

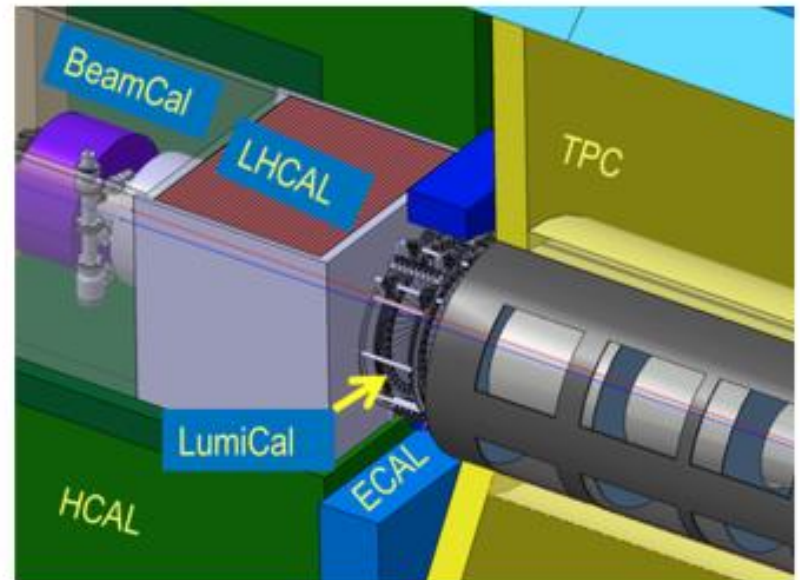
# The luminosity measurement

Detector Basic 18/07/04

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# Introduction

- LumiCal will measure the luminosity
- LumiCal are foreseen in the very forward regions of the detector.
- LumiCal covers polar angle between 31 and 77 mrad.



# Bhabha scattering

The differential cross section of Bhabha scattering,  $\frac{d\sigma_B}{d\theta}$ , is

$$\frac{d\sigma_B}{d\theta} \approx \frac{32\pi\alpha_{em}^2}{s} \frac{1}{\theta^3}$$

$\theta$  is the polar angle of the scattered electron with respect to the beam.

$\alpha$  is constant.

$s$  is values of kinematic invariant.

The approximation holds at small  $\theta$ .

# Luminosity measurement

Bhabha scattering will be used as the measurement process for the luminosity.

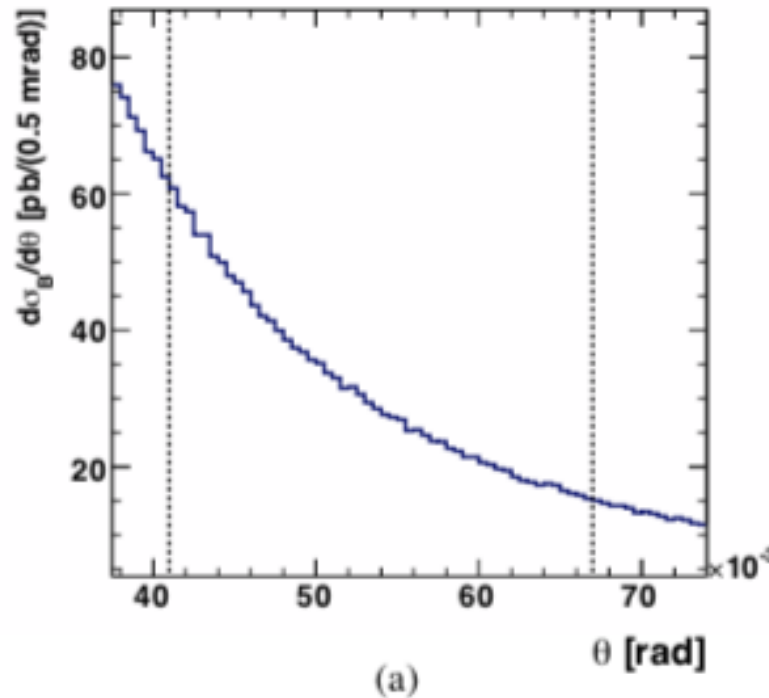
The luminosity  $L$  is

$$L = \frac{N_B}{\sigma_B}$$

$\sigma_B$  is the integral of the differential cross section.

$N_B$  is the number of counted events.

# the most critical quantity to control



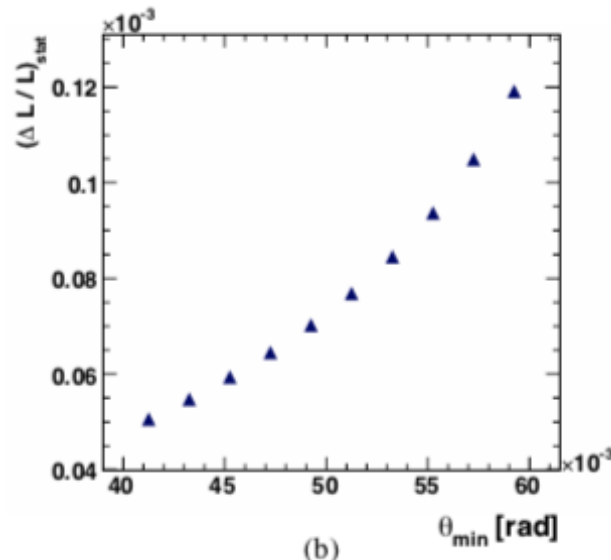
$$\frac{d\sigma_B}{d\theta} \text{ vs polar angle } \theta [1]$$

Because of the steep  $\theta$  dependence of the cross section, the most critical quantity to control when counting Bhabha events is **the inner acceptance radius** of the calorimeter.

# the most critical quantity to control

Furthermore, the  $\theta$ -range must be chosen such that the number of Bhabha events measured provides the required relative statistical uncertainty of  $10^{-3}$ .

By choosing the lower bound of the polar angle between 40 and 60 mrad the latter requirement is reached.



Dependence of the statistical uncertainty [1]

# References

- [1] H. Abramowicz, et al., "Forward Instrumentation for ILC Detectors"  
JINST 5 (2010) P12002, arXiv:1009.2433