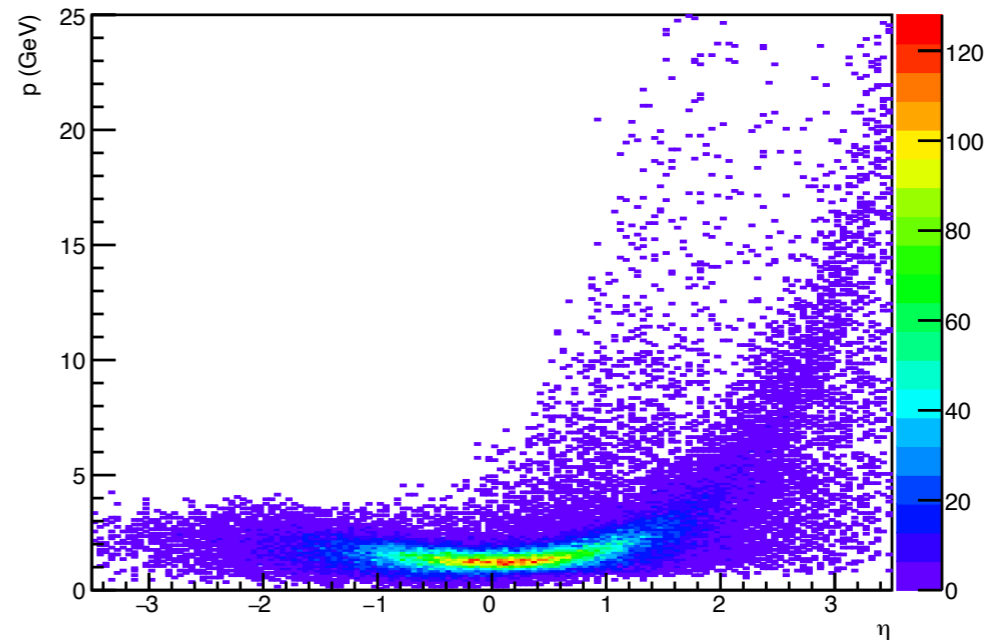
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$$Y(4220) \rightarrow J/\psi \pi^+ \pi^- \quad J/\psi \rightarrow e^+ e^-$$

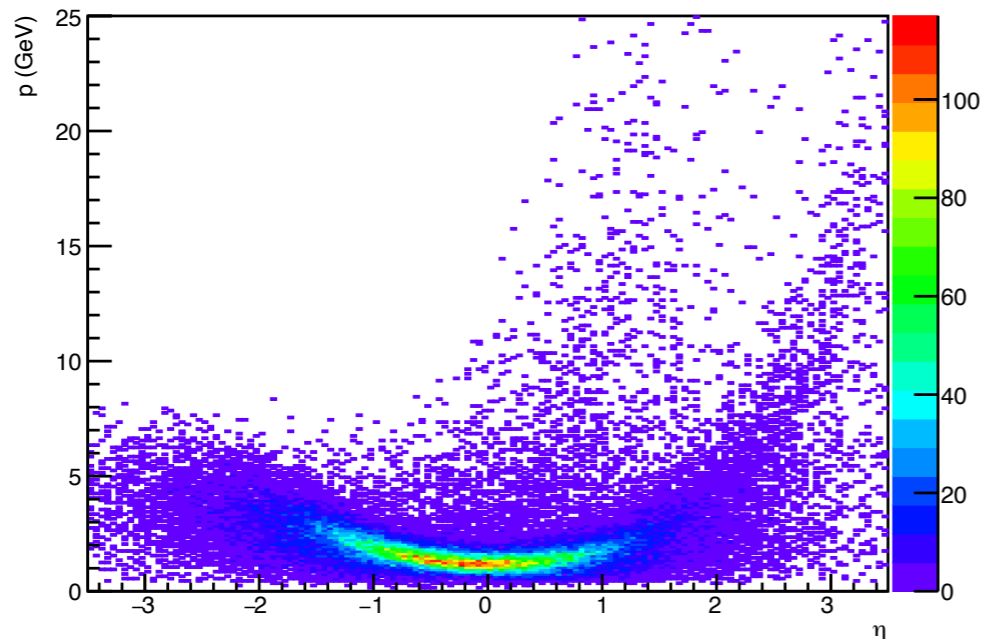
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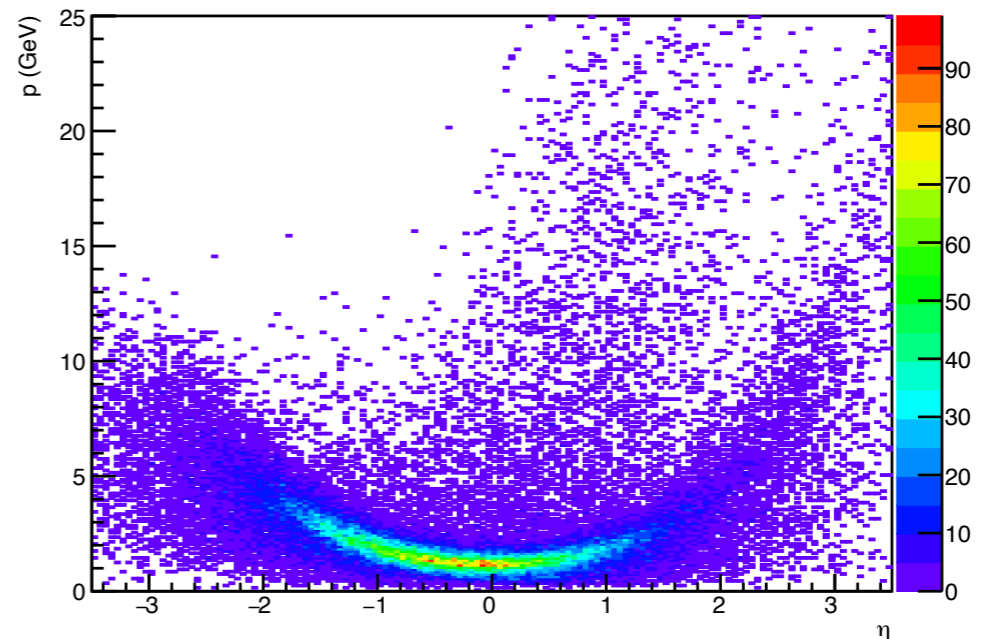
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Beam energies: 18_275



More events from larger W, decay e^\pm at central/backward η

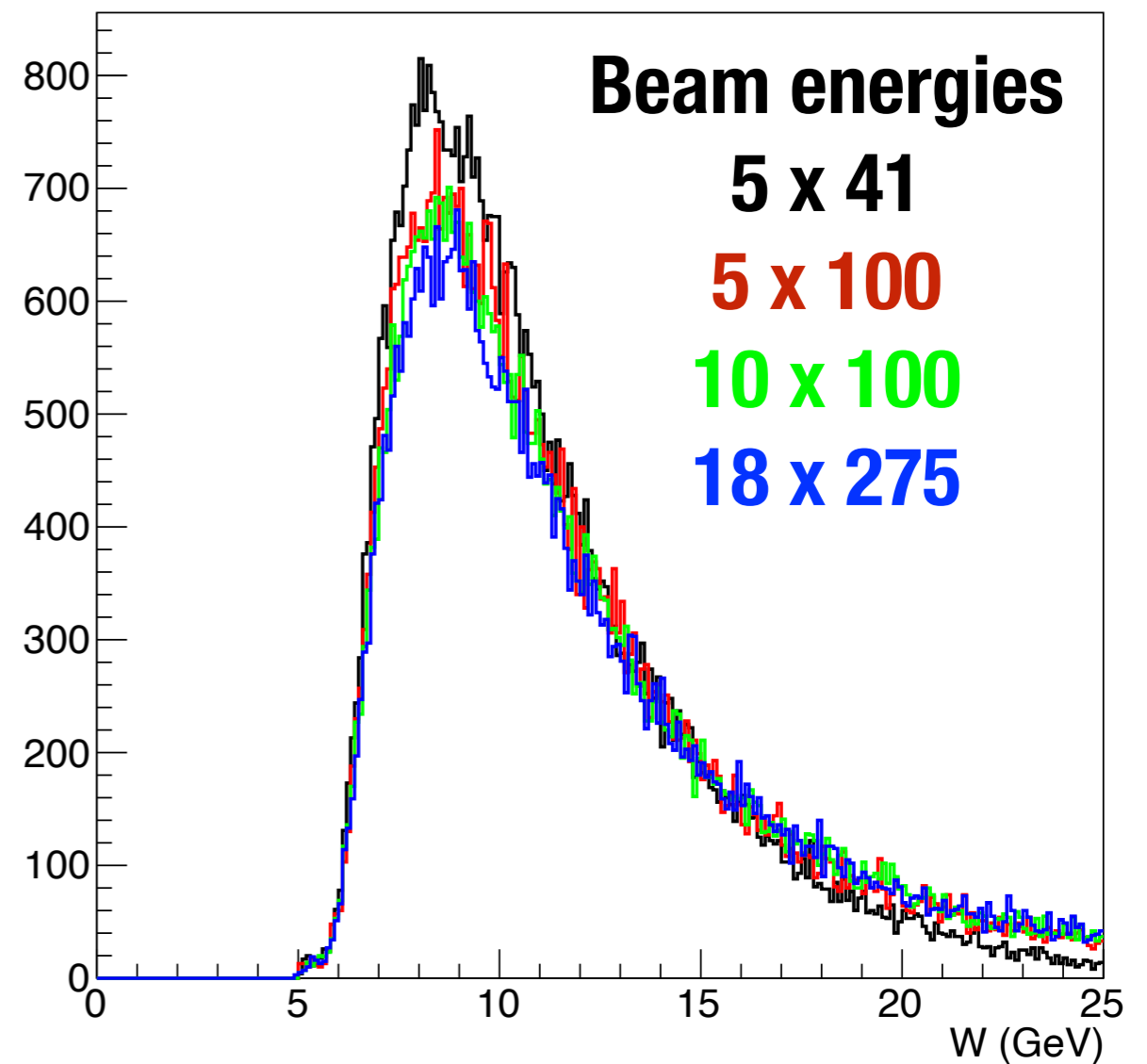
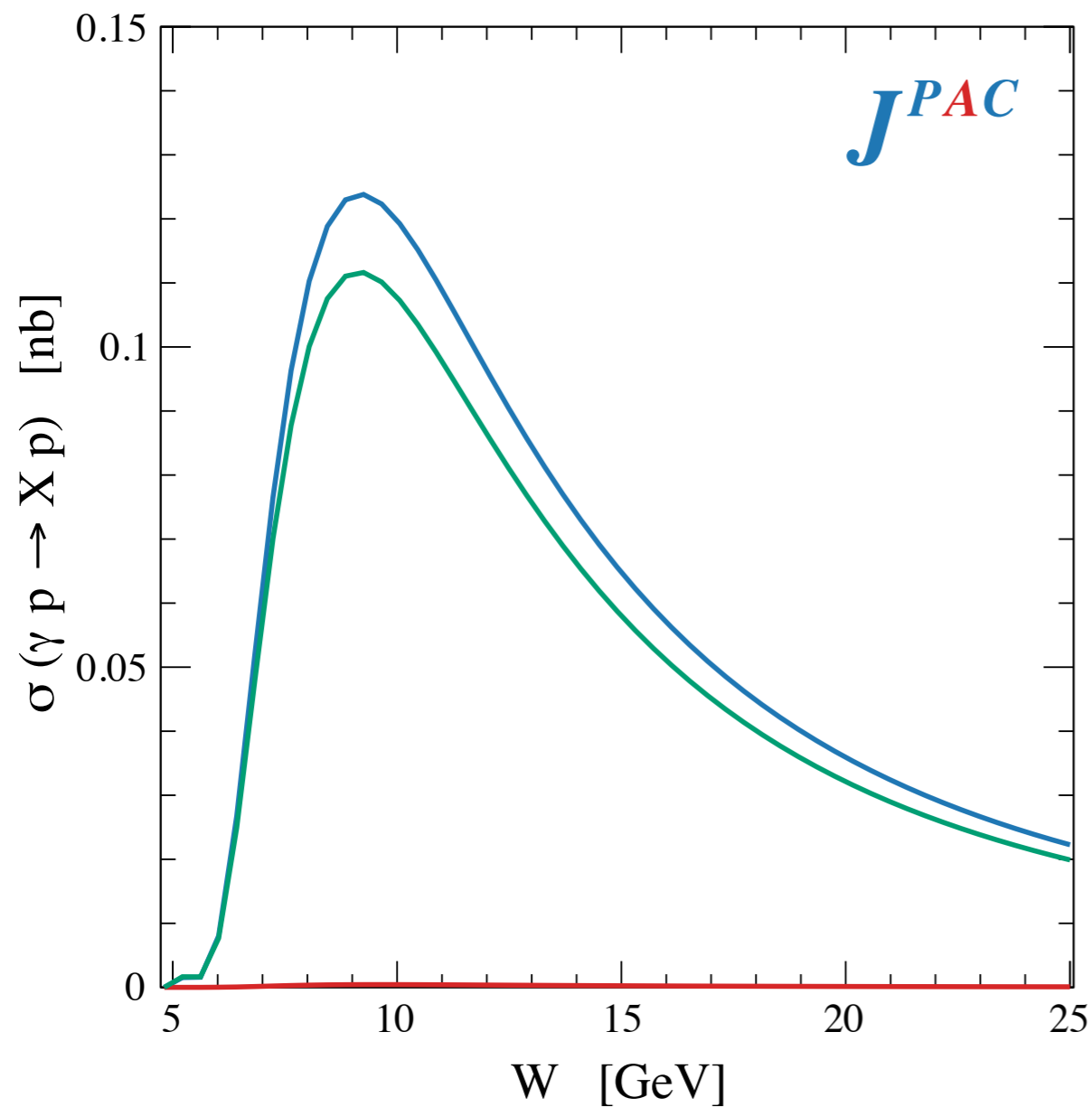
Summary

- * New theoretical predictions from JPAC for exclusive XYZ photoproduction
- * elSpectro event generator convolutes JPAC predictions with virtual photon flux
- * **What's next:** compare with PYTHIA backgrounds for purity and statistical precision estimates
- * Electron ID requirements remain critical for J/ψ identification: may drive e/π in detector matrix
- * Tracking resolutions in forward direction will impact mass resolution: tracking WG expected to provide updated parametrizations

Backup

elSpectro generator: $X(3872)$, ρ/ω exch.

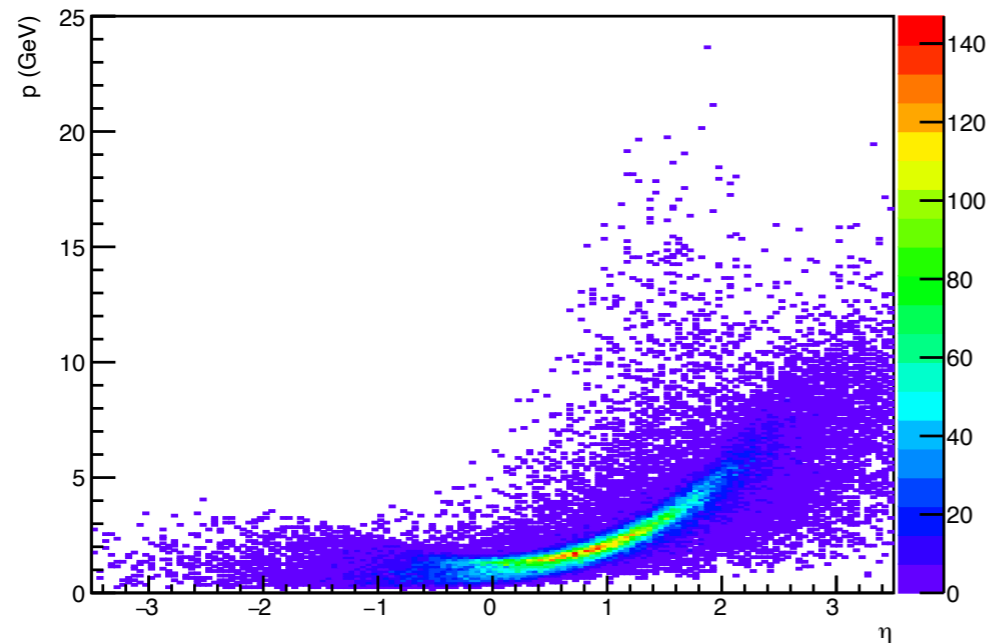
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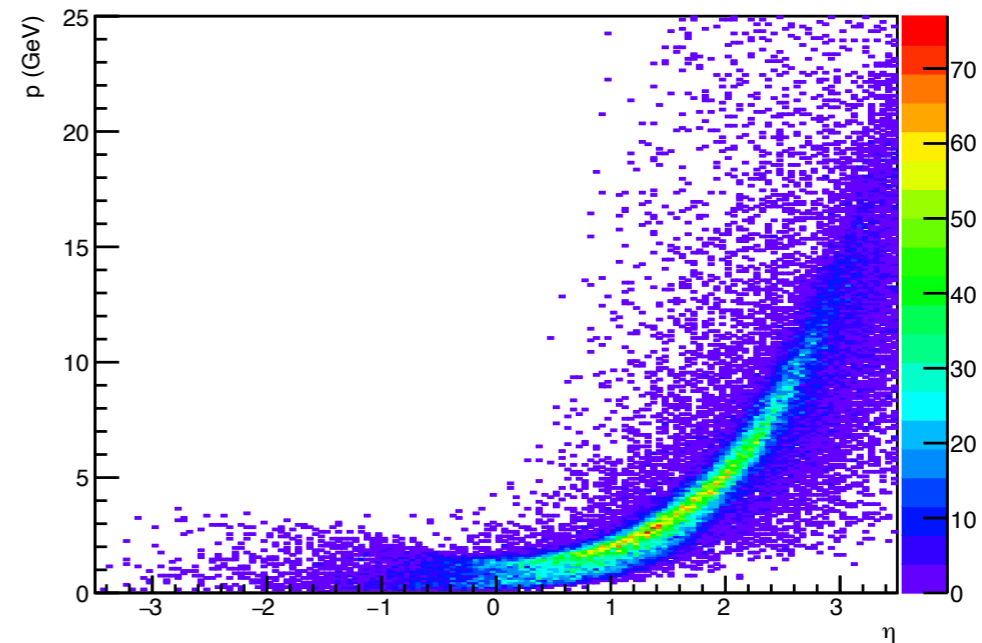
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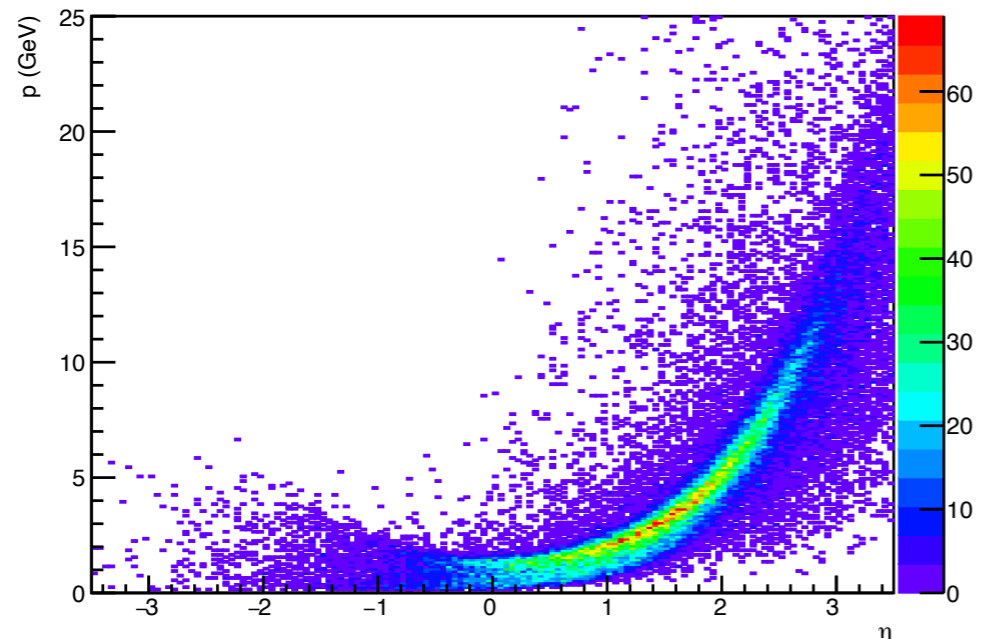
Beam energies: 5_41



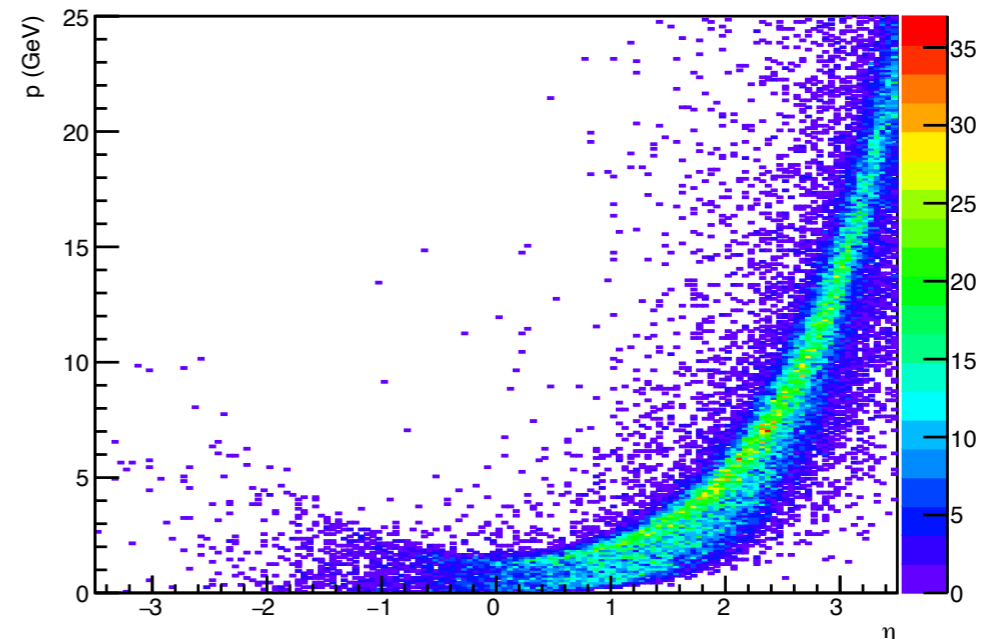
Beam energies: 5_100



Beam energies: 10_100



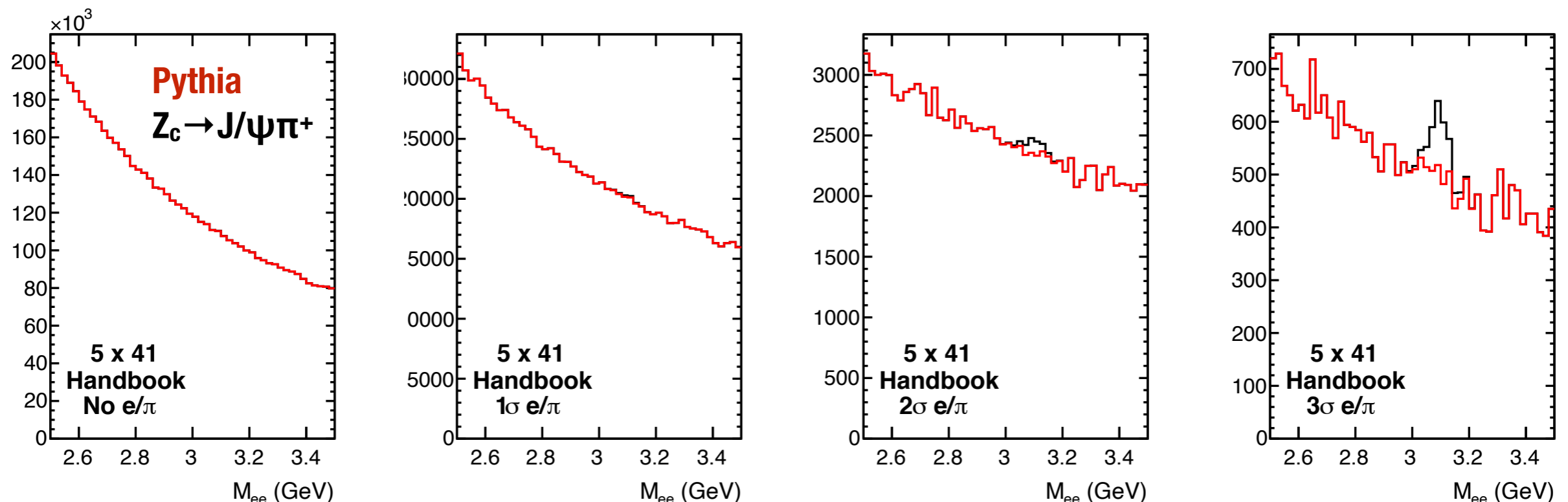
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Old background studies: e/π requirements

- * First background study with normalized
 - * 10M inclusive Pythia events: $\sigma \sim 10 \mu\text{b}$
 - * 10k Z_c events: $\sigma \sim 10 \text{ nb}$, (optimistic?) model prediction
- * **e/π separation** required to identify J/ψ (ad-hoc, not in eic-smear)
- * No exclusive requirement yet (low- Q^2 tagger or neutron in ZDC)



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