

Luminosity of New XYZ Data

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May 31, 2017

Datasets

- The data was taken since December, 2016 to May, 2017.
- 8 Energy Points from 4190 to 4280, Run No. stretch from 47543 to 51498.
- 1 M. MC events for each energy point, generated by modified Babayaga NLO.

Modified Babayaga NLO Package

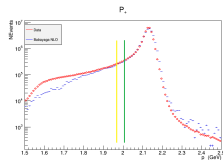
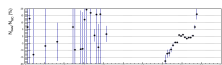
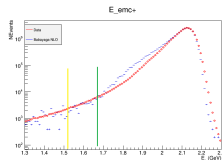
- Added a cut of $M(ee) > 3.8$ GeV in Babayaga NLO, to increase sampling efficiency.
- The addition of such cuts are supported by the generator, so the 0.1% uncertainty claim should still be valid.

Event Selection Criteria

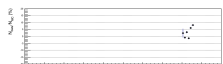
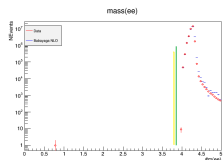
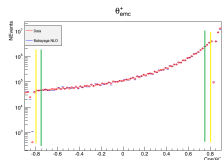
Bhabha Method I (using EMC+MDC info)

- 2 good tracks, ncharge=0.
- E Cut: $E_+, E_- > 1.55/4.26$ Ecms.
- P Cut: $P_+, P_- > 2/4.26$ Ecms.
- $\text{Cos}\theta$ Cut: $\text{Cos}(\theta)$ in range $[-0.8, 0.8]$
- $M(ee)$ Cut: $M(ee) > 3.8$ (This cut has zero power on either MC or data, cutting no events)

Corresponding Graphs



Yellow: Standard Cuts
Green: Altered Cuts



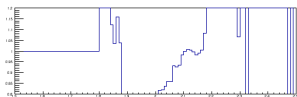
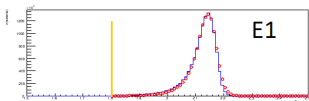
Event Selection Criteria

Alternative criteria for calculating the uncertainty of tracking efficiency.

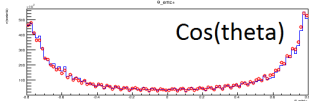
Bhabha Method II (using only EMC info)

- At least 2 valid EMC showers, pick the most energetic 2.
- E Cut: $E_1, E_2 > 1.8/4.26 E_{\text{cms}}$.
- $\text{Cos}\theta$ Cut: $\text{Cos}(\theta)$ in range $[-0.8, 0.8]$
- $\Delta\phi$ Cut: $|(180^\circ - \Delta\phi)|$ in range $[5^\circ, 40^\circ]$

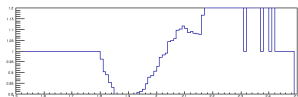
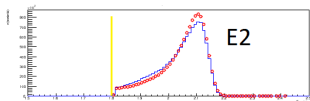
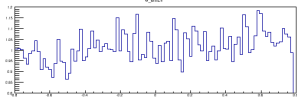
Corresponding Graphs



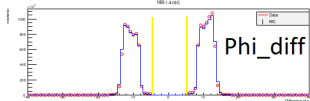
theta (deg)



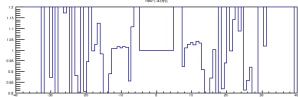
theta (deg)



theta (deg)



theta (deg)



Calculating Systematic Uncertainties

- E Cuts: Alternative Cuts at 1.7/4.26 Ecms
- $\cos(\theta)$ Cuts: Alternative Cuts at [-0.75, 0.75]
- P Cuts: Alternative Cuts at 2.05/4.26 Ecms
- $M(ee)$ Cuts: Alternative Cuts at 3.85 GeV.
- Energy Bias: Same dataset, but let the algorithm think the E_{cms} is +1/-1 MeV
- MC Statistics: 1 M. Events per energy point.
- Tracking Efficiency: Comparing the result of two Methods (4190 energy point).
- Babayaga NLO: Quoting the generator's authors' claim.

Luminosity and Uncertainty Results

	4190	4200	4210	4220	4237	4246	4270	4280
Luminosity(pb⁻¹)	521.9	523.7	511.2	508.2	528.9	532.7	529.3	174.5
	Uncertainties							
On E Cuts(%)	0.09	0.07	0.07	0.06	0.10	0.08	0.08	0.09
On Cosθ Cuts(%)	0.20	0.23	0.12	0.09	0.14	0.08	0.18	0.27
On P Cuts(%)	0.01	0.12	0.04	0.01	0.09	0.04	0.03	0.09
On M(ee) Cuts(%)	0							
Energy Bias(%)	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00
Tracking Efficiency(%)	+0.64(4190 result)						+0.55	+0.67
Babayaga NLO Generator(%)	0.1							
MC Statistics(%)	0.3							
Combined(%)	0.75	0.76	0.73	0.72	0.74	0.72	0.74	0.77

Summary

- Calculated the Luminosity of the New XYZ data.
- The Uncertainties are dominated by tracking efficiency. Needs further checking.