Photons, Pairs and Background for Nominal and LowP accelerator options

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Accelerator Parameters

		nom	low N	lrg Y	low P
N	$\times 10^{10}$	2	1	2	2
n_b		2820	5640	2820	1330
$\varepsilon_{x,y}$	µm, nm	9.6, 40	10,30	12,80	10,35
$\beta_{x,y}$	cm, mm	2, 0.4	1.2, 0.2	1, 0.4	1, 0.2
$\sigma_{x,y}$	nm	543, 5.7	495, 3.5	495, 8	452, 3.8
D_y		18.5	10	28.6	27
δ_{BS}	%	2.2	1.8	2.4	5.7
σ_z	µm	300	150	500	200
P_{beam}	MW	11	11	11	5.3
L	$\times 10^{34}$	2	2	2	2

half bunch number and same $\sigma_x \sigma_y$ → half Luminosity
double running time

half bunch number and smaller $\sigma_x \sigma_y$ → same Luminosity
more beamstrahlung (2.5 x)

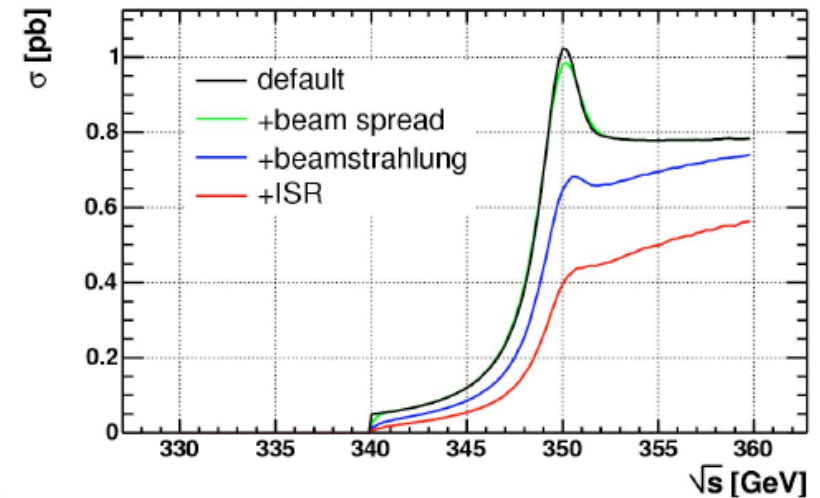# Smaller vertical beamsize: beamstrahlung energy rises from 2 to 6 % of the beam energy
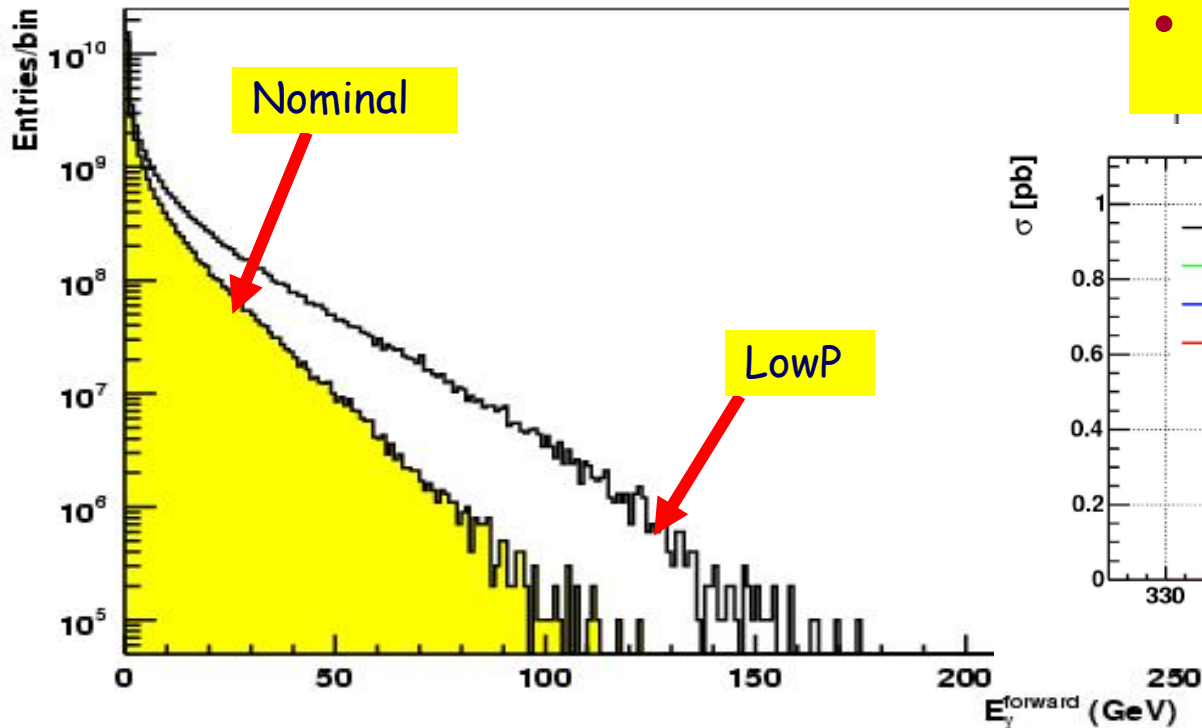
Nominal parameters : $E\gamma = 1.16 \times 10^{11}$ GeV per bX

LowP parameters : $E\gamma = 2.94 \times 10^{11}$ GeV

The effective center-of –mass energy is wider spread:

- Impact on precision mass measurements (Higgs recoil)
- Threshold scan e.g. for top, any pair produced new particles.

Energy spectrum of beamstrahlung, Nom - LowP

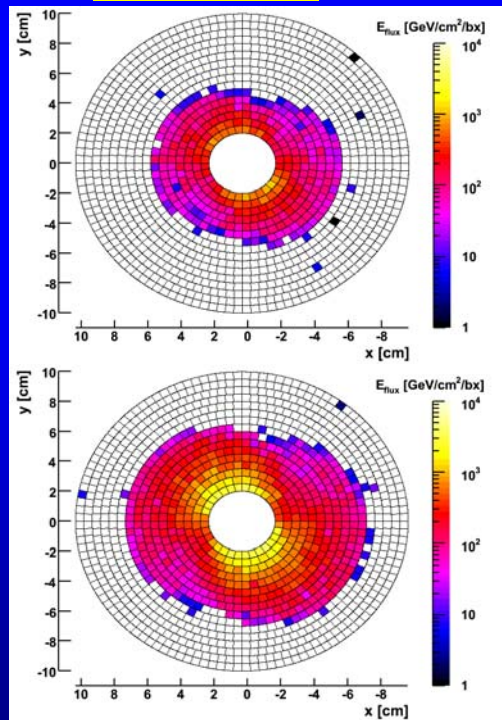# Number and Depositions of Incoherent Pairs

Larger number of photons:

Nominal parameters : $N\gamma = 2.6 \times 10^{10}$ GeV per bX

LowP parameters : $N\gamma = 3.8 \times 10^{10}$ GeV

Higher bunch charge density: → **Larger number and larger energy of pairs**

2 mrad

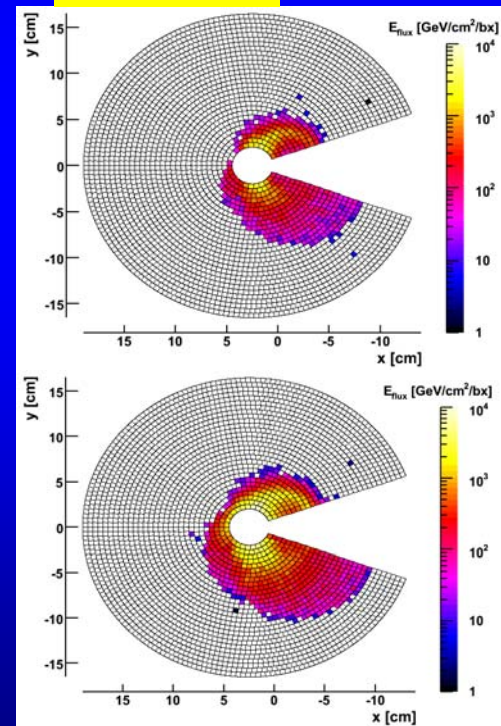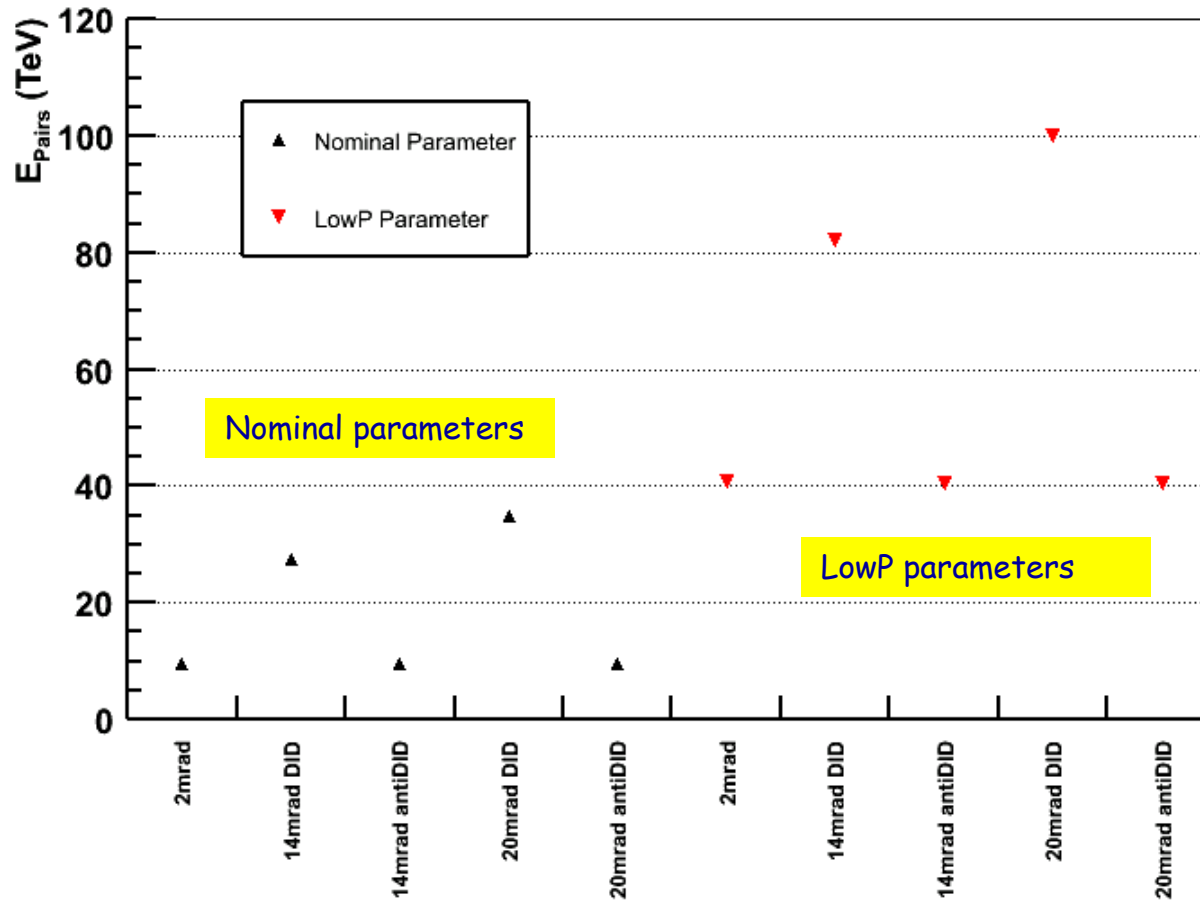14 mrad

Nominal parameters

LowP parameters

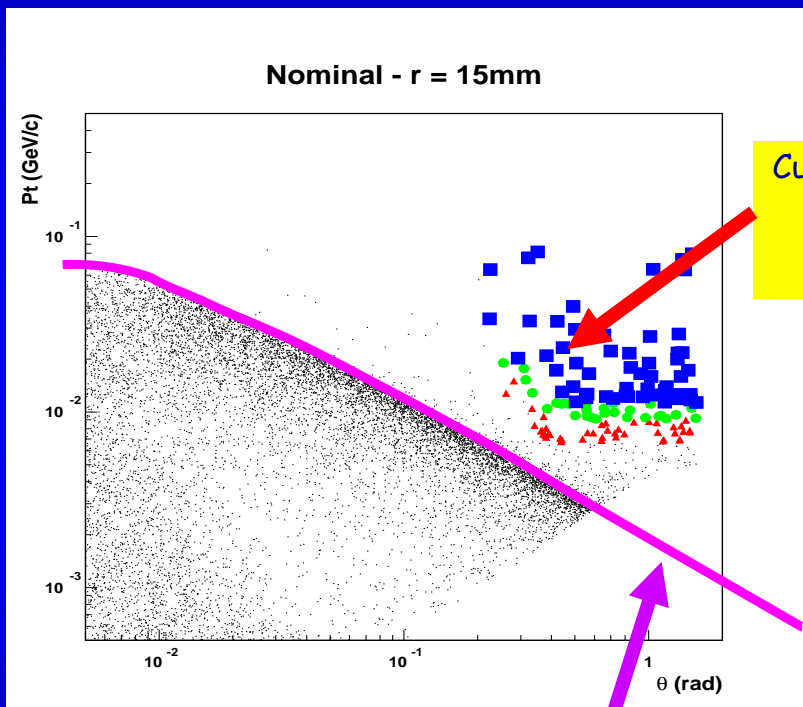# Energy Depositions of Incoherent Pairs on BeamCal for several accelerator/magnetic field options

P_T vs polar angle distributions

Nominal - r = 15mm

Pt (GeV/c)

θ (rad)

Low P - r = 15mm

B = 3 T
B = 4 T
B = 5 T

θ (rad)
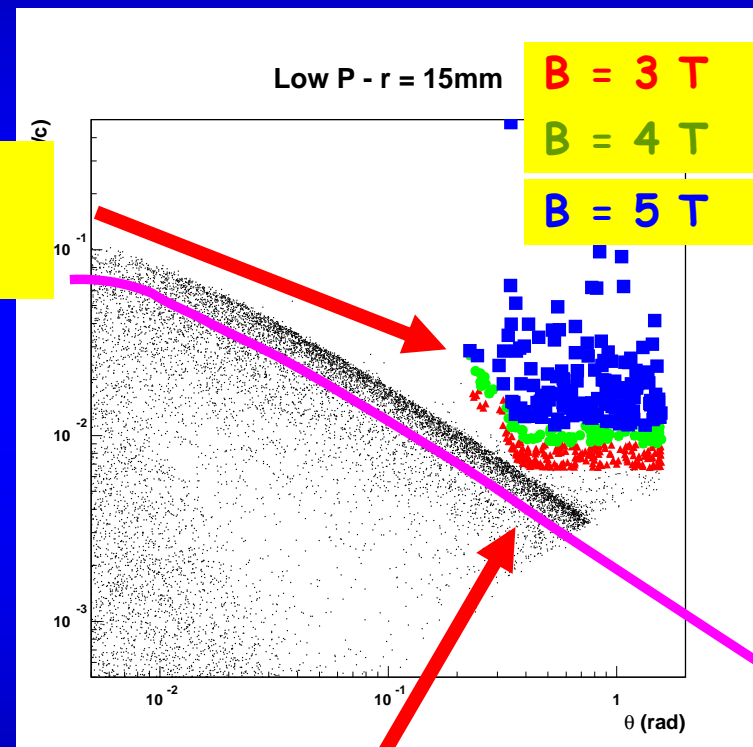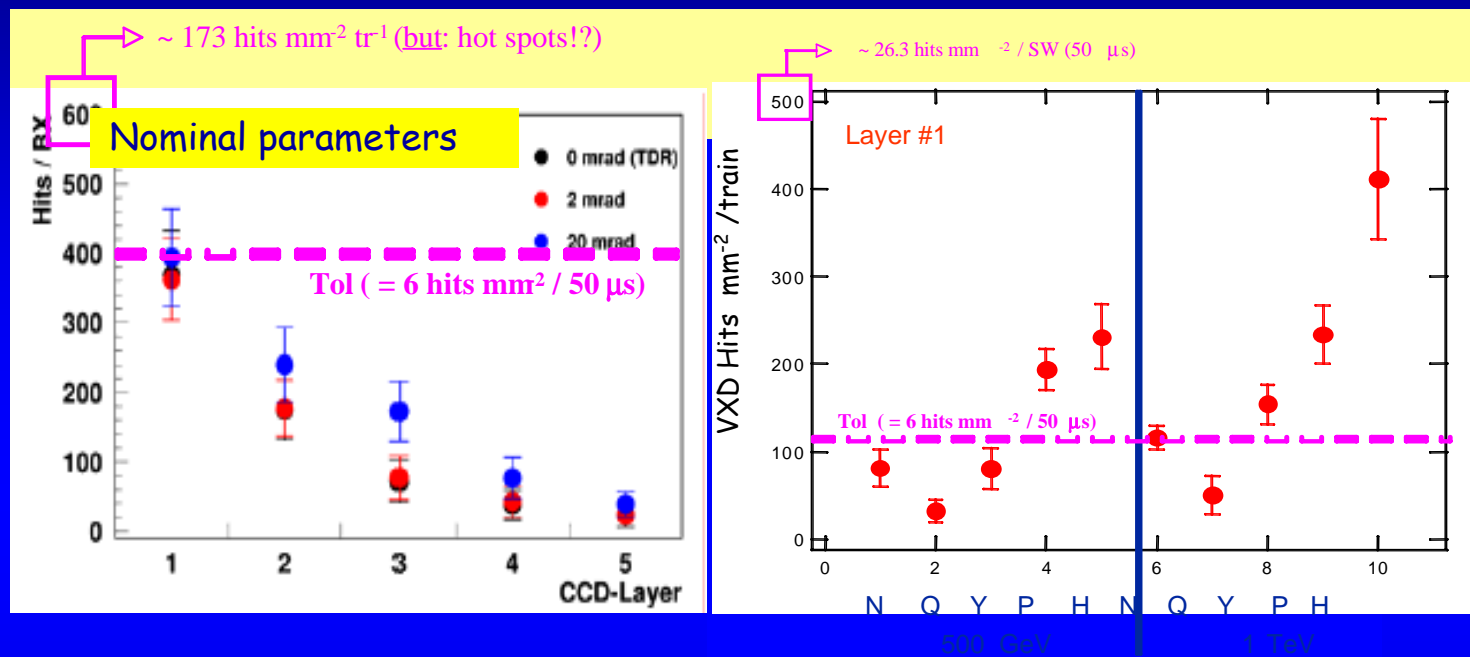
Curling into the first layer of the Pixel detector

Deflection limit of nominal case

safety margin needed (beams may be not perfect)

September, 2006   MDI phone meeting

thanks to **Cecile Rimbault**

Known from previous studies (K. Buesser, T. Maruyama, discussions with W. Kozanecki)

~ 173 hits mm^{-2} tr^{-1} (but: hot spots!?)

~ 26.3 hits mm^{-2} / SW (50 µs)

Nominal parameters

Tol (= 6 hits mm^2 / 50 µs)

Layer #1

Tol (= 6 hits mm^{-2} / 50 µs)

These studies include only electrons and photons.
Neutron production will be also enhanced !

New estimates are expected for the time of the Valencia workshop

(I would like to thank Ch. Grah for several plots)

September, 2006   MDI phone meeting

Summary

- The lowP parameter set will either double the running time to reach a certain benchmark, or will increase beamstrahlung substantially.

- The latter may have serious impact on physics precision measurement, the physics potential of the linear collider may become less striking.

- More beamstrahlung induces also more incoherent pairs.

- The latter have impact of the performance of the BeamCal, may have impact on the LumiCal, and enhance background in the vertex and tracking detectors.

- The fraction of large p_T tracks from e^+e^- pairs hitting the vertex detector is growing and might be a dangerous issue

- To quantify all topics would need detailed simulations for 14 mrad Xangle

Message to the conveners of Valencia and Beijing