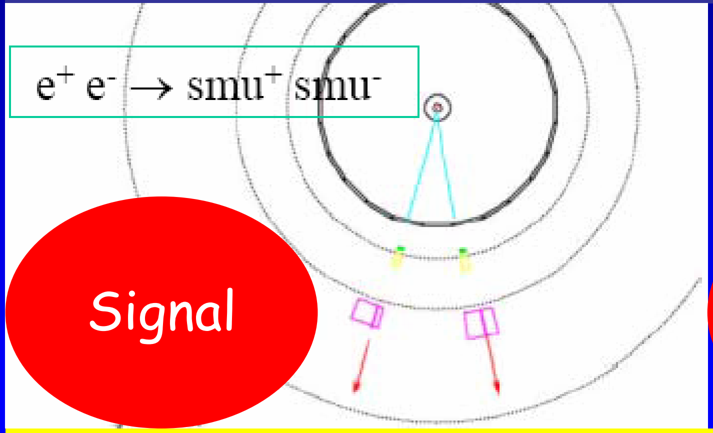
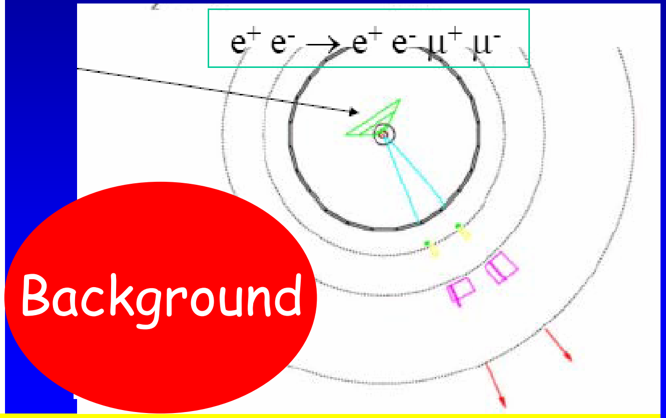
Forward Electron Veto Performance and SUSY Searches

W. Lohmann, DESY

Signatures, Signal, Background

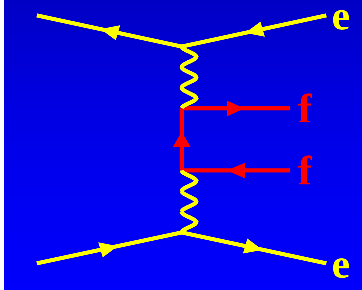
SUSY: Detection of l = μ,τ sleptons for small Δm

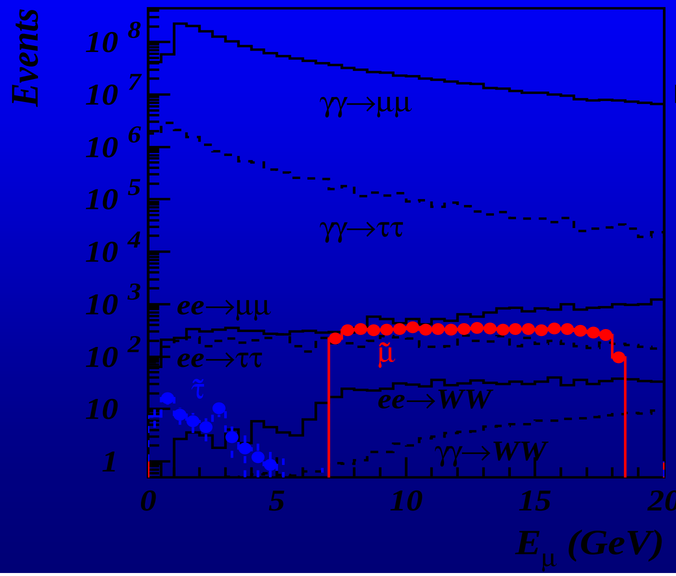


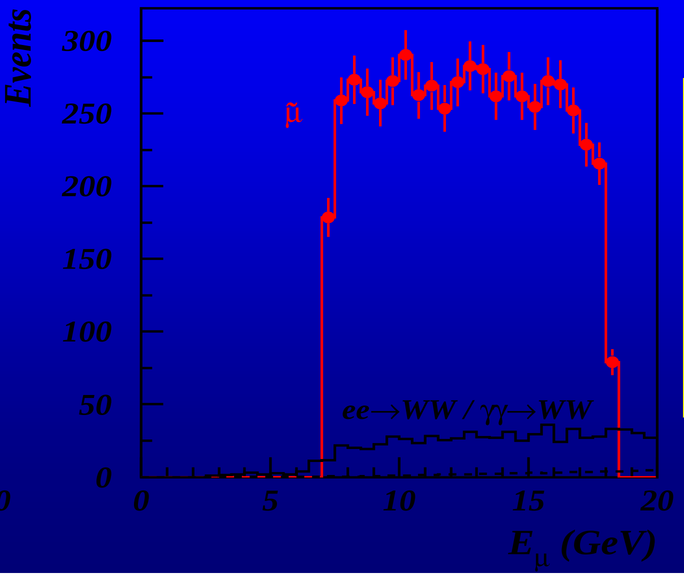


$\sigma \sim 10$ fb

$\sigma \sim 10^6$ fb







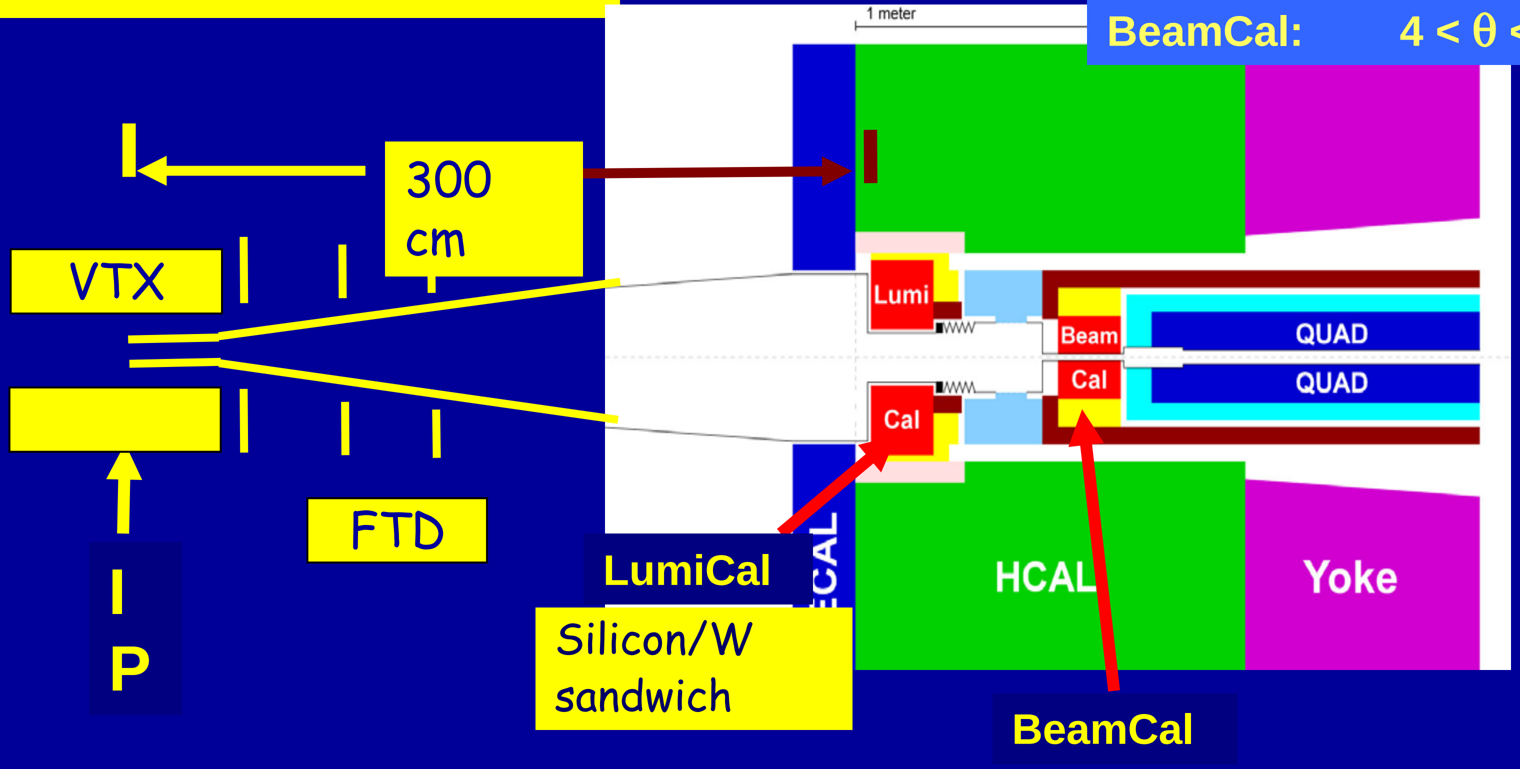
- **Detection of high energy electrons at small angles necessary**

Studies so far used:

LumiCal: $26 < \theta < 82$ mrad

BeamCal: $4 < \theta < 28$ mrad

$L^* = 4$m



300 cm

VTX

FTD

IP

LumiCal

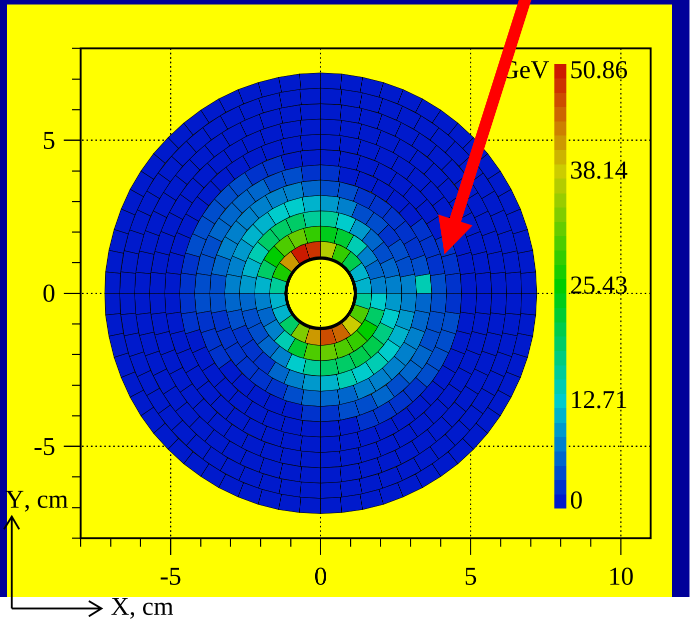
Silicon/W sandwich

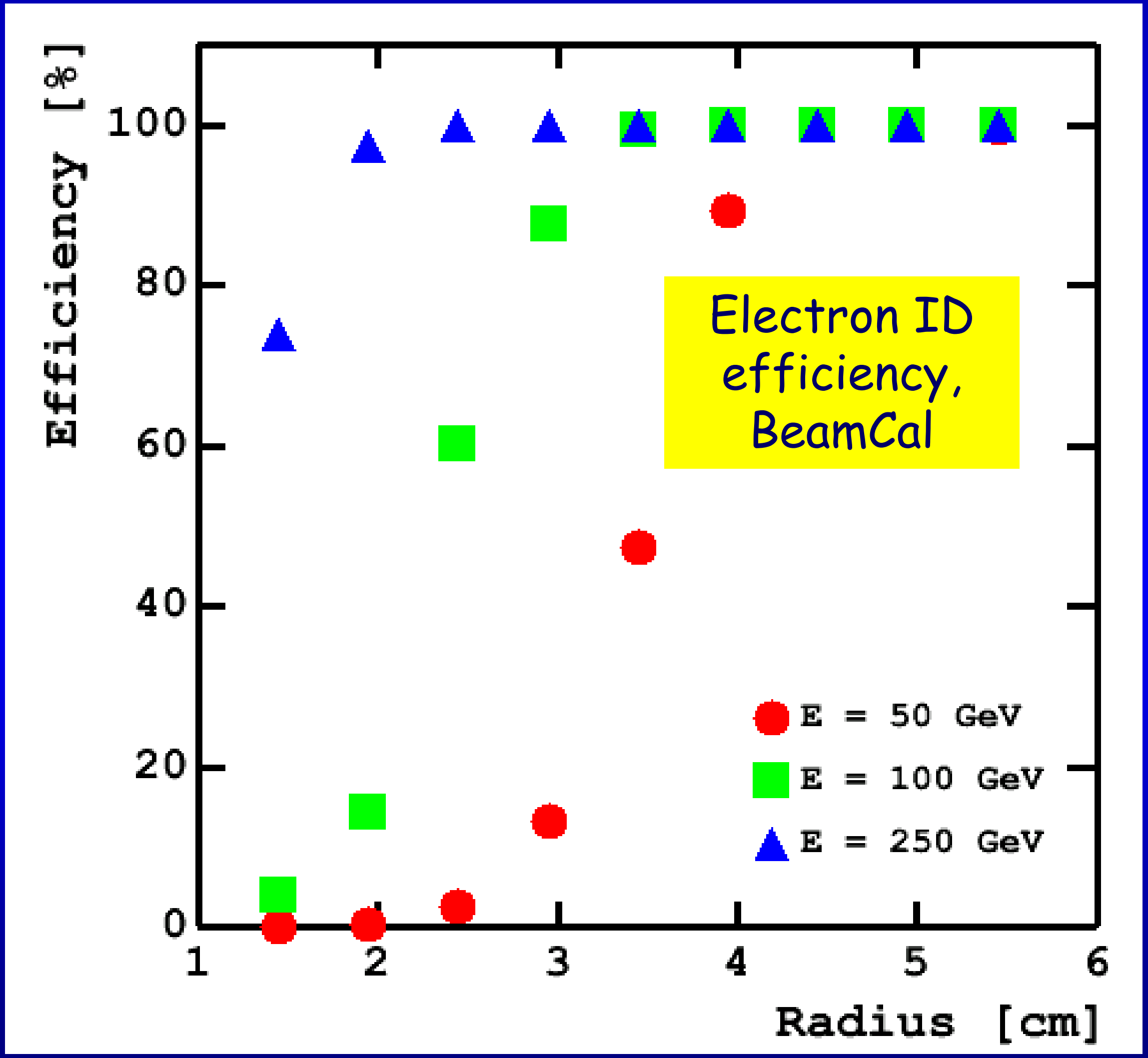
BeamCal

Problem: several TeV depositions from incoherent pairs per BX,

How well can we detect single e^-?

Single e^-





Electron ID efficiency, BeamCal

Sandwich Cal.
$30\ X_0$
$1X_0$ sampling
R_M ~ 1 cm
Pad size ~ 1 cm^2

These efficiencies are parametrized and available for 0/2/20 mrad crossing angle,

(If you would like to use ask Vladimir)

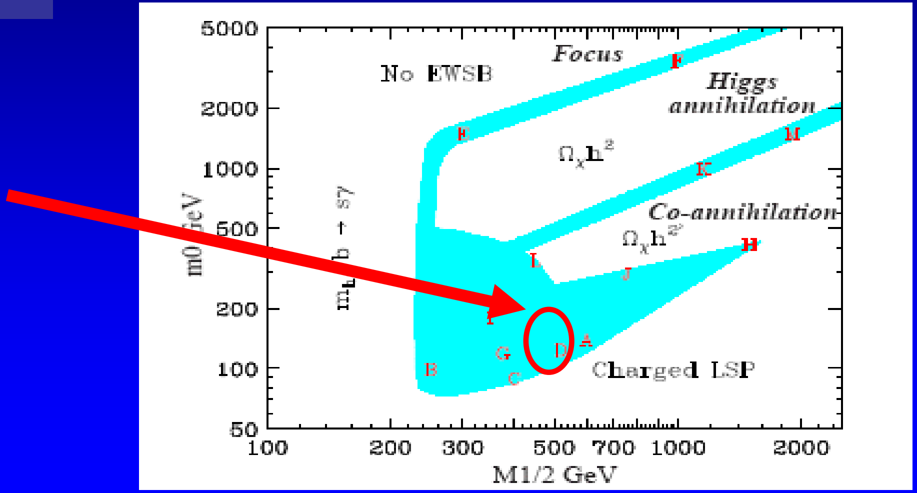
Not yet for 14 mrad

Quantitative estimates

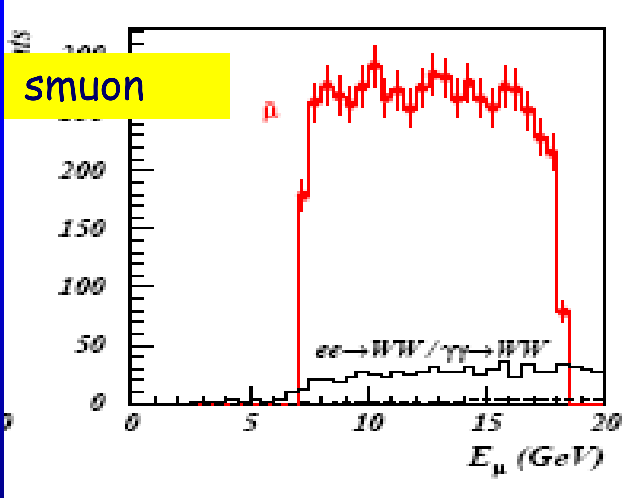
P. Bambade et al. hep-ph/0406010

Smuon and Stau pair production in a WMAP favoured region (co-aanihilation region, small mass difference between stau and neutralino

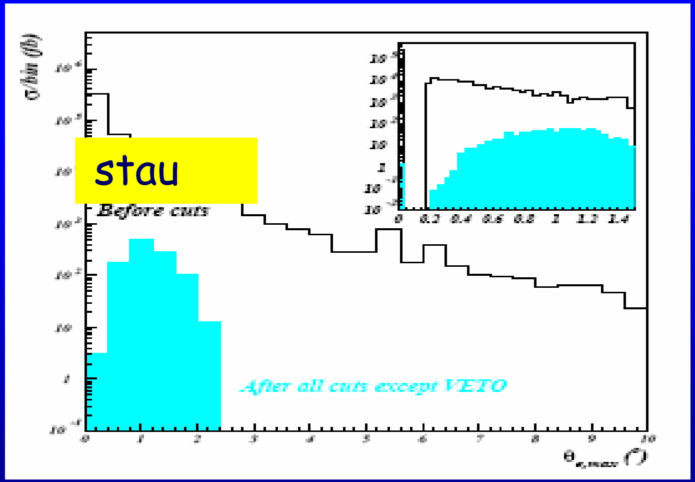
Standard TESLA beam parameters,
0/20 mrad crossing angle,
Simplified electron veto efficiency



Results



smuon



stau

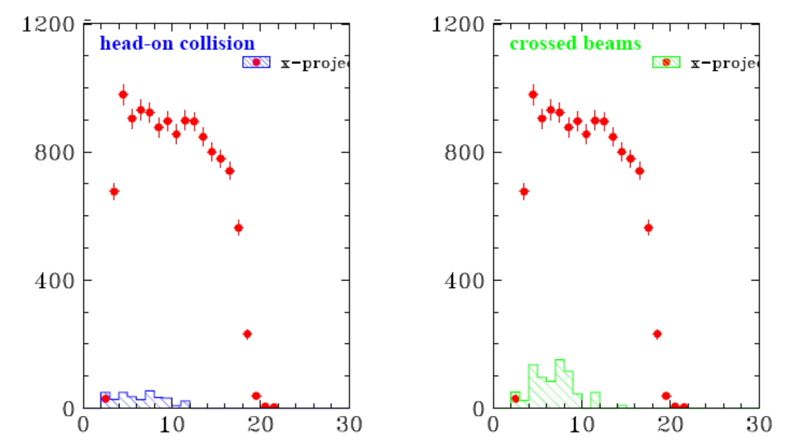
Conclusion: Stau detection is no problem at small crossing angle
for 20 mrad 25 % signal efficiency reduction

H.U. Martyn, hep-ph/0408226

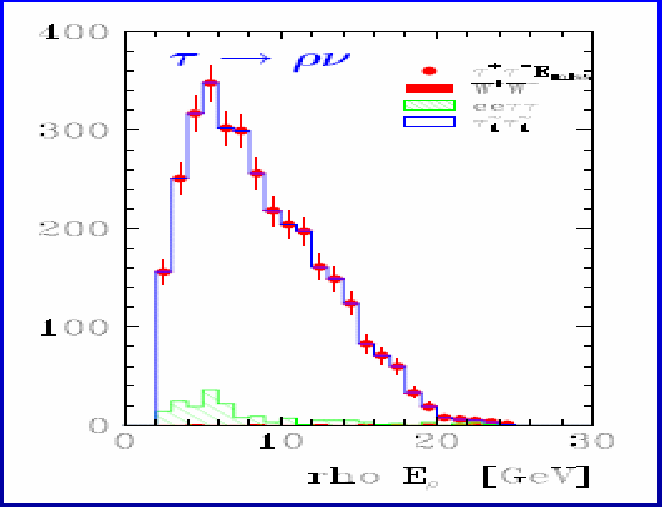
$$
\begin{aligned}
e^+_L e^-_R &\rightarrow \tilde{\mu}_R \tilde{\mu}_R \rightarrow \mu^+ \tilde{\chi}^0_1 \mu^- \tilde{\chi}^0_1 , \\
e^+_L e^-_R &\rightarrow \tilde{\tau}_1 \tilde{\tau}_1 \rightarrow \tau^+ \tilde{\chi}^0_1 \tau^- \tilde{\chi}^0_1 .
\end{aligned}
$$

Standard TESLA beam parameters,
0/20 mrad crossing angle,
(3.5 mrad and 5.7 mrad lower
acceptance cut)
Simplified electron veto efficiency

smuon



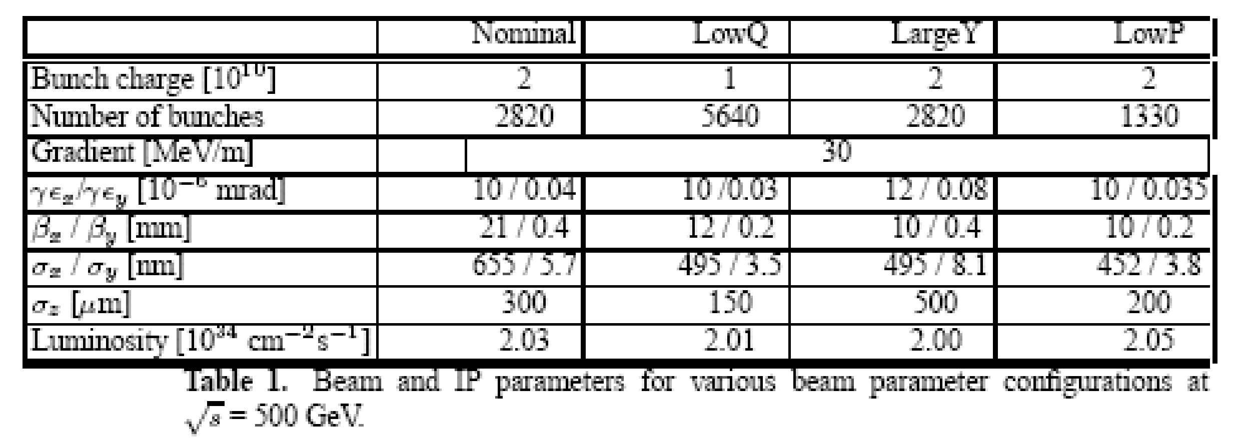
stau



Conclusion: Stau detection is possible at small crossing angle
background enhanced by a factor 2-3

V. Drugakov, Bangalore

Several beam parameter settings



	Nominal	LowQ	LargeY	LowP
Bunch charge [10^{10}]	2	1	2	2
Number of bunches	2820	5640	2820	1330
Gradient [MeV/m]		30		
$\gamma\epsilon_x/\gamma\epsilon_y$ [10^{-6} mrad]	10 / 0.04	10 /0.03	12 / 0.08	10 / 0.035
β_x / β_y [mm]	21 / 0.4	12 / 0.2	10 / 0.4	10 / 0.2
σ_x / σ_y [nm]	655 / 5.7	495 / 3.5	495 / 8.1	452 / 3.8
σ_z [μm]	300	150	500	200
Luminosity [10^{34} cm^{-2}s^{-1}]	2.03	2.01	2.00	2.05

Table 1. Beam and IP parameters for various beam parameter configurations at $\sqrt{s} = 500$ GeV.

Veto efficiencies for 2/20 mrad

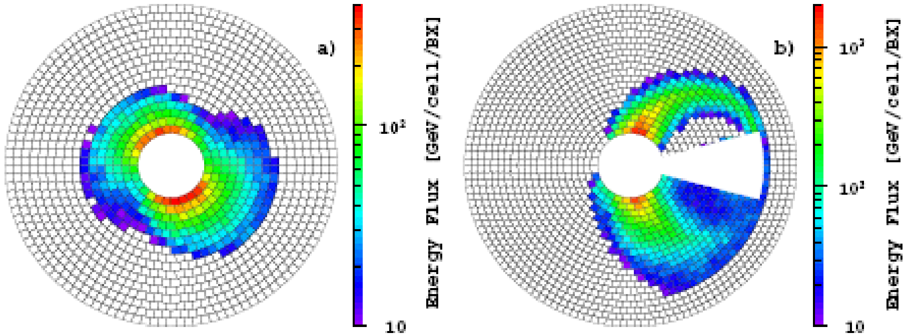
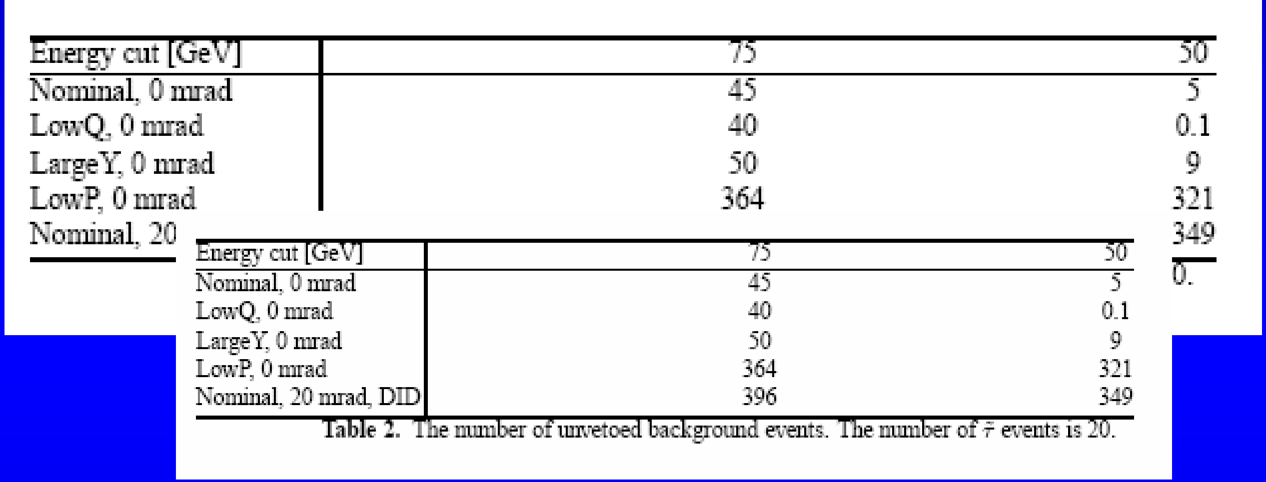


Figure 1. The energy density of beamstrahlung remnants per bunch crossing as a function of position in the $r - \varphi$ plane at the a) 2 mrad and b) 20 mrad with DID field crossing angles.

Results

Stau pair production (previous parameters)
After selection cuts: 20 signal events, 3×10^5 background
Apply now electron veto:

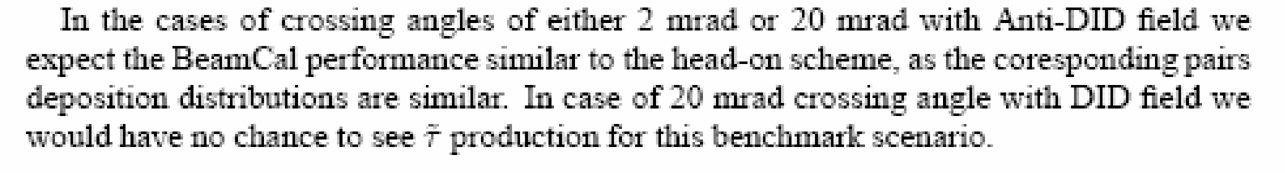


Energy cut [GeV]	75	50
Nominal, 0 mrad	45	5
LowQ, 0 mrad	40	0.1
LargeY, 0 mrad	50	9
LowP, 0 mrad	364	321
Nominal, 20 mrad, DID	396	349

Table 2. The number of unvetoed background events. The number of $\tilde{\tau}$ events is 20.

Energy cut [GeV]	75	50
Nominal, 0 mrad	45	5
LowQ, 0 mrad	40	0.1
LargeY, 0 mrad	50	9
LowP, 0 mrad	364	321
Nominal, 20		349
		0.

Conclusion:



In the cases of crossing angles of either 2 mrad or 20 mrad with Anti-DID field we expect the BeamCal performance similar to the head-on scheme, as the coresponding pairs deposition distributions are similar. In case of 20 mrad crossing angle with DID field we would have no chance to see $\tilde{\tau}$ production for this benchmark scenario.

My Conclusions:

The electron veto capability of the forward calorimeters is essential for new particle searches with large missing energy and momentum

For 20 mrad and DID field we have the 'worst case',

means smallest 'reach area'.

For 14 mrad work is needed