University of Glasgow

Data to MC Matching: J/ψ Photoproduction in RG-B

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Efficiency Matching

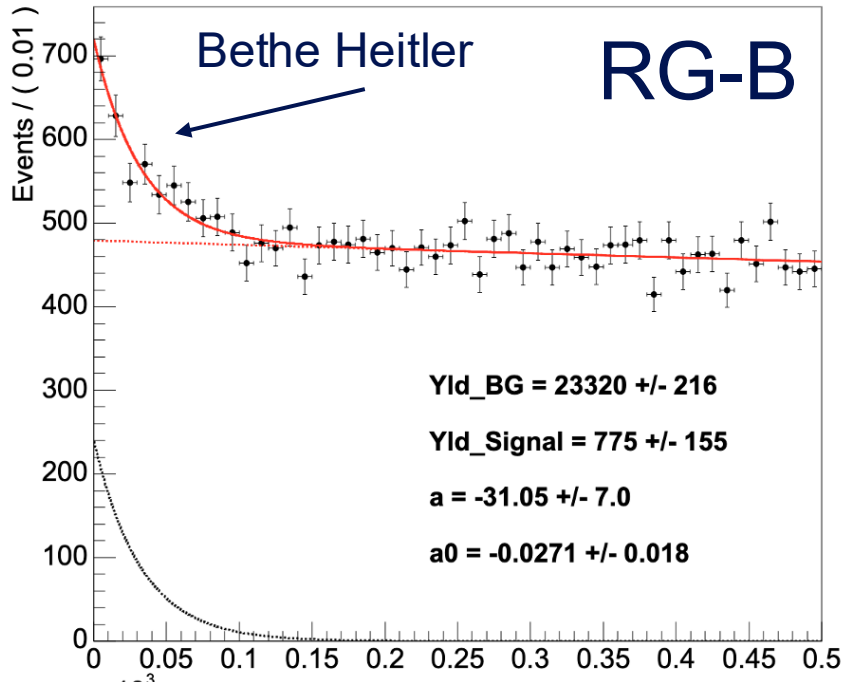
Calculate ratio Bethe Heitler events in RG-B over that in MC as predicted by QED + GEMC: ~0.7

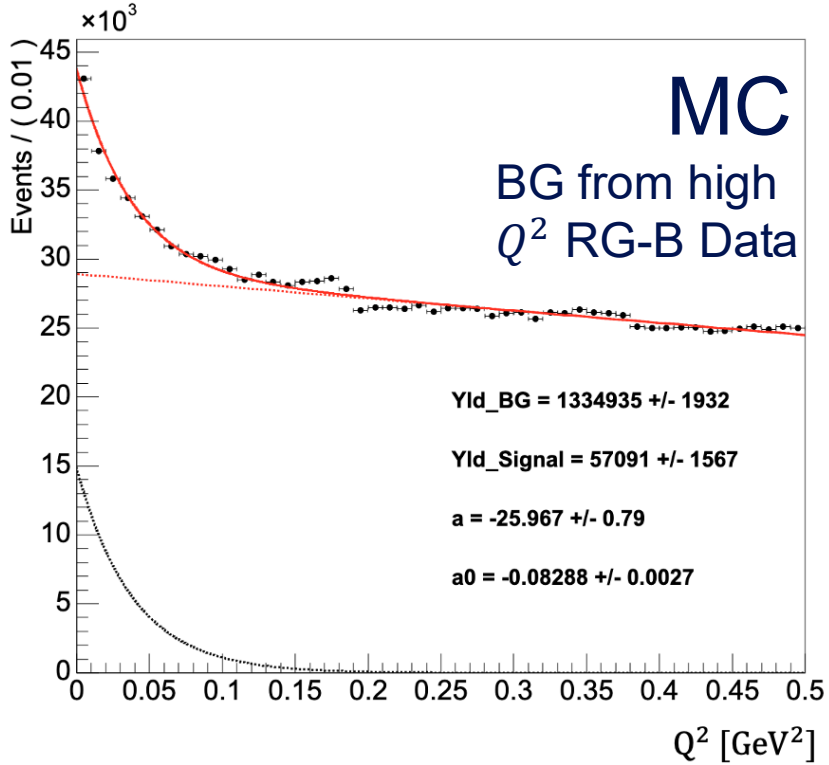
Use this ratio to correct J/ψ cross section:

- Same final state e^+e^-N
- Similar kinematics ($M(e^+e^-)$ > 2.0 GeV for BH, $M(e^+e^-)$ = 3.097 GeV for J/ψ)

We can bring ratio to ~0.95 using a variety of corrections comparing data and MC:

- Neutron detection efficiency from $ep \rightarrow e'\pi^+n$
- Rate of change of tracking efficiency vs beam current
- Electron & positron PID efficiency from $e^{\pm} \rightarrow e^{\pm}\gamma$ (see event builder PID & ML PID)
- Rate of change of number of J/ψ vs cut widths on exclusivity variables





Ad-Hoc Smearing

Not perfect but better
Remaining effects on efficiency corrected as detailed in previous slide

Care about MC and RG-B resolution matching because it affects cut and fit efficiency

Ad-Hoc because I'm not claiming it's ideal, it just gives better resolution matching

Obtain smearing with black box multi objective optimization algorithm from pymoo

Obtained/applied after momentum corrections to final state particles

Algorithm aims to optimize $|1 - \frac{\sigma_{MC}}{\sigma_{RGB}}|$ where σ denotes:

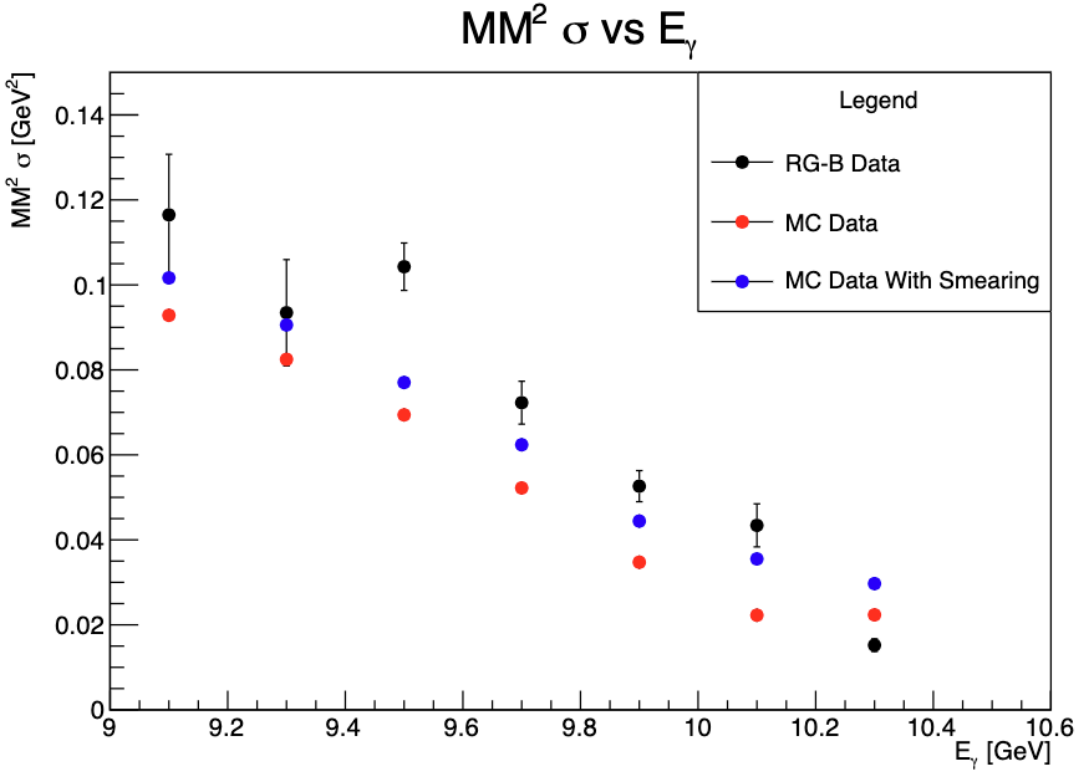
- Width of peak in missing mass squared
- Width of J/ψ peak in $M(e^+e^-)$
- Q^2 slope

Problem: Q^2 slope hard to fit at J/ψ mass in RG-B due to few J/ψ events

- Could obtain smearing using Bethe Heitler events as in previous slide? Does that make sense when also using width of J/ψ peak?
- Instead set heuristic that slope shouldn't increase more than factor of 2 in MC

Smearing done by sampling a random number from a gaussian centered at 0 and adding to the reconstructed momentum and angles of e^+, e^-, N in MC

Optimisation algorithm finds 9 best gaussian widths for each of the momentum and angles of each of e^+, e^-, N



Particle	p Parameter	θ Parameter	ϕ Parameter
e^-	0.007711	0.000578	0.040824
e^+	0.002995	0.002381	0.062472
p	0.009557	0.006279	0.017479

Table 2: Smearing parameters.