Radiative Bhabha scattering at low angles in the TESLA Forward Calorimeter

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August 2004
How many Bhabha events will be in the detector acceptance?

$$e^+ + e^- \rightarrow e^+ + e^- + (\gamma + \gamma + \ldots)$$

Detector beam pipe

$$\theta_{\text{min}} = 5 \text{ mrad}$$
$$\theta_{\text{max}} = 28 \text{ mrad}$$
Monte Carlo generators

**BHLUMI**

Any kind of Bhabha events but minimum scattering angle couldn't be zero.

**We loose radiative events, when one electron scatters at zero angle and another hit the detector.**

**TEEGG**

Only specific events configuration are possible:
- *ETRON* – single e in the detector acceptance (the rest in the beam pipe)
- *GAMMA* – single gamma in the detector acceptance
- *EGAMMA* – only e and gamma in the detector acceptance

**It compensate losses in bhlumi.**

**We need to combine BHLUMI and TEEGG to produce all possible Bhabha events.**
electron angular distribution

for completely coincident events (in electron configuration) we have:

$$X_{\text{sec}_\text{teegg}} = 31.655 \pm 0.483 \text{ nb}$$

$$X_{\text{sec}_\text{bhlumi}} = 30.426 \pm 0.321 \text{ nb}$$
We combined these programmes in following way:

- ETRON
- GAMMA
- EGAMMA

Any other configurations

How to get the total cross section for Bhabha scattering?

1. **exclude** from BHLUMI events that meet the TEEGG requirements
2. **add** the cross sections from all TEEGG configurations

- Non radiative Bhabha
- Radiative Bhabha
  (with $e^+$ and $e^-$ in the detector acceptance)
Results

Cross section vs energy cut

Events per bunch vs energy cut

TEEGG cross section (ETRON+GAMMA+EGAMMA)

BHLUMI with TEEGG events excluded

Total Bhabha cross section
Results

Cross section vs energy cut

Events per bunch vs energy cut

Non radiative Bhabha (only $e^+$ or $e^-$ in the final state)

All events with $e^+$ and $e^-$ in the final state

Total Bhabha cross section
Results
(single particle in the detector from Bhabha scattering)

Cross section vs energy cut
Events per bunch vs energy cut
P.S. Activity on GEANT-4 detector simulation

**Status:** The geometry of Forward Calorimeter is ready
The read-out is ready
Physics description is ready

Electromagnetic shower from electron with energy 100 GeV (signal from diamond)

**Next steps:**
- study real Bhabha events with background
- make compatible with LCIO