The Higgs and the Terascale: an Outlook

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The main LHC results so far

• A robust exclusion interval for the SM Higgs. Only a narrow window below 600 GeV: 115.5-127 GeV.

Plus some indication for $m_H \sim 125$ GeV

• No evidence of new physics, although a big chunk of new territory has been explored

• Important results on B and D decays from LHCb
  [e.g. $B_s \rightarrow J/\Psi \phi$, $B_s \rightarrow \mu \mu$, … CP viol in D decay]

K. Jacobs
C. Paus
P. Sphicas
T. Nakada
The 95% exclusion intervals for the light Higgs

- LEP
- 115.5-127 GeV
- The window of opportunity
- $m_H > 600$ GeV also allowed
- ATLAS, CMS
- Tevatron
- $600$ GeV
A light SM Higgs can only be in 115.5-127 GeV range in agreement with EW tests. Also, $300 < m_H < 600$ GeV is excluded by ATLAS and/or CMS.
Some “excess” was reported in the allowed $m_H$ window

**Is this the Higgs signal?**

We hope yes, but the present evidence could still evaporate with more statistics

We need to wait for the 2012 run

But, assuming that the excess is the first manifestation of a signal, it is important to discuss the implications

Many papers on the ArXiv after Dec. 13th
Observed excess over SM for $m_H \sim 126$ GeV in:
$H \rightarrow \gamma\gamma$ ($2.8\sigma$), $H \rightarrow ZZ^* \rightarrow 4l^\pm$ ($2.1\sigma$), $H \rightarrow WW^* \rightarrow l\ell\ell\ell$ ($1.4\sigma$).

Combined: $3.6\sigma$ (but with look-elsewhere-effect $2.3\sigma$)

The most obvious “elsewhere” is CMS
Also in CMS there is an excess, but smaller (2.6 $\sigma$)
Do the masses really coincide?

Erler ‘11
Peaks come and go!

**CMS History: $H \rightarrow \gamma\gamma$**

- EPS (1.09/fb) LP (1.66/fb)
- Dec 19 (4.76/fb)
- ‘peaks’ come and go
- of course now we are getting into interesting territory
A moderate enhancement of the $\gamma\gamma$ rate may be indicated
The SM Higgs is close to be observed or excluded!

Either the SM Higgs is very light (115.5 - 127 GeV) or rather heavy (i.e. > 600 GeV)

The range $m_H = 115.5 - 127$ GeV is in agreement with precision tests, compatible with the SM and also with the SUSY extensions of the SM

$m_H \sim 125$ GeV is what you expect from a direct interpretation of EW precision tests: no fancy conspiracy with new physics to fake a light Higgs while the real one is heavy

$m_H > 600$ GeV would point to the conspiracy alternative
Theoretical bounds on the SM Higgs mass

$\Lambda$: scale of new physics beyond the SM

Upper limit: No Landau pole up to $\Lambda$
Lower limit: Vacuum (meta)stability

If the SM would be valid up to $M_{\text{GUT}}, M_{\text{Pl}}$ with a stable vacuum then $m_H$ would be limited in a small range

$\Theta$ depends on $m_t$ and $\alpha_s$  
$130 \text{ GeV} < m_H < 180 \text{ GeV}$
But metastability (with sufficiently long lifetime) is enough!

In the absence of new physics, for \( m_H \sim 125 \text{ GeV} \),
the Universe becomes metastable at a scale \( \Lambda \sim 10^{10} \text{ GeV} \)

And the SM remains viable up to \( M_{Pl} \) (early universe implications)
Note that $\lambda = 0$ at the Planck scale (and no physics in between) implies $m_H \sim 130 \text{ GeV}$ depending on $m_t$ and $\alpha_s$.

$$m_h > 130 \text{ GeV} + 1.8 \text{ GeV} \left( \frac{m_t - 173.2 \text{ GeV}}{0.9 \text{ GeV}} \right) - 0.5 \text{ GeV} \left( \frac{\alpha_s(M_Z) - 0.1184}{0.0007} \right) \pm 3 \text{ GeV}$$

not far from 125 GeV

Elias-Miro’ et al, Holthausen et al, Wetterich ‘11
The Standard Model works very well
So, why not find the Higgs and declare particle physics solved?

Because of both:

Conceptual problems

• Quantum gravity
• The hierarchy problem
• The flavour puzzle

and experimental clues:

• Neutrino masses
• Coupling unification
• Dark matter
• Baryogenesis
• Vacuum energy
• some experimental anomalies: $(g-2)_\mu$

Some of these problems point at new physics at the weak scale: eg Hierarchy
Dark matter (perhaps)

insert here your preferred hints
An enlarged SM (to include RH ν’s and no new physics) remains an (enormously fine tuned) option

A light Higgs

SO(10) non SUSY GUT

SO(10) breaking down to SU(4)xSU(2)_LxSU(2)_R at an intermediate scale (10^{11-12})

Majorana neutrinos and see-saw (\(\rightarrow 0\nu\beta\beta\))

Axions as dark matter

Baryogenesis thru leptogenesis

(but: (g-2)_{\mu} and other present deviations from SM should be disposed of)
Some amount of new physics could bring EW precision tests better into focus.

The best fit $m_H$ is low, more so if not for $A_{FB}^b$, $m_W$ is a bit large.
Muon g-2

\( a_\mu \) is a plausible location for a new physics signal!!

e.g. could be light SUSY (now tension with LHC)

\[ \delta a_\mu = 13 \cdot 10^{-10} \left( \frac{100 \text{GeV}}{M_{SUSY}} \right)^2 \tan \beta \]

Status: summer 2011 (published results shown only)

- JN 09 (e⁺e⁻-based)
  \(-299 \pm 65\)

- DHMZ 10 (τ-based)
  \(-195 \pm 54\)

- DHMZ 10 (e⁺e⁻)
  \(-287 \pm 49\)

- HLMNT 11 (e⁺e⁻)
  \(-261 \pm 49\)

- BNL-E821 (world average)
  \(0 \pm 63\)

\( \Delta a_\mu = a_\mu^{\text{exp}} - a_\mu^{\text{SM}} = (28.7 \pm 8.0) \times 10^{-10} \)

\( \Rightarrow 3.6 \) "standard deviations" \((e^+e^-)\)

\( \Rightarrow 2.4 \) "standard deviations" \((\tau)\)

\( a_\mu^{\text{exp}} - a_\mu^{\text{SM}} = (28.7 \pm 8.0) \times 10^{-10} \)

Error dominated by the error from \( \gamma - \gamma \)
Some NP hints from accelerator experiments

\[ A^b_{FB} \quad \text{LEP} \quad \sim 3\sigma \]

\[ (g-2)_\mu \quad \text{Brookhaven} \quad \sim 3\sigma \]

\( \text{tt}^{\text{bar}} \) FB asymmetry \quad \text{Tevatron (mostly CDF)} \quad \sim 3\sigma \) at large \( M_{tt} \)

Dimuon charge asymmetry \quad \text{D0} \quad \sim 3.9\sigma

Wjj excess at \( M_{jj} \sim 144 \) GeV

only candidate to open prod. of NP

\[ B_s \rightarrow J/\psi \phi \quad \text{Tevatron, LHCb} \quad \sim \text{went away} \]

\[ B \rightarrow \tau \nu \quad \text{BaBar, Belle} \quad \sim 2.5\sigma \]

\( \bullet \bullet \bullet \)
A non-LHC very important result

MEG new limit on $\text{Br}(\mu \rightarrow e \gamma) < 2.4 \times 10^{-12}$

Also goes in the direction of the SM

Large mixing in $\nu$ Yukawa
MEG now
MEG goal
Small mixing in $\nu$ Yukawa
Neutrino masses are really special!

\[ m_t/(\Delta m_{\text{atm}})^{1/2} \sim 10^{12} \]

Massless \( \nu \)'s?
- no \( \nu_R \)
- \( L \) conserved

Small \( \nu \) masses?
- \( \nu_R \) very heavy
- \( L \) not conserved

Very likely: \( \nu \)'s are special as they are Majorana fermions
Are neutrinos Dirac or Majorana fermions?

Under charge conjugation C: particle \(<--\>\) antiparticle

For bosons there are many cases of particles that coincide (up to a phase) with their antiparticle: \(\pi^0, \rho^0, \omega, \gamma, Z^0\).....

A fermion that coincides with its antiparticle is called a Majorana fermion. Are there Majorana fermions?

Neutrinos are probably Majorana fermions

Of all fundamental fermions only \(\nu\)'s are neutral

If lepton number \(L\) conservation is violated then no conserved charge distinguishes neutrinos from antineutrinos

\[
\begin{bmatrix}
  uuuu \nu_e \\
  ddde
\end{bmatrix}
\begin{bmatrix}
  ccc \nu_\mu \\
  sss \mu
\end{bmatrix}
\begin{bmatrix}
  ttt \nu_\tau \\
  bbb \tau
\end{bmatrix}
\]
ν's are nearly massless because they are Majorana particles and get masses through L non conserving interactions suppressed by a large scale $M \sim M_{\text{GUT}}$

$$m_\nu \sim \frac{m^2}{M}$$

$m : \leq m_t \sim \nu \sim 200 \text{ GeV}$  
$M : \text{scale of L non cons.}$

Note:

$$m_\nu \sim (\Delta m^2_{\text{atm}})^{1/2} \sim 0.05 \text{ eV}$$

$M \sim 10^{14} - 10^{15} \text{ GeV}$

Neutrino masses are a probe of physics at $M_{\text{GUT}}$!
How to prove that ν’s are Majorana fermions?

All we know from experiment on ν masses strongly indicates that ν's are Majorana particles and that L is not conserved (but a direct proof still does not exist).

\[ 0νββ = dd \rightarrow uue-e^- \]

Detection of 0νββ (neutrinoless double beta decay) would be a proof of L non conservation (\(\Delta L=2\)). Thus a big effort is devoted to improving present limits and possibly to find a signal.

Heidelberg-Moscow, Cuoricino-Cuore, GERDA
Baryogenesis by decay of heavy Majorana $\nu$'s

BG via Leptogenesis near the GUT scale

$T \sim 10^{1.2\pm3}$ GeV \textit{(after inflation)}

Only survives if $\Delta(B-L)$ is not zero

(otherwise is washed out at $T_{ew}$ by instantons)

Main candidate: decay of lightest $\nu_R$ ($M \sim 10^{12}$ GeV)

$L$ non conserv. in $\nu_R$ out-of-equilibrium decay:

$B-L$ excess survives at $T_{ew}$ and gives the obs. B asymmetry.

Quantitative studies confirm that the range of $m_1$ from $\nu$ oscillations is compatible with BG via (thermal) LG

In particular the bound

$\text{m}_1 < 10^{-1}$ eV

Can be relaxed for degenerate neutrinos

So fully compatible with oscill'n data!!

Buchmuller, Yanagida, Plumacher, Ellis, Lola, Giudice et al, Fujii et al

.....
Most of the Universe is not made up of atoms: $\Omega_{\text{tot}} \sim 1$, $\Omega_b \sim 0.045$, $\Omega_m \sim 0.27$

Most is Dark Matter and Dark Energy

Most Dark Matter is Cold (non-relativistic at freeze out)
Significant Hot Dark matter is disfavoured
Neutrinos are not much cosmo-relevant: $\Omega_\nu < 0.015$

SUSY has excellent DM candidates: eg Neutralinos $\rightarrow$ LHC
Also Axions are still viable (introduced to solve strong CPV)
(in a mass window around $m \sim 10^{-4}$ eV and $f_a \sim 10^{11}$ GeV
but these values are simply a-posteriori)

Identification of Dark Matter is a task of enormous
importance for particle physics and cosmology

LHC?
LHC has good chances because it can reach any kind of WIMP:

**WIMP**: Weakly Interacting Massive Particle

with \( m \sim 10^1-10^3 \) GeV

For WIMP’s in thermal equilibrium after inflation the density is:

\[
\Omega_\chi h^2 \approx \text{const.} \cdot \frac{T_0^3}{M_{\text{Pl}}^3 \langle \sigma A v \rangle} \approx \frac{0.1 \text{ pb} \cdot c}{\langle \sigma A v \rangle}
\]

...can work for typical weak cross-sections!!!

This “coincidence” is a good indication in favour of a WIMP explanation of Dark Matter
Strong competition from underground labs
The “little hierarchy” problem

e.g. the top loop (the most pressing):

\[
\delta m_h^2|_{top} = \frac{3 G_F}{2 \sqrt{2} \pi} \frac{m_t^2 \Lambda^2}{2 m_t^2 \Lambda} \sim (0.2 \Lambda)^2
\]

This hierarchy problem demands new physics near the weak scale

\(\Lambda\): scale of new physics beyond the SM

- \(\Lambda \gg m_Z\): the SM is so good at LEP
- \(\Lambda \sim \text{few times } G_F^{-1/2} \sim o(1\text{TeV})\) for a natural explanation of \(m_h\) or \(m_W\)

Barbieri, Strumia

The LEP Paradox: \(m_h\) light, new physics must be close but its effects were not visible at LEP2

The B-factory Paradox: and not visible in flavour physics
Another area where the SM is good, too good.....

With new physics at ~ TeV one would expect the SM suppression of FCNC and the CKM mechanism for CP violation to be sizably modified.

But this is not the case

an intriguing mystery and a major challenge for models of new physics
While it is a theorem that at the EW scale there must be the Higgs (one or more) or some other new physics (e.g. new vector bosons) because otherwise there are unitarity violations at a few TeV.

On the other hand the hierarchy problem is an issue based on naturalness (the request of avoiding enormous unjustified, unnecessary fine tuning in the theory).

Given the stubborn refuse of the SM to step aside, and the terrible unexplained naturalness problem of the cosmological constant, many people have turned to the anthropic philosophy.

Still, one thing is the cosmological constant and another the SM (where all is very explicit and in front of us and many ways out are known).
Solutions to the hierarchy problem

• Supersymmetry: boson-fermion symm.
  The most ambitious and widely accepted
  Simplest versions now marginal
  Plenty of viable alternatives

• Strong EWSB: Technicolor
  Strongly disfavoured by LEP. Coming back in new forms

  Composite Higgs
  Higgs as PG Boson, Little Higgs models......

• Extra spacetime dim’s that somehow “bring” $M_\text{Pl}$ down to $o(1\text{TeV})$ [large ED, warped ED, ......]. Holographic composite H
  Exciting. Many facets. Rich potentiality. No baseline model emerged so far

• Ignore the problem: invoke the anthropic principle
  Extreme, but not excluded by the data
A striking result of the 2011 LHC run (\(> 1 \text{ fb}^{-1}\)) is that the new physics is pushed further away.

**Examples:**

- Sequential \(W'\): \(m_{W'} > 2.3 \text{ TeV}\)
- Sequential \(Z'\): \(m_{Z'} > 1.9 \text{ TeV}\)
- Axi-gluon: 2.5-3.2 TeV
- Gluino: \(m_g > \sim 0.5 - 1 \text{ TeV}\)

Many generic signatures searched. Not a single significant hint of new physics found

But only \(\sim 20-25\%\) of the 2011 statistics has been analysed.
Di-lepton Channel

Sequential SM: \( m(Z') > 1.9 \text{ TeV} \) at 95\% C.L.

RS graviton (\( k/M_{Pl} = 0.1 \)): \( m(G) > 1.8 \text{ TeV} \) at 95\% C.L.
Di-photon Channel

RS graviton (k/MPl = 0.1):
m(G) > 1.7 TeV at 95% C.L.
$W' \rightarrow l \nu$

Sequential SM:
$m(W') > 2.3$ TeV at 95% C.L.
Dijet

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<th>95% CL Limits (TeV)</th>
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<td>Expected</td>
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<td><strong>Excited Quark q⁺</strong></td>
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<td>Color Octet Scalar</td>
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<td>Observed</td>
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<tr>
<td>String Resonances</td>
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<tr>
<td>W⁺ Bosons</td>
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</tr>
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\[
\sqrt{s} = 7 \text{ TeV} \\
|\eta| < 2.5, |\Delta\eta| < 1.3
\]
SUSY: boson fermion symmetry

The hierarchy problem: \[ \delta m_{h|top}^2 = \frac{3G_F}{2\sqrt{2}\pi}m_t^2\Lambda^2 \sim -(0.2\Lambda)^2 \]

In broken SUSY $\Lambda^2$ is replaced by $(m_{\text{stop}}^2 - m_t^2)\log\Lambda$

$m_H > 114.4$ GeV, $m_{\chi^+} > 100$ GeV, EW precision tests, success of CKM, absence of FCNC, all together, impose sizable Fine Tuning (FT) particularly on minimal realizations (MSSM, CMSSM…).

Yet SUSY is a completely specified, consistent, computable model, perturbative up to $M_{\text{Pl}}$, quantitatively in agreement with coupling unification (GUT’s) (unique among NP models) and has a good DM candidate: the neutralino (actually more than one).

Remains the reference model for NP
Beyond the SM SUSY is unique in providing a perturbative theory up to the GUT/Planck scale.

Other BSM models (little Higgs, composite Higgs, Higgsless....) all become strongly interacting and non perturbative at a multi-TeV scale.
Jets + missing $E_T$  

CMSSM (degenerate s-quarks)
Here also lepton(s)+jets+missing $E_T$
The general MSSM has $> 100$ parameters

Simplified versions with a drastic reduction of parameters are used for practical reasons, e.g.

CMSSM, mSUGRA: universal gaugino and scalar soft terms at GUT scale $m_{1/2}$, $m_0$, $A_0$, $\tan\beta$, sign($\mu$)

NUHM1,2: different than $m_0$ masses for $H_u, H_d$ (1 or 2 masses)

It is only these oversimplified models that are now cornered
Impact of $m_H \sim 125$ GeV on SUSY models

Simplest models with gauge mediation are disfavoured (predict $m_H$ too light)

Djouadi et al; Draper et al, ‘11

some versions, eg gauge mediation with extra vector like matter, do work

Endo et al ‘11

Anomaly mediation is also generically in trouble

Gravity mediation is better but CMSSM, mSUGRA, NUHM1,2 need squarks heavy, $A_t$ large and lead to tension with g-2 (that wants light SUSY) and $b \rightarrow s\gamma$

Akura et al; Baer et al; Battaglia et al; Buchmuller et al, Kadastik et al; Strege et al; ‘11
maximal top mixing is required

\[ m_h \text{ [GeV]} \]

\[ m_{\tilde{t}_1} \text{ [GeV]} \]

\( X_t = A_t \)

\( X_t = X_t^{\text{max}} \)

\( X_t = 0 \)

\( \tan \beta = 20 \)

Hall et al ‘11
Arbey et al '11

CMSSM
MSSM

Heinemeyer et al ’11

\[ M_A = 400 \text{ GeV}, M_{\text{SUSY}} = 1 \text{ TeV} \]

\[ M_A = 1 \text{ TeV}, \tan \beta = 20 \]
mSUGRA

Akula et al. ‘11
Baer et al. '11
Baer et al '11

NUHM1,2

add 1 or 2 separate mass parameters for Hu, Hd
Buchmuller et al. '11

CMSSM

2011

heavier scalars with new data

g-2 in trouble

2010

with g-2 $m_H \sim 119$ GeV

without g-2 $m_H \sim 125$ GeV

NUHM1

J. Ellis
Input data for fits of CMSSM, NUHM1...... include

• The EW precision tests
• Muon g-2
• Flavour precision observables
• Dark Matter
• Higgs mass constraints and LHC
SUSY

With new data ever increasing fine tuning

One must go to SUSY beyond the CMSSM, mSUGRA, NUHM1,2

There is still room for more sophisticated versions

• Heavy first 2 generations
• NMSSM
• $\lambda$ SUSY
• Split SUSY
• Large scale SUSY
• • • • •
Beyond the CMSSM, mSugra, NUHM1,2

Heavy 1st, 2nd generations

Flavour and CP problems improved

Dimopoulos, Giudice 1995
Pomarol, Tommasini 1995
B, Dvali, Hall 1995
Cohen, Kaplan, Nelson 1996

lighter gauginos, g-2 can be rescued

\[ \lambda_t Q_3 H t \]
For example, may be gluinos decay into 3-gen squarks

\[ \tilde{g} \rightarrow \tilde{\ell}_1 t \quad ; \quad \tilde{\ell}_1 \rightarrow b\tilde{\chi}_1^\pm \]

and \[ \tilde{\chi}_1^\pm \rightarrow W^* \tilde{\chi}_1^0 \]

- $m_{\text{gluino}} > 500 \text{ GeV at 95\% C.L.}$
- $m_{s\text{-top}} > \sim 250 \text{ GeV}$
An extra singlet Higgs

In a promising class of models a singlet Higgs $S$ is added and the $\mu$ term arises from the $S$ VEV (the $\mu$ problem is soved)

$$ \lambda S H_u H_d $$

Mixing with $S$ can bring the light Higgs mass down at tree level

(no need of large loop corrections)

**NMSSM:** $\lambda < \sim 0.7$ the theory remains perturbative up to $M_{\text{GUT}}$

(no need of large stop mixing, less fine tuning)

**SUSY:** $\lambda \sim 1 - 2$ for $\lambda > 2$ theory non pert. at $\sim 10$ TeV
NMSSM Higgs Mass

\[ \lambda = 0.6, 0.7 \]
\[ m_{\tilde{t}_1} = 1200, 500 \text{ GeV} \]

2 loops

Tree only

Stop Mass

Fine Tuning

Suspect

FeynHiggs

Hall et al '11
Mixing with $S$ makes $h$ light already at tree level

No need of loops

Fine tuning can be very small

It is not excluded that at 125 GeV you see the heaviest of the two and the lightest escaped detection at LEP

Ellwanger ‘11
In MSSM it is not possible to obtain an enhanced $\gamma\gamma$ signal for $m_H \sim 125$ GeV, while it is possible eg in NMSSM or $\lambda$ SUSY

Arvanitaki et al '11
In λ SUSY the bb mode can be suppressed [so B(γγ) enhanced]

Hall et al ’11
\( \lambda \) SUSY spectrum (\( \lambda = 2 \))

Drawbacks:
relation with GUT’s & coupling unification is generically lost

\( g-2? \)
If the Fine Tuning problem is ignored (anthropic philosophy) than SUSY particles can drift at large scales

Split SUSY: maintains coupling unification and viable DM candidate but otherwise allows heavy SUSY particles

Giudice et al ‘11

Large scale SUSY: all sparticles heavy. The quartic Higgs coupling is fixed by the gauge coupling at the large scale and fixes $m_H$ at the EW scale

Hall et al ‘11

These models are strongly constrained by $m_H \sim 125$ GeV Remain valid with the large scale brought down, more so (if $\tan \beta$ is large)
Predicted range for the Higgs mass

Giudice, Strumia'11

- $\tan\beta = 50$
- $\tan\beta = 4$
- $\tan\beta = 2$
- $\tan\beta = 1$

Split SUSY

High-Scale SUSY

Experimentally favored

Higgs mass $m_h$ in GeV vs. Supersymmetry breaking scale in GeV
High-Scale supersymmetry

$m_h = 126$ GeV
68, 95, 99% CL

Split supersymmetry

$m_h = 126$ GeV
68, 95, 99% CL
• Composite Higgs: an alternative class of models
discussed here by Rattazzi, Wulzer, Santiago

Georgi, Kaplan ’84

The light Higgs is a bound state of a strongly interacting sector. Pseudo-Goldstone boson of an enlarged symmetry.
eg. SO(5)/SO(4)

Agashe/ Contino/Pomarol/Sundrum/ Grojean/Rattazzi....

\( v \sim \text{EW scale} \quad f \sim \text{SI scale} \)
\(~ f < m_\rho < \sim 4\pi f \)
\( \xi = (v/f)^2 \)
\( \xi \) interpolates between SM \( [\xi \sim 0] \)
and some degree of compositeness
\( [\xi \sim o(1) \text{ limited by precision EW tests,} \]
\( \xi=1 \) is as bad as technicolor]
The Higgs couplings are deformed by $\xi$-dependent effects

\[
\mathcal{L} = \frac{1}{2} (\partial_{\mu} h)^2 - V(h) + \frac{v^2}{4} \text{Tr} \left( D_{\mu} \Sigma^\dagger D^{\mu} \Sigma \right) \left[ 1 + 2a \frac{h}{v} + b \frac{h^2}{v^2} + \ldots \right] \\
- m_i \overline{\psi}_{Li} \Sigma \left( 1 + c \frac{h}{v} + \ldots \right) \psi_{Ri} + \text{h.c.,}
\]

SM: $a = b = c = 1$

\[
a = \sqrt{1 - \xi} \quad b = 1 - 2\xi
\]

for $\text{SO}(5)/\text{SO}(4)$
Detectable $\xi$ effects at the LHC

- Higgs couplings
- $WW$ scattering
- 2-Higgs Production

$WW \rightarrow WW$

$WW \rightarrow hh$

Contino et al
Conclusion

The Higgs comes closer

2012 will be the year of the Higgs:
yes or no to the SM Higgs

New Physics is pushed further away

But the LHC experiments are just at the start and
larger masses can be reached in 2012
and even more in the 14 TeV phase

Supersymmetry? Compositeness? Extra dimensions?
Anthropic? We shall see
As a last speaker, on behalf of all participants, I most warmly thank the Organisers of this very interesting Workshop that really came at the right time with the right people.