ECCE homework for J/ψ detection

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Outline

- Acceptance
- Efficiency
- Purity
- Cross section

Simulation Detail

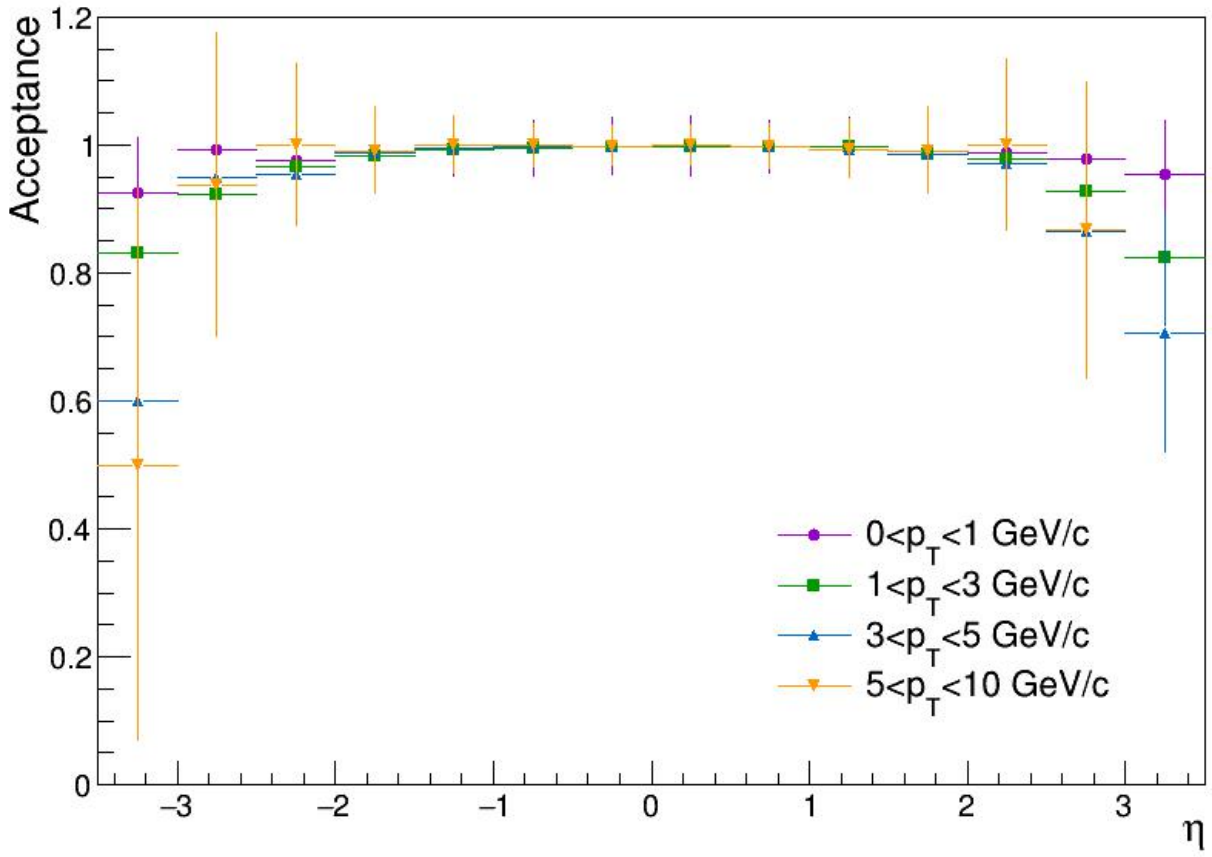
For Acceptance, Efficiency:
Input: Directly put single J/ψ into detector and force it decay to dielectron (vertex(0,0,0))
Detector: July Concept
events: 0.2 million J/ψ
Method:
1) Acceptance: If both daughters are in tracking coverage ($-3.5<\eta<3.5$), we think this J/ψ is accepted.
2) Efficiency:
a) If both daughters are detected by tracking, we think this J/ψ is detected. So this efficiency can be viewed as the combination with the acceptance and the Kalman filtering efficiency in tracking.
b) If both daughters are detected by tracking and they can reconstruct a J/ψ, we think this J/ψ is not only detected but reconstructed. So this efficiency can be viewed as a)+reconstruction efficiency.

Need to know: the Kalman filtering efficiency in tracking depends on the initialization parameter to some extent, we initialize it with “positron”, so the efficiency of electron will have a lower detected efficiency at low momentum ($p<1.25$ GeV/c) (for p_T is about <0.5 GeV/c) due to different charge from the initialization. So the acceptance and the efficiency should be higher.

Acceptance

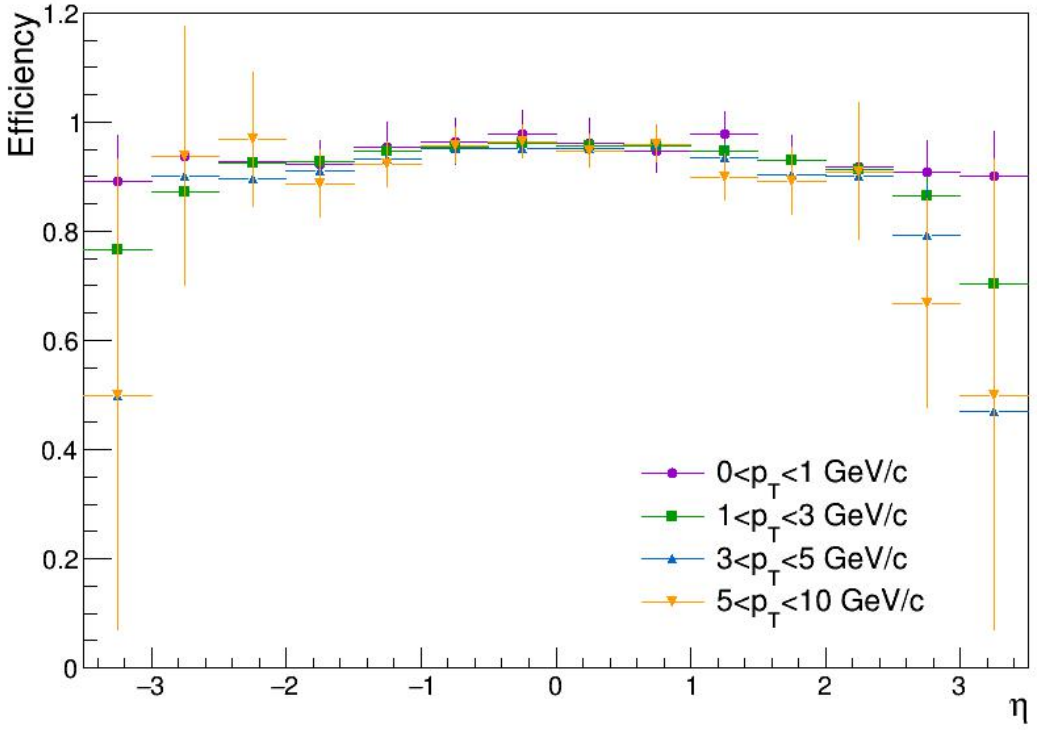
input J/ψ:
Uniform $0<p_T<10$ GeV/c
RapidityRange $-4<y<4$
Vertex (0.,0.,0.)

Acceptance in different p_T ranges with the η distribution (with a cut from -3.5 to 3.5), We use the truth η.

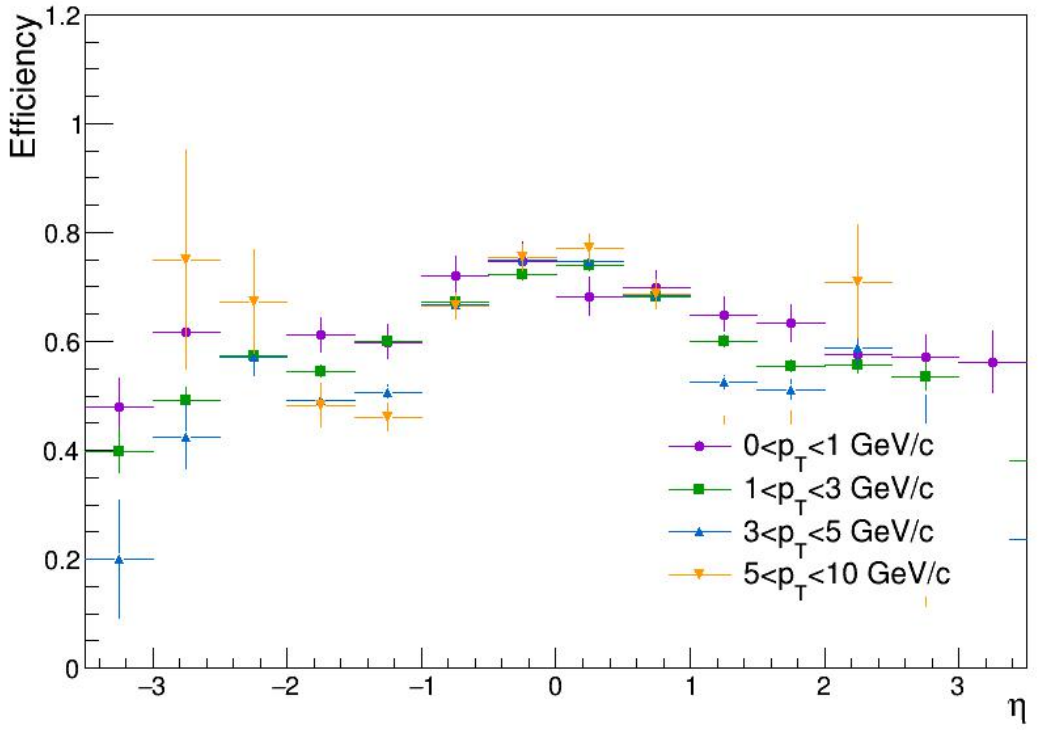


Efficiency

a)

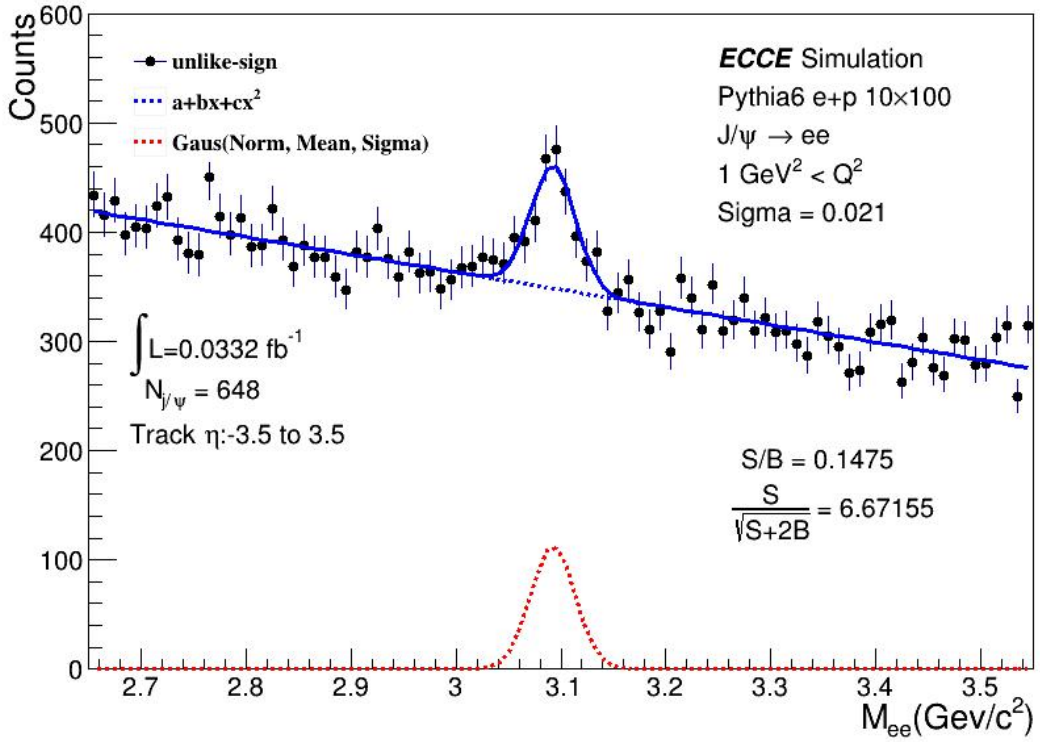


b)



Efficiency

For method b), we define the J/ψ is reconstructed when the invariant mass is near the truth mass (3.0969 GeV), with the width according to the reconstruction in the ep 10×100 GeV simulation (July Concept, about 20 million events, perferct eID):

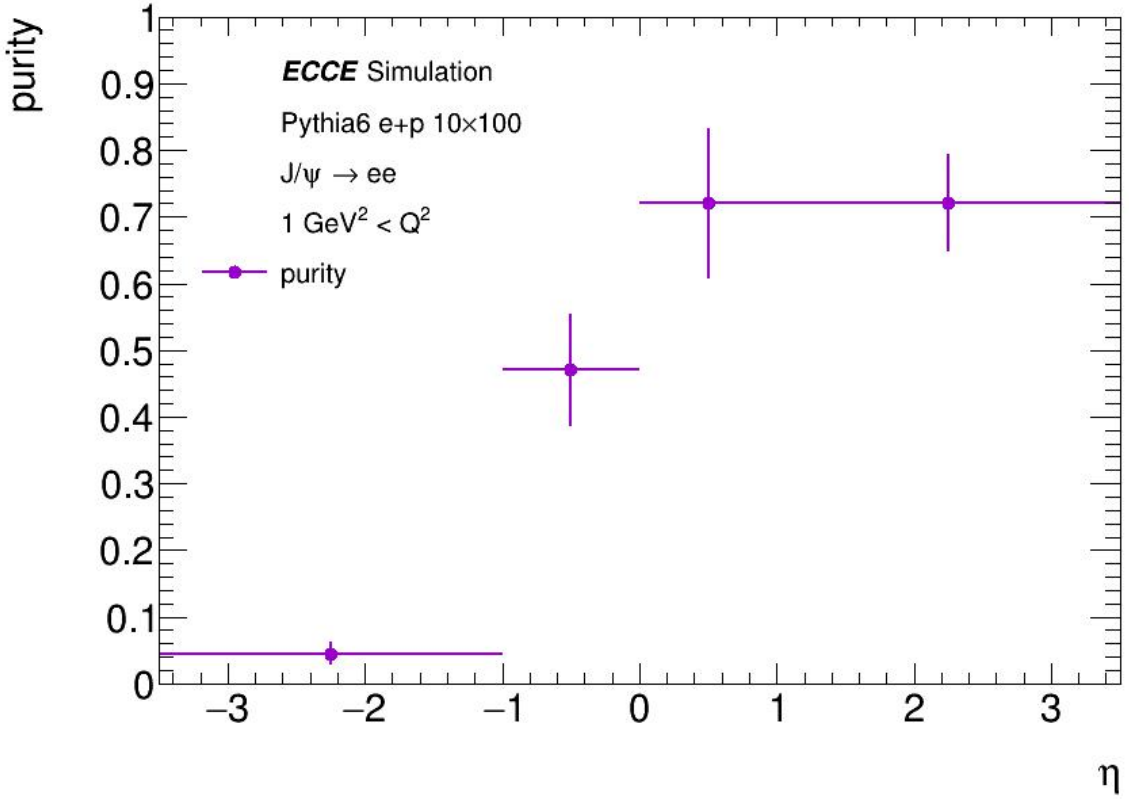


reconstruted mass requirement:
(3.097-3*0.021) ~ (3.097+3*0.021) GeV

Purity

ep 10×100 GeV simulation (July Concept, about 20 million events, perferct eID) without any cut. Purity of J/ψ in forward and central region. Purity is defined as S/T, where S and aT are signal and total counts in unlike-sign dielectron reconstruction. (perfect eID)

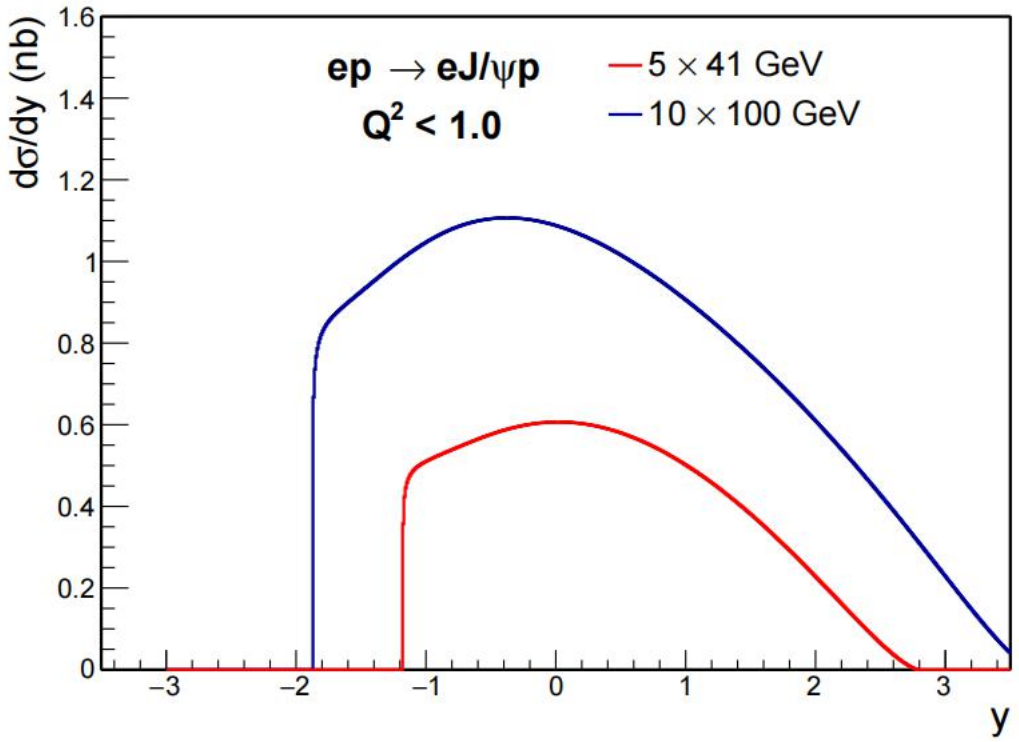
most background due to the scattered electron, so a bad purity is shown in electron going direction.



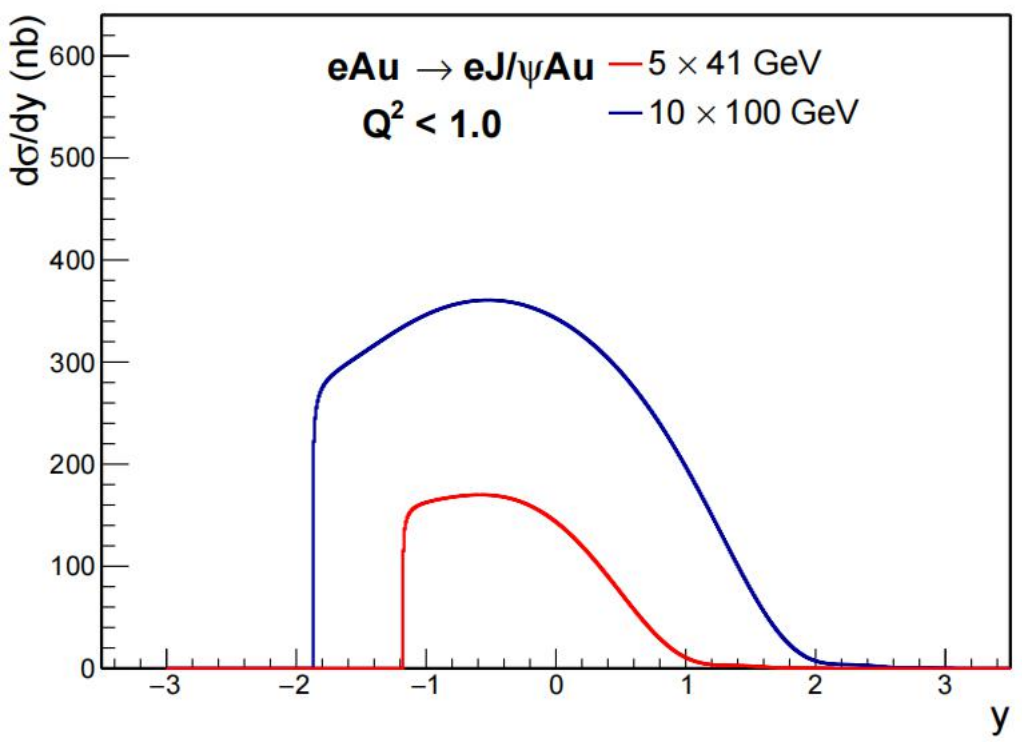
Cross section

Rapidity distribution of exclusive photoproduction of J/ψ for 5×41 GeV and 10×100 GeV of ep and eAu collision

integral luminosity: $100fb^{-1}$



integral luminosity: $10fb^{-1}$

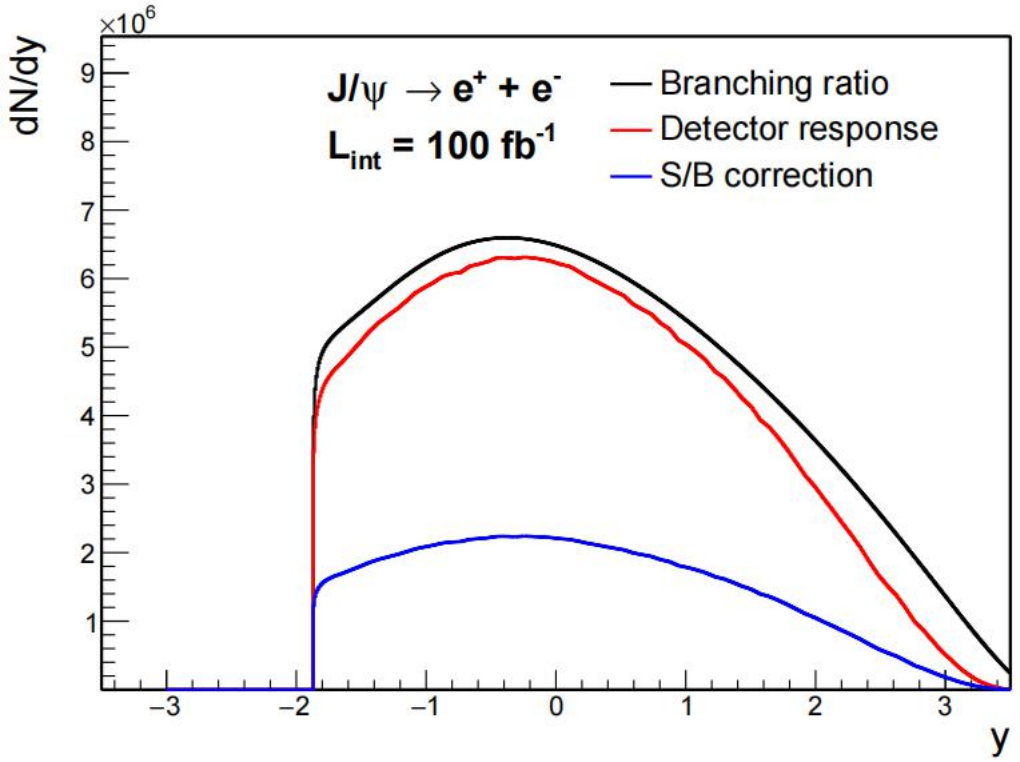


simulated by eSTARLight and these are the theoritical calculation results.

Cross section

With detector response and S/B ratio correction from ecce full detector simulation.
N=Lσ, more details can be found in exclusive quarkonium note.

ep——>epJ/ψ



eAu——>eAuJ/ψ