La Thuile, 7 March '02

Round Table:
"A Picture of HEP in the LHC Era"

The Point of View of Physics

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Main open problems in particle physics

The problem number 1

- What and where is the Higgs
- What new physics near the weak scale
  - Supersymmetry ?
  - Extra dimensions ?
  - New strong forces ?

LHC, NLC, CLIC, VLHC, μ collider

Problem number 2 — The Flavour problem

Quarks
- FCNC, rare decays
- CKM, is $\not{C}$P fully CKM?
- p decay........

Leptons
- Rare decays ($\mu \to e\gamma$,...)
- ν oscill's, masses, mixings
- μ_{g-2} ......

→ LHC, new B,K, ... factories, superbeams, ν factories, undrgrnd detect's &labs

The interest on ν masses, mixing and ~~CP~~ will last:

- same dignity as for quark masses and CKM
- added interest for Majorana and cosmol. features:
  - L non conservation, link to GUT's
  - Baryogenesis thru leptogenesis, hot DM

While superbeams could be an intermediate step ν-factories are the ultimate facility.

Precision measurements of ν mixing parameters:

θ_{23}, Δm^2_{23} at ~1%, θ_{13} down to few tenth of a degree,

sign(Δm^2_{23}), CP violation phase iff MSW-LA

rare μ and K decays, precision e-w tests...

Apart from additional "local" projects, the main "international" or even "world" projects are:

LHC, NLC, ν-factory
CLIC, VLHC, μ-collider

The LHC has been designed to explore the relevant energy region and to give a clear answer to Problem 1.

The motiv.s for an e^+e^- collider to look at the same physics is that the picture from the LHC will be coarse-grained.

Assuming the standard way beyond the Standard Model

Conceivably the LHC will achieve:

Higgs:

Observed

$\Delta m/m \sim 10^{-2} - 10^{-3}$

one or two decays measured

SUSY:

Discovered a number of sparticles

many missed

(e.g. heavier higgses, gauginos, sleptons)

few precise measurements done

In 1987 a La Thuile Workshop concluded that to cover the whole LHC range a e^+e^- collider must have 2E = 2 TeV → CLIC

For NLC:
2E = 0.5-1 TeV-> sensitivity to new physics threshold

Conceivably the NLC will achieve:

Higgs:

The lightest H cannot escape

Studied; $\Delta m/m$ -> few 10^{-4}
more decays observed-> couplings

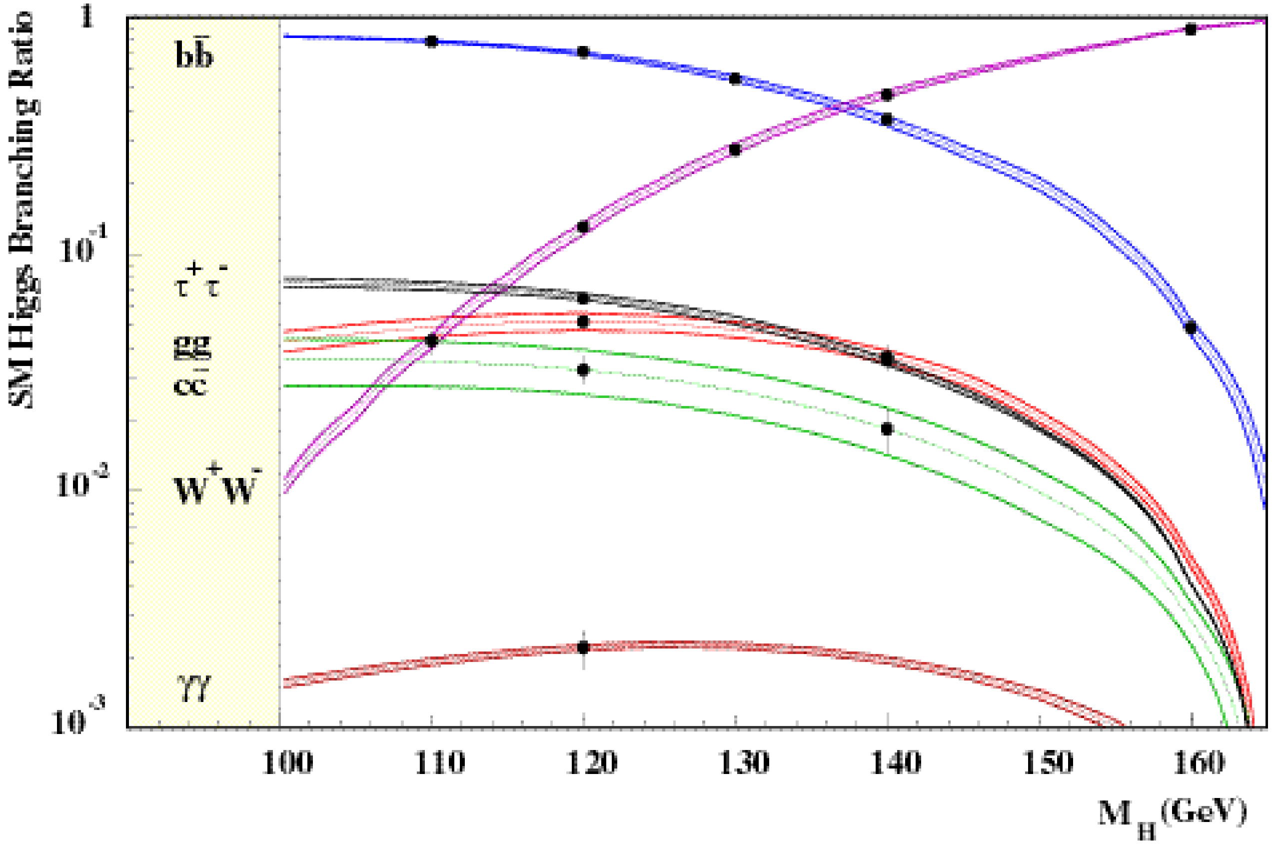
SUSY:

More thresh dep. But e-w spectrum most probably in

Discovered all e-w coupled sparticles, within reach;
many precise measur'ts done

+ top physics, more precision e-w tests.....

Expected accuracy on H branching ratios



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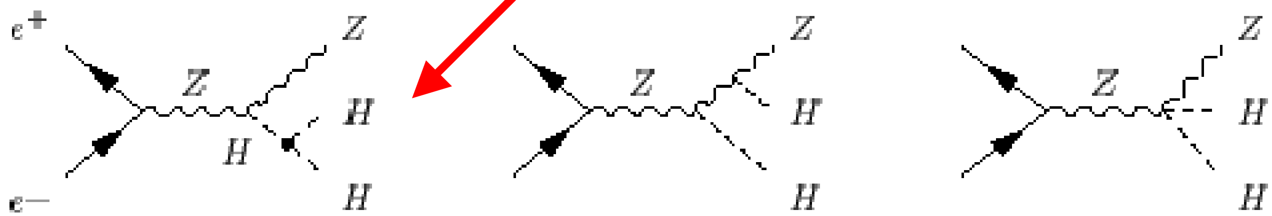
Measuring λ_{HHH} (test of SM Higgs potential)

e^+e^- -> ZHH



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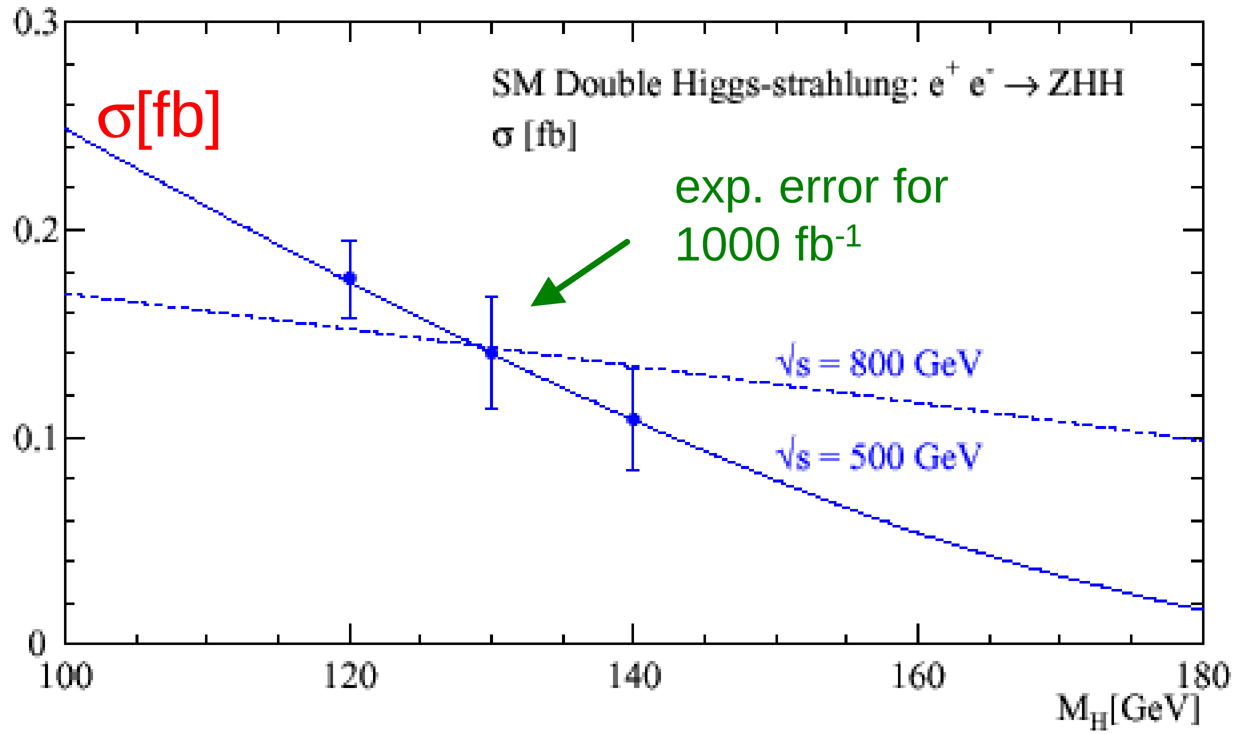

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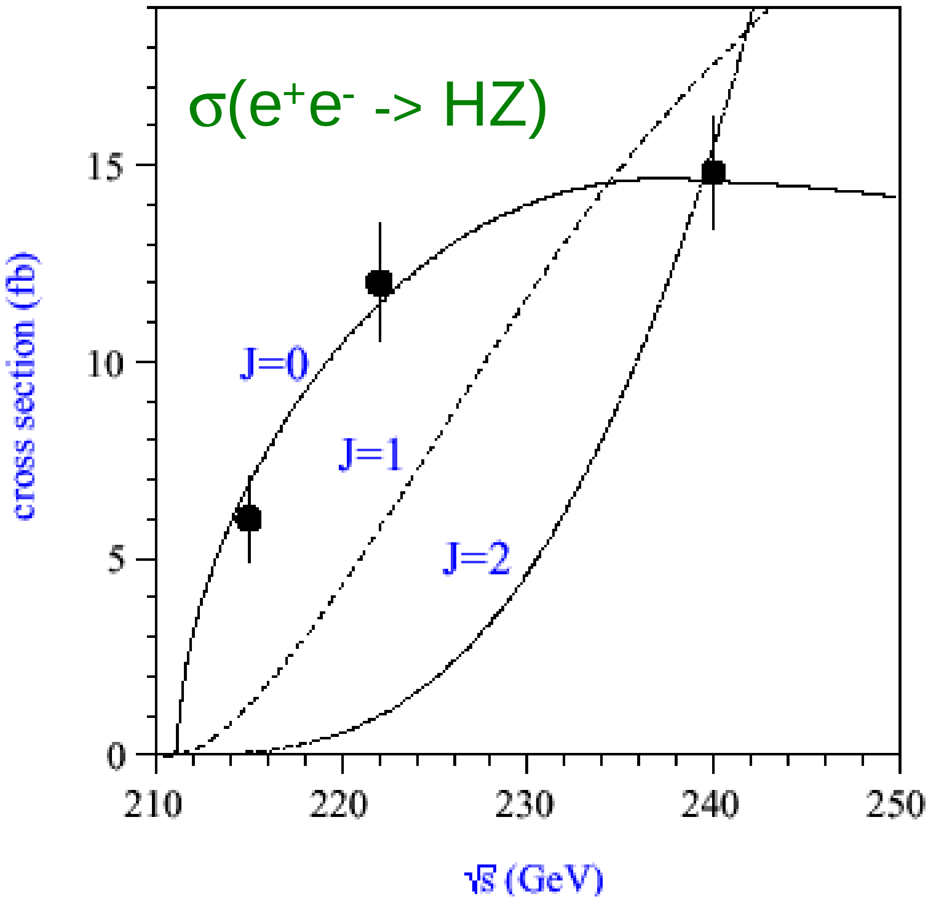
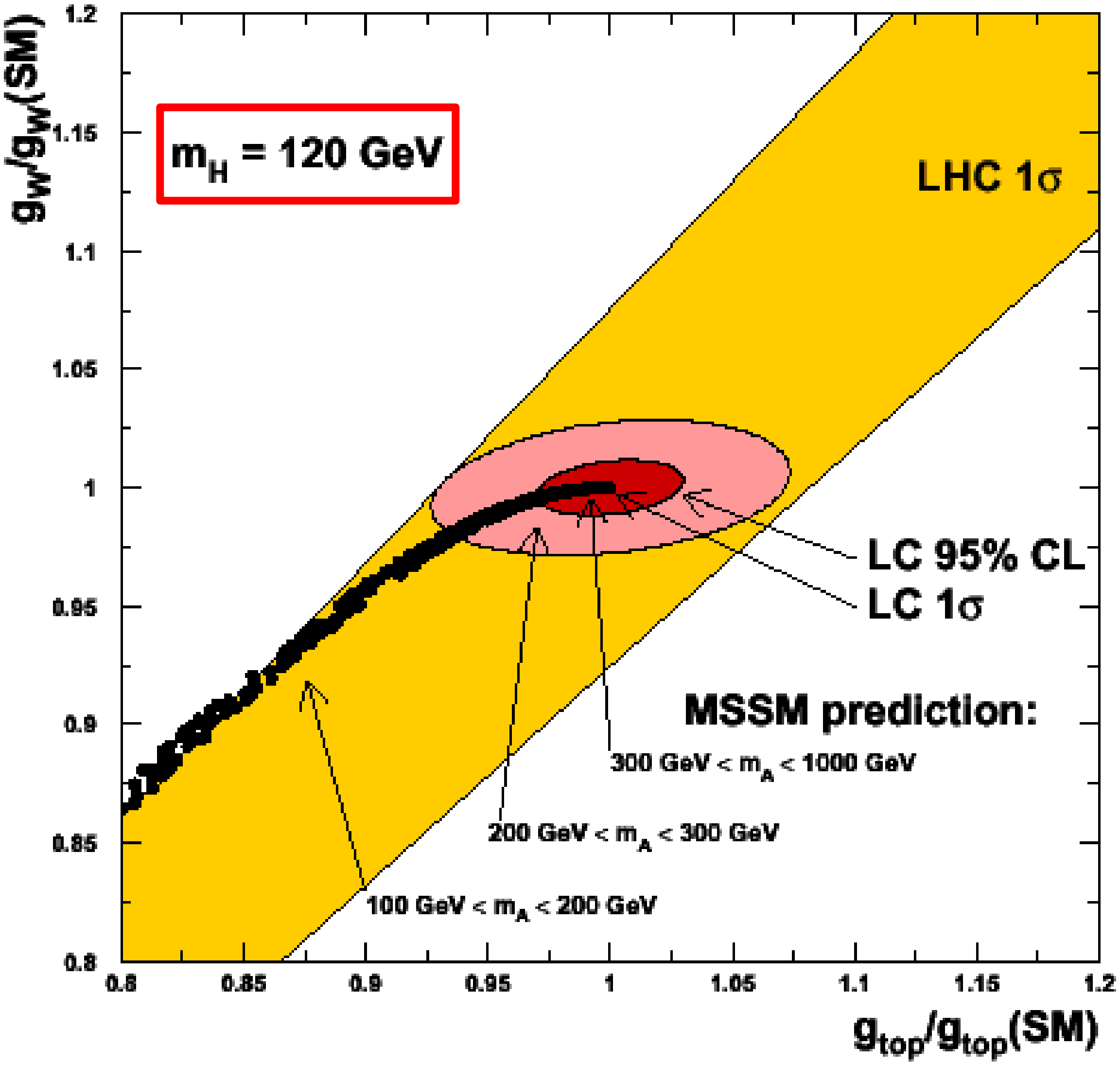
Measuring the Higgs spin

m_H=120 GeV



SUSY: example of LHC vs NLC precision

g_{ttH} and g_{WWH} in SM and MSSM from LHC and NLC



No doubts, a NLC ~10 yrs before CLIC would be a great asset for particle physics.

From the point of view of physics, the best in the LHC years would be NLC and a ν-factory (plus some "local" projects)

CLIC and even more so VLHC & the μ-factory would be for a later stage.

The real problem is whether we can afford:

LHC ~ 3Bl
NLC ~ 4Bl € (including detectors)
ν-fact. ~ 1-1.2 Bl

but that is not my theme here!