LCWS 2006 Bangalore

BeamCal Performance at Different ILC Beam Parameter Sets

Vladimir Drugakov NC PHEP, Minsk

Motivation

Prerequisite:
"Suggested ILC Beam Parameter Range" Rev. 2/28/05

TESLA machine parameters had been chosen to achieve a high peak luminosity but with a high disruption parameter which **left little room for operational optimization**

Changes to ease operational constraints would likely cause the peak luminosity to decrease

It was suggested to **define an operating plane** where a number of different machine configurations achieve **the same peak luminosity**

This range is meant to provide **a guideline** so that the **ILC Working Groups** can consider what will be difficult and what will not

Introduction

Physics motivation:

- in some models, amount of DM in the Universe depends on difference between $\tilde{\chi}$ and $\tilde{\tau}_1$ masses

-> one needs to **measure $\tilde{\tau}$ mass** precisely

Introduction

Physics motivation:

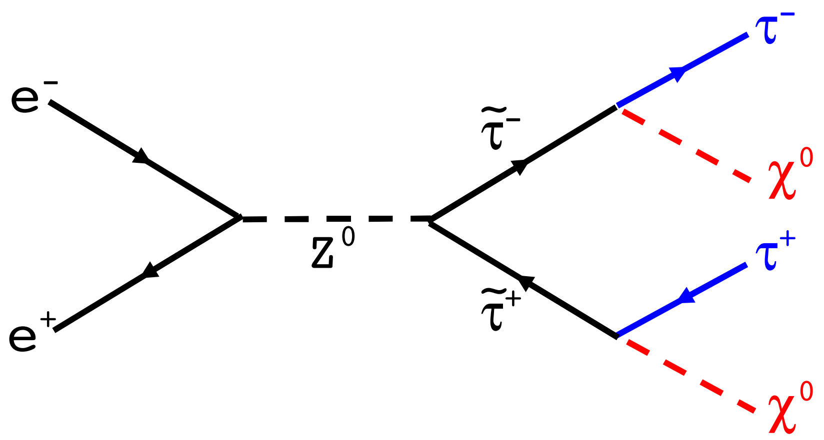
- in some models, amount of DM in the Universe depends on difference between $\tilde{\chi}$ and $\tilde{\tau}_1$ masses

-> one needs to measure $\tilde{\tau}$ mass precisely

Physics background:

- $\gamma\gamma$ events with 4-fermion final states
- eliminating strategy:
    - **cut on $\tau\tau$ acoplanarity** if $p_t(e)$ is low
    - **electron veto** when $p_t(e)$ is high

New Particle Searches



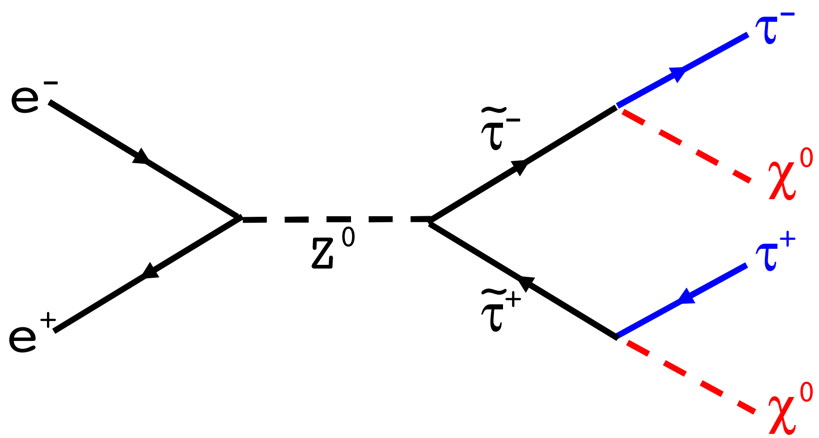
The Physics:

stau pair production

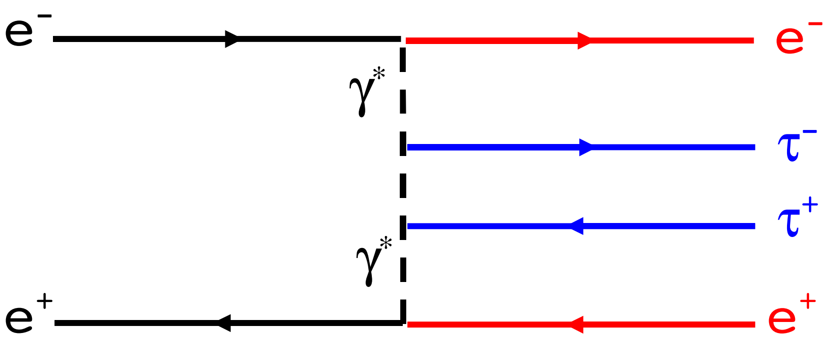
Signature:

$\tau^+ \tau^-$ + missing energy

New Particle Searches



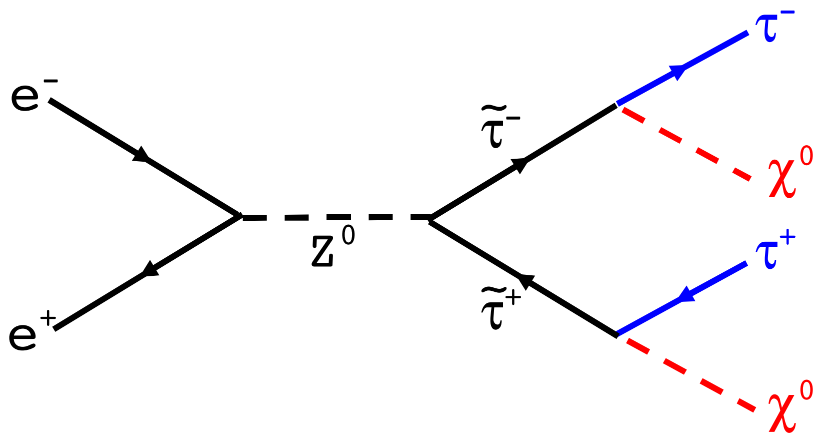
The Physics:
stau pair production
Signature:
$\tau^+ \tau^-$ + missing energy



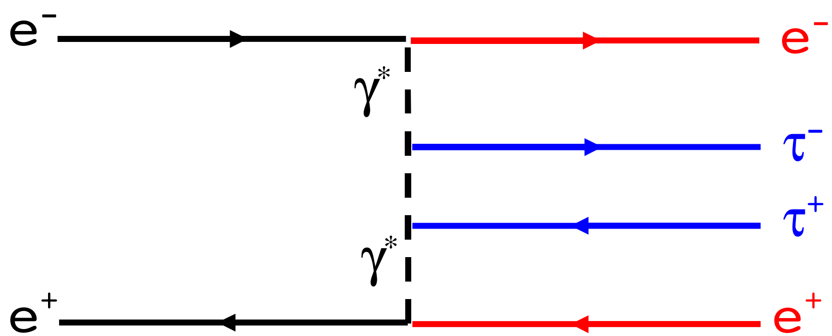
The Background:
two-photon events
Signature:
$\tau^+ \tau^-$ + missing energy
(if electrons are not tagged)

i.e. mimic SUSY event

New Particle Searches



The Physics:
stau pair production
Signature:
$\tau^+ \tau^-$ + missing energy



The Background:
two-photon events
Signature:
$\tau^+ \tau^-$ + missing energy
(if electrons are not tagged)

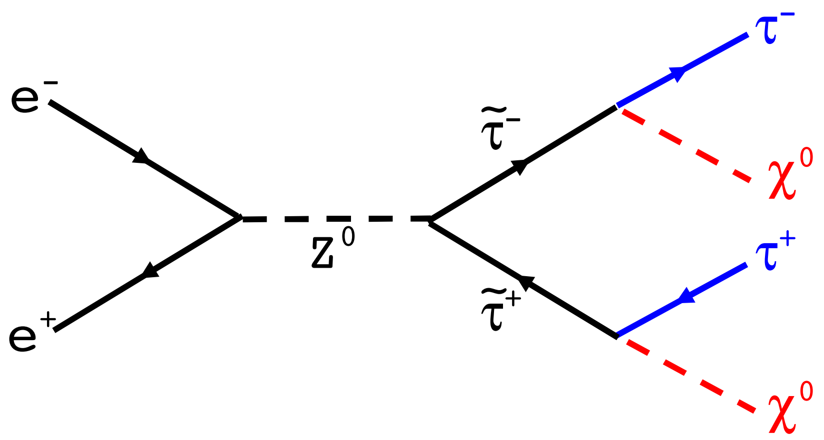
i.e. mimic SUSY event

strategy:

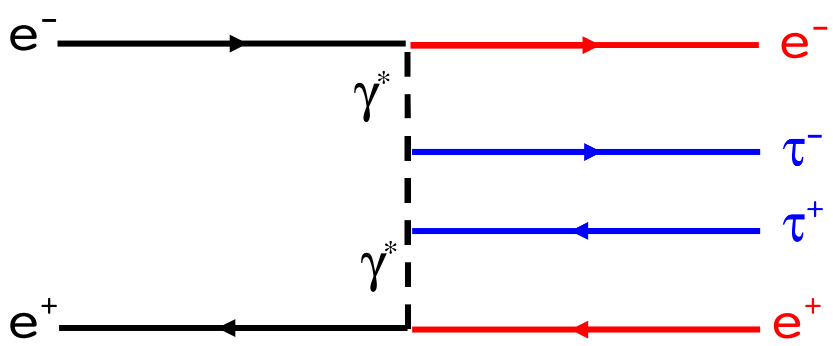
- e^+e^- in BP: cut on $\tau\tau$ acoplanarity
- e hits BeamCal: electron veto is vital

SUSY analysis is done

New Particle Searches



The Physics:
stau pair production
Signature:
$\tau^+ \tau^-$ + missing energy



The Background:
two-photon events
Signature:
$\tau^+ \tau^-$ + missing energy
(if electrons are not tagged)

i.e. mimic SUSY event

After all cuts applied except veto ($L=500 fb^{-1}$):

2-photon events ~ $2.7 \cdot 10^5$

SUSY events ~ 20

SUSY analysis is done by Z.Zang(LAL)

Introduction

Physics motivation:

- in some models, amount of DM in the Universe depends on difference between $\tilde{\chi}$ and $\tilde{\tau}_1$ masses

-> one needs to measure $\tilde{\tau}$ mass precisely

Physics background:

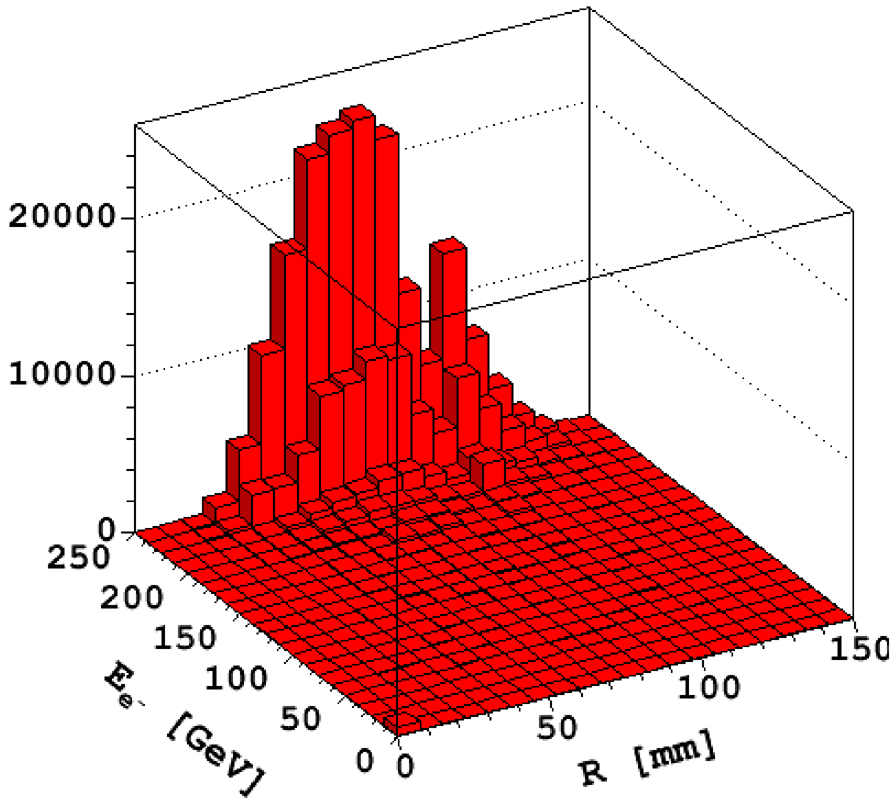
- $\gamma\gamma$ events with 4-fermion final states
- eliminating strategy:
  - cut on $\tau\tau$ acoplanarity if $p_t(e)$ is low
  - electron veto when $p_t(e)$ is high

Electron veto:

- **problematic near BP,** due to superposition with the beamstrahlung remnants

Veto requirements and performance

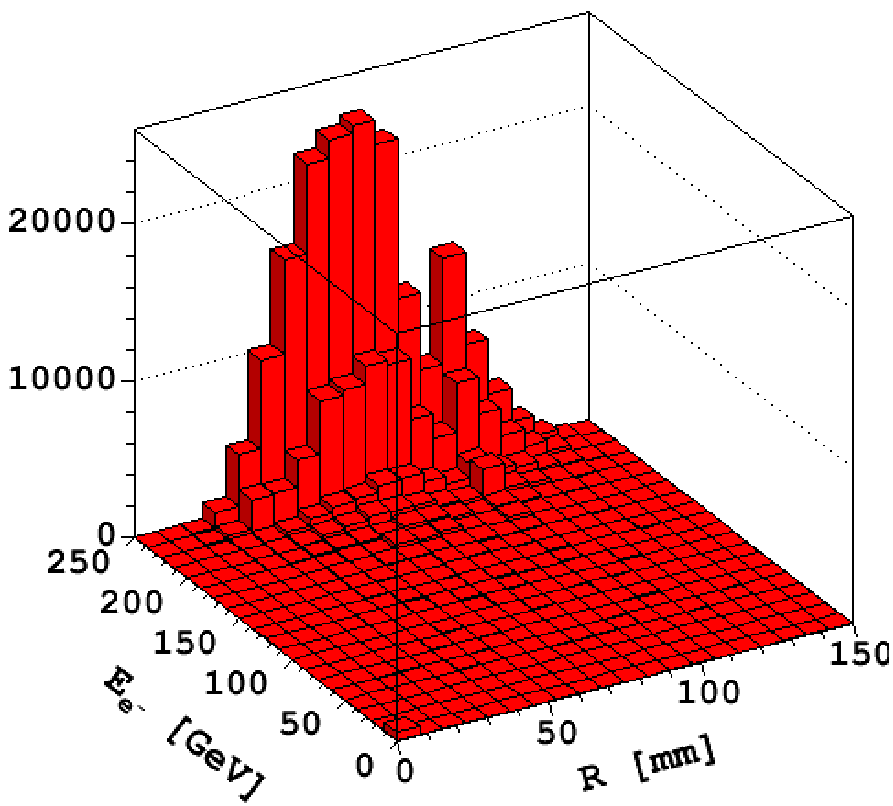
the electrons from $\gamma\gamma$ events
passed all cut except veto



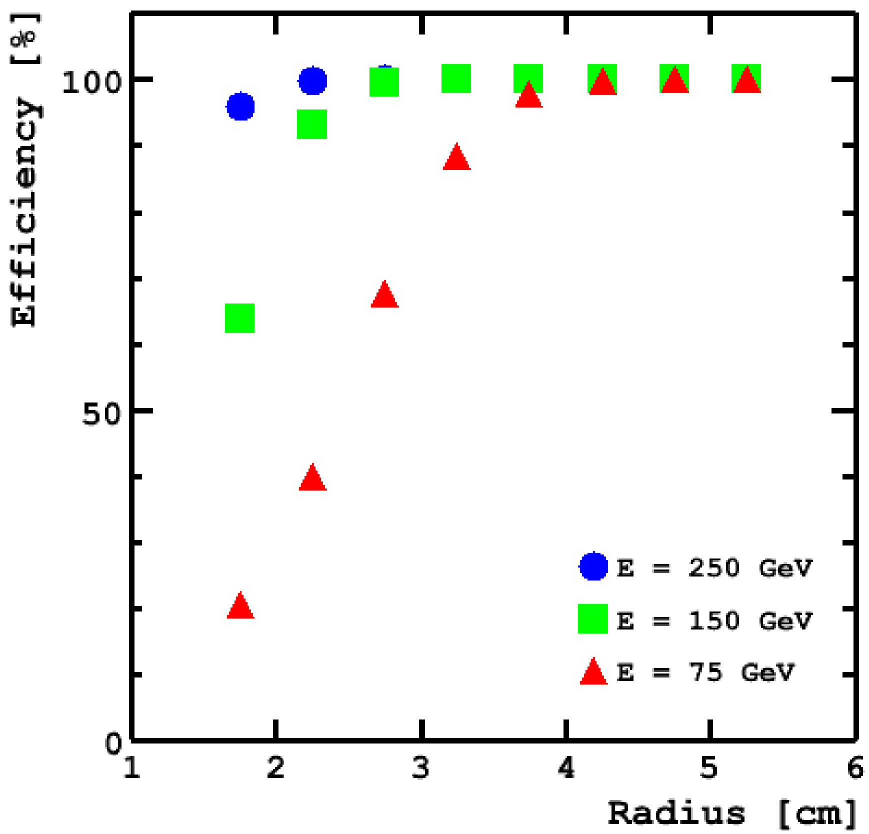
ntuple provided by Z.Zhang (LAL)

Veto requirements and performance

the electrons from $\gamma\gamma$ events
passed all cut except veto



BeamCal veto performance



Introduction

Physics motivation:

- in some models, amount of DM in the Universe depends on difference between $\tilde{\chi}$ and $\tilde{\tau}_1$ masses

-> one needs to measure $\tilde{\tau}$ mass precisely

Physics background:

- $\gamma\gamma$ events with 4-fermion final states
- eliminating strategy:
    - cut on $\tau\tau$ acoplanarity if $p_t(e)$ is low
    - electron veto when $p_t(e)$ is high

Electron veto:

- problematic near BP, due to superposition with the beamstrahlung remnants

Study:

- S/N is benchmark in **comparison of different designs**

Strategy

Physics program:

- compare 4 suggested beam parameter configurations:

$L = 2x10^{34} cm^{-2} s^{-1}$ – all configurations

Nominal

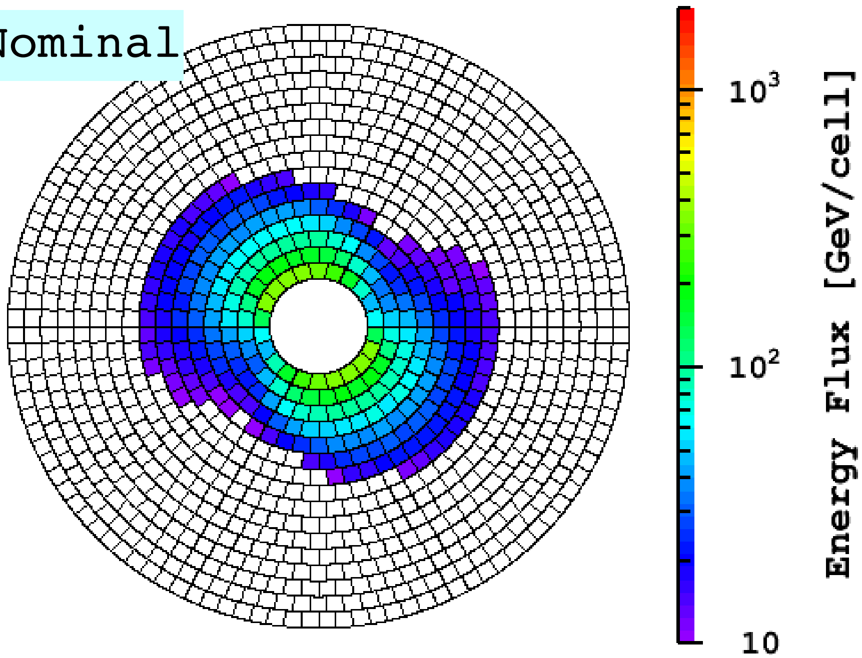
Low Q - half Q, double Nb, shorter and smaller bunch

Large Y - longer, larger bunch

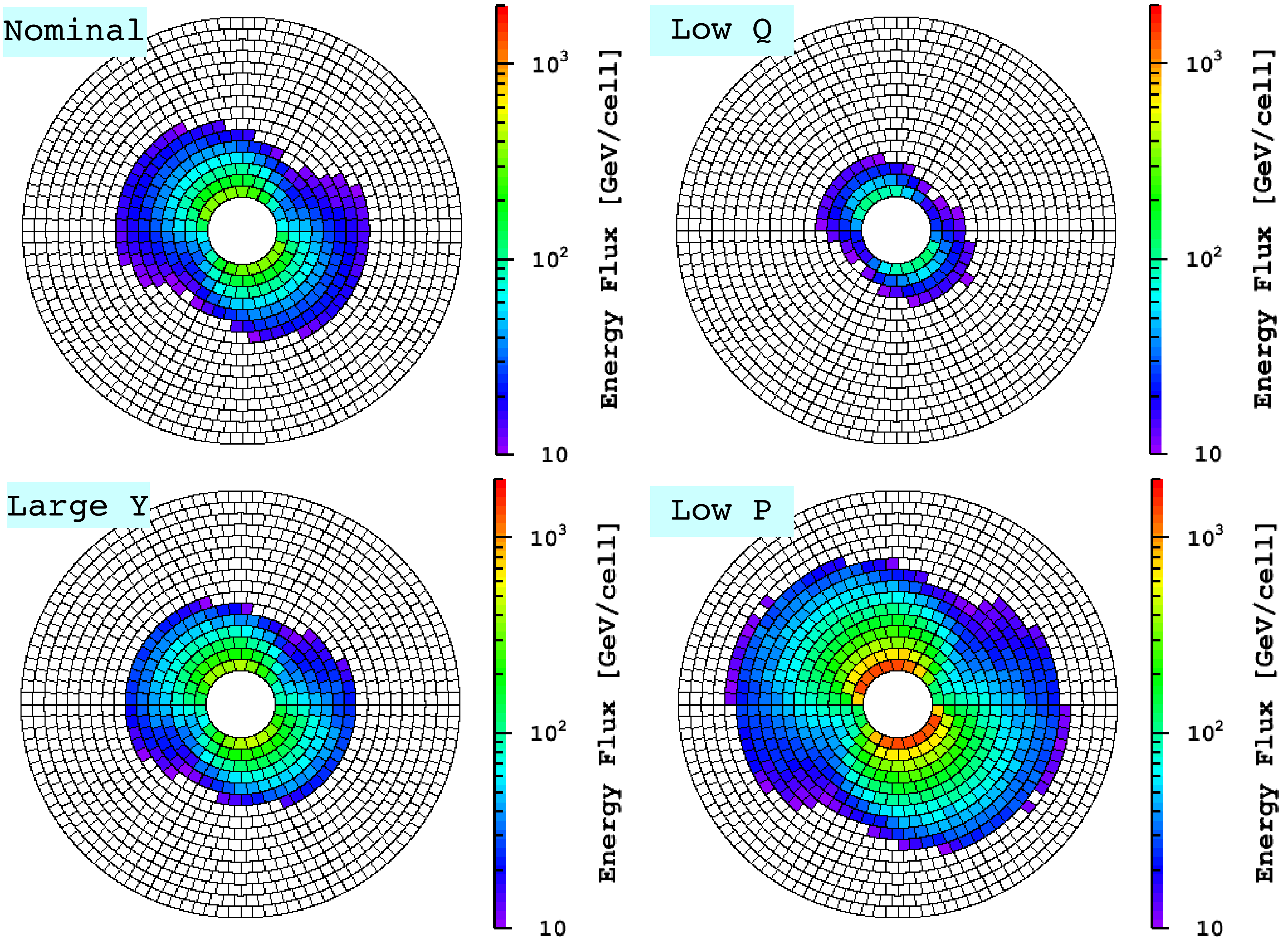
Low P - half Nb, shorter and smaller bunch

Beam Parameter Sets

Nominal



Beam Parameter Sets



Strategy

Physics program:

- compare 4 suggested beam parameter configurations:

Nominal
Low Q - half Q, double Nb, shorter and smaller bunch
Large Y - longer, larger bunch
Low P - half Nb, shorter and smaller bunch

Strategy:

- calculate veto efficiency table for each design
  - full simulation chain to be done for each design
- include this MC into stau analysis

Strategy

Physics program:

- compare 4 suggested beam parameter configurations:

Nominal
Low Q - half Q, double Nb, shorter and smaller bunch
Large Y - longer, larger bunch
Low P - half Nb, shorter and smaller bunch

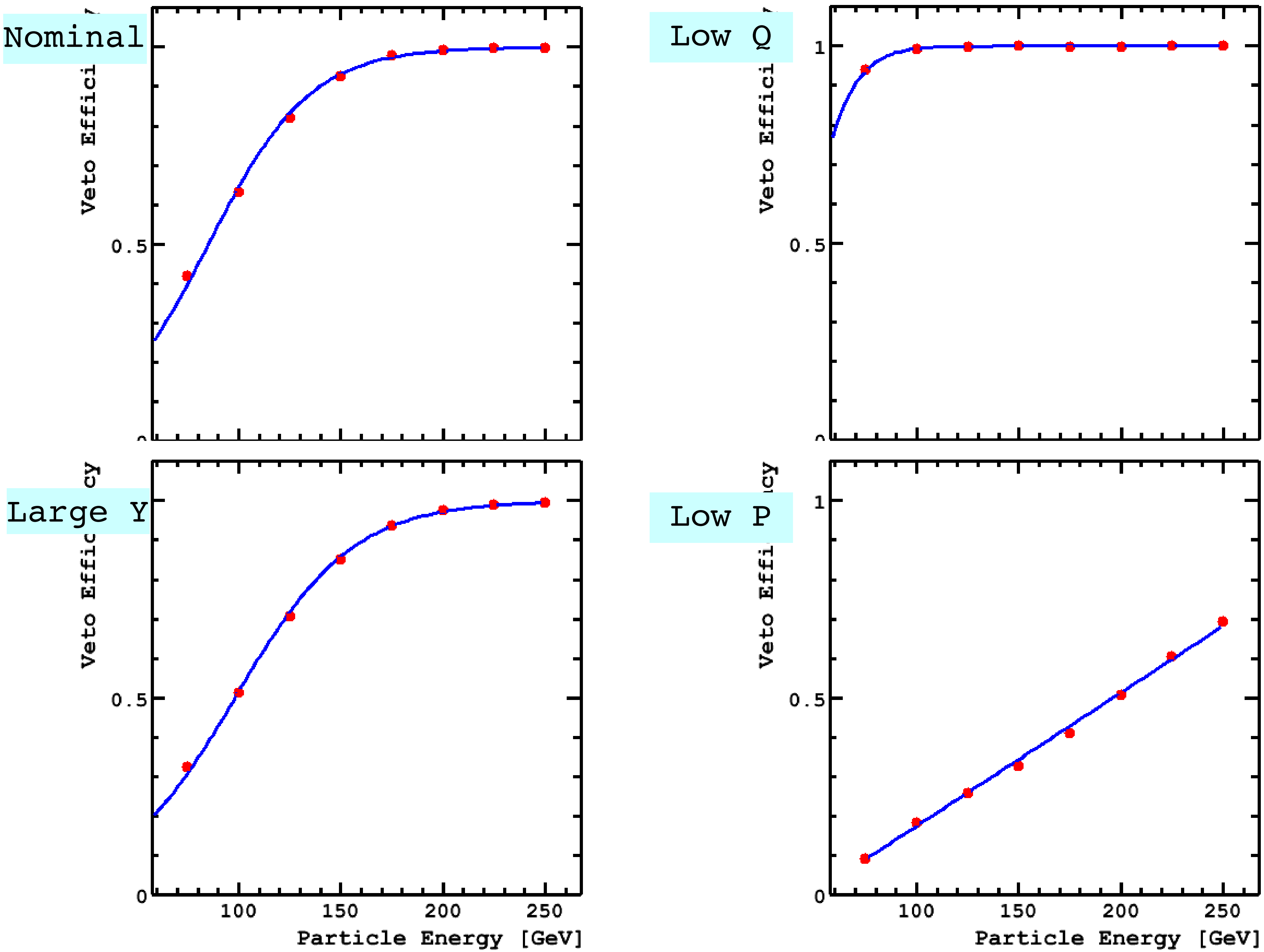
Strategy:

- calculate veto efficiency table for each design
  - full simulation chain to be done for each design
- include this MC into stau analysis

Analysis Details:

- algorithm is tuned with common energy threshold in a cell tower and fake rate (10%)

Results. Veto Efficiency in the 2^{nd} Ring



Results

L = 500fb^{-1}

Number of **SUSY events** ~ 20

Number of unvetoed **2-photon events:**

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

Results

L = $500fb^{-1}$

Number of **SUSY events** ~ 20

Number of unvetoed **2-photon events:**

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

Summary

- **Low Q** – feasible, reliable
- **Nominal, Large Y** – seems feasible, not relible
- **Low P, Large X angle** - unfeasible

Summary

- **Low Q** – feasible, reliable
- **Nominal, Large Y** – seems feasible, not relible
- **Low P, Large X angle** - unfeasible

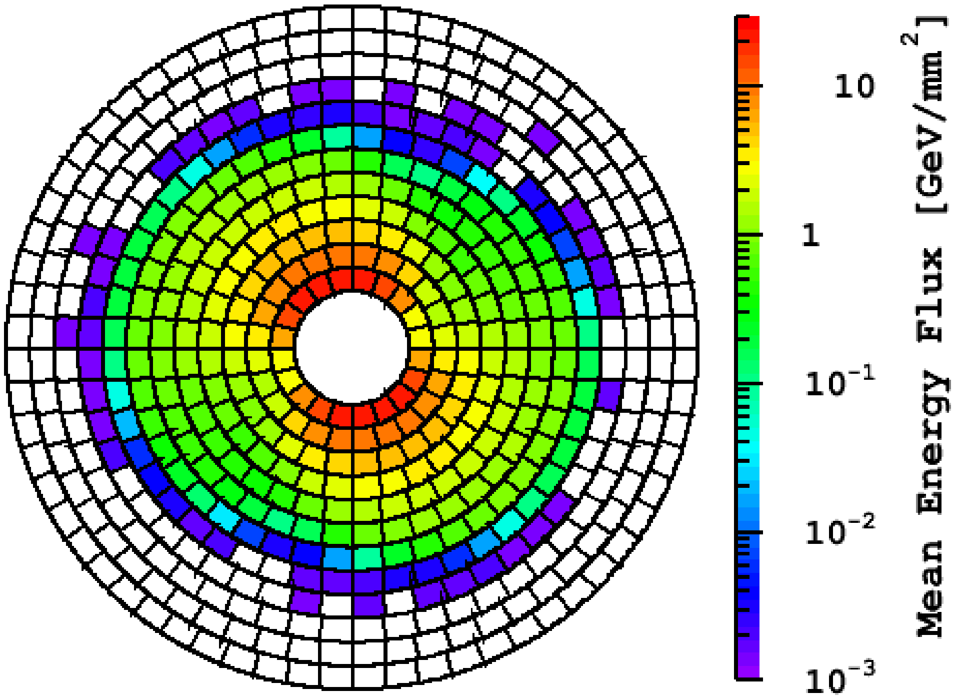
- **new veto efficiency functions** are obtained for different beam parameter configurations:
simple, easy to use, fast
-> can be easily incorporated into any analysis involving forward veto

Spare Slides

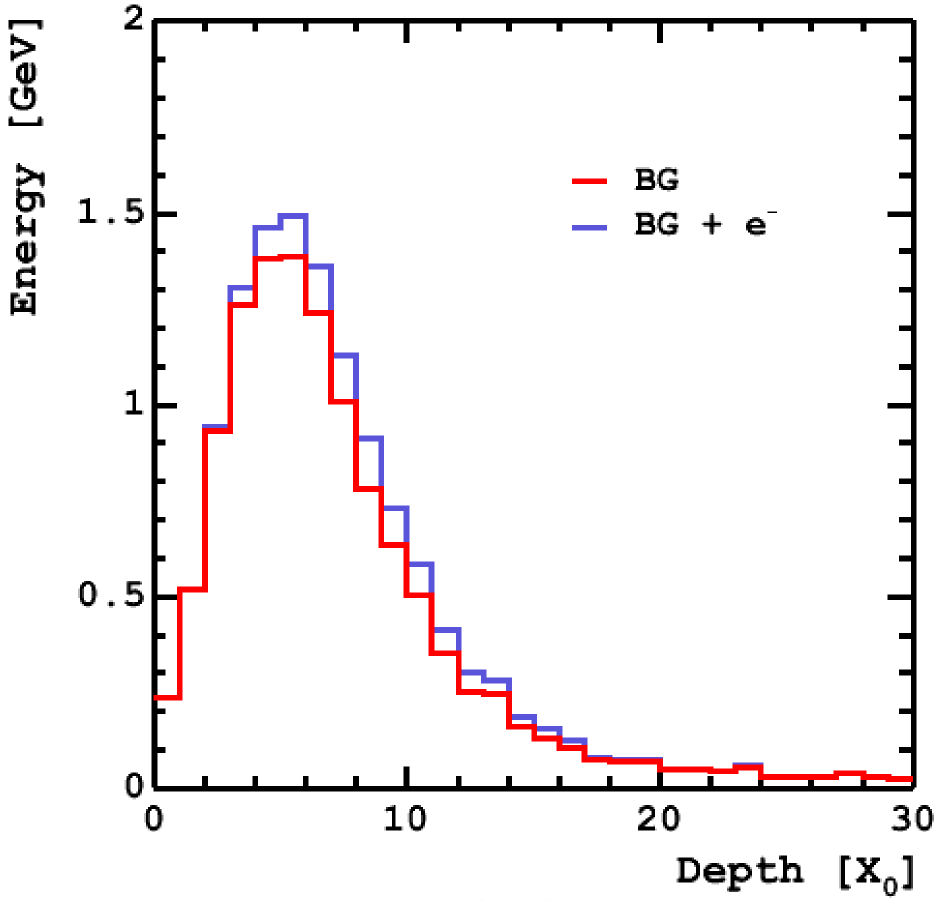
Beamstrahlung remnants. Pairs

BeamCal will be hit by beamstrahlung remnants carrying about 20 TeV of energy per bunch crossing.

the distribution of this energy per bunch crossing at $\sqrt{s}$ = 500GeV



100GeV electron on top of beamstrahlung



Severe background for electron recognition