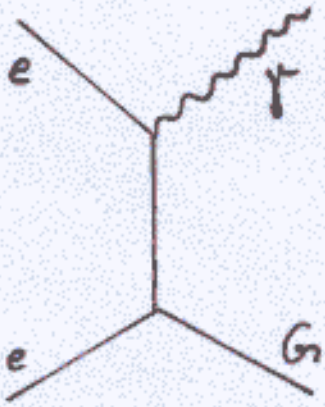
Anja Vest

Direct signature of extra dimensions

$$e^+e^- \rightarrow \gamma G \rightarrow \gamma \not{E}_T$$



cross - section :

$$\frac{d\sigma}{dx_\gamma \, d\cos\theta} = \frac{\alpha}{64} S_{\delta-1} \left(\frac{\sqrt{s}}{M_D}\right)^{\delta+2} \frac{1}{s} f(x_\gamma, \cos\theta)$$

(Giudice et al.)

$$x_\gamma = \frac{2E_\gamma}{\sqrt{s}}$$

θ : angle between the photon and the beam direction

M_D : fundamental mass scale $\sim$ TeV

δ : number of extra - dimensions (2, 3, 4 ...)

M_D can be seen as the effective Planck mass of the higher dimensional theory.

$$\frac{1}{G_N} = 8\pi R^{\delta} M_D^{2+\delta}$$

R: radius of the compactified space assumed to be a torus

($R \sim 10^{\frac{32}{\delta} - 19}$ meters)

In the higher $(3+\delta)$-dim. space the graviton propagates as a massless, non interacting spin-2 particle

Projected onto the 3-dim. space, it appears as a tower of massive kaluza-klein excitations.

mass-spectrum:

$$m_G \sim \frac{i}{R}$$

i: number of modes

Generator:

$e^+e^- \rightarrow \gamma G$ + ISR (A. Vest)
+ beamstrahlung (CIRCE)

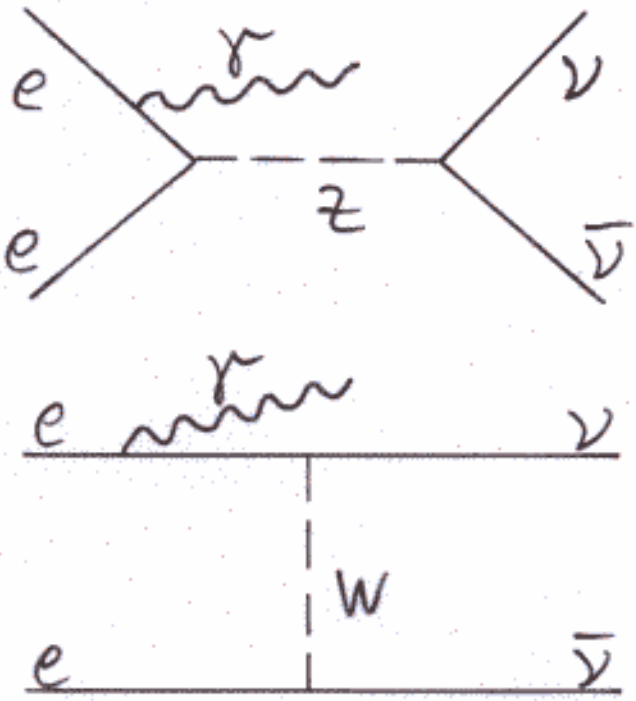
detector-simulation: SIMDET

Parameters:

$\sqrt{s}$ = 500 GeV
δ = 2, 3, 4
$\mathcal{L}$ = 100 fb^{-1} (500 fb^{-1})

background:

$e^+e^- \rightarrow \nu\bar{\nu}\gamma$



Cinematic cuts :

$E_T > 10$ GeV

$E_T < 175$ GeV

(to eliminate the peak contribution from $e^+e^- \to \gamma Z$)

$1^\circ < \theta < 179^\circ$

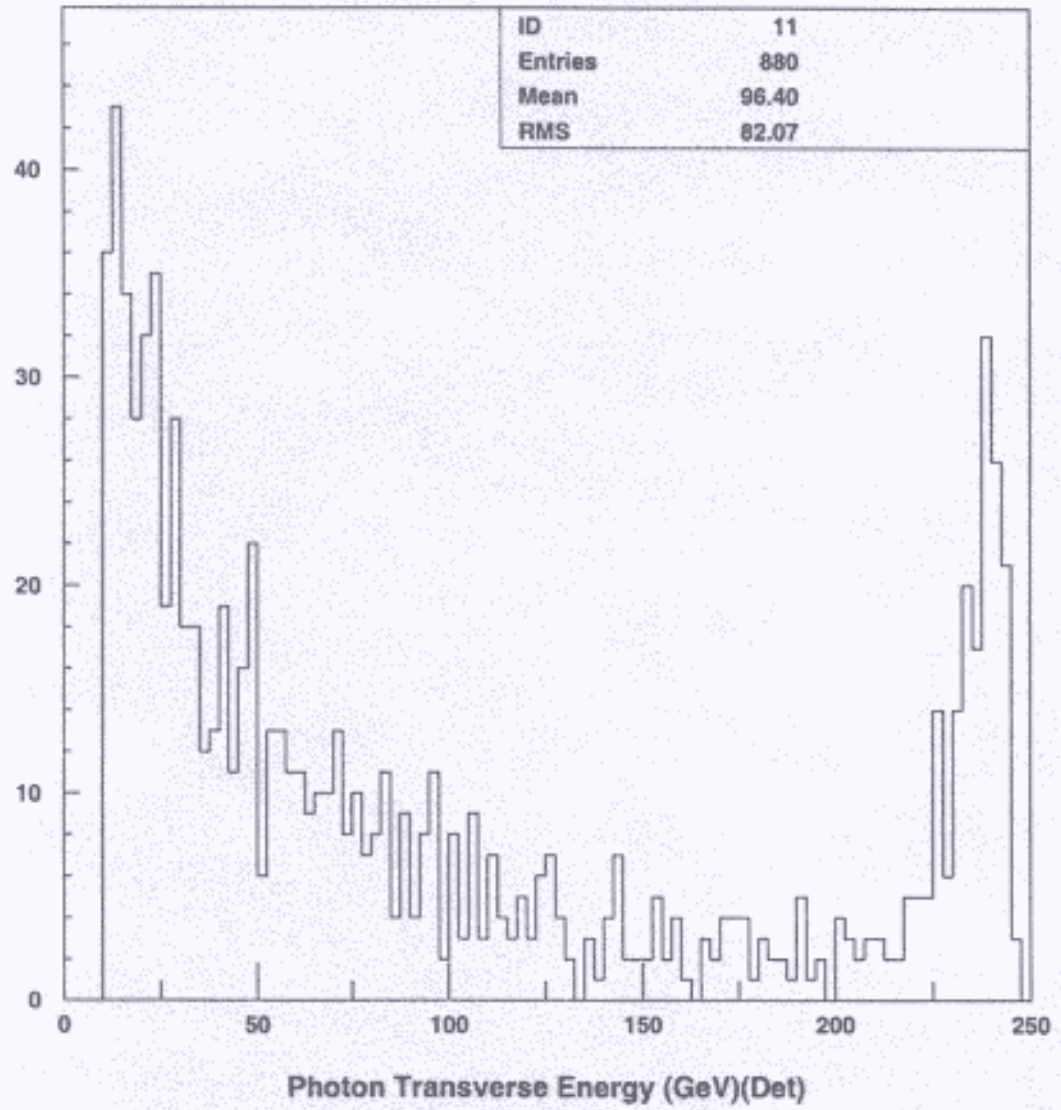
if $\theta < 5^\circ$ or $\theta > 175^\circ$,
then $E_T > 10$ GeV

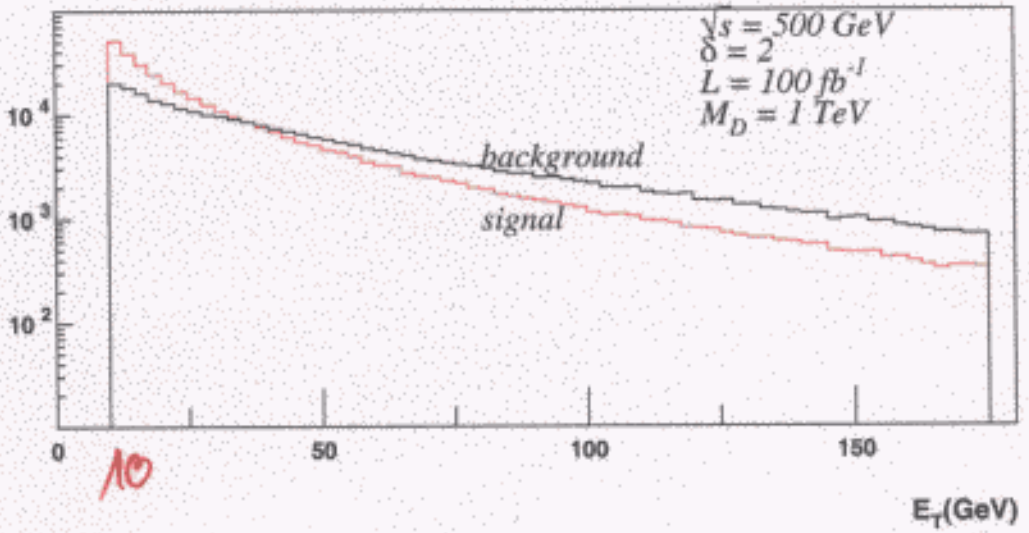
analysis :

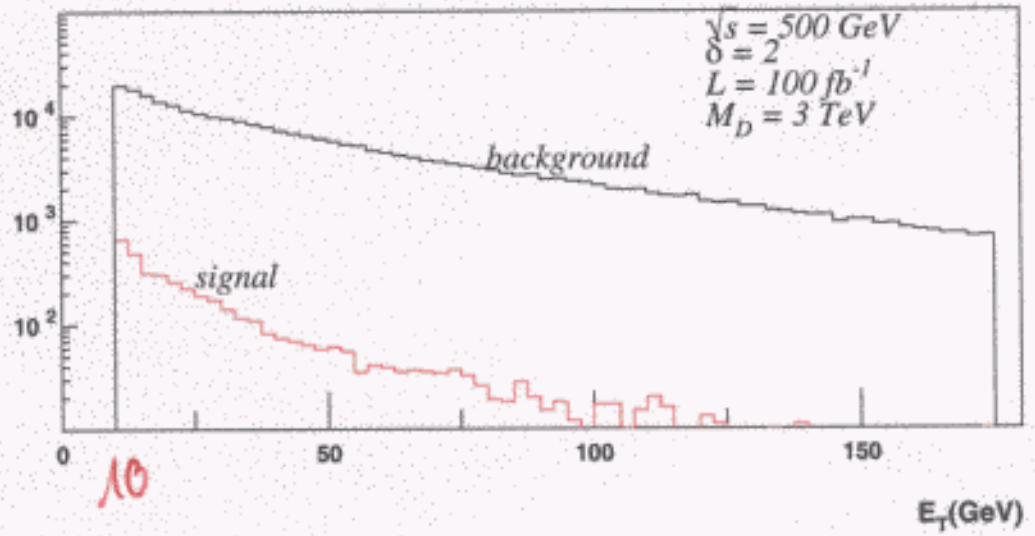
$$\chi^2 = \sum_{\text{bins}} \frac{(N_{S+B} - f_u N_B)^2}{f_u^2 N_B} + \left(\frac{1-f_u}{\Delta f_u}\right)^2$$

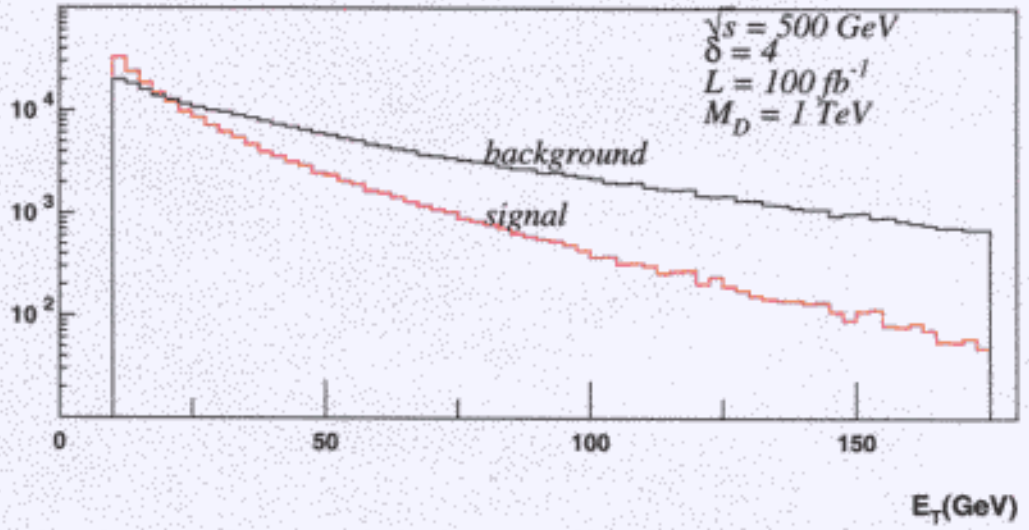
$\Delta f_u = \begin{cases} 0{,}01 \\ 0{,}001 \end{cases} \to \chi^2_{min}$ at $f_u \simeq 1$

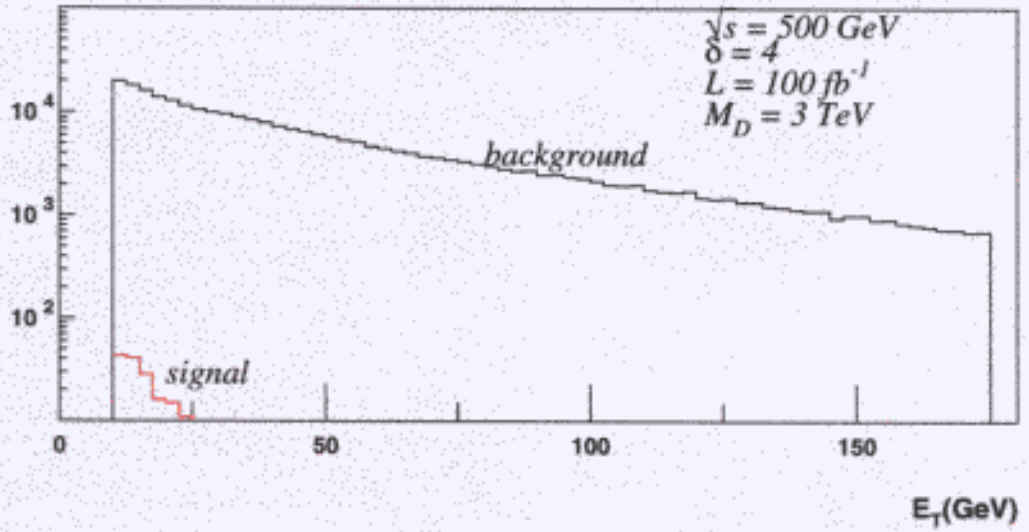
$e^+e^- \rightarrow \nu\bar{\nu}\gamma$

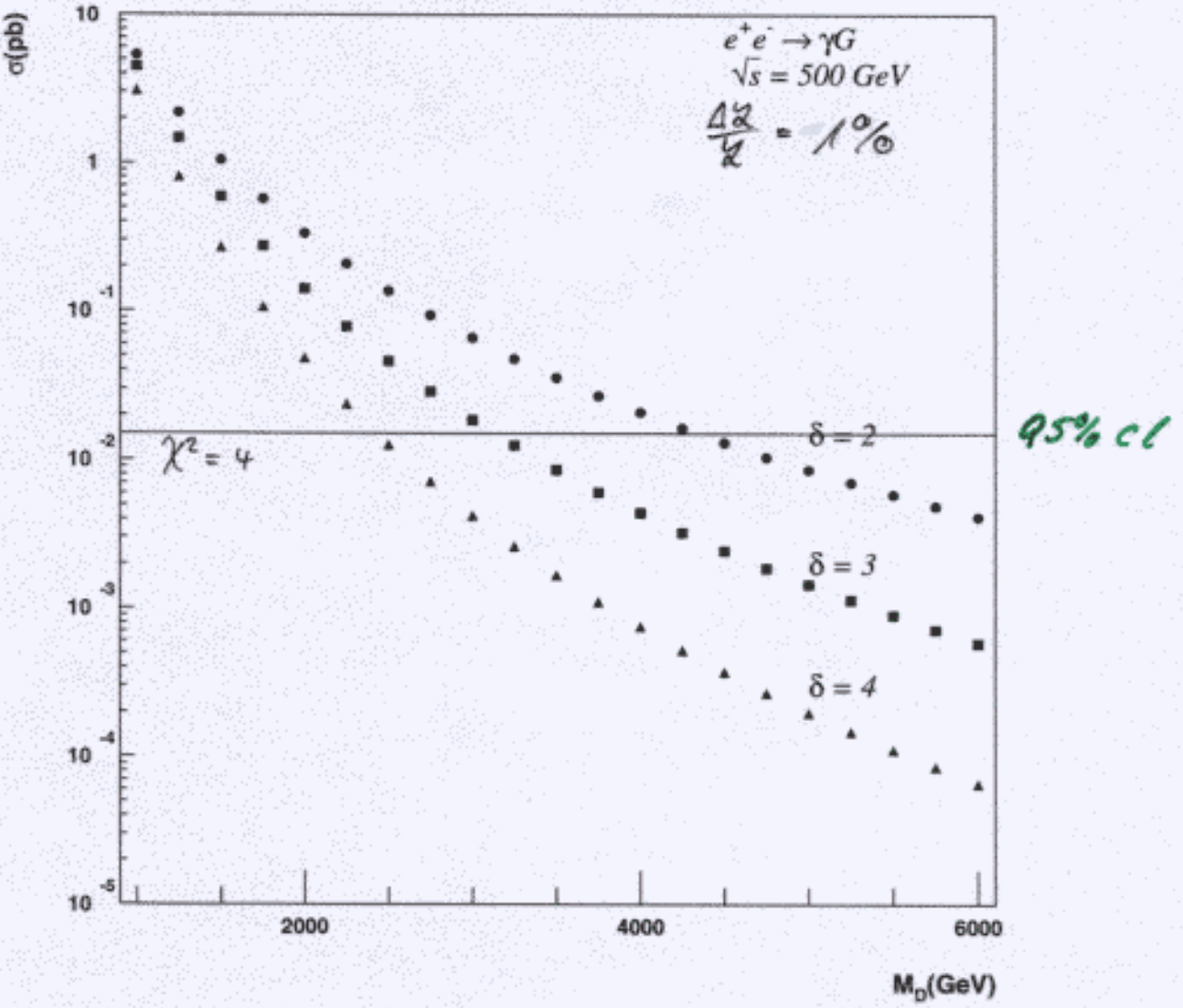



√s = 500 GeV
δ = 2
L = 100 fb-1
MD = 1 TeV
background
signal
10 4
10 3
10 2
0
50
100
150
ET(GeV)


√s = 500 GeV
δ = 2
L = 100 fb-1
MD = 3 TeV
background
signal
10 4
10 3
10 2
0
50
100
150
ET(GeV)


√s = 500 GeV
δ = 4
L = 100 fb-1
MD = 1 TeV
background
signal
10 4
10 3
10 2
0
50
100
150
ET(GeV)


√s = 500 GeV
δ = 4
L = 100 fb-1
MD = 3 TeV
background
signal
10 4
10 3
10 2
0
50
100
150
ET(GeV)


σ(pb)
10
1
10^-1
10^-2
10^-3
10^-4
10^-5
e+e- → γG
√s = 500 GeV
Δα/α = 1%
χ² = 4
δ = 2
δ = 3
δ = 4
2000
4000
6000
M_D(GeV)

95% cl

results:

at $\sqrt{s}$ = 500 GeV

$\mathcal{L}$ = 100 fb^{-1}

$\frac{\Delta\mathcal{L}}{\mathcal{L}}$ = 1%, $\chi^2 = 4$ (C.L. = 95%)

$\rightarrow \sigma$ = 15 fb

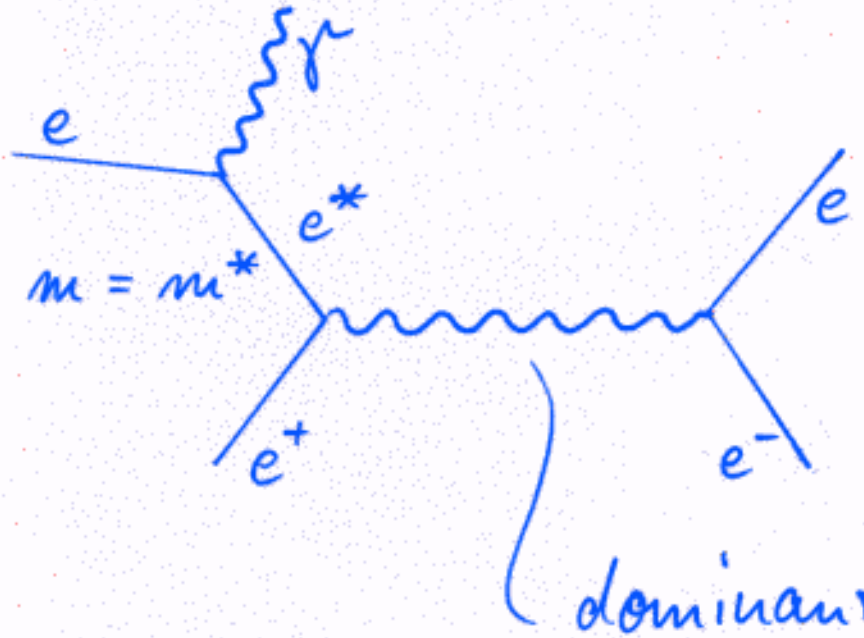
δ	M_D (TeV)
2	4,3
3	3,1
4	2,2

prospects:

- higher $\mathcal{L}$ (1000 fb^{-1}) + higher $\sqrt{s}$ (800 GeV)
- Polarisation.

Excited electrons

$$e^+e^- \to e e^* \to e e \gamma$$



dominant $q^2 = 0$

Cross - section:

$$\frac{d\sigma}{d\hat{t}} = -\frac{\pi\alpha^2}{\Lambda^4}\,\frac{\hat{u}}{\hat{s}}\left[\frac{\hat{s}^2}{(\hat{s}-m^{*2})^2 + m^{*2}\Gamma_{e^*}^2} + \frac{\hat{u}^2}{(\hat{u}-m^{*2})^2}\right.$$

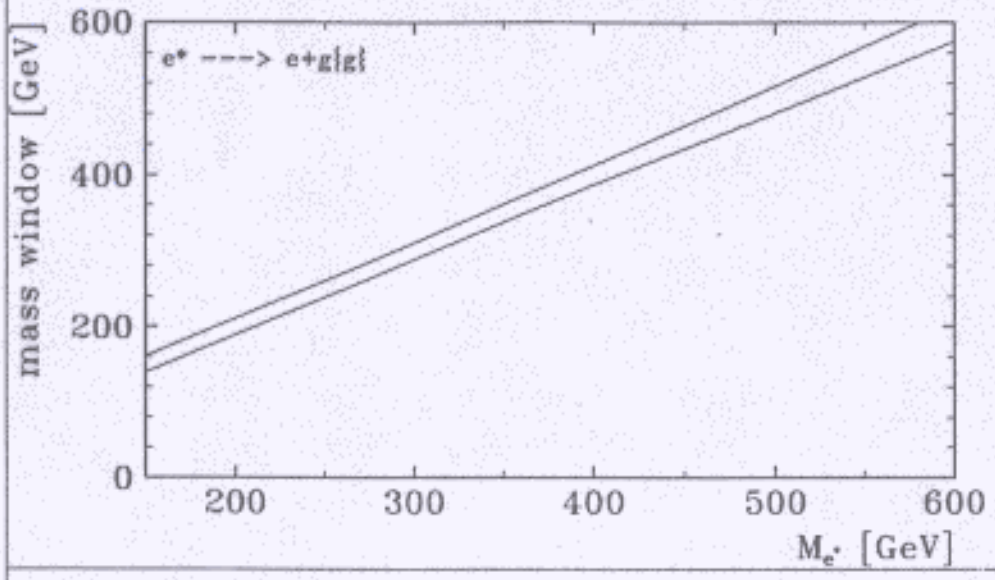
$$\Gamma_{e^*} = \frac{\alpha}{4}\,\frac{m^{*3}}{\Lambda^2}$$

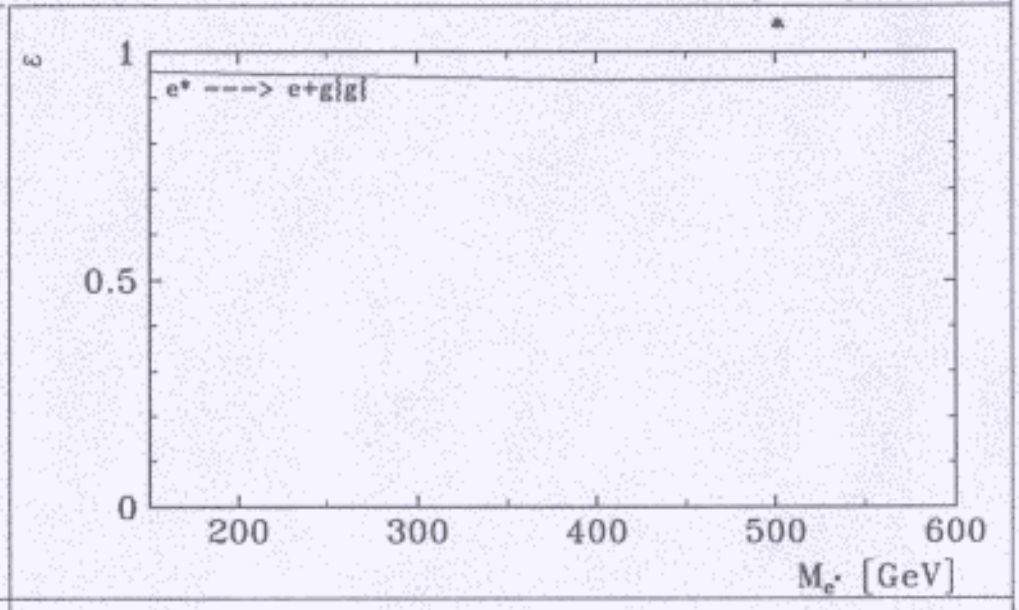
background:

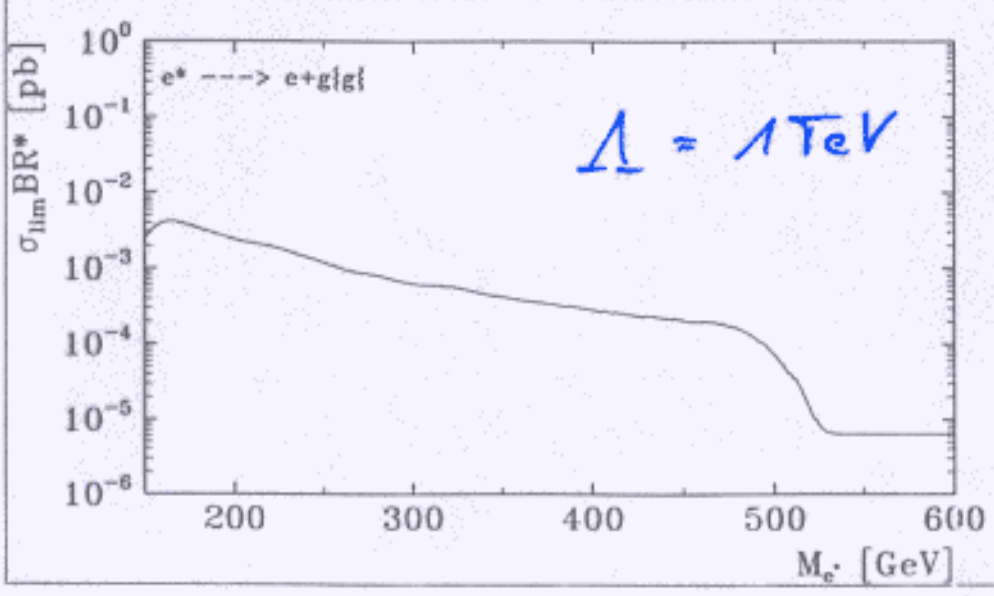
$$e^+e^- \to e^+e^-\gamma$$

Look – e* – ANALYSIS

Date 16/08/2000







Λ = 1 TeV