Courants neutres et nouvelle physique au LHC

Les courants neutres : aujourd'hui et demain

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Christophe Grojean

CERN-TH & CEA-Saclay-IPhT

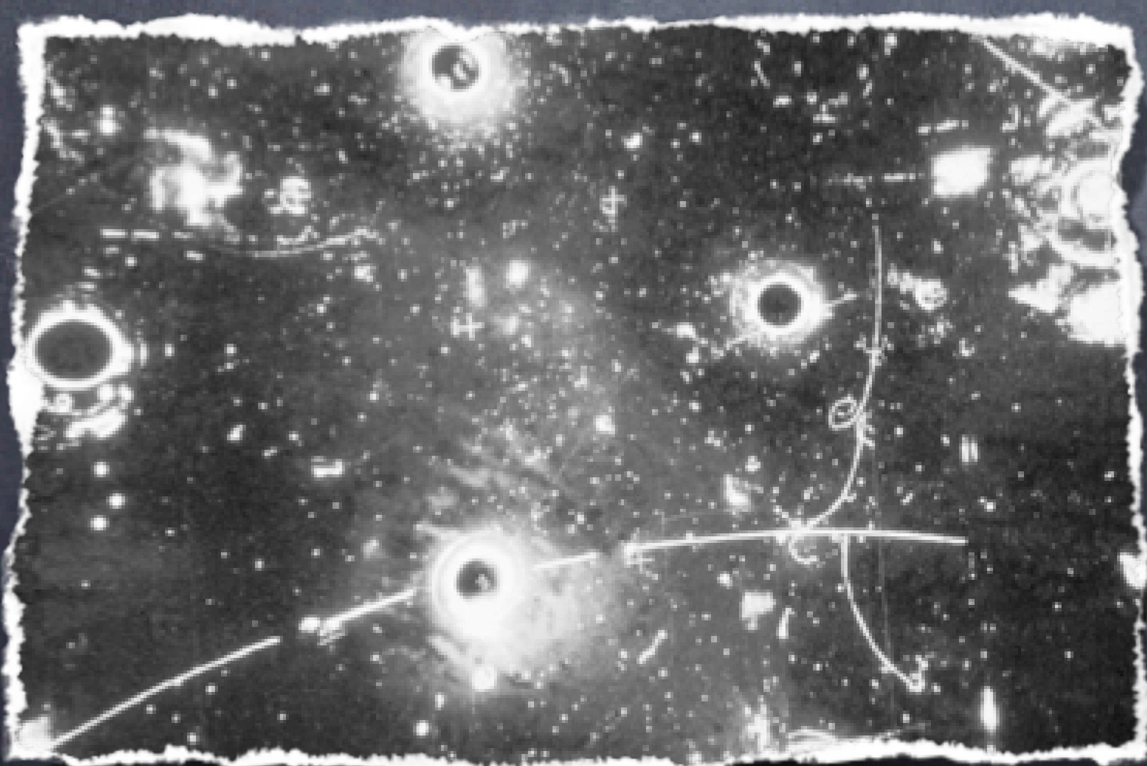
(Christophe.Grojean[at]cern.ch)

The Standard Model

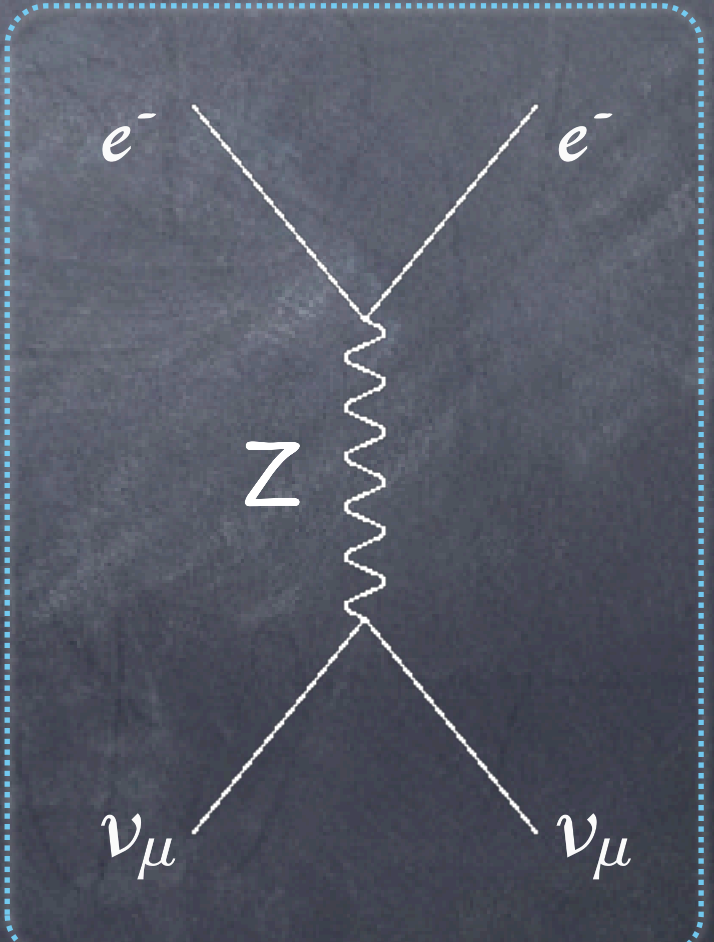
the strong, weak and electromagnetic interactions of the elementary particles are described by gauge interactions

$SU(3)_C \times SU(2)_L \times U(1)_Y$

$\nu_\mu \, e^- \to \nu_\mu \, e^-$



[Gargamelle collaboration, '73]



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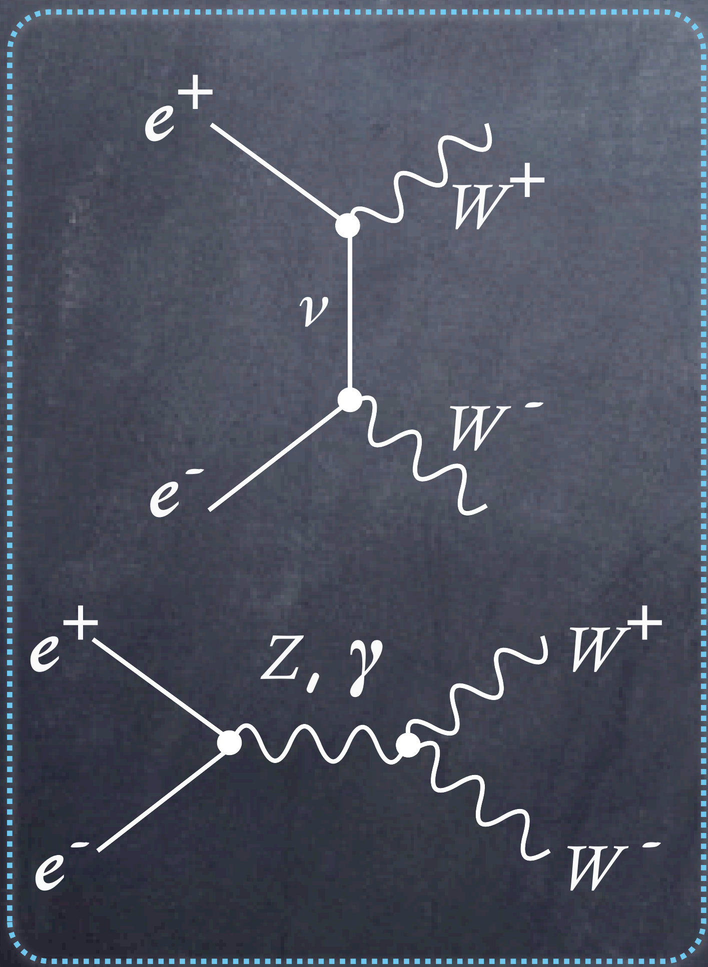
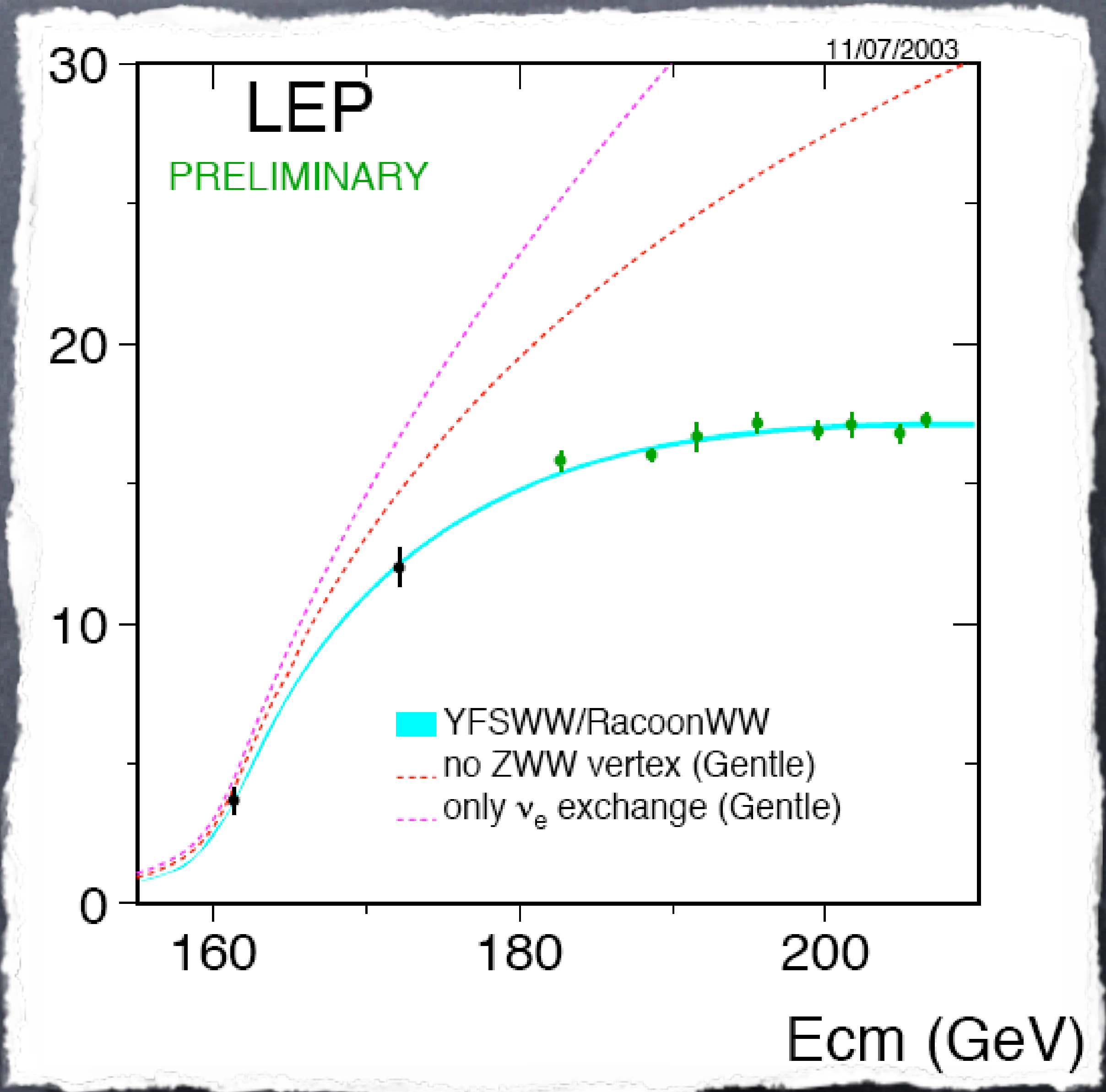
$e^+e^- \rightarrow W^+W^-$





The Standard Model and the Mass Problem

the strong, weak and electromagnetic interactions of the elementary particles are described by gauge interactions

$SU(3)_C \times SU(2)_L \times U(1)_Y$

the masses of the quarks, leptons and gauge bosons don't obey the full gauge invariance

- $\begin{pmatrix} \nu_e \\ e \end{pmatrix}$ is a doublet of $SU(2)_L$ but $m_{\nu_e} \ll m_e$
- a mass term for the gauge field isn't invariant under gauge transformation $\delta A^a_\mu = \partial_\mu \epsilon^a + g f^{abc} A^b_\mu \epsilon^c$

⇒ spontaneous breaking of gauge symmetry ⇐

The source of the Goldstone's

symmetry breaking: new phase with more degrees of freedom

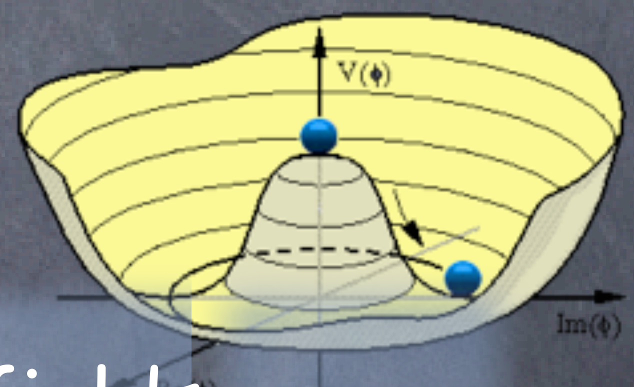
massive $W^\pm$, Z: 3 physical polarizations=eaten Goldstone bosons $\frac{SU(2)_L \times SU(2)_R}{SU(2)_V}$

⇛ Where are these Goldstone's coming from? ⇚

what is the sector responsible for the breaking $SU(2)_L \times SU(2)_R$ to $SU(2)_V$?

with which dynamics? with which interactions to the SM particles?

common lore: from a scalar Higgs doublet



$$H = \begin{pmatrix} h^+ \\ h^0 \end{pmatrix}$$

Higgs doublet = 4 real scalar fields

3 eaten Goldstone bosons ← → One physical degree of freedom the Higgs boson

The source of the Goldstone's

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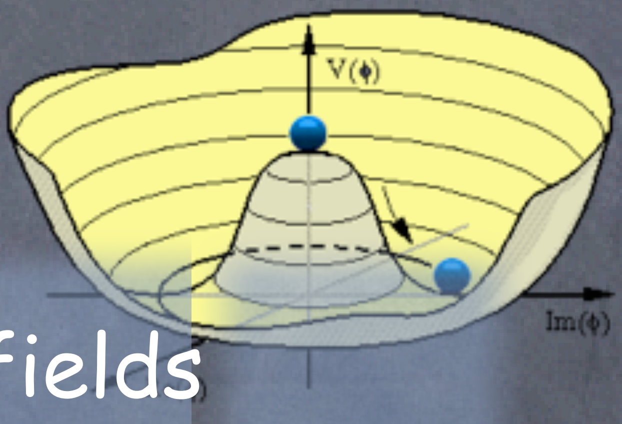

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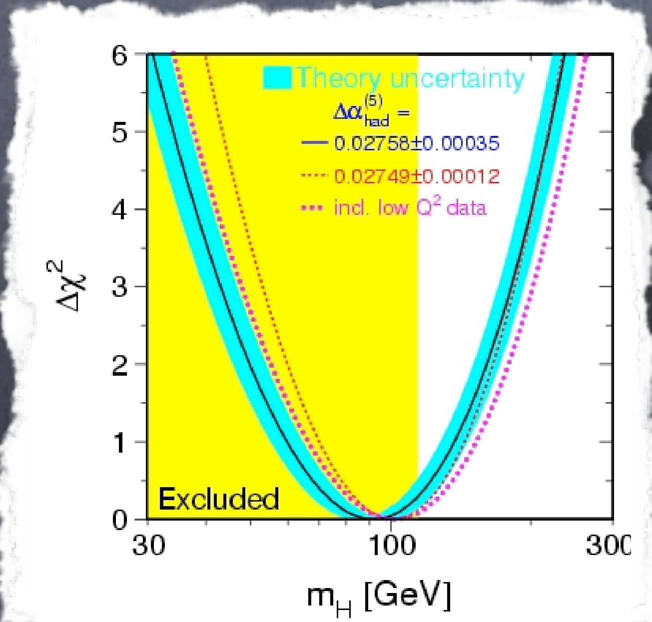
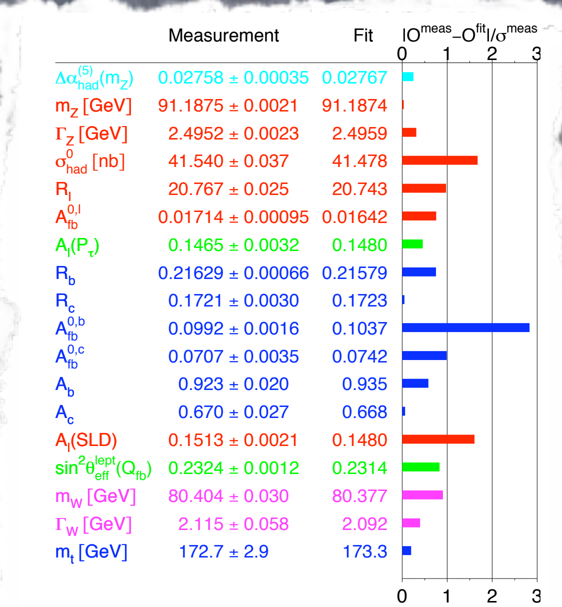
Good agreement with EW data

(doublet ⇔ ρ=1)





	Measurement	Fit
$\Delta\alpha^{(5)}_{had}(m_Z)$	0.02758 ± 0.00035	0.02767
m_Z [GeV]	91.1875 ± 0.0021	91.1874
Γ_Z [GeV]	2.4952 ± 0.0023	2.4959
σ^0_{had} [nb]	41.540 ± 0.037	41.478
R_l	20.767 ± 0.025	20.743
$A^{0,l}_{fb}$	0.01714 ± 0.00095	0.01642
$A_l(P_\tau)$	0.1465 ± 0.0032	0.1480
R_b	0.21629 ± 0.00066	0.21579
R_c	0.1721 ± 0.0030	0.1723
$A^{0,b}_{fb}$	0.0992 ± 0.0016	0.1037
$A^{0,c}_{fb}$	0.0707 ± 0.0035	0.0742
A_b	0.923 ± 0.020	0.935
A_c	0.670 ± 0.027	0.668
A_l(SLD)	0.1513 ± 0.0021	0.1480
$\sin^2\theta^{lept}_{eff}(Q_{fb})$	0.2324 ± 0.0012	0.2314
m_W [GeV]	80.404 ± 0.030	80.377
Γ_W [GeV]	2.115 ± 0.058	2.092
m_t [GeV]	172.7 ± 2.9	173.3

But the Higgs hasn't been seen yet...

other origins of the Goldstone's: condensate of techniquarks, A_5...

The source of the Goldstone's

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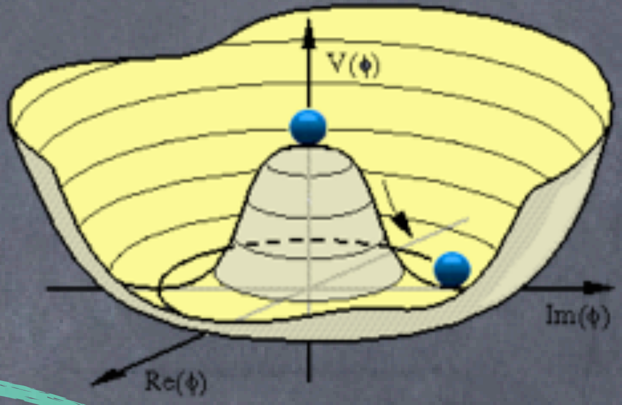


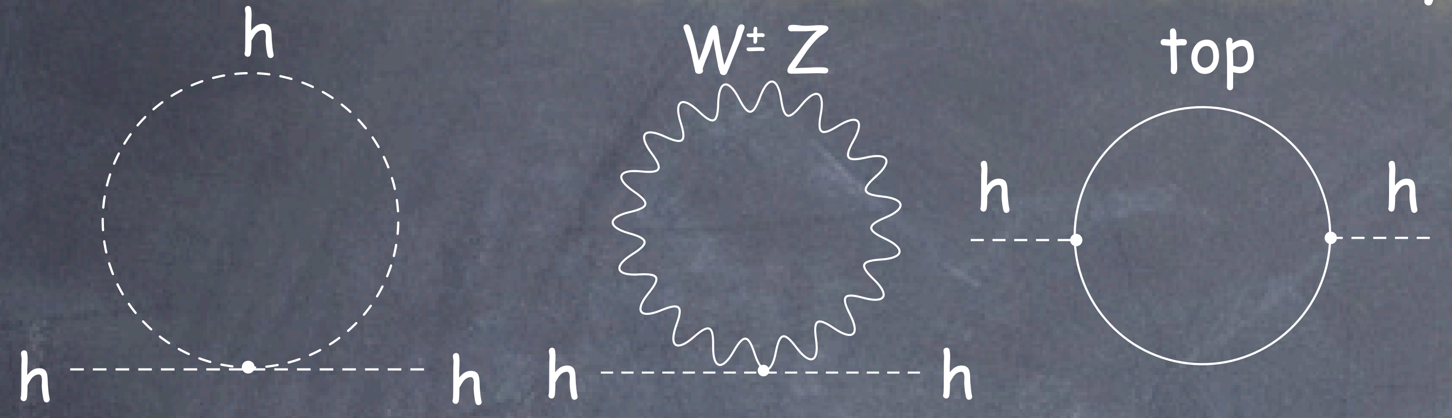
a (too?) simple picture that calls for new physics

- The Higgs has not been seen yet
- There is no dynamics: a description but not an explanation of EWSB
- Instability under radiative corrections: "the hierarchy problem"
- Instability under radiative corrections: triviality, stability...

- Precisions measurements (g_μ-2, LR asymmetries etc)
- Neutrinos masses
- Dark matter
- Dark energy
- Matter-antimatter asymmetry
- Inflation
- Fermion mass and mixing hierarchies
- Strong CP problem
- Charge quantization & GUT
- Quantization of gravity

The hierarchy problem

need new degrees of freedom to cancel Λ^2 divergences
and ensure the stability of the weak scale



$$m_H^2 \sim m_0^2 - (115\ \text{GeV})^2 \left(\frac{\Lambda}{400\ \text{GeV}}\right)^2$$

1. add a sym. such that a Higgs mass is forbidden until this sym. is broken
   - supersymmetry [Witten, '81]
   - gauge-Higgs unification [Manton, '79, Hosotani '83]
   - Higgs as a pseudo Nambu-Goldstone boson [Georgi-Kaplan, '84]
2. lower the UV scale
   - large extra-dimension [Arkani-Hamed-Dimopoulos-Dvali, '98]
   - 10^{32} species [Dvali '07]
3. remove the Higgs
   - technicolor [Weinberg '79, Susskind '79]

Hierarchy problem vs flavor: tension

Clash of Scales

Higgs sector

$\Lambda < 3\text{-}4$ TeV

?

Flavor

$\Lambda > 10^{4\div5}$ TeV

the higher the scale of new physics, the more fine-tuned the Higgs, the less likely a discovery at LHC

SM & al.

H = elem. scalar: dim=1

$$\Lambda^2 |H|^2$$

sick when $\Lambda \to \infty$

$$y_{ij}\, H q_i \bar{q}_j \;\&\; \frac{1}{\Lambda^2}(q_i \bar{q}_j q_k \bar{q}_k q_l)$$

fine when $\Lambda \to \infty$

Technicolor

$H = \langle q\bar{q} \rangle$: dim=3

$$\frac{1}{\Lambda^2}|H|^2$$

fine when $\Lambda \to \infty$

$$\frac{1}{\Lambda^2} H q_i \bar{q}_j \;\&\; \frac{1}{\Lambda^2}(q_i \bar{q}_j q_k \bar{q}_k q_l)$$

sick when $\Lambda \to \infty$

Hierarchy problem vs flavor: lesson?

Clash of Scales

Higgs sector

Λ < 3-4 TeV

?

Flavor

$\Lambda > 10^{4\div5}$ TeV

Is flavor telling us anything about the solution to the hierarchy problem?

conformal TC

dim $_H$ = 1 but dim $_{|H|^2}$ = 4

would solve both pbs

but it seems impossible to realize

[Luty-Okui '04, Rattazzi et al '08]

SM & al.

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$\Lambda^2 |H|^2$

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Hierarchy problem vs flavor: lesson?

Clash of Scales

?

Higgs sector		Flavor
Λ < 3-4 TeV	⟷	Λ > $10^{4\div5}$ TeV

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H = elem. scalar: dim=1

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fine when $\Lambda \to \infty$

1

conformal TC

2

partial compositeness [Kaplan '91]

mixing elem. and composite fermions

dim $q_{R,L}$=3/2, dim $\mathcal{O}_{R,L}$=$d_{R,L}$

$$\frac{q_L \mathcal{O}_R}{\Lambda_R^{d_R-5/2}} + \frac{q_R \mathcal{O}_L}{\Lambda_L^{d_R-5/2}} + \frac{\mathcal{O}_L \mathcal{O}_R}{\Lambda^{d_L+d_R-4}}$$

$d_{R,L}$≈5/2 solves the flavor pb

Technicolor

H=<$q\bar{q}$>: dim=3

$\frac{1}{\Lambda^2}|H|^2$

fine when $\Lambda \to \infty$

$\frac{1}{\Lambda^2} H q_i \bar{q}_j$ & $\frac{1}{\Lambda^2}(q_i\bar{q}_j q_k \bar{q}_k q_l)$

sick when $\Lambda \to \infty$

Partial compositeness: fermion masses

partial compositeness

mixing elem. and composite fermions

dim $q_{R,L}$=3/2, dim $\mathcal{O}_{R,L}$=$d_{R,L}$

$$\frac{q_L \mathcal{O}_R}{\Lambda_R^{d_R-5/2}} + \frac{q_R \mathcal{O}_L}{\Lambda_L^{d_R-5/2}} + \frac{\mathcal{O}_L \mathcal{O}_R}{\Lambda^{d_L+d_R-4}}$$

integrating out heavy fields

amount of compositeness $f_{q_{L,R}}$

$$\frac{\Lambda_R \Lambda_L}{\Lambda} \left(\frac{\Lambda}{\Lambda_R}\right)^{d_R} \left(\frac{\Lambda}{\Lambda_L}\right)^{d_L} q_L q_R$$

1 fermion mass hierarchy easily generated by small diff. in anomalous dims

2 alignment mixing angles/masses is also explained

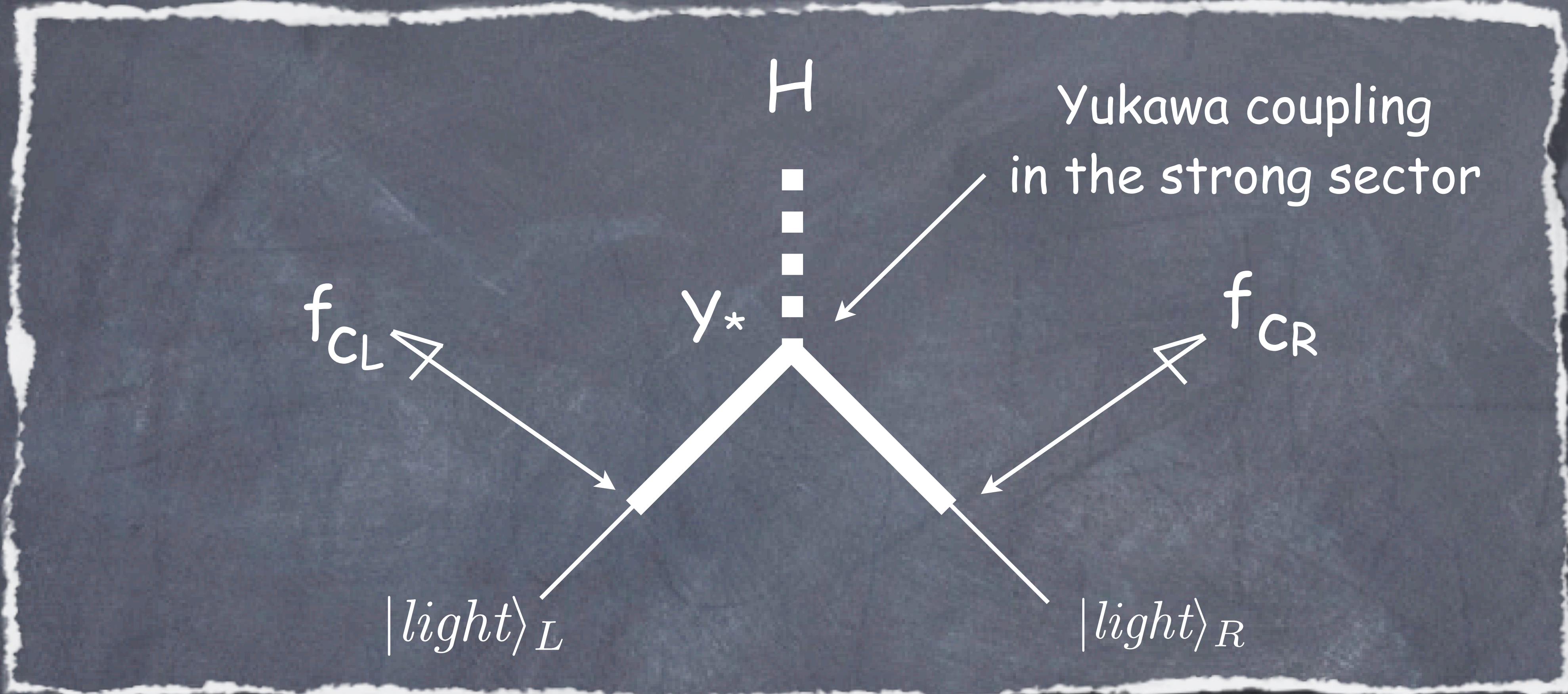
$$V_{CKM} \sim \begin{pmatrix} 1 & \lambda & \lambda^3 \\ \lambda & 1 & \lambda^2 \\ \lambda^3 & \lambda^2 & 1 \end{pmatrix}$$

$$m_{u_i} \propto f_{q_i} f_{u_i} \qquad m_{d_i} \propto f_{q_i} f_{d_i}$$

$$V_{CKM}^{ij} \sim f_{q_i}/f_{q_j}$$

Partial Compositeness: fermion masses

Higgs part of the strong sector: it couples only to composite fermions

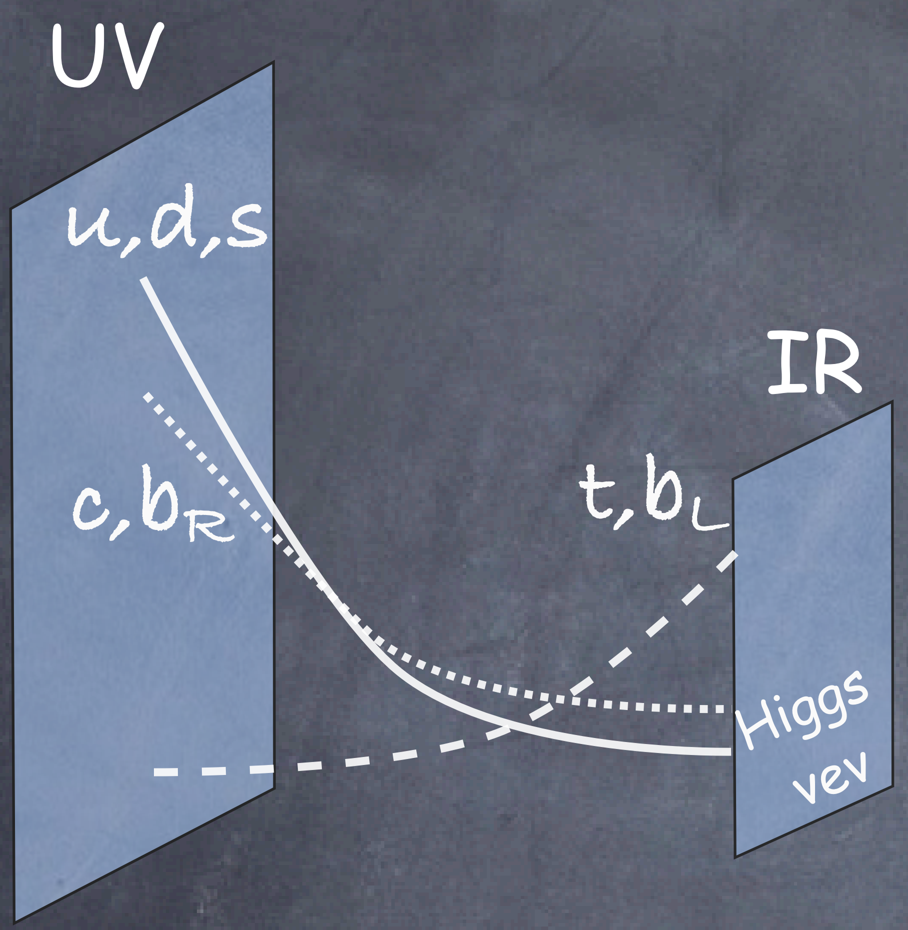


when the Higgs gets a vev, the light dof will acquire a mass prop. to

$$Y^{eff} = Y_\star f_{c_L} f_{c_R}$$

Yukawa hierarchy comes from the hierarchy of compositeness

Partial compositeness: xdim realization



[Grossman and Neubert, '00]
[Gherghetta and Pomarol, '00]
[Huber, '03]

fermion zero-mode has an exponential profile in the bulk

$$\chi(z) = \frac{f_c}{\sqrt{R'}} \left(\frac{z}{R}\right)^2 \left(\frac{z}{R'}\right)^{-c}$$

f_c is the "value" of wavefct. on the IR:

$$f_c = \sqrt{\frac{1-2c}{1-(R/R')^{1-2c}}}$$

c < 1/2: heavy fermion $f_c \sim \mathcal{O}(1)$

c > 1/2: light fermion $f_c \sim (R/R')^{c-1/2} \ll 1$

light fermion exponentially localized on the UV brane

➲ overlap with Higgs vev on the IR tiny

➲ exponentially small 4D mass

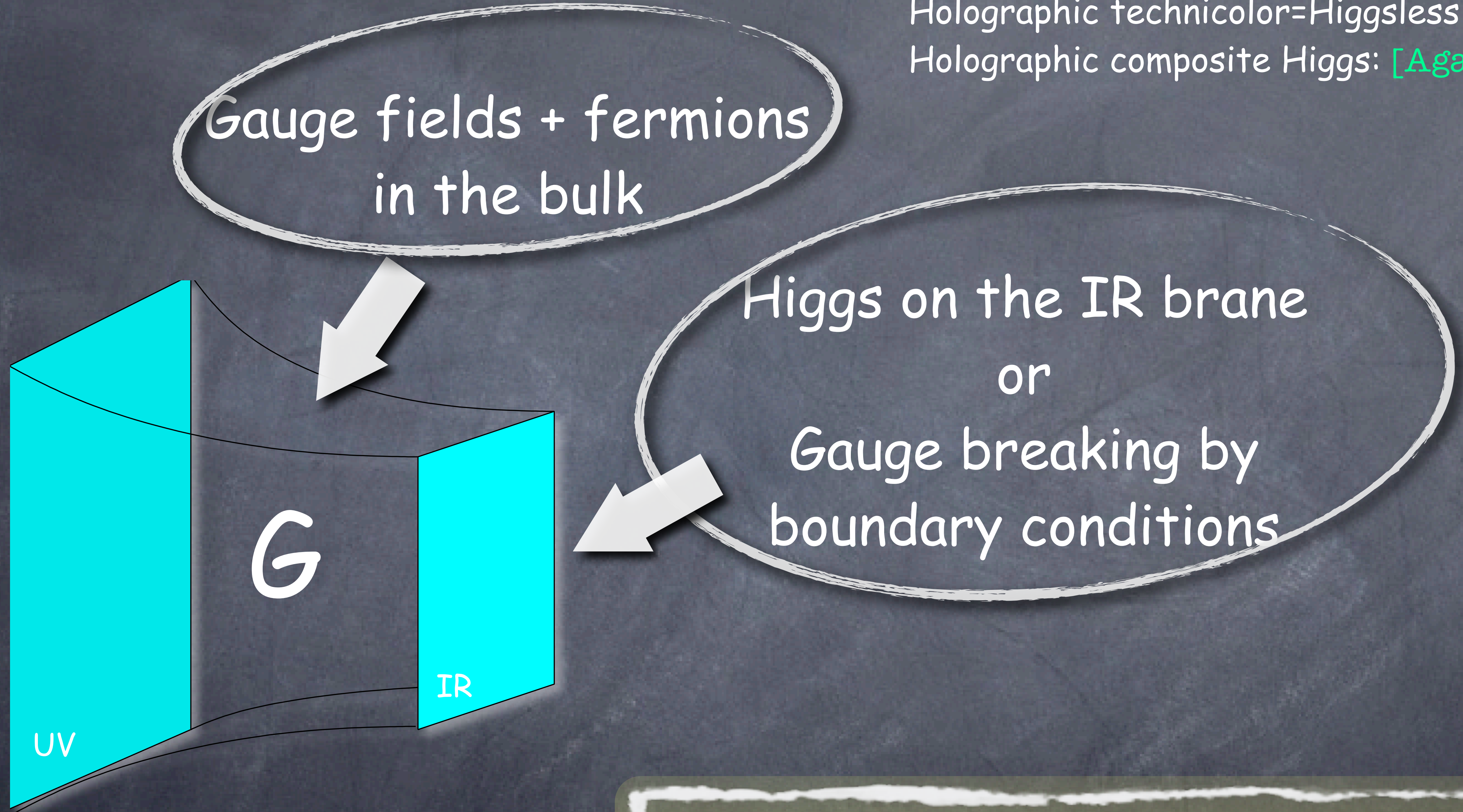
UV localized fermion=elementary

IR localized fermion=composite

5D models=weakly coupled dual of 4D strongly models

Holographic Models of EWSB

Bulk gauge fields: [Pomarol, '00]
Holographic technicolor=Higgsless: [Csaki et al., '03
Holographic composite Higgs: [Agashe et al., '04]



$G=SU(2)_L \times SU(2)_R \times U(1)_{B-L}$
$G=SO(5) \times U(1)_X$
$G=SO(6) \times U(1)_X$

- UV completion: log running of gauge couplings
- Custodial symmetry from bulk $SU(2)_R$

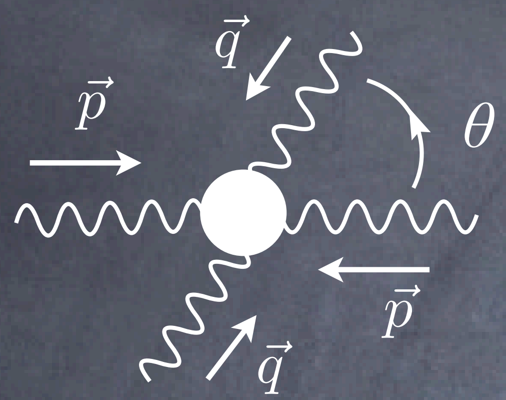
5D Higgsless Models

Unitarization of (Elastic) Scattering Amplitude

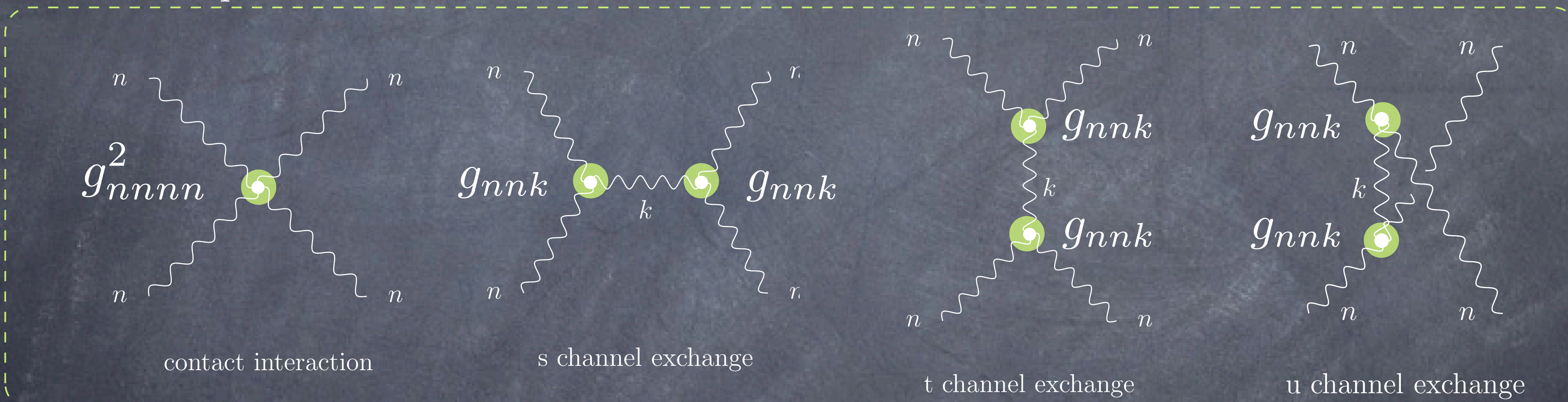
[Csaki, Grojean, Murayama, Pilo, Terning '03

Same KK mode 'in' and 'out'

$$\epsilon^\mu_\perp = \left(\frac{|\vec{p}|}{M}, \frac{E}{M}\frac{\vec{p}}{|\vec{p}|}\right)$$



$$\mathcal{A} = \mathcal{A}^{(4)}\left(\frac{E}{M}\right)^4 + \mathcal{A}^{(2)}\left(\frac{E}{M}\right)^2 + \dots$$



$$\mathcal{A}^{(4)} = i\left(g^2_{nnnn} - \sum_k g^2_{nnk}\right)\left(f^{abe}f^{cde}(3+6c_\theta - c^2_\theta) + 2(3-c^2_\theta)f^{ace}f^{bde}\right)$$

= 0 KK sum rules (enforced by 5D Ward identities)

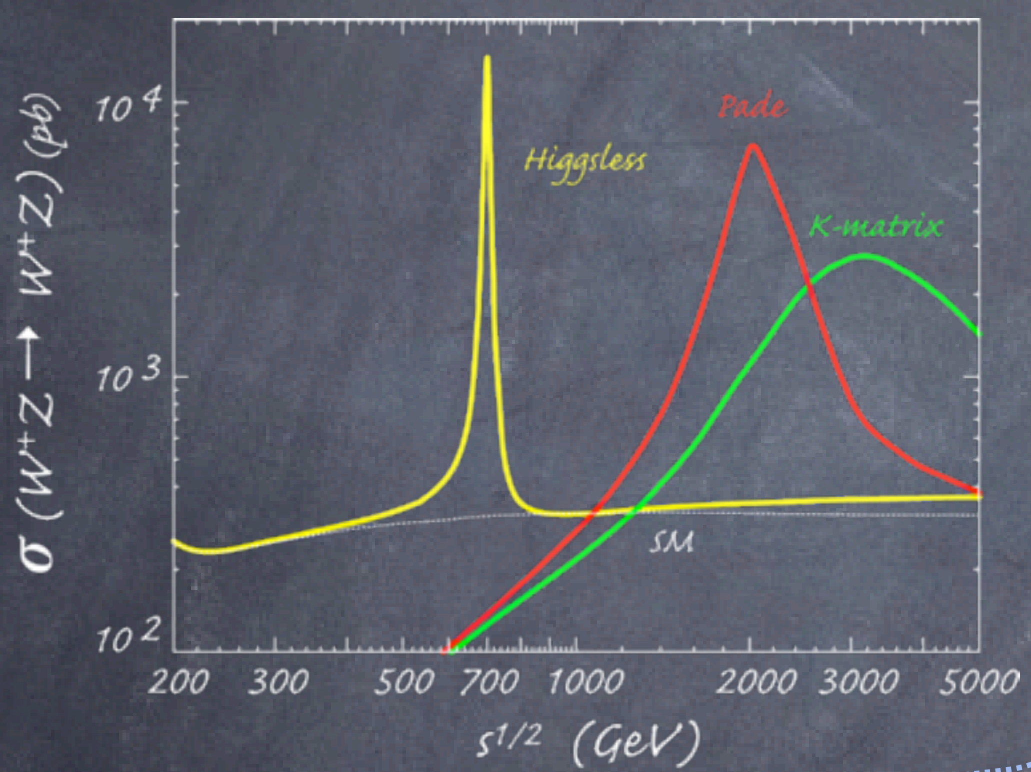
$$\mathcal{A}^{(2)} = i\left(4g^2_{nnnn} - 3\sum_k g^2_{nnk}\frac{M^2_k}{M^2_n}\right)\left(f^{ace}f^{bde} - s^2_{\theta/2}f^{abe}f^{cde}\right)$$

Collider Signatures

unitarity restored by vector resonances whose masses and couplings are constrained by the unitarity sum rules

[Birkedal, Matchev, Perelstein '05]
[He et al. '07]

WZ elastic cross section

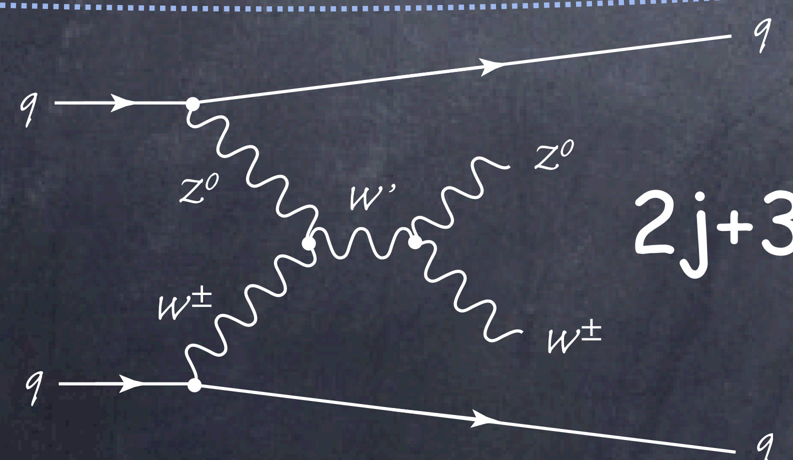


$$g_{WW'Z} \leq \frac{g_{WWZ} M_Z^2}{\sqrt{3} M_{W'} M_W} \qquad \Gamma(W' \to WZ) \sim \frac{\alpha M_{W'}^3}{144 s_w^2 M_W^2}$$

a narrow and light resonance

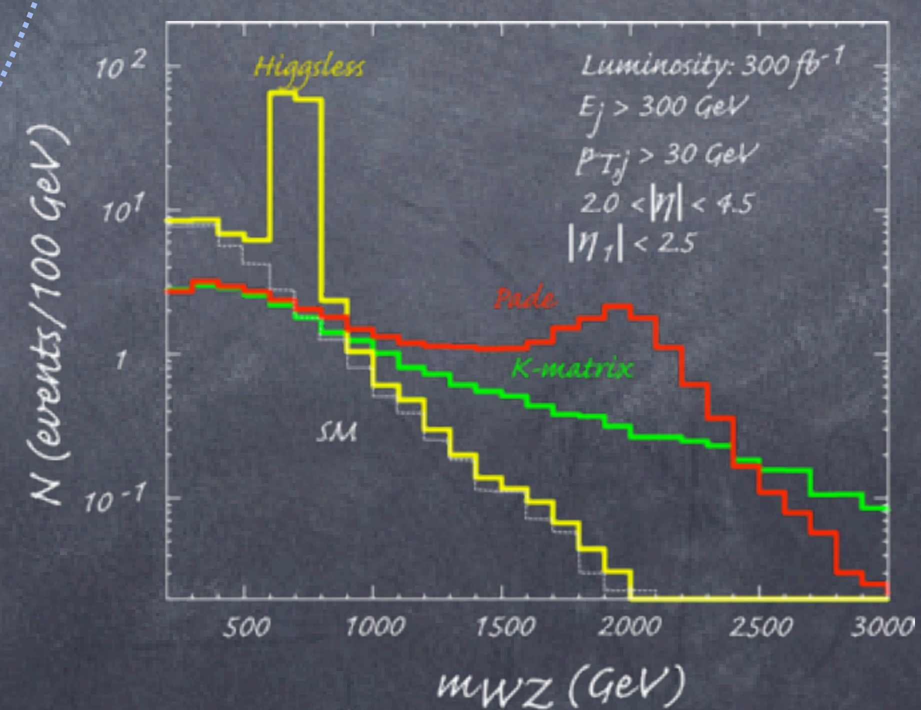
no resonance in WZ for SM/MSSM

W' production



2j+3l+$E\!\!\!/_T$

VBF (LO) dominates over DY since couplings of q to W' are reduced



Number of events at the LHC, 300 fb^{-1}

discovery reach @ LHC (10 events)

$550\ \text{GeV} \to 10\ \text{fb}^{-1}$

$1\ \text{TeV} \to 60\ \text{fb}^{-1}$

should be seen within one/two year

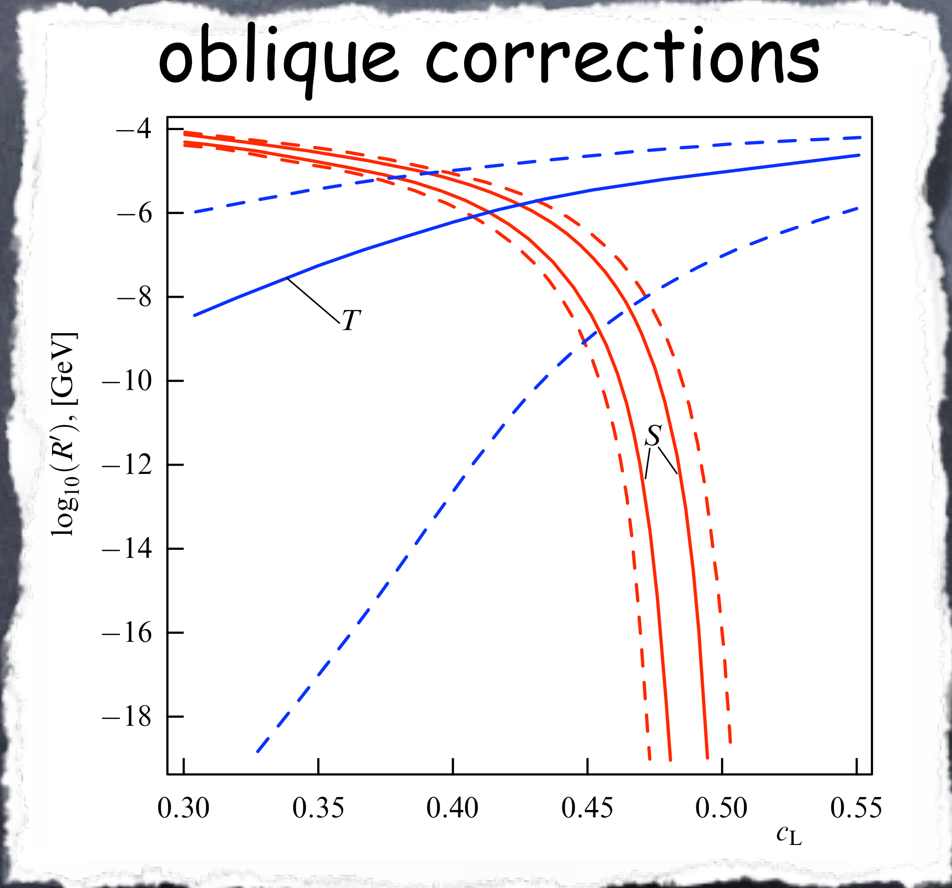
Facing EW precision data

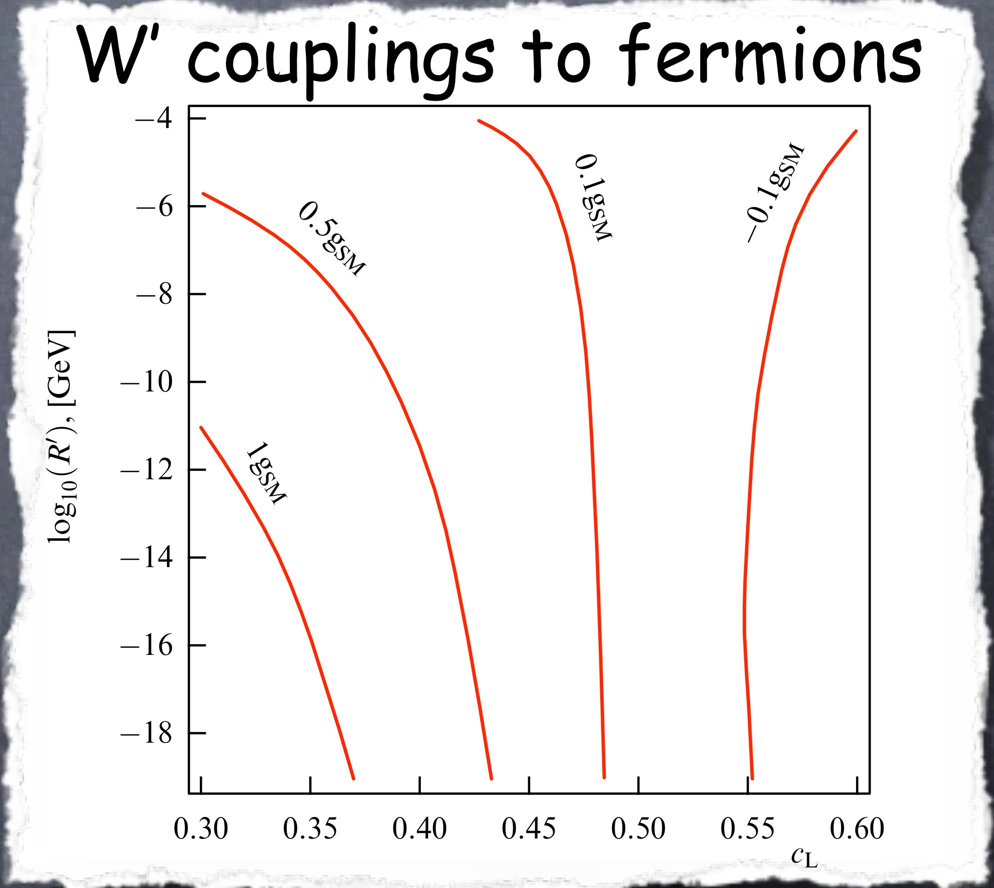
At the lowest order in the Log(R_{IR}/R_{UV}) expansion: S=T=Y=W=0

At next order $S = \dfrac{6\pi}{g^2 \log(R_{IR}/R_{UV})} \approx 1.15$ ...like in usual technicolor models

S can be tuned away by delocalizing the fermions in the bulk
they will decouple from W', Z' etc

[Cacciapaglia et al '04, Foadi et al '04, Casalbuoni et al '05





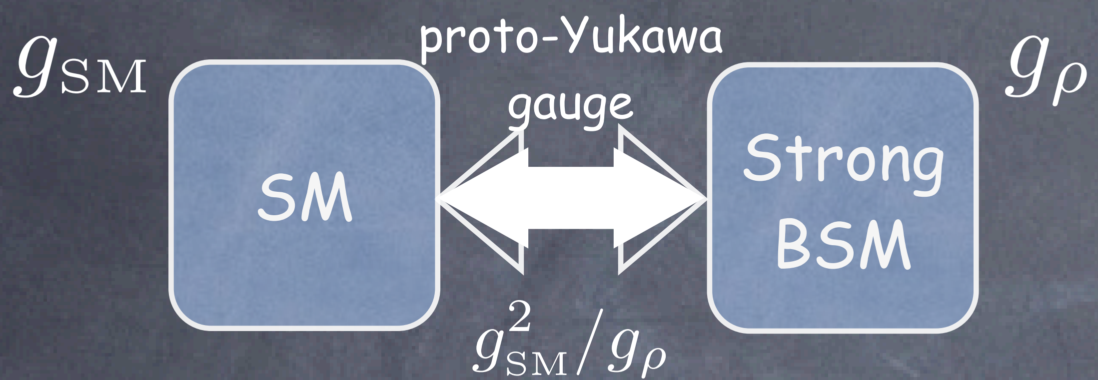
Setup stable under radiative corrections?

[Dawson, Jackson '08]

Composite Higgs Models

4D Composite Higgs & Vector Resonances

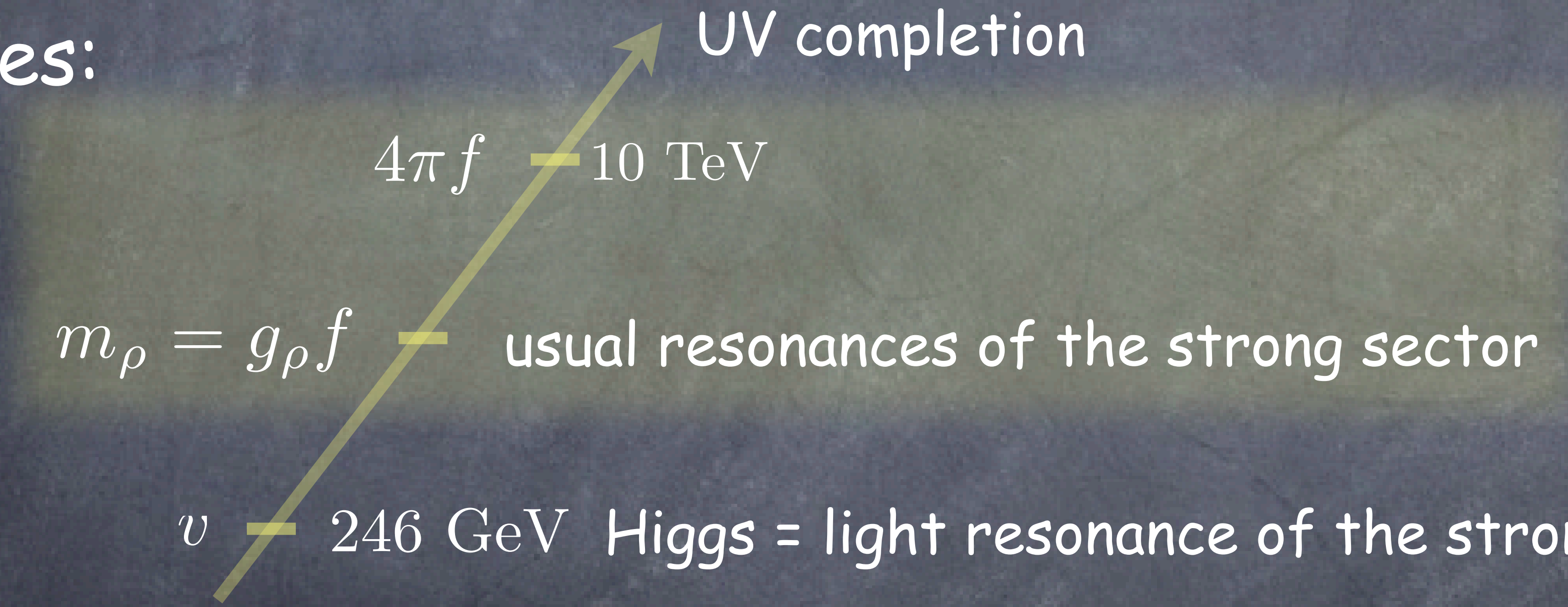
Higgs=Pseudo-Goldstone boson of the strong sector



m_{Higgs}=0 when g_{SM}=0

global symmetry → G/H ← residual global symmetry

3 scales:



} not easily accessible at LHC → indirect probes

strong sector broadly characterized by 2 parameters

m_ρ = mass of the resonances

g_ρ = coupling of the strong sector or decay cst of strong sector $f = \frac{m_\rho}{g_\rho}$

Continuous interpolation between SM and TC

$$\xi = \frac{v^2}{f^2} = \frac{(\text{weak scale})^2}{(\text{strong coupling scale})^2}$$

$\xi = 0$

SM limit

all resonances of strong sector, except the Higgs, decouple

$\xi = 1$

Technicolor limit

Higgs decouple from SM; vector resonances like in TC

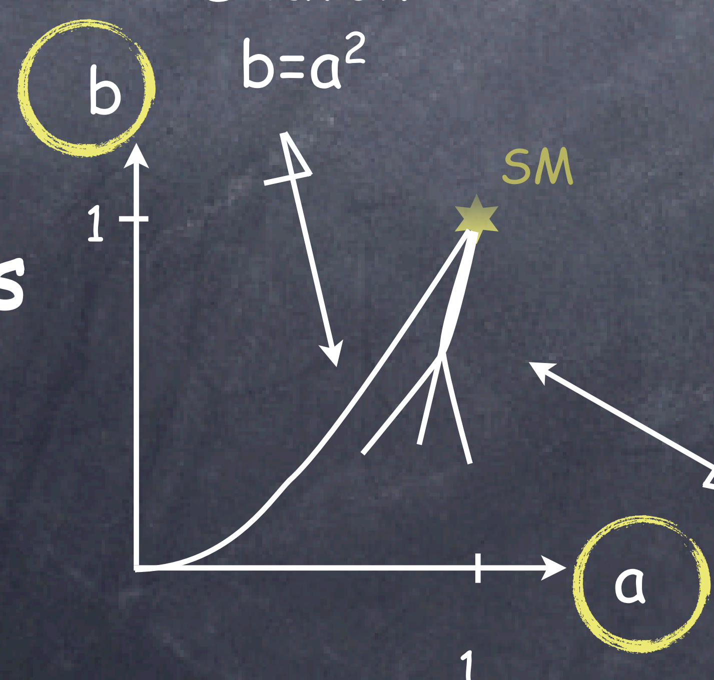
Composite Higgs

vs.

SM Higgs

Dilaton

Dilaton
b=a²



$$\mathcal{L}_{\text{EWSB}} = \left(a\, \frac{v}{2}\, h \; + b\, \frac{1}{4}\, h^2 \right) \text{Tr}\left(D_\mu \Sigma^\dagger D_\mu \Sigma \right)$$

Composite Higgs
universal behavior for large f
$a=1-\xi/2 \quad b=1-2\xi$

Testing the composite nature of the Higgs?

if LHC sees a Higgs and nothing else*:
is it elementary or composite?

¿¿¿ evidence for fine-tuning & string landscape ???

¿¿¿ Higgs forces have a secret hidden gauge origin ???

- Model-dependent: production of resonances at m_ρ
- Model-independent: study of Higgs properties & W scattering
  - strong WW scattering
  - strong HH production
  - Higgs anomalous coupling
  - anomalous gauge bosons self-couplings

* a likely possibility that precision data seems to point to, at least in strongly coupled models

SILH Effective Lagrangian

(strongly-interacting light Higgs)

[Giudice, Grojean, Pomarol, Rattazzi '07]

- extra Higgs leg: H/f
- extra derivative: ∂/m_ρ

Genuine strong operators (sensitive to the scale f)

$$\frac{c_H}{2f^2}\left(\partial_\mu\left(|H|^2\right)\right)^2 \qquad \frac{c_T}{2f^2}\left(H^\dagger \overleftrightarrow{D^\mu} H\right)^2 \qquad \frac{c_y y_f}{f^2}|H|^2 \bar{f}_L H f_R + \text{h.c.} \qquad \frac{c_6\lambda}{f^2}|H|^6$$

custodial breaking

Form factor operators (sensitive to the scale m_ρ)

$$\frac{ic_W}{2m_\rho^2}\left(H^\dagger\sigma^i \overleftrightarrow{D^\mu} H\right)(D^\nu W_{\mu\nu})^i \qquad \frac{ic_B}{2m_\rho^2}\left(H^\dagger \overleftrightarrow{D^\mu} H\right)(\partial^\nu B_{\mu\nu})$$

$$\frac{ic_{HW}}{m_\rho^2}\frac{g_\rho^2}{16\pi^2}(D^\mu H)^\dagger\sigma^i(D^\nu H)W^i_{\mu\nu} \qquad \frac{ic_{HB}}{m_\rho^2}\frac{g_\rho^2}{16\pi^2}(D^\mu H)^\dagger(D^\nu H)B_{\mu\nu}$$

minimal coupling: $h\to\gamma Z$

loop-suppressed strong dynamics

$$\frac{c_\gamma}{m_\rho^2}\frac{g_\rho^2}{16\pi^2}\frac{g^2}{g_\rho^2}H^\dagger H B_{\mu\nu}B^{\mu\nu} \qquad \frac{c_g}{m_\rho^2}\frac{g_\rho^2}{16\pi^2}\frac{y_t^2}{g_\rho^2}H^\dagger H G^a_{\mu\nu}G^{a\mu\nu}$$

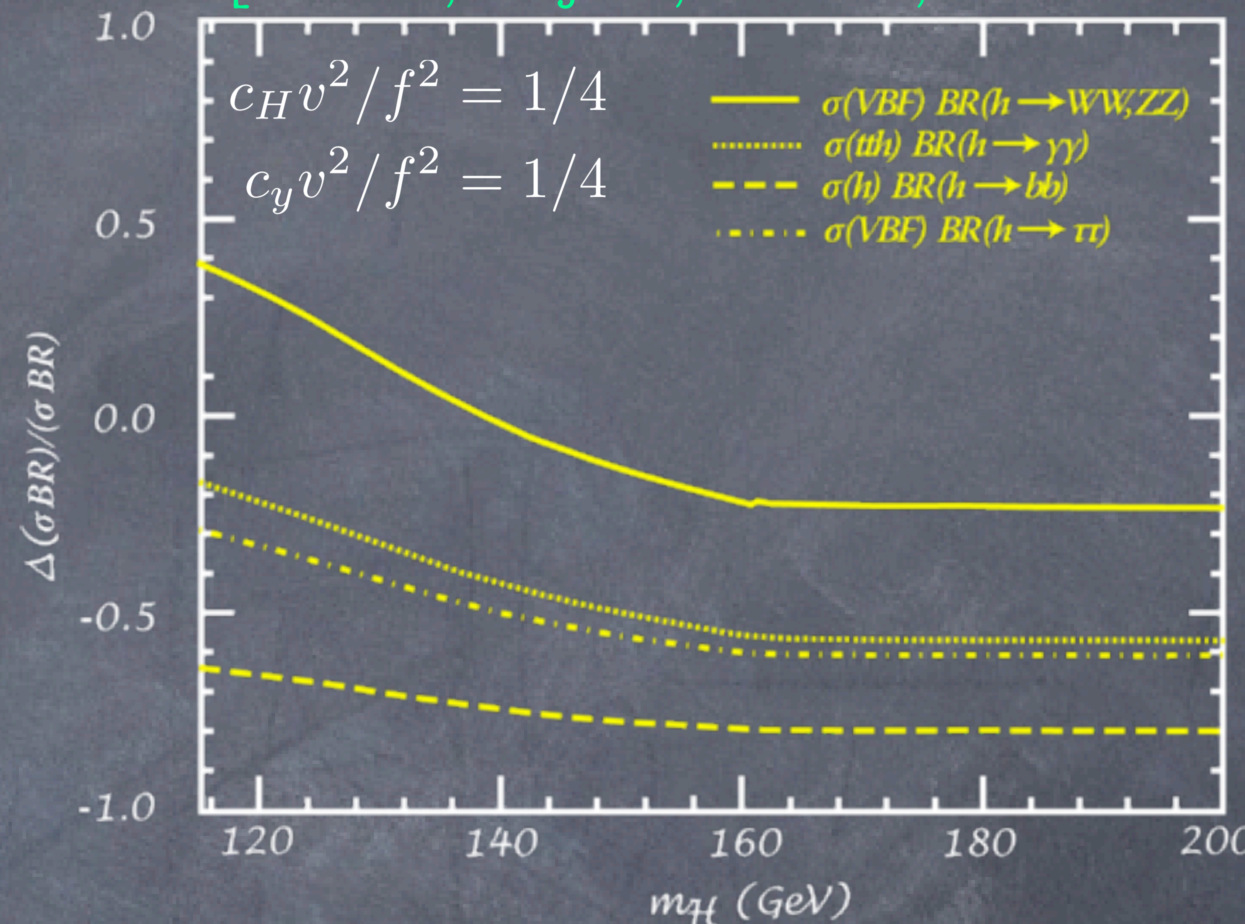
Goldstone sym.

Higgs anomalous couplings @ LHC

$$\Gamma\left(h \to f\bar{f}\right)_{\rm SILH} = \Gamma\left(h \to f\bar{f}\right)_{\rm SM}\left[1-\left(2c_y + c_H\right)v^2/f^2\right]$$

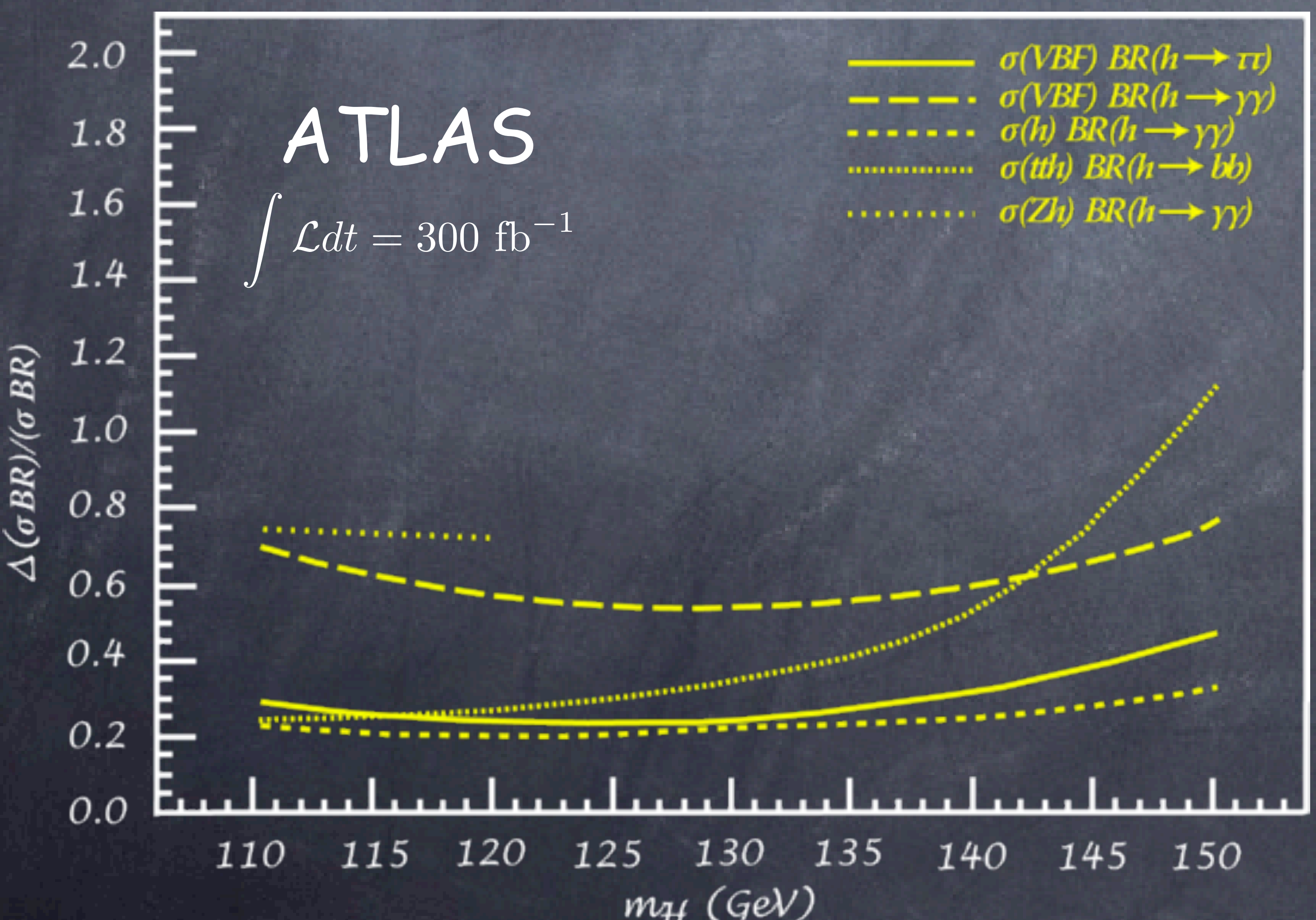
$$\Gamma\left(h \to gg\right)_{\rm SILH} = \Gamma\left(h \to gg\right)_{\rm SM}\left[1-\left(2c_y + c_H\right)v^2/f^2\right]$$

[Giudice, Grojean, Pomarol, Rattazzi '07]



observable @ LHC?

Duhrssen '03



LHC can measure

$$c_H \frac{v^2}{f^2},\quad c_y \frac{v^2}{f^2}$$

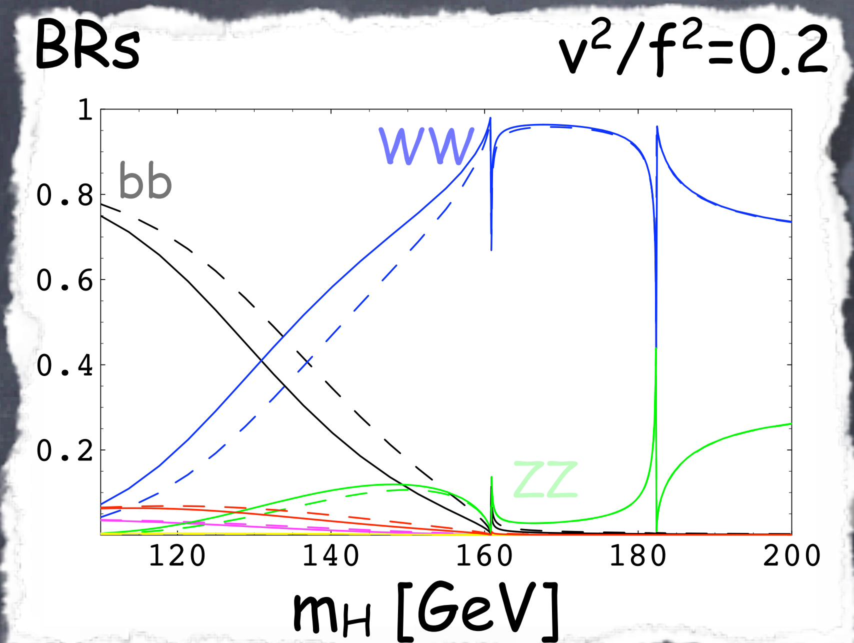
up to 0.2-0.4

i.e. $4\pi f \sim 5-7\ \text{TeV}$

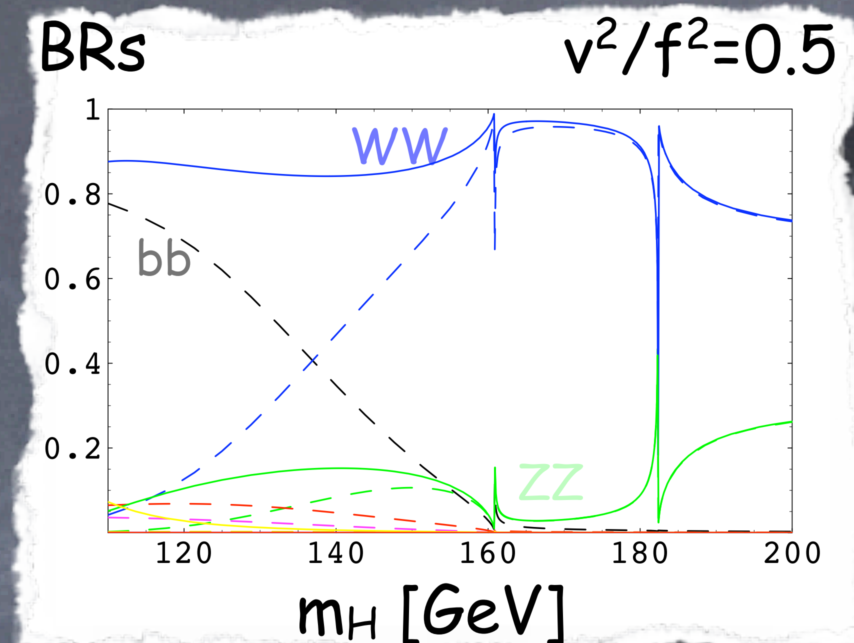
(ILC/CLIC could go to few % ie test composite Higgs up to $4\pi f \sim 30\ \text{TeV}$)

Higgs' BRs and Total Width

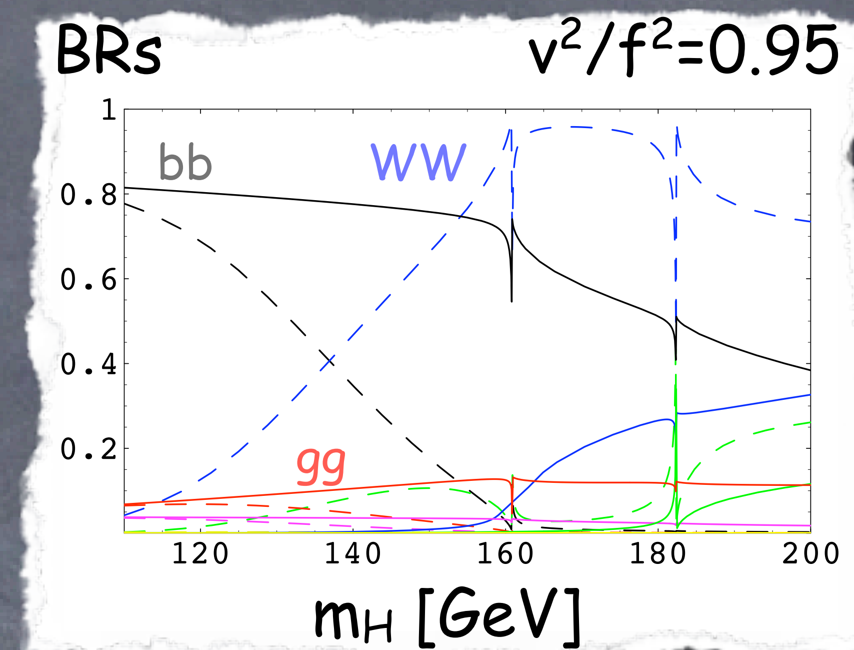
MCHM$_{5D}$ (Contino et al. '04) with fermions embedded in 5+10 of SO(5)



slight modifications

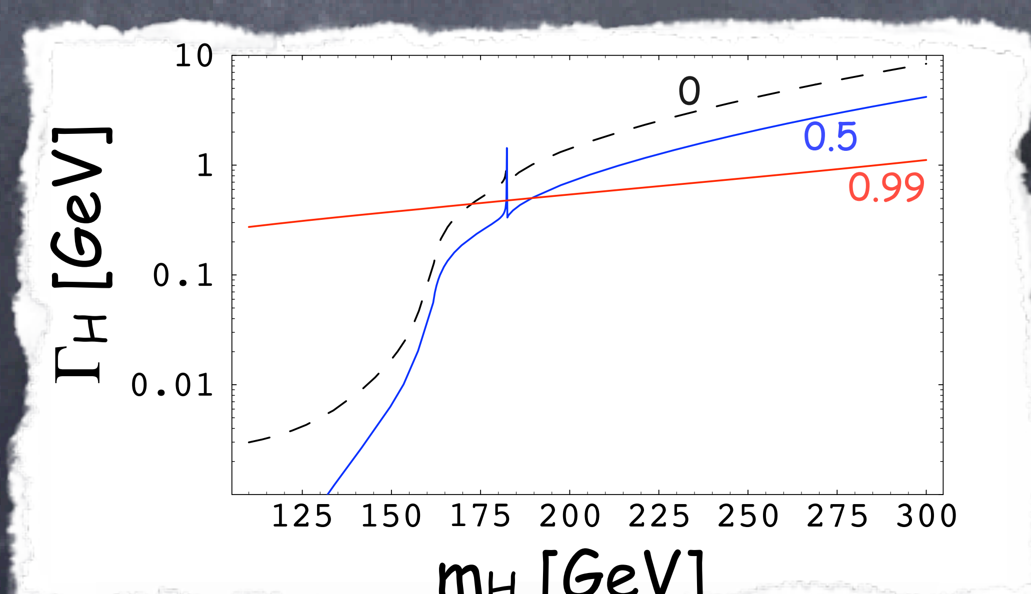


suppress bb



suppress WW

Higgs total width



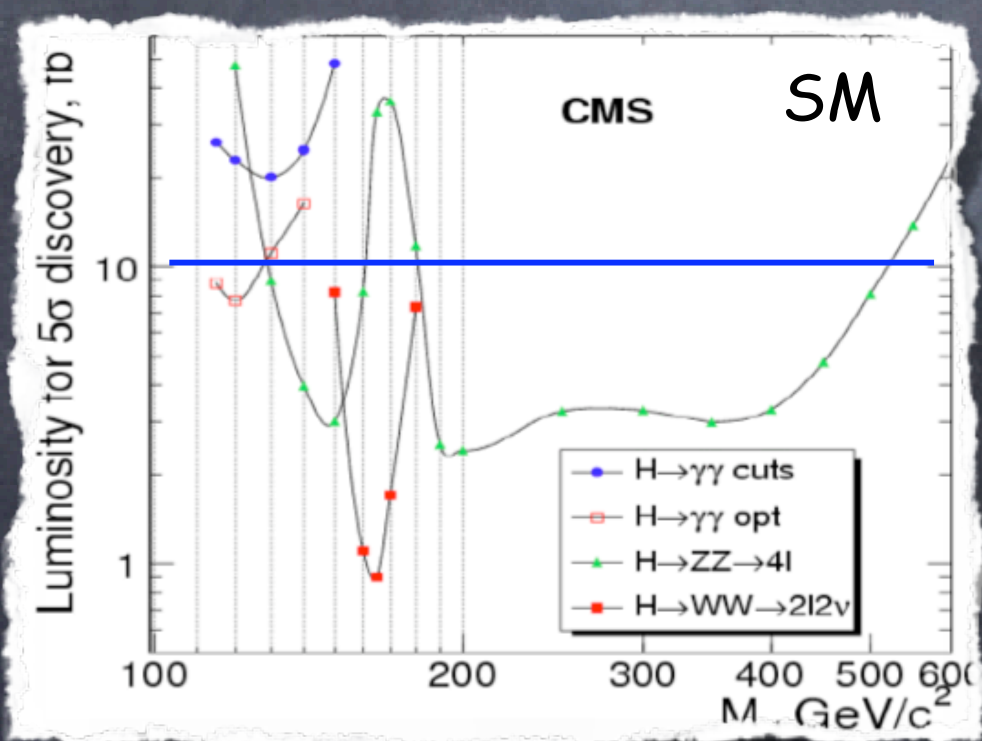
- - - SM

—— composite Higgs

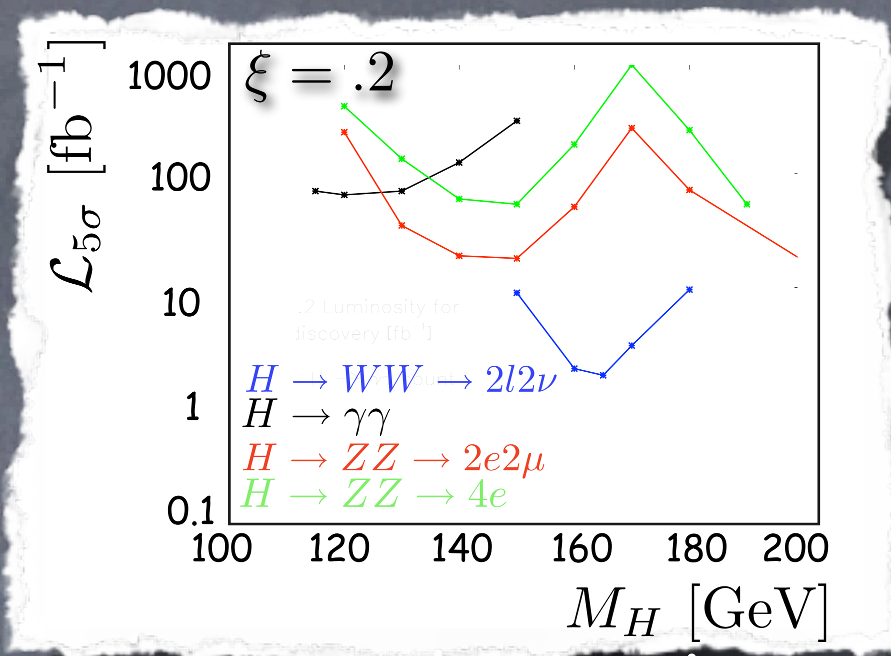
Composite Higgs search @ LHC

[Espinosa, Grojean, Muehlleitner 'in progress]

the modification of Higgs couplings and BRs affects the Higgs search



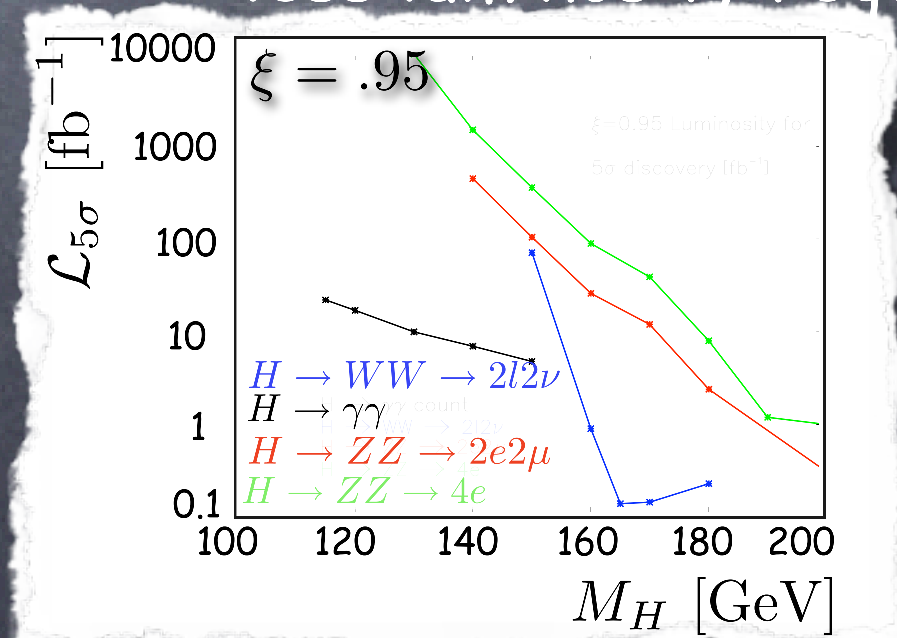
large
compositeness scale



more luminosity required

less luminosity required

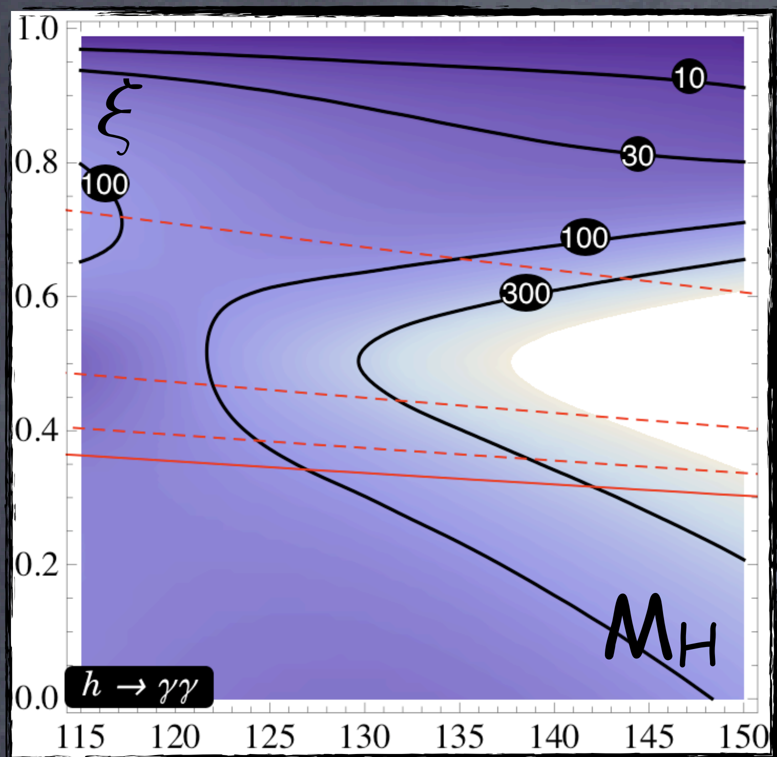
small
compositeness scale

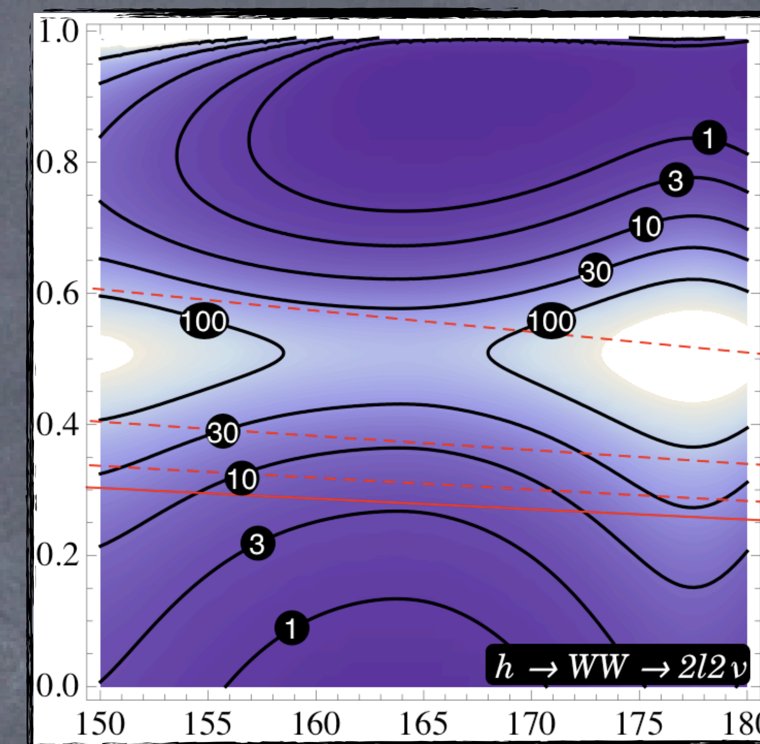


Composite Higgs search @ LHC

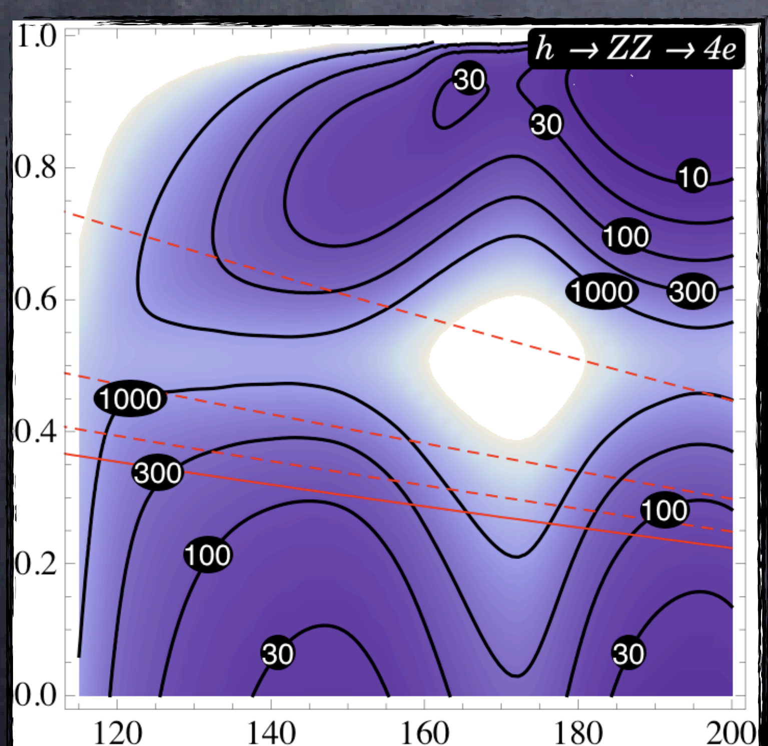
[Espinosa, Grojean, Muehlleitner 'in progress]

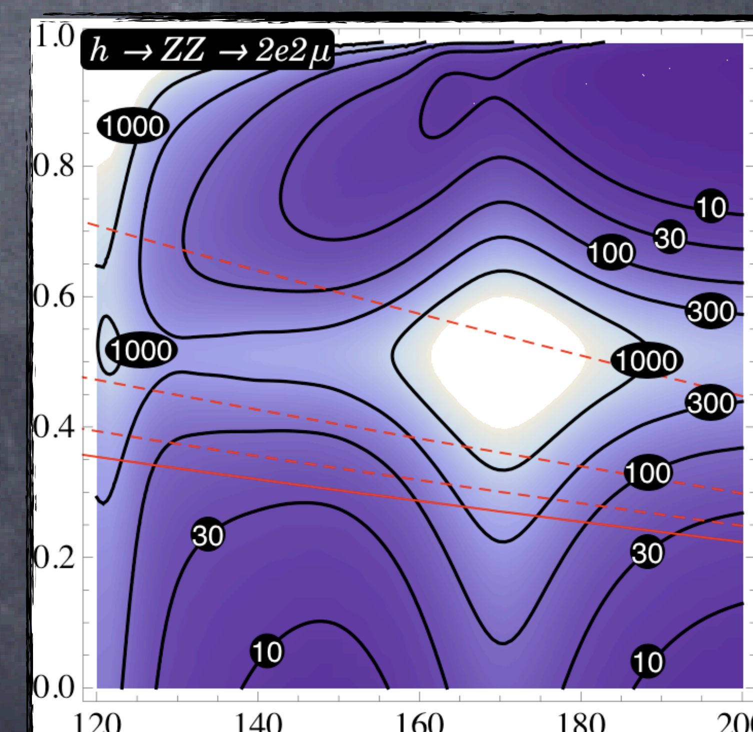
the modification of Higgs couplings and BRs affects the Higgs search





contour lines of luminosity needed for 5σ discovery in the (ξ,M_H) plane





(neglect effects from heavy resonances)

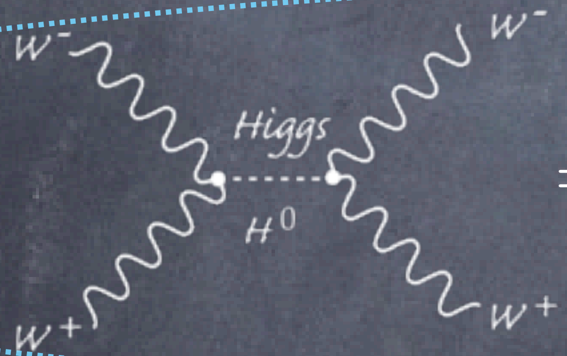
Strong WW scattering

Giudice, Grojean, Pomarol, Rattazzi '07

$$\mathcal{L} \supset \frac{c_H}{2f^2}\,\partial^\mu\left(|H|^2\right)\partial_\mu\left(|H|^2\right) \qquad c_H \sim \mathcal{O}(1)$$

$$H = \begin{pmatrix} 0 \\ \frac{v+h}{\sqrt{2}} \end{pmatrix} \Longrightarrow \mathcal{L} = \frac{1}{2}\left(1 + c_H\frac{v^2}{f^2}\right)(\partial^\mu h)^2 + \ldots$$

Modified Higgs propagator ~ Higgs couplings rescaled by $\dfrac{1}{\sqrt{1 + c_H\frac{v^2}{f^2}}} \sim 1 - c_H\dfrac{v^2}{2f^2} \equiv 1 - \xi/2$



$$= -(1-\xi)g^2\frac{E^2}{M_W^2}$$

no exact cancellation of the growing amplitudes

Even with a light Higgs, growing amplitudes (at least up to m_ρ)

$$\mathcal{A}\left(W_L^a W_L^b \to W_L^c W_L^d\right) = \mathcal{A}(s,t,u)\delta^{ab}\delta^{cd} + \mathcal{A}(t,s,u)\delta^{ac}\delta^{bd} + \mathcal{A}(u,t,s)\delta^{ad}\delta^{bc}$$

$$\mathcal{A}_{\rm LET}(s,t,u) = \frac{s}{v^2} \Longrightarrow \mathcal{A}_\xi = \frac{s}{f^2}$$

LET=SM-Higgs

unitarity restored by the exchange of heavy vector resonances

Falkowski, Pokorski, Roberts '07

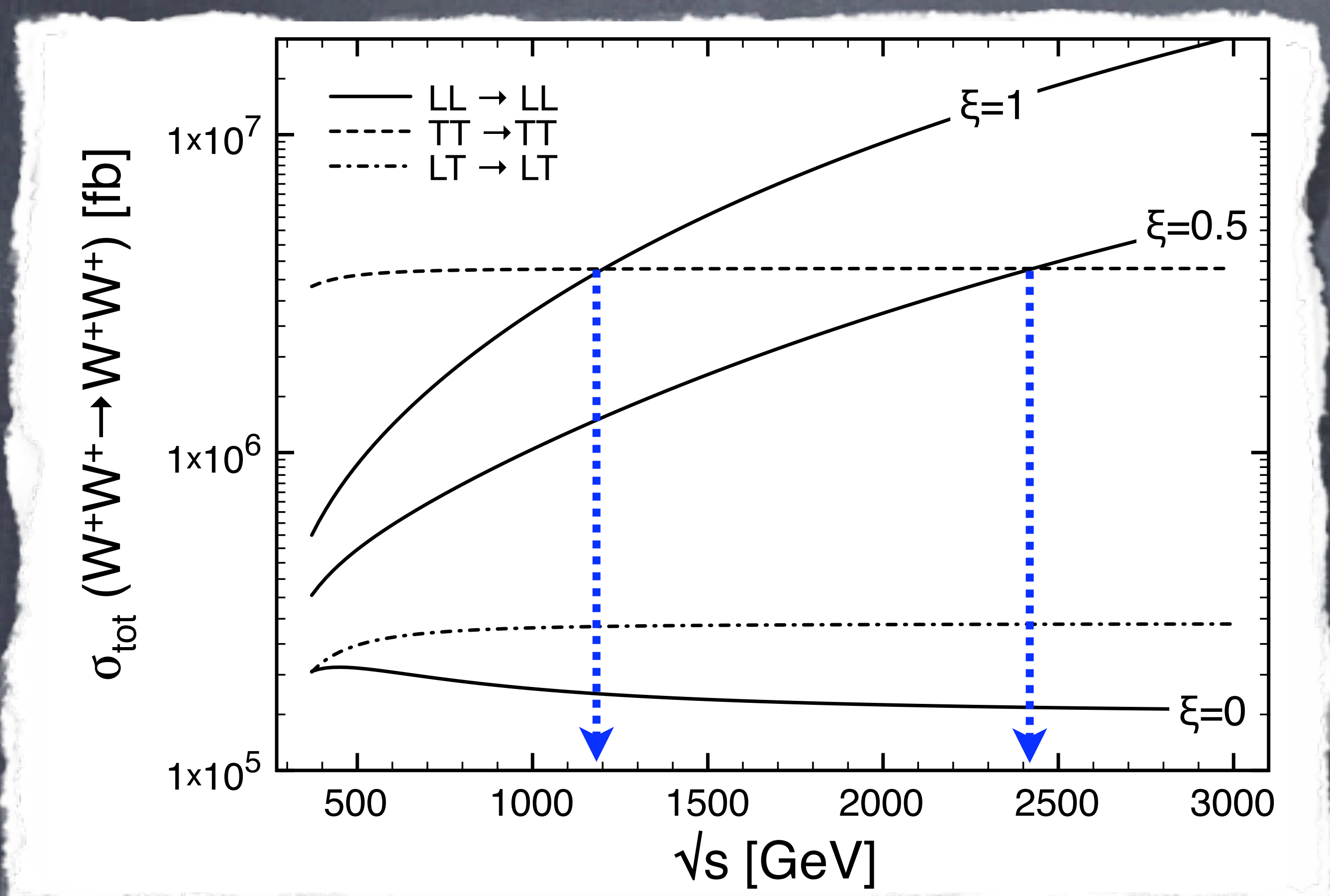
Onset of Strong Scattering

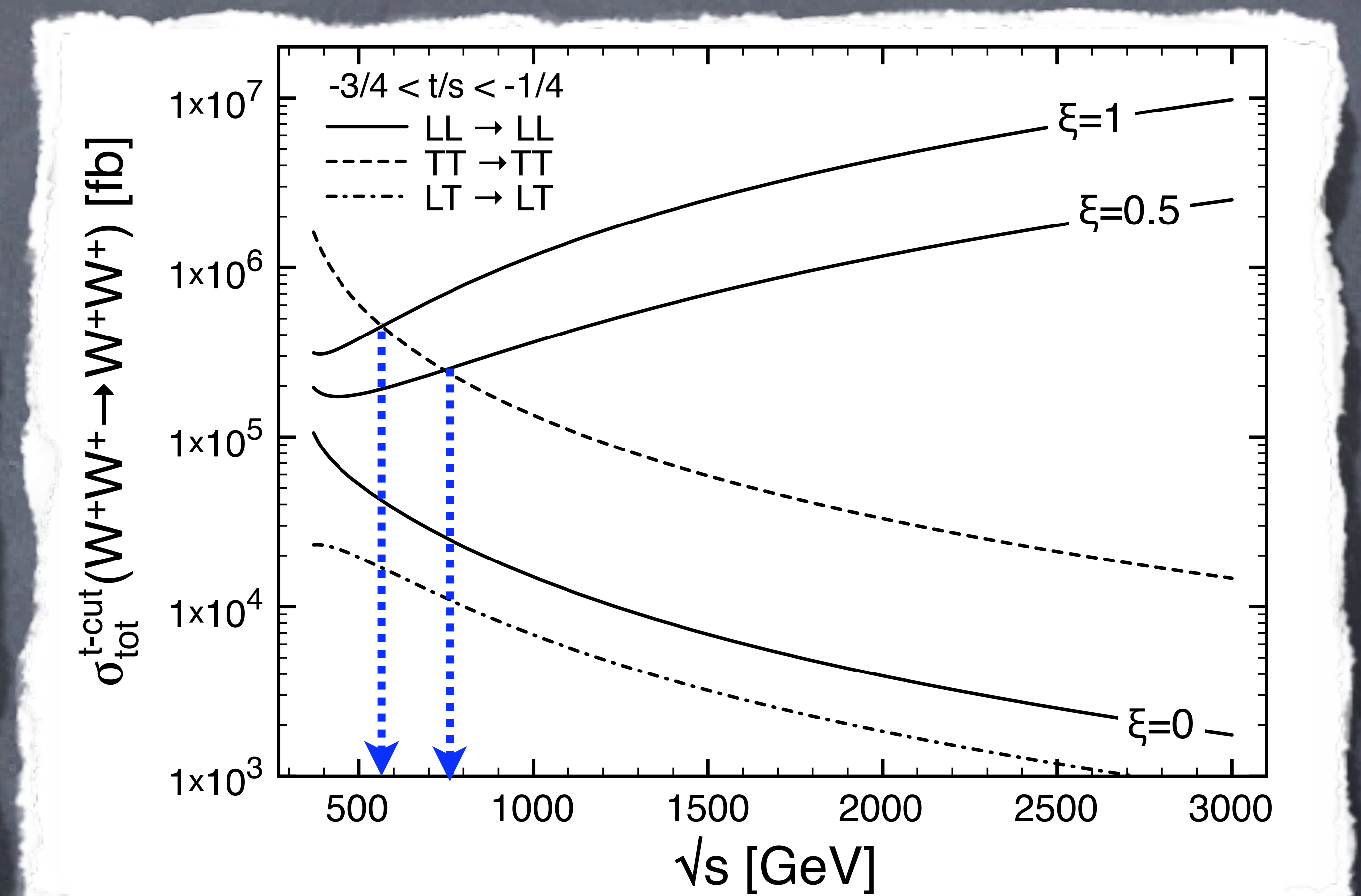
Contino, Grojean, Moretti, Piccinini, Rattazzi 'to appear

NDA estimates: $(\mathcal{A}_{TT\to TT} \sim g^2) \sim (\mathcal{A}_{LL\to LL} \sim s/v^2)$ @ $\sqrt{s} \sim 2M_W$

but disentangling L from T polarization is hard

because of the structure of the amplitudes (Coulomb enhancement)





The onset of strong scattering is delayed to larger energies due to the dominance of TT → TT background

The dominance of T background will be further enhanced by the pdfs since the luminosity of W_T inside the proton is $\log(E/M_W)$ enhanced

With LHC energy, access to strong scattering is difficult

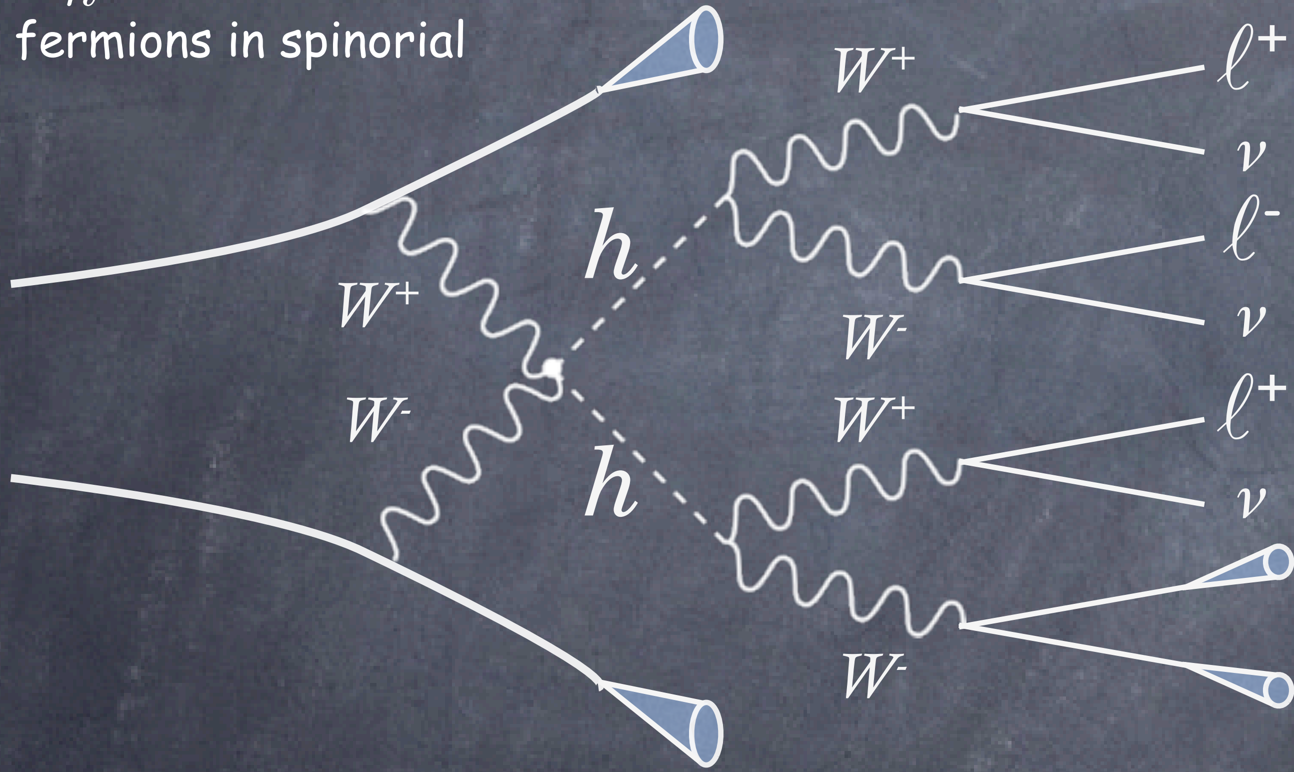
Strong Higgs production: (3L+jets) analysis

Contino, Grojean, Moretti, Piccinini, Rattazzi 'to appear

strong boson scattering ⇔ strong Higgs production

$$\mathcal{A}\left(Z_L^0 Z_L^0 \to hh\right) = \mathcal{A}\left(W_L^+ W_L^- \to hh\right) = \frac{c_H s}{f^2}$$

$m_h = 180$ GeV
fermions in spinorial



More complicated final states, smaller BRs
but no T polarization pollution

acceptance cuts

jets	leptons
$p_T \geq 30$ GeV	$p_T \geq 20$ GeV
$\delta R_{jj} > 0.7$	$\delta R_{lj(ll)} > 0.4(0.2)$
$\|\eta_j\| \leq 5$	$\|\eta_j\| \leq 2.4$

Dominant backgrounds: W$\ell\ell$4j, $\bar{t}t$W2j, $\bar{t}t$2W, 3W4j...

forward jet-tag, back-to-back lepton, central jet-veto

v/f	1	$\sqrt{.8}$	$\sqrt{.5}$
significance (300 fb^{-1})	4.0	2.9	1.3
luminosity for 5σ	450	850	3500

⇚ good motivation for SLHC

Fermion Partners

The couplings of gauge bosons to fermions receive corrections
the heavier the fermion, the bigger the correction
expect O(10%) deviation in Zb_Lb_L, beyond exp. bound

custodial symmetry might be helpful to protect $Z_{b_L\bar{b}_L}$

[Agashe, Contino, Da Rold, Pomarol '06]

custodial embedding

$$Q_L = \begin{pmatrix} t_L^{2/3} & t_L^{5/3} \\ b_L^{-1/3} & b_L^{2/3} \end{pmatrix} \equiv (2,\bar{2})_{2/3}$$

$$t_R \equiv (1,1)_{-2/3}$$
$$b_R \equiv (1,1)_{1/3}$$

then b_L is an eigenstate of L ⇔ R and this ensures that $\delta Z_{b_L\bar{b}_L} = 0$

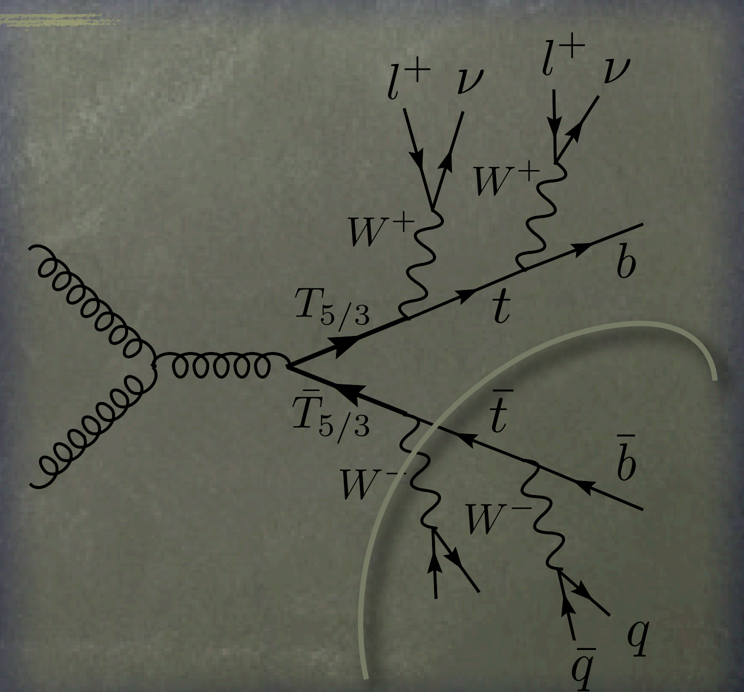
but we expect deviations in $Zt_L\bar{t}_L$ $\quad Wt_L\bar{b}_L$ $\quad Zb_R\bar{b}_R$

Search in same-sign di-lepton events

[Contino, Servant '08]

- *tt+jets* is not a background [except for charge mis-ID and fake e^-]
- the resonant (tW) invariant mass can be reconstructed

discovery potential (LHC_{14TeV})
$M_{5/3}$=500 GeV → 56 pb^{-1}
$M_{5/3}$=1 TeV → 15 fb^{-1}



Conclusions

EW interactions need Goldstone bosons to provide mass to W, Z

⇓ ⇓ ⇓ ⇓ ⇓ ⇓

EW interactions also need a UV moderator/new physics

to unitarize WW scattering amplitude

We'll need another Gargamelle experiment

to discover the still missing neutral current of the SM: the Higgs

weak NC ⇔ gauge principle

Higgs NC ⇔ ?

LHC is prepared to discover the "Higgs"

collaboration EXP-TH is important to make sure

e.g. that no unexpected physics (unparticle, hidden valleys) is missed (triggers, cuts...)

Should not forget that the LHC will be a (quark) top machine

and there are many reasons to believe that the top is an important agent of the Fermi scale