LC Physics Study Group Meeting

Introduction

2003.4.25 at KEK
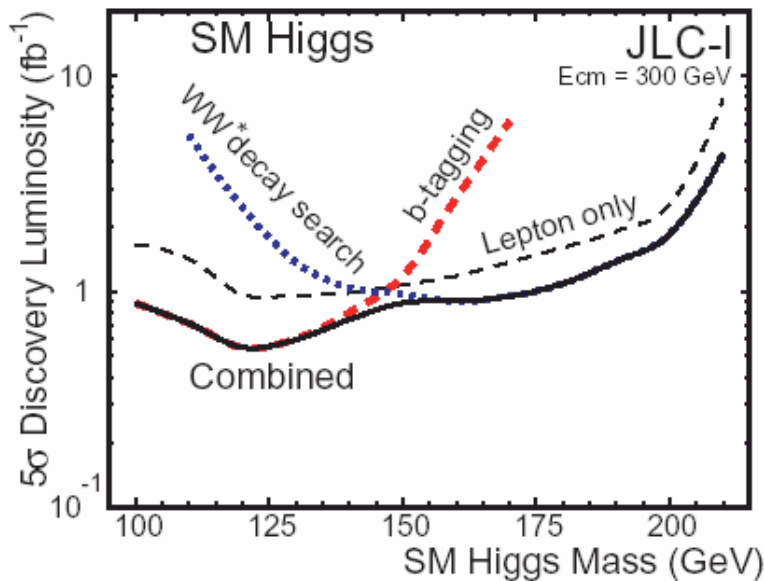
Yasuhiro Okada (KEK)

Past activities on LC physics study (among theorists and experimentalists) .

- JLC-1 (92)
- World-wide LCWS

  91, 93, 95(Morioka),99,00, 02(Jeju)

- ACFA LCWS

  98(Beijing), 99(Seoul), 00(Taipei), 01(Beijing), 02(Tokyo)

- ACFA report on "Physics and Experiments at JLC" (01)
- "Roadmap" report, JLC project (03)

Higgs physics

Detection

Coupling measurements

| $\sqrt{s}$	300 GeV	400 GeV	500 GeV
Δm_h (lepton-only)	80 MeV	—	—
Δm_h	40 MeV	—	—
$\Delta\sigma/\sigma$ (lepton-only)	2.1%	2.5%	2.9%
$\Delta\sigma/\sigma$	1.3%	—	—
$\Delta(\sigma_h \cdot Br(b\bar{b})$	2.0%	—	—
ZZH-coupling $\Delta ZZH/ZZH$	1.1%	1.3%	1.5%
WWH-coupling $\Delta WWH/WWH$	1.6%	—	—
$\Delta\Gamma_{h^0}/\Gamma_{h^0}$	5.5%	12%	16%
Yukawa coupling $\Delta\lambda/\lambda$			
λ_b	2.8%	6.1%	8.1%
λ_τ	3.5%	—	—
λ_c	11.3%	13%	15%
λ_b/λ_τ	2.3%	—	—
λ_b/λ_c	11%	12%	14%
$\lambda_{up-type}$	4.1%	—	—
$\lambda_{down-type}/\lambda_{up-type}$	3.2%	—	—
$\Delta(\sigma \cdot Br)/(\sigma \cdot Br)$			
$h^0 \to b\bar{b}$	1.1%	1.3%	1.7%
$h^0 \to W^+W^-$	5.1%	12%	16%
$h^0 \to \tau^+\tau^-$	4.4%	—	—
$h^0 \to c\bar{c}+gg$	6.3%	—	—
$h^0 \to c\bar{c}$	22%	23%	27%
$h^0 \to gg$	10%	11%	13%
$h^0 \to \gamma\gamma$	—	—	—
$h^0 \to Z^0\gamma$	—	—	—

mh=120 GeV,Lint=500/fb
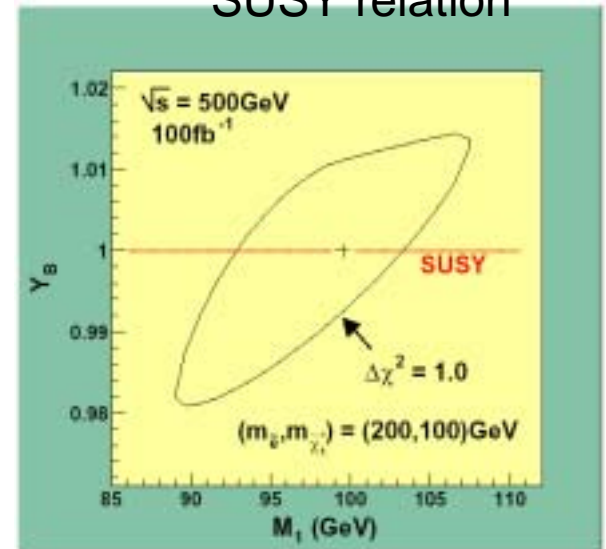
Supersymmetry

Smuon production
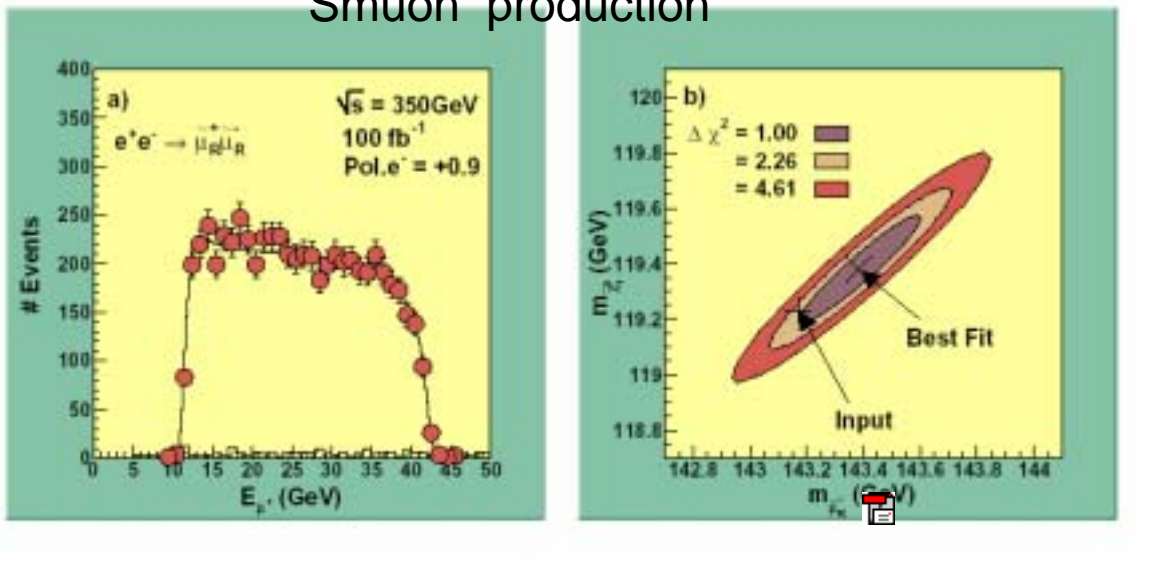
GUT relation
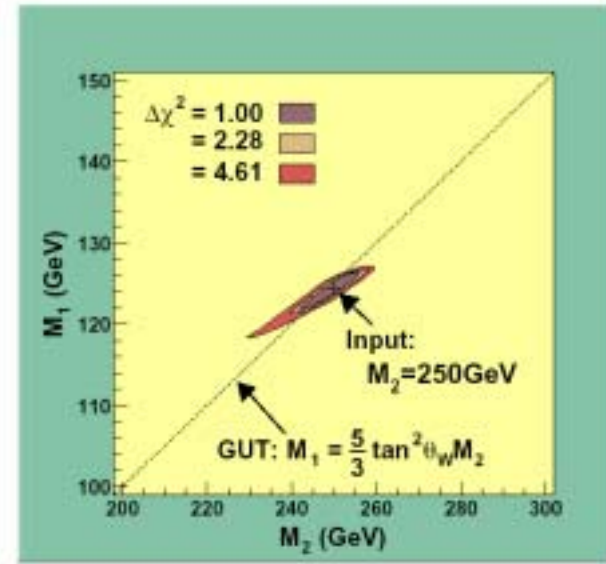
Chargino production
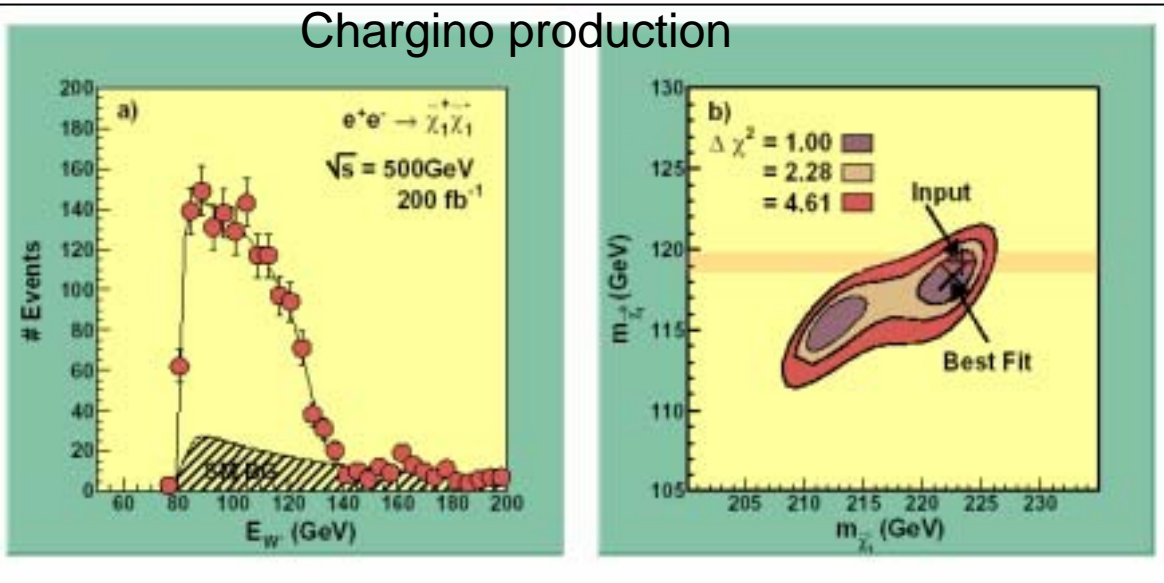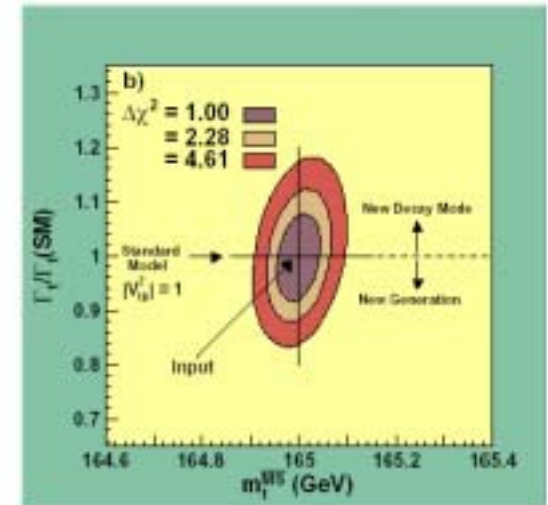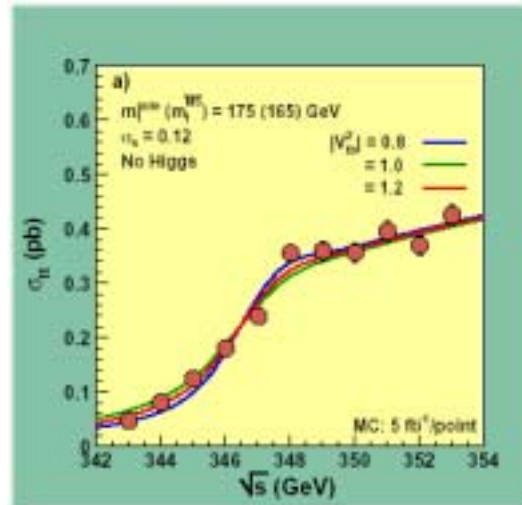
SUSY relation

Top and W boson

Mass and width determination
by top threshold scan

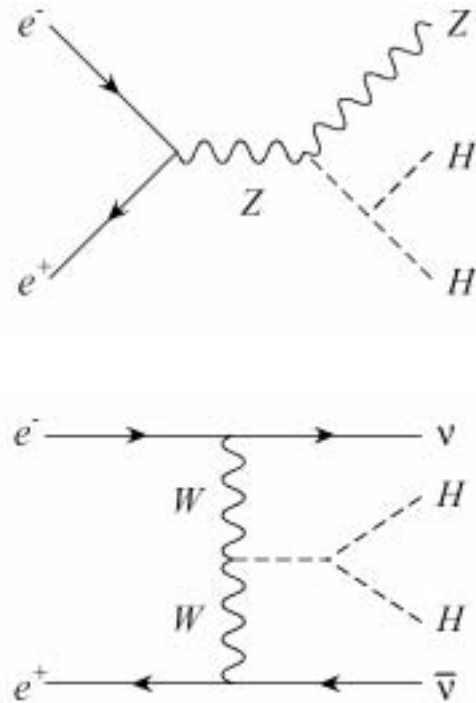Sensitivity to triple
Gauge boson coupling
constants

$$\mathcal{L}_{WWV}/g_{WWV} = ig_1^V(W_{\mu\nu}^\dagger W^\mu V^\nu - W_\mu^\dagger V_\nu W^{\mu\nu}) + i\kappa_V W_\mu^\dagger W_\nu V^{\mu\nu}$$
$$+ \frac{i\lambda_V}{m_W^2}W_{\lambda\mu}^\dagger W_\nu^\mu V^{\nu\lambda},$$
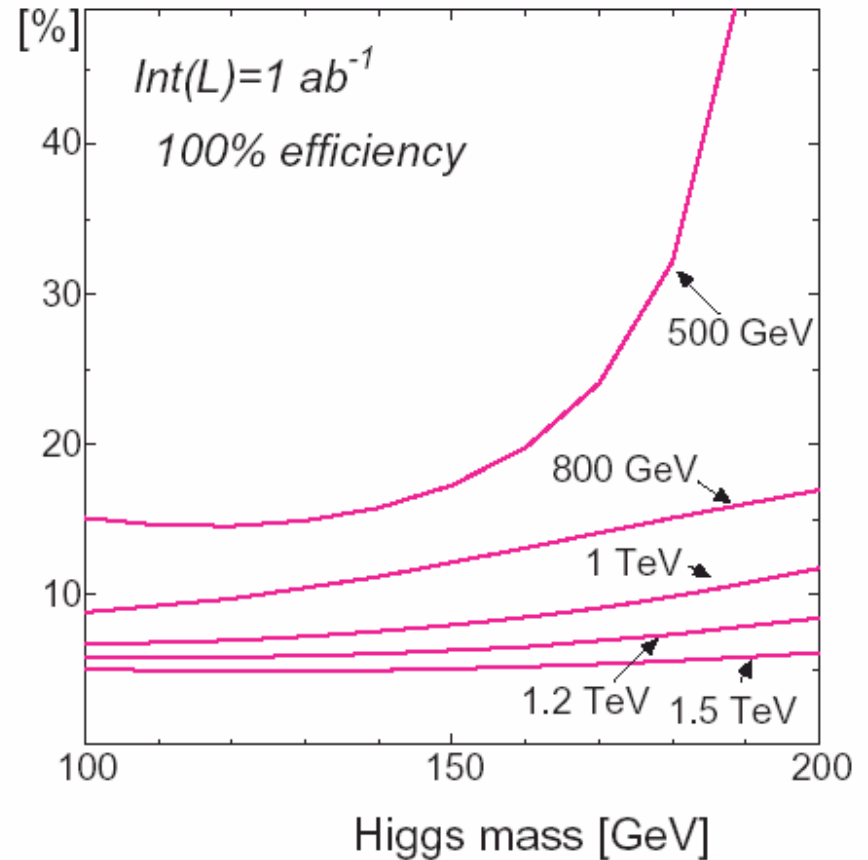
$\sqrt{s} = 500$ GeV and $\mathcal{L} = 50\ fb^{-1}$

Process	$\Delta\kappa_\gamma$	$\Delta\kappa_Z$	λ
W^+W^-	$-0.0052 \sim 0.0057$	$-0.0064 \sim 0.0062$	$-0.012 \sim 0.021$
$e\nu W$	$-0.021 \sim 0.020$	$-$	$-0.039 \sim 0.038$
$\nu\bar{\nu}\gamma$	$-0.071 \sim 0.075$	$-$	$-0.044 \sim 0.079$
$\nu\bar{\nu}Z$	$-$	$-0.29 \sim 0.25$	$-0.46 \sim 0.17$
$W^+W^-\gamma$	$-0.020 \sim 0.016$	$-0.018 \sim 0.025$	$-0.025 \sim 0.028$
W^+W^-Z	$-0.053 \sim 0.041$	$-0.071 \sim 0.15$	$-0.050 \sim 0.030$
$eeWW$	$-0.032 \sim 0.039$	$-$	$-0.084 \sim 0.12$

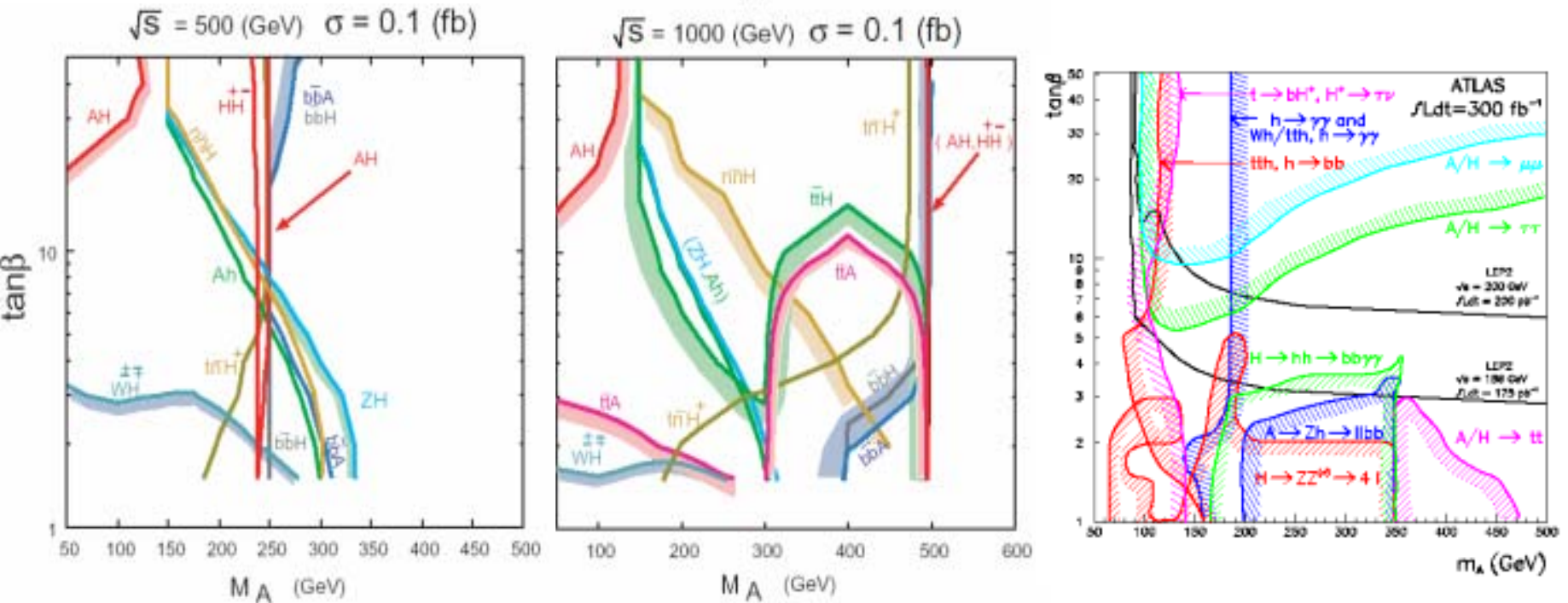# Things calculated only theoretically, ...

Higgs self-coupling measurement

Y.Yasui, et.al.

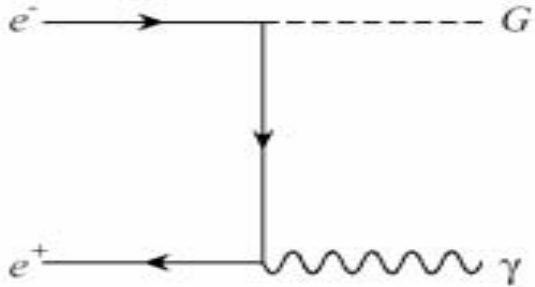# Heavy Higgs boson in MSSM

LC (Contours of production cross sections)

LHC

S.Kiyoura, et. al.
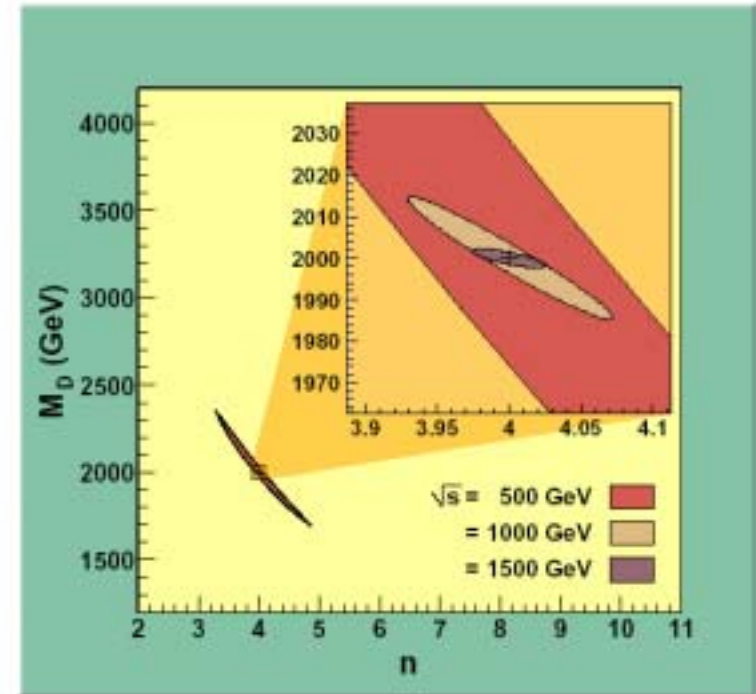
Extra-dimensions

Determination of the number of
extra-dimensions by the missing-mass
distribution.

K. Odagiri

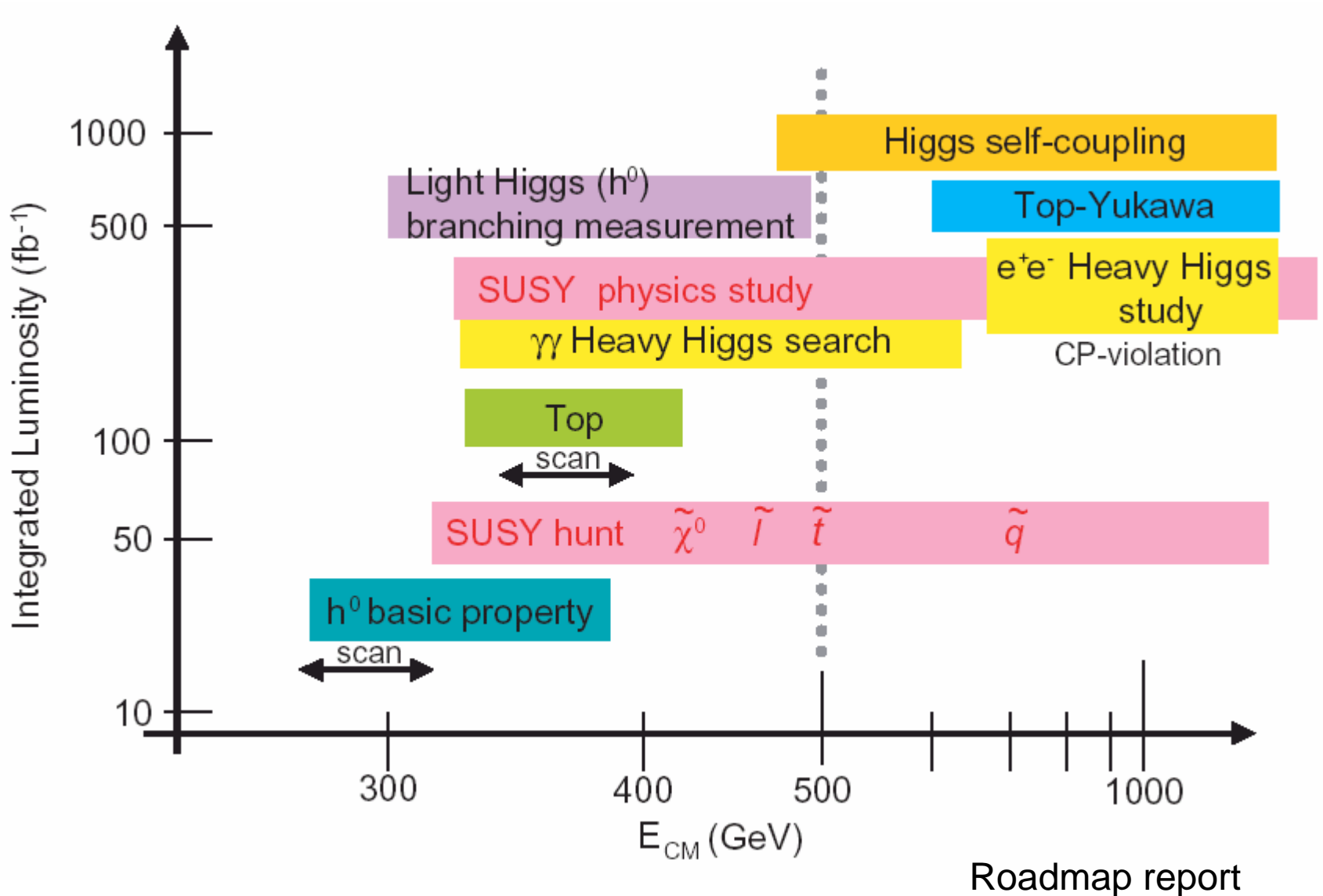# Heavy Higgs boson production in a photon-photon collider

$$\gamma\gamma \to \mathrm{H}, \mathrm{A} \to \bar{\mathrm{t}}\, \mathrm{t}$$

A : solid line
H: long-dashed

E.Asakawa, et. al..
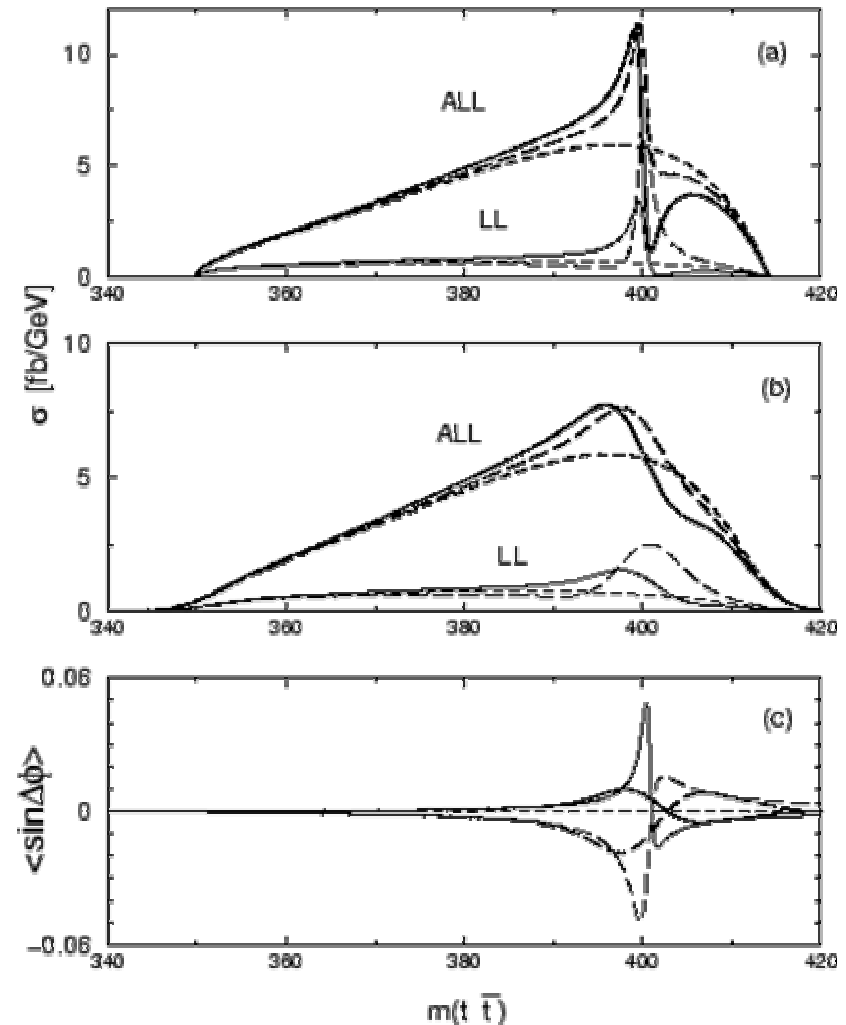
Physics research at each stage of energy and integrated luminosity

Roadmap report

- Many issues remain to be studied.
- Simulation studies are necessary to evaluate detection efficiencies and backgrounds for some important processes.

	LHC	LC 500 GeV	LC 1 TeV
Light Higgs boson (120 - 140 GeV)			
Detection	○	○	–
Width (Γ_H)	△	○	–
J^P	△	○	–
Coupling (g_{VVH}, Y_{ffH})	○	◎	–
Top Yukawa C.C.(Y_{ttH})	△	×	○
Self-coupling(λ_{HHH})	×	△	○
500 GeV SM Higgs boson			
Detection	○	×	○
Top quark			
Δm_t	~ 1 GeV	$\lesssim$ 100 MeV	–
Width (Γ_t)	×	a few %	–
Supersymmetry			
Squark mass reach	$\lesssim$ 2.5 TeV	$\lesssim \sqrt{s}/2$	
Slepton/Chargino/Neutralino	Cascade decay	Pair production	
Mass measurement	○	◎	
Proving SUSY (Spin, Coupling)	×	◎	
Testing SUSY breaking model	○	○	
MSSM Heavy Higgs	high tan β	$\lesssim \sqrt{s}/2$	
Indirect constraint			
on SUSY parameters	△	○	○
Large Extra Dimension			
KK graviton	○	△	○
Black hole production	○	×	△
Z', KK graviton of RS model, KK mode of W and Z, etc.	Direct production	Contact interaction	
Mass reach	○	○	◎

Roadmap report 11

Today's meeting

- Hear a report on past/on-going activities from each "group".

(Higgs, New Physics, Top, Gamma-gamma,

 Luminosity, +World-wide study on LHC/LC)

- Set next goals for each group.

- Discuss how to proceed.

- We should present many results, for example, at LCWS 2004 and ACFA LCWS 2003.

To be discussed

- Form working groups and choose conveners.
- List items to be studied.
- Decide analysis methods (platform, etc.).
- List activities involving both theorists and experimentalists.
- Set up rough schedule of activities.
- Decide immediate next steps (tutorial school for beginners, etc.)

  etc. etc.