Forward detectors with ePIC simulation

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Motivation

- Work in collaboration with Mark Baker and Kong Tu on vetoing incoherent VM production using the far forward detector array.
- Based on https://arxiv.org/abs/2108.01694.

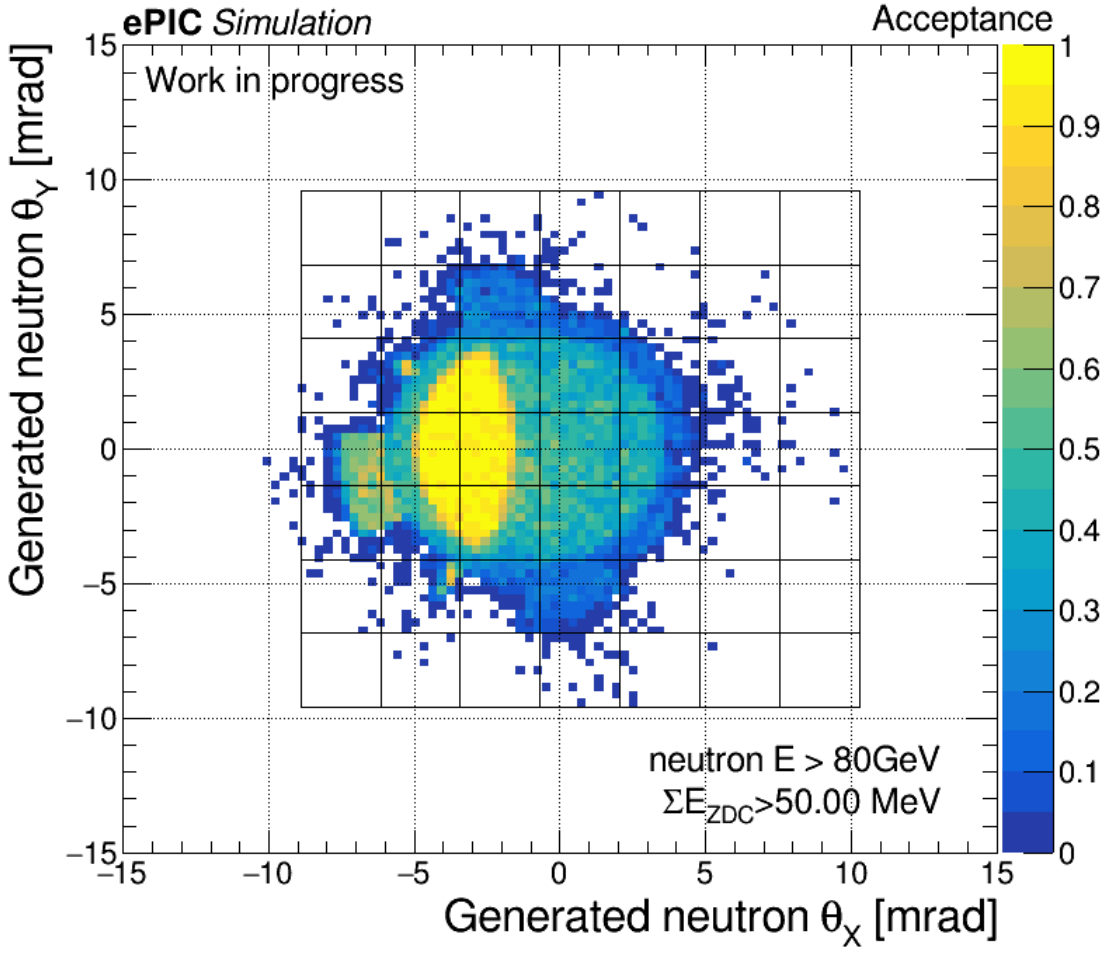
Investigation of the background in coherent J/ψ production at the EIC

Wan Chang,[1,2,*] Elke-Caroline Aschenauer,[2,†] Mark D. Baker,[3,‡] Alexander Jentsch,[2,§] Jeong-Hun Lee,[2] Zhoudunming Tu,[2,4,¶] Zhongbao Yin,[1] and Liang Zheng[5]

- More about this work will be presented by Eden during one of the upcoming Far-Forward meetings.
- Today we discuss a single particle response of the Far-Forward detector array in ePIC simulation (B0, RP, ZCD, OMD)
- The goal is to test the simulation framework for future physics analysis
- Please note the simulation results are very fresh and not conclusive. The primary goal is to discuss the readiness of the simulation setup.

Forward neutrons

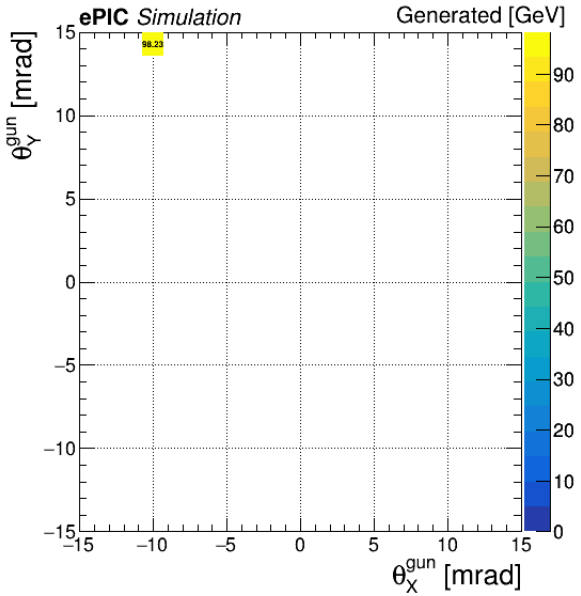
- The detection of neutrons in ZDC was tested with neutron particle gun
- Neutrons were generated with E<120 GeV and |θ| < 10 mrad
- Acceptance for neutrons mostly within |θ| < 5 mrad, not symmetric, with average detection efficiency of 50%
- The undetected 50% of the neutrons interact earlier (see next slide)

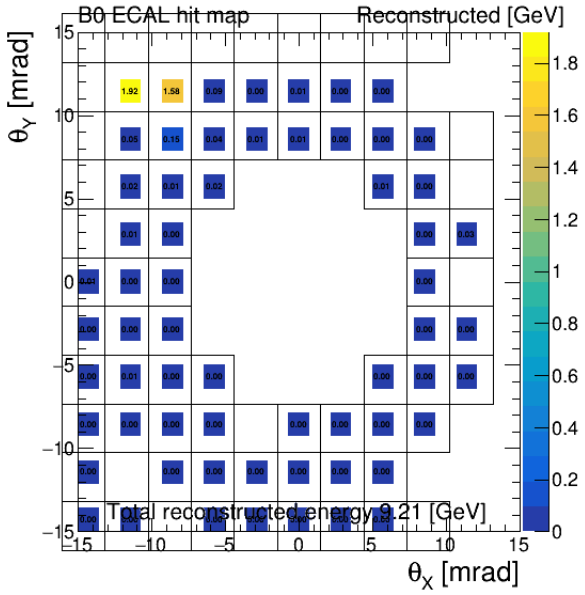


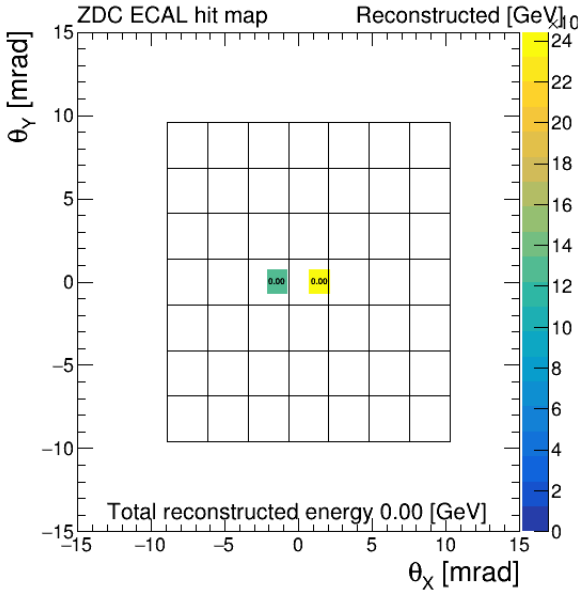
Forward neutrons

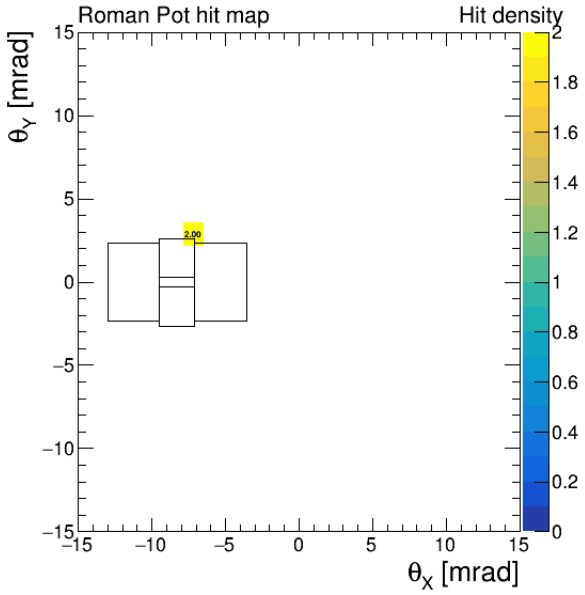
- In many events neutrons interact earlier

Example of neutron deposited large amount of energy in B0 ECAL (B0 ECAL λ is almost 1)





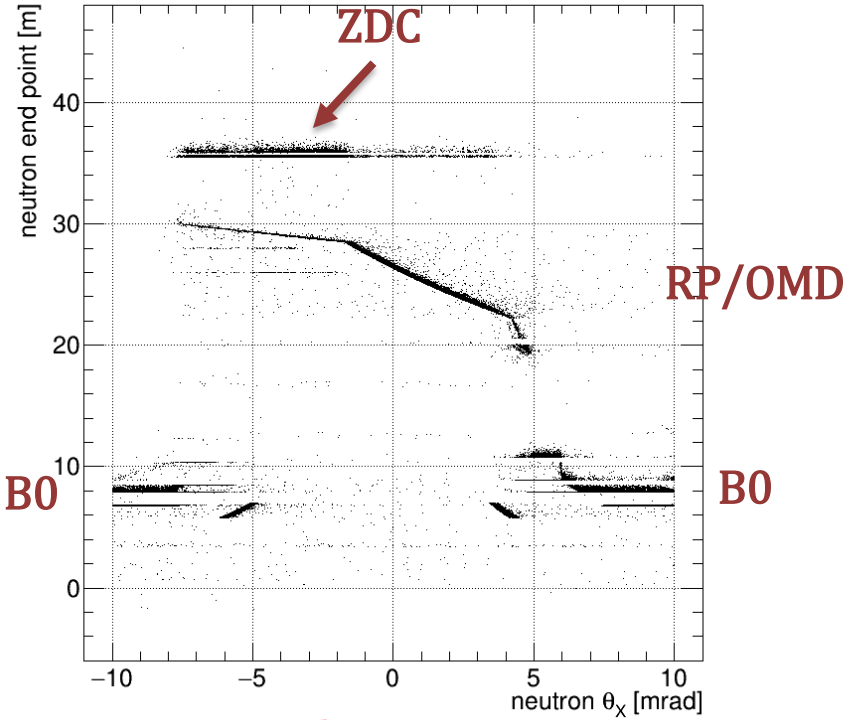


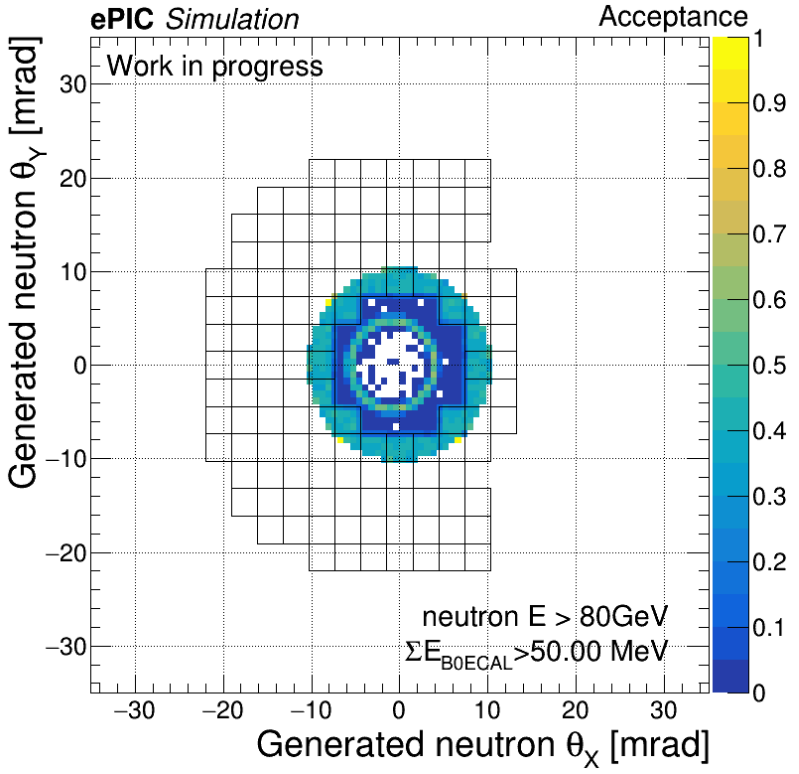


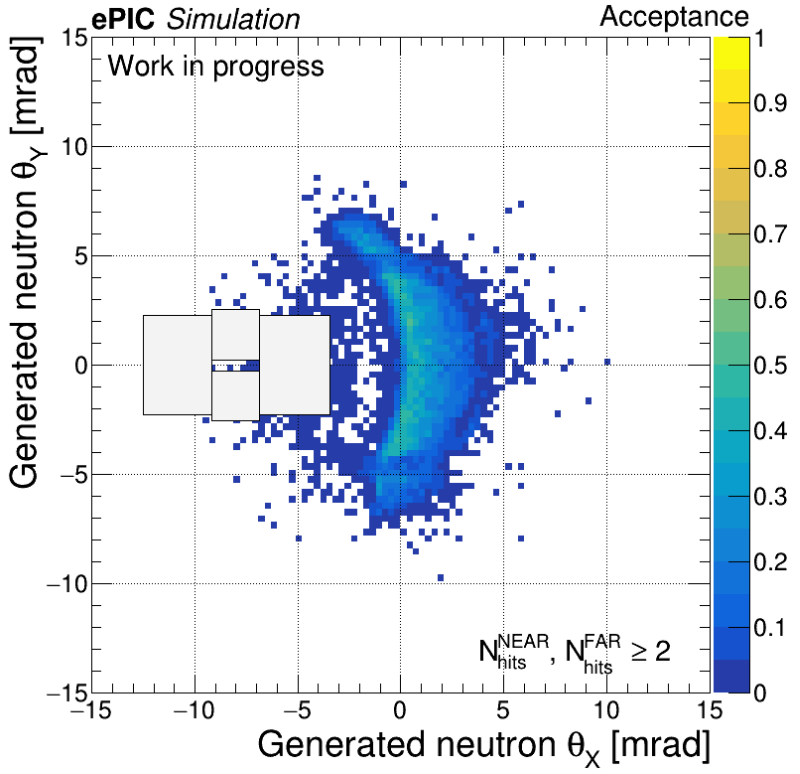
Forward neutrons

For θ > 5 mrad: B0 – detection efficiency of 50% (B0 ECAL λ is almost 1)

For θ < 5 mrad: a fraction of the events with neutrons are measured in the RP via secondaries



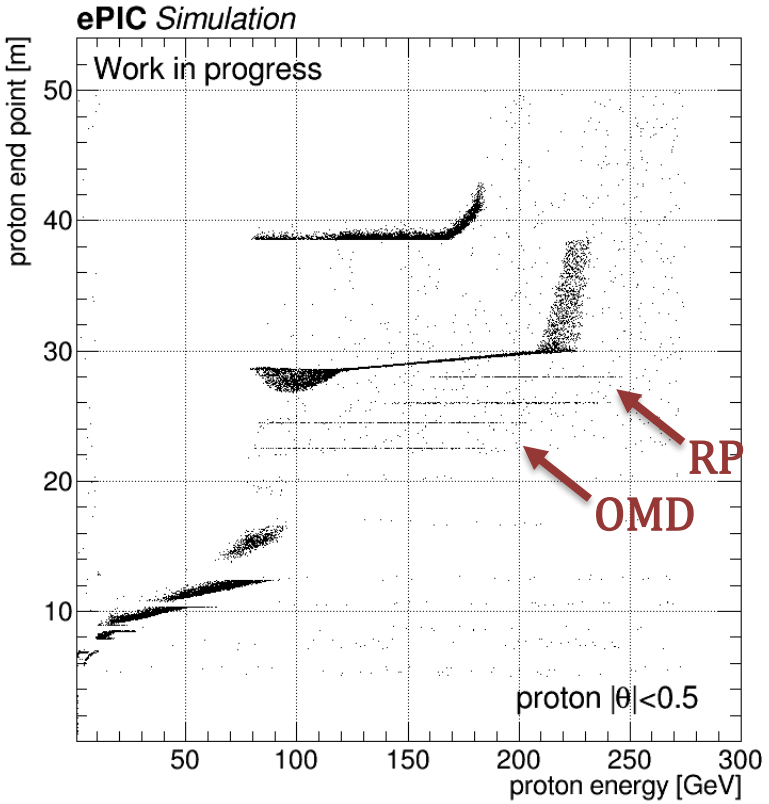


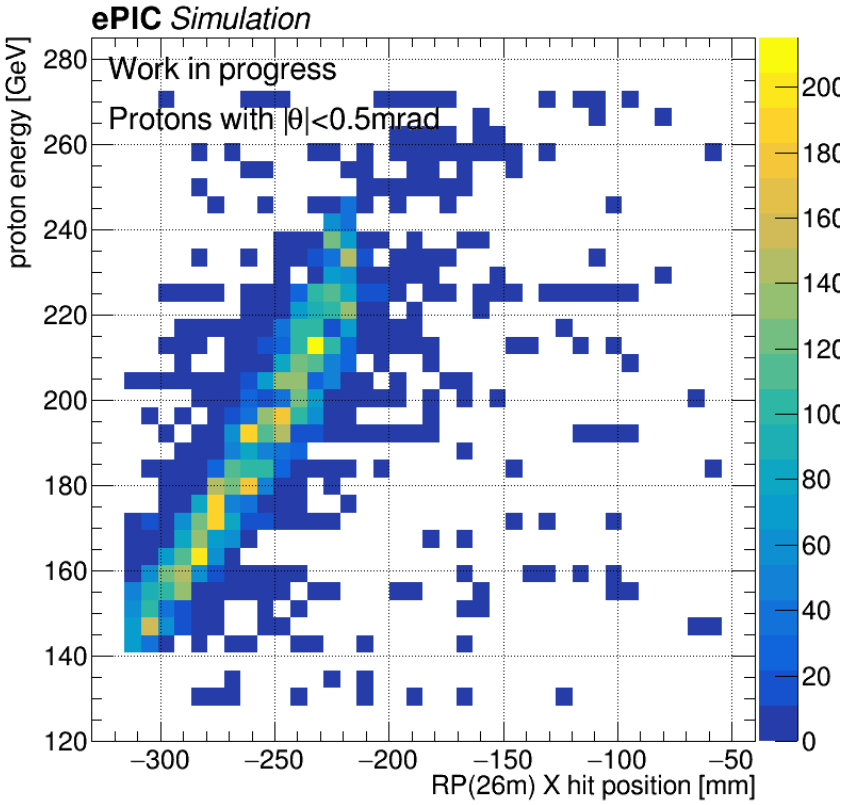


Forward protons

Protons with |θ|<2.5 mrad and E < 275 GeV were generated in 18x275 configuration.

Protons with energy from 140 GeV measured with the RP



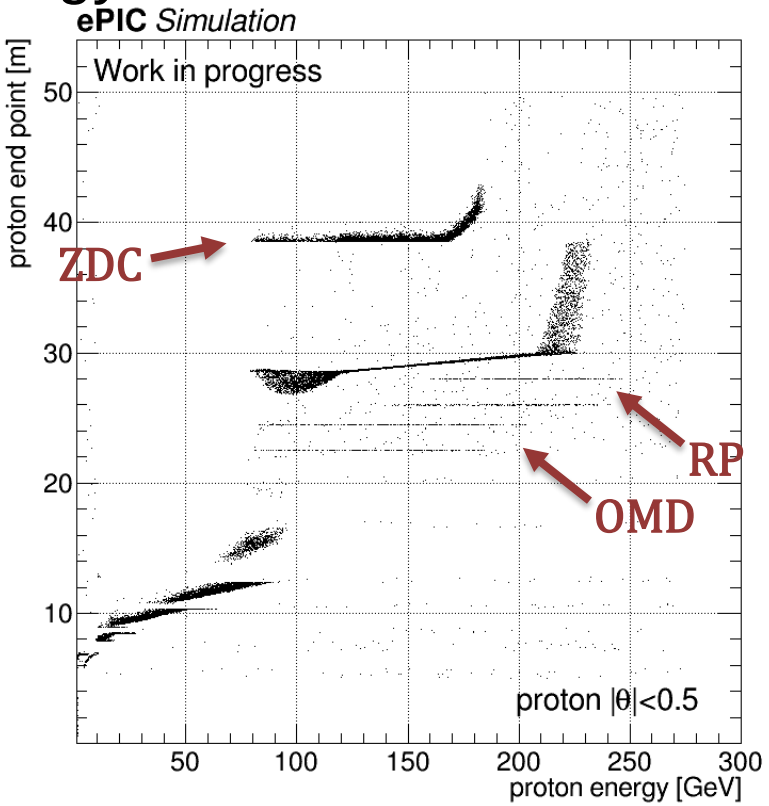


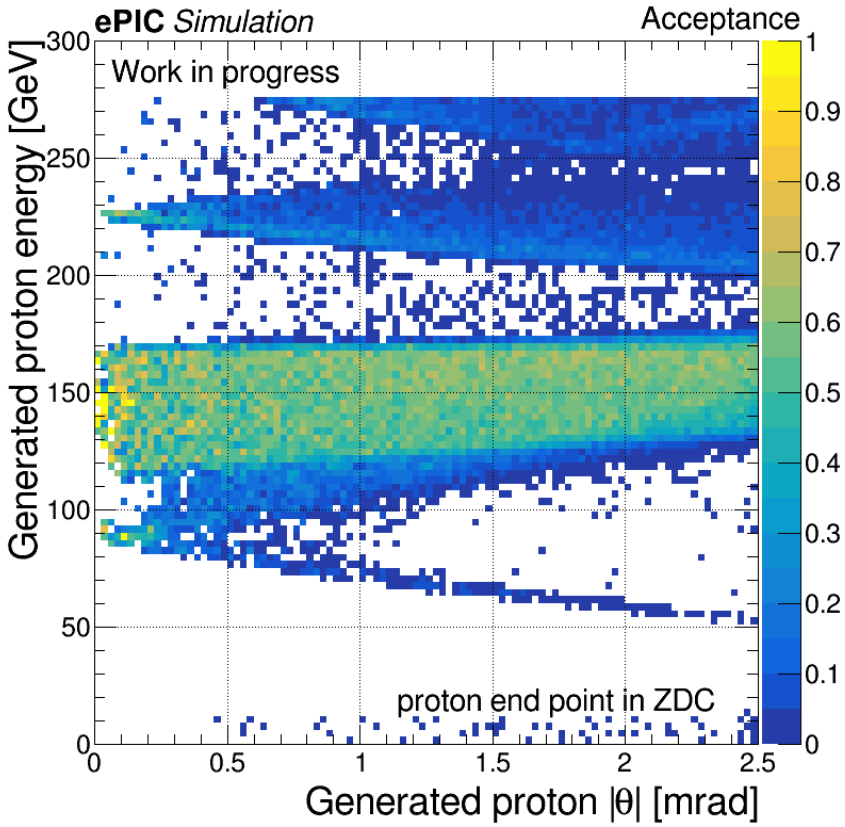
Forward protons

Protons with |θ|<2.5 mrad and E < 275 GeV were generated in 18x275 configuration.

Protons with energy from 140 GeV measured with the RP

Protons with energy within 120 – 160 GeV range can interact with ZDC





Summary and discussion

Summary:

- ~50% of neutrons with $|\theta|<5$ and $\theta_X>0$, interact earlier and not detected in the ZDC. Those neutrons scatter and secondaries can be measured with the RP
- Protons with energy above ~150 GeV can be measured in RP

Discussion:

- Are we happy with ZDC acceptances
- Are charged particles in the RP (and probably OMD) are simulated properly

Backup

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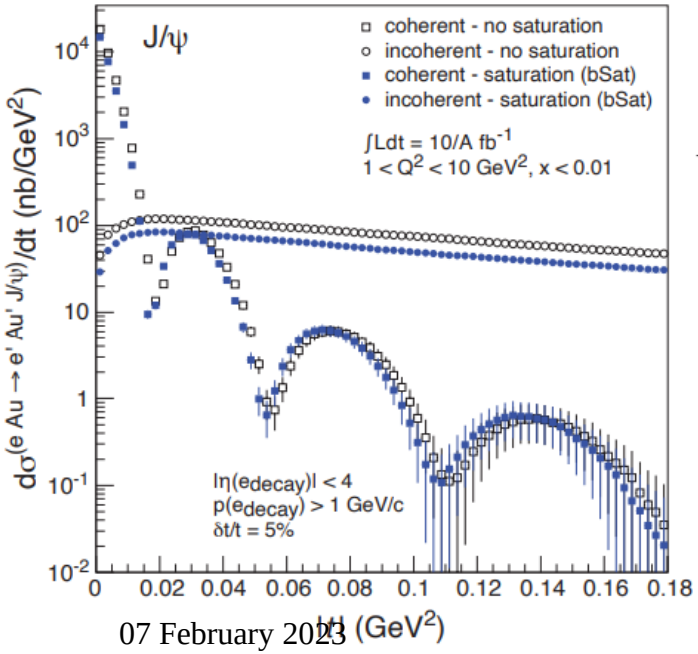

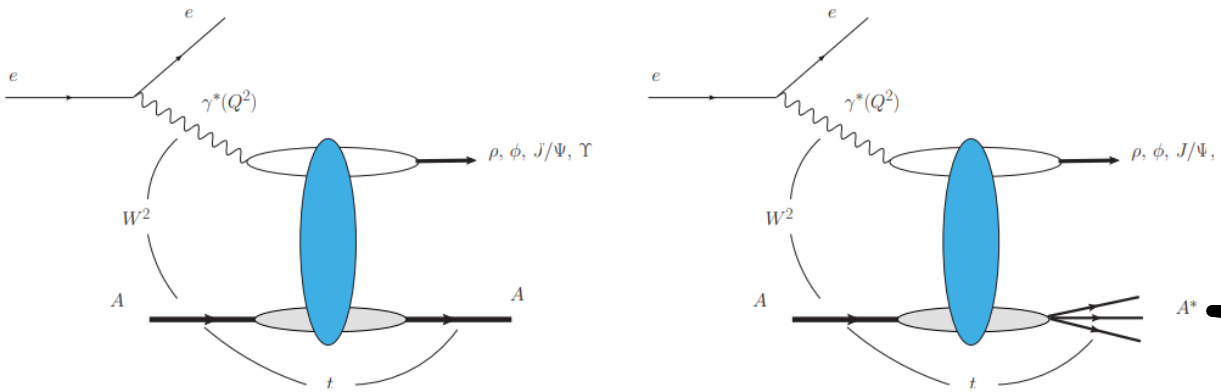

Figure 1: The coherent (left) and incoherent (right) exclusive vector meson production in eA collisions.

produced particle	rate
only neutron	7.66%
only proton	0%
only photon	3.25%
neutron and proton	3.19 %
neutron and photon	44.24 %
proton and photon	2.27 %
neutron, proton and photon	39.39 %

TABLE II. Summary of particles produced in incoherent J/ψ production in BeAGLE.

Taken from 1905.06759

Backgrounds in coherent J/ψ production

Eden Mautner, Michael Pitt

Detecting incoherent interactions:

Results from [2108.01694](2108.01694)

- Veto.1: no activity other than e^- and J/ψ in the main detector ($|\eta| < 4.0$ and $p_T > 100$ MeV/c) ;
- Veto.2: Veto.1 and no neutron in ZDC;
- Veto.3: Veto.2 and no proton in RP;
- Veto.4: Veto.3 and no proton in OMDs;
- Veto.5: Veto.4 and no proton in B0;
- Veto.6: Veto.5 and no photon in B0;
- Veto.7: Veto.6 and no photon with $E > 50$ MeV in ZDC.