THE ONLY REALLY PURE FIELD AT OUR DISPOSAL IS

e_L, e_R

NOT AVAILABLE IN e^+
γ
hadron beams

(also, to a certain extent, μ's; but we cannot switch their polarization).

$|\vec{P}_{e^-}| = 80\%$ is routinely reached in SLD running at SLAC

- There is no known flux limit
- Theoretical estimates put attainable $|\vec{P}|_{e^-}$ values at $< 95\%$

$|\vec{P}|_{e^+}$ is a much harder task

NO PROJECT BEYOND 65% IF RING ENVISIONED

THE ACCESSIBILITY OF

(I)

- HIGH DEGREES OF POLARIZATION
- EASY HELICITY REVERSAL

FOR BOTH INCOMING BEAMS

IS ESSENTIAL FOR ENHANCEMENT OF SIGNAL AND SUPPRESSION OF BACKGROUND

→ EASY CHOICE OF CHIRAL COUPLINGS

(II)

- DISTINCTIVE CHOICE OF INCOMING QUANTUM #'s FOR INITIAL STATE:

	Q_{ee}	S_z	L	L_e	I_3^W	Y^W
$e_L^- e_L^-$	−2	+1	2	2	−1	−2
$e_L^- e_R^-$	−2	0	2	2	−½	−3
$e_R^- e_R^-$	−2	−1	2	2	0	−4

PERMITS PROBING BEYOND THE CAPABILITIES OF LHC **AND** e^+e^- COLLIDERS

WEAK SYMMETRY BREAKING -
THE HIGGS SECTOR
(plus extensions)

THE CLASSICAL DISCOVERY GRAPH

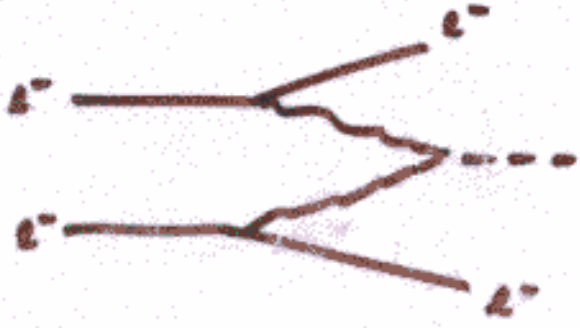
CLOSE TO THRESHOLD

BUT: need $\mu^+\mu^-$ decay of Z^0 for definition

cross-section falls $\sim s^{-1}$

AT HIGHER ENERGIES:

ZZ FUSION GRAPH



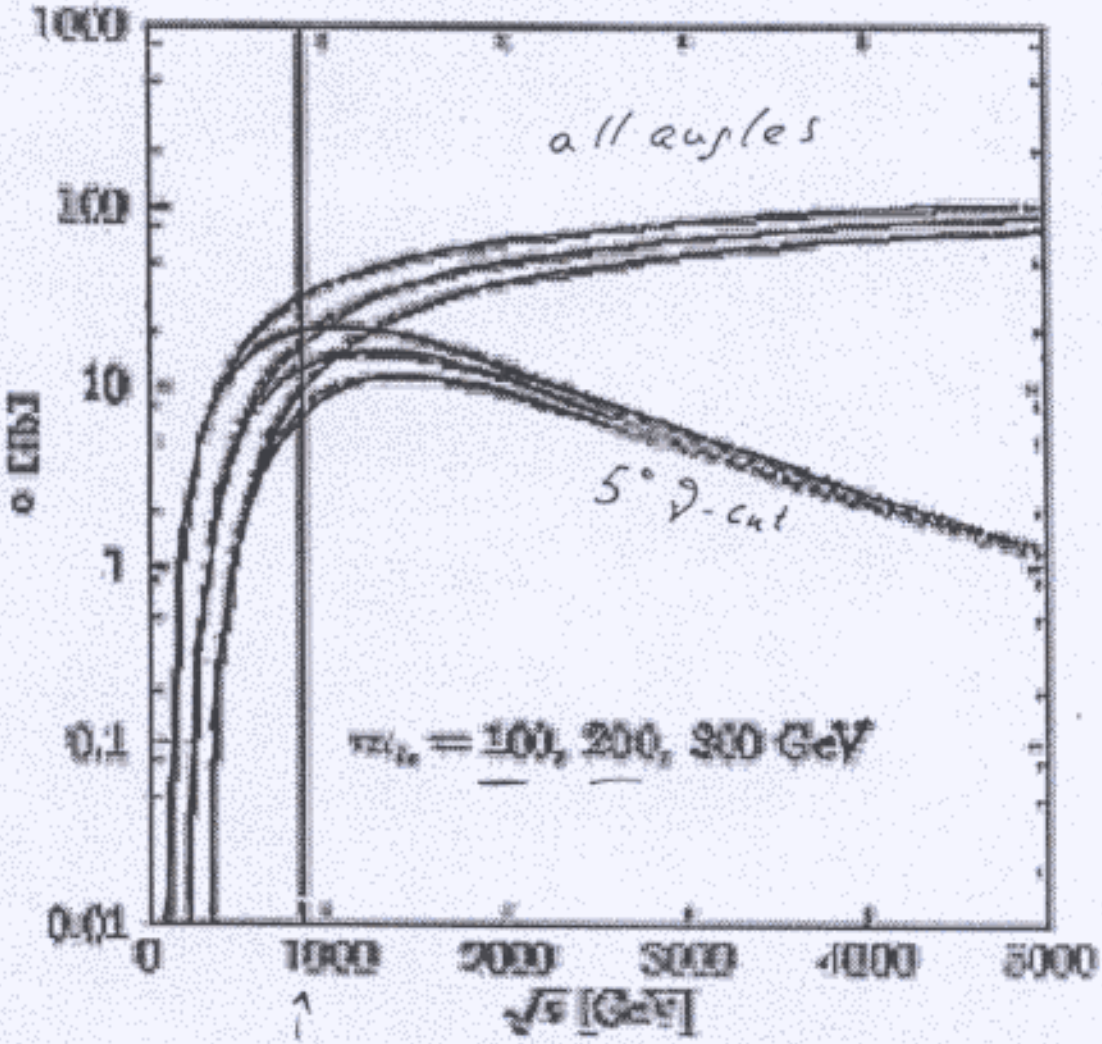
BECOMES COMPETITIVE

CROSS SECTION σ_{LL} SATURATES

all angles $\sigma_{LL} \to$ const? $\frac{1}{m_Z^2}$ $\sqrt{s} \to \infty$

OR,
WITH CUT $\vartheta_{ij} \geq 5^\circ$ $\sigma_{LL} \to$ const $\frac{1}{s}$ $\sqrt{s} \to \infty$

...



$\sqrt{s} = 850$ GeV

→ $\sqrt{s} = 500$ GeV is sufficient to cover a narrower m_H band: $m_H \leq 150$ GeV

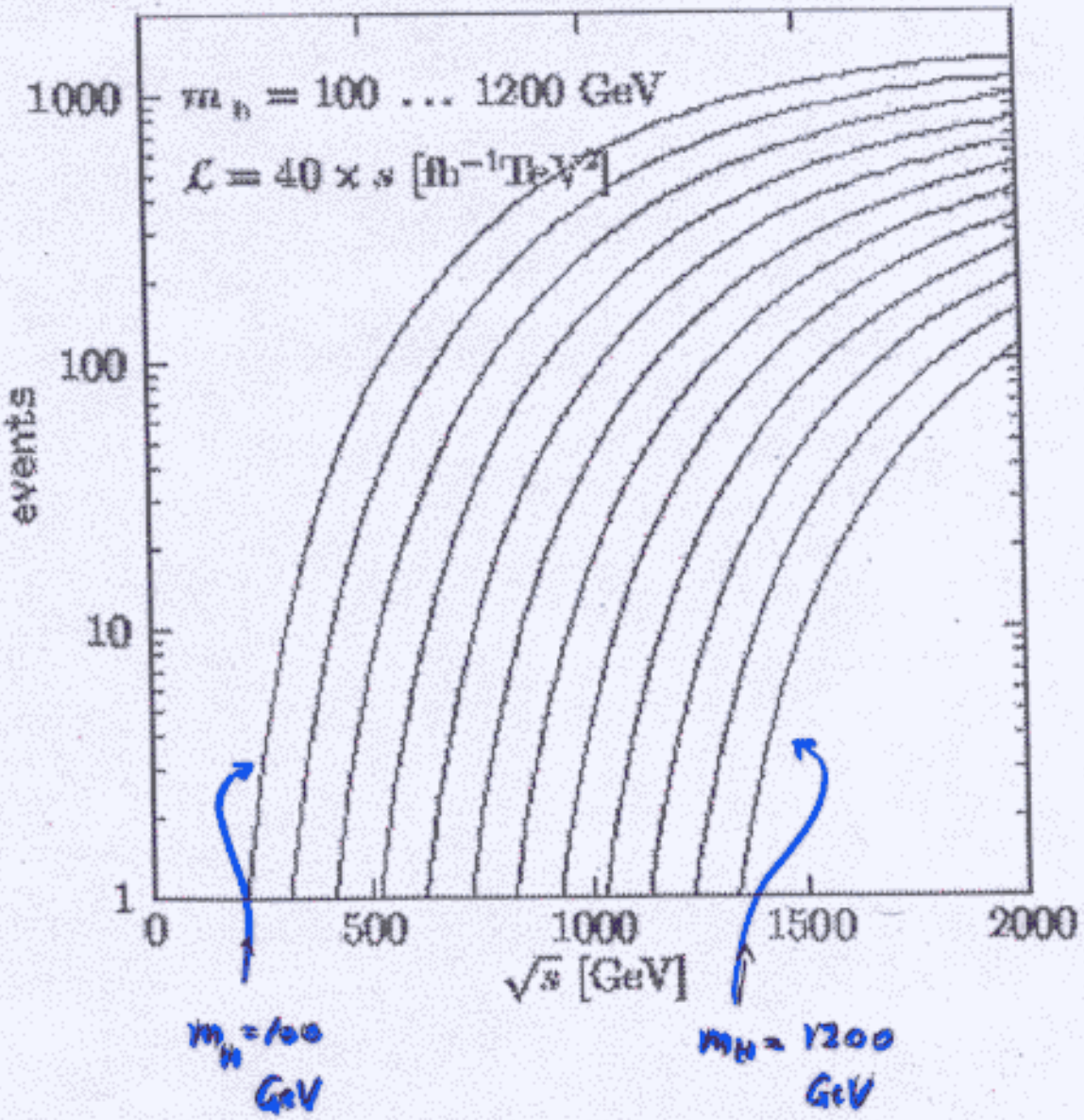
P. Rinkowski

$\sigma_{LL} \cdot \mathcal{L} = N_{LL}$ event rates for $m_H = [100, (100), 1200]$ GeV.

$\mathcal{L} = 40 \cdot \frac{s}{1(\text{TeV})^2} \cdot \frac{1}{f_b}$ assumed.

2 events

no angular cuts.

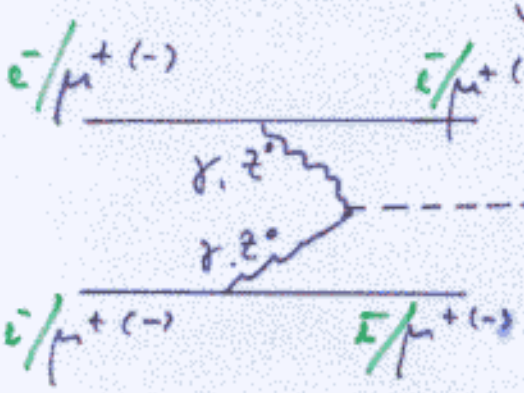


P. Minkowski

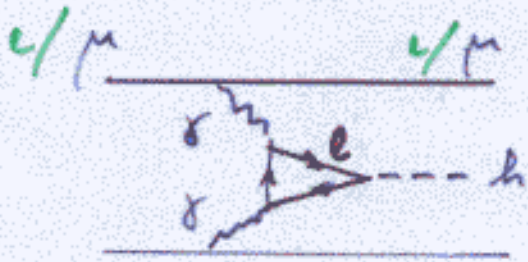
• HIGGS SCALARS:

SINGLE H^0 / h^0 PRODUCTION

via $\gamma\gamma$, Z^0Z^0 FUSION



ADD CP-odd A^0



AT ENERGIES $\sqrt{s} > 2.5\, m_H$,

"CENTRAL PRODUCTION"

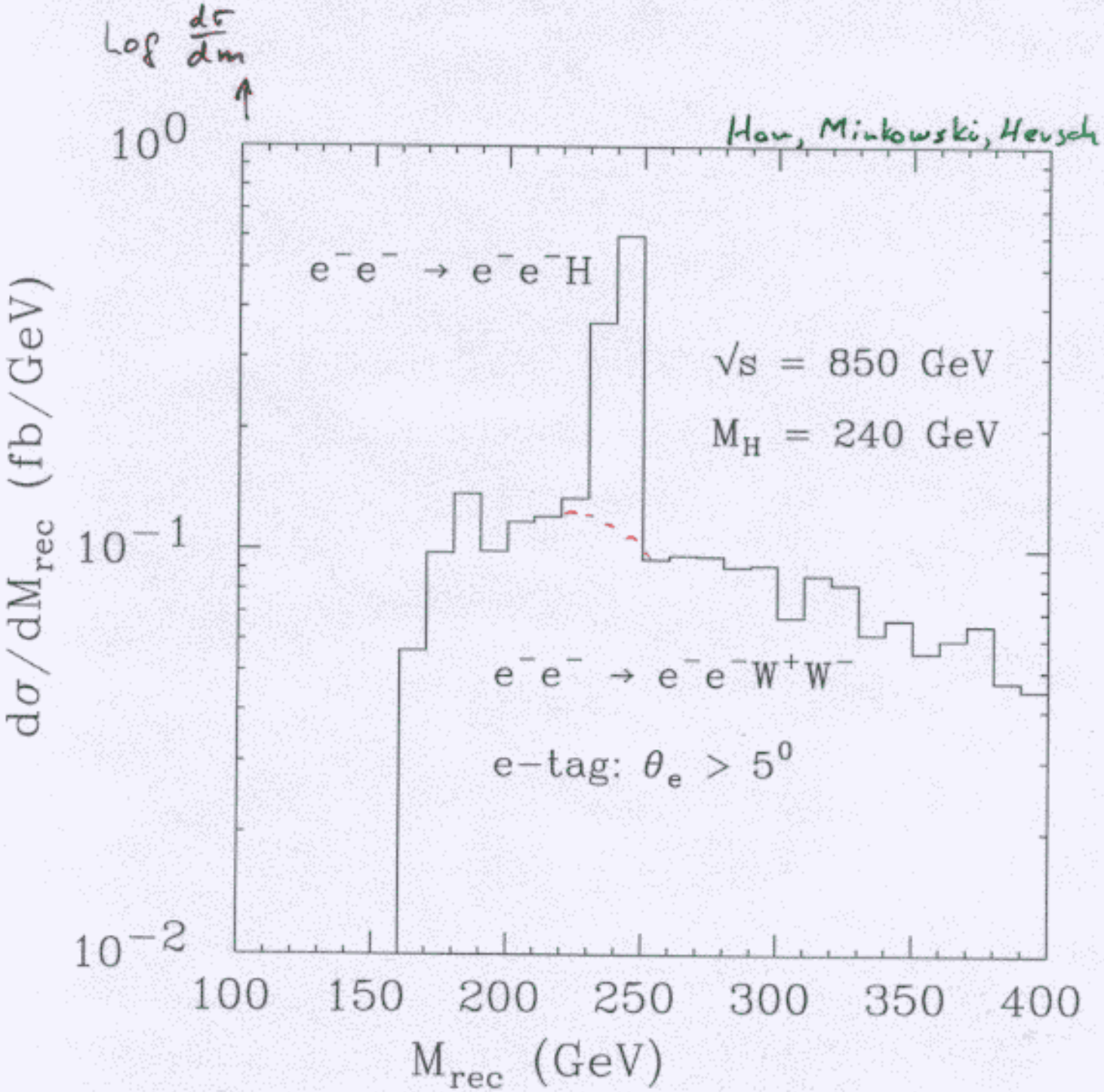
WITH MASS DETERMINATION FROM THE DETECTION OF HIGH-$p_\perp$ $e/\mu^{(\pm\pm)}$ IS

THE PREFERRED DETECTION MECHANISM:

→ LARGE (SATURATED) X-SECTION

→ GOOD $m(H)$ RESOLUTION

→ APPLIES TO "INVISIBLE DECAYS"


Log $\frac{d\sigma}{dm}$
Han, Minkowski, Heusch
10^0
10^{-1}
10^{-2}
$e^-e^- \to e^-e^-H$
$\sqrt{s}$ = 850 GeV
M_H = 240 GeV
$e^-e^- \to e^-e^-W^+W^-$
e−tag: $\theta_e > 5^0$
$d\sigma/dM_{rec}$ (fb/GeV)
100 150 200 250 300 350 400
M_{rec} (GeV)

MAKING THE BEST USE OF "EXOTIC" QUANTUM NUMBERS

Imagine we find unexpected structure in

$$\sigma_{tot}(\sqrt{E}) \quad (e^-e^- \to e^-e^-)$$

$$\frac{d\sigma}{d\Theta}(e^-e^- \to e^-e^-)$$

We cannot always do a meticulous energy scan,

but it is **TRIVIAL TO CHANGE e^- HELICITY**

e.g. → a structure could easily be

due to

strong WW scattering

extended (strong) Higgs sector H^{--}

dilepton gauge boson X^{--}

prod' and decay

changing $e_L^- \leftrightarrows e_R^-$ can decide very quickly !

DOES THE SIGNAL SURVIVE?

- - - VANISH?

J. GUNION WORKED OUT THE DETAILS OF SUCH NON-MINIMAL MODELS.

PHYSICAL MANIFESTATIONS: SEVERAL MORE HIGGS BOSONS REQUIRED, OF WHICH

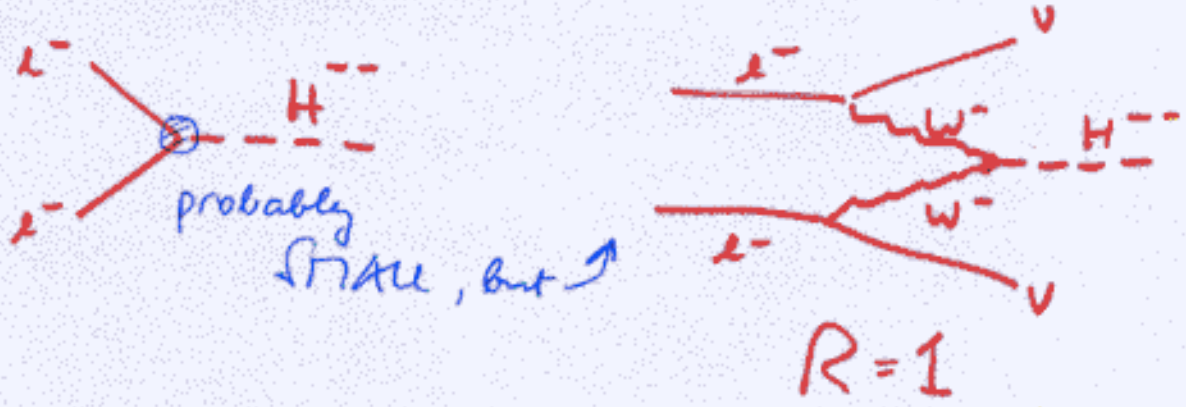
SIGNATURE H_5^{--} $(\Gamma_w = 1)$

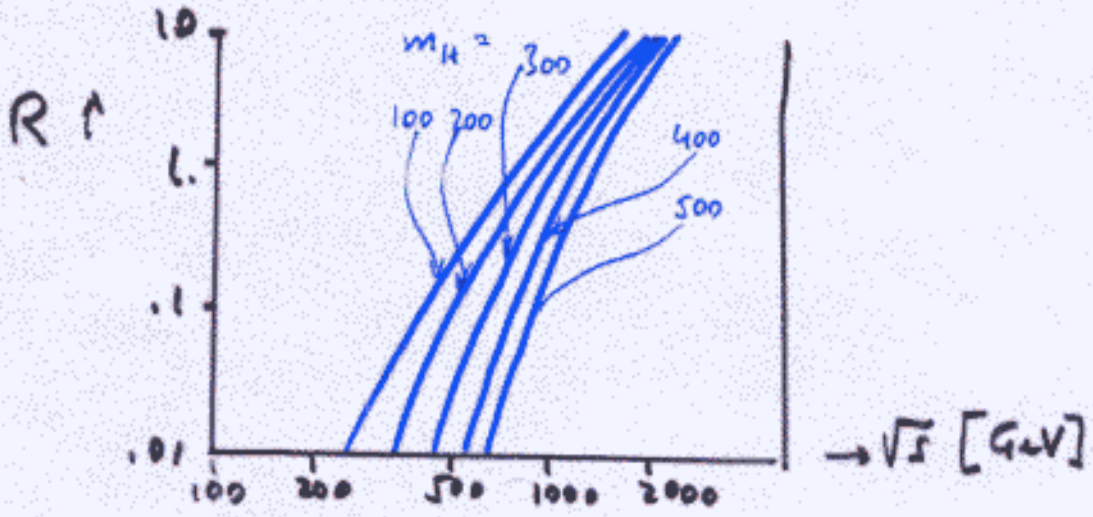
CAN BE PRODUCED IN

$$e^+e^- \xrightarrow{\gamma,Z^0} H_5^{++} H_5^{--}$$

WITH $R=1$, BUT ONLY AT $\sqrt{s} > 2m$

MOST SPECTACULARLY





3-GENERATION $SU_3 \times SU_3 \times U_1$

Width Y
≈ 3% mass
(like Z, W)
if M(Q) > M(Y)
as expected
otherwise
Width Y ≈
10%-12%, more.

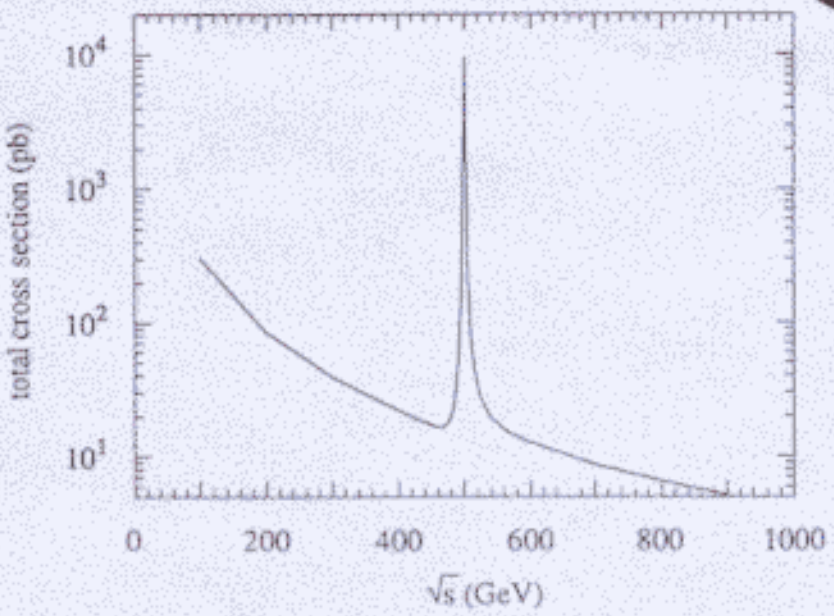


FIG. 6. Total cross section for $e^-e^- \to e^-e^-$ in the presence of X^{--} as a function of $\sqrt{s}$, where $|\cos\theta| < 0.8$ is used and $M_X = 500$ GeV is assumed.

$I_w(X^{--}) > \frac{1}{2}$

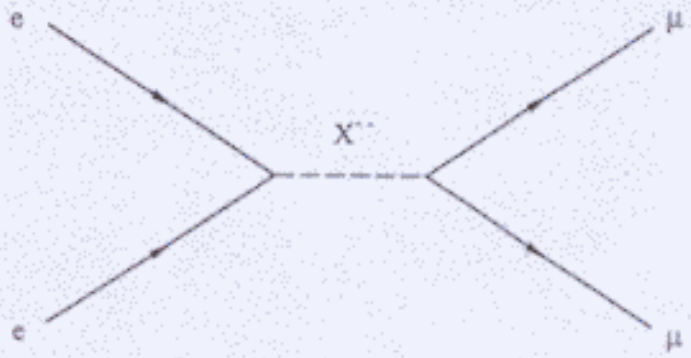


FIG. 7. Feynman diagram for the process $e^-e^- \to \mu^-\mu^-$ induced by X^{--}.

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This wor
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From PHF + D. Ng PR D45, 4248 (92)
See also: PHF MPL A7, 2017 (1992)

Doubly Charged Lepton Y^{--} (P. FRAMPTON)

H^{--} belongs to $I_W = 1$ triplet

y^{--} "dilepton" $\in I_W = \frac{1}{2}$ doublet

We can easily disentangle these two effects by reversing helicities:

If the signal shows up in

$e_L^- e_L^-$ ⟶ H^{--}

$e_L^- e_R^-$ ⟶ y^{--}

$e_R^- e_R^-$ ⟶ neither

we need a B.G.?

SPECTACULAR SIGNATURES IN S-CHANNEL STRUCTURE

WITH TYPICAL H WIDTHS ?

→ DECAYS

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

H^-H^-

↳ $\ell^-\ell^- + \nu$'s

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^- → di-lepton → narrow peaks e^-e^- $\mu^-\mu^-$ see below!