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INTERNAL REPORT
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International Atomic Energy Agency

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INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

T O P I C A L   M E E T I N G

ON THE PHYSICS OF COLLIDING BEAMS

20 - 22 June 1974

(SUMMARIES AND CONTRIBUTIONS)

MIRAMARE - TRIESTE

July 1974

A COMPARISON OF e^+e^- SCATTERING IN THE DEEP INELASTIC REGION

E. Bloom
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New experiment on $e^+p \to e^+ + x$, compare with $e^-p \to e^- + x$.

SLAC Group A

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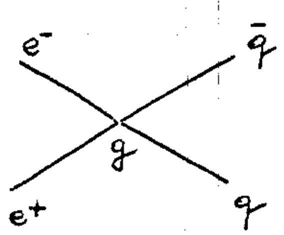
$\sigma_{e^+e^- \to h}$ large. Now many models. Consider set involving contact interactions



Non-electromagnetic g suggested by Pati-Salam, Richter, Bigi-Bjorken. What does inelastic scattering say about these models?

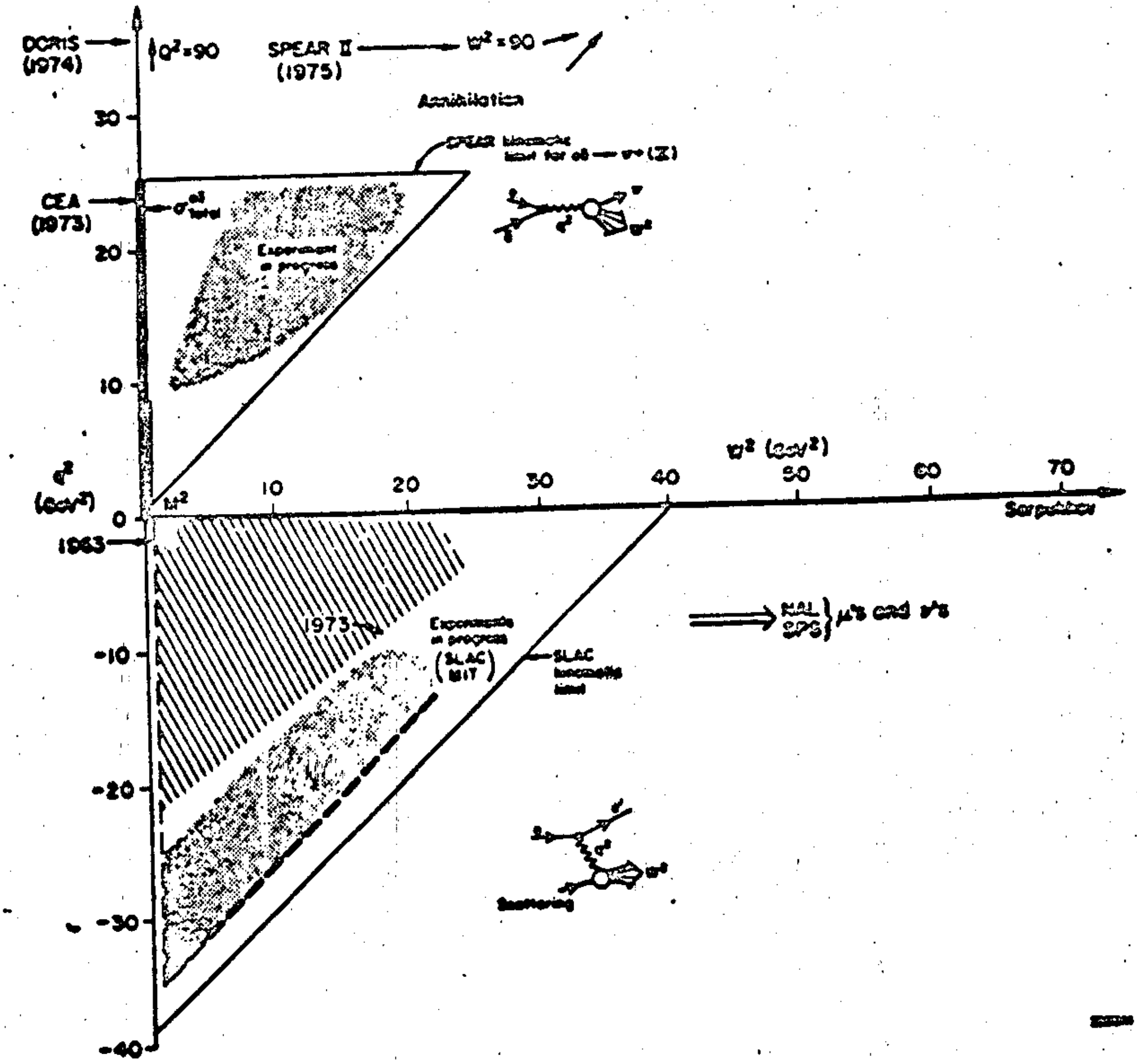


Fig. 1

Range in q^2 similar for both sides

Scaling in ω' good
to < 10% of 1.0 < Q^2 ≤ 16

B_n are moments [illegible]
by D. Gross.

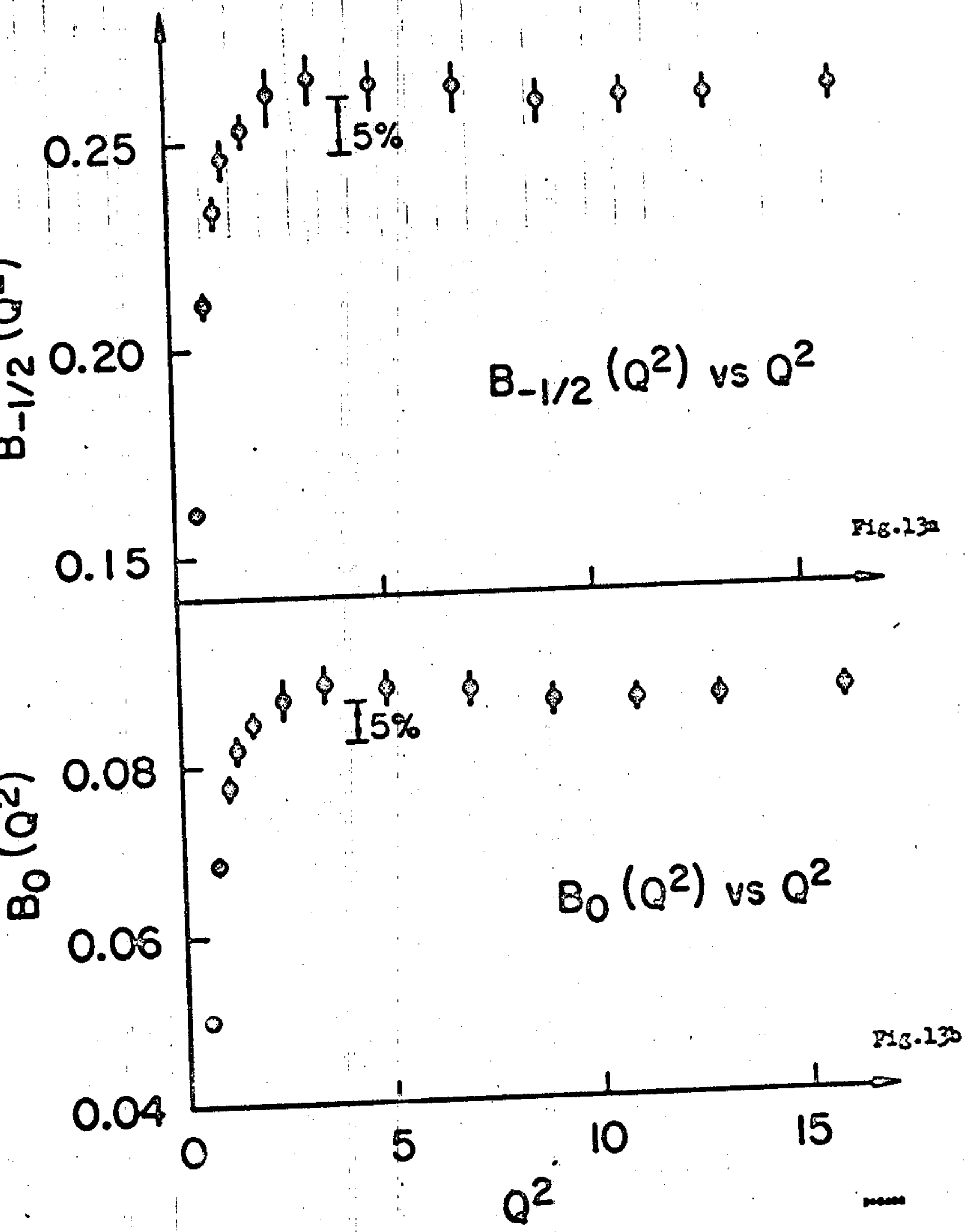
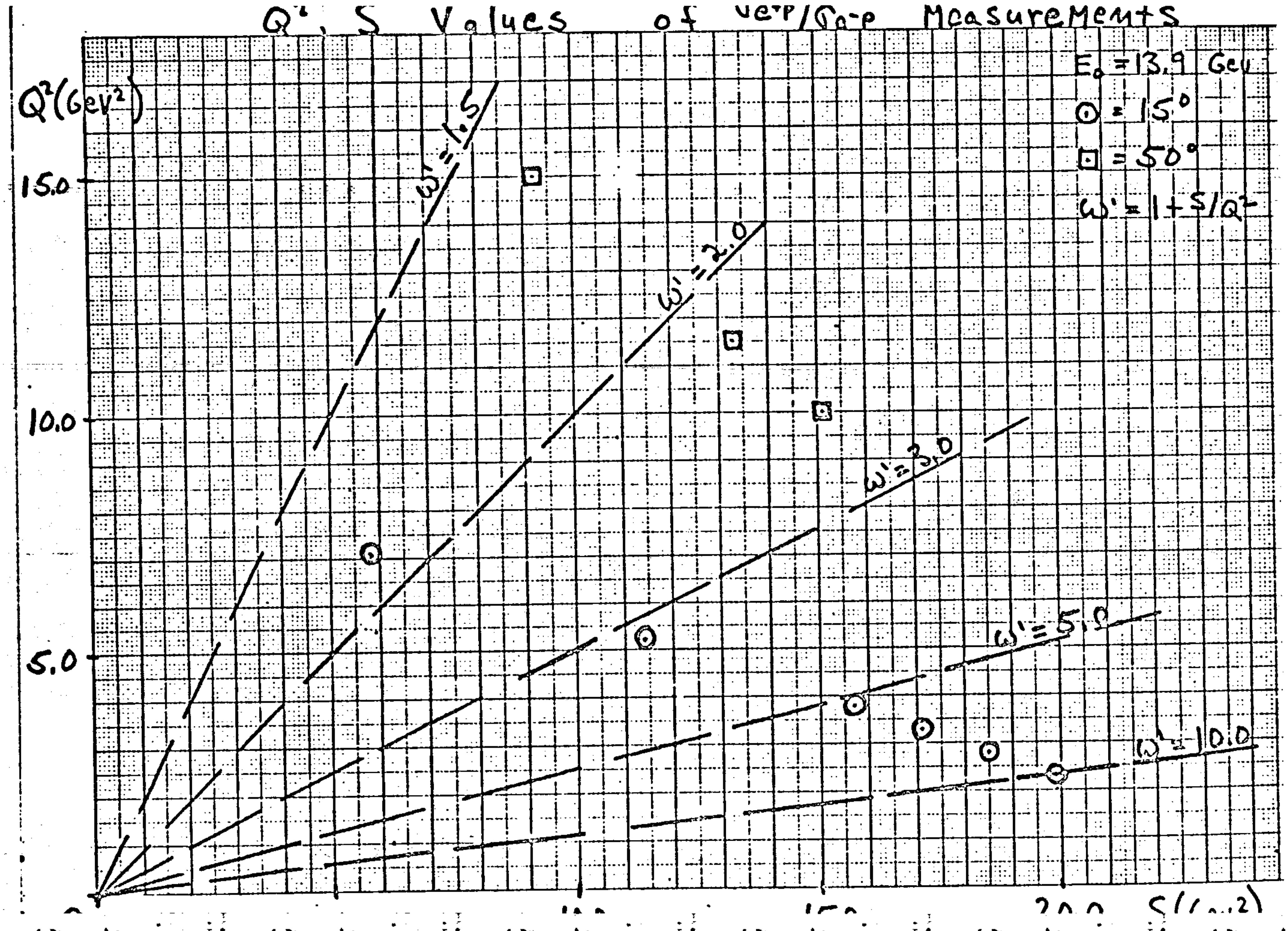
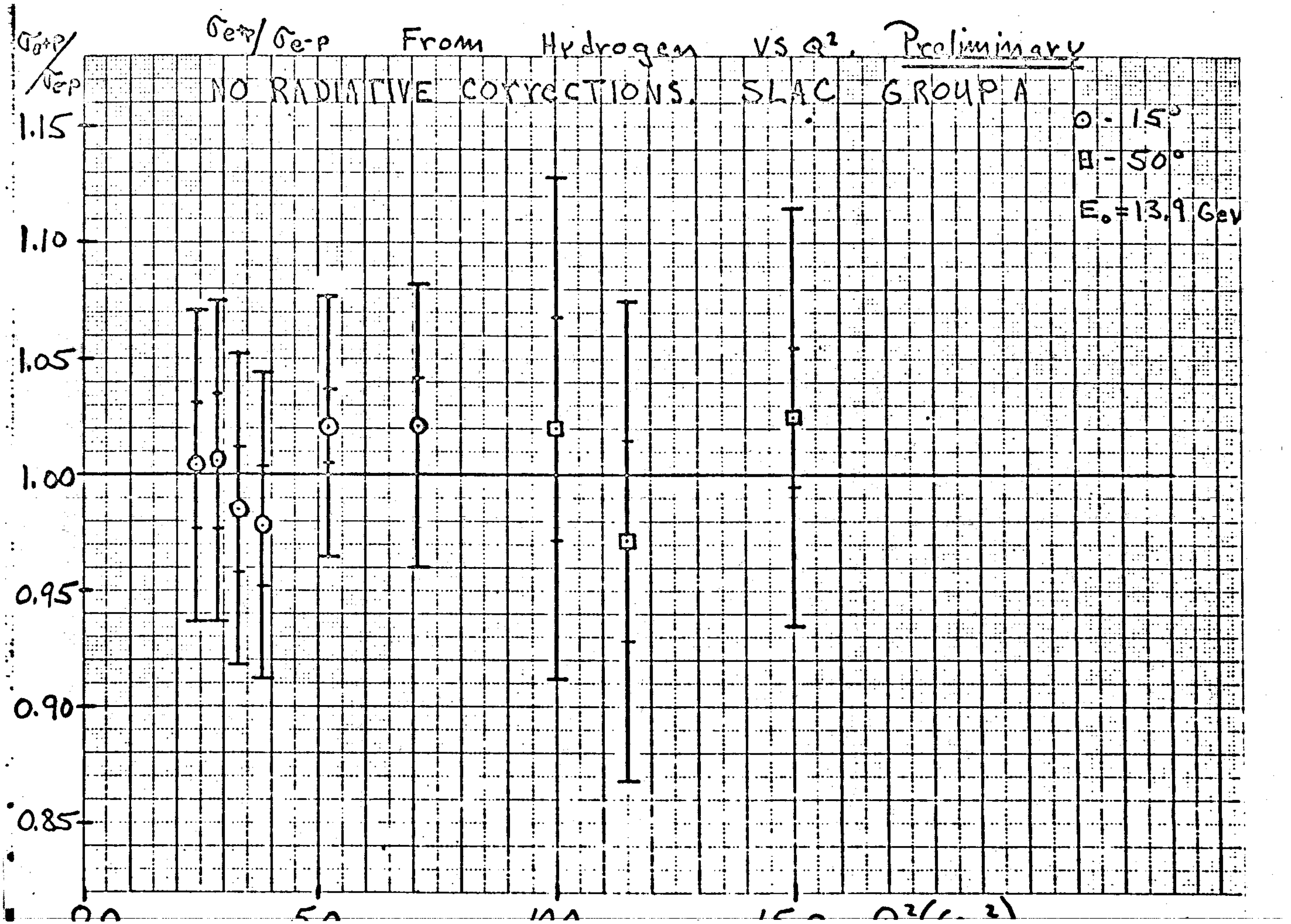


Fig.13a

Fig.13b



Q², S Values of νe-p/σn-p Measurements
E₀ = 13.9 GeV
⊙ = 15°
⊡ = 50°
ω' = 1 + S/Q²
ω' = 1.5
ω' = 2.0
ω' = 3.0
ω' = 5.0
ω' = 10.0
Q²(GeV²)
15.0
10.0
5.0
200
S(



$\sigma_{e^+p}/\sigma_{e^-p}$ From Hydrogen vs Q^2. Preliminary
NO RADIATIVE CORRECTIONS. SLAC GROUP A
$\sigma_{e^+p}/\sigma_{e^-p}$
1.15
1.10
1.05
1.00
0.95
0.90
0.85
⊙ - 15°
⊡ - 50°
E_0 = 13.9 GeV

Result from UCSB. Preliminary. Experiment at SLAC. $\lesssim 1\%$ statistical error.

$$1 < Q^2 \leqslant 3.5 \ (\mathrm{GeV}/c)^2$$

$$2 < \nu < 9$$

within presently uncertain systematic error see no difference between $e^{\pm}p$. Hope to get final answer to better than 1%.

Comparison with models. Pati-Salam, University of Maryland preprint, January 1974.

Bigi-Bjorken SLAC-Pub 1422, May 1974.

Bjorken-Bigi

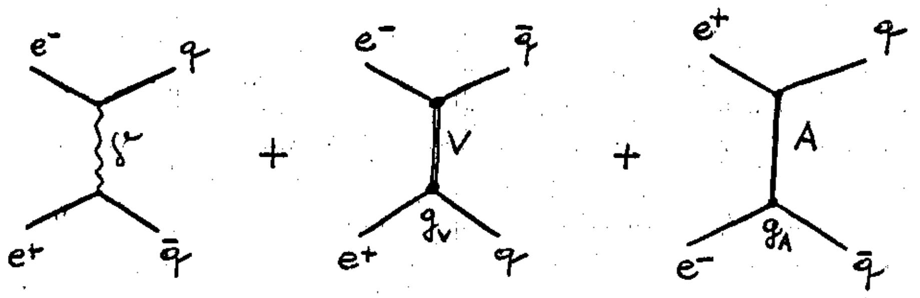
$$\mathcal{L}'_I = \sum_{i,j} g_i^j \, (\bar{e}\,\Gamma_i\, e)\,(\bar{q}_j\,\Gamma_i\, q_j) \qquad \Gamma_i = S,\ PS,\ A,\ V \quad ,$$

generally j is colour quark quantum numbers. In what I show $g_i^j = g_i$ for all j.

So for Bjorken and Bigi

$$\sigma_{e^+e^- \to h} \sim c/s + c's \quad ,$$

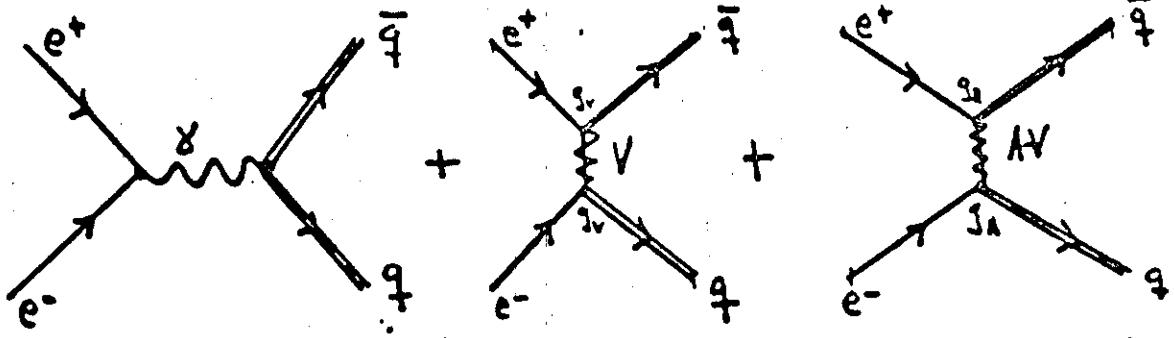
i.e. no interference term which gives constant contribution to cross-section. Bigi also calculated à la Pati-Salam



again with $g_A^j = g_V^j = g^j$. As I will show later, this is an important difference compared to Pati-Salam.

Model of Pati and Salam

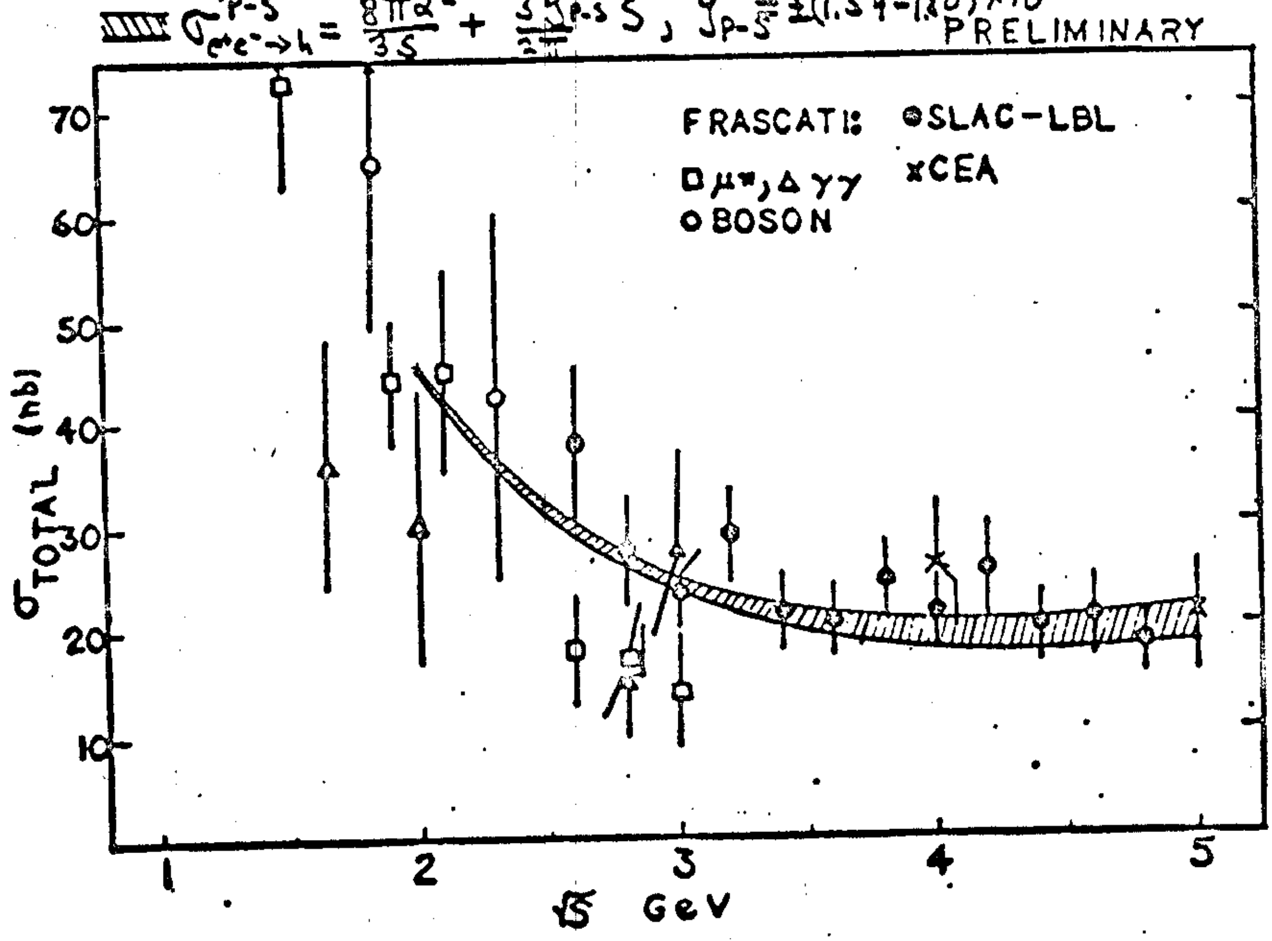
Interpreted by I. Bigi in the context of Paper of Bigi and Bj.

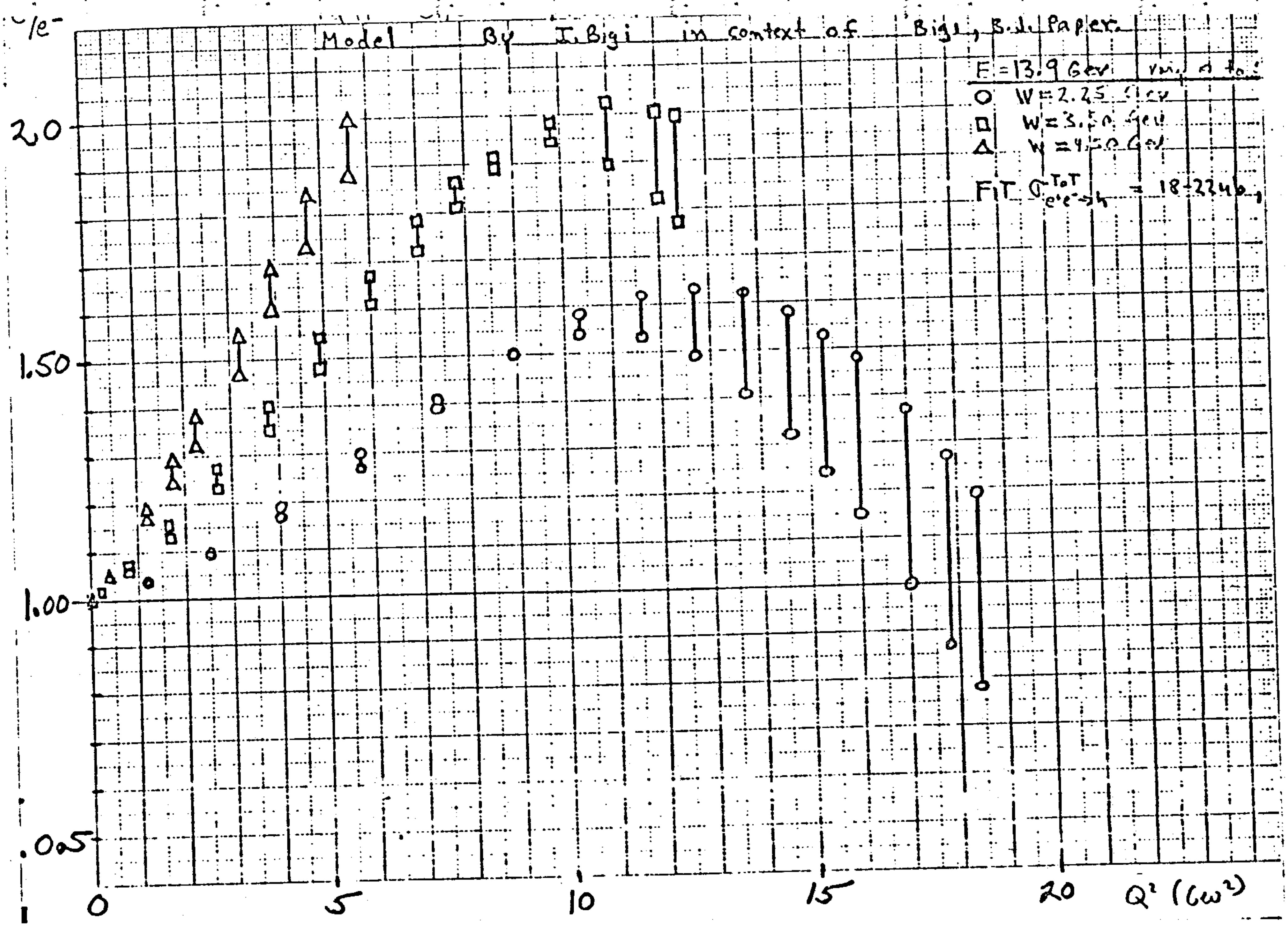


$\underline{g_A = g_V}$ for all quarks.

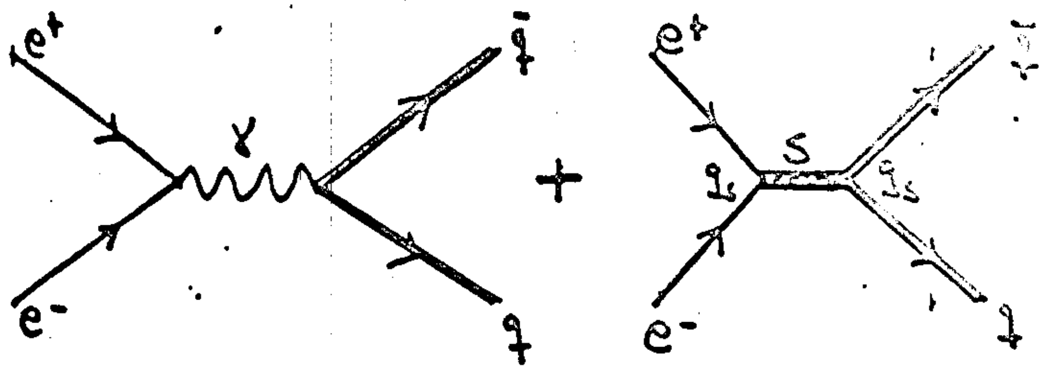
no [illegible]

$\sigma^{P-S}_{e^+e^-\to h} = \frac{8\pi\alpha^2}{3s} + \frac{3g^2_{P-S}}{2\pi}s$, $g_{P-S} = \pm(1.54-1.80)\times 10^{-3}$

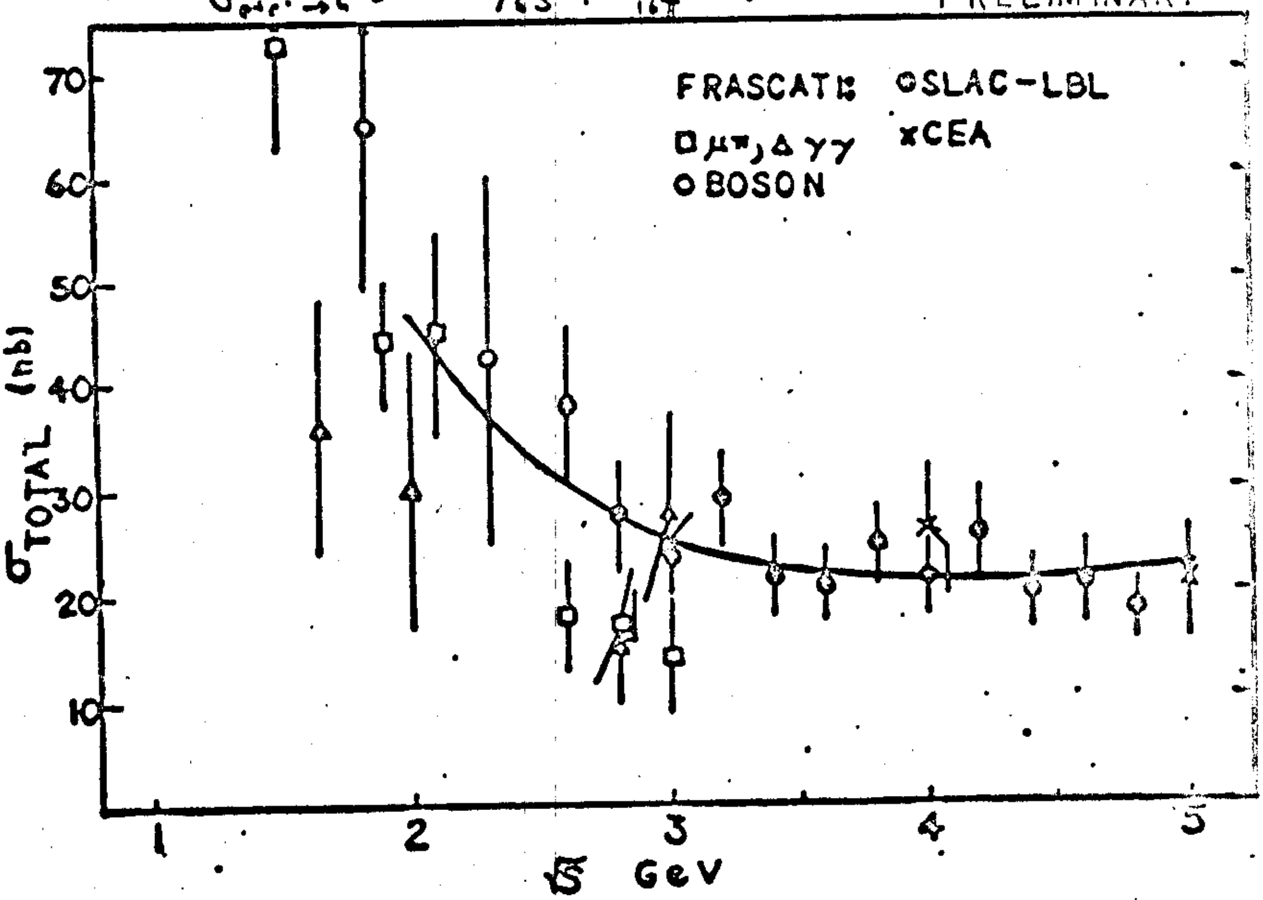


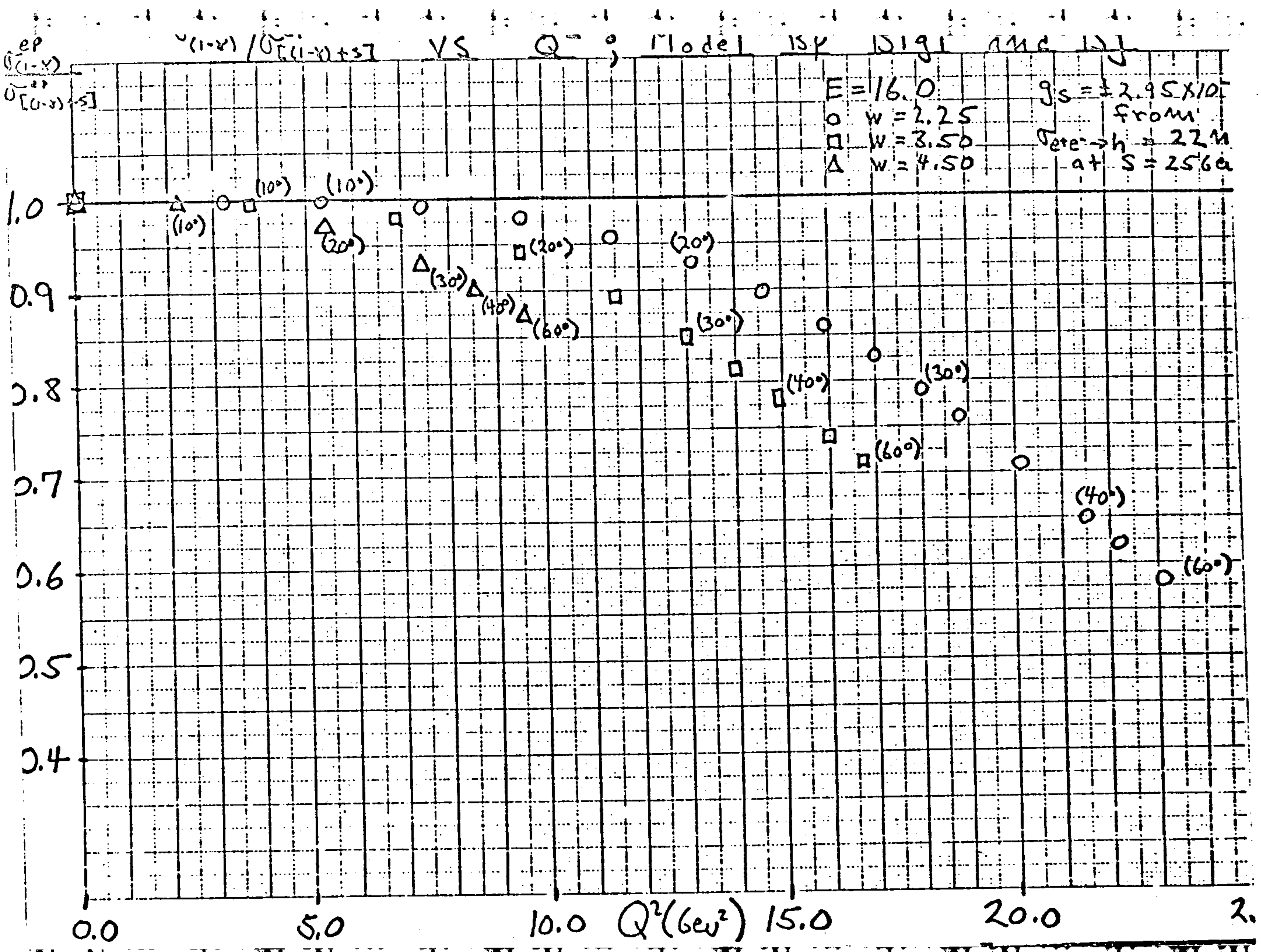

Model By I. Bigi in context of Bigi, B.J. Paper
E = 13.9 Gev
O W = 2.25 Gev
□ W = 3.50 Gev
Δ W = 4.50 Gev
FIT $\sigma^{TOT}_{e^+e^- \to h}$ = 18 ± 22 μb
2.0
1.50
1.00
.005
0
5
10
15
20
Q^2 (GeV^2)

1-Photon exchange plus scalar contact term. Model of Bigi and Bj, SLAC Pub-1422, May 1974.

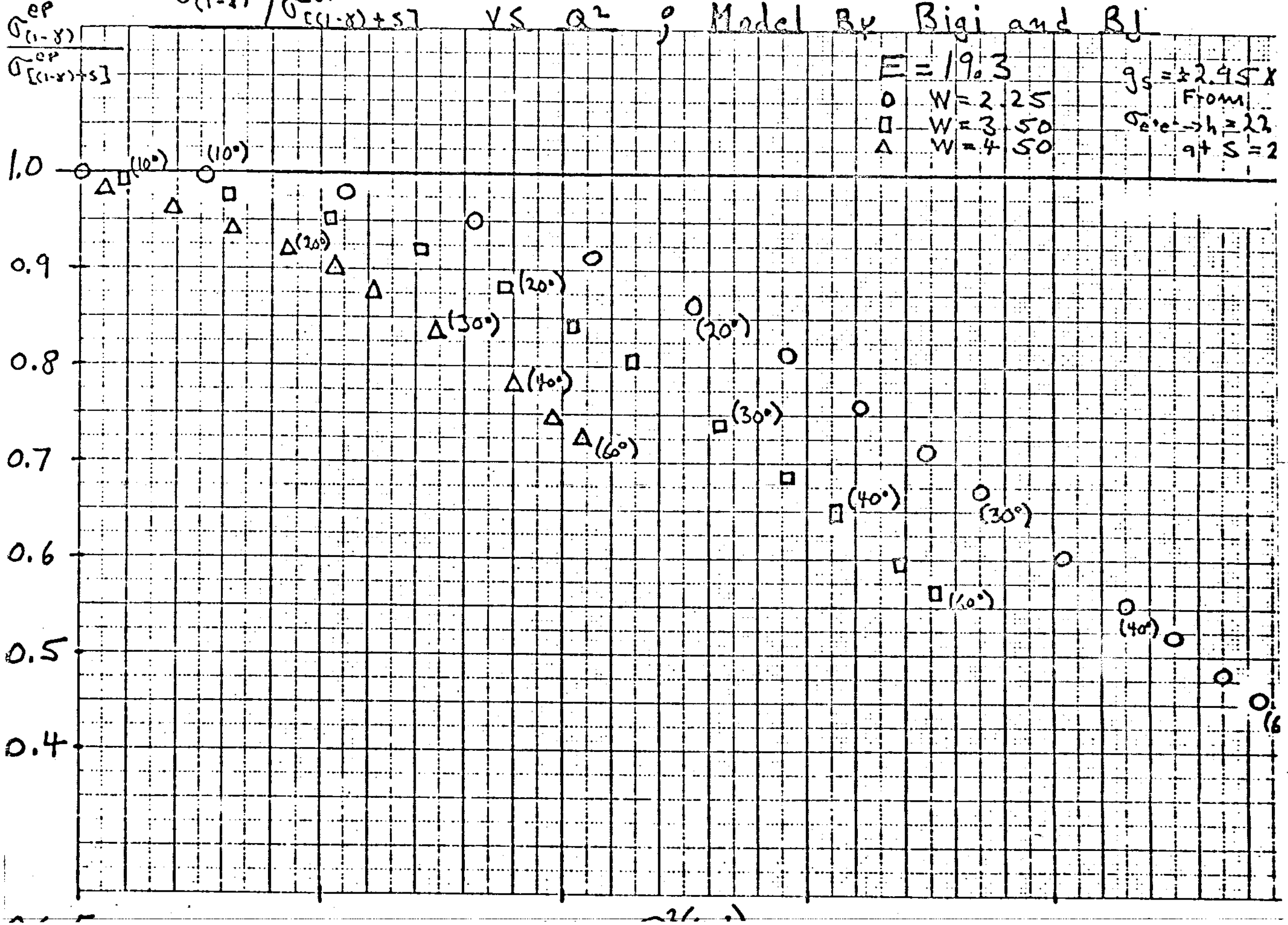


— $\sigma^S_{e^+e^- \to h} = 8\pi\alpha^2/3s + \frac{9 g_s^2}{16\pi} s$, $g_s = \pm 2.15 \times 10^{-3}$




σ(1-Y) / σ[(1-Y)+S] VS Q²; Model by Bigi and DJ
E = 16.0
o W = 2.25
□ W = 3.50
Δ W = 4.50
gs = 2.95×10
from
σe+e-→h = 22n
at S = 256
(10°)
(20°)
(30°)
(40°)
(60°)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.0
5.0
10.0
15.0
20.0
Q²(GeV²)

$\sigma^{''}_{(1-x)} / \sigma^{ep}_{[(1-x)+s]}$ VS Q^2 ; Model By Bigi and Bj



New experiment from Group A at SLAC at 60°. Much data between Q^L of 20 and 30 GeV^2. Preliminary results soon.

<u>Pati-Salam prediction</u>

$$\begin{bmatrix} p_a & p_b & p_c & \nu_e \\ n_a & n_b & n_c & e^- \\ \lambda_a & \lambda_b & \lambda_c & \mu \\ \chi_a & \chi_b & \chi_c & \nu_\mu \end{bmatrix}$$

so $e^\pm$ coupling only to n_i quarks, $g_\lambda = g_p = 0$. This gives interference term for $\sigma_{e^+e^- \to h}$ (which is generally true).

$$\sigma_{e^+e^- \to h} = c_1/s + c_2 + c_3 s$$ where usually c_2, c_3 are related if new interaction

$$c_2 \approx g \quad , \quad c_3 \approx g^2 \ .$$

Definite calculation using coloured quarks, no charm gives

$$\sigma_{e^+e^- \to h} = \frac{4\pi\alpha^2}{3}\left[\left(\frac{2}{s}\right) + \epsilon + 3\,\epsilon^2 s\right]$$

Note: $g = \alpha\epsilon/(\mathrm{BeV})^2$ for $\epsilon = 1/25$ about six times smaller effective coupling than obtained by Bigi-Bjorken.

As for predictions for inelastic scattering. Pati-Salam have not calculated definite models. They promise some definite predictions soon.