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Separation of σ_l and σ_t in the Region of Deep Inelastic Electron-Proton Scattering

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SEPARATION OF σ_{ℓ} AND σ_t IN THE REGION OF DEEP INELASTIC ELECTRON - PROTON SCATTERING

by

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Abstract

From the recent SLAC and DESY data on inelastic e-p scattering σ_ℓ and σ_t were separated for momentum transfers of 0.8 and 2 $(GeV/c)^2$. It is found that the contribution of σ_ℓ to the cross section is small.

Transverse and longitudinal cross sections were separated for momentum transfers of 0.8 and 2.0 $(GeV/c)^2$ using the recent SLAC[1] and DESY[2] data. The results obtained by SLAC at 6^o and 10^o were used. The DESY data were taken at 47.8^o and 76.0^o. Fig.1 shows some typical straight line fits. The combined data have sufficiently different values of ε to permit σ_ℓ and σ_t to be separated, while the DESY data alone would not allow a proper separation.
Figs.2 and 3 show the ratio σ_ℓ/σ_t for the two momentum transfers. The mean value for this ratio is 0.25 ± 0.15 for $q^2 = 0.8\ (GeV/c)^2$ and 0.1 ± 0.1 for $q^2 = 2\ (GeV/c)^2$.

A summary of theoretical predictions for the ratio of σ_ℓ and σ_t is shown in Table I. The experimental results are compatible with the parton model, with the field theoretical model and with the quark model. The prediction from the vector-dominance model is larger than the experimental result.

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Figure Captions:

Table I: Predictions for σ_ℓ / σ_t for large q^2 and ν

Fig.1 : Some typical straight line fits

Fig.2 : The ratio σ_ℓ/σ_t for $q^2 = 0.8$ (GeV/c)^2

Fig.3 : The ratio σ_ℓ/σ_t for $q^2 = 2.0$ (GeV/c)^2.

TABLE I:

Predictions for σ_ℓ/σ_t for large q^2 and ν

MODEL	PREDICTION FOR σ_ℓ/σ_t
Parton Model	0 for spin 1/2 constituents
Bjorken, Paschos[3]	∞ for spin 0 constituents
Field Theoretical Model	
Drell, Levy, Yan[4]	0
Vector Dominance	
Sakurai[5]	$\xi\, q^2/M_\rho^2 (1 - q^2/2M_p\nu)^2$ with $\xi \approx 1$
Fraas, Schildknecht[6]	q^2/M_ρ^2
Current Commutators	0 for quarks (spin 1/2 fields)
Callan, Gross[7]	∞ field algebra (spin 1 fields)

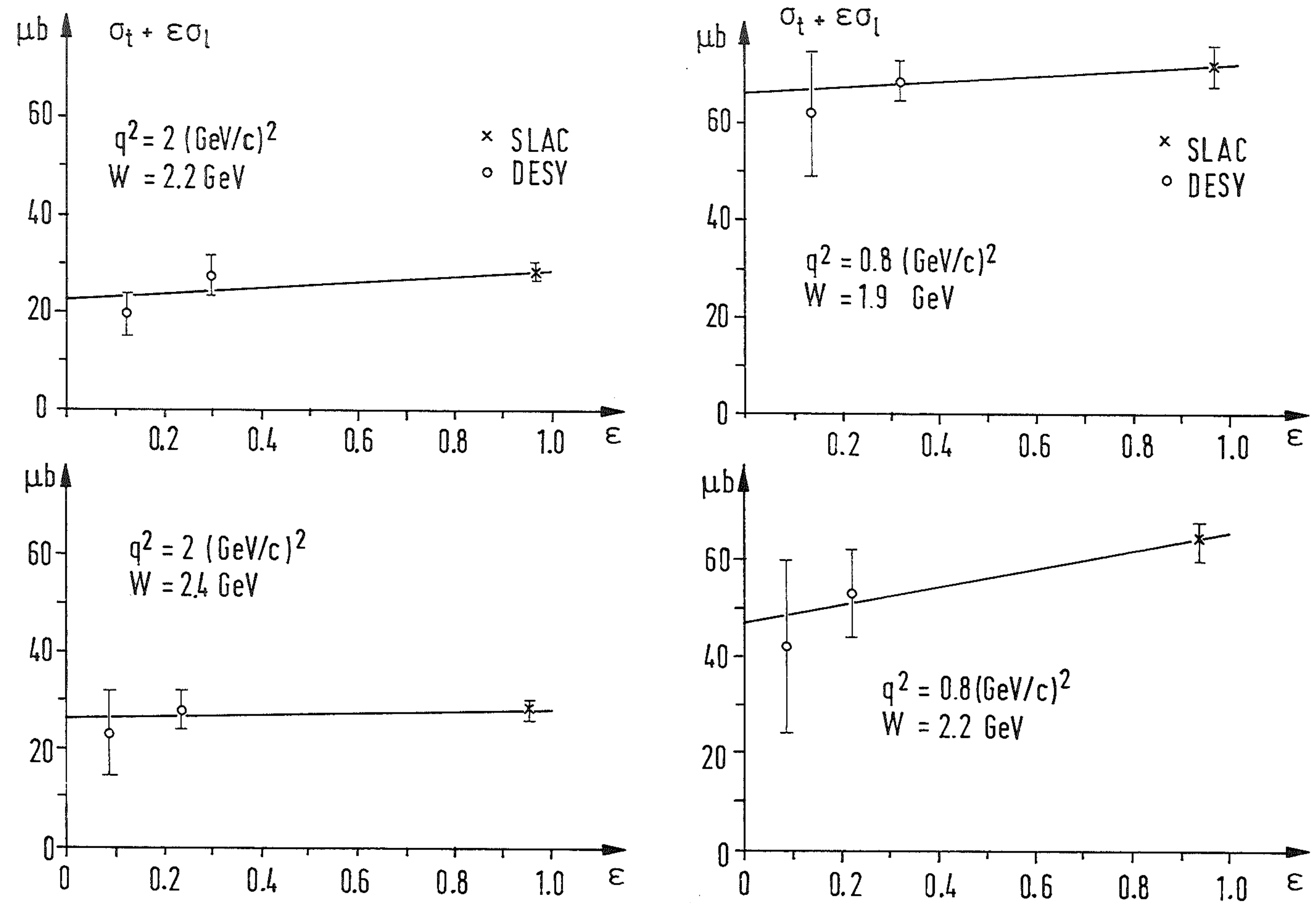
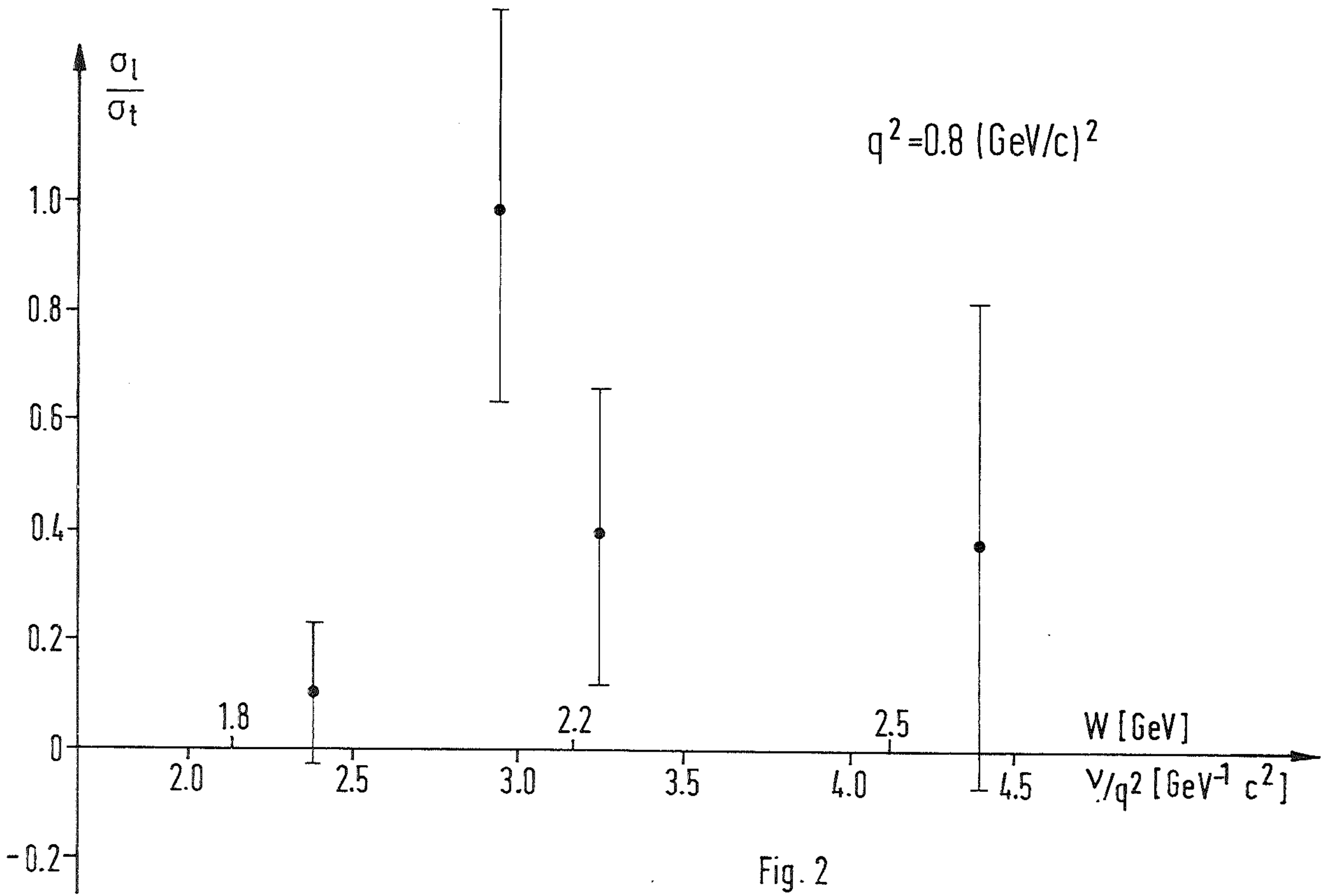
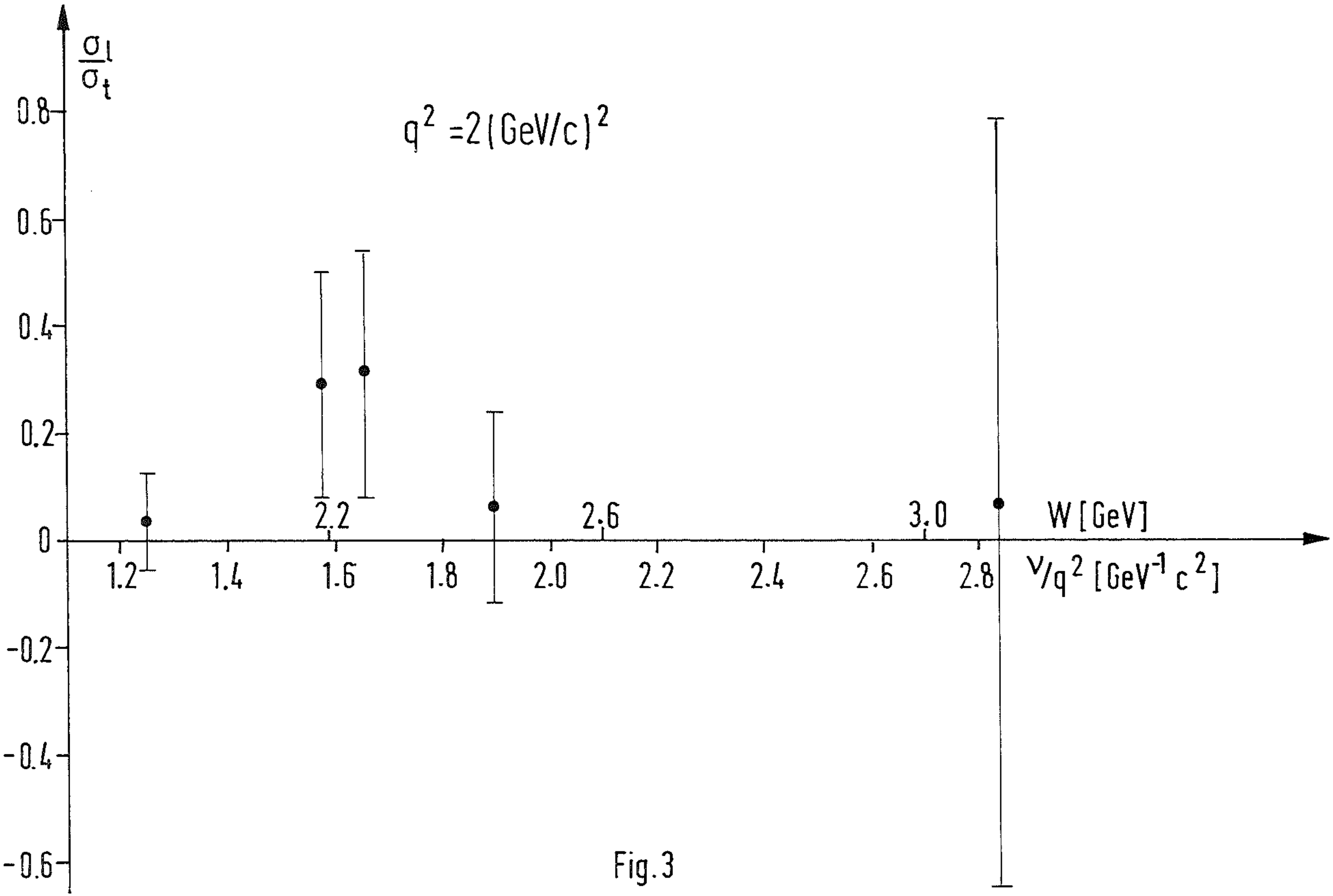

μb
σt + εσl
q2 = 2 (GeV/c)2
W = 2.2 GeV
× SLAC
o DESY
60
40
20
0
0.2
0.4
0.6
0.8
1.0
ε
μb
σt + εσl
× SLAC
o DESY
q2 = 0.8 (GeV/c)2
W = 1.9 GeV
μb
q2 = 2 (GeV/c)2
W = 2.4 GeV
μb
q2 = 0.8 (GeV/c)2
W = 2.2 GeV

Fig.1



σl / σt
q² = 0.8 (GeV/c)²
1.0
0.8
0.6
0.4
0.2
0
-0.2
1.8
2.2
2.5
W [GeV]
2.0
2.5
3.0
3.5
4.0
4.5
ν/q² [GeV⁻¹ c²]

Fig. 2



$\frac{\sigma_l}{\sigma_t}$
$q^2 = 2 (GeV/c)^2$
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
2.2
2.6
3.0
W [GeV]
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
ν/q^2 [GeV^{-1} c^2]

Fig. 3