Search for R-parity Violating Scalar Top Decays in Electron Positron Collisions at Center-of-Mass Energy 189 – 208 GeV

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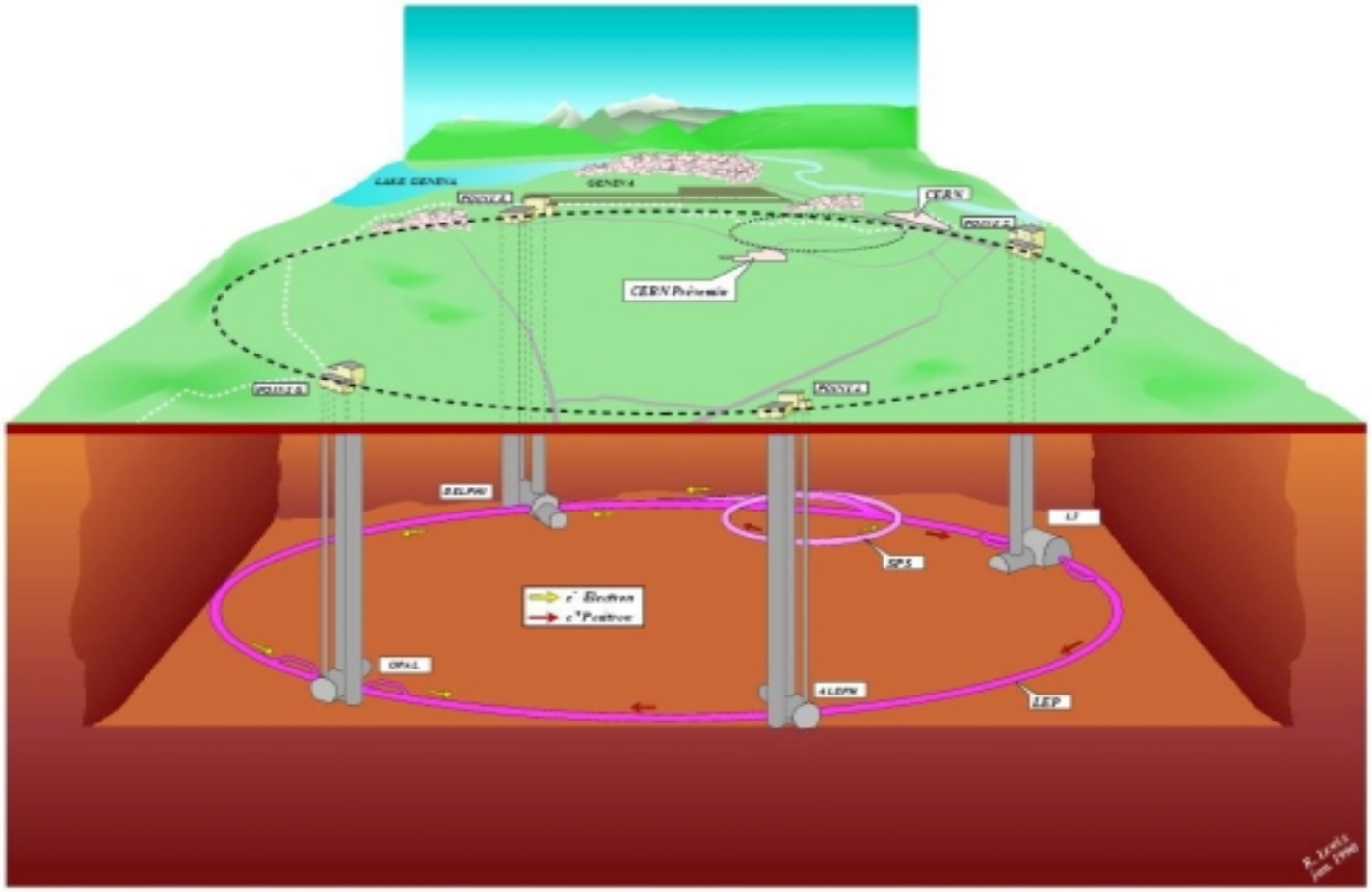
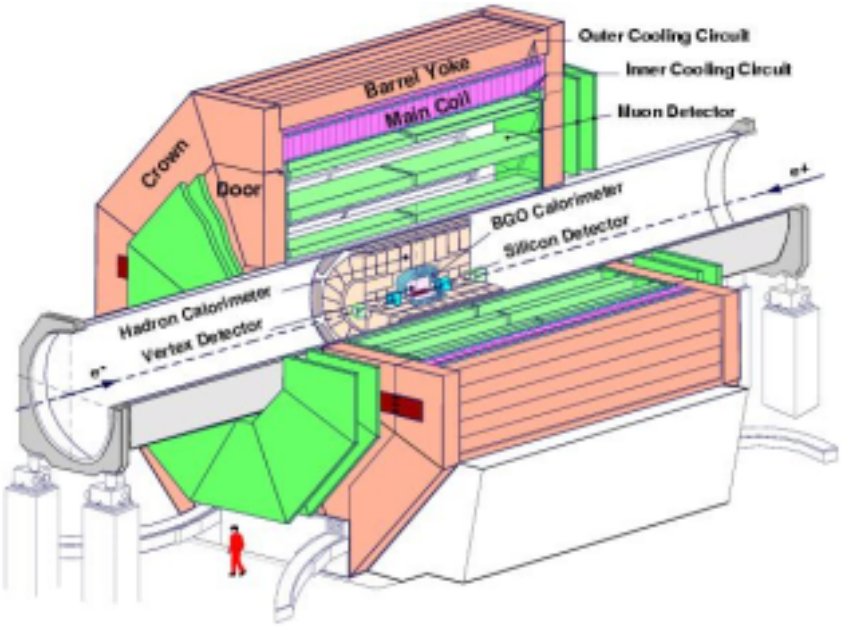
Outline

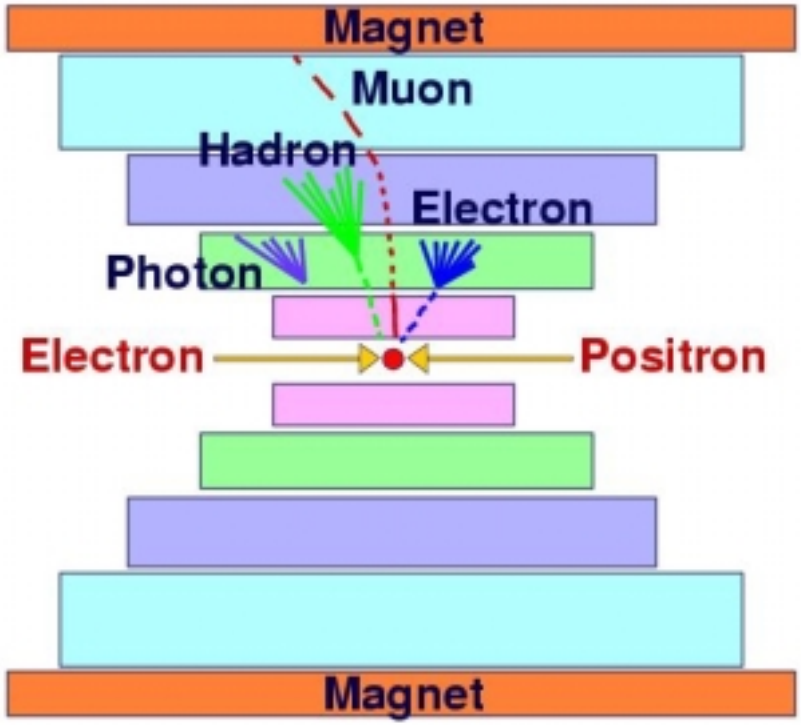
- Description of L3 detector
- R - parity
- Data and Monte Carlo samples
- Analysis
- Result
- Summary

LEP



L3 Detector


Outer Cooling Circuit
Inner Cooling Circuit
Barrel Yoke
Main Coil
Muon Detector
Crown
Door
BGO Calorimeter
Silicon Detector
Hadron Calorimeter
Vertex Detector
e+
e-


Magnet
Muon
Hadron
Electron
Photon
Electron
Positron
Magnet

R-parity

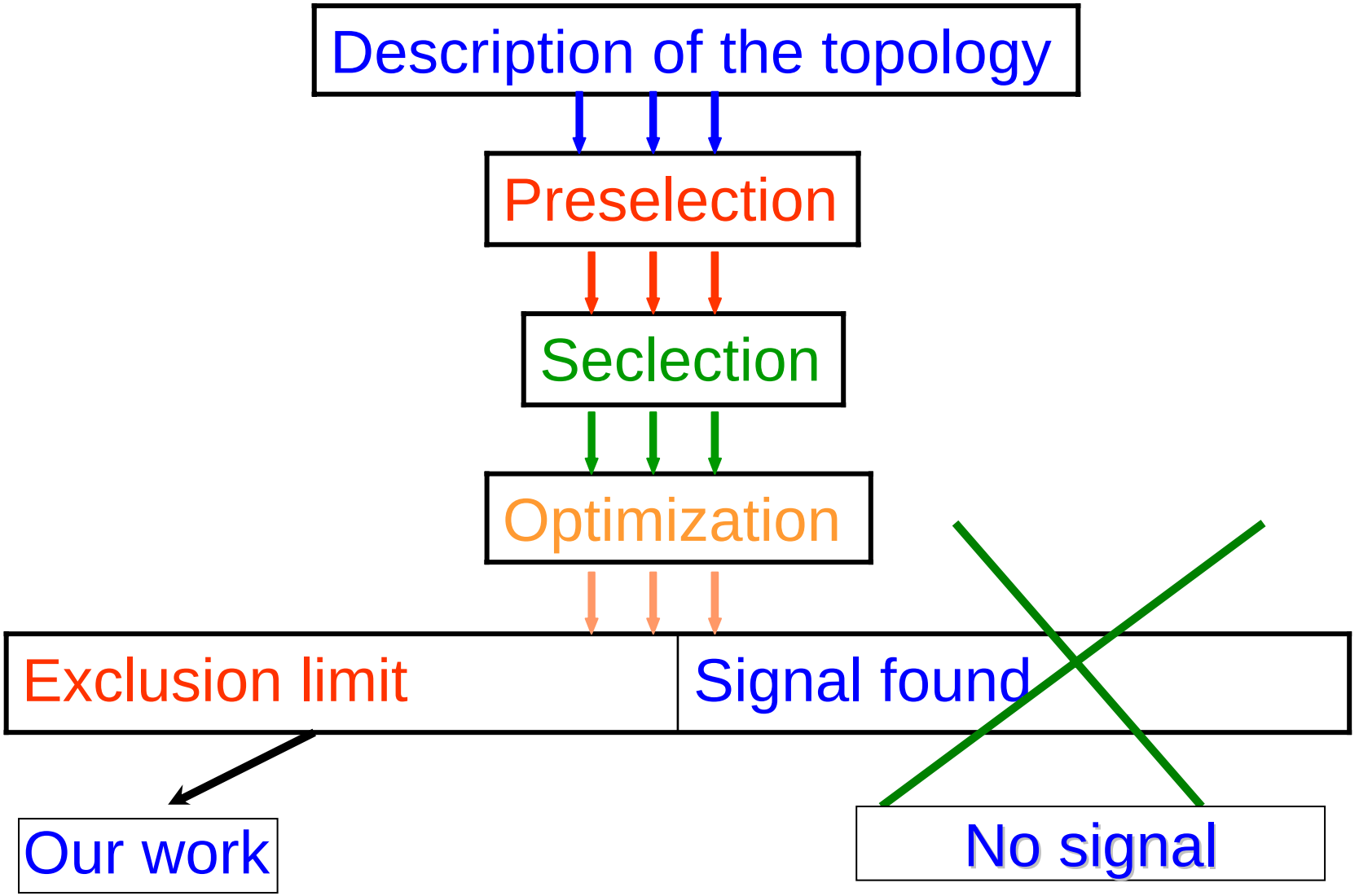
$$R = (-1)^{3B+L+2S}$$

R=+1 for Standard Model particles

R=-1 for SUSY particles

	How stable is the Lightest SUSY Particle (LSP)	Large missing energy?	Event can be fully reconstructed?	Sparticle production
RPC	Stable	Yes	Usually not	In pairs
RPV	Unstable	No	Yes	Single production allowed

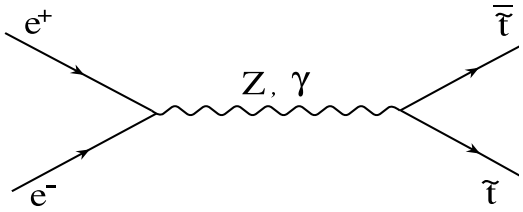
Analysis


Description of the topology
Preselection
Seclection
Optimization
Exclusion limit
Signal found
Our work
No signal

Reaction

Signal Reaction

$$e^+e^- \rightarrow \tilde{t}\,\bar{\tilde{t}} \rightarrow b\tau^-\bar{b}\tau^+$$



Max. cross section for $\cos\theta = 1$

Min. cross section for $\cos\theta = 0.57$ for LEP

no Z-exchange

Topology

- Signal: at least

  2 jets + n leptons

  n= 0, 1, 2

- Background: 2 fermion states

  2 photon states

  4 fermion states

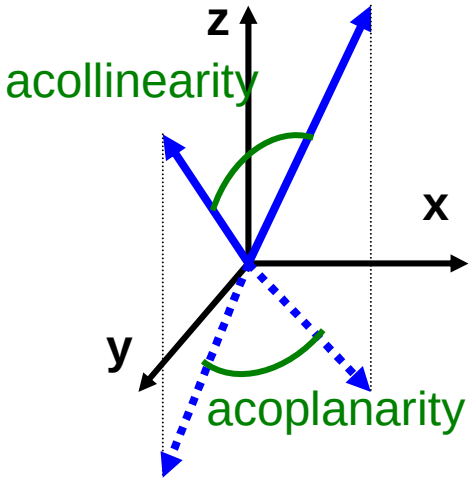
All generated by Monte Carlo

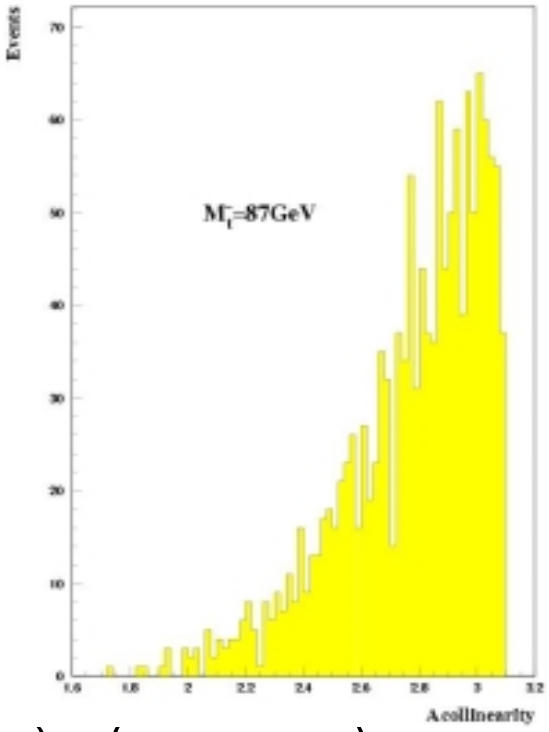
Data

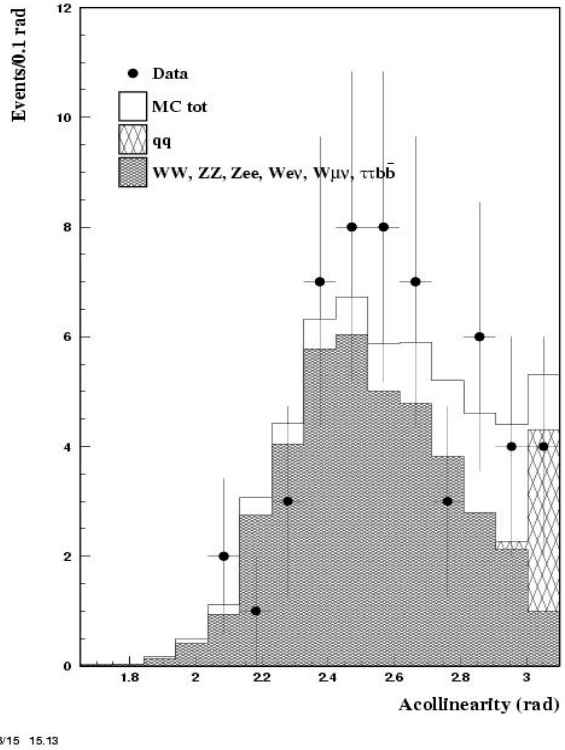
Energy (GeV)	Luminosity (pb^{-1})
189	176.4
192	29.52
196	81.35
200	77.57
202	38.98
204	75.69
206	130.5
208	8.713

Analysis

Preselection 189 GeV



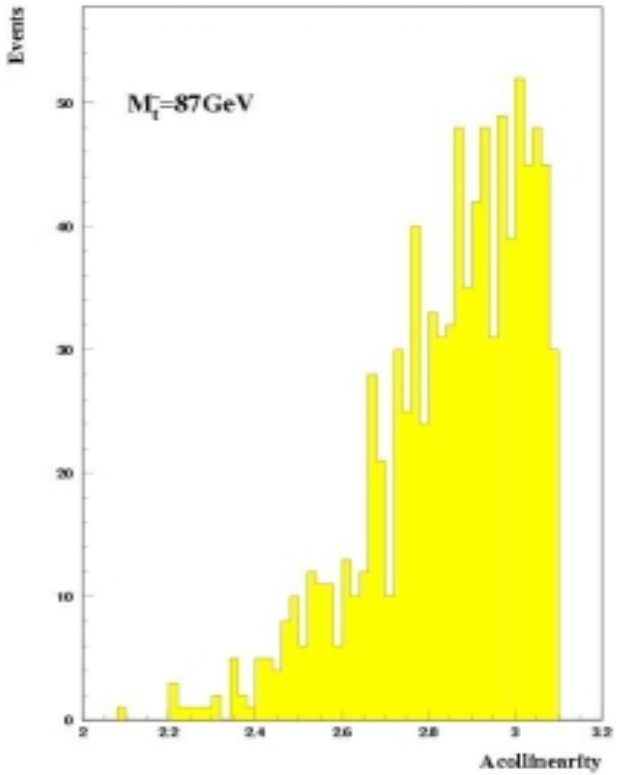


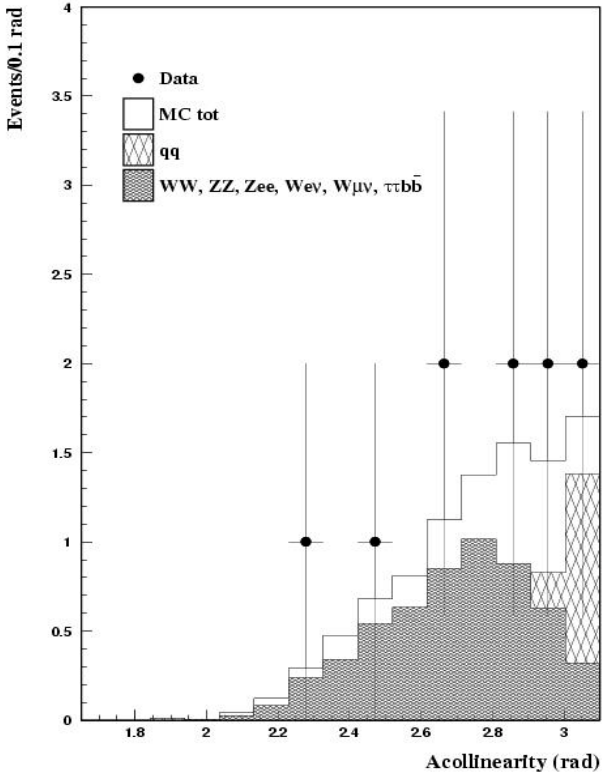


$$acop = \frac{\left(P_{x,1} * P_{x.2}\right) + \left(P_{y,1} * P_{y,2}\right)}{\left|\sqrt{P_{x,1}^2 + P_{y,1}^2} + \sqrt{P_{x,2}^2 + P_{y,2}^2}\right|}$$

Analysis

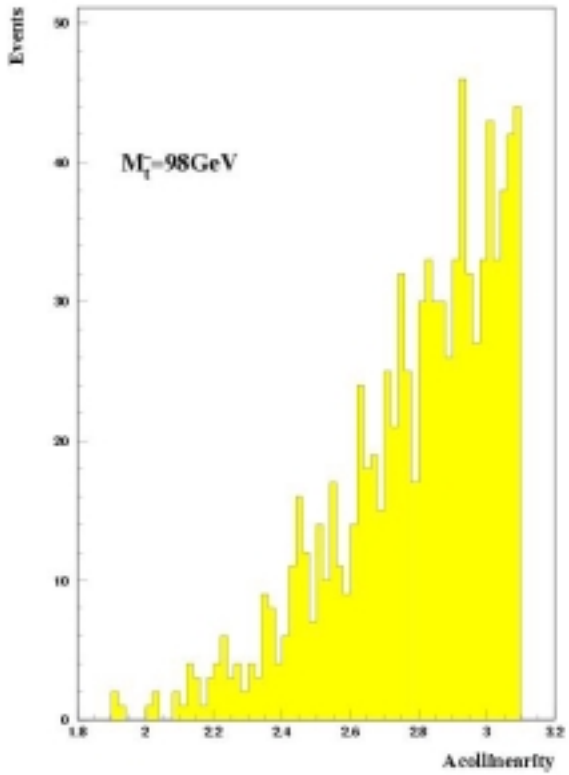
Selection 189 GeV

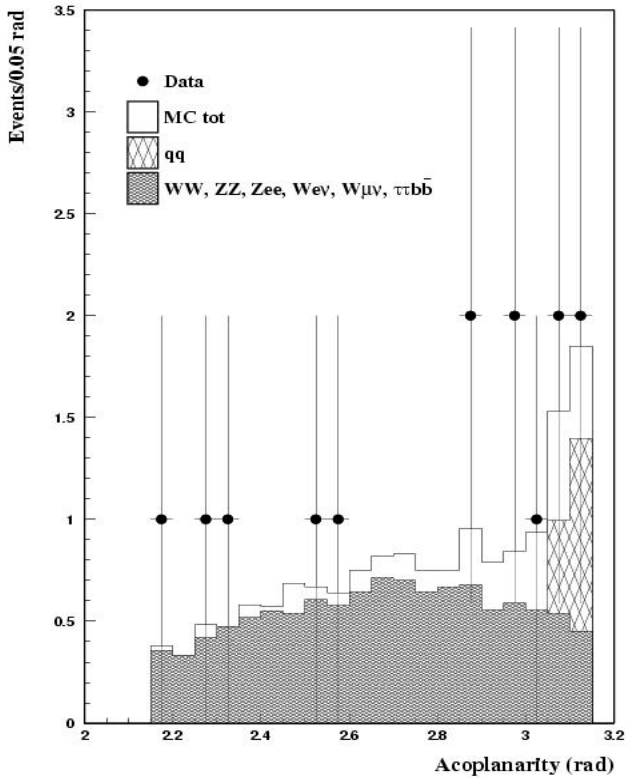




Analysis

Selection 206 GeV





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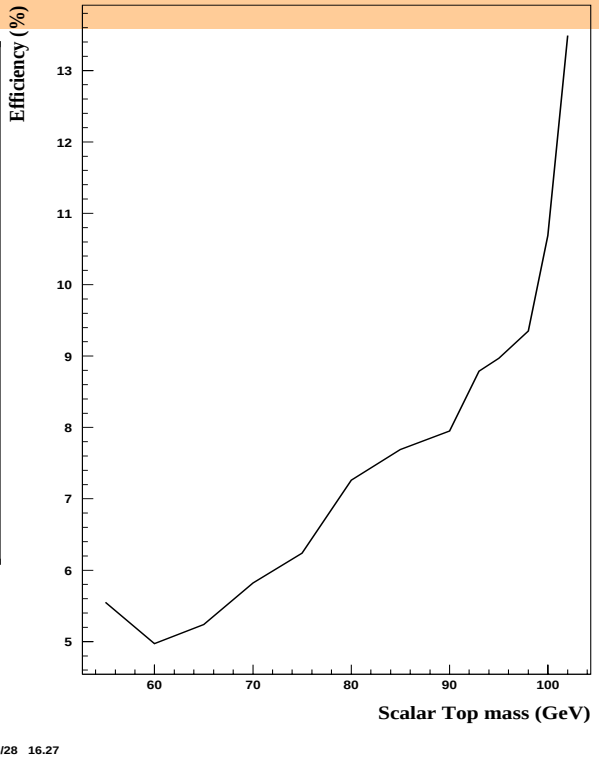
Optimization

Center-of-Mass Energy (GeV)	MC events	Data events	Luminosity (pb-1)
189	1.43	2	176.4
200	1.08	0	77.57
202	1.21	1	38.98
204	0.75	0	75.69
206	1.65	1	130.5



Used variables:

acol + acop or

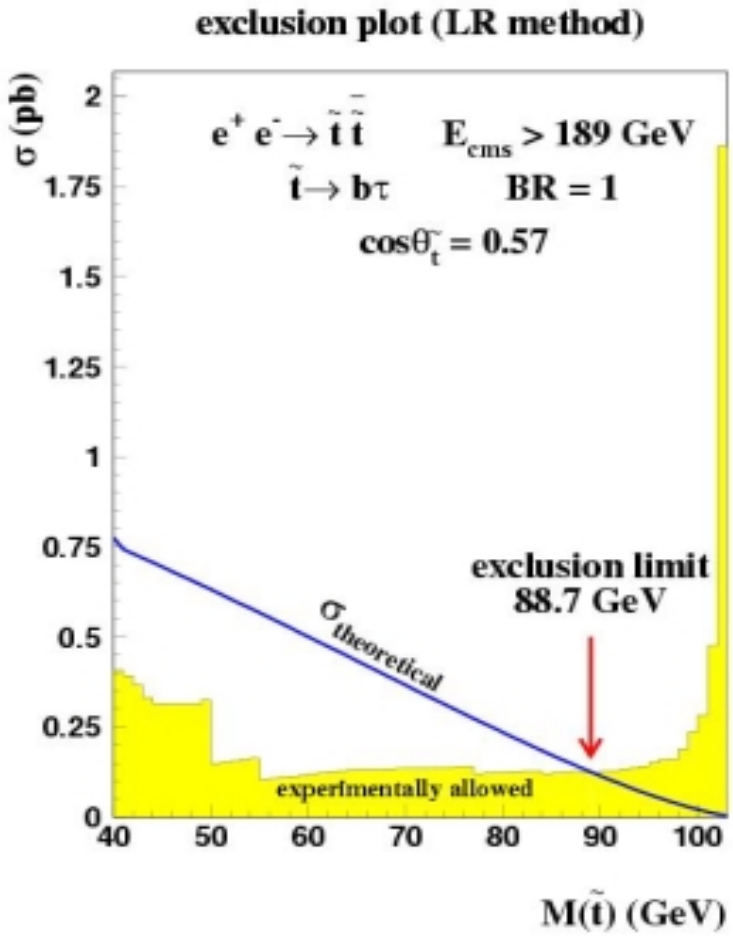
sjet (3D angle between jets)

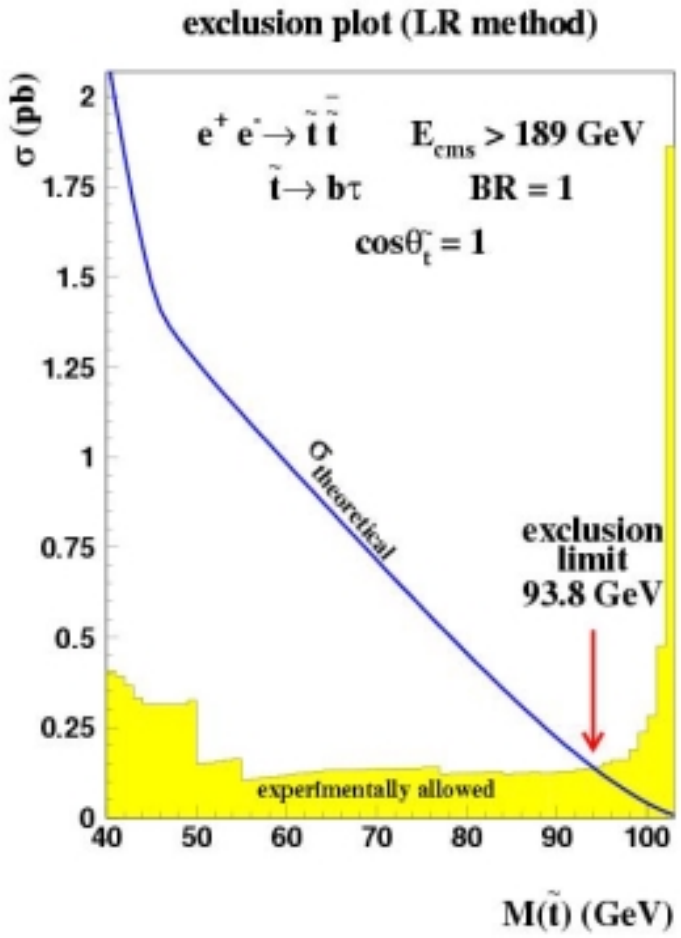
ucsdbt4 (b tag parameter)

evis (normalized vis. Energy)

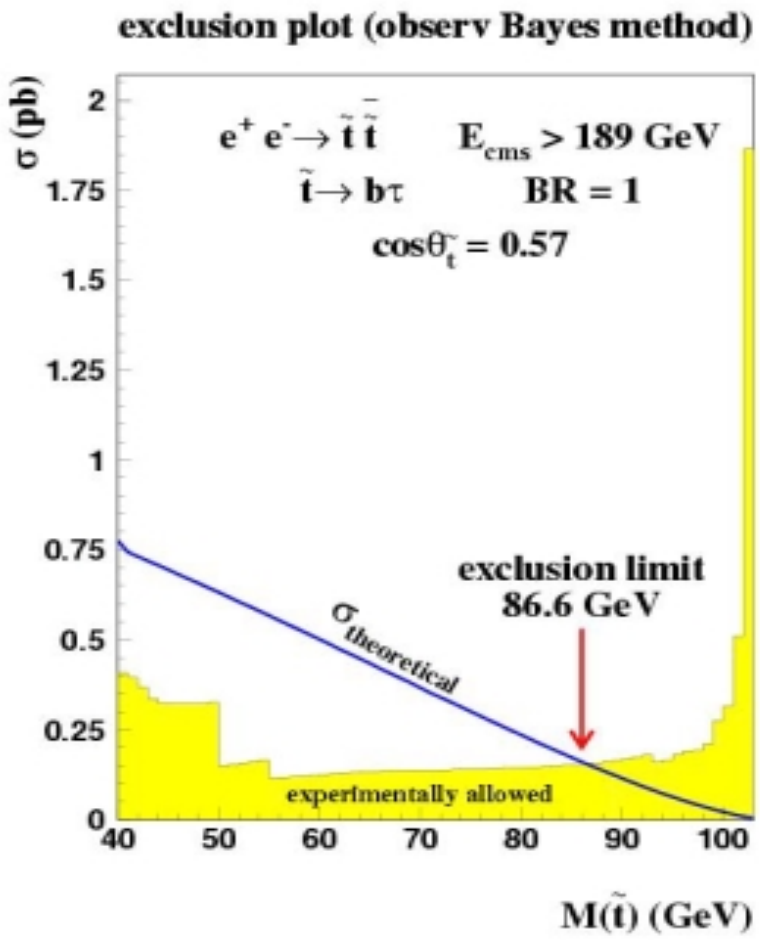
No signal seen at all energies

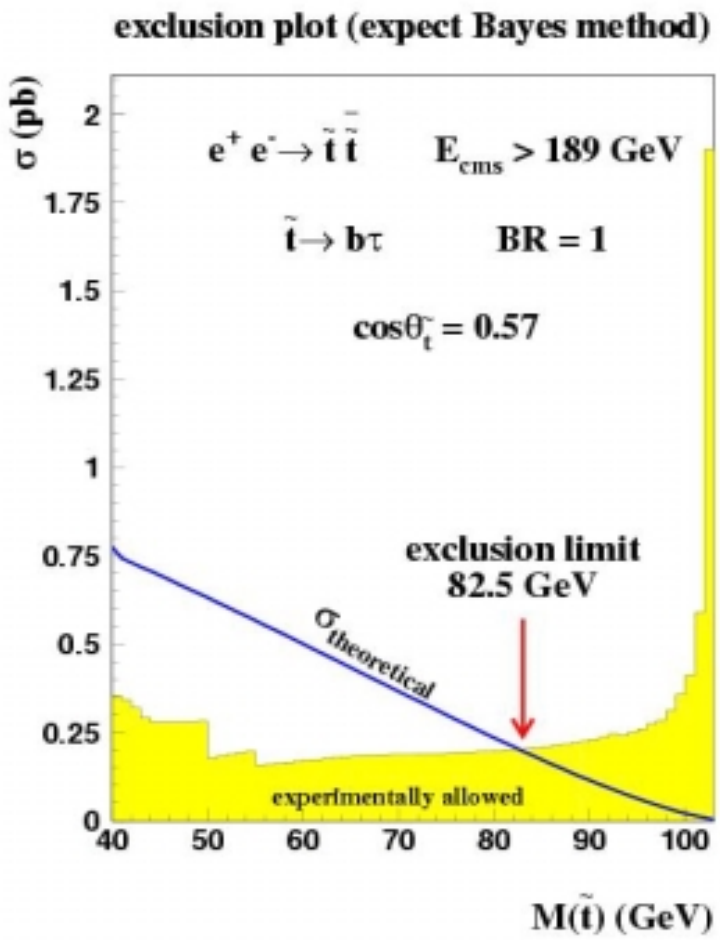
Exclusion


exclusion plot (LR method)
σ (pb)
$e^+ e^- \to \tilde{t}\,\bar{\tilde{t}}$ $E_{cms} > 189$ GeV
$\tilde{t} \to b\tau$ BR = 1
$\cos\theta_t^* = 0.57$
$\sigma_{theoretical}$
exclusion limit
88.7 GeV
experimentally allowed
M($\tilde{t}$) (GeV)

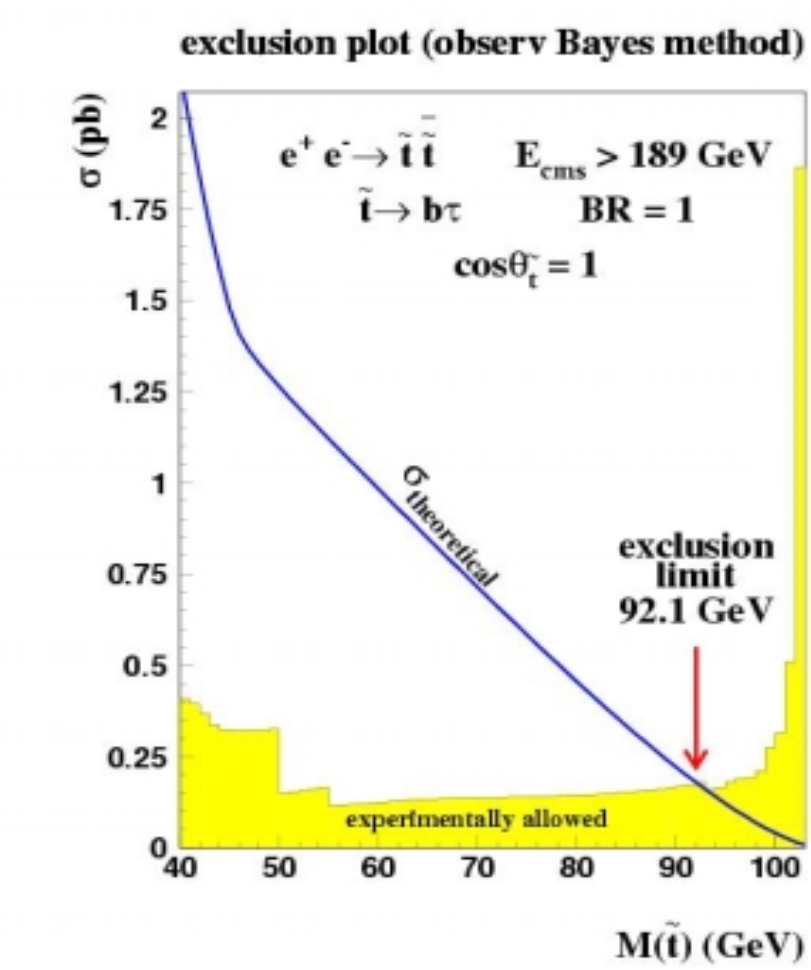

exclusion plot (LR method)
σ (pb)
$e^+ e^- \to \tilde{t}\,\bar{\tilde{t}}$ $E_{cms} > 189$ GeV
$\tilde{t} \to b\tau$ BR = 1
$\cos\theta_t^* = 1$
$\sigma_{theoretical}$
exclusion limit
93.8 GeV
experimentally allowed
M($\tilde{t}$) (GeV)

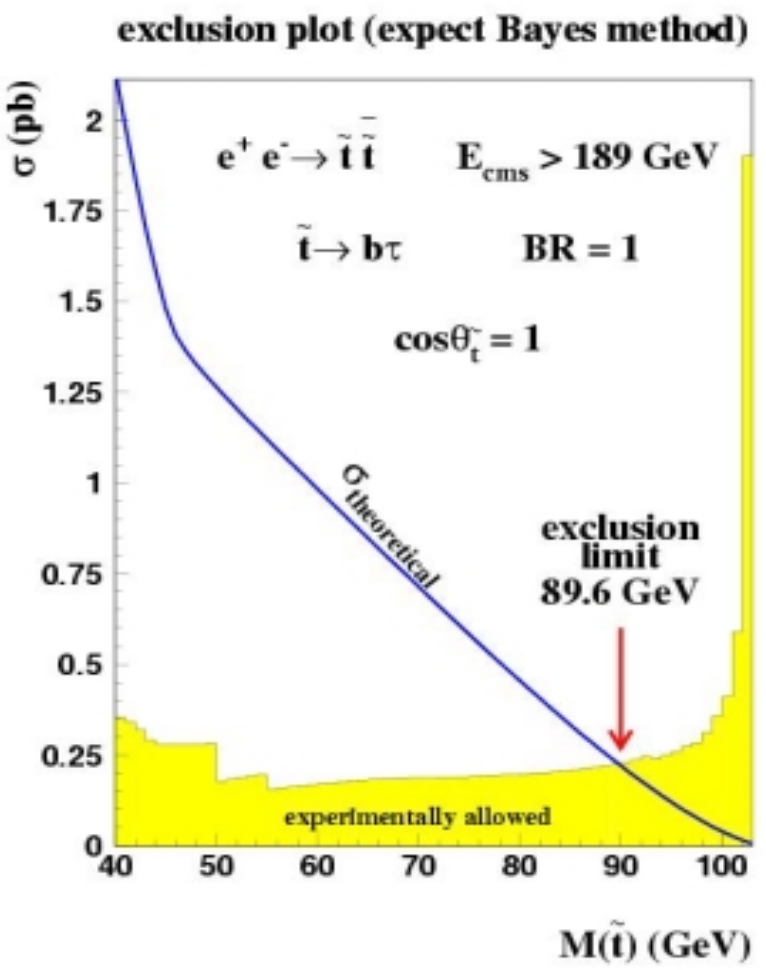
Exclusion


exclusion plot (observ Bayes method)
σ (pb)
$e^+ e^- \to \tilde{t}\bar{\tilde{t}}$
$E_{cms} > 189$ GeV
$\tilde{t} \to b\tau$
BR = 1
$\cos\theta_t^* = 0.57$
exclusion limit
86.6 GeV
$\sigma_{theoretical}$
experimentally allowed
M(t̃) (GeV)


exclusion plot (expect Bayes method)
σ (pb)
$e^+ e^- \to \tilde{t}\bar{\tilde{t}}$
$E_{cms} > 189$ GeV
$\tilde{t} \to b\tau$
BR = 1
$\cos\theta_t^* = 0.57$
exclusion limit
82.5 GeV
$\sigma_{theoretical}$
experimentally allowed
M(t̃) (GeV)

Exclusion


exclusion plot (observ Bayes method)
σ (pb)
$e^+ e^- \to \tilde{t}\bar{\tilde{t}}$
$E_{cms} > 189$ GeV
$\tilde{t} \to b\tau$
BR = 1
$\cos\theta^*_t = 1$
$\sigma_{theoretical}$
exclusion limit 92.1 GeV
experimentally allowed
$M(\tilde{t})$ (GeV)


exclusion plot (expect Bayes method)
σ (pb)
$e^+ e^- \to \tilde{t}\bar{\tilde{t}}$
$E_{cms} > 189$ GeV
$\tilde{t} \to b\tau$
BR = 1
$\cos\theta^*_t = 1$
$\sigma_{theoretical}$
exclusion limit 89.6 GeV
experimentally allowed
$M(\tilde{t})$ (GeV)

Results

Mass upper limits (GeV)		
Method	$\cos\theta = 0.57$	$\cos\ \theta\ = 1$
LR	88.7	93.8
Bayes Method expect	86.6	92.1
Bayes Method observ	82.5	89.6

Summary

- Search for $\tilde{t} \rightarrow b\tau$ decays at E > 189 GeV
- No signal was found
- $\tilde{t} \rightarrow b\tau$ is excluded for max. mixing up to mass of 93.8 GeV and for min mixing up to 82.5 GeV