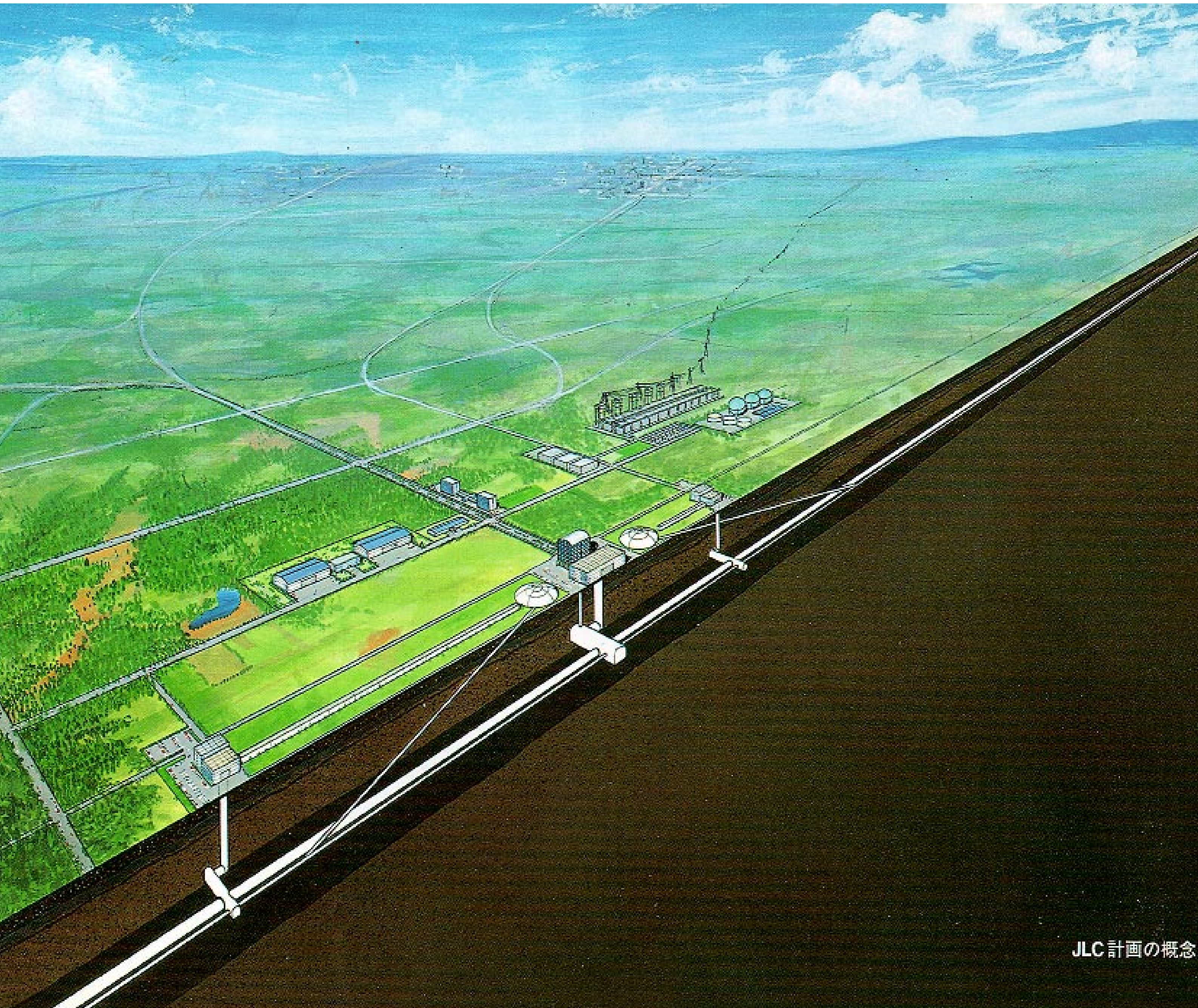
Physics Plan at JLC

HADRON STRUCTURE'98,Stara Lesna,Slovakia
T.Tauchi (KEK), September 11,1998

e^+e^- Linear Collider

JLC-1: E_{cm} = 250 ~ 500 GeV

JLC-2: E_{cm} > 1 TeV



The Final Report of the Subcommittee on Future Projects of High Energy Physics in Japan

19 May 1997

Subcommittee members:

K. Hagiwara (KEK), K. Inoue (Kyushu Univ.), K. Kawagoe (Kobe Univ.),
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M. Yoshioka (KEK, Subcommittee Secretary)

Principal Recommendations

Concerning the future projects of high energy physics in Japan, we make the following recommendations.

1. The e^+e^- Linear Collider project is the next principal project for research in high energy physics in Japan.
   - The center-of-mass energy of the collision in its first phase will be 250∼500 GeV. Aiming at its concurrent operation with LHC, every effort has to be taken to start its construction in the beginning of the 2000s. After the completion of the first phase, the second phase upgrade to the center-of-mass energy $\gtrsim$1 TeV will be made.
   - The e^+e^- Linear Collider project should be open to the international research community, and Japan should play the leading role as its host country.
   - An organization to execute the project should be formed and its globalization should be actively pursued.
2. It is essential to carry out the KEKB project, which is under construction, as planned. The other domestic and international projects in accelerator and non-accelerator experiments should also be promoted, in order to develop a broad academic basis.
3. The cultivation of human resources should be pursued in order to push forward the principal and the other projects.

The Working Group

In the 2nd plenary meeting, ACFA announced its endorsement of the e+e- linear collider as one of the major future facilities in the Asia-Pacific region. In fact, recent world-wide research at existing facilities has enabled us to form a more and more concrete picture of "TeV-scale physics" and, consequently, has made more and more crucial the e+e- linear collider's role in its exploration. According to the recent picture, the linear collider is expected to produce very important, decisive physics outputs even in the initial stage (in the energy region below 500GeV) of its energy upgrading program ; for instance, a top quark study at threshold, which is very important in its own right, can be a key to new physics and, more importantly, the Higgs particle will almost certainly manifest itself there or the SUSY/GUTS scenario will be disapproved.

In addition to its role as an energy frontier machine for High Energy Physics, the linear collider has a facet which can be shared with a new means for materials science. The ultra-low emittance beam essential to the linear collider is also an indispensable element of the next-generation, coherent x-ray source. In order to efficiently and effectively promote accelerator science in the region, one should start seriously thinking about the possibility of integrating both into a single project.

Turning our attention to activities in Asian region, we see significant progress in high energy and synchrotron radiation experiments at various domestic facilities. Not only that, many researchers from ACFA member nations are actively participating in large-scale experiments such as at LEP-II, Tevatron collider, HERA and PEP-II/KEKB. The Asian physics community on which ACFA is based has grown significantly and has set a firm enough foundation to prepare for further advancement.

In response to the ACFA statement issued in the last year, considering the importance of the linear collider project and the potential of our community to realize it, we set up a study group under ACFA. ***The charge of the group is to elucidate physics scenario and experimental feasibilities and to write up a report to ACFA within two years.*** Taking account of the scale of and the world-wide interests in such project, actual studies shall hopefully be carried out in a more global scope in spite of the regional nature of ACFA's initiative. KEK should play a secretarial role in the study.

ZHENG Zhipeng
Chairman
Asian Committee for Future Accelerators

To ACFA Joint Linear Collider home page
For comments and changes send email to webmaster@acfahep.kek.jp

ACFA Joint Linear Collider Physics and Detector Working Group

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The Asian Committee for Future Accelerators (ACFA), considering the importance of the Electron-Positron Linear Collider Project and the potential of the Asian community to realize it, has initiated the Physics & Detector Study Group under ACFA.
The charge of the group is to elucidate physics scenario and experimental feasibilities at the Linear Collider. Taking account of the scale of and the world-wide interests in such project, actual studies shall be open for other regions and hopefully carried out in a more global scope.

What's New	News about this web pages Events
Working Group	About the working group Contact persons
Members	Institutions List Members list Mailing List on this host
Studies	**Physics** Higgs SUSY Top Electroweak QCD **Detectors** Vertex Detector Central Tracker Particle Identification Calorimeter Muon Detector Data Acquisition/Electronics **Options** Electron-electro Electron-gamm Gamma-gamm **Computing/Network** Generator Simulator Analysis Framework W3 **Interface** Interaction Region Luminosity Monitor Polarization
Related Web Server	Electron-Positron Linear Collider Project

For comments and changes send email to webmaster@acfahep.kek.jp

Physics Target

Beyond the Standard Model

$\Downarrow$

SUSY

Theretical motivation:

Dynamics based on new symmetry

(guiding principle)

Grand unification

solves the hierarchy problem

Experimental indications

Precise experiments at LEP/SLC:

unification of three couplings with SUSY

difficulties of technicolor model

upper bound of Higgs mass

M_h < 280GeV(95%CL)

CDF/D0 Experiments:

Heavy Top quark; Mt=173.8 ± 5.0GeV

Prediction on M_h

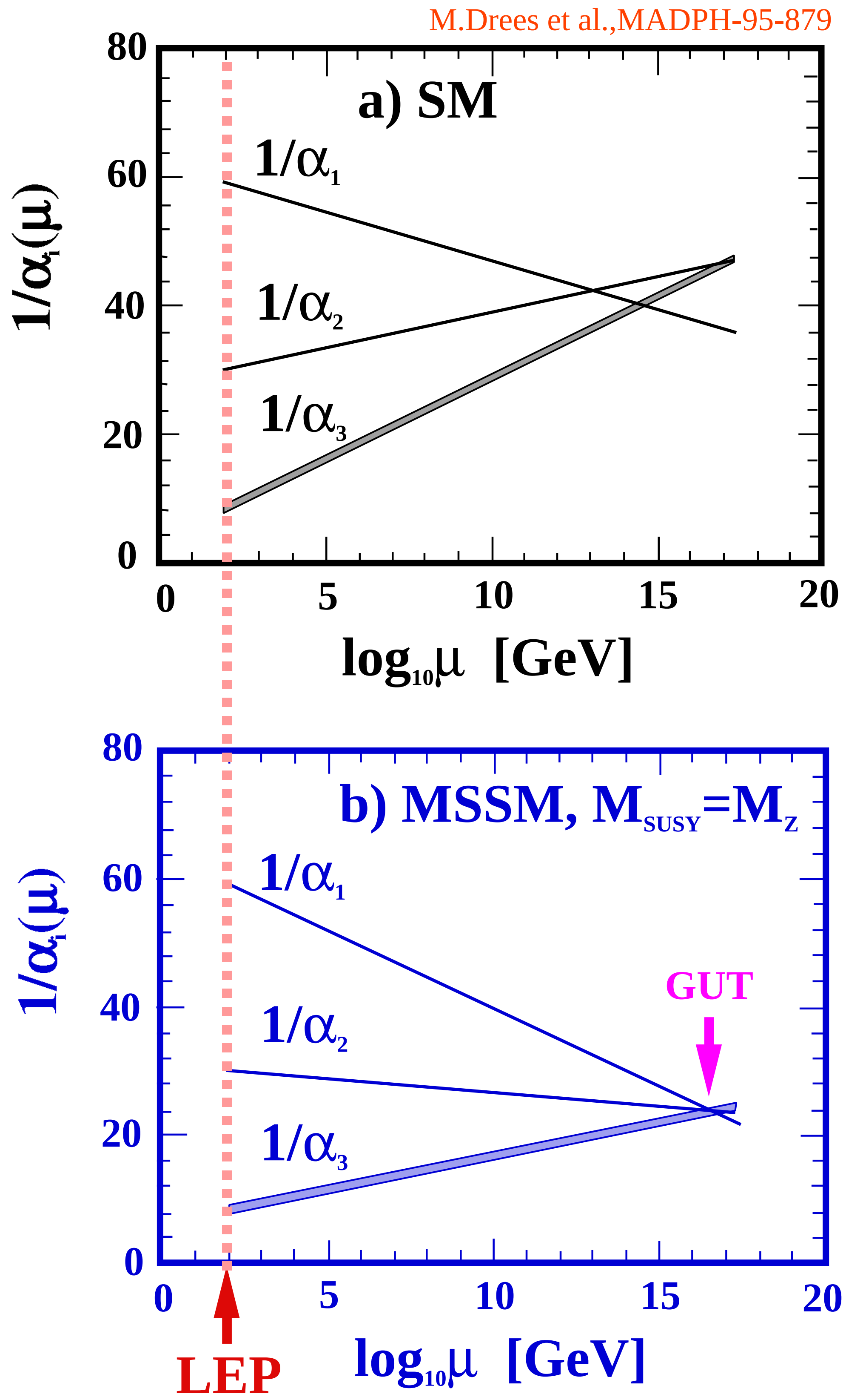
Lower bound by vacuum instability due to top-Yukawa interaction: 90GeV@Λ=1 TeV

Upper bound by SUSY

130 GeV (MSSM)

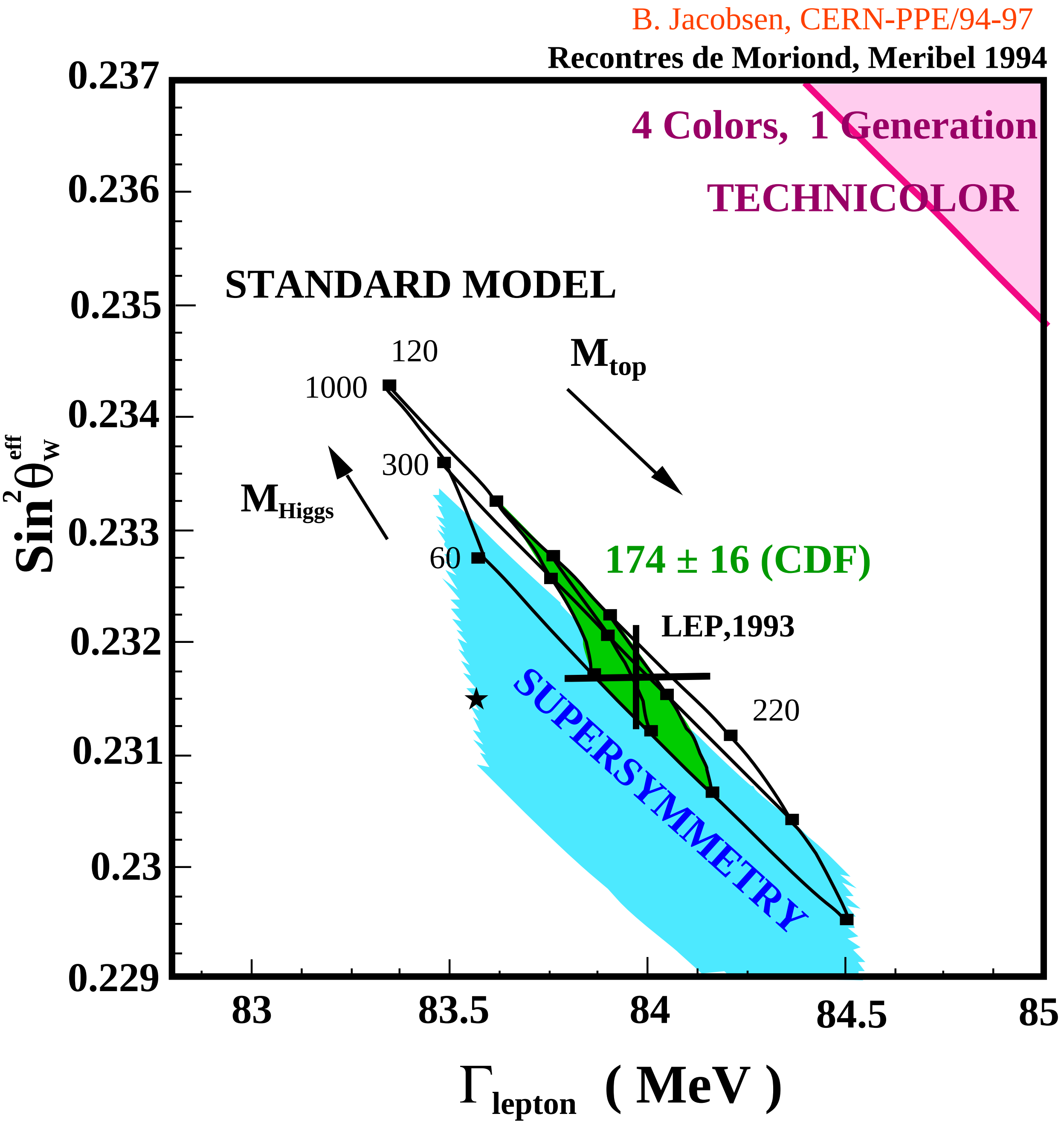
180 GeV(non minimal SUSY: NMSSM)

90GeV < M_h < 130 (180) GeV



M.Drees et al.,MADPH-95-879
a) SM
1/α1
1/α2
1/α3
1/αi(μ)
log10μ [GeV]
b) MSSM, MSUSY=MZ
GUT
LEP

LEPデータとテクニカラー



★: the Standard Model expectation without electroweak radiative correction

Experimental Indication of M_H

presented by Dean Karlen at ICHEP 98, Vancouver, July,1998

Global electroweak fit using as input:

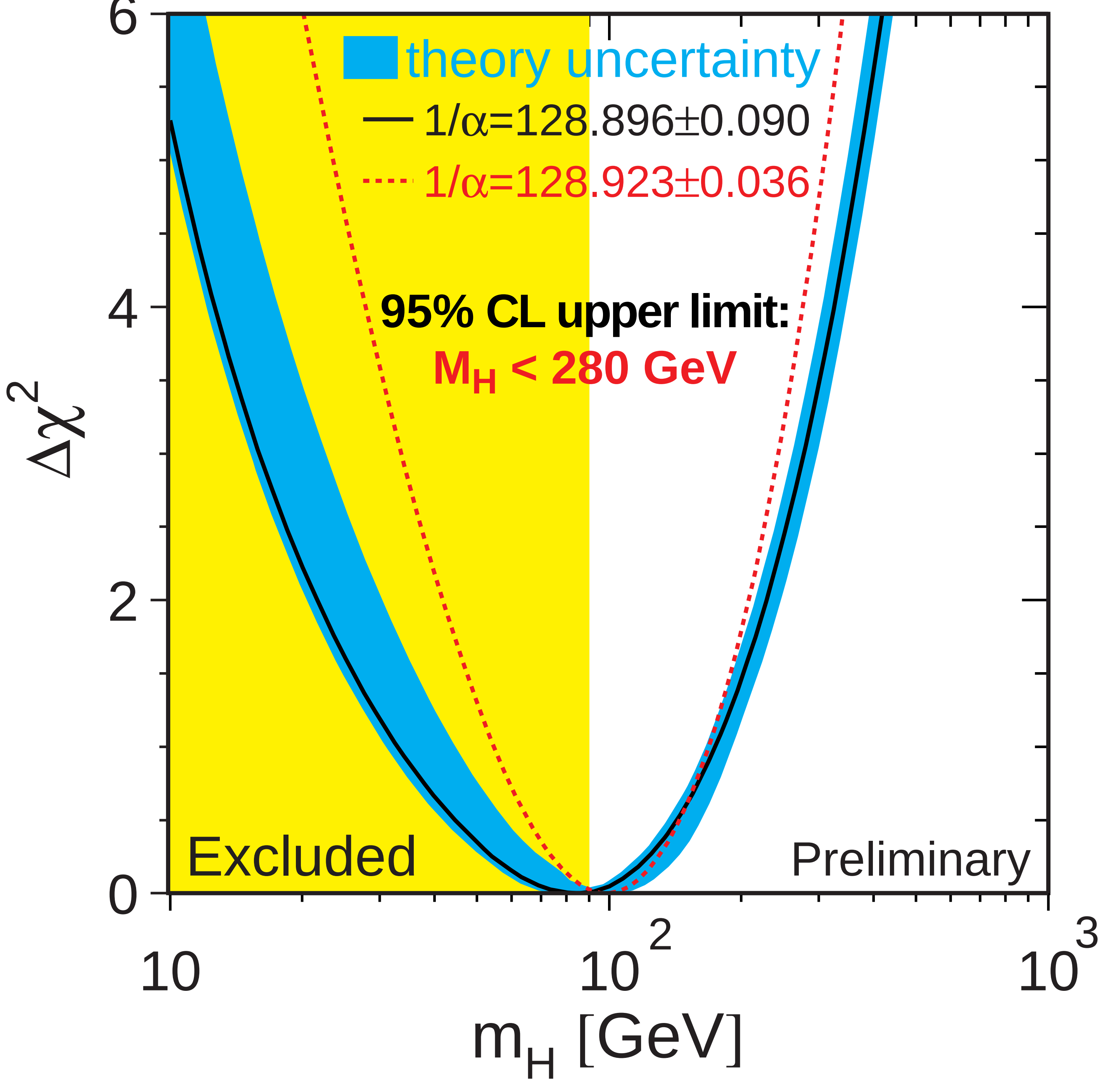
(1) Z^o measurements from LEP/SLC, m_W from LEP2 and Tevatron

(2) $\sin^2\theta_W$(on-shell) = 0.2255 ± 0.0021 (NuTeV and CCFR)

(3) m_t = 173.8 ± 5.0 GeV (CDF and D0)

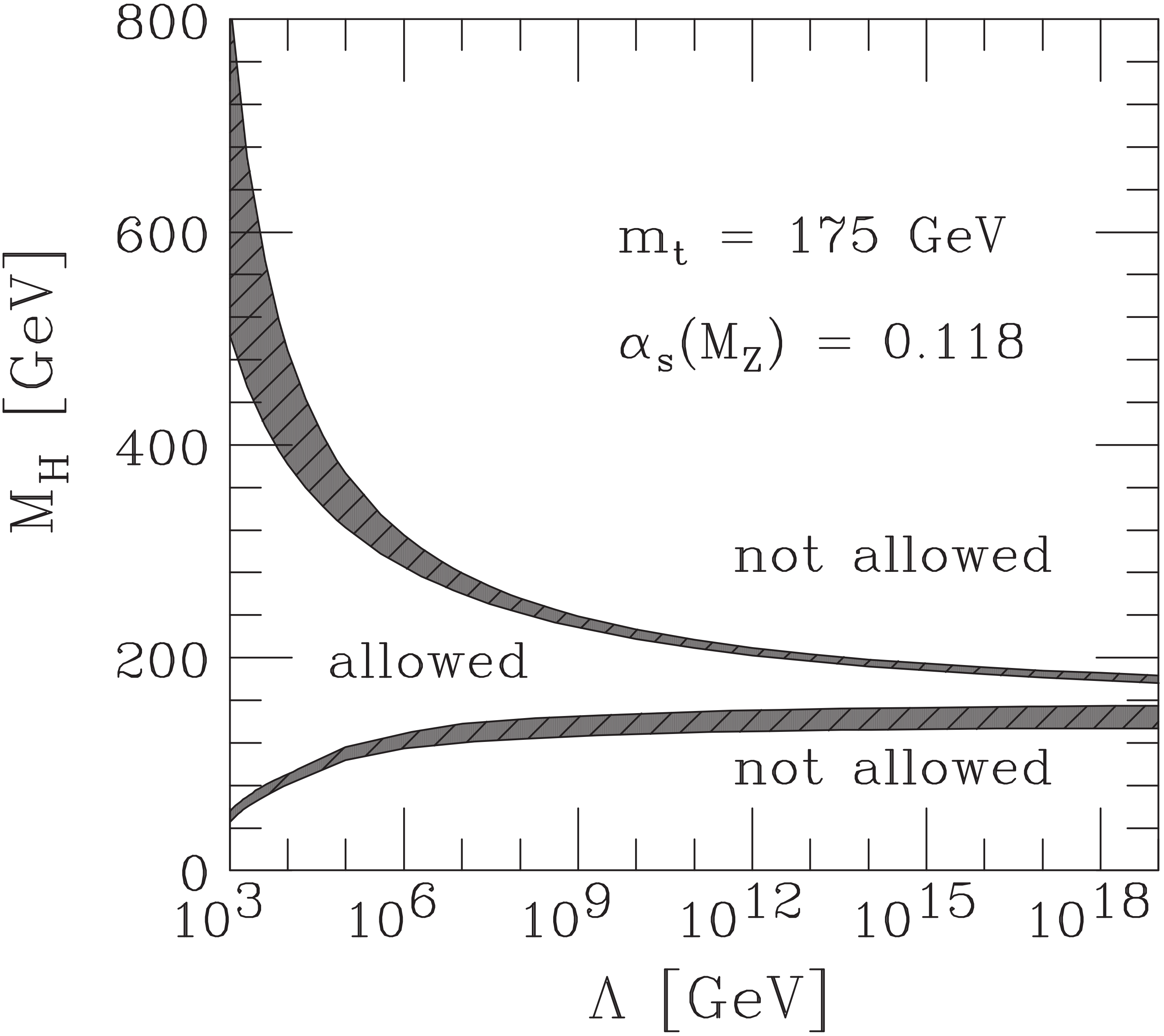
(4) $1/\alpha(m_Z)$ = 128.896 ± 0.090

LEP Electroweak Working Group, summer 1998



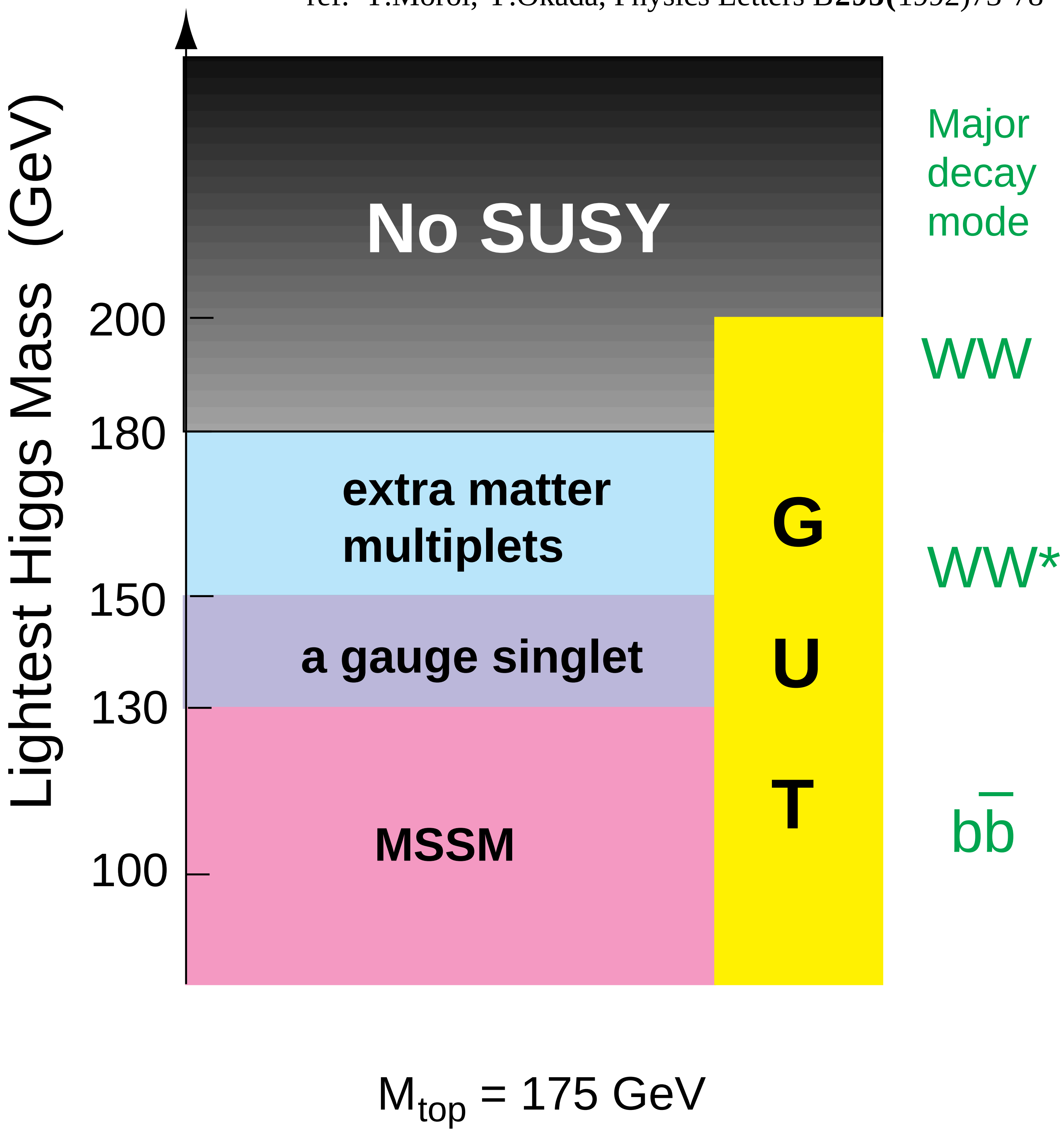
SM Higgs mass bounds

T.Hambye and K.Riesselmann, DESY 97-152



Upper Bound of
Lightest SUSY-Higgs Mass

ref. T.Moroi, Y.Okada, Physics Letters B**295(**1992)73-78



Physics Scenario

Discovery of light Higgs(h)

$\Downarrow$

Dawn to SUSY world

$\Downarrow$

measurements of Brs of h $\rightarrow b\bar{b}, c\bar{c}, gg, \gamma\gamma$

Discovery of H, A, H^+, H^-

$\Downarrow$

Experimental verification of SUSY

Discovery and precise measurement of SUSY particles

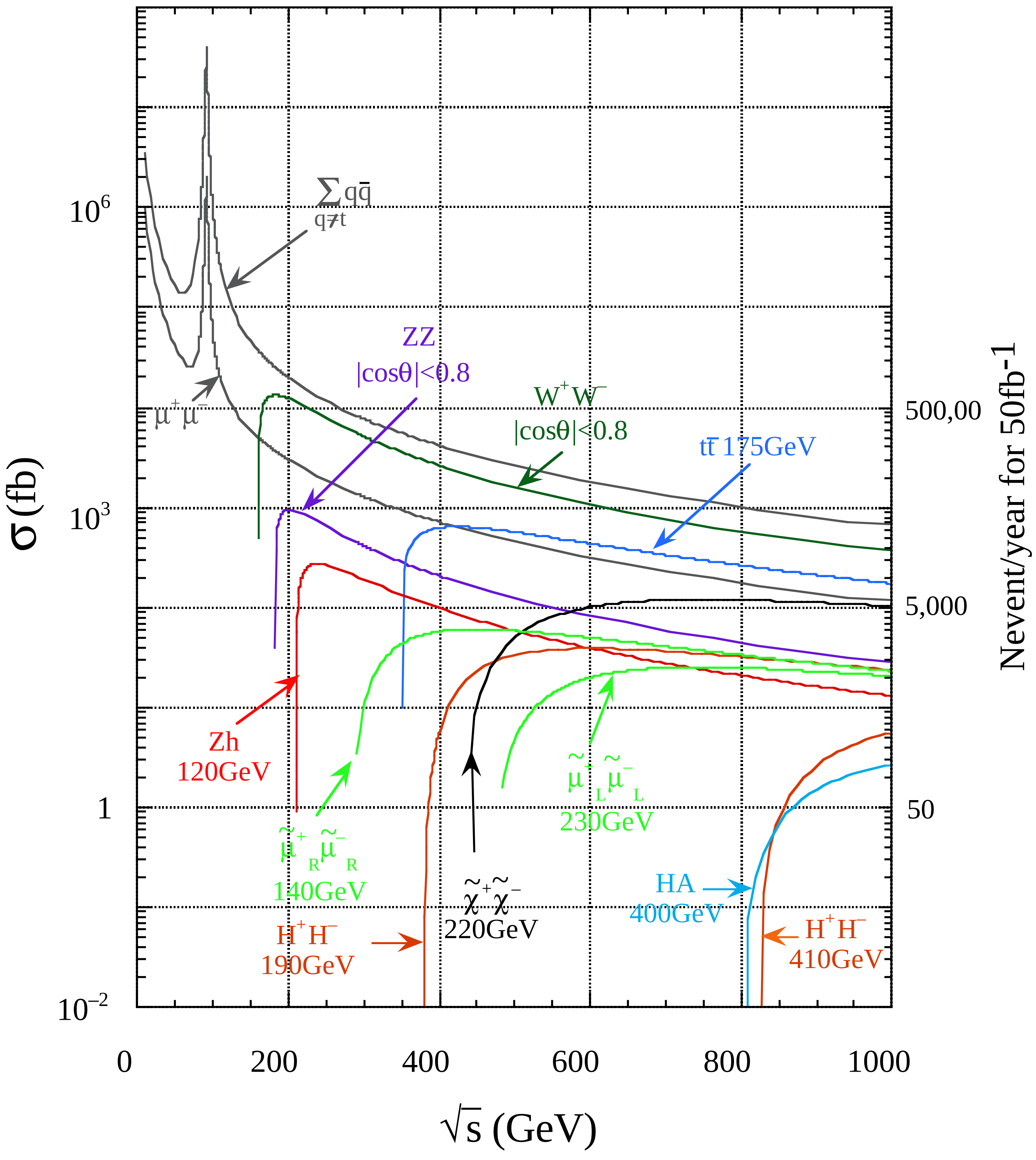
$\Downarrow$

Determination of m_0, μ, M_2, $\tan\beta$ (SUGRA)

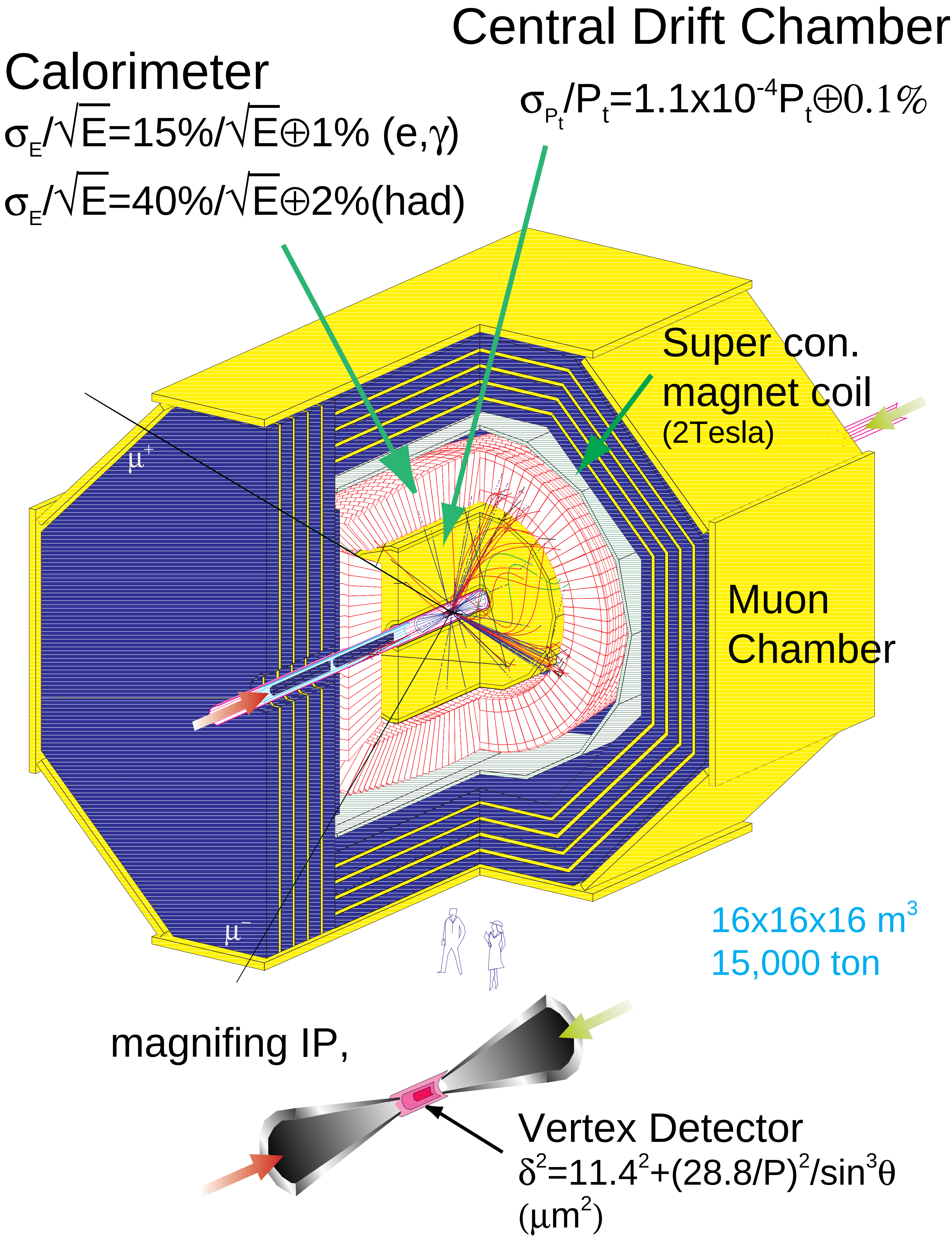
Crosssections and number of events

when $L = 5\times10^{33}\ cm^{-2}s^{-1}$

$L_{year} = L \times 10^7 sec = 50 fb^{-1}$



JLC detector

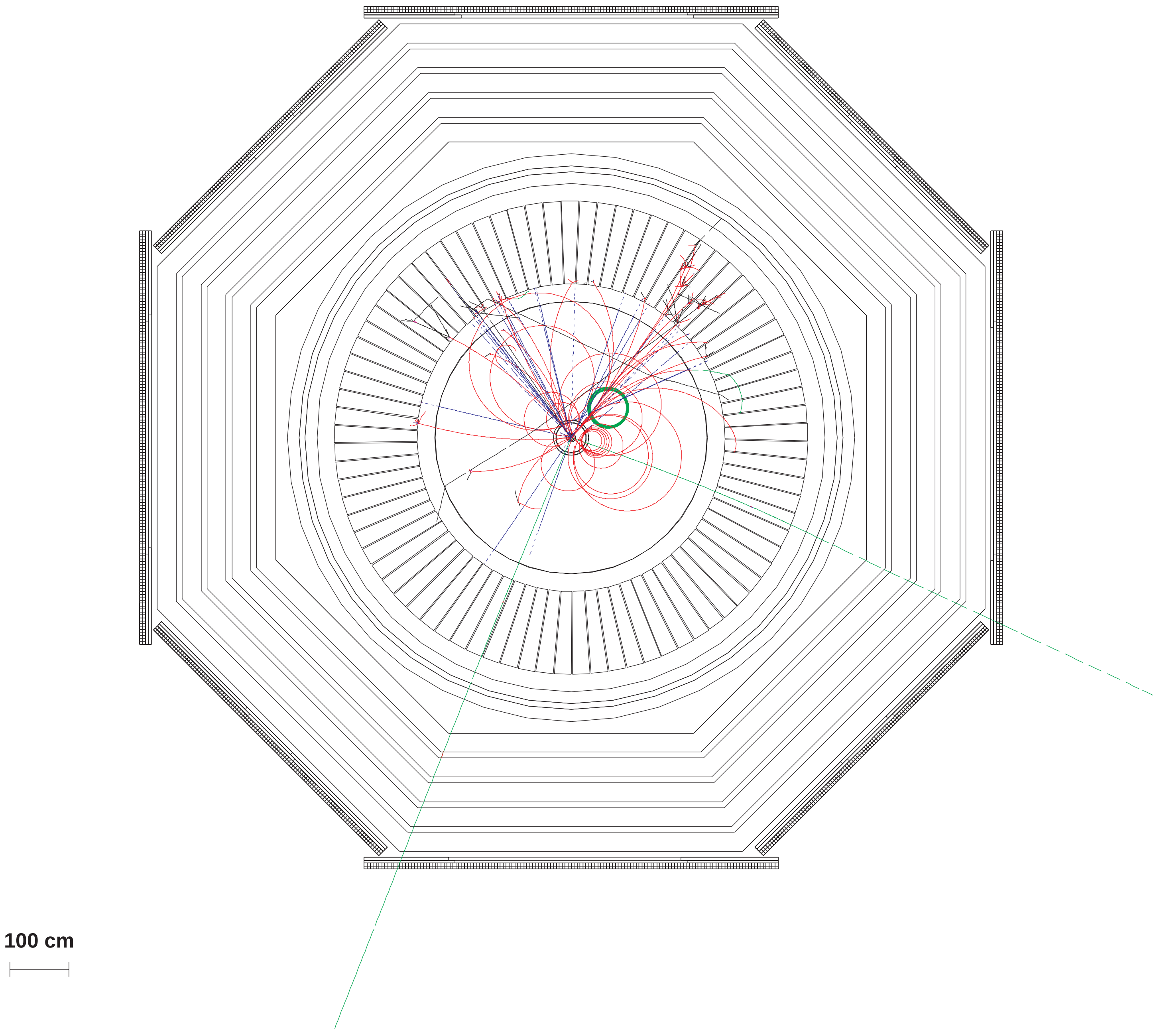


$e^+e^- \rightarrow h\,Z$

$h \rightarrow b\bar{b}$

$Z \rightarrow \mu^+\mu^-$

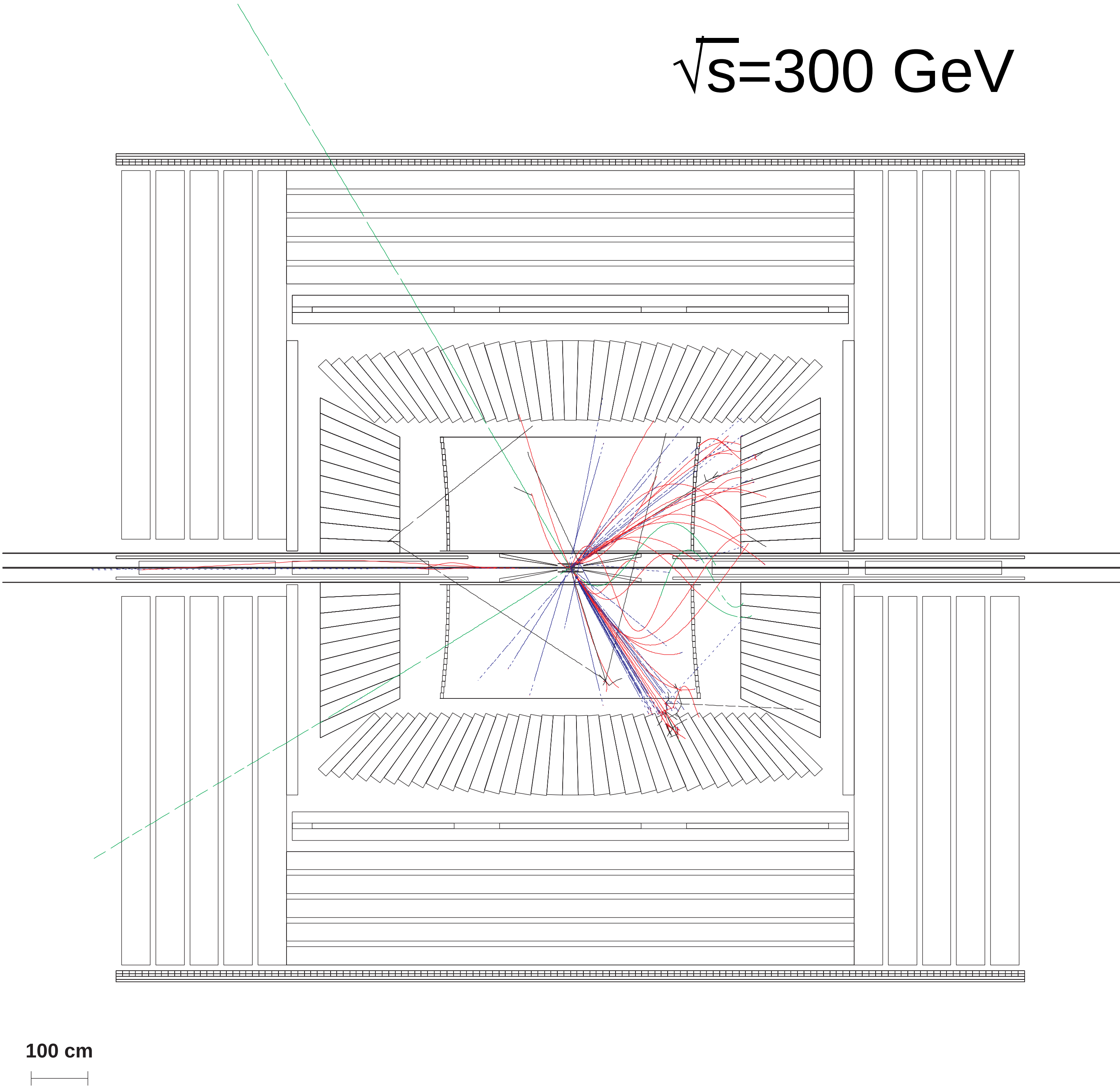
$\sqrt{s}$=300 GeV



$$e^+e^- \rightarrow h\,Z$$

$$h \rightarrow b\bar{b}$$

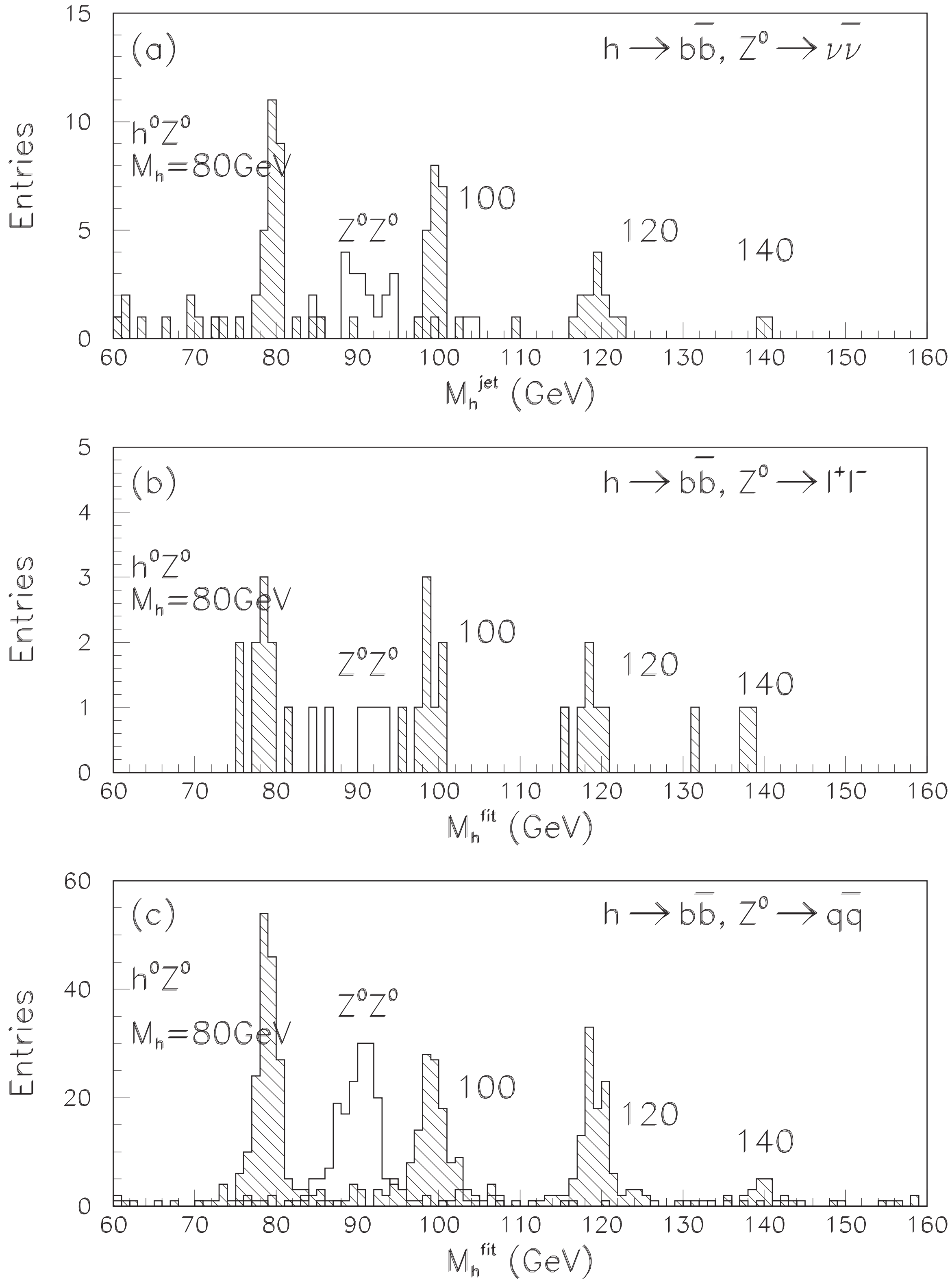
$$Z \rightarrow \mu^+\mu^-$$



Discovery Run

$\sqrt{s}=300GeV, \int Ldt=4fb^{-1}$

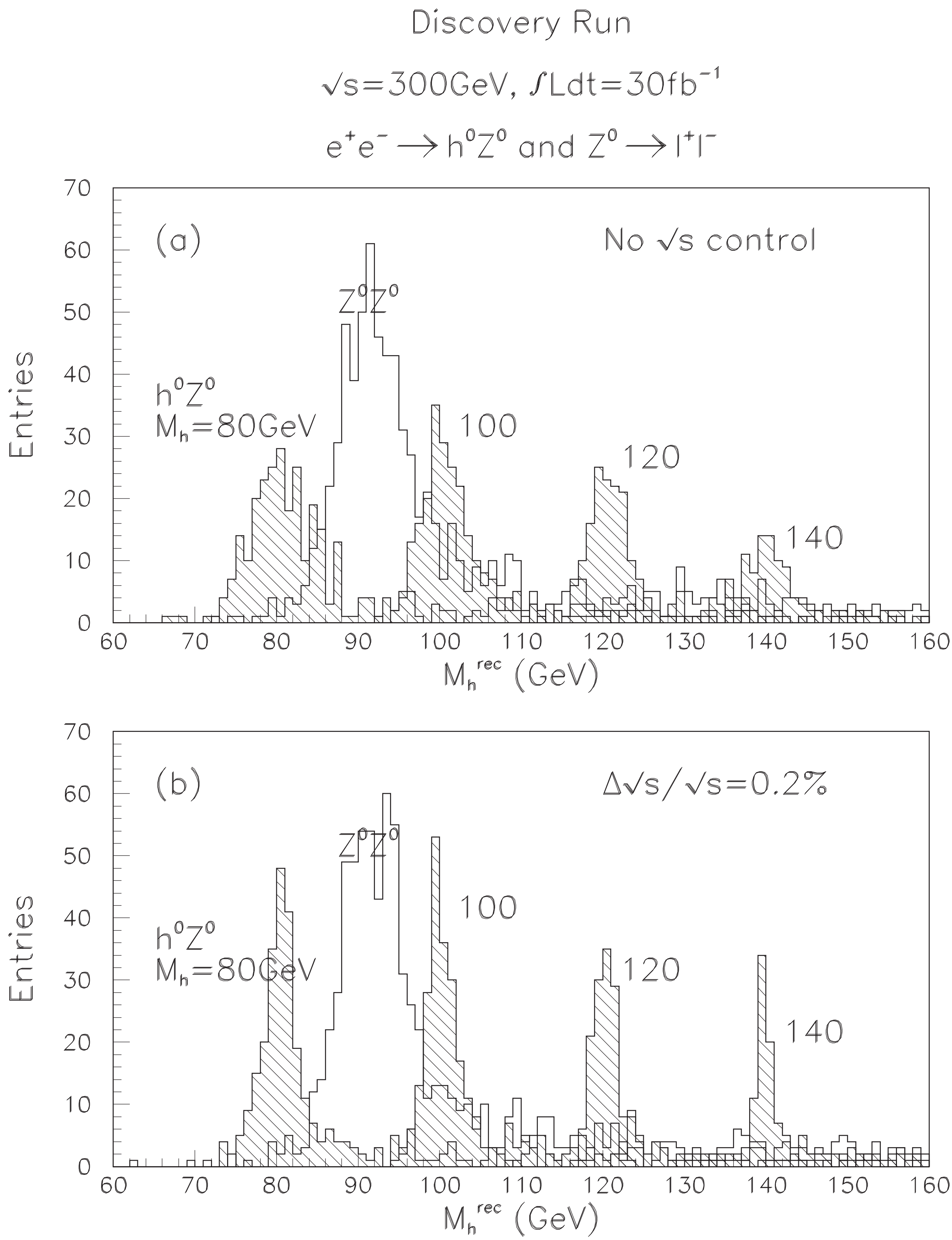
$e^+e^- \rightarrow h^0Z^0$



note: for M_h=140GeV, there is significant decay mode of $h \rightarrow WW^*$.

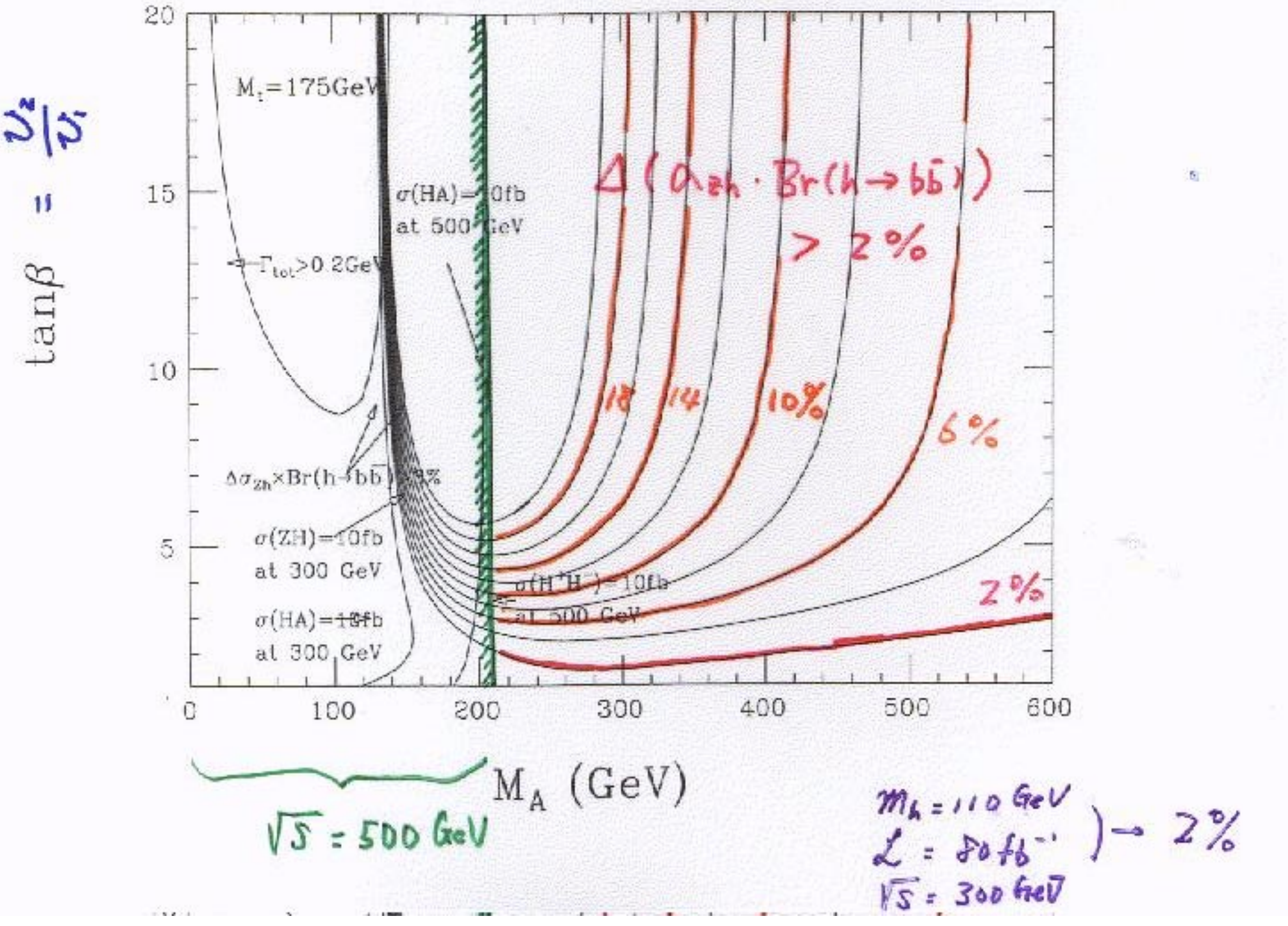
Higgs Discovery by Recoil Mass

independ of Higgs decay modes



SM ⟷ MSSM Higgs ($m_t = 175$ GeV)

Non-minimality Contour



$e^+e^- \longrightarrow h\,Z$

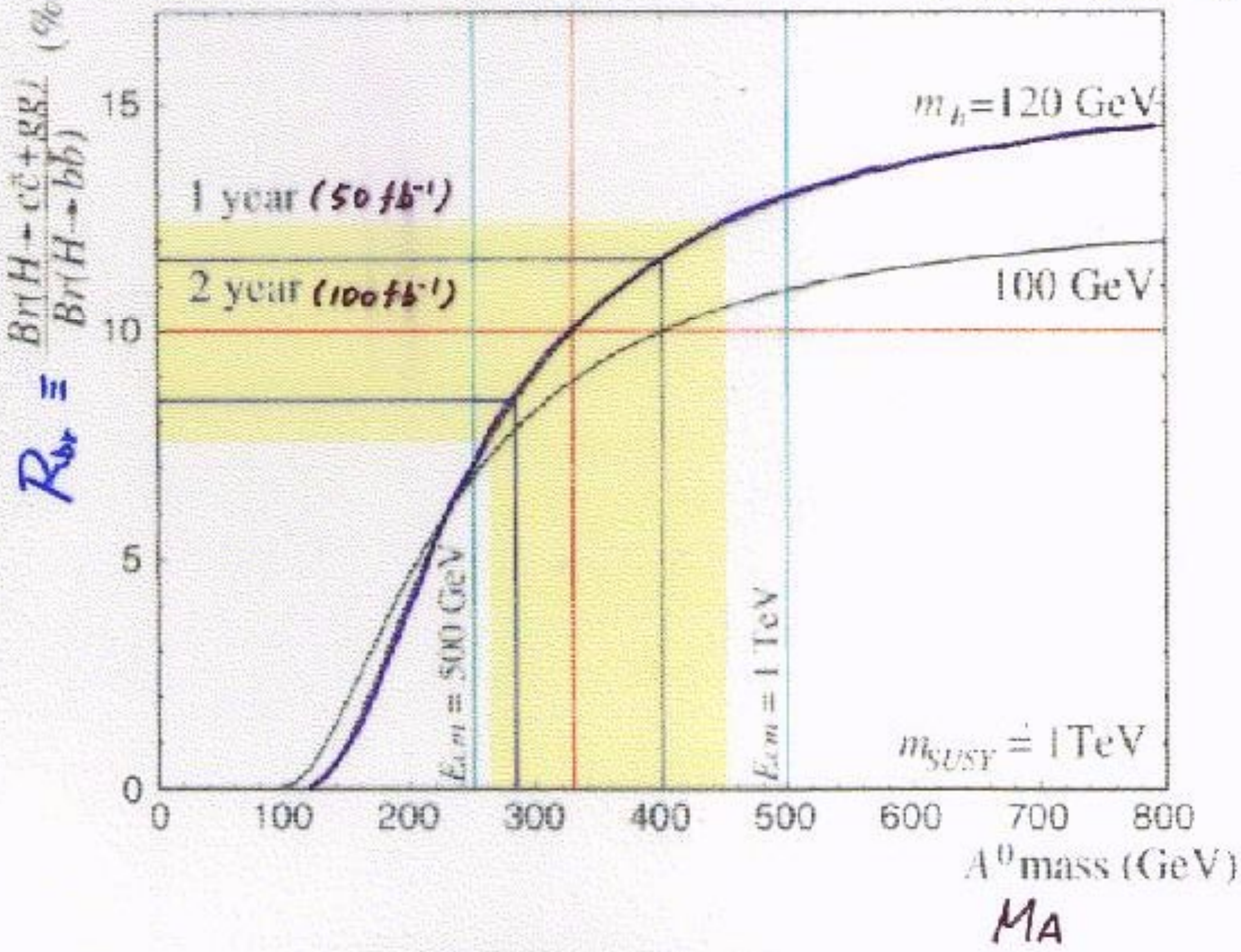
$\quad \hookrightarrow b\bar{b},\ c\bar{c}+gg$

$\sqrt{s} = 300\,GeV$

I. Nakamura

LCWS95, Sep. 1995, Appi

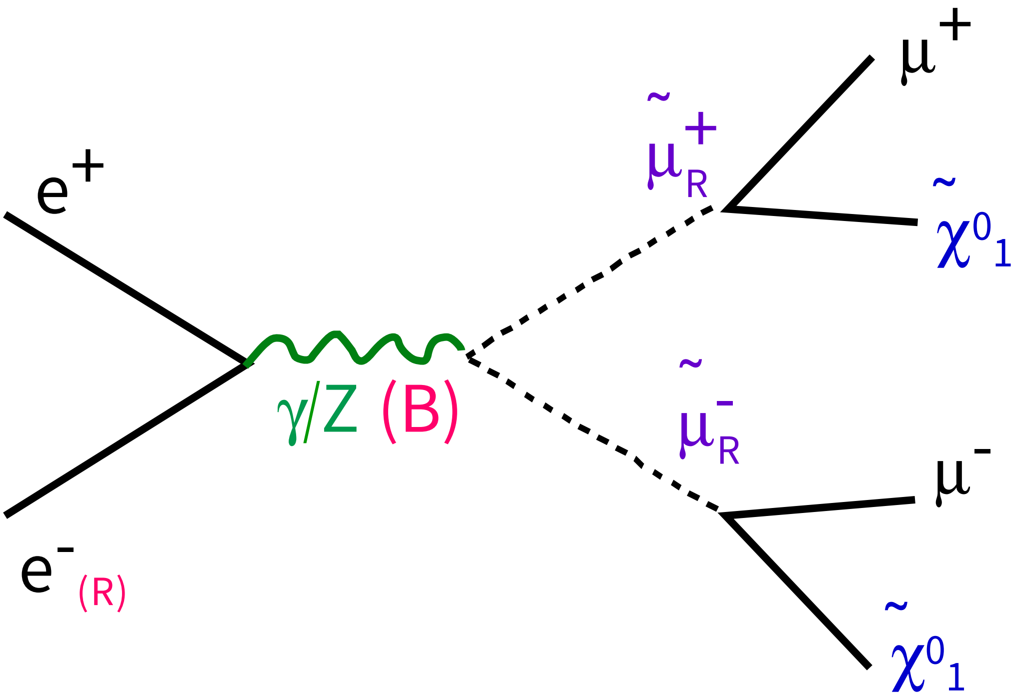
$$\frac{R_{bb}(MSSM)}{R_{bb}(SM)} \simeq \left(\frac{m_h^2 - m_A^2}{m_Z^2 + m_A^2}\right)^2$$



smuon($\tilde{\mu}_R$)production:

In general,

mass of $\tilde{\mu}_R$(U(1)) < mass of $\tilde{\mu}_L$(SU(2))



$P(e^-_R)$=100% $\Rightarrow$ large reduction of W^+W^- bkg.

min- and maximum of E_μ ($\tilde{\mu}_R \to \mu\ \tilde{\chi}^0_1$)

$\Downarrow$

masses of $\tilde{\mu}_R$, $\tilde{\chi}^0_1$ at 1%

selectron($\tilde{e}_R$) production:

also neutralino exchange in t-channel.

$\Rightarrow$ M_1

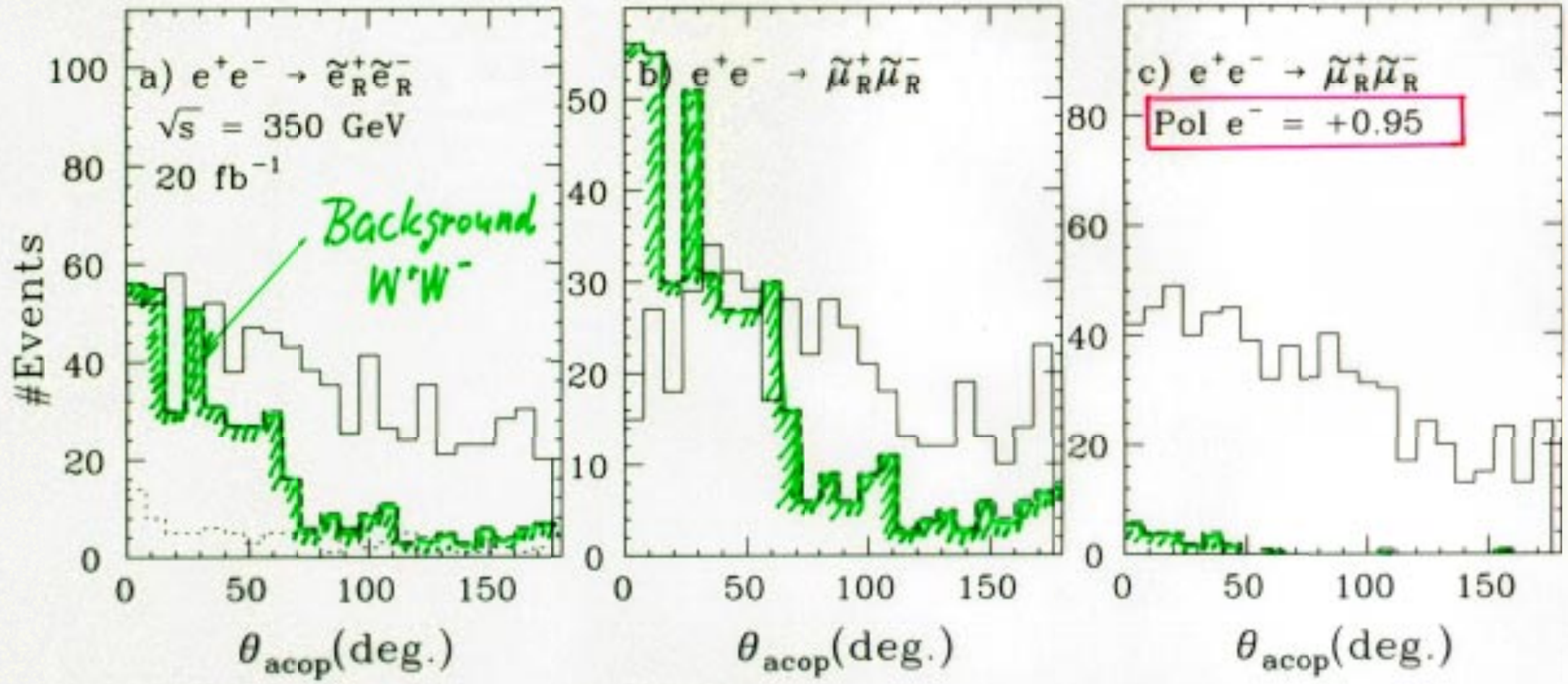
SUSY - sleptons

$$\tilde{\ell}_R \tilde{\ell}_R \rightarrow \ell \tilde{\chi}_1^0 \ell \tilde{\chi}_1^0$$

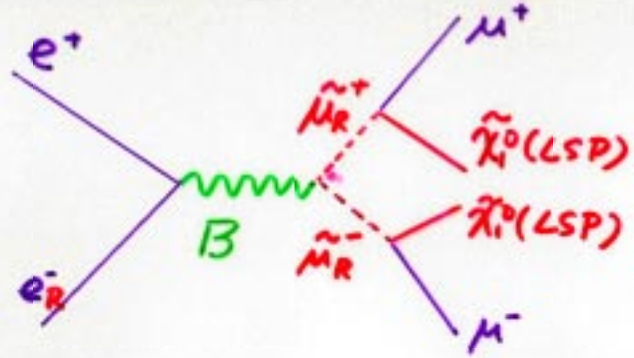
Acoplaner lepton pairs

e.g. $m_0 = 70\,GeV$, $\mu = 400\,GeV$, $M_2 = 250\,GeV$, $\tan\beta = 2$

$M_{\tilde{\ell}_R} = 141.9\,GeV$, $M_{\tilde{\chi}_1^0} = 117.8\,GeV$



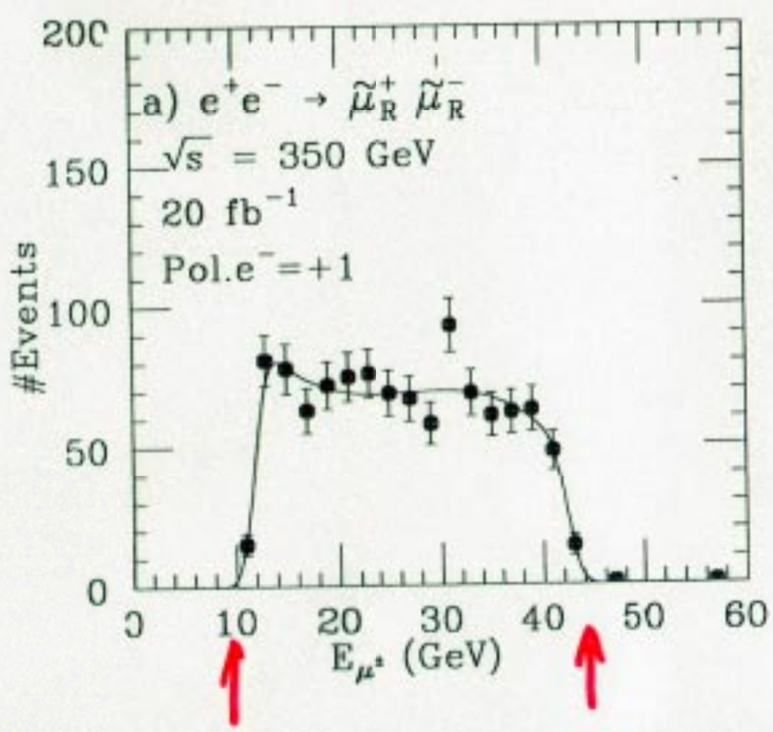
Determination of $m_{\tilde{\ell}_R}$, $m_{\tilde{\chi}^0}$

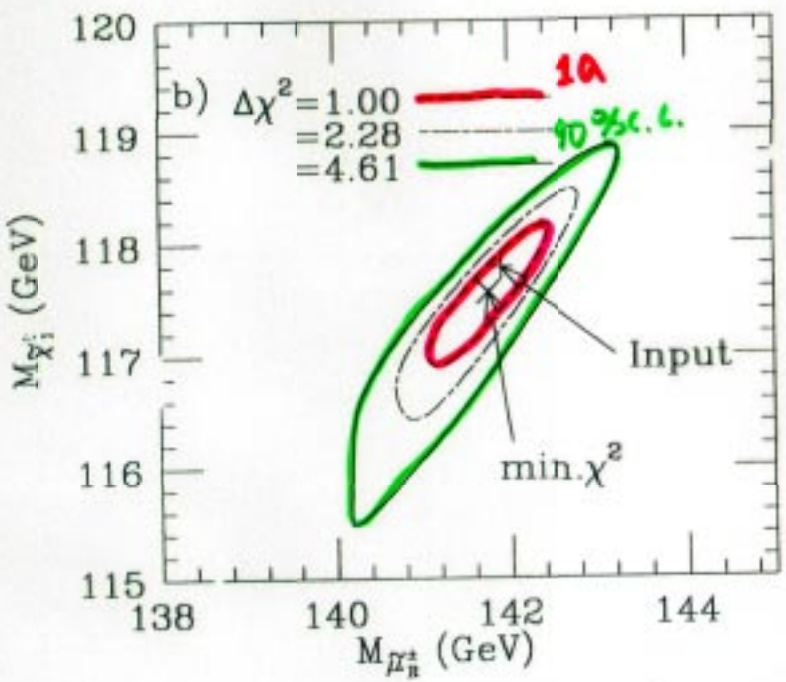


2 end points in E_μ distribution $\Rightarrow m_{\tilde{\mu}_R}, m_{\tilde{\chi}^0}$

$\Delta m_{\tilde{\mu}_R} = \pm 0.8$ GeV

$\Delta m_{\tilde{\chi}^0} = \pm 0.6$ GeV





Chargino production

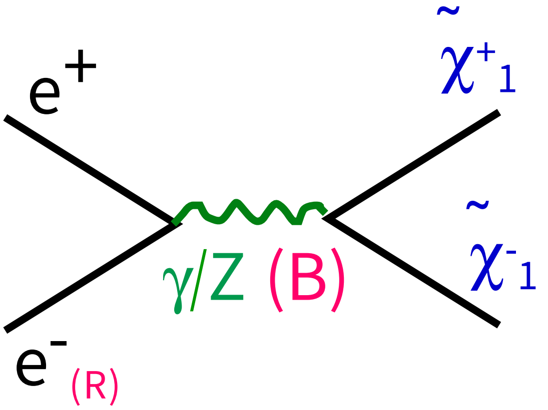
Charginos: $\tilde{\chi}_1^{+,-}, \tilde{\chi}_2^{+,-} \leftarrow$ mixture of $\tilde{W}^{+,-}$, $\tilde{H}^{+,-}$

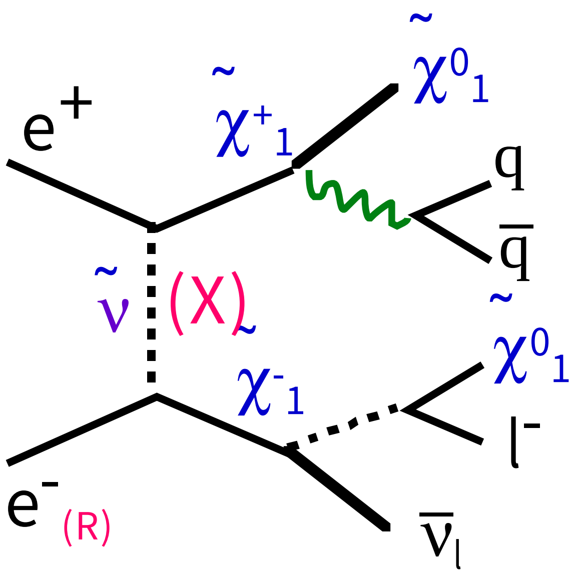
Neutralinos: $\tilde{\chi}^0_{1,2,3,4} \leftarrow$ mixture of $\tilde{B}$, $\tilde{W}^0$, $\tilde{H}_1^0$, $\tilde{H}_2^0$

$(M_1, M_2, \mu, \tan\beta, M_W, M_Z, \theta_W)$

$\mu >> M_{1,2}$: $\tilde{\chi}_1^{+,-}, \tilde{\chi}^0_1 \approx$ gaugino $\rightarrow M_{\chi^{+,-}} \approx 2M_{\chi^0}$

$\mu << M_{1,2}$: $\tilde{\chi}_1^{+,-}, \tilde{\chi}^0_1 \approx$ higgsino $\rightarrow M_{\chi^{+,-}} \approx M_{\chi^0}$





e^-_R **beam:** couple to **B** only $\rightarrow \tilde{H}^{+,-}$ component

100%pol. $\Rightarrow$ U(1) gauge interaction

e^-_L **beam:** sensitive to $\tilde{\nu}$ exch. $\rightarrow \tilde{W}^{+,-}$ component

$$m^2_{\tilde{\nu}} < m^2_{\tilde{l}_L} < m^2_{\tilde{\nu}} + (1-\sin^2\theta_W) m_Z^2$$

min,max E(2 jets) $\Rightarrow$ masses of $\tilde{\chi}_1^{+,-}, \tilde{\chi}^0_1$

$\Rightarrow \mu$, M_2 , $\tan\beta$

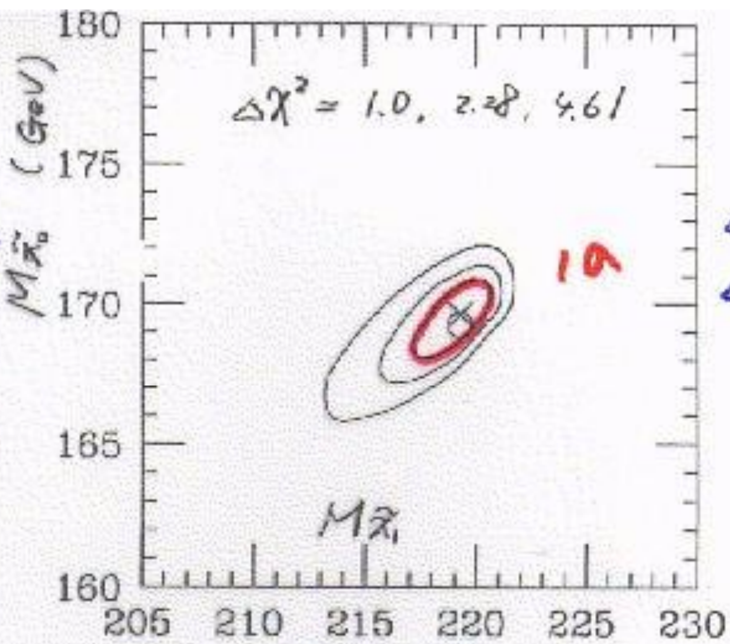
$\tilde{\chi}_1^+ \tilde{\chi}_1^-$

$\hookrightarrow \tilde{\chi}_0 q\bar{q} \Rightarrow$ Acoplanar lepton + 2jet

$\hookrightarrow \tilde{\chi}^0 \ell \bar{\nu}_e$

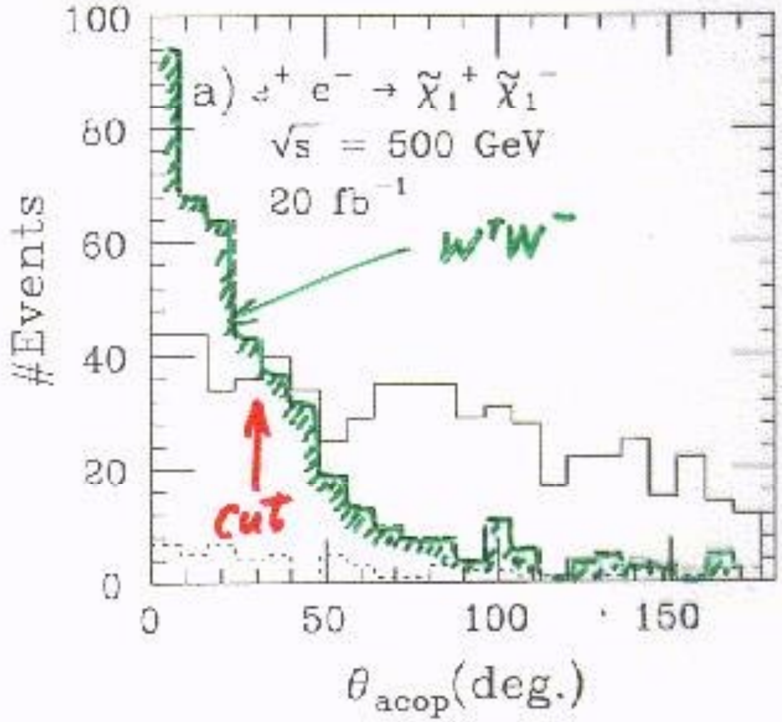
e.g. $m_0 = 400\,\mathrm{GeV}$, $\mu = 250\,\mathrm{GeV}$, $M_2 = 400\,\mathrm{GeV}$
$\tan\beta = 2$

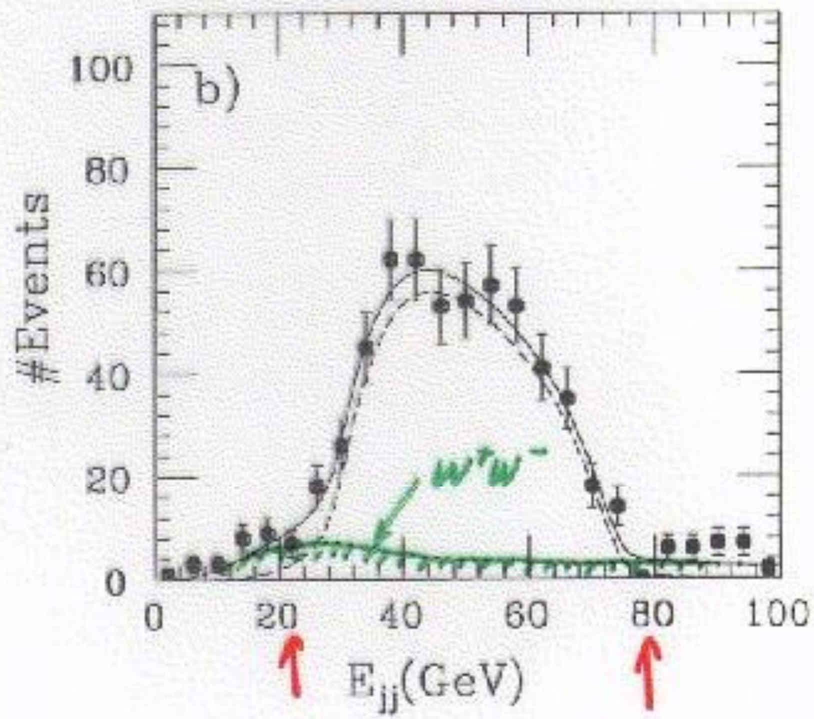
$m_{\tilde{\chi}^\pm} = 219.3\,\mathrm{GeV}$, $m_{\tilde{\chi}^0} = 169.2\,\mathrm{GeV}$



$\Delta M_{\tilde{\chi}_1^\pm} = \pm 2\,\mathrm{GeV}$

$\Delta m_{\tilde{\chi}_0} = \pm 1.5\,\mathrm{GeV}$





stau ($\tilde{\tau}$) production:

due to the Yukawa interaction

mass eigen state ≠ symmetry eigen state

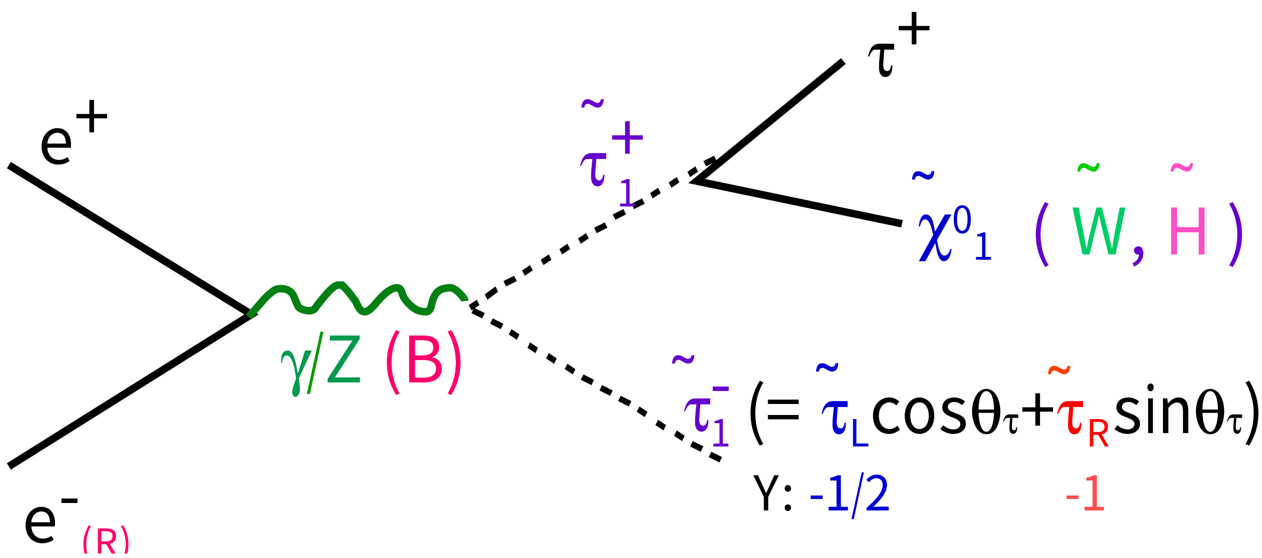
⇓

possibility of lightest slepton

min,maxE$_\rho$ $(\tilde{\tau}_1^- \to \tau^- \to \rho^- \nu)$, $\sigma(e^+ e^-_R \to B \to \tilde{\tau}_1^+ \tilde{\tau}_1^-)$

⇓ ⇓

masses of $\tilde{\tau}_1, \tilde{\chi}^0_1$ $\tilde{\tau}_R - \tilde{\tau}_L$ **mixing** (θ_τ)



τ polarization in $\tilde{\tau}_1 \to \tau\ \tilde{\chi}^0_1 \Rightarrow$ **tanβ**

⇑

gaugino, higgsino components in $\tilde{\chi}^0_1$

gauge-, Yukawa-($Y_\tau \sim m_\tau/\cos\beta$) interaction

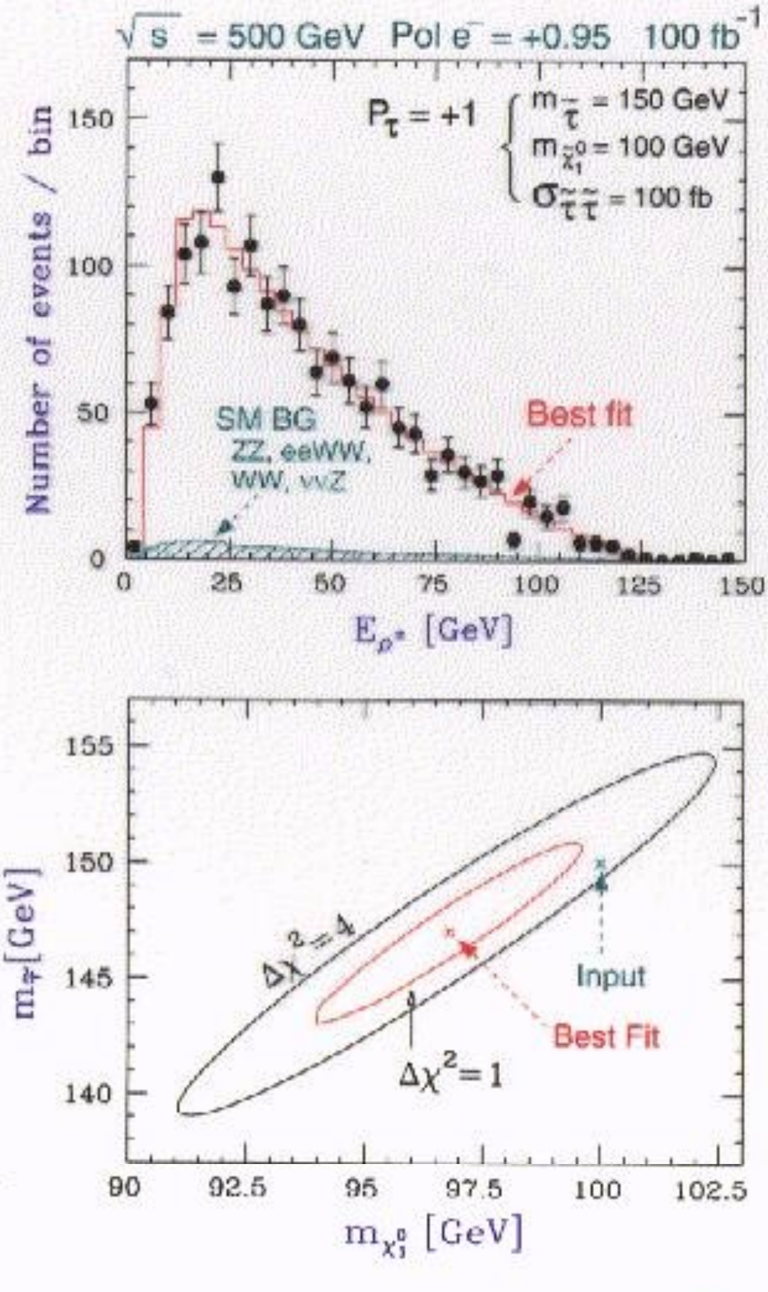
Chirality: **preserve**, **change**

Mass Determination

K. Fujii, Cracow '96
KEK preprint 96-41 (PRD)

Can't measure E_τ because of a missing ν, however, we can still measure

$E_{\rho^\pm}$ distribution ------▸ $(m_{\tilde{\tau}^\pm}, m_{\tilde{\chi}_1^0})$

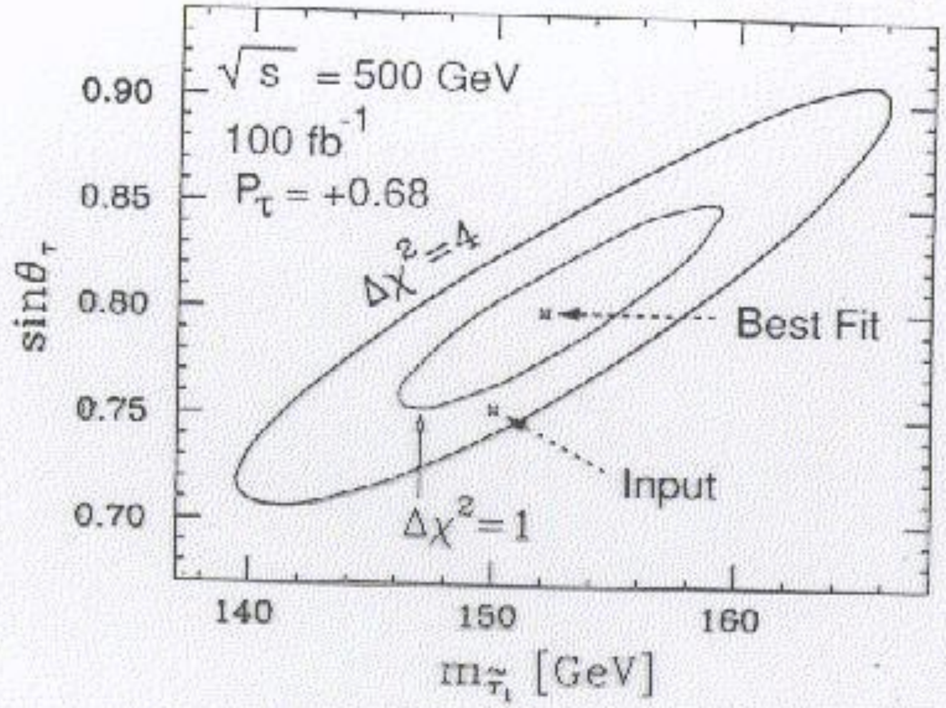


If we combine $m_{\tilde{\chi}_1^0}$ from $\tilde{e}_R^\pm$ and $\tilde{\mu}_R^\pm$ studies

$\Delta m_{\tilde{\tau}} / m_{\tilde{\tau}} \lesssim 1\%$ possible with 100 fb^{-1}

$e^+e^- \to \tilde{\tau}_1^+ \tilde{\tau}_1^-$

M. Nojiri et al.
Snowmass 96, LCWS 95



τ polarization by $\tau \to \rho \to \pi^+\gamma\gamma$

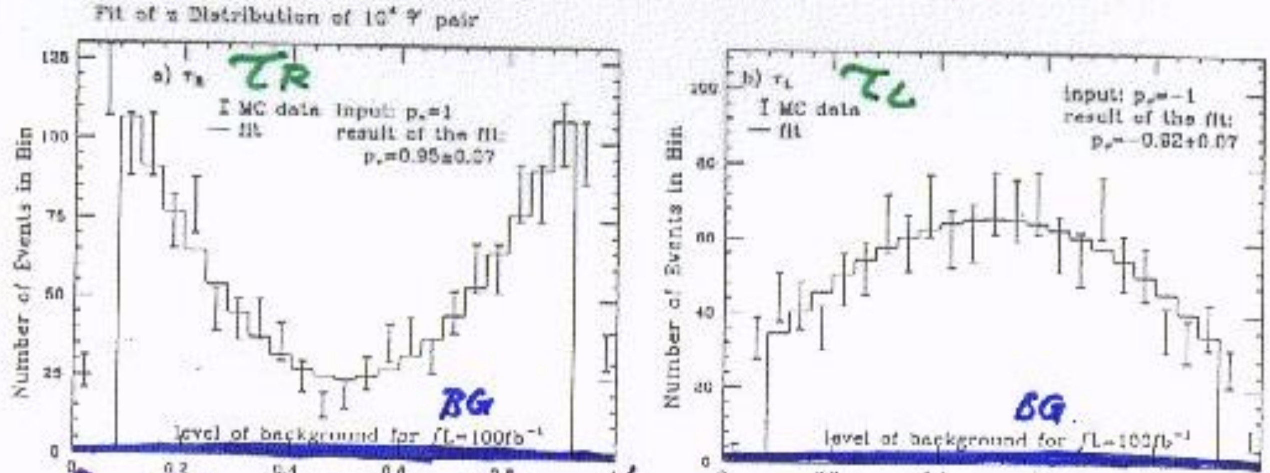


Figure 3: $z(= E_{\pi^+}/E_\rho)$ distribution of the decay $\tilde{\tau} \to \tau \to \rho \to \pi^+\gamma\gamma$ for $E_\rho > 20$ GeV. Input value of $P_\tau = 1(-1)$ for Fig.3a)(Fig.3b)) respectively. $N(e^+e^- \to \tilde{\tau}\tilde{\tau})$ =10,000, $m_{\tilde{\tau}_1} = 150$ GeV and $m_\chi = 100$ GeV . The background is generated consistent with $\int \mathcal{L} = 100 fb^{-1}$. Upper histograms are the best fit curve, while bars show MC events. Lower histograms show level of backgrounds.

BG: eeZ, eνW, W⁺W⁻, ZZ, eeWW, ννZ

K. Fujii. Cracow '96

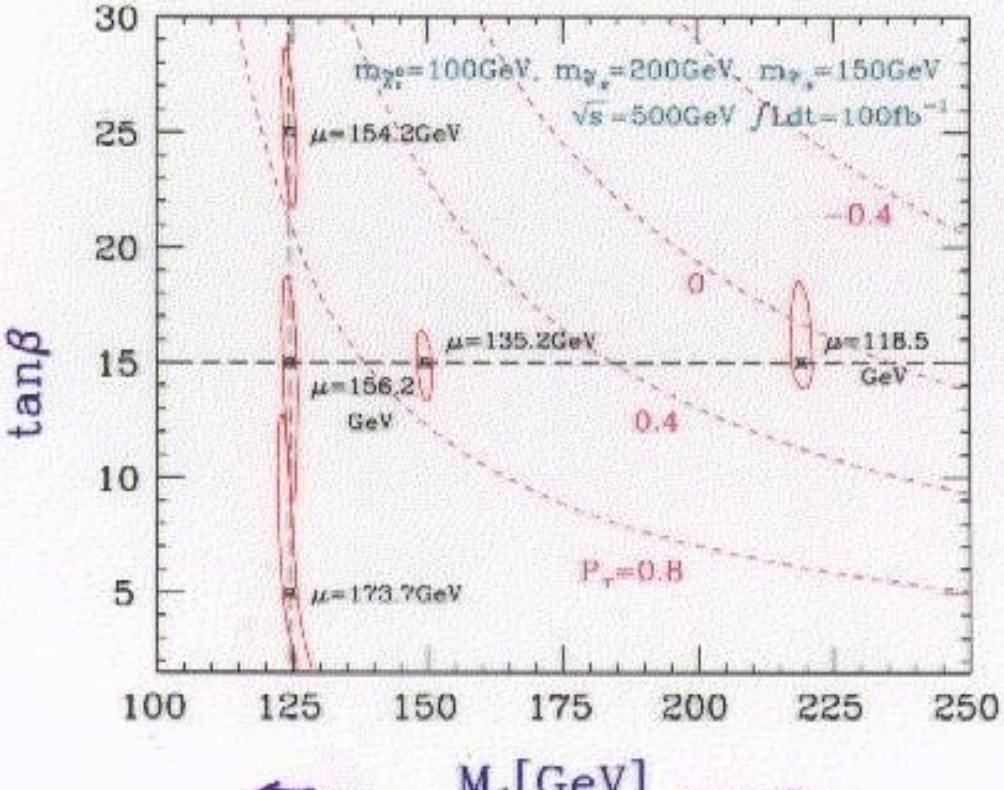
Results from Lepton Sector Global Fit

M. Nojiri et. al. KEK Preprint 96-41 (PRD)

$\tilde{e}$, $\tilde{\tau}$

Sample typical points in the parameter space and see how well we can determine tanβ

$P_{e^-} = 95\%$



← $\mu/M_1 > 1$ → $\mu/M_1 < 0$

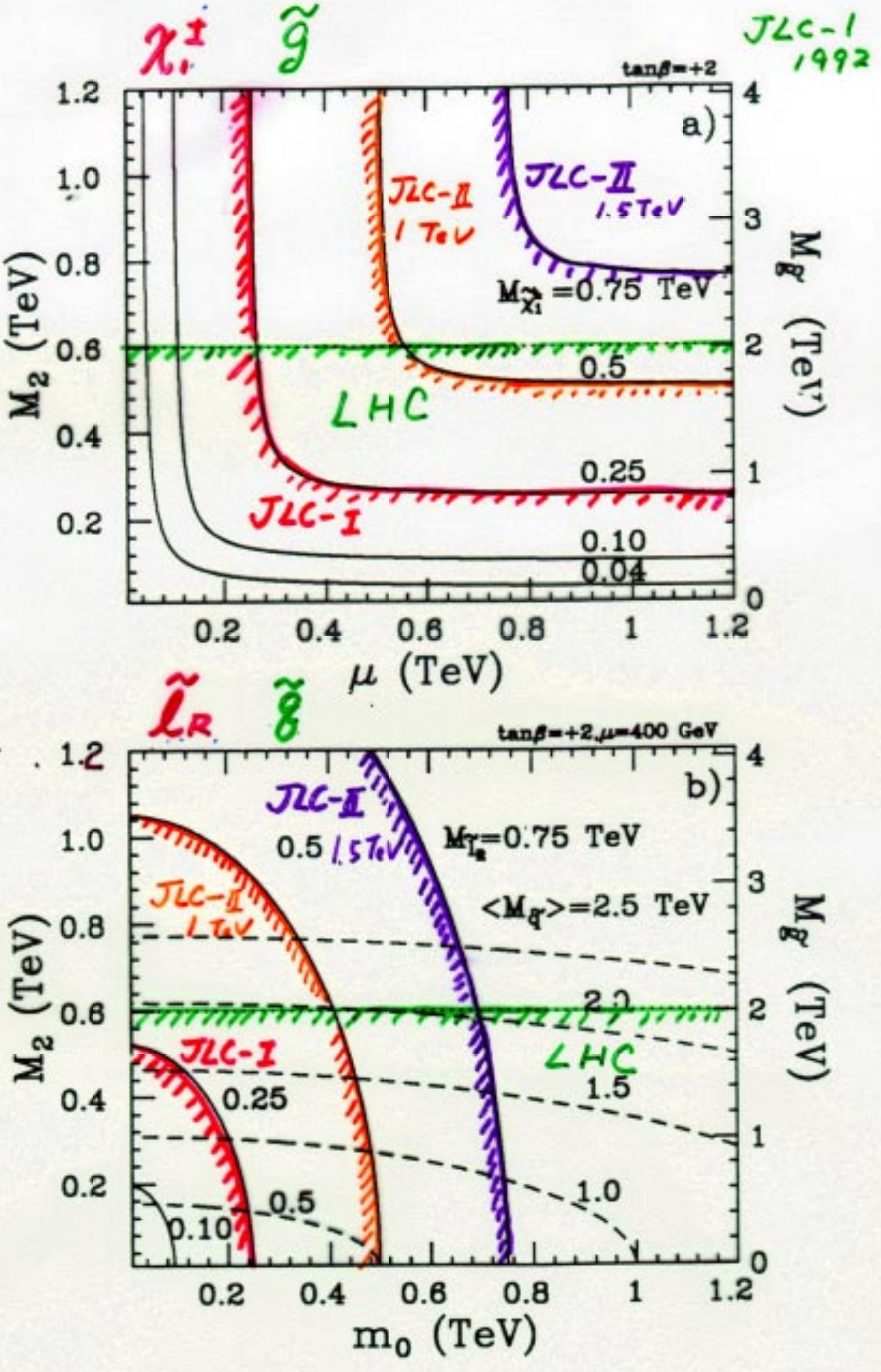
- Quickly lose sensitivity to tanβ as the LSP becomes Bino-rich!
- On the other hand, fairly good measurement is possible if it becomes higgsino-like!

Note: GUT model:

$$\frac{M_1}{M_2} = \frac{5}{3}\tan^2\theta_W \simeq 0.5$$

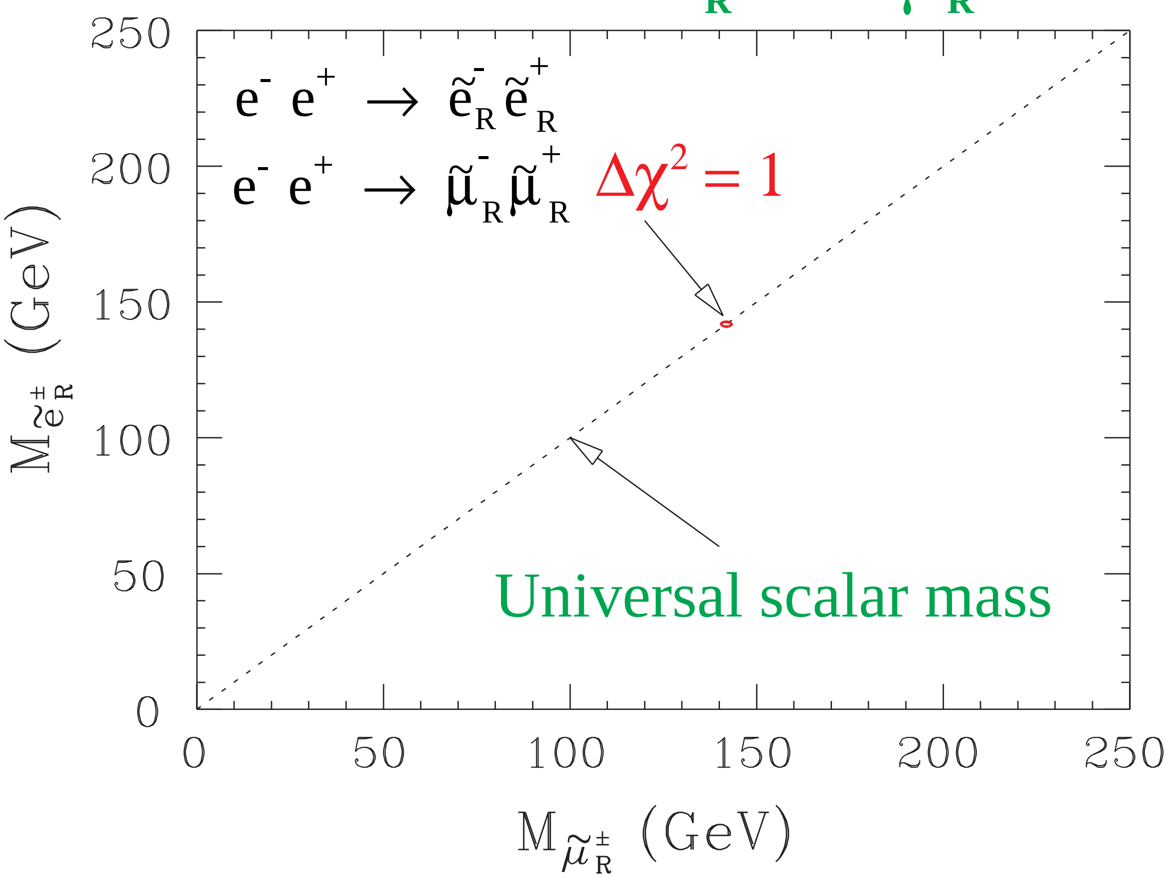
K. Fujii. Cracow '96

JLC & LHC SUGRA

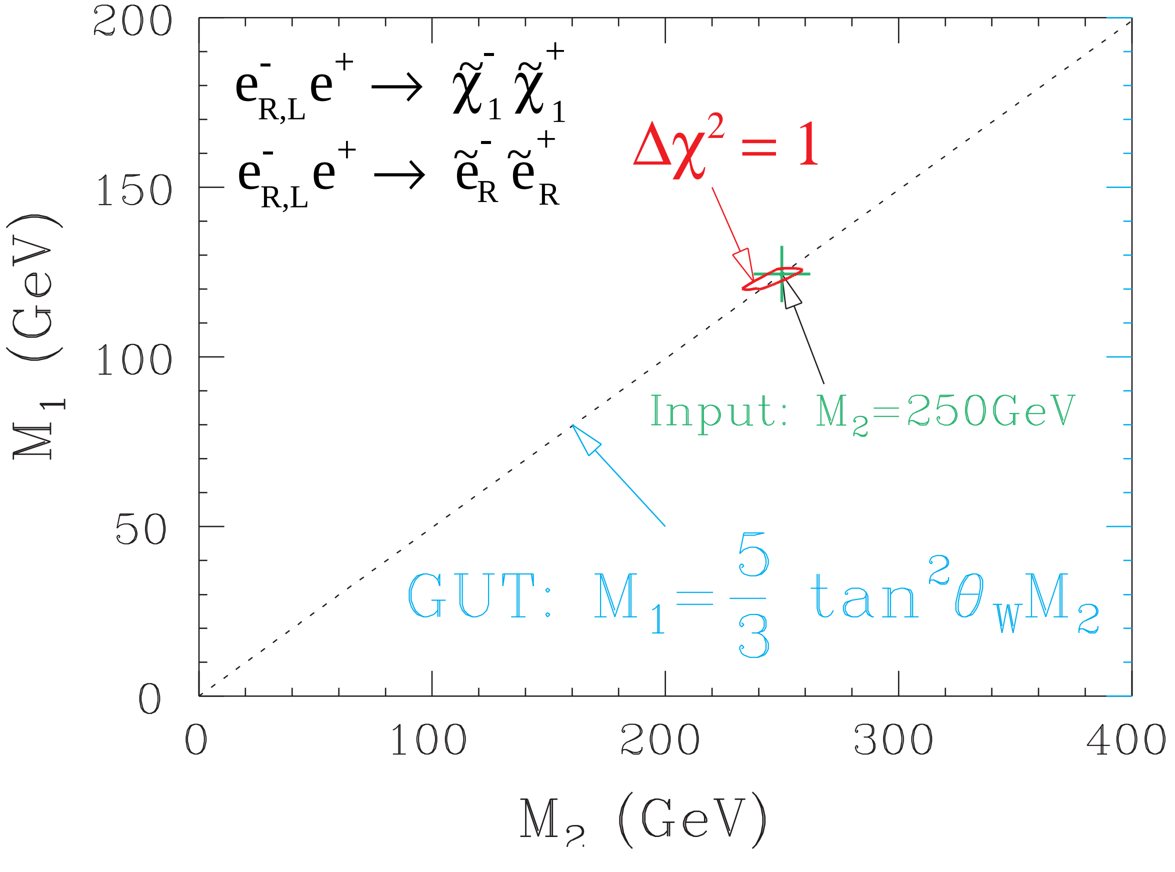


Test of SUSY-GUT

(1) Mass degeneracy $M_{\tilde{e}_R} = M_{\tilde{\mu}_R}$



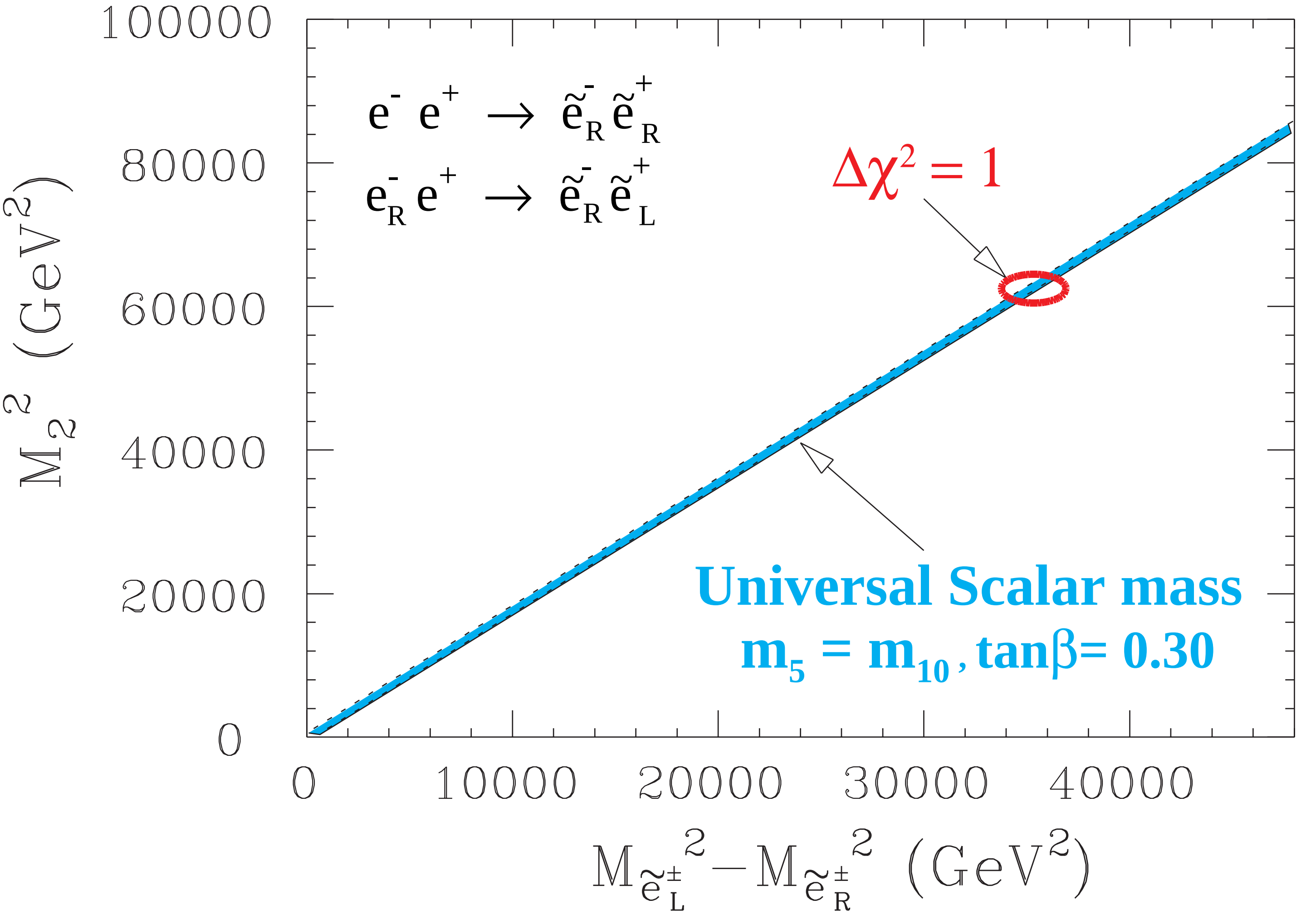
(2) From the measurements of slepton and chargino.



(3) Mass difference in sleptons.

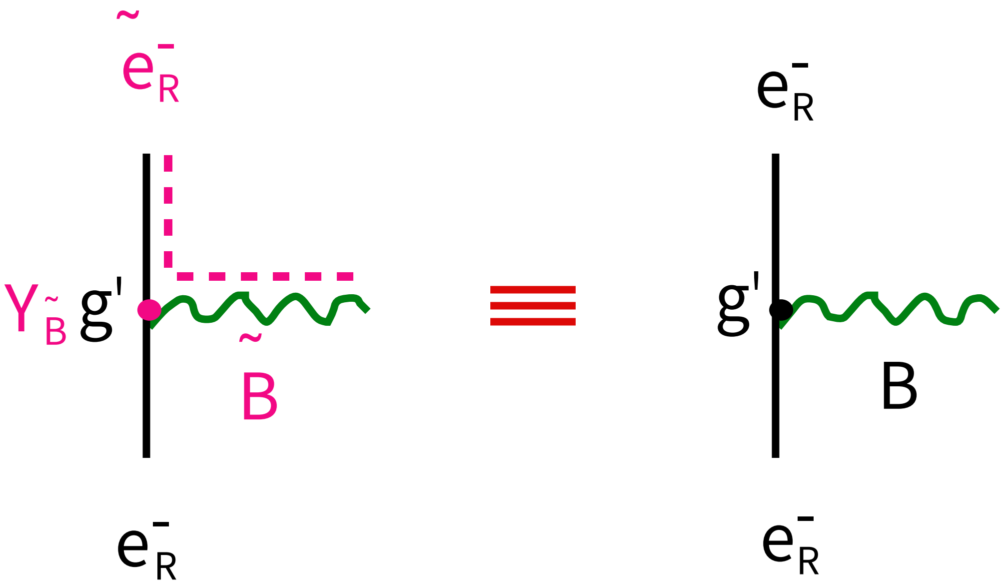
$$m^2_{\tilde{l}_L} - m^2_{\tilde{l}_R} \cong \left(\frac{3}{2}(\alpha_0^2 - \alpha_2^2) - \frac{5}{22}(\alpha_0^2 - \alpha_1^2) \right) \frac{M_2^2}{\alpha_2^2}$$

because of $\sin^2\theta_W \approx 1/4$.



Test of SUSY

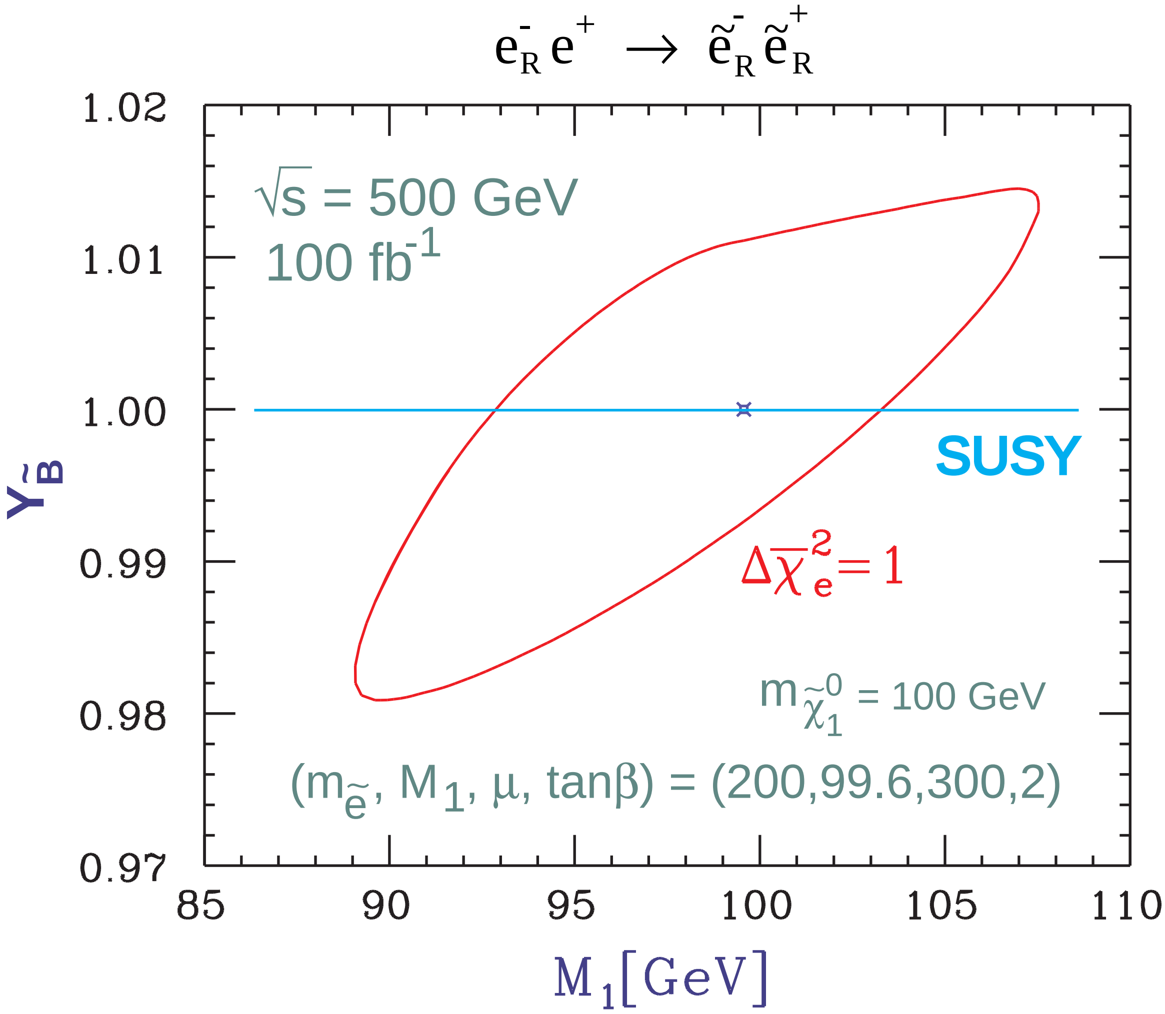
SUSY predicts the relation between coupling constants, that is $Y_{\tilde{B}} = 1$ as,



for the process of $\mathbf{e^+e^-} \rightarrow \tilde{\mathbf{e}}^+_R \tilde{\mathbf{e}}^-_R$, where $g' = g \tan\theta_W$.

Note: For M_1, $\mu >> M_Z$, the mixing in neutralino is expected to be very small, that is, $\tilde{\chi}^0_1 \approx \tilde{B}$.

From masses of selectron, neutralino and the angular distribution of selectron production, and assuming the GUT relation between M_1 and M_2 in mass matrix of neutralinos;



Test of SUSY-GUT

(1) Mass degeneracy

$$M_{\tilde{e}_R} = M_{\tilde{\mu}_R}$$

(2) From the measurements of slepton and chargino.

$$\frac{M_1}{M_2} = \frac{3}{5}\tan^2\theta_W$$

(3) Mass difference of sleptons.

$$m^2_{\tilde{l}_L} - m^2_{\tilde{l}_R} \cong \left(\frac{3}{2}\left(\alpha_0^2 - \alpha_2^2\right) - \frac{5}{22}\left(\alpha_0^2 - \alpha_1^2\right)\right)\frac{M_2^2}{\alpha_2^2}$$

because of $\sin^2\theta_W \approx 1/4$.

Summary:Physics

1. Top

If QCD corrections are precisely calculated,

Δm_t = 0.2 GeV 10 fb^{-1} ; **$\Delta m_t / m_t$** = 0.1%

$\Delta\Gamma_t/\Gamma_t$ =0.05 100 fb^{-1} ; 4th generation, unknown decay

$\Delta\alpha_s$=0.002 100 fb^{-1} ; GUT

$\Delta\beta_h$=0.25 10 fb^{-1} ; Yukawa interaction

2. W anomalous coupling

$\Delta\kappa_{Z,\gamma} \sim \lambda_{Z,\gamma} \sim$ 1 % 30 fb^{-1} $P_{e-} > 90\%$; Beyond the SM

3. Higgs

Discovery: $m_h < E_{cm} - M_z$ +10 GeV 30 fb^{-1}

if $m_h > 180$ GeV $\Rightarrow$ SUSY killer

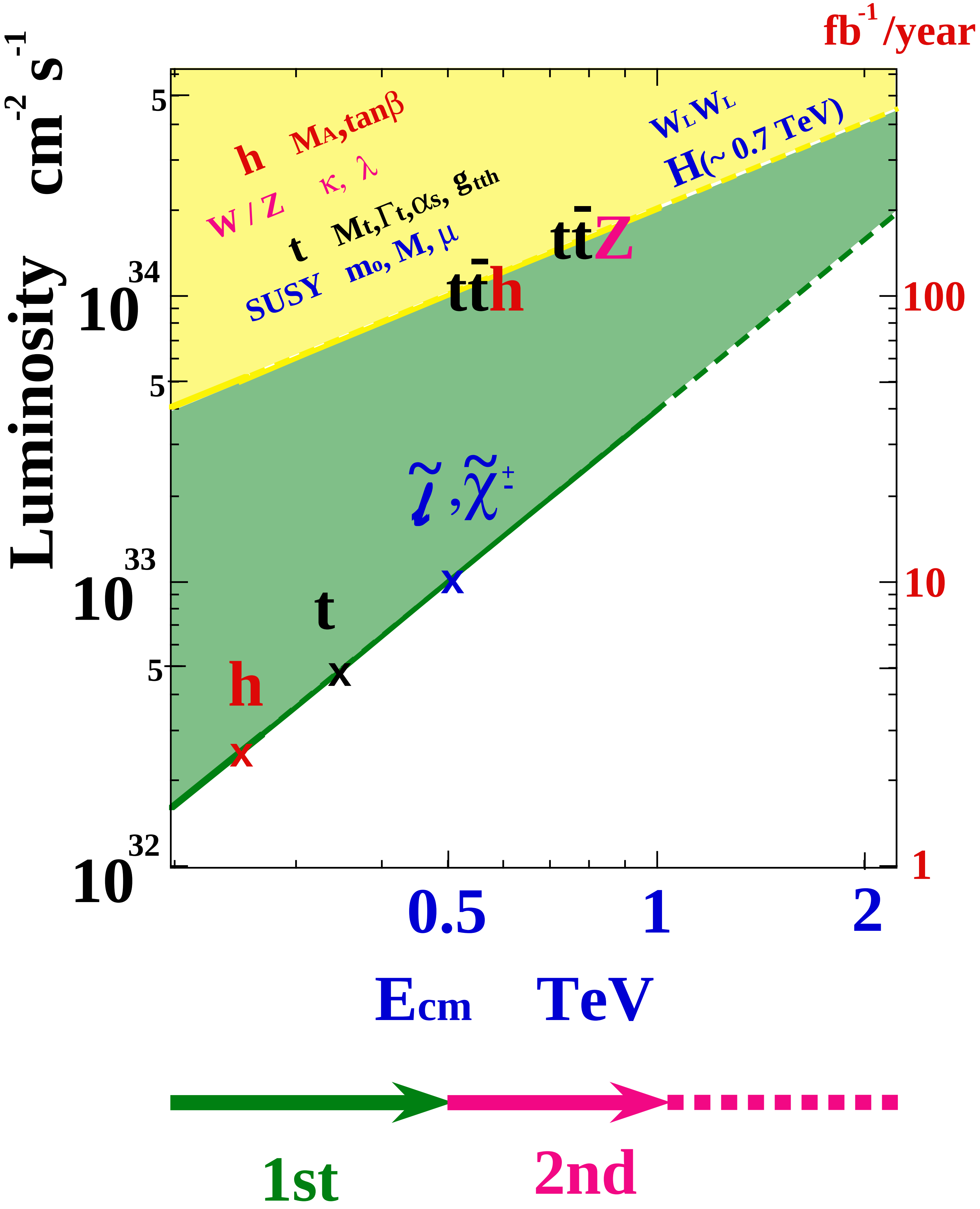
Precise measurements: 100 fb^{-1};SM or SUSY

4. SUSY (GUT)

Discovery: $m_{SUSY} < E_{cm}/2$ 10 fb^{-1}

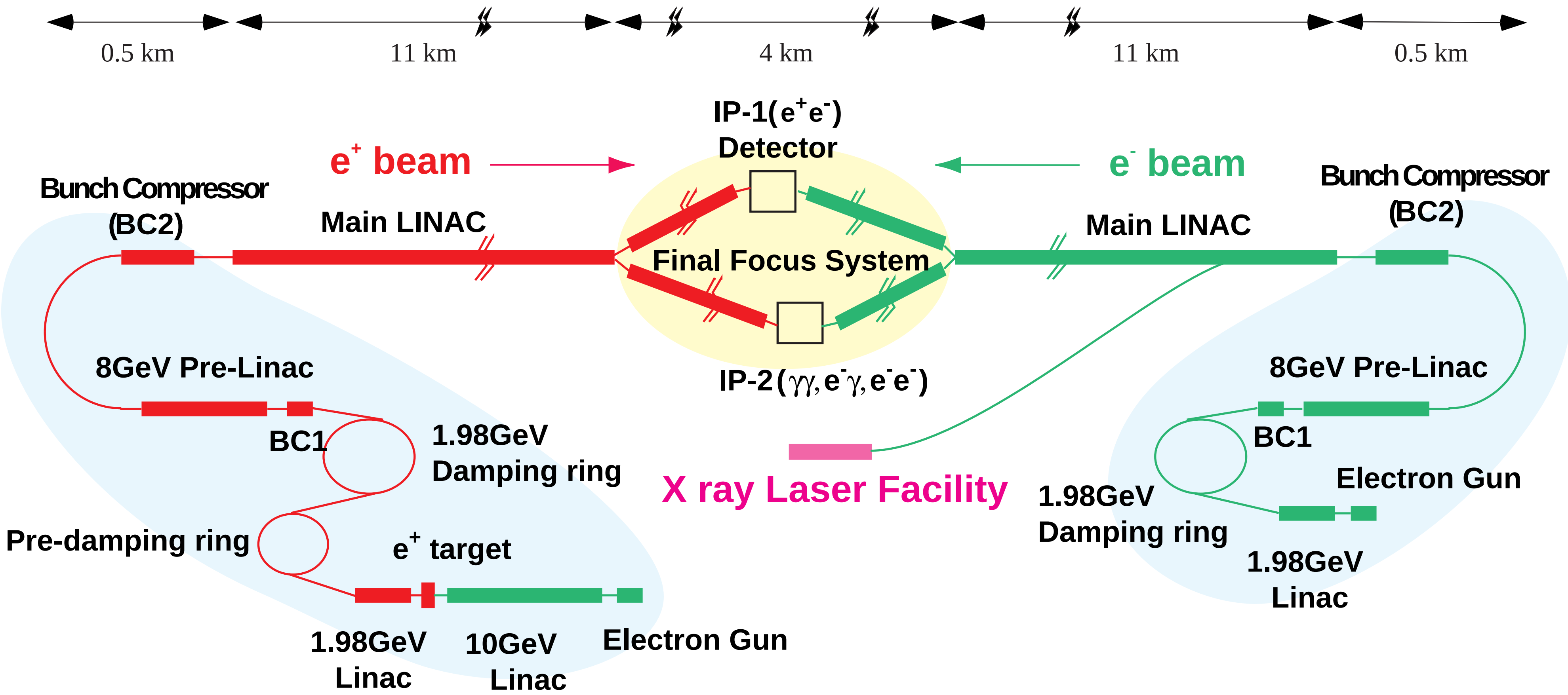
Precise measurements: 100 fb^{-1}

m_0, M_i, tanβ, μ, A $\Rightarrow$ Planck world



Luminosity cm^{-2} s^{-1}
fb^{-1}/year
h M$_A$,tanβ
W / Z κ, λ
t M$_t$,Γ$_t$,α$_s$, g$_{tth}$
SUSY m$_0$, M, μ
W$_L$W$_L$
H(~ 0.7 TeV)
t$\bar{t}$Z
t$\bar{t}$h
$\tilde{l}$, $\tilde{\chi}^{\pm}$
t
h
5
10^{34}
5
10^{33}
5
10^{32}
100
10
1
0.5
1
2
E$_{cm}$ TeV
1st
2nd

Schematics of JLC accelerator complex



JLC Parameters

based on the X-band Main Linac (April, 1997)

RF frequency	11.4 GHz (λ=2.6 cm)			
#Electrons/Bunch	7.0×10^{9} (6.45×10^{9} at IP)			
#Banches/Train	85			
Bunch separation	1.4 nsec			
G(loaded)	55.6MeV/m			
Normalized emittance	3(H) / 0.03(V) 10^{-6} rad m LINAC			
	3.3(H) / 0.048(V) 10^{-6} rad m IP			
Horizontal crossing angle	8 mrad			

Ecm=	250 GeV	500 GeV	1.0 TeV	
#Klystrons/beam	1053	2197	4485	
Length/linac	2.07	4.32	8.81	km
AC-power(wall-plug)	55	115	234	MW
	assuming 28% WP $\rightarrow$RF efficiency			
Rep.rate	150	150	150	Hz
β_x^*(mm) / β_y^*(μm)	10 / 100	10 / 100	10 / 100	
σ_x^*(nm) / σ_y^*(nm)	367 / 4.43	260 / 3.14	184/2.28	
ΔE/E due to BS	1.34	3.40	6.90	%
Pinch enhancement	1.581	1.585	1.599	
Luminosity $\times10^{33}$	4.13	8.28	16.72	$cm^{-2}s^{-1}$

The numbers are those with crab crossing. Luminosities are 3.15, 5.18, 7.66 x $10^{33}/cm^2/s$ for Ecm=250, 500, 1000GeV, respectively, with no crab crossing.

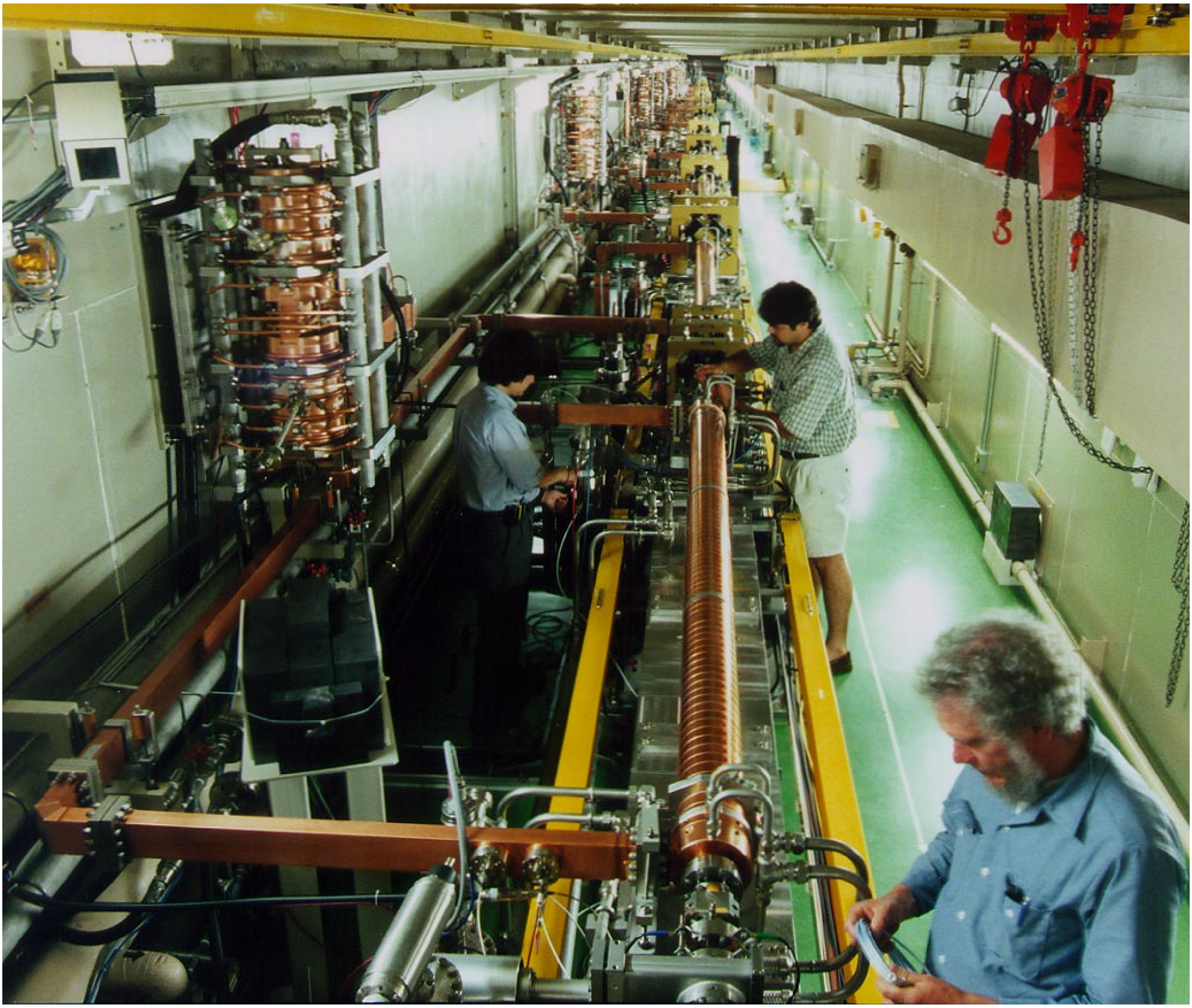
ATF-LINAC

Total length = 70 m, Maximum energy = 1.54 GeV

9 x 85MW Klystrons (S-band, 2,856 MHz,λ=100cm)

Average accelerating gradient = 30 MeV/m

It has been operating since autumn 1995.



ATF-Damping Ring

	expectation	present(6/29/98)	
Beam Energy	1.54	1.29	GeV
Intensity	2×10^{10} x 20	8×10^{9},single bunch	
Repetition rate	25	0.78	Hz
RF voltage	800	400	kV
COD amplitude	< 1	2(x), 0.5(y)	mm
Bunch length	5	7.8	mm
Damping time			
Horizontal	19.5	17.0	msec
Vertical	29.9	27.3	msec
Longitudinal	20.6	19.5	msec
Emittance:unnormalized			
Horizontal (ε_x)	1.1×10^{-9}	$(1.5\pm0.2)\times10^{-9}$	m
Vertical (ε_y)	1.1×10^{-11}	$\sim36\times10^{-11}$	m

It has been operating since January 1997.

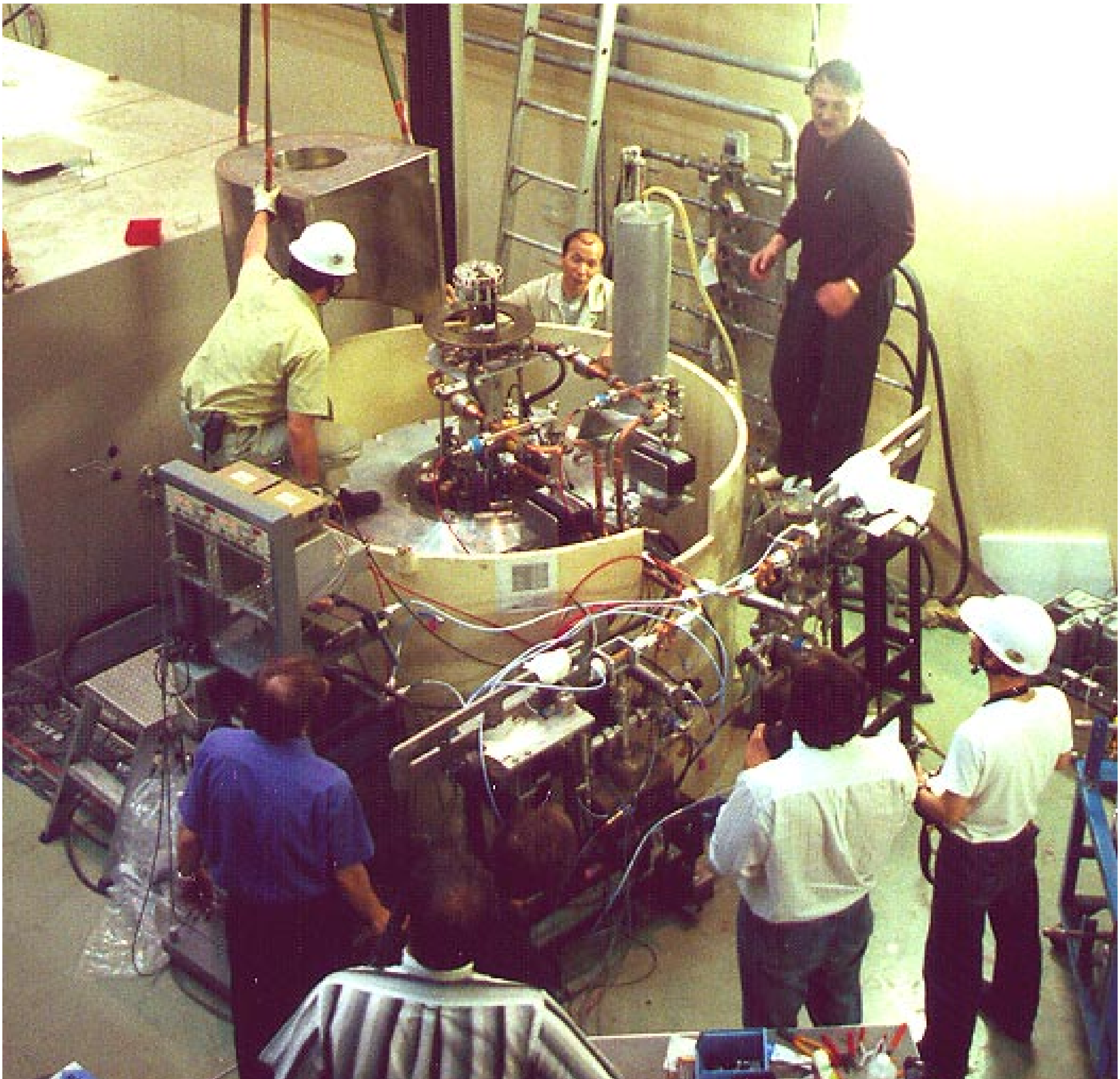
X band Klystron

XB72K No.9(solenoid-focused) and BINP PPM

achieved	XB72K No.9	BINP PPM
Output power	72 MW	55/ 77.4 MW
Pulse length	200 nsec	430/ 100 nsec
	(modulator limited)	(vacuum limited)
Effciency	31%	33/38%

Newly designed XB72K No.10 is expected to produce 126MW at 1.5µsec pulse, eff.=48.5%. It will be tested in this October.

This picture shows a setup of testing BINP PPM.



C band Klystron

Performances by high power test , August,1997

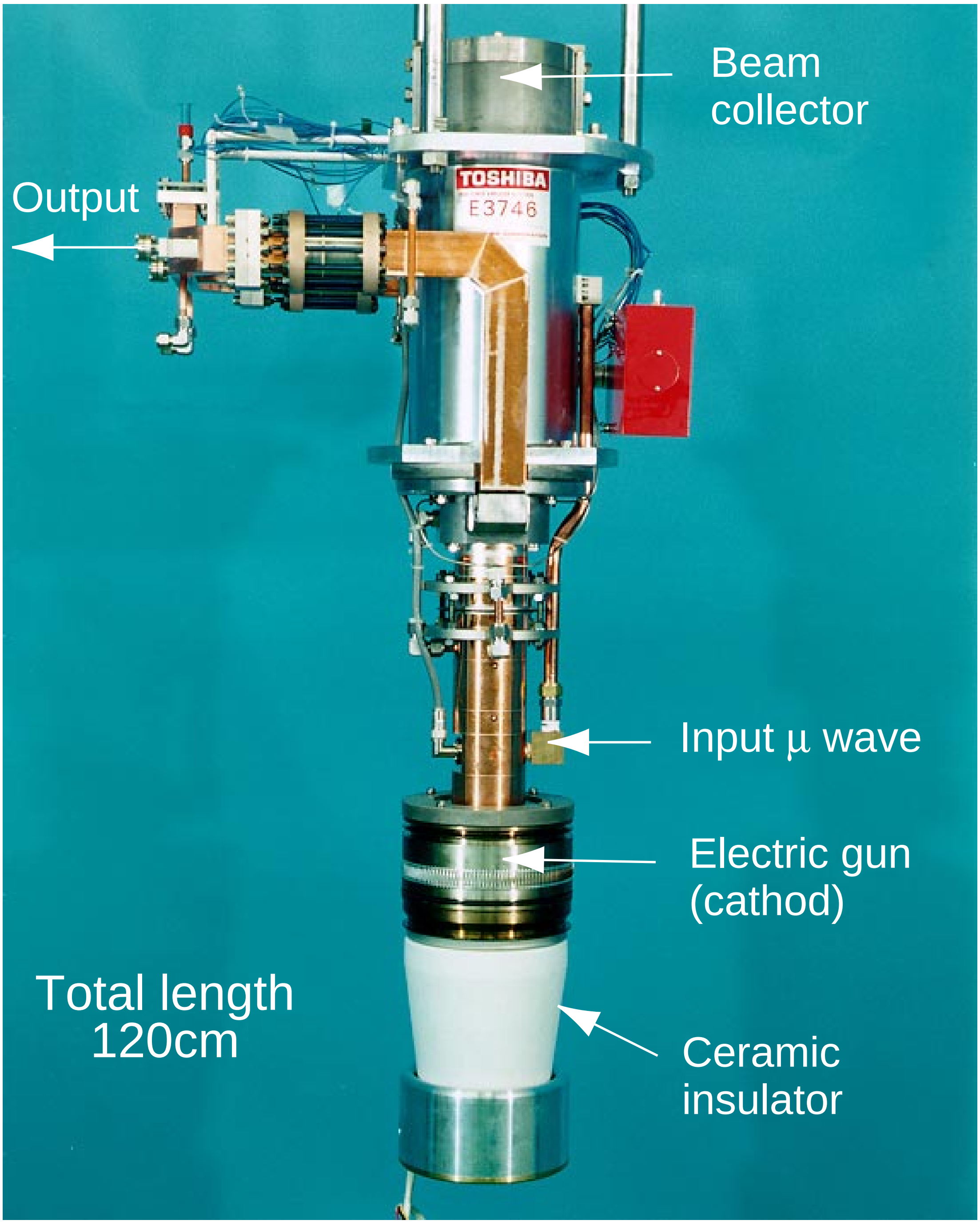
Short pulse mode:

50MW, 1μsec, 20 pps, 43% efficiency

Long pulse mode:

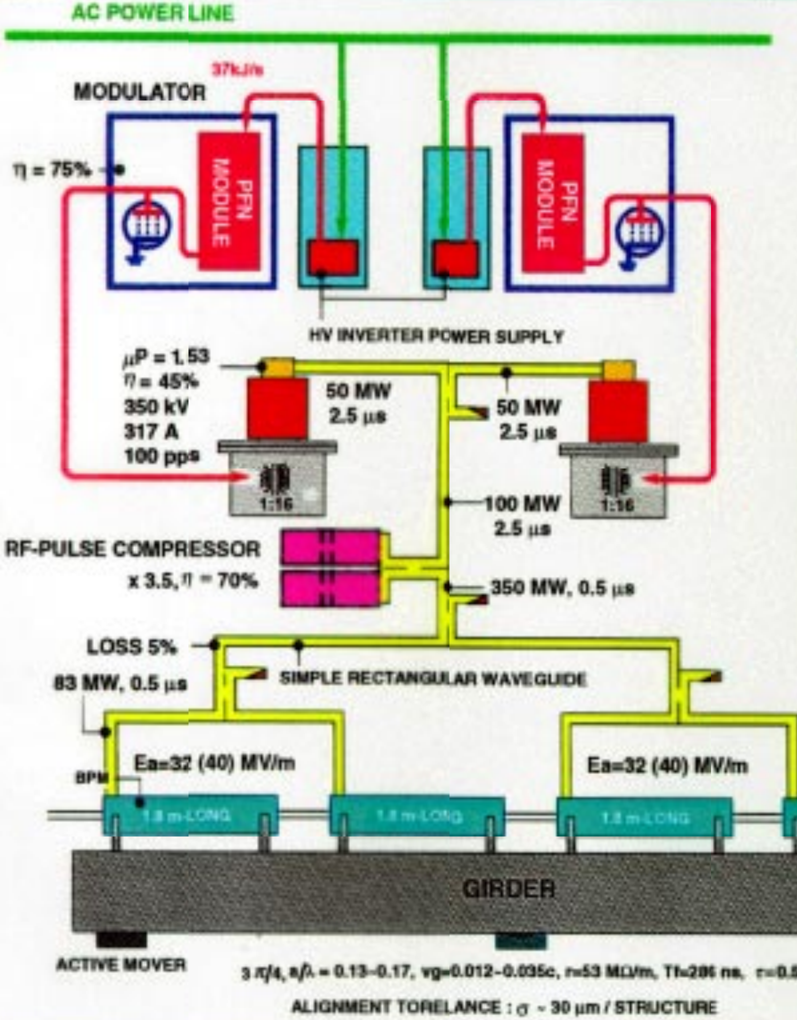
46.4MW, 2.5μsec, 50 pps, 42% efficiency

These already fulfill the design values.



C-band LC

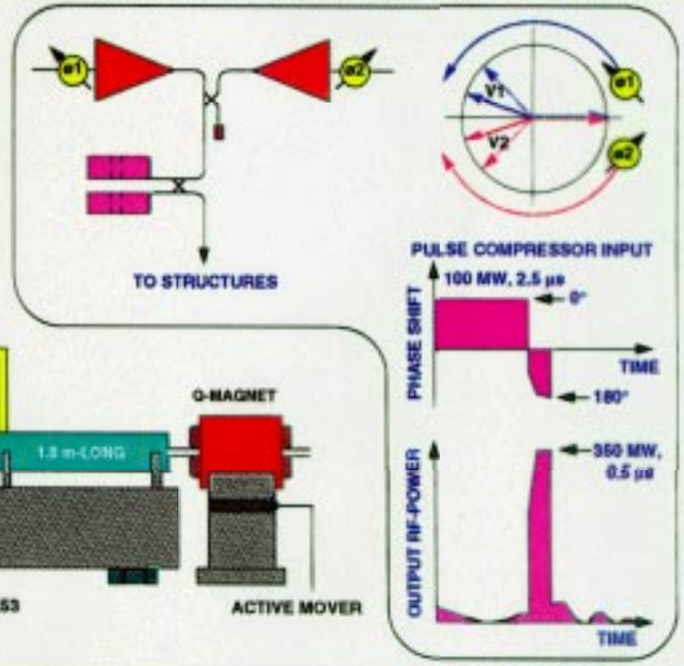
MAIN LINAC RF-SYSTEM   C-band LINEAR COLLIDER



5712 MHz, $\sqrt{S}$ =500 GeV FOR TWO LINACS

RF-SYSTEM	: 2040 UNITS
MODULATORS	: 4080
KLYSTRONS	: 4080
ACC. STRUCTURES	: 8160
ACTIVE LENGTH	: 14.7 KM
WALL-PLUG POWER	: 150 MW

BEAM LOADING COMPENSATION USING PHASE -TO-AMPLITUDE MODULATION



JLC Road Map

Linear Collider Schedule (Tentative)

JLC Promotion Ofiice at KEK,July 9, 1998

presented by H.Sugawara, KEK Director General, at ICHEP, Vancouver, 1998

Year	Month	
1999		ACFA discussion on construction site.
		ISG activities.
		ACFA study and International Physics/Detector study activities.
		Scientific study on site candidates.
2000	1	ISG pre-design report.
	2	ACFA discussion on regional cooperative framework.
	3	**JHEPC decision** on the project (in consultation with MESSC).
	4	KEK submits a request for site investigation budget to MESSC.
		Conceptual design work begins.
		Preliminary environmental assessment begins.
2001	3	CDR to MEST (,JSC and ACFA) as a major element of the 2nd-phase Basic Plan for Science and Technolody.
	4	Site-specific Engineering Design begins.
		Environmental assessment continues.
		Discussions on international framework begin.
2002	4	KEK submits **construction budget request** to MEST.
	6	An agreement on partners and budget sharing.
2003	1	Final design optimization begins.
	4	Construction begins.

Conclusion

1. JLC as

ACFA Joint Linear Collider,

but open to the international reserach community.

2. E_{cm}= 250 - 500GeV is very important.

SUSY or ?

3. e^+e^- collision will be in 2008.

4. Please join us.

ACFA physics and detector working group and the world-wide collaboration are initiated recently.