BABAR

Karlsruhe Institute of Technology

ECOLE NORMALE SUPERIEURE DE LYON

BaBar

Luminosity Determination

presented by

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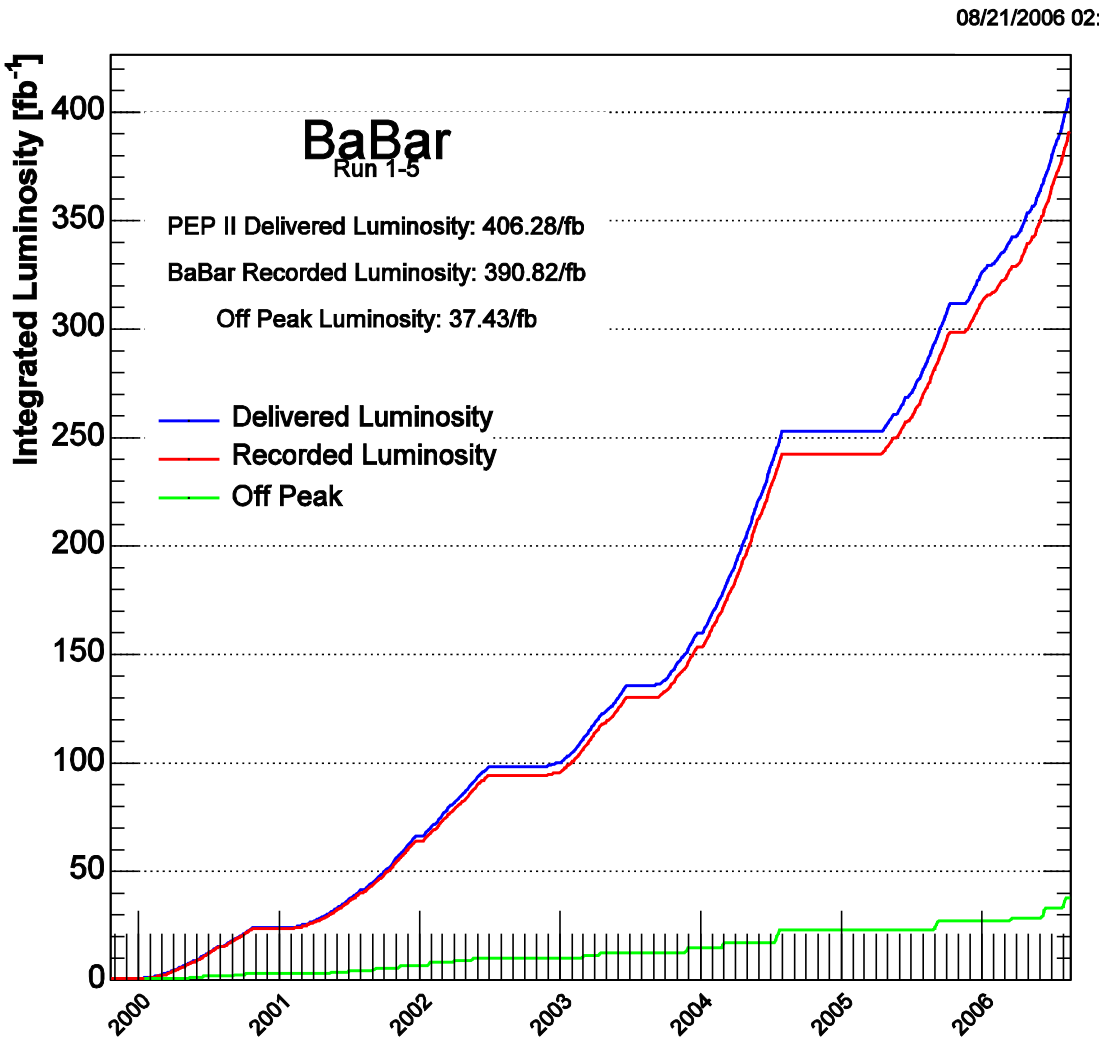
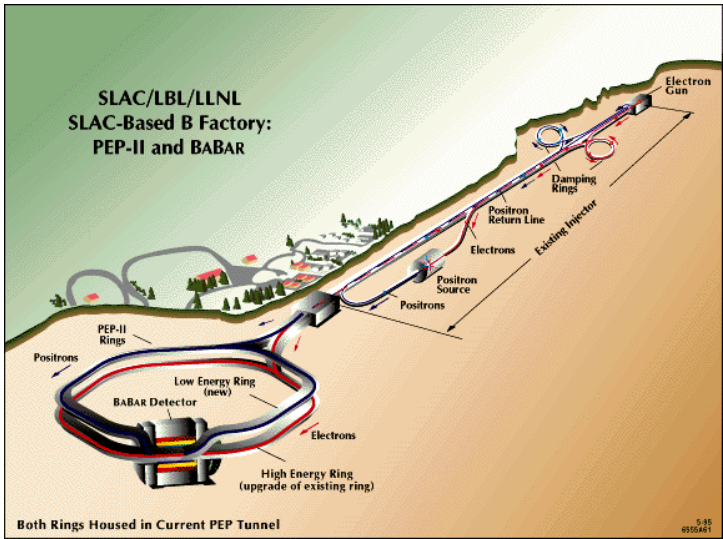
Overview

- Background
  - BaBar facility
  - Luminosity Determination
  - Event Generators
- Results
  - Test of Babayaga@NLO
  - Comparison with BHWIDE
- Conclusion

Accelerator



E_{CM}=10.56GeV



Luminosity Determination

- $L_{int} = N_{ev} / \sigma_{vis}$
- $\sigma_{vis} = \varepsilon \cdot \sigma_{theo}$

↑

detector efficiency + smearing effects due to limited detector resolution

→ determination of hadronic cross-sections with ISR:

$$\sigma_{had} = N_{ev} / L_{int}$$

Actual Luminosity Determination:

$e^+e^- \rightarrow e^+e^- (\gamma)$ **BHWIDE** (Phys.Lett.B390 (1997) 298)

$e^+e^- \rightarrow \mu^+\mu^- (\gamma)$ **BKQED** (Nucl.Phys.B228 (1983) 537)

$e^+e^- \rightarrow \gamma\gamma$ **BKQED**

Luminosity Determination

Selection criteria applied on Bhabha sample:

- Two charged tracks
- $\cos(\theta_{CMS}) < 0.7$ (both) & $\cos(\theta_{CMS}) < 0.65$ (one)
- $P_{1CMS}/E_{Beam} > 0.75$ & $P_{2CMS}/E_{Beam} > 0.50$
- $|3\text{-d accolinearity } -180°| < 30°$
- EMC, one at least $E/P > 0.7$
- EMC, other at least $E/P > 0.4$ OR $=0$

↓

Luminosity Determination

with a precision of O(1%)

(Ref.: BaBar Analysis Document #229)

Event Generators

Bhabha-scatterting: $e^+e^- \rightarrow e^+e^- (\gamma)$	theoretical accuracy
• BHWIDE	~0.5%
• Babayaga@NLO	~0.1%
• Babayaga (version 3.5)	~0.5%

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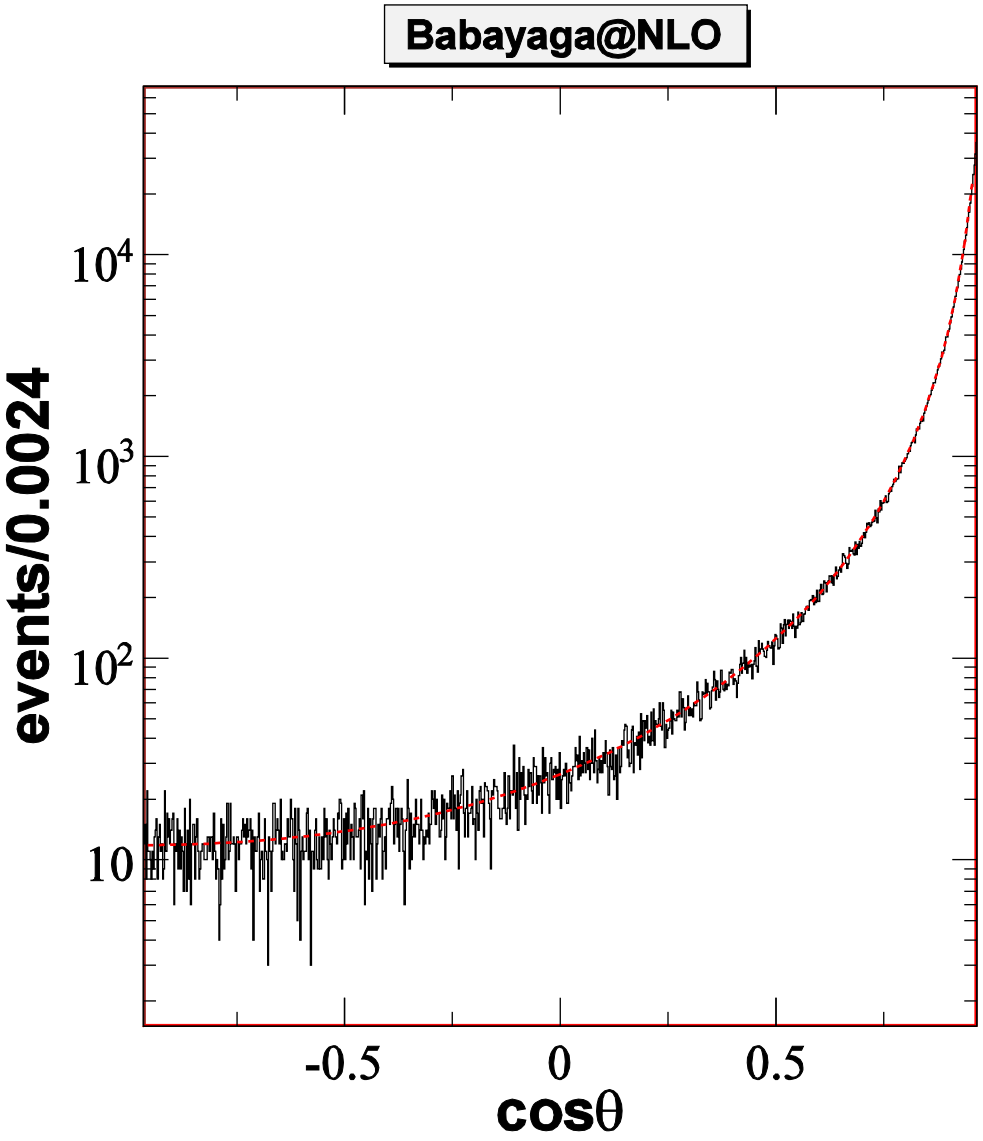
Born Approximation



$$\frac{d\sigma}{d\Omega} = f(\cos\theta)$$

Total Cross Section

weighted events

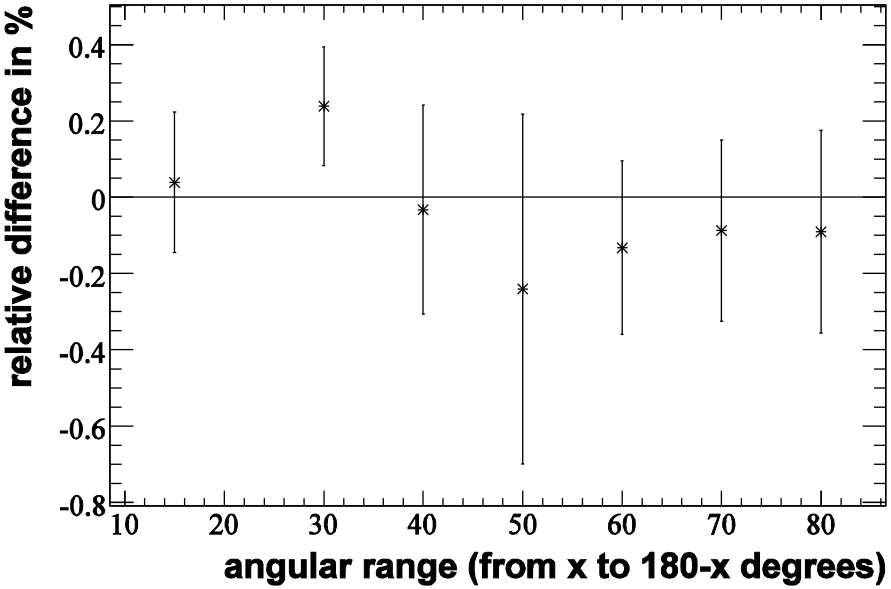
with all corrections

angular range (CM)	cross-section / [nb]	
	BHWIDE	Babayaga@NLO
15°-165°	124.89±0.08	124.85±0.15
30°-150°	25.568±0.016	25.507±0.024
40°-140°	12.363±0.008	12.367±0.026
50°-130°	6.690±0.005	6.706±0.026
60°-120°	3.784±0.003	3.789±0.006
70°-110°	2.060±0.002	2.062±0.003
80°-100°	0.881±0.001	0.881±0.002

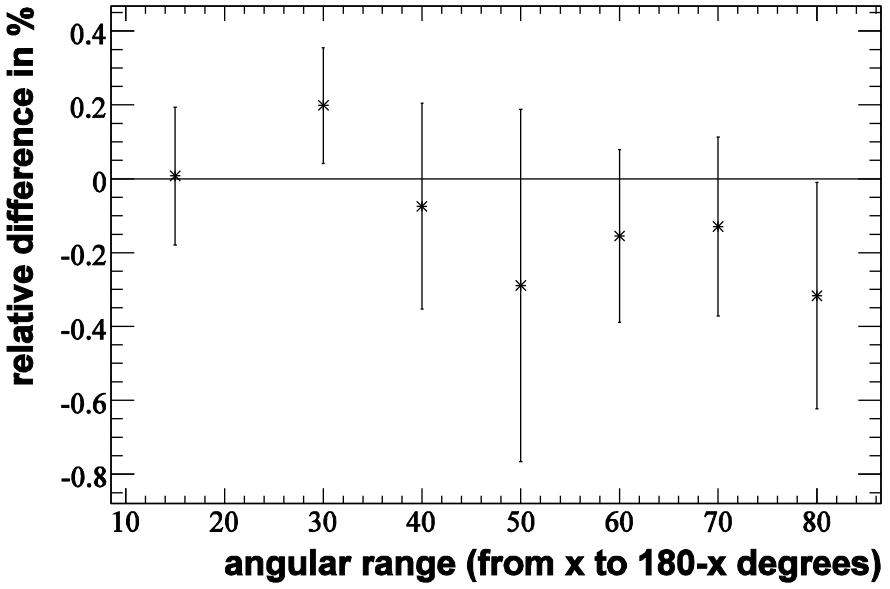
Total Cross Section

weighted events

with all corrections

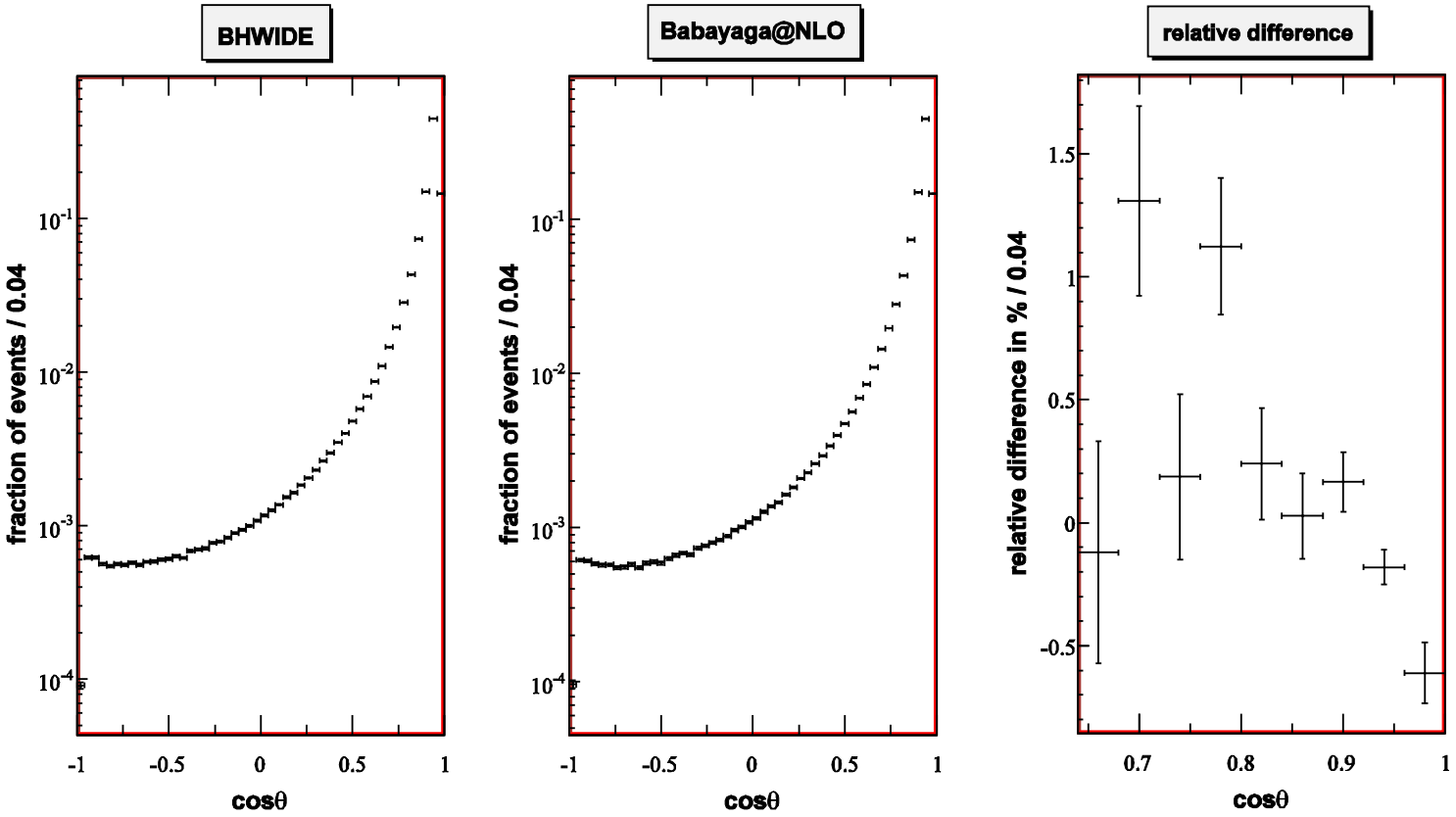


without vacuum polarization



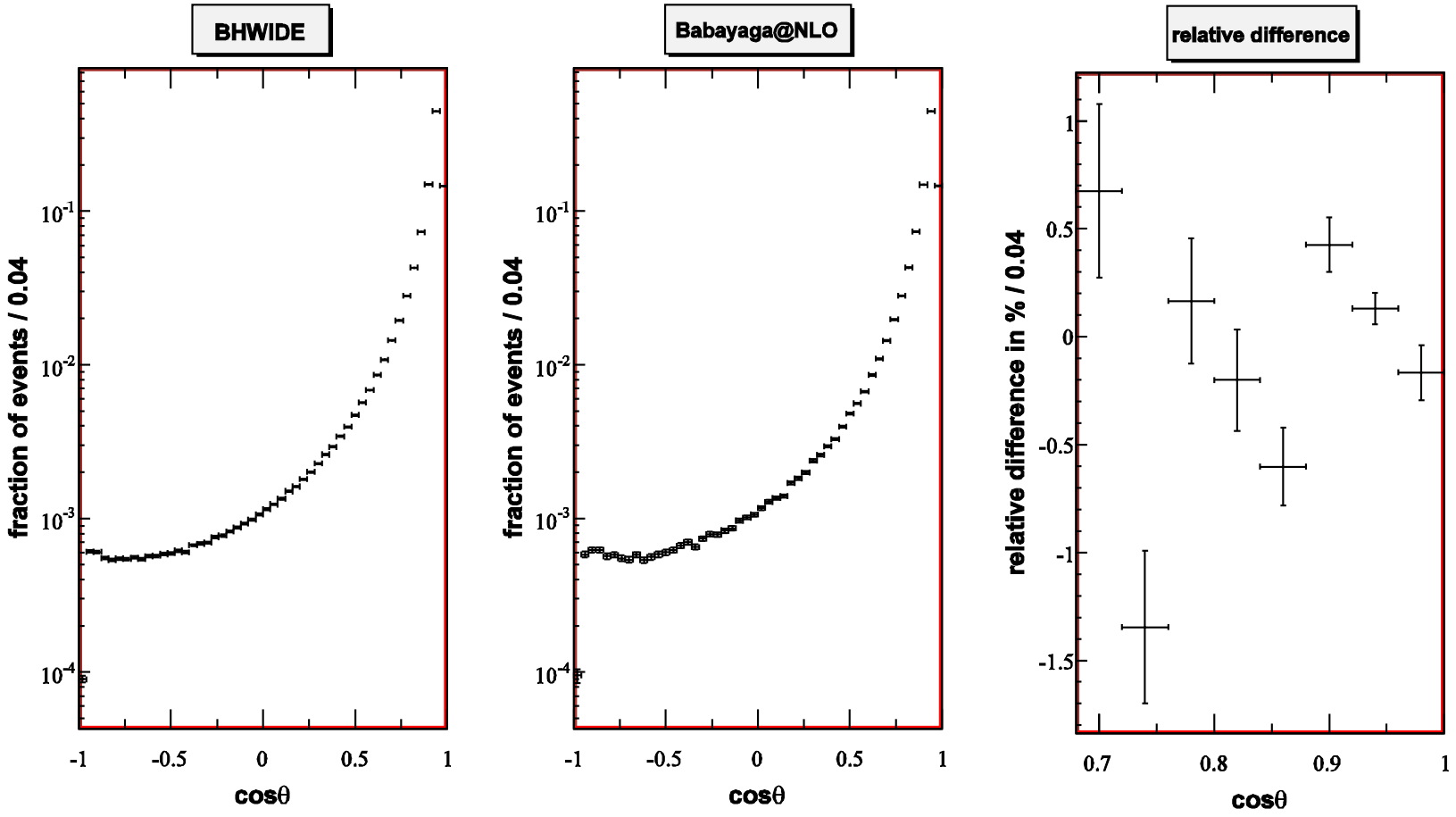
Differential Cross Section

θ = angle between incoming and outgoing e^+ $(15° < \theta < 165°)$

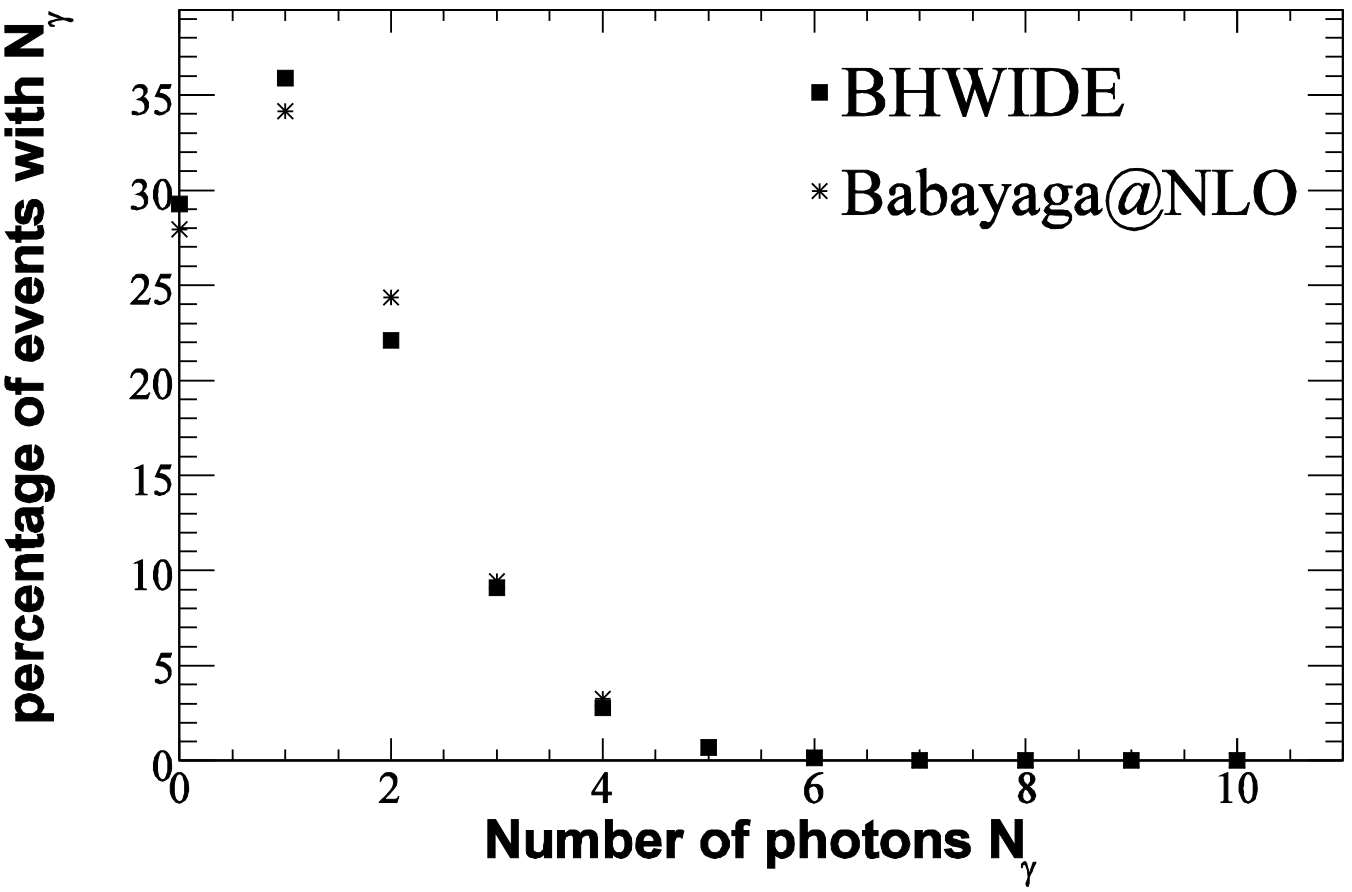


Differential Cross Section

without vacuum polarization



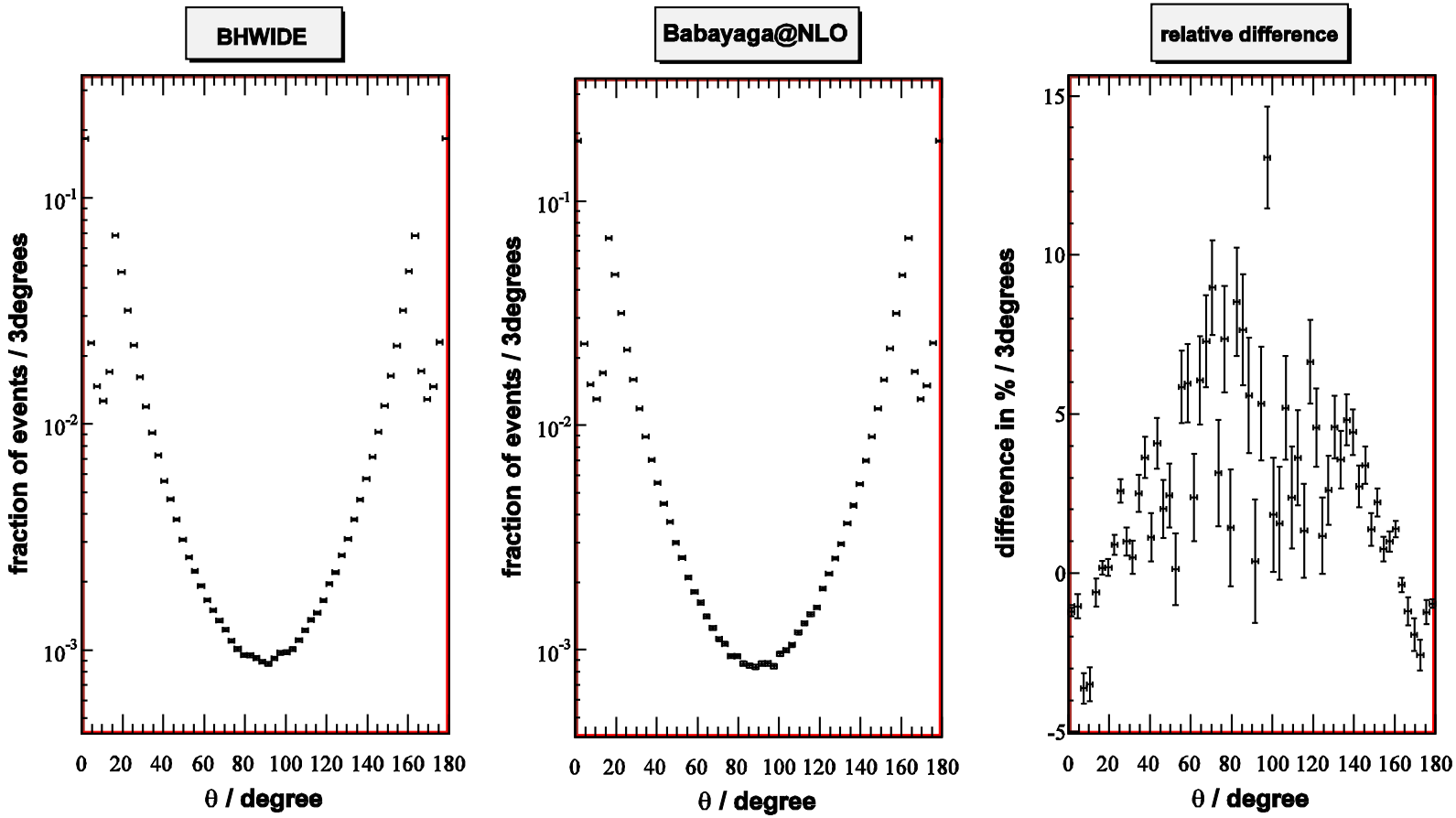
Photon Distribution



γ cut-off energy E_{CUT} = 0.5MeV

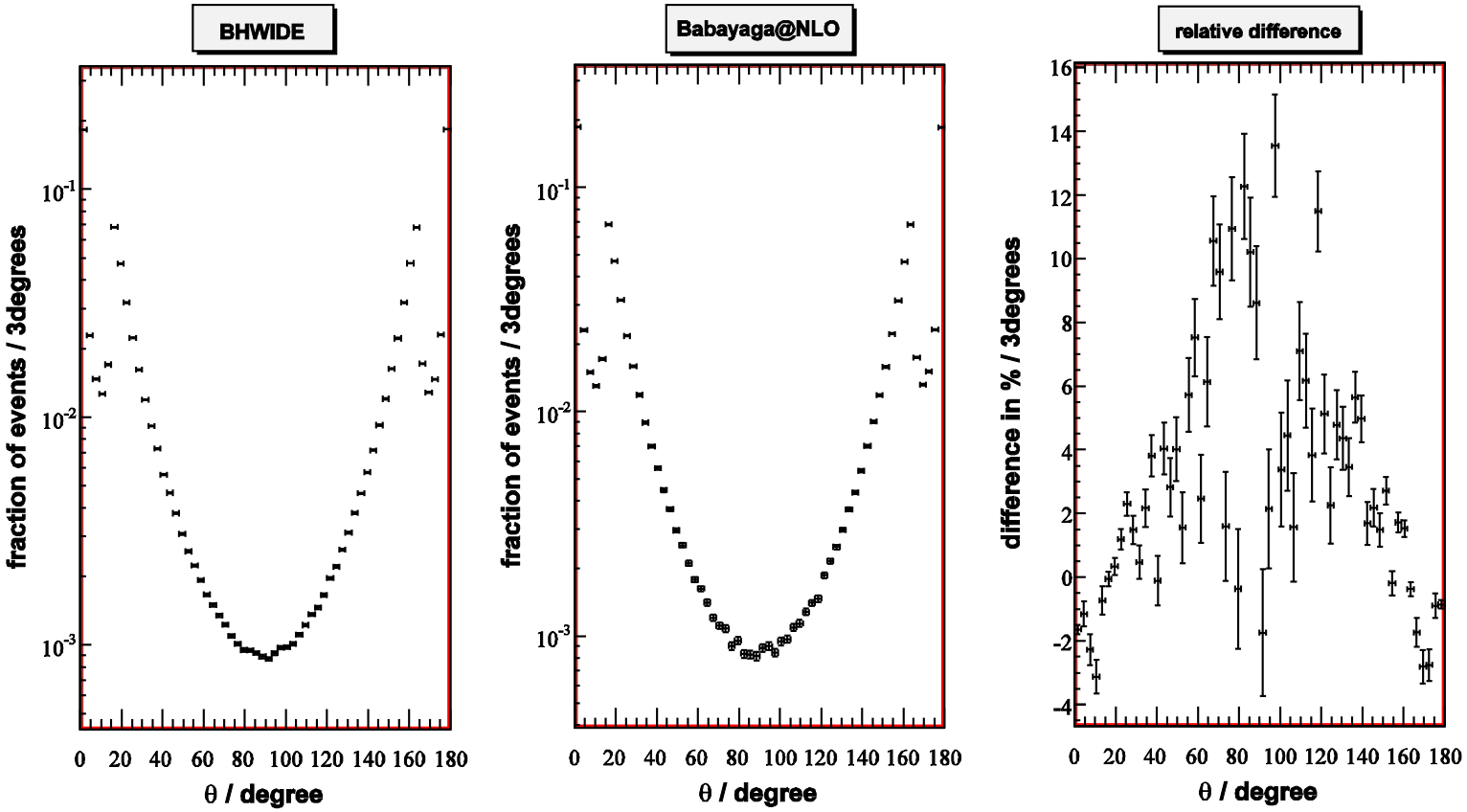
Hardest Photon

θ = angle between incoming e^- and most energetic γ



Hardest Photon

without vacuum polarization



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Conclusion

- Babayaga@NLO tested
- Limited statistics due to “slow” unweighting process on desktop computer
- Very good agreement on permil level of σ_{tot} between Babayaga@NLO and BHWIDE
- Small differences in σ_{dif}
- Babayaga@NLO can now be implemented into BaBar detector simulation framework

Thank You!