Calorimeter Studies

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September 19, 2006

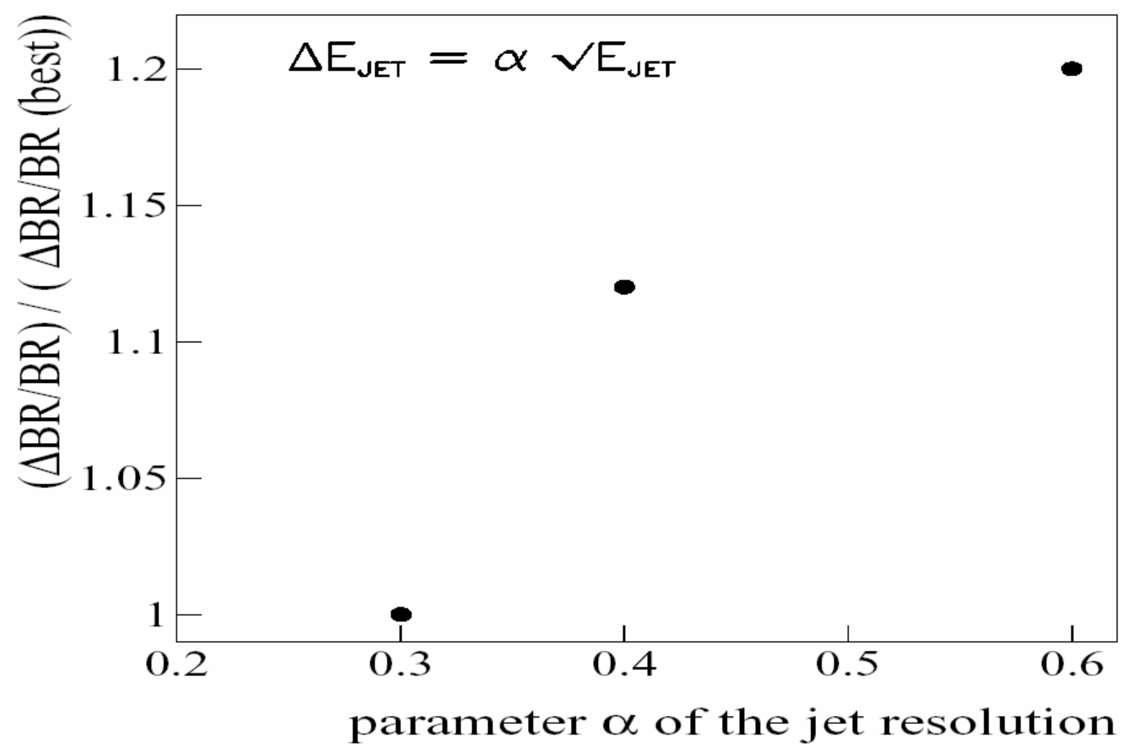
Error on $BR(H \to WW^*)$ from measurement of

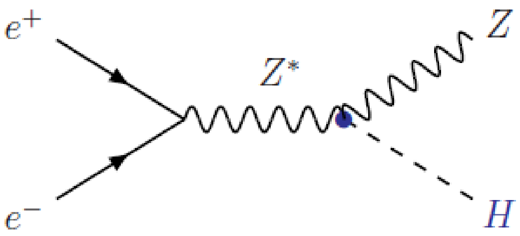
$e^+e^- \to ZH \to q\bar{q}WW^* \to q\bar{q}q\bar{q}l\nu$ at $\sqrt{s} = 360$ GeV, L=500 fb^{-1}

J.-C. Brient, LC-PHSM-2004-001

$\Delta E/\sqrt{E} = 60\% \to 30\%$

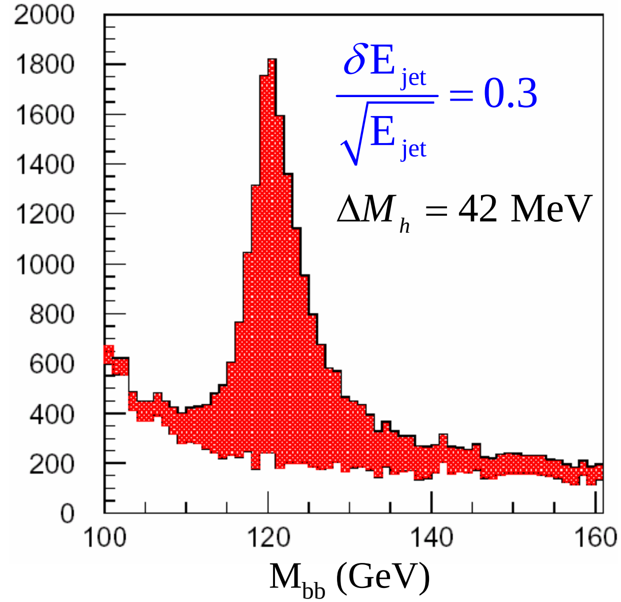
equiv to $1.4\times$ Lumi

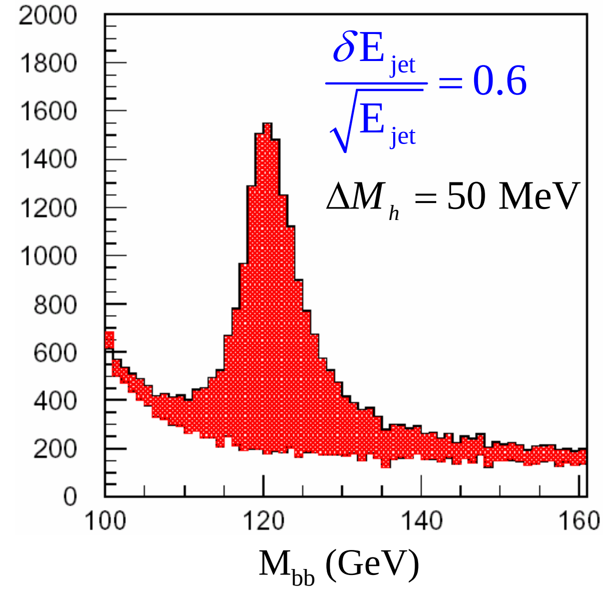


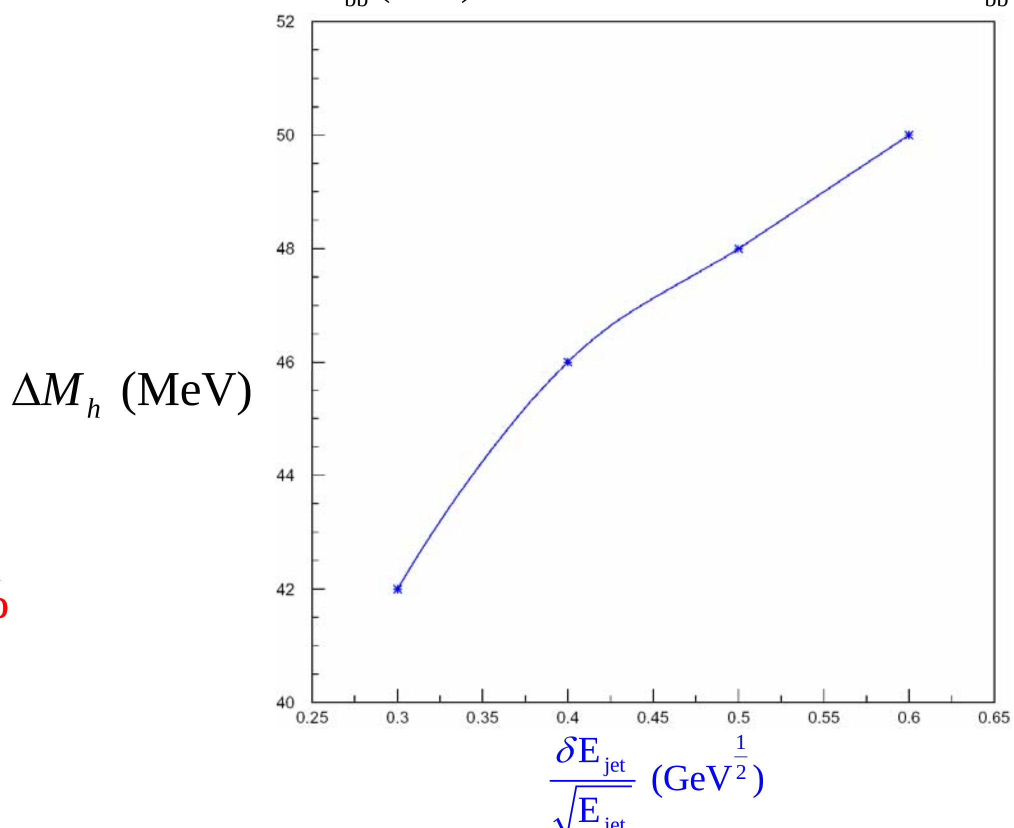


$$e^+e^- \to ZH$$
$$\to qqb\bar{b}$$

$$\sqrt{s} = 350\ GeV$$
$$L = 500\ fb^{-1}$$







$\Delta E/\sqrt{E} = 60\% \to 30\%$

equiv to $1.4\times$ Lumi

$$e^+e^- \to \tilde{\chi}_1^+ \tilde{\chi}_1^- \to \tilde{\chi}_1^0 \tilde{\chi}_1^0 W^+ W^- \to \tilde{\chi}_1^0 \tilde{\chi}_1^0 qqqq$$

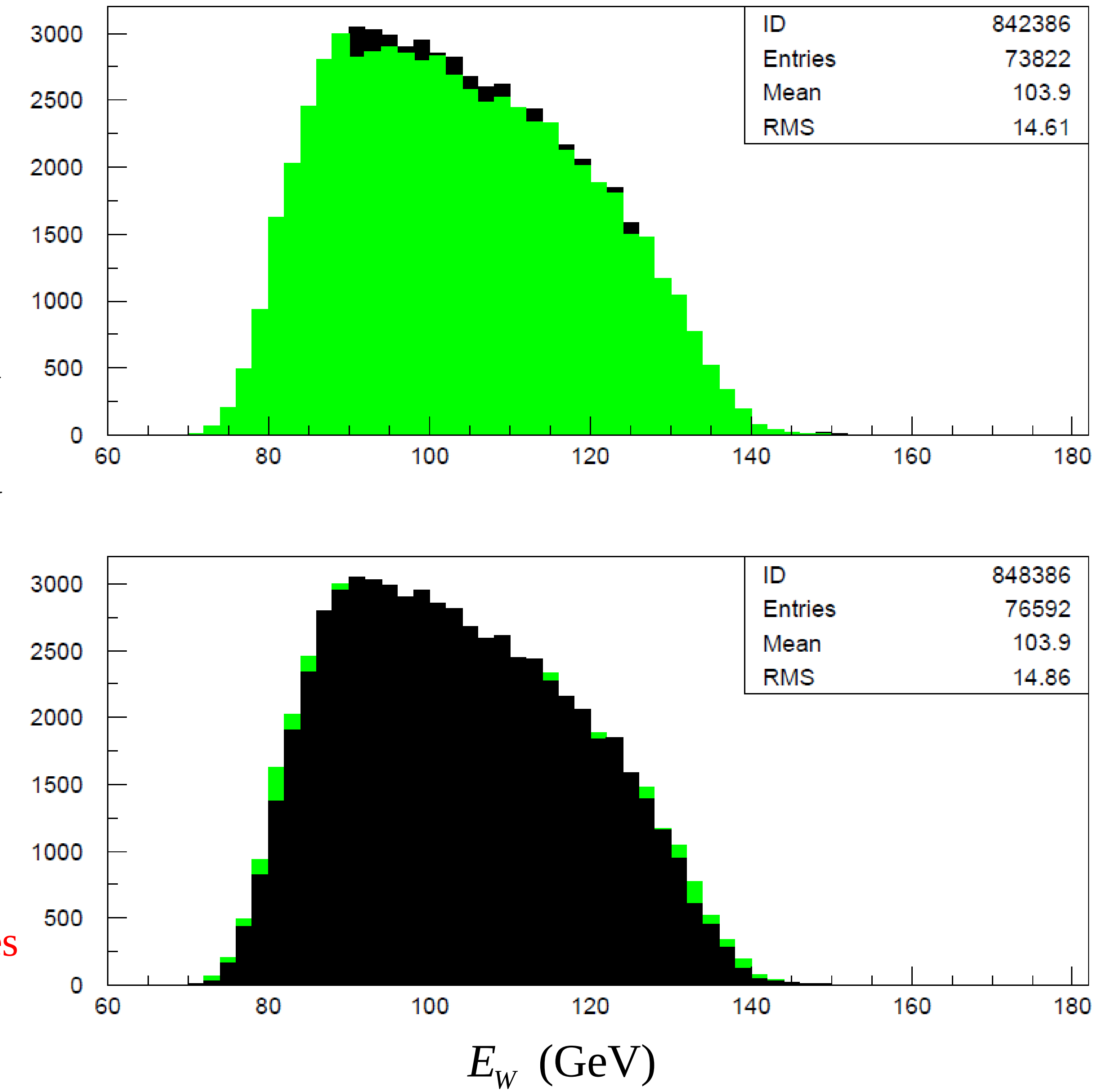
$M_{\tilde{\chi}_1^0} = 106.2$ GeV

$\sqrt{s} = 500$ GeV

$M_{\tilde{\chi}_1^+} = 198.4$ GeV (black)

$M_{\tilde{\chi}_1^+} = 200.4$ GeV (green)

Due to W mass the energy spectrum doesn't shift to left or right as in slepton case but instead get wider or narrower $\Rightarrow$ all energies contribute to mass meas.



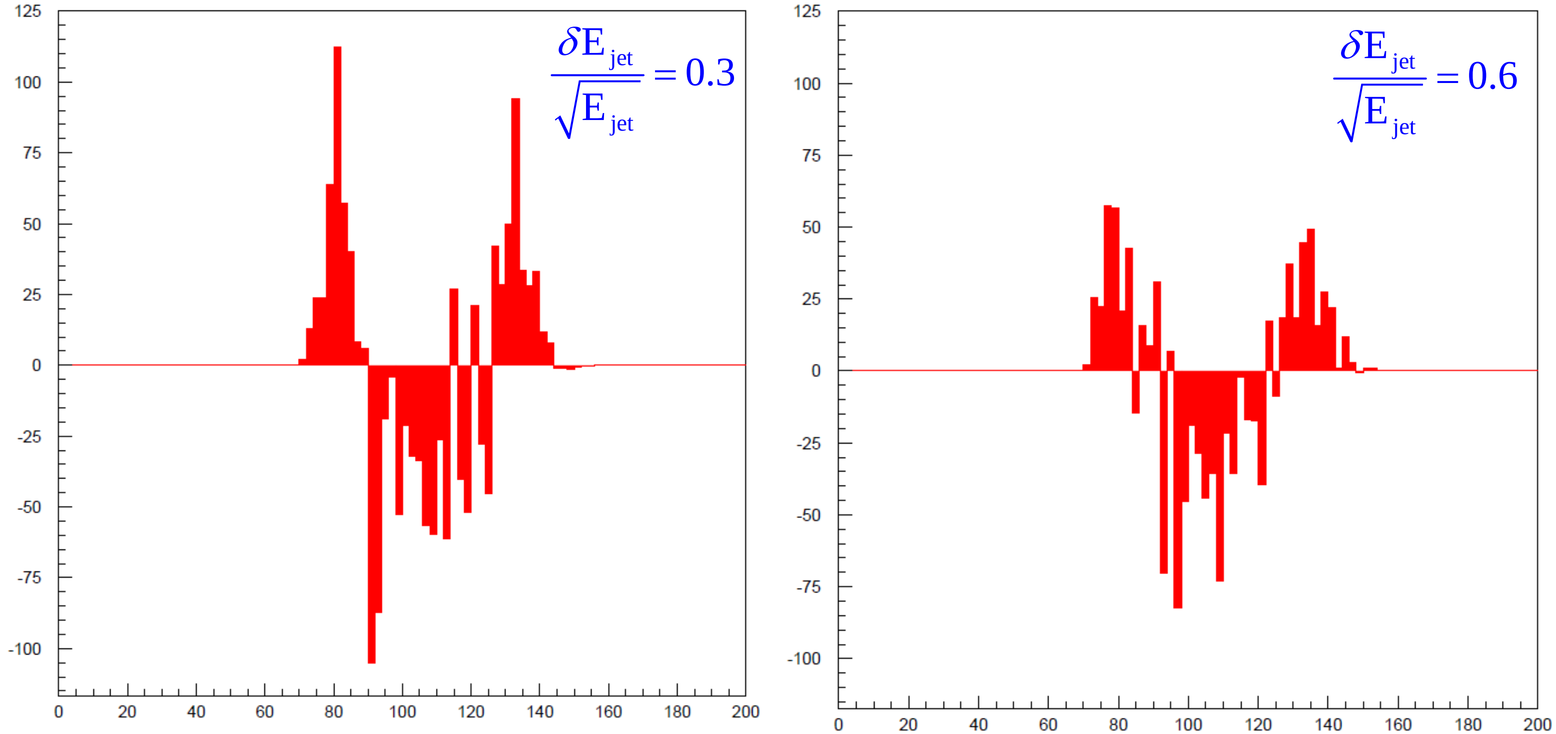
$$e^+e^- \to \tilde{\chi}_1^+\tilde{\chi}_1^- \to \tilde{\chi}_1^0\tilde{\chi}_1^0 W^+W^- \to \tilde{\chi}_1^0\tilde{\chi}_1^0 qqqq$$

$M_{\tilde{\chi}_1^+} = 199.4$ GeV

$M_{\tilde{\chi}_1^0} = 106.2$ GeV

$\sqrt{s} = 500$ GeV

$$\frac{dN_{bin}}{dM_{\tilde{\chi}_1^+}}$$



E_W (GeV) E_W (GeV)

$$e^+e^- \rightarrow \tilde{\chi}_1^+\tilde{\chi}_1^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 W^+W^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 qqqq$$

$M_{\tilde{\chi}_1^+} = 199.4$ GeV

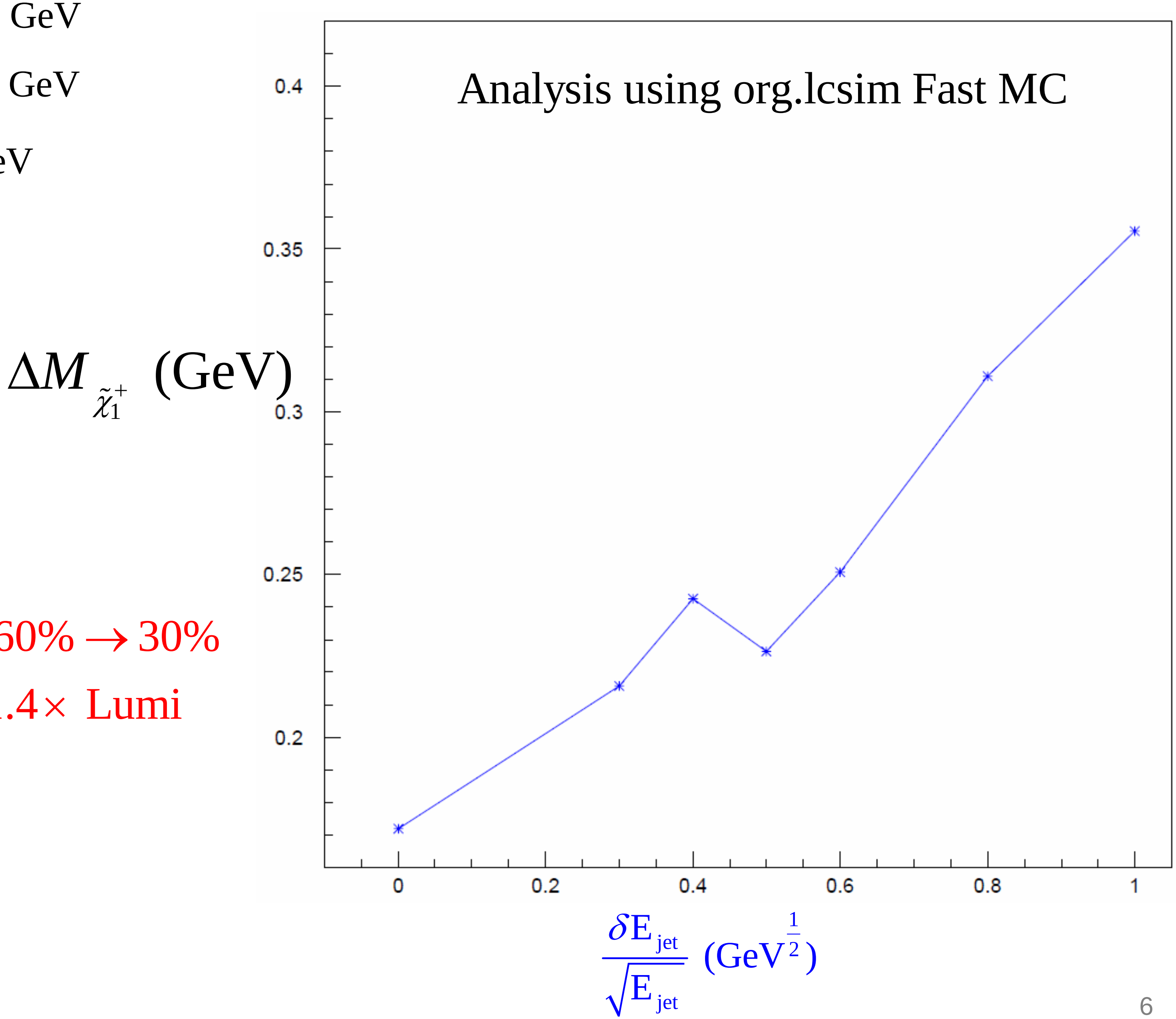
$M_{\tilde{\chi}_1^0} = 106.2$ GeV

$\sqrt{s} = 500$ GeV

$L = 500\ fb^{-1}$

$\Delta E/\sqrt{E} = 60\% \rightarrow 30\%$

equiv to $1.4\times$ Lumi



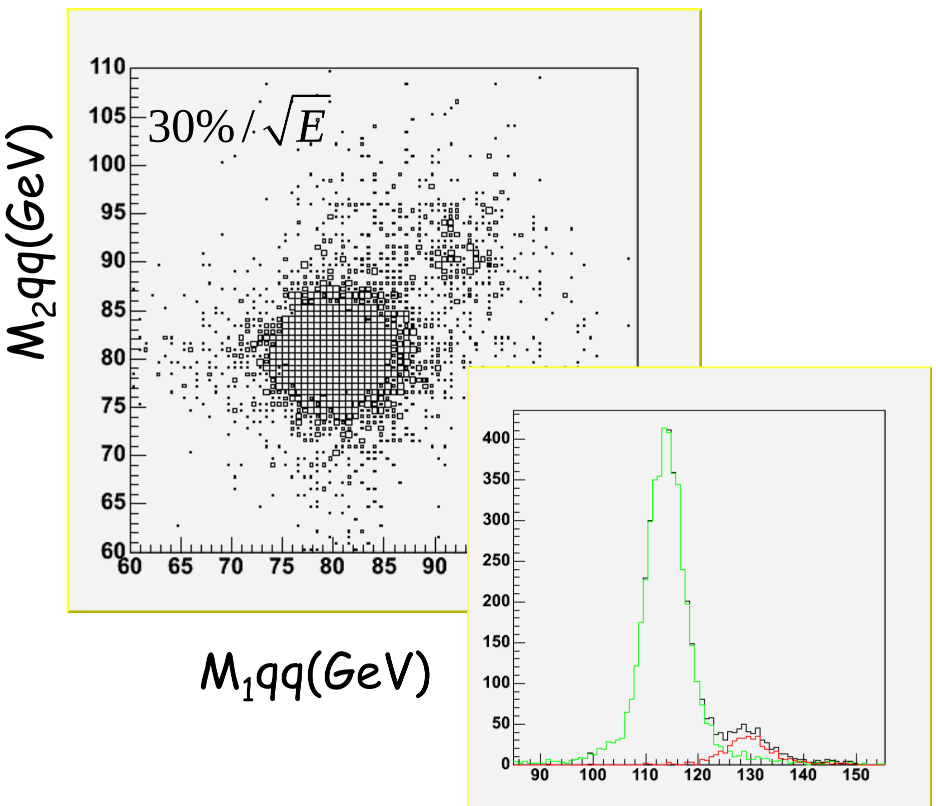
SUSY study in jet mode by Miyamoto

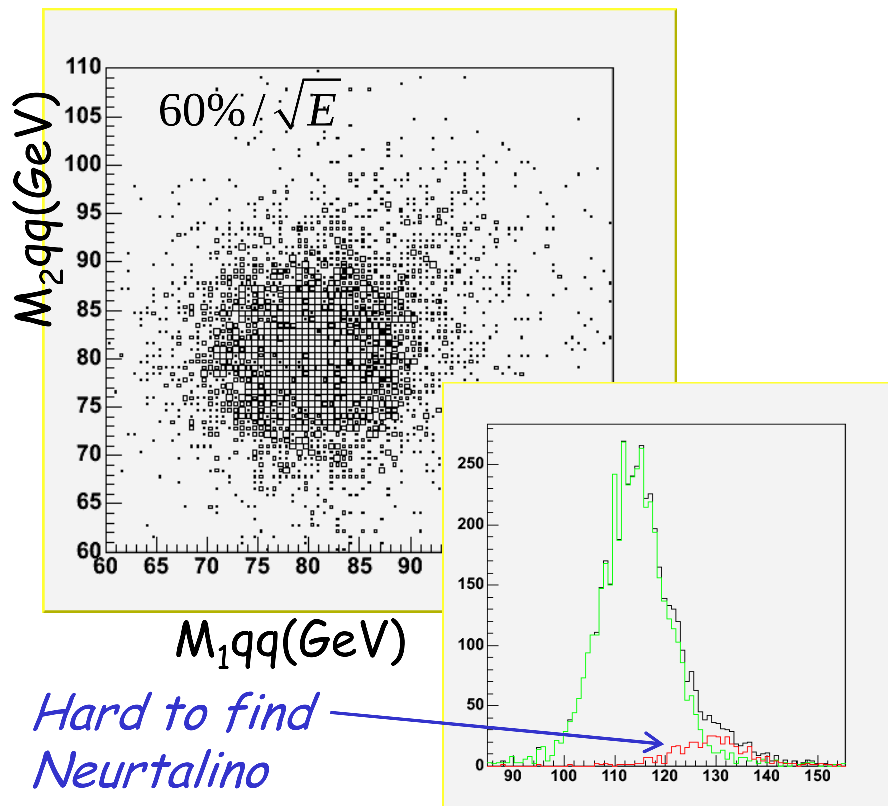
$$e^+e^- \to \tilde{W}^+\tilde{W}^- \to \tilde{\chi}_1^0\tilde{\chi}_1^0 W^+W^-$$

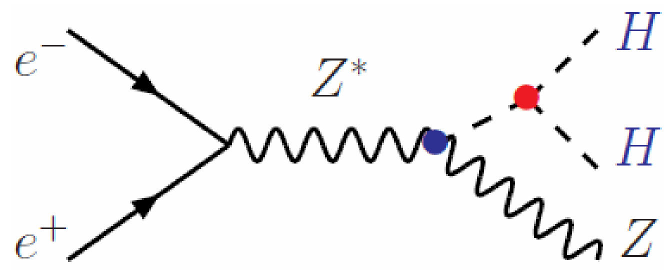
$$e^+e^- \to \tilde{\chi}_2^0\tilde{\chi}_2^0 \to \tilde{\chi}_1^0\tilde{\chi}_1^0 ZZ$$

SUSY parameter:
m_0=500GeV, μ=400GeV
M_2=250GeV, $\tan\beta$=3

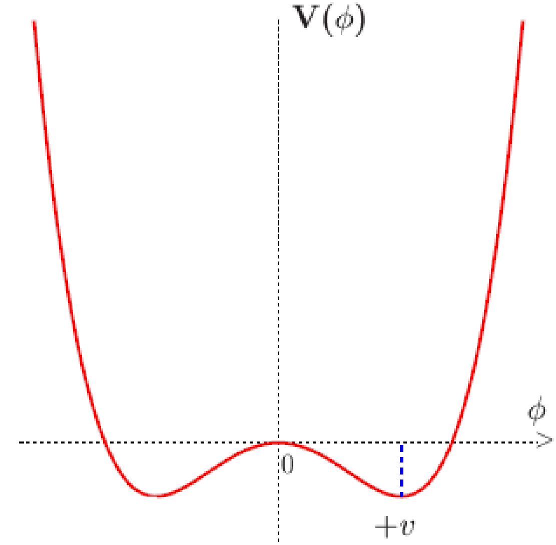
	LSP+WW	LSP+ZZ
σ(0.5TeV, fb)	20.1	1.8
No. of jet events (0.5ab^{-1})	4641	441







$$g_{HHH} = -6\mu^2 / \mathrm{v}$$



$$V(\phi) = \frac{1}{2}\mu^2\phi^2 + \frac{1}{4}\lambda\phi^4$$

Standard Model:

$$M_H^2 = 2\lambda \mathrm{v}^2 = -2\mu^2$$

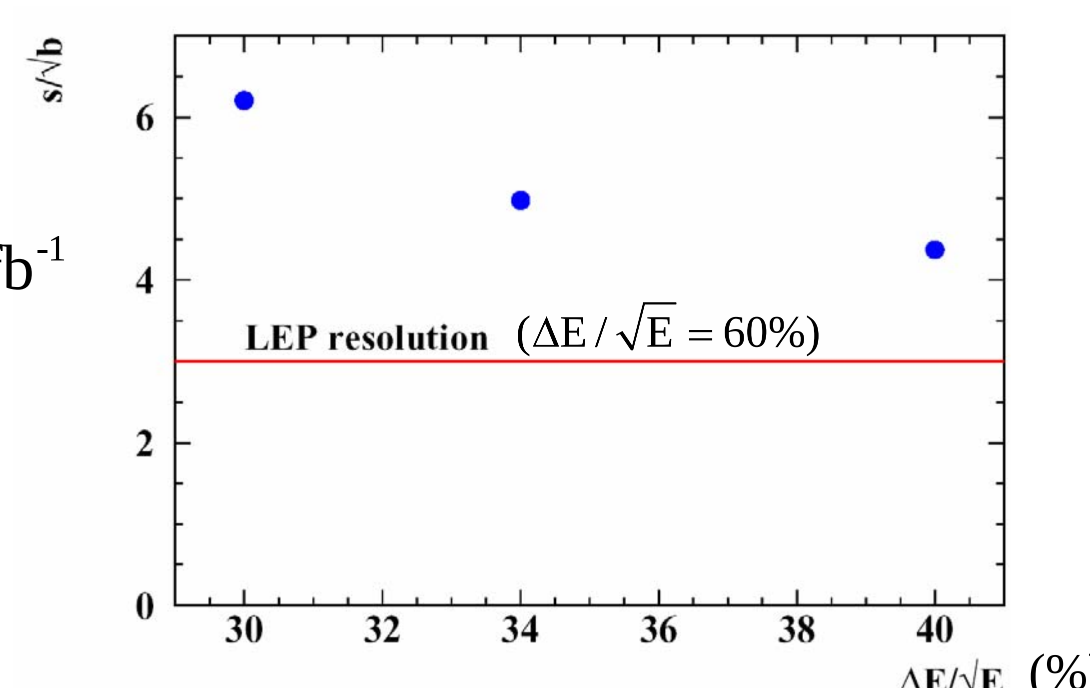
$e^+e^- \rightarrow ZHH \rightarrow q\bar{q}b\bar{b}b\bar{b}$

$\sqrt{s}$ = 500 GeV, L=1000 fb^{-1}

$\Delta E/\sqrt{E} = 60\% \rightarrow 30\%$

equiv to $4\times$ Lumi

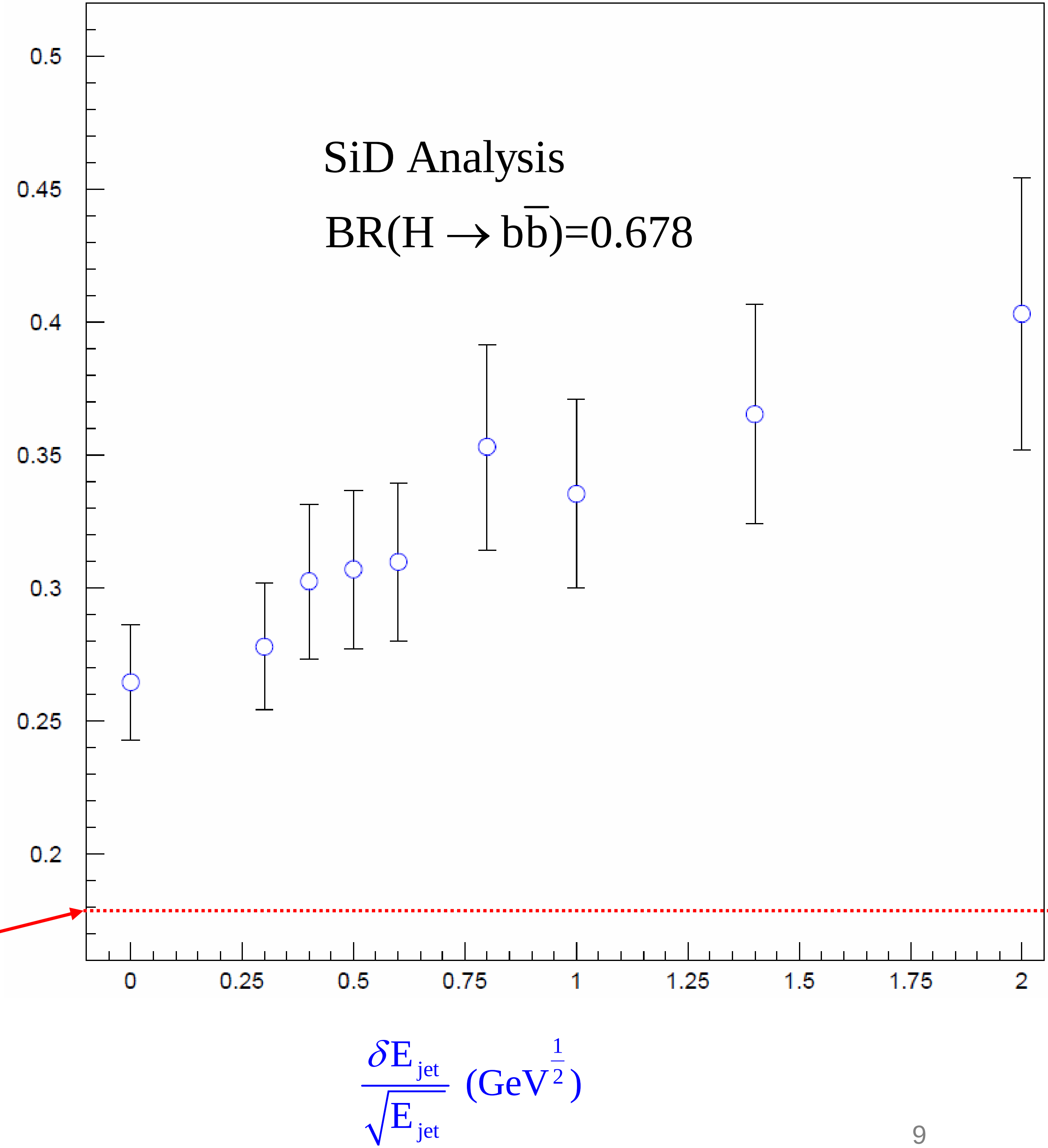
C. Castanier et al. hep-ex/0101028



$$e^+e^- \rightarrow ZHH$$
$$\rightarrow qqb\bar{b}b\bar{b}$$

$$\sqrt{s} = 500\ GeV$$
$$L = 2000\ fb^{-1}$$

$$\frac{\Delta g_{hhh}}{g_{hhh}}$$

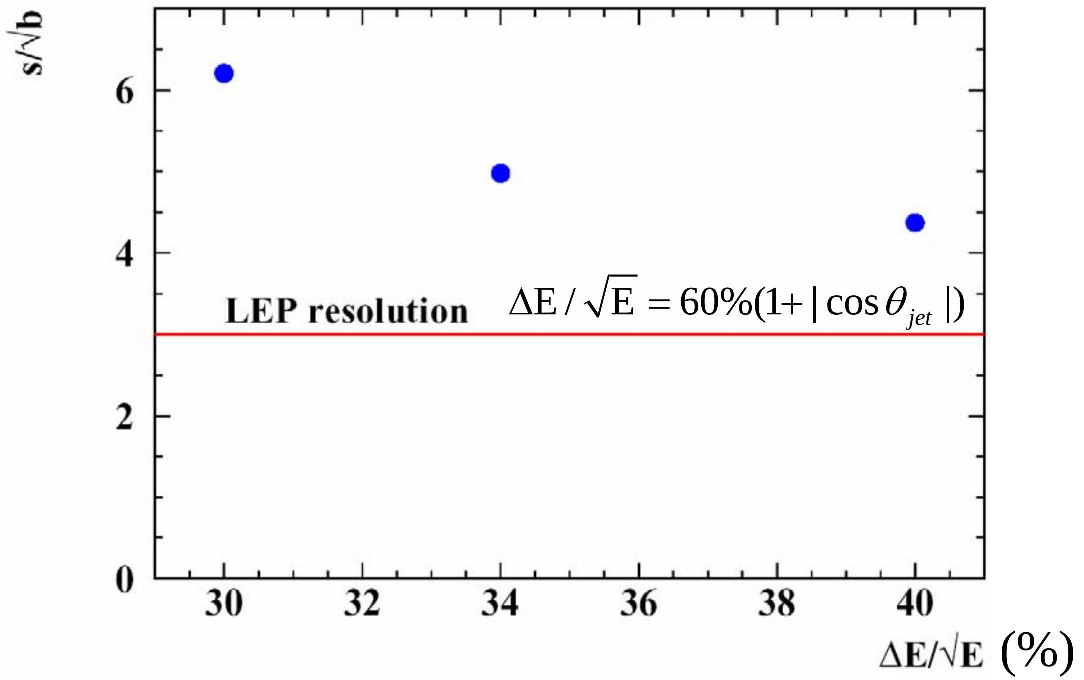


TESLA TDR result

for $\frac{\delta E_{jet}}{\sqrt{E_{jet}}} = 0.3$

$$e^+e^- \to ZHH$$
$$\to qqxxxx$$

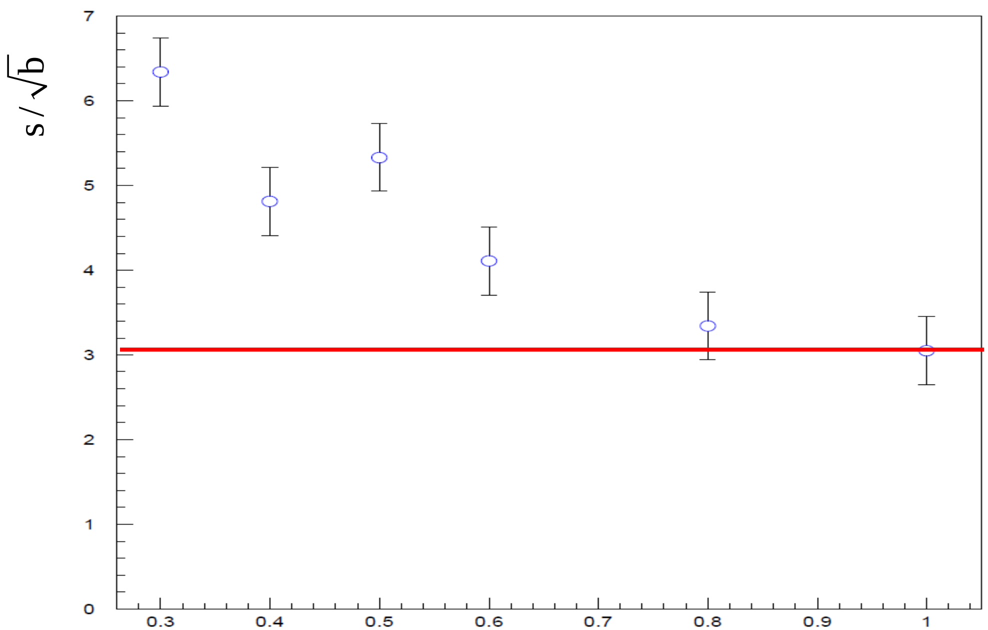
$$\sqrt{s} = 500\ GeV$$
$$L = 500\ fb^{-1}$$



Non-Gaussian E_{jet} parameterization

$BR(H \to b\bar{b})$=0.853

$BR(W \to c\bar{s})$=0

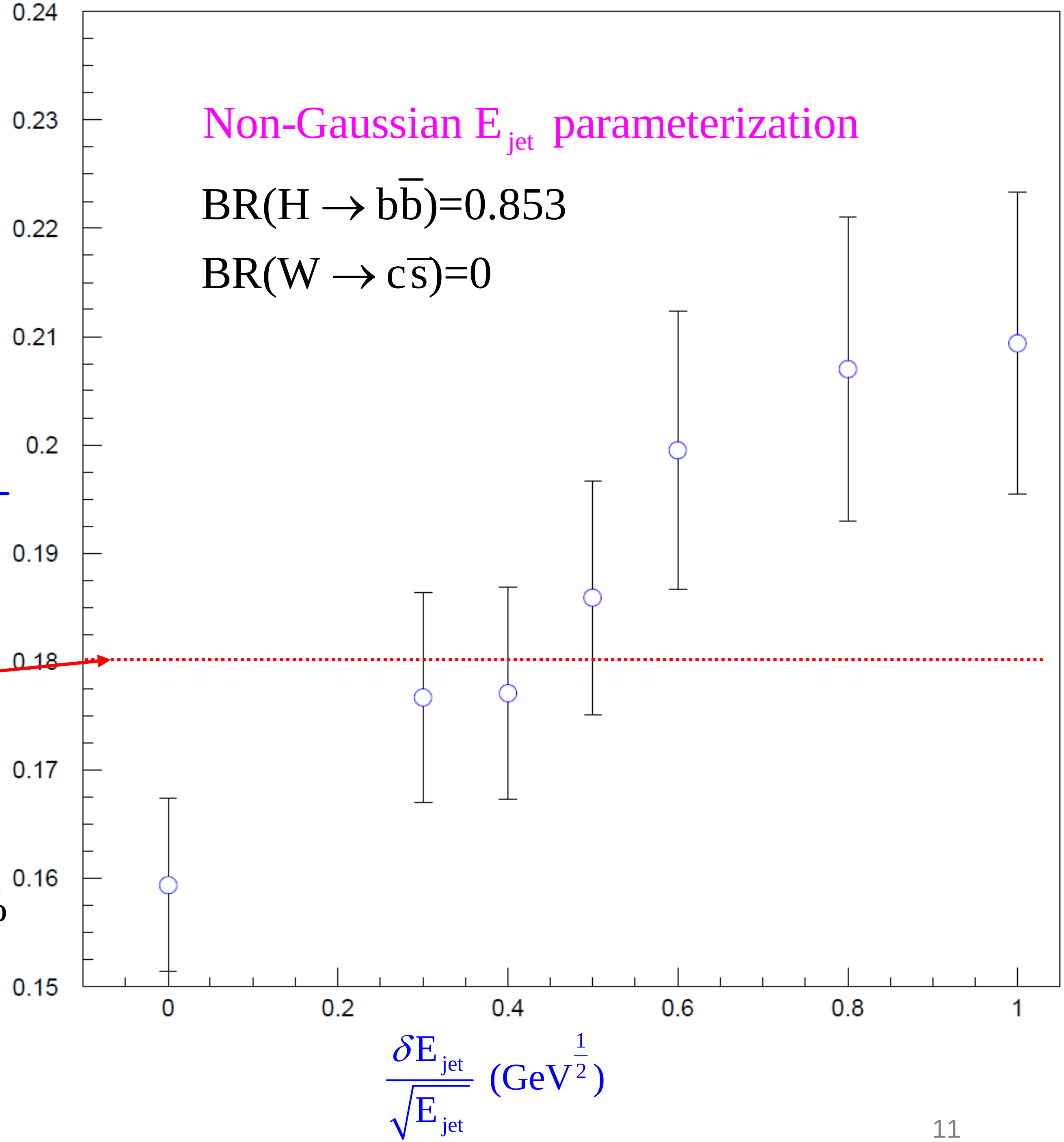


$$e^+e^- \rightarrow ZHH$$
$$\rightarrow qqxxxx$$

$\sqrt{s} = 500\ GeV$

$L = 2000\ fb^{-1}$

$\dfrac{\Delta g_{hhh}}{g_{hhh}}$



TESLA TDR result

for $\dfrac{\delta E_{jet}}{\sqrt{E_{jet}}} = 0.4$

$\Delta E/\sqrt{E} = 100\% \rightarrow 30\%$

equiv to $1.4\times$ Lumi

Jet Energy Resolution Conclusions

- Most studies indicate an effective luminosity gain of 40% as the jet energy resolution is improved from 60% to 30% over sqrt(E).
- There is one study which shows an effective luminosity gain of a factor of 4 as the jet energy resolution is improved from 60% to 30%, but another study of the same process indicates a much smaller dependence on jet energy resolution. It is clearly important to reconcile these two results –we're getting close.
- More physics studies involving direct W and Z production are required before conclusions can be drawn regarding required calorimeter performace.