Nominal and LowP Accelerator Parameters – Impact on the Detector Performance and its Physics Potential

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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

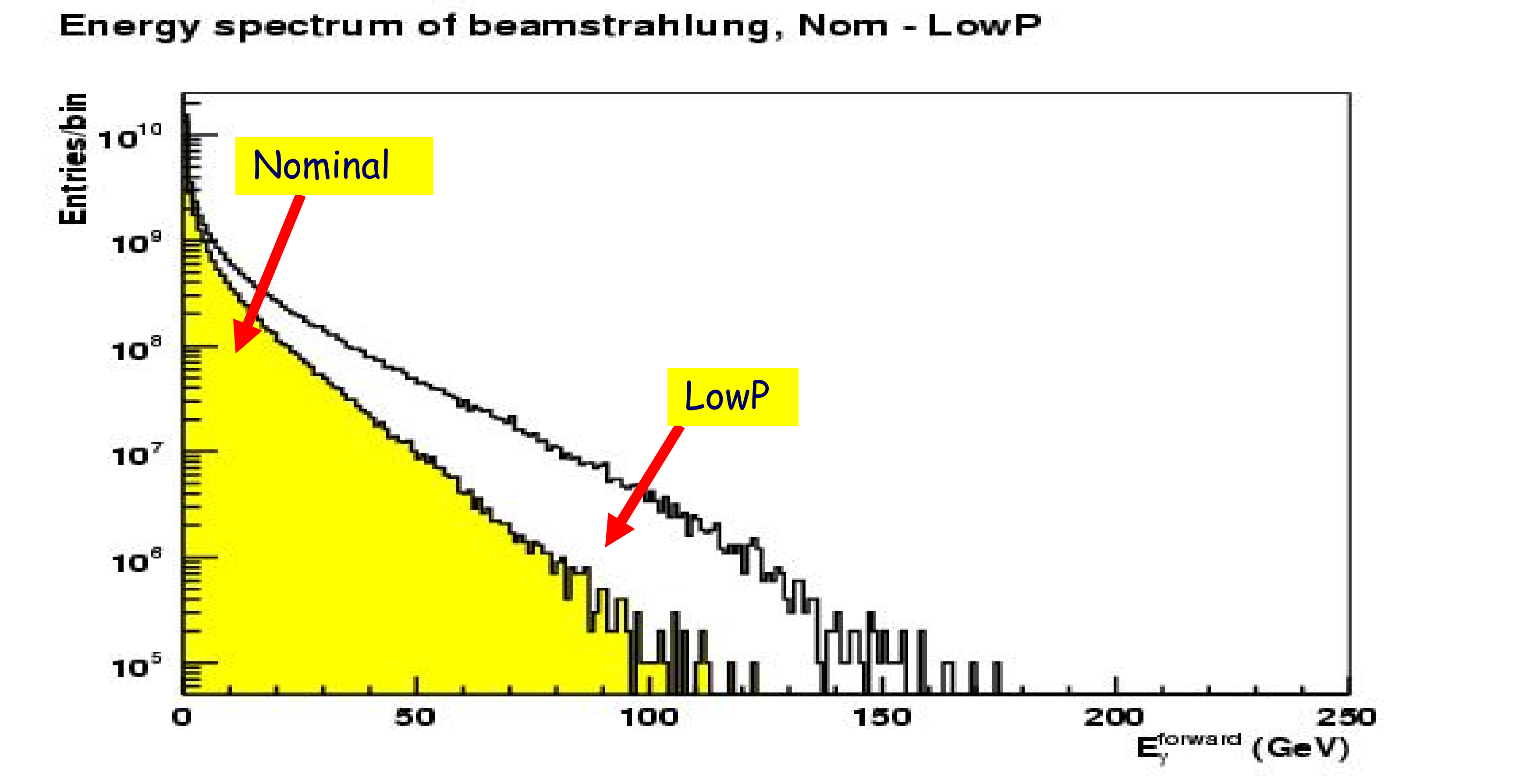
half bunch number and same σ_x σ_y → half Luminosity, double running time

half bunch number and smaller σ_x σ_y → same Luminosity, more beamstrahlung (2.5 x)

Smaller vertical beamsize: beamstrahlung energy rises from 2 to 6 % of the beam energy

Nominal parameters : Eγ = 1.16×10^{11} GeV per bX

LowP parameters : Eγ = 2.94×10^{11} GeV



Number and Depositions of Incoherent Pairs

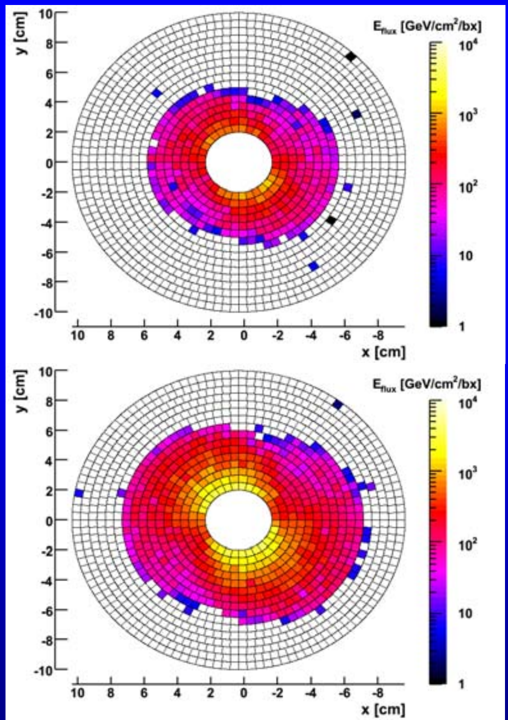
Larger number of photons:

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

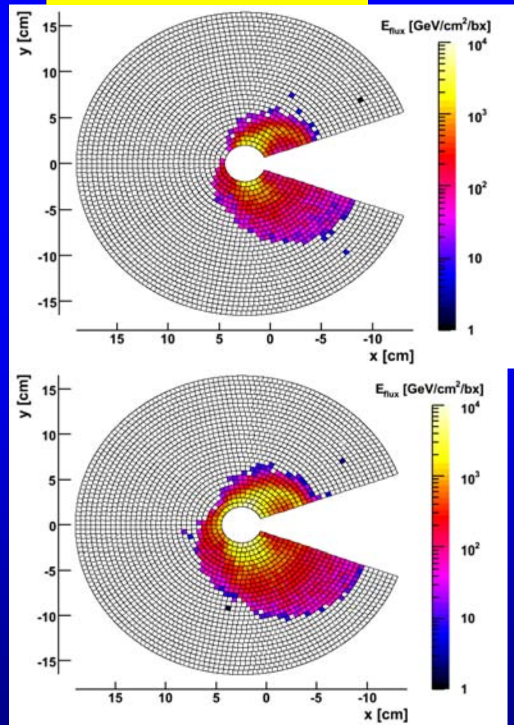
2 mrad



Nominal parameters

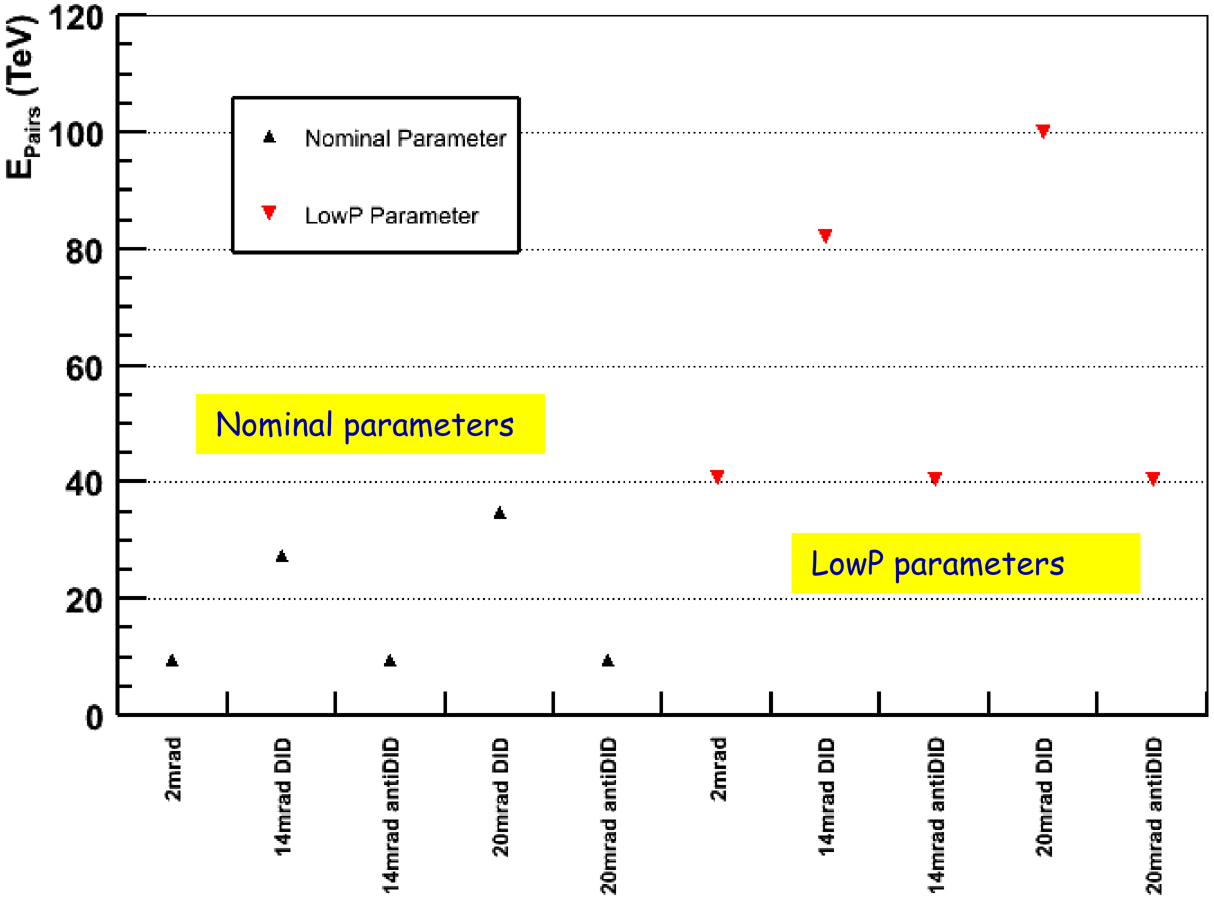
LowP parameters

14 mrad, DID



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

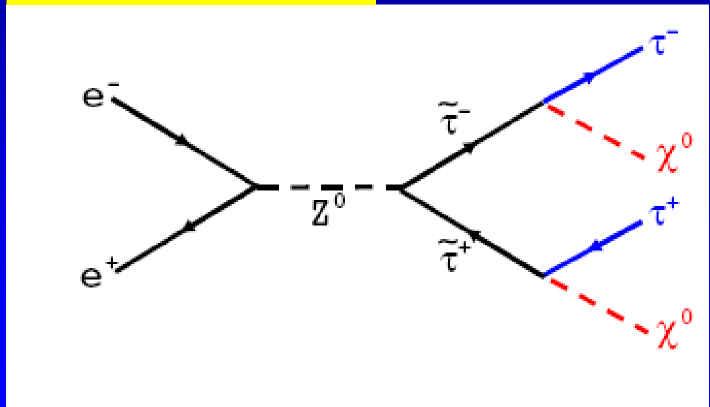
E_{pair}



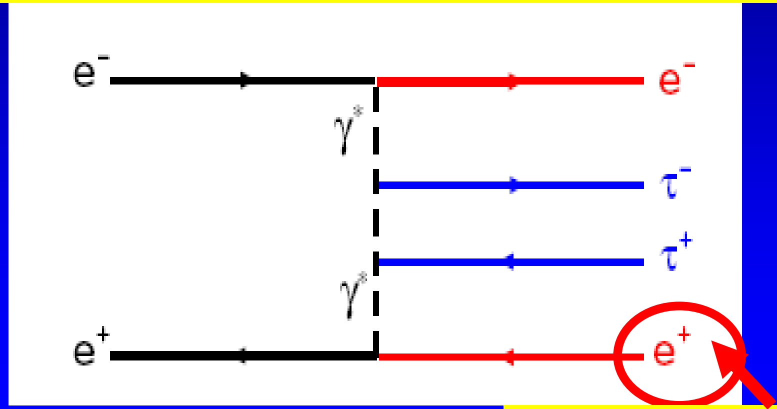
Ch. Grah

Impact on Particle Searches

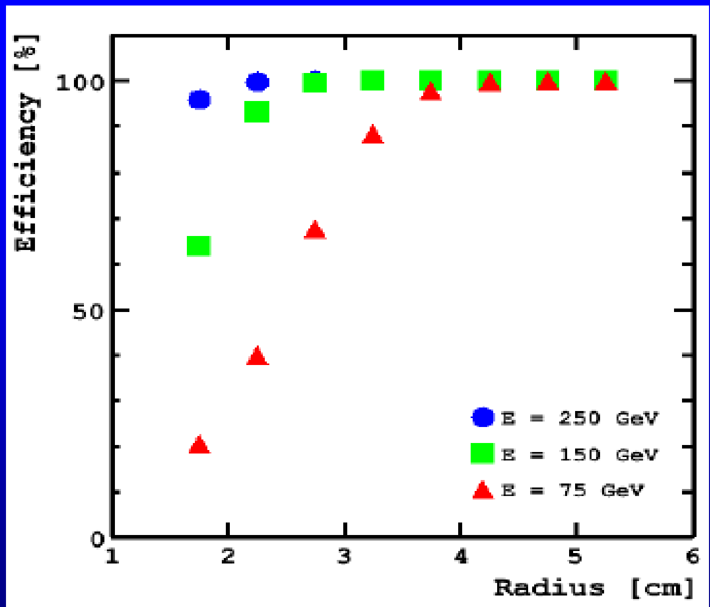
We want to see



Will be there,~! 10^4 larger cross section



Suppress by e^- veto



Electron veto efficiency forTESLA parameters (as example)

(center-of-mass energy 500 GeV)

Example for $\Delta m \sim 5GeV$

In a certain SUSY scenario we expect 20 signal events ($500fb^{-1}$);

Compare this to the expectation of background for several accelerator options (2 mrad)

Veto Energy Cut, GeV	75	50
Nominal	45	5
Low Q	40	0.1
Large Y	50	9
Low P	364	321
Nominal, 20mrad	396	349

DID B-field

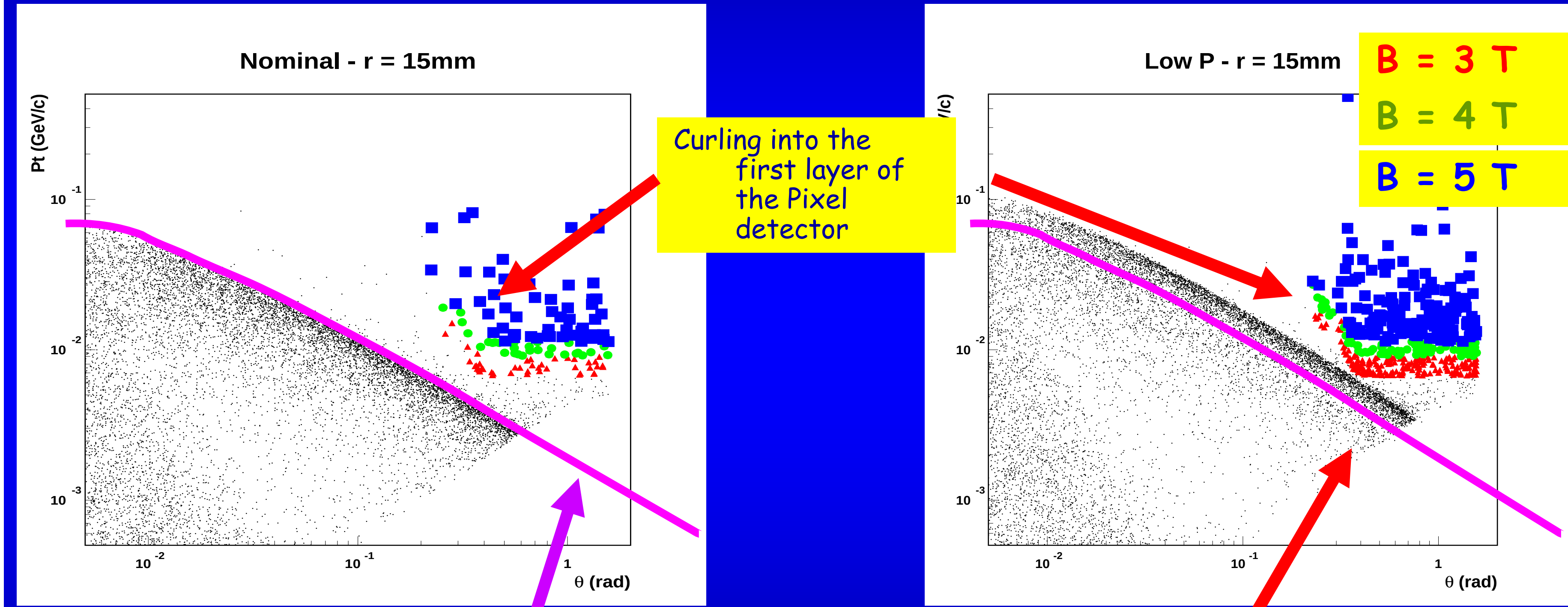
Expectation for 14 mrad: (Slightly) worse than for 2mrad (anti-DID field)

Dramatically worse for 14 mrad and DID field (as for 20 mrad)
How much worse should be quantified!

V. Drugakov et al.

Potential Background in the Pixel Detectors

P_T vs polar angle distributions



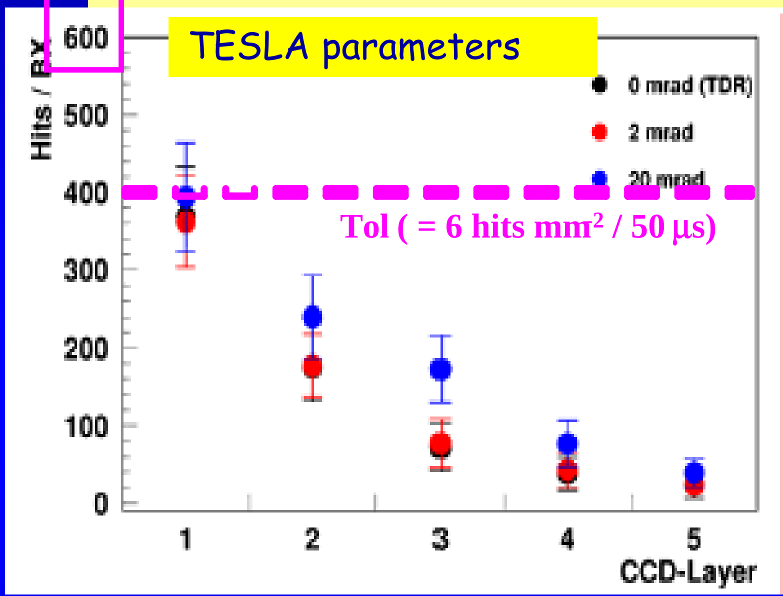
Deflection limit of nominal case

safety margin needed (beams may be not perfect)

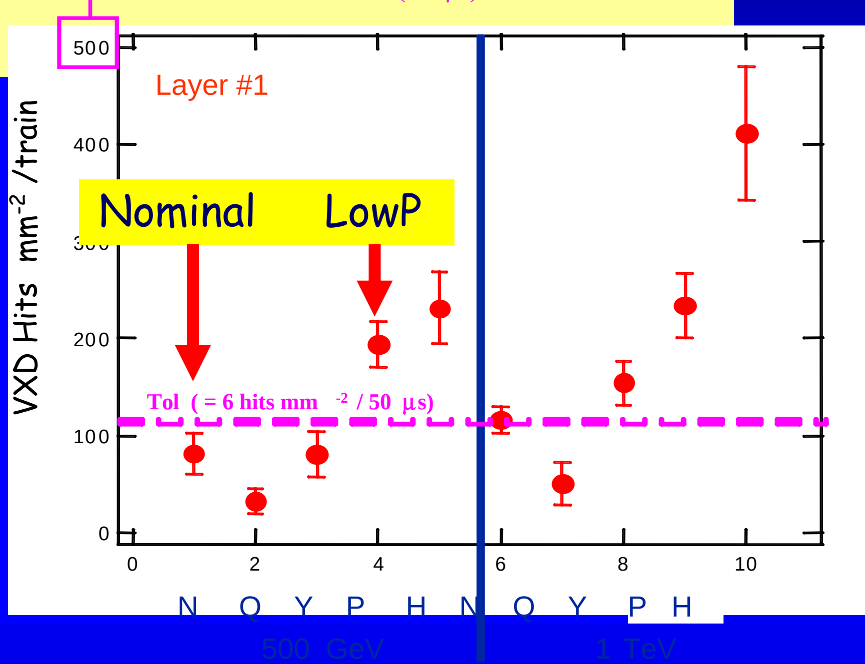
(Cecile Rimbault)

Known from previous studies (K. Buesser, T. Maruyama)

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

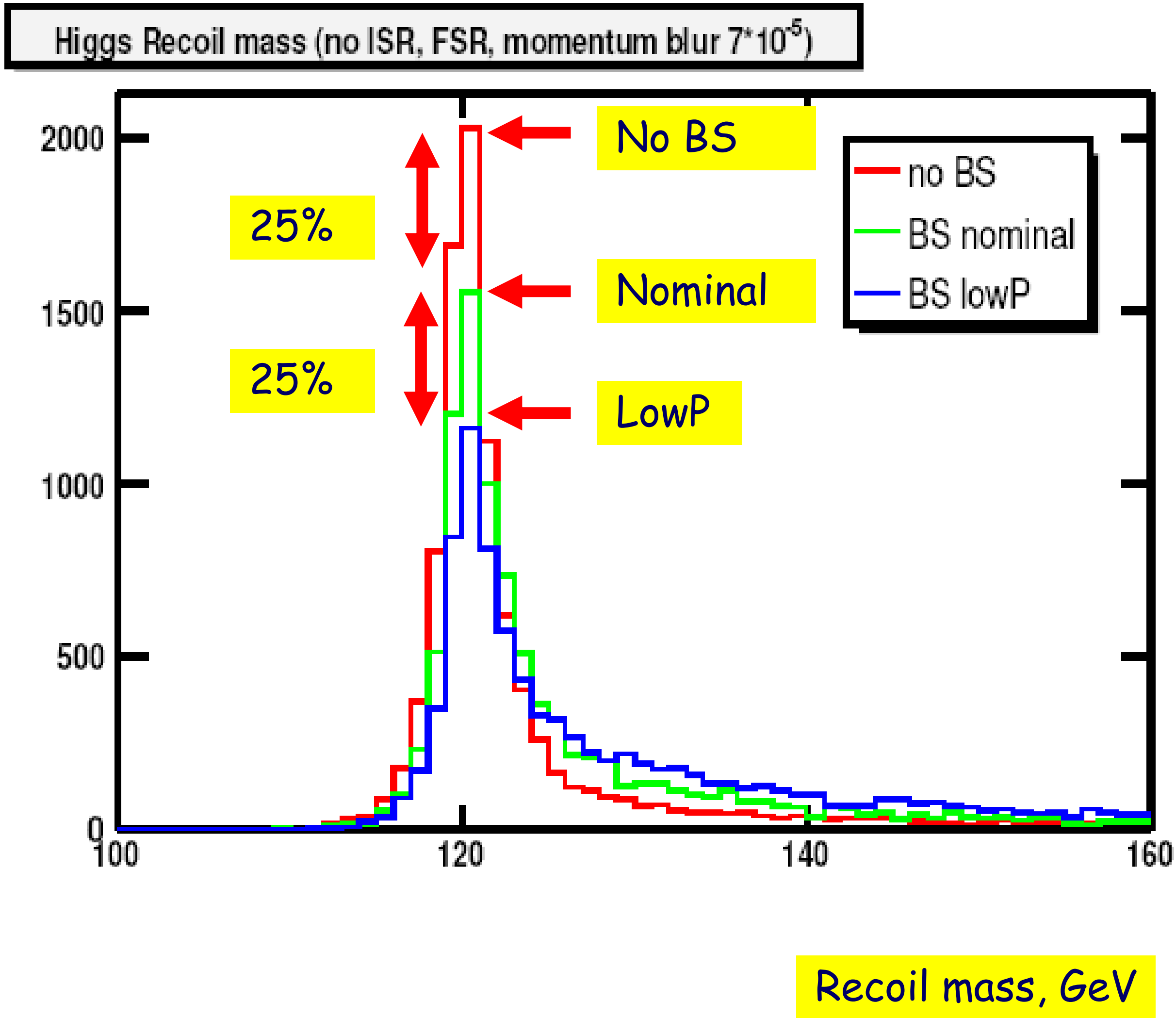


~ 26.3 hits mm^{-2} / SW (50 µs)



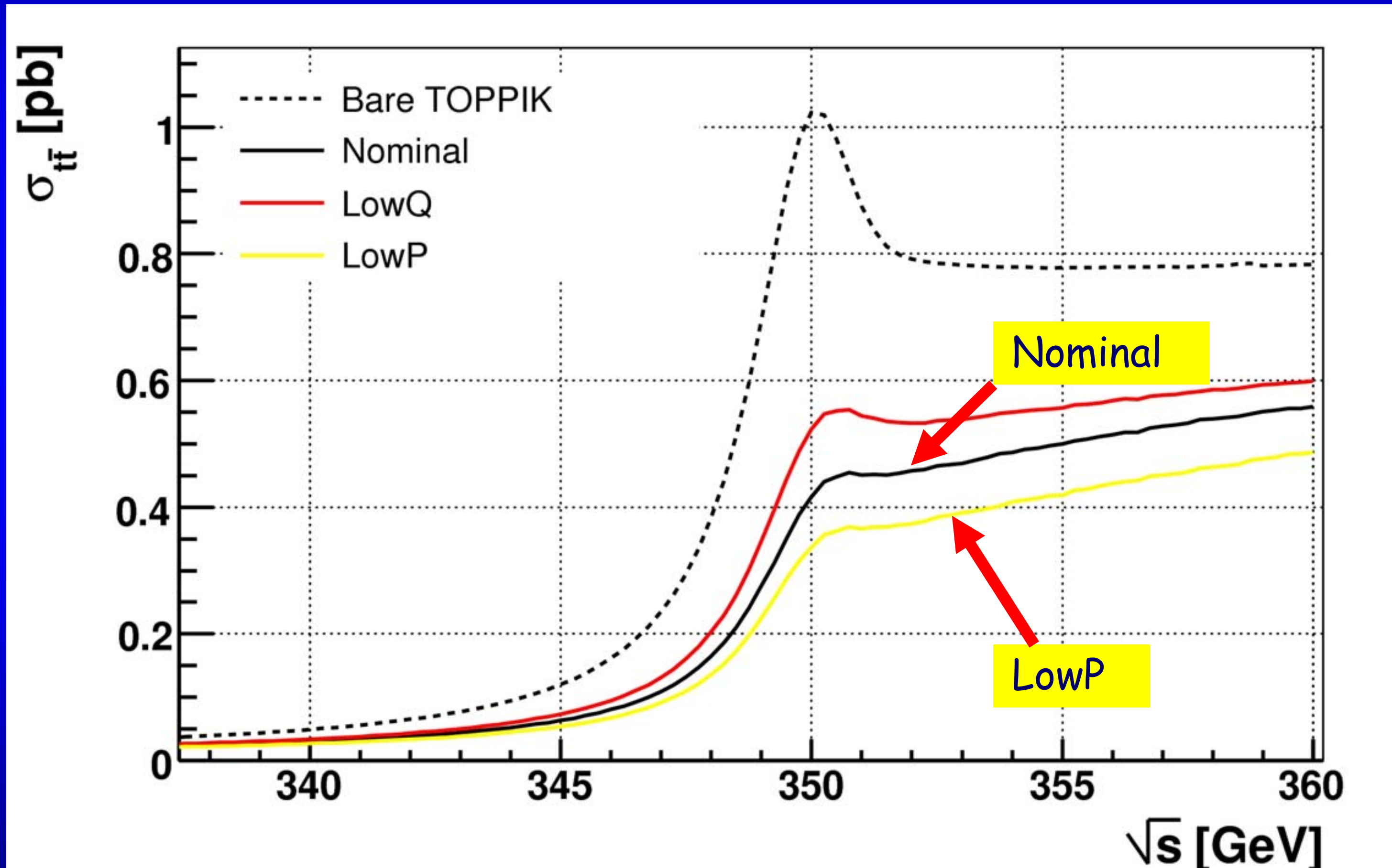
These studies include only electrons and photons.
Neutron production will be also enhanced !

Higgs Boson Recoil Mass

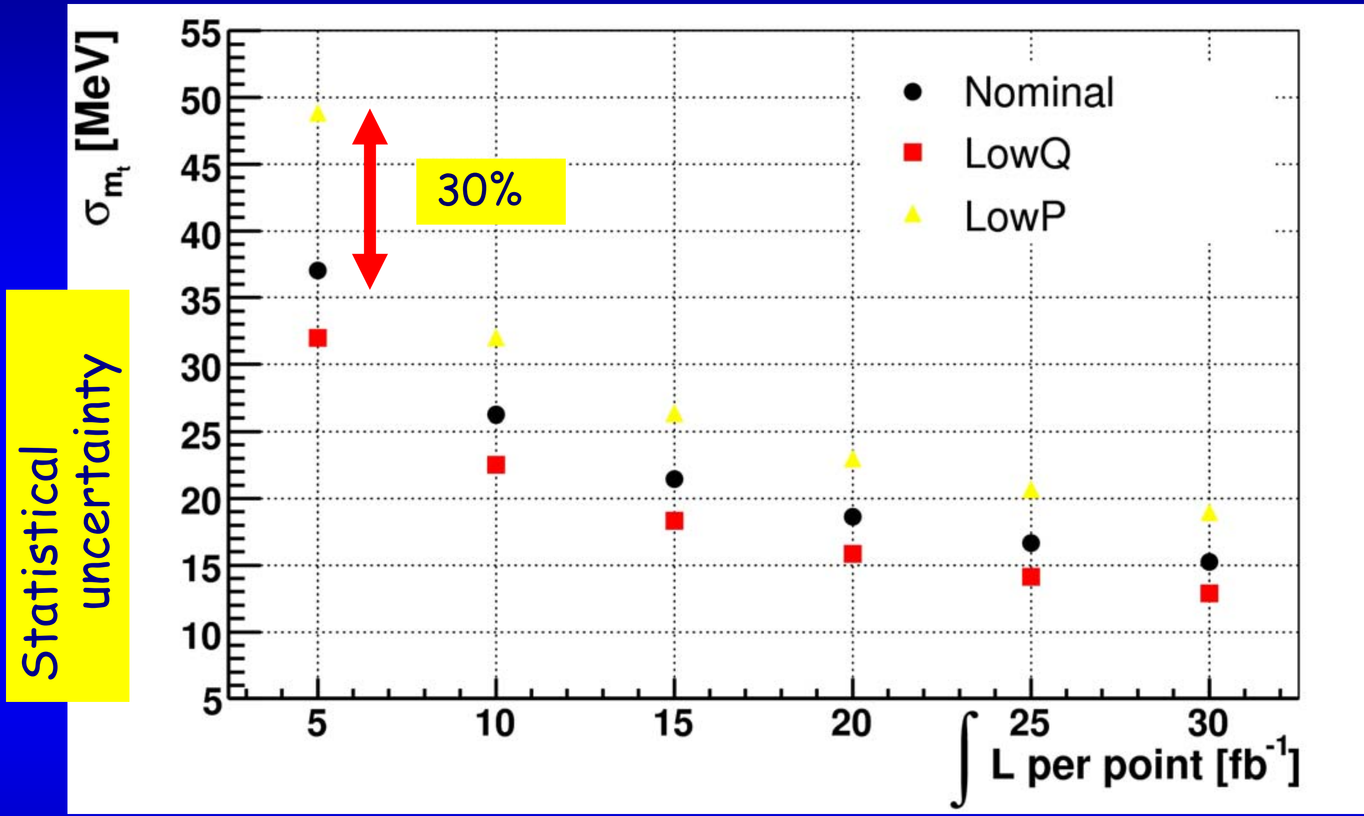


(Martin Ohlerich)

Threshold Scan, e.g. top mass



Threshold Scan, e.g. top mass



(Stewart Boogert)

Summary

- The lowP parameter set will either enlarge the running time to reach a certain benchmark, or will increase beamstrahlung substantially.
- The latter may have serious impact on physics precision measurements, may become less striking. (m_{top},other threshold scans, Higgs boson recoil)
- More beamstrahlung induces also more incoherent pairs. this has impact of the performance of the BeamCal, may have impact on the LumiCal, and enhance background in the vertex and tracking detectors.
- Degraded BeamCal photon veto efficiency limits the sensitivity in searches (e.g. low Δm for SUSY, Δm = 5 GeV is a challenge)
- The fraction of large p_T tracks from e^+e^- pairs crossing the vertex detector is growing and might be a dangerous issue
- To quantify all topics would need detailed simulations for 14 mrad Xangle