Precision Requirements for the Luminosity Measurement with LumiCal

Data sample : 10^8 events for each energy regime CLIC3TeV, ILC500, GigaZ with BHLUMI

Method:

1. generated particles projected on first LumiCal plane and merged if distance between them was < 15mm or entered the same cell
2. gaussian smearing was applied to true energy value
3. true and smeared events passing the cut

   E_L , E_R > 0.8 E_{beam}

   were counted and luminosity shift calculated for several values of energy resolution σ(E) and bias ΔE

Position Accuracy

The contribution of polar angle offset to relative error on luminosity can be estimated using approximate formula :

$$\Delta\mathcal{L}/\mathcal{L} \approx 2\,\Delta\theta\,/\theta_{min} \qquad (1)$$

The size of $\Delta\theta$ solely due to uncertainty of LumiCal z position and inner radius r can be estimated using straightforward obtainable formula :

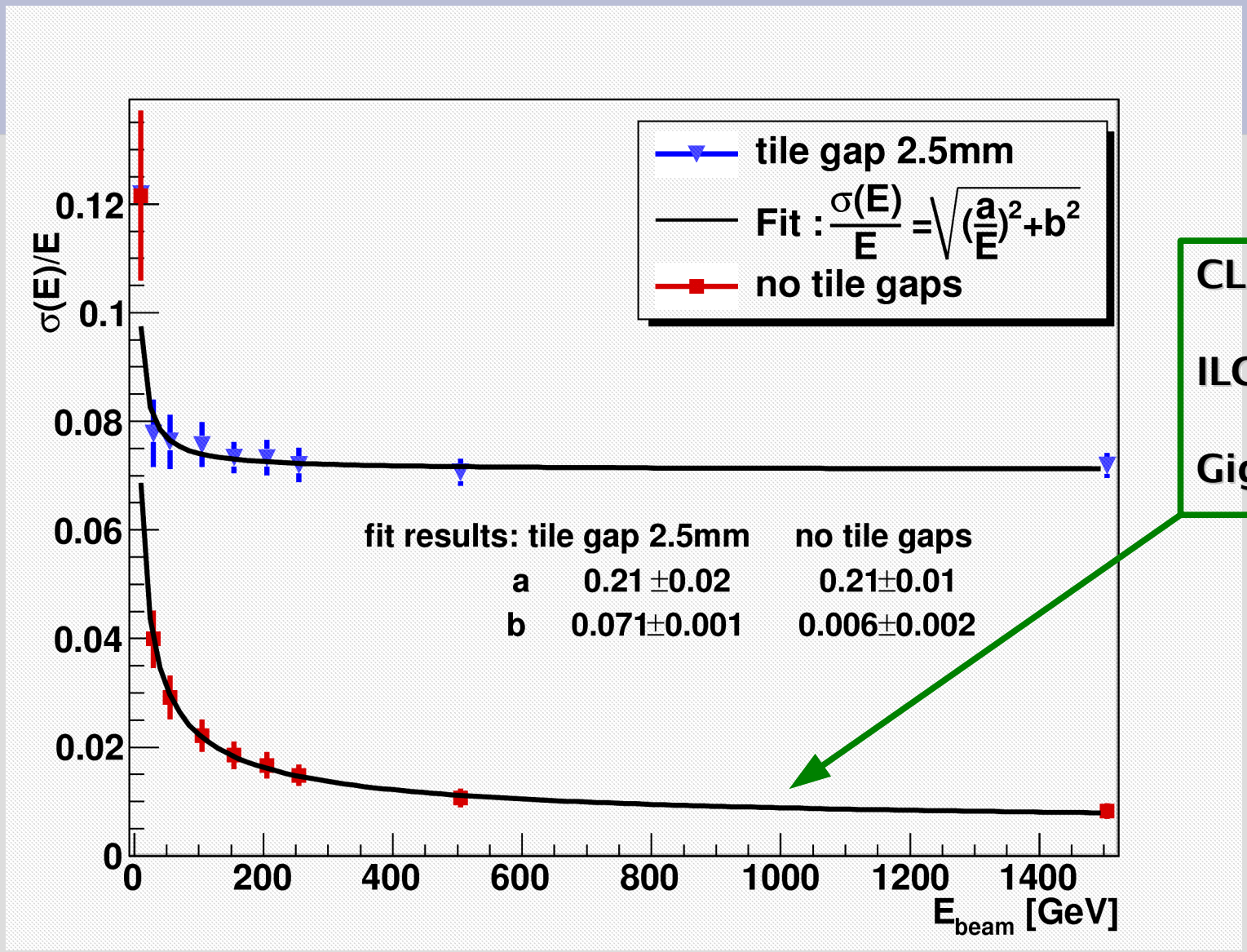
$$\Delta\theta \approx (R_{min}\,\Delta z - z_{nom}\Delta r)\,/\,z_{nom}(z_{nom}+\Delta z) \qquad (2)$$

Where R_{min} is inner radius of LumiCal and z_{nom} is nominal distance from interaction point along z axis. Combining (1) and (2), and setting consecutively uncertainties
Δz and Δr to zero, one calcutates upper limits for their size independently.

Results of these calculations are collected in the table 1.

	Required $\Delta L/L$	Z_{nom} [mm]	R_{min} [mm]	θ_{min} [rad]	$\Delta\theta_{max}$ [rad]	Δz_{max} [mm]	Δr_{max} [mm]
ILC GigaZ	$\leq 10^{-4}$	2500	80	0.032	1.6×10^{-6}	< 0.125	$< 4\times10^{-3}$
ILC 500GeV	$\leq 10^{-3}$	2500	80	0.032	1.6×10^{-5}	< 1.25	$< 4\times10^{-2}$
CLIC 3TeV	$\leq 10^{-2}$	2500	100	0.040	2×10^{-4}	< 12.5	< 0.5

Simulated LumiCal Energy Resolution

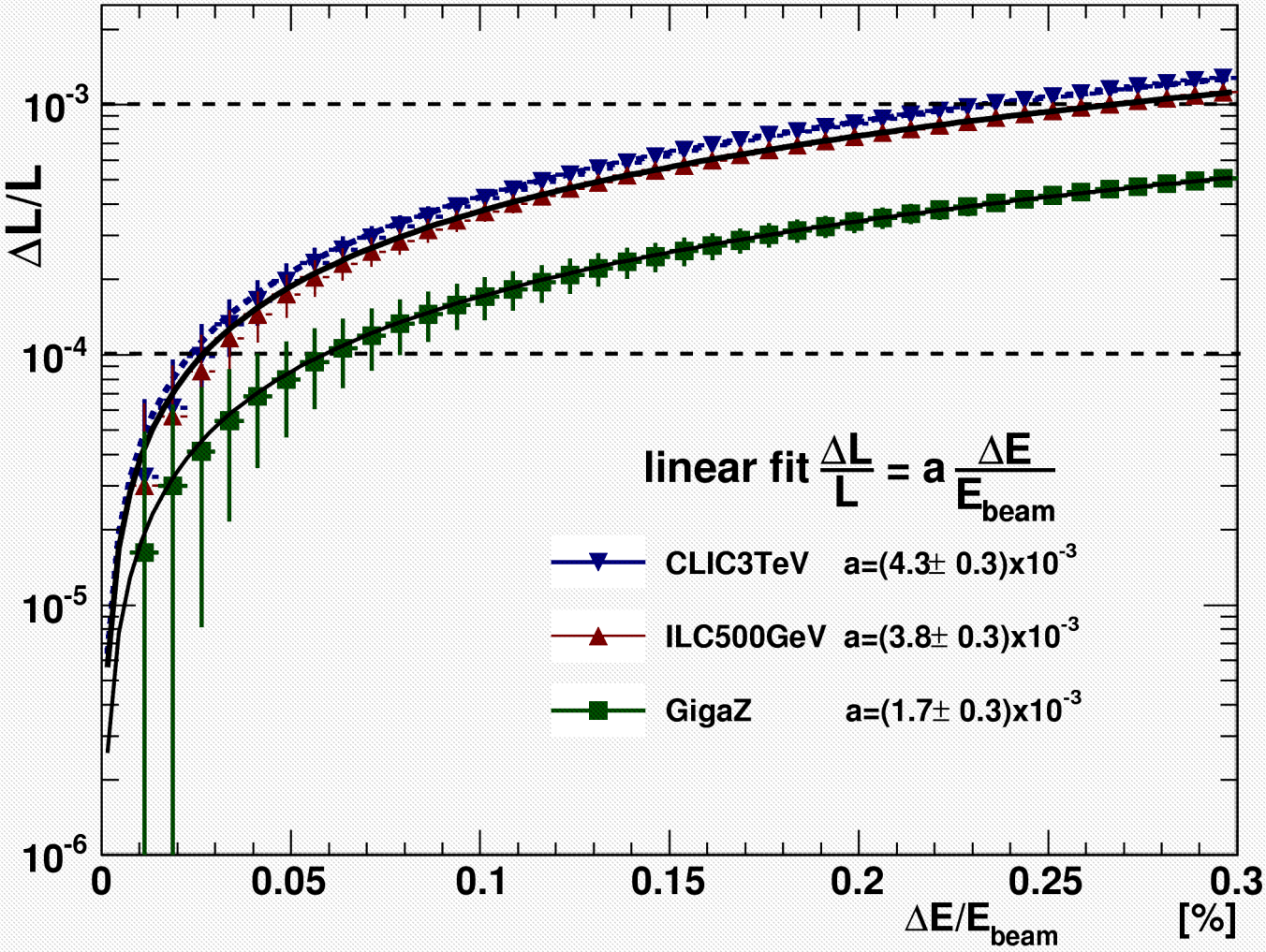


CLIC σ(E)/E ≈ 1.1%

ILC500 σ(E)/E ≈ 1.5%

GigaZ σ(E)/E ≈ 3.3%

Energy Bias

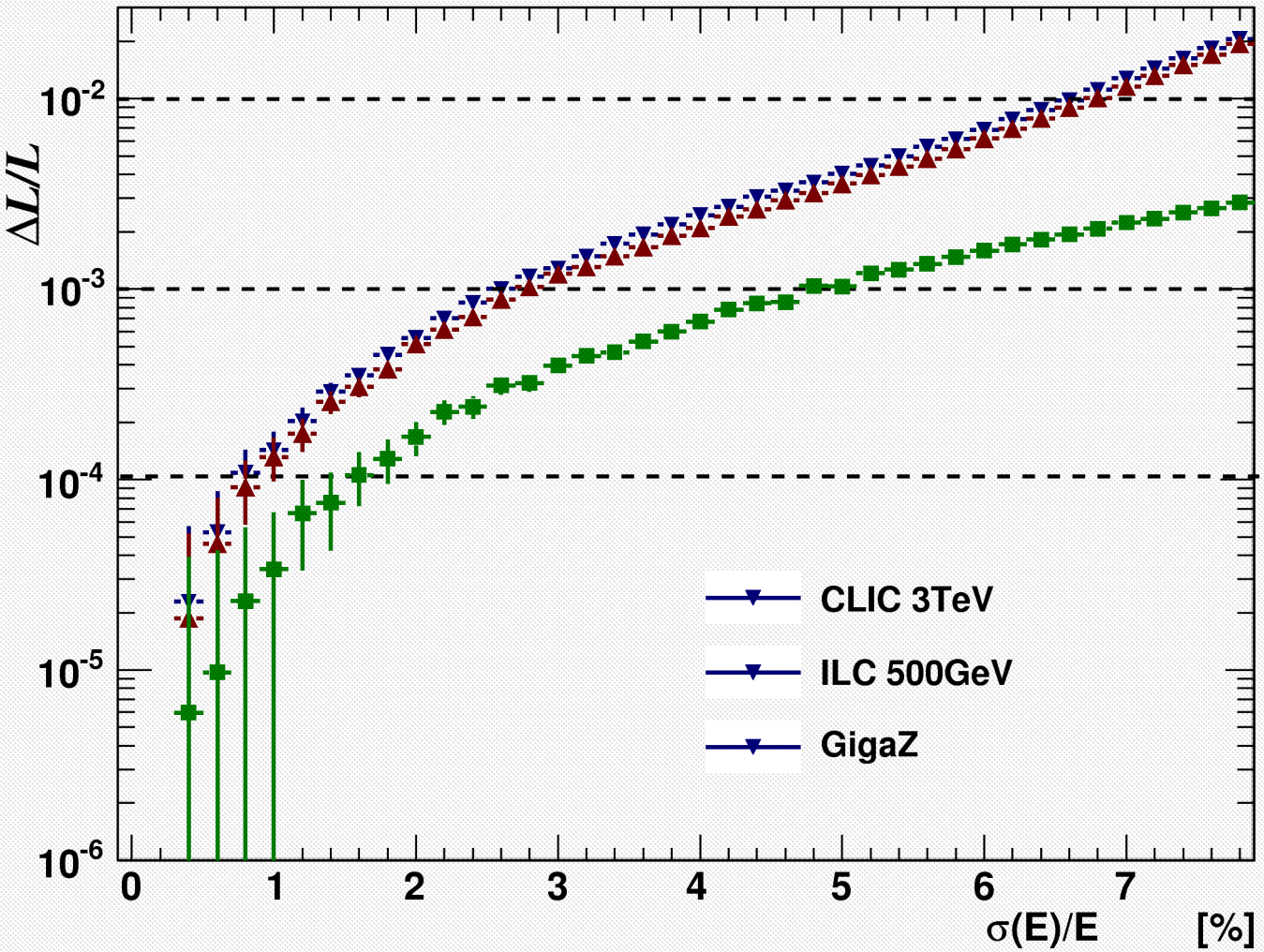


CLIC $\Delta E <$ 35 GeV

ILC500 $\Delta E <$ 0.66 GeV

GigaZ $\Delta E <$ 0.026 GeV

Energy Resolution

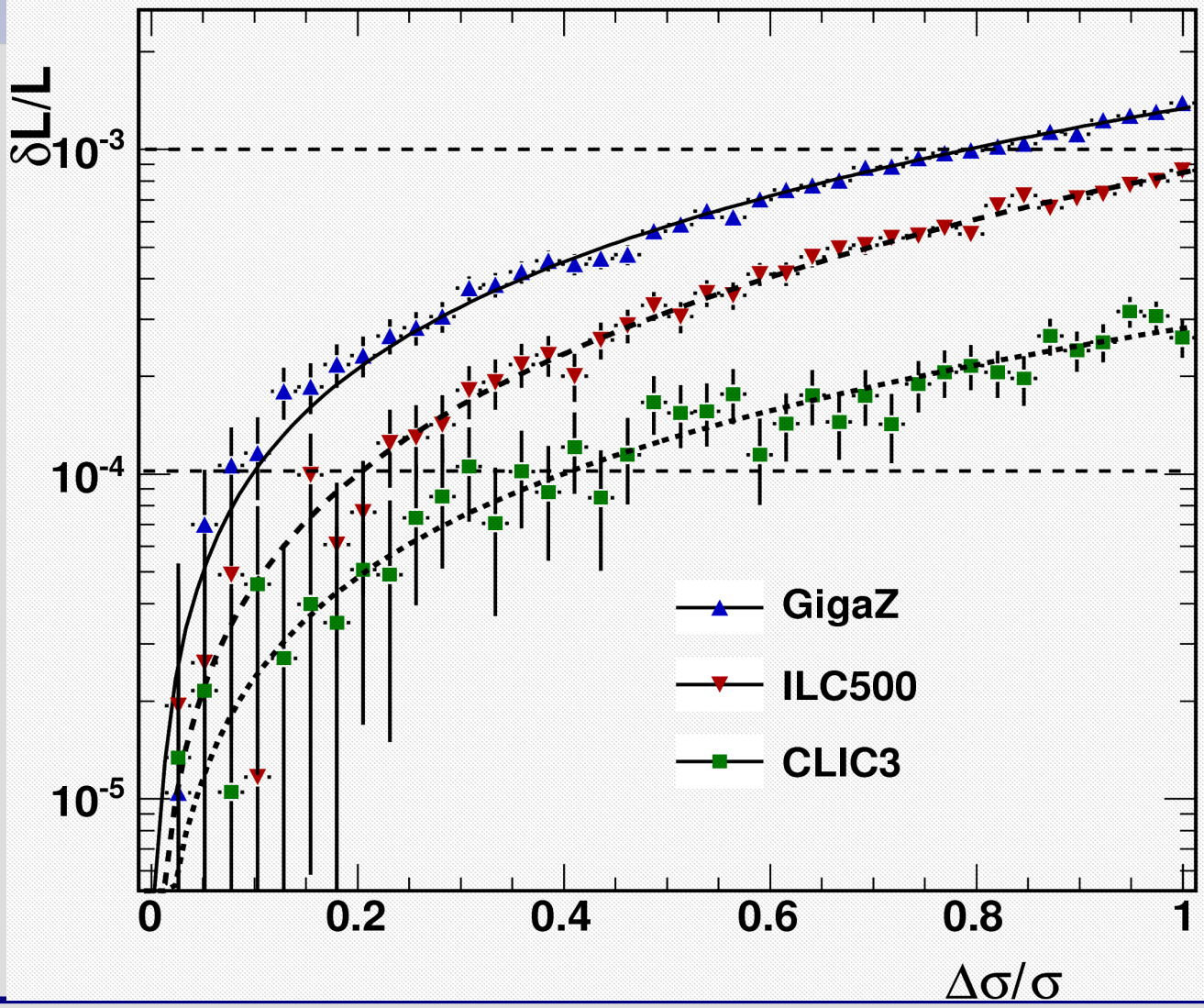


CLIC σ(E)/E < 6.5%

ILC500 σ(E)/E < 2.5%

GigaZ σ(E)/E < 1.5%

Energy Resolution Mesurement Accuracy



To keep luminosity shift controlled under 10^{-4} required accuracy of the energy resolution measurement is :

CLIC $\Delta\sigma/\sigma < 45\%$
ILC500 $\Delta\sigma/\sigma < 21\%$
GigaZ $\Delta\sigma/\sigma < 10\%$

Thank You