m_W FROM POLARISED THRESHOLD SCAN

G.W. WILSON
23/9/00

UPDATE

- July slide

1) Polarisation systematics..

2) Reasonable background spin model

3) Control of bkgd. spin structure

Will produce a nice plot – but presently mostly concerned with demonstrating that this measurement is indeed feasible !

(N.B. $\mathcal{L}$, σ_b, ϵ, E_b^*, beamstrahlung $\longrightarrow$ ✓)

* If $\langle\sqrt{s}\rangle$ from $Z\gamma$ works.

M_W FROM POLARISED THRESHOLD SCAN

STATUS REPORT / PLANS

G.W. WILSON
14/7/00

Available documentation.

1) Sitges talk (on web)
2) Sitges proceedings

BASIC OPEN ISSUES (ie. potential show stoppers)

1) E_{beam} error
2) Beam-strahlung / energy spread of $\frac{dL}{d\sqrt{s}}$ (Is current TESLA design in CIRCE incl. ΔE_b?)
3) * Polarisation systematics. (Use in situ $Z(\gamma)$ events to measure $\mathbb{P}$?)
4) Theoretical errors. (presumably scan helps.....)
5) Control of bkgd. spin structure.

REFINEMENTS

1) Reasonable bkgd. spin model. *
2) Upgrade event selection performance wrt LEP2.
3) SIMDET studies? May be useful for evaluating whether beamstrahlung can be an event selection issue. (Is SIMDET updated now?)

POLARISATION SYSTEMATICS

GWW, Sitges proceedings : $\Delta M_W = 4.9$ MeV $\frac{\Delta P}{P} = 0.25\%$

$\Delta m_W = 4.6$ MeV $\frac{\Delta P}{P} = 0\%$

$\Delta m_W = ?$ $\frac{\Delta P}{P}$ larger

convergence problems in the fits.

The solution

use $e^+e^- \to Z(\gamma)$ at $\sqrt{s} = 161$ GeV

to measure $P_{e^+}, P_{e^-}, \sigma_{RR}, A_{LR}^{Z(\gamma)}$

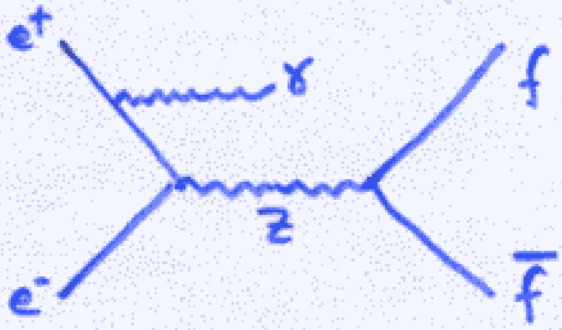
with "Blondel scheme".

discussed previously by K. Mönig.

At $\sqrt{s} = 161$ GeV,

$$\sigma_{\sqrt{s'} \lesssim 120\,\text{GeV}} \simeq 100 \text{ pb}$$

and Zee, WW, ZZ backgrounds are small



$f = q, \mu$

$m_{f\bar{f}} \simeq m_Z$

10^7 radiative return events in $100\ fb^{-1}$!

POLARISATION SYSTEMATICS

e^+ : L , R , 0

e^- : L , R , 0

so 6 ABSOLUTE POLARISATIONS TO MEASURE

P_L^+ , P_R^+ , P_0^+

P_L^- , P_R^- , P_0^-

PROPOSED HELICITY COMBINATION SHARING

$e_R^+ e_L^-$: 70% WW enhancement

$e_L^+ e_R^-$: 23% WW suppression.

L L	1% each.
R R	
0 0	
L 0	
R 0	
0 L	
0 R	

$\Rightarrow$ CAN MEASURE ALL SIX POLARISATIONS

FROM

MINUIT TASK: FIT W MASS TO NUMBER OF EVENTS in EACH CHANNEL

FCN= 211.4589 FROM MINOS STATUS=SUCCESSFUL 1984 CALLS 3004 TOTAL
EDM= .70E-06 STRATEGY= 1 ERROR MATRIX ACCURATE

	EXT NO.	PARAMETER NAME	VALUE	PARABOLIC ERROR	MINOS ERRORS NEGATIVE	MINOS ERRORS POSITIVE
	1	WMASS	80.383	.52990E-02	-.53041E-02	.52938E-02
	2	BKGLL	.19168E-01	.10968E-02	-.10973E-02	.10963E-02
	3	BKGLQ	.80181E-01	.30944E-02	-.30967E-02	.30919E-02
	4	BKGQQ	.39732	.47314E-02	-.47324E-02	.47302E-02
	5	FLUMI	1.0000	.23151E-02	-.23138E-02	.23161E-02
	6	REFFLL	1.0023	.21894E-02	-.21892E-02	.21897E-02
	7	REFFLQ	.99853	.19873E-02	-.19867E-02	.19878E-02
	8	REFFQQ	.99922	.20900E-02	-.20896E-02	.20903E-02
	9	ALPHAS	.12000	constant		
	10	ALRLL	.15000	constant		
	11	ALRLQ	.33000	constant		
	12	ALRQQ	.49000	constant		
	13	ALRMZ	.15940	.20791E-02	-.20803E-02	.20776E-02
0.78	14	PELL	.78225	.50929E-02	-.50870E-02	.50950E-02
0.82	15	PELR	.82069	.28556E-02	-.28522E-02	.28577E-02
0.01	16	PELZ	.60436E-02	.33653E-02	-.33673E-02	.33629E-02
0.62	17	PPOSL	.61810	.29707E-02	-.29685E-02	.29717E-02
0.58	18	PPOSR	.58001	.37921E-02	-.37892E-02	.37927E-02
-0.01	19	PPOSZ	-.11807E-01	.28543E-02	-.28538E-02	.28547E-02
	20	XSRR	99.948	.85487E-01	-.85206E-01	.85759E-01

$\Rightarrow \Delta M_W = 5.3$ MeV for $\int \mathcal{L}\,dt = 100\ fb^{-1}$

assuming $\Gamma_W = f_{SM}(M_W)$, A_{LR}^{bkgd} known.

MINUIT TASK: FIT W MASS TO NUMBER OF EVENTS in EACH CHANNEL

FCN= 199.8177 FROM MINOS STATUS=SUCCESSFUL 1104 CALLS 1749 TOTAL
EDM= .74E 05 STRATEGY= 1 ERROR MATRIX ACCURATE

EXT	PARAMETER		PARABOLIC	MINOS ERRORS	
NO.	NAME	VALUE	ERROR	NEGATIVE	POSITIVE
1	WMASS	80.382	.51967E-02	-.52023E-02	.51913E-02
2	BKGLL	.19312E-01	.11177E-02	-.11171E-02	.11182E-02
3	BKGLQ	.79986E-01	.30280E-02	-.30269E-02	.30290E-02
4	BKGQQ	.39700	.46713E-02	-.46694E-02	.46731E-02
5	FLUMI	1.0007	.17910E-02	-.17901E-02	.17919E-02
6	REFFLL	1.0023	.21697E-02	-.21708E-02	.21685E-02
7	REFFLQ	.99879	.19045E-02	-.19042E-02	.19047E-02
8	REFFQQ	.99955	.20057E-02	-.20060E-02	.20053E-02
9	ALPHAS	.12000	constant		
10	ALRLL	.15000	constant		
11	ALRLQ	.33000	constant		
12	ALRQQ	.49000	constant		
13	ALRMZ	.16029	.33911E-03	-.33917E-03	.33904E-03
14	PELL	.80001	.22214E-02	-.22208E-02	.22215E-02
15	PELR	.80000	constant		
16	PELZ	.00000E+00	constant		
17	PPOSL	.59999	.18000E-02	-.17949E-02	.18048E-02
18	PPOSR	.60000	constant		
19	PPOSZ	.00000E+00	constant		
20	XSRR	99.976	.53469E-01	-.53474E-01	.53464E-01

Also assume $P_L^+ = P_R^+$, $P_L^- = P_R^-$, $P_0^+ = P_0^- = 0$

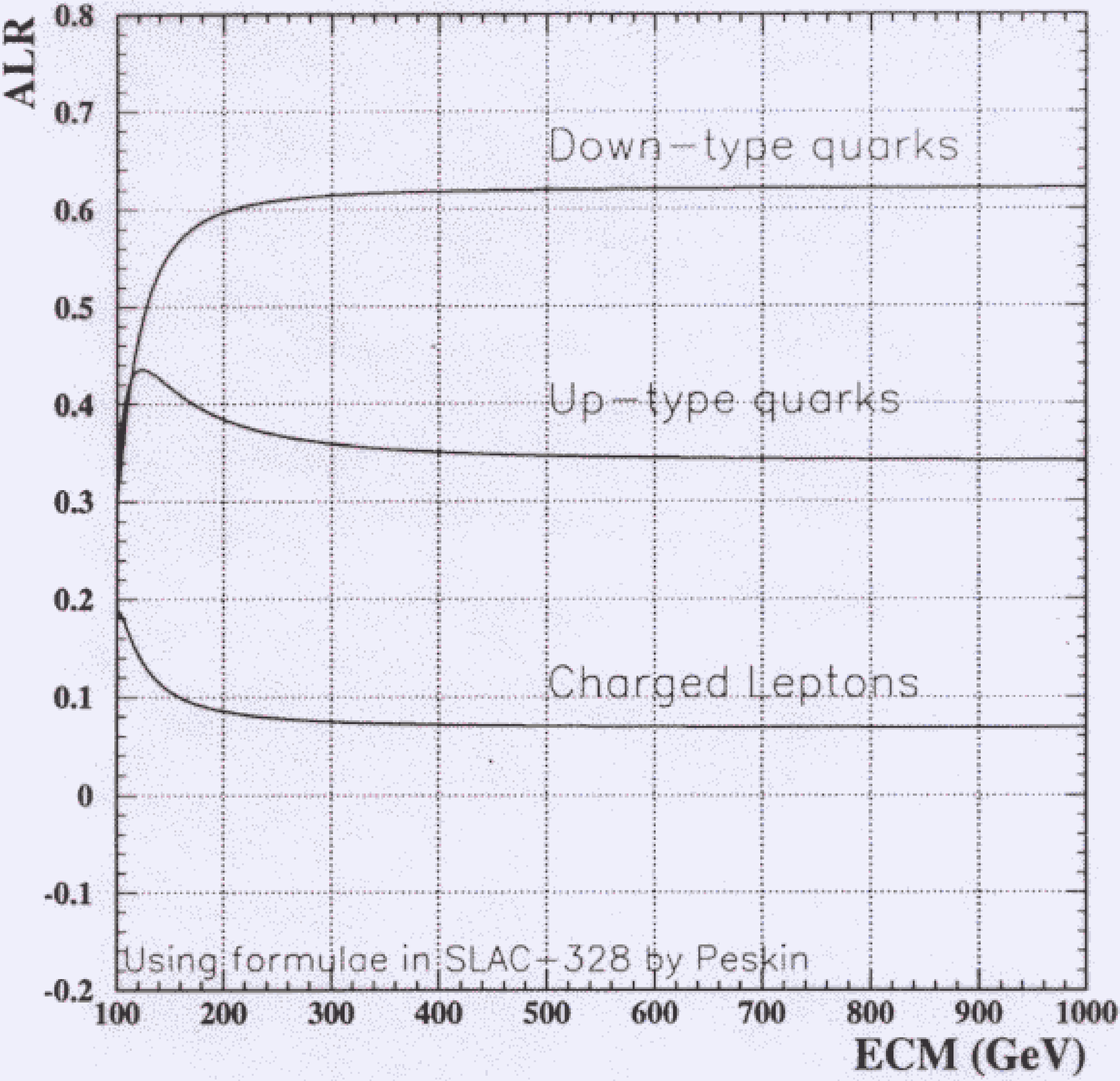
$\Rightarrow \Delta M_W = 5.2\,\text{MeV}$

(so don't NEED these assumptions)

REASONABLE BKGD. SPIN MODEL?

HAD NEGLECTED A_{LR}^{bkgd}.

$$e^+e^- \to f\bar{f}$$



Thanks to Arnd Brandenburg for pointing out the fallacies in the Phys. Rep. polarisation discussion!

Sensitivity to A_{LR}^{bkgd} .....

A_{LR}^{bkgd}	ΔM_W (MeV)
0	4.6
0.45	5.8
0.50	6.2
0.55	6.9

EVEN if we KNOW A_{LR}^{bkgd} well

sensitivity degrades!

Assuming i) $A_{LR}^{bkgd}(l\nu l\nu) = 0.15$
$A_{LR}^{bkgd}(qql\nu) = 0.33$
$A_{LR}^{bkgd}(qqqq) = 0.49$ } $\Rightarrow$ $\Delta M_W = 5.2$ MeV

If $A_{LR}^{bkgd}(l\nu l\nu) = A_{LR}^{bkgd}(qql\nu) = A_{LR}^{bkgd}(qqqq) = 0.5$

then $A_{LR} = 0.50 \pm 0.01 \rightarrow \pm 4$ MeV on M_W.

CONCLUSIONS

- RADIATIVE RETURNS SOLVE POLARISATION SYSTEMATIC ISSUES

- $A_{LR}^{bkgd} \neq 0 \Rightarrow$ DEGRADES SENSITIVITY A BIT

- A_{LR}^{bkgd} CONTROL IS AN OPEN ISSUE WHICH MAY ARGUE FOR A HIGHER PURITY SELECTION. ie. $\ell\nu\ell\nu$, $q\bar{q}e\nu$, $q\bar{q}\mu\nu$

  WITH LITTLE $e^+e^- \to q\bar{q}$ CONTAMINATION.