STRONG $W_L W_L$ SCATTERING

SUPPOSE WE DO NOT FIND AN ELEMENTARY HIGGS SCALAR UP TO 1 TeV

$\Rightarrow$ partial-wave unitarity will be violated (below $4\pi v$)

... THERE **MUST** BE A PROCESS FOR E.W.S.B.

if no $\left\{ \begin{array}{l} \text{light } h^0, H^0, A^0, H^\pm \\ \text{sparticles} \end{array} \right\}$ are observed,

$\Rightarrow$ THERE REMAINS THE POSSIBILITY OF A STRONGLY INTERACTING E.W. SECTOR:

W_L take the place of gauge bosons

$W_L W_L$ acquires a $\left.\begin{array}{l}\text{NEW} \\ \text{STRONG}\end{array}\right\}$ interaction

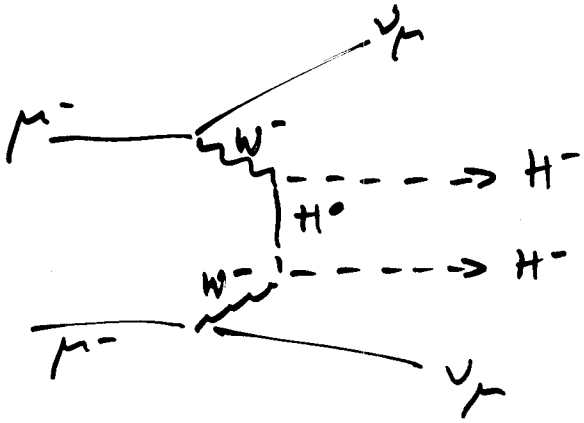
THIS NEW INTERACTION (Technicolor, ...?) MUST BE INVESTIGATED AS FULLY AS π-π INTERACTIONS WERE IN THE '60's

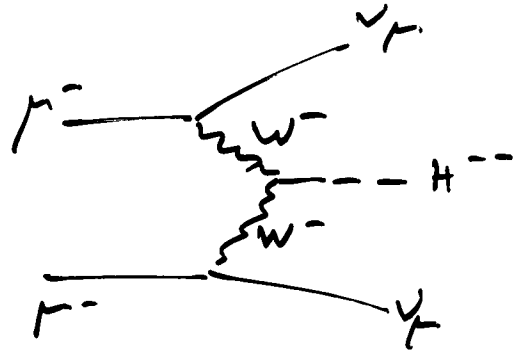
$\rightarrow$ all J, I channels.

• EXTENDED HIGGS SECTOR

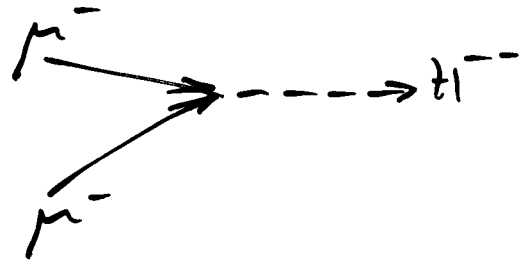
(STRONGLY MODEL-DEPENDENT)

W^-W^- FUSION TO $\begin{cases} H^-H^- \\ H^{--} \end{cases}$





OR, VIA DIRECT DILEPTON COUPLING



, pair production at LHC? $H^{--}H^{++}$

IN THE STANDARD $SU_{2,L}$ CASE WITH $Q_\mu = I_3^W + \frac{Y^W}{2}$

$\mu_R^-\mu_R^- \to H^{--}\ (I^W=0,\ I_3^W=0,\ Y=-4)$

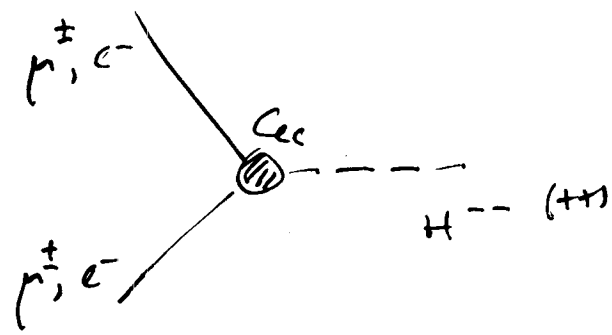
CHOOSE POL'NS:

$\mu_L^-\mu_R^- \to H^{--}\ (\ \tfrac{1}{2}\quad -\tfrac{1}{2}\quad -3)$

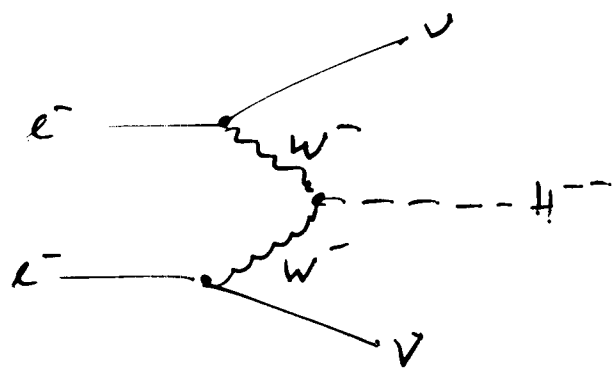
$\mu_L^-\mu_L^- \to H^{--}\ (\ 1\quad -1\quad -2)$

TO UNEARTH CORRECT REP'N

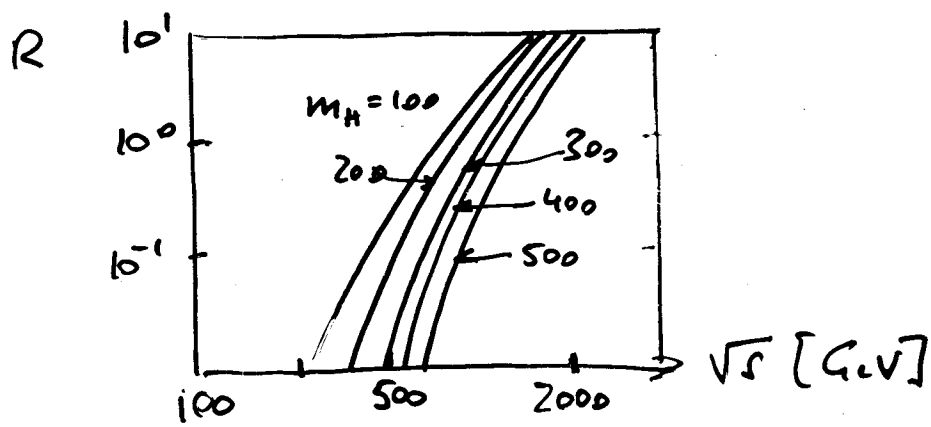
WE DO NOT KNOW THE COUPLING STRENGTH OF DIRECT $H^{--}\ell^-\ell^-$ COUPLING, $C_{\ell\ell}$



BUT CAN CALCULATE $W^-W^-H^-$ "FUSION"



TO AMOUNT TO A FULL UNIT OF R



SPECTACULAR SIGNATURES IN S-CHANNEL STRUCTURE

WITH TYPICAL H WIDTHS !

→ DECAYS 2-body $H^{--} \to W^- W^-$; $e^- e^-$

$H^- H^-$

↳ $\ell^- \ell^- + \nu\nu$

3-body → $W^- W^{-*}$

↳ ...

4-body → $W^{-*} W^{-*}$

↳ $\ell^- + \nu$

↳ $\ell^- + \nu$

IF $m(H^{--}) < 2m_W$

2-body $H^{--} \to e^- e^-$!

$e^- e^-$ COLLIDER CERTAINLY APPEARS NEEDED

FOR FULL EXPLORATION OF

EXTENDED HIGGS SECTOR !

NOTE OF CAUTION: Beware of $e^- e^- \to$ $\boxed{\text{di leptons}}$ →

narrow peaks $\boxed{\begin{matrix} e^- e^- \\ \mu^- \mu^- \end{matrix}}$

see below !

CLEARLY, THE MUON COLLIDER IN ITS

TWO LIKE-SIGN VERSIONS

COULD PLAY A PIVOTAL ROLE

IN ASCERTAINING THE NATURE OF

A LARGER HIGGS SECTOR

μ Polarization plays a distinctive role in this!

I^w, I_3^w, Y^w CHOICES

TELL THE DIFFERENCE

BETWEEN MORE EXOTIC REP'S

HIGHER ENERGY

MUON vs. ELECTRON MASS

} CAN VITALLY ADD TO

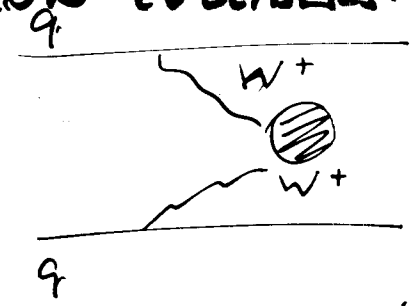
EVIDENCE FROM

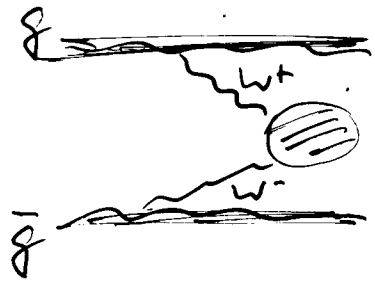
e^-e^- COLLISIONS!

$I=2$ SECTOR OF $W_L W_L$ SCATTERING:

- POSSIBLY UNIQUE DYNAMICS FOR EXTENDED GAUGE SECTORS
- FEWER BACKGROUNDS FOR EXPERIMENTAL SIGNALS:

HADRON COLLIDERS:





no contr's of order α_W, $\alpha_W \alpha_S$ in $I=2$ sector

WORST BACKGROUND (CHANOWITZ) tree-level

$q q \to q q W W$

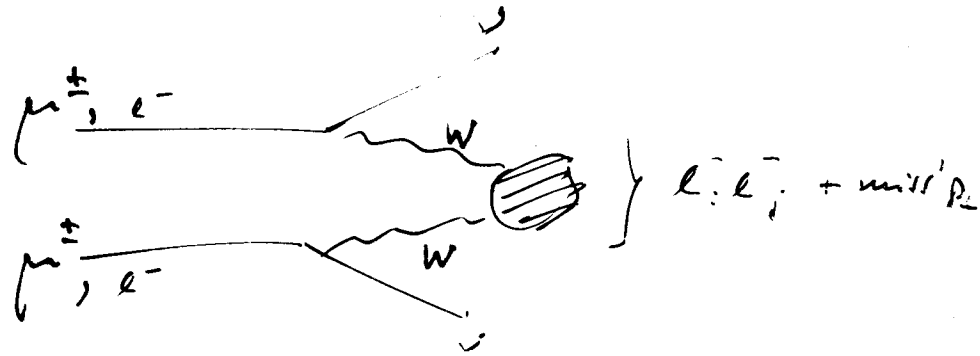
with light H^0 $\propto \alpha_W \alpha_W$

(mostly $W_T W_T$, $W_T W_L$

almost no $W_L W_L$

PRESENT IN $pp \to \ell^+ \ell^+ (\ell^- \ell^-) + \ldots$

THIS BACKGROUND IS ABSENT IN $e^- e^-$, $\mu^\pm \mu^\pm$



Can't miss a I = 2 resonance!

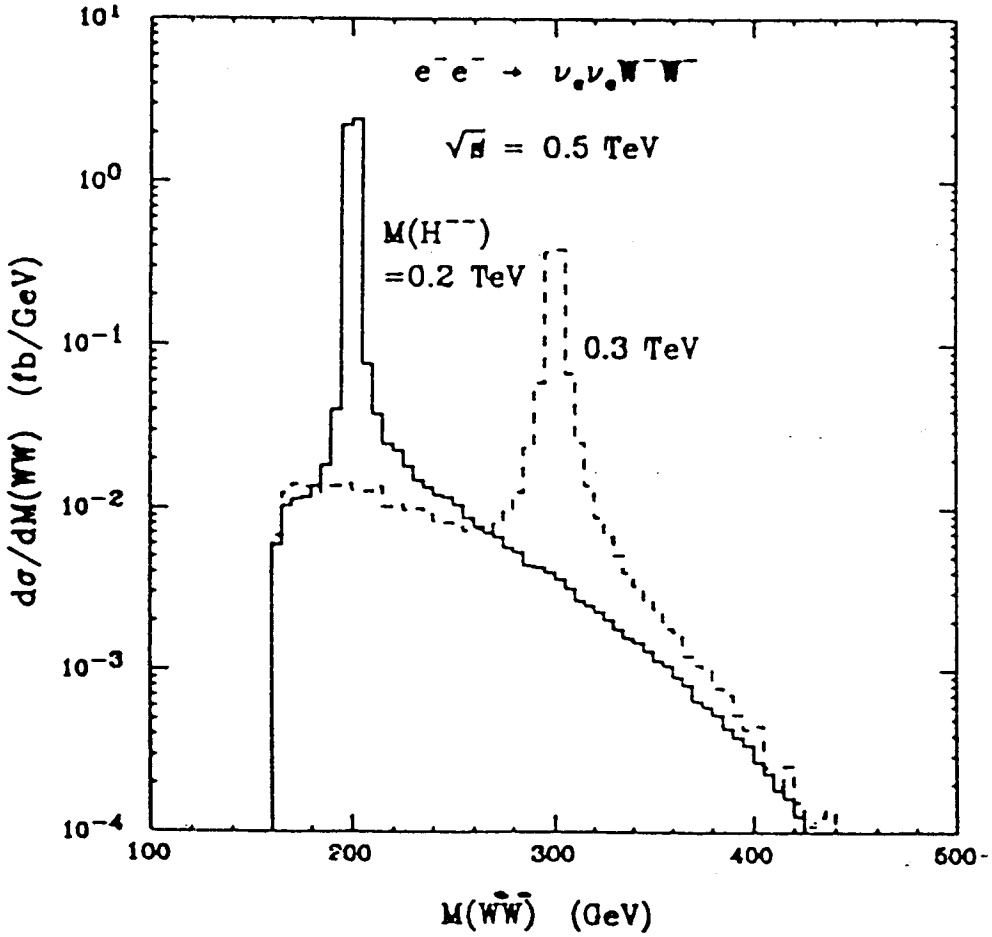


FIG. 11. The distribution in the W^-W^- invariant mass for $e^-e^- \to \nu_e\nu_e W^-W^-$ including the contribution of a doubly charged Higgs boson of mass $M(H^{--}) = 0.2$ or 0.3 TeV.