PR 00-002

F_2^N at Low Q^2

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January, 2000

633-30.99

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Submitted by

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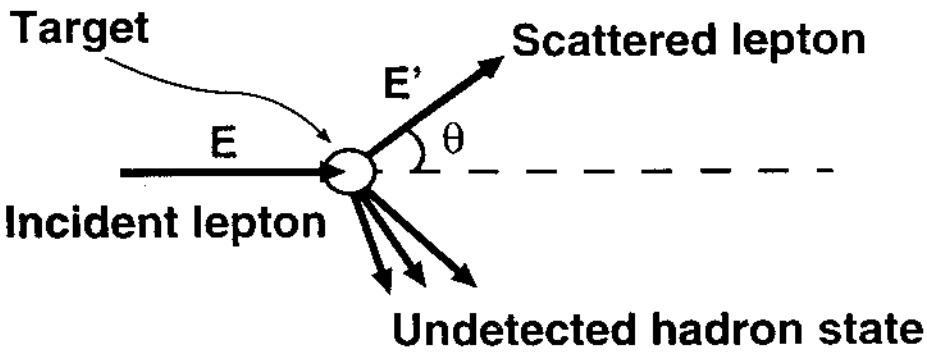
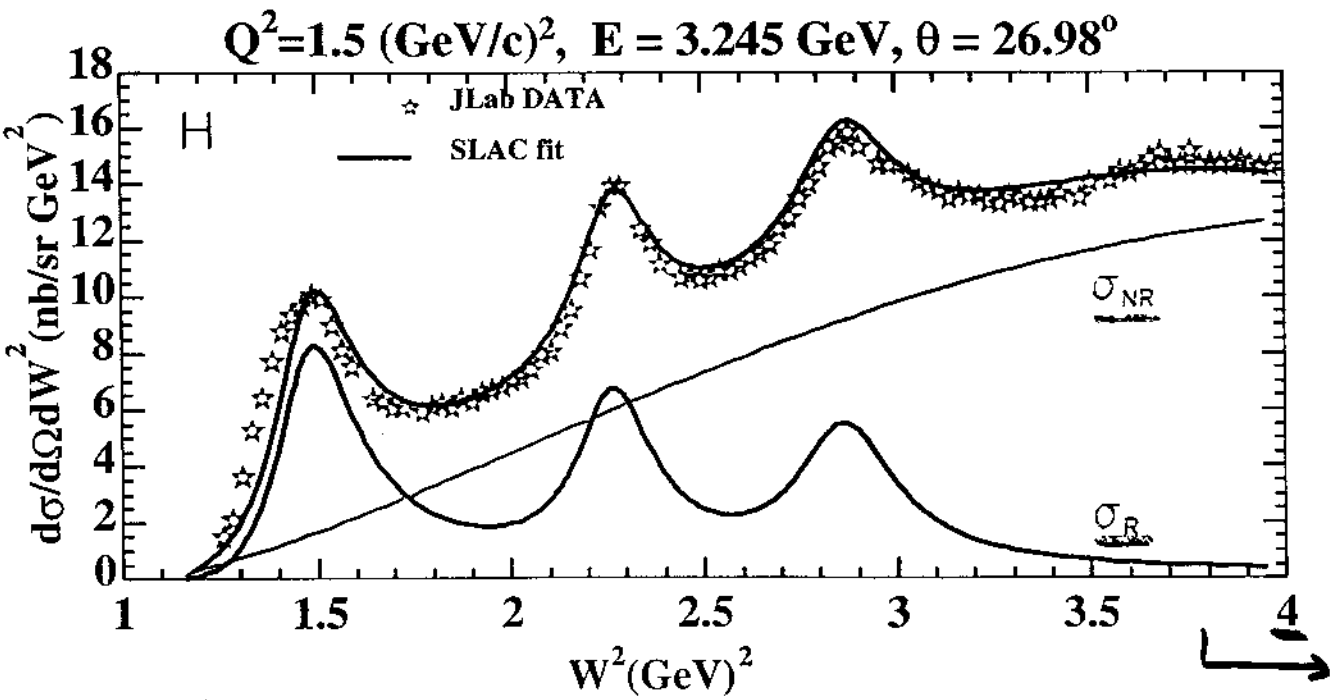
Inclusive electron scattering

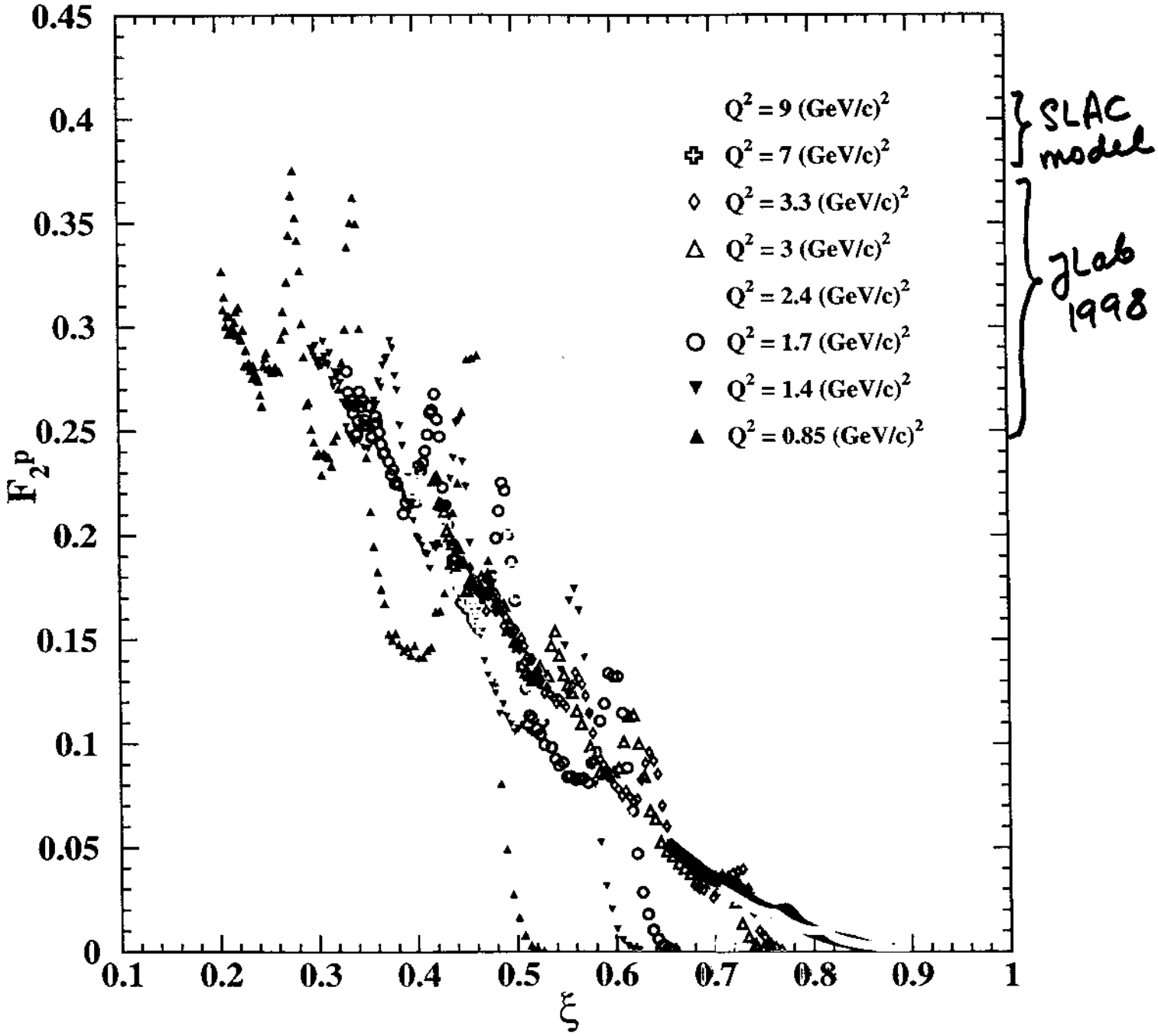


$$x = \frac{Q^2}{2\,M\,\nu}; \quad \xi = \frac{2x}{1+r}\,, \quad r = \sqrt{1 + \frac{4M^2x^2}{Q^2}}$$

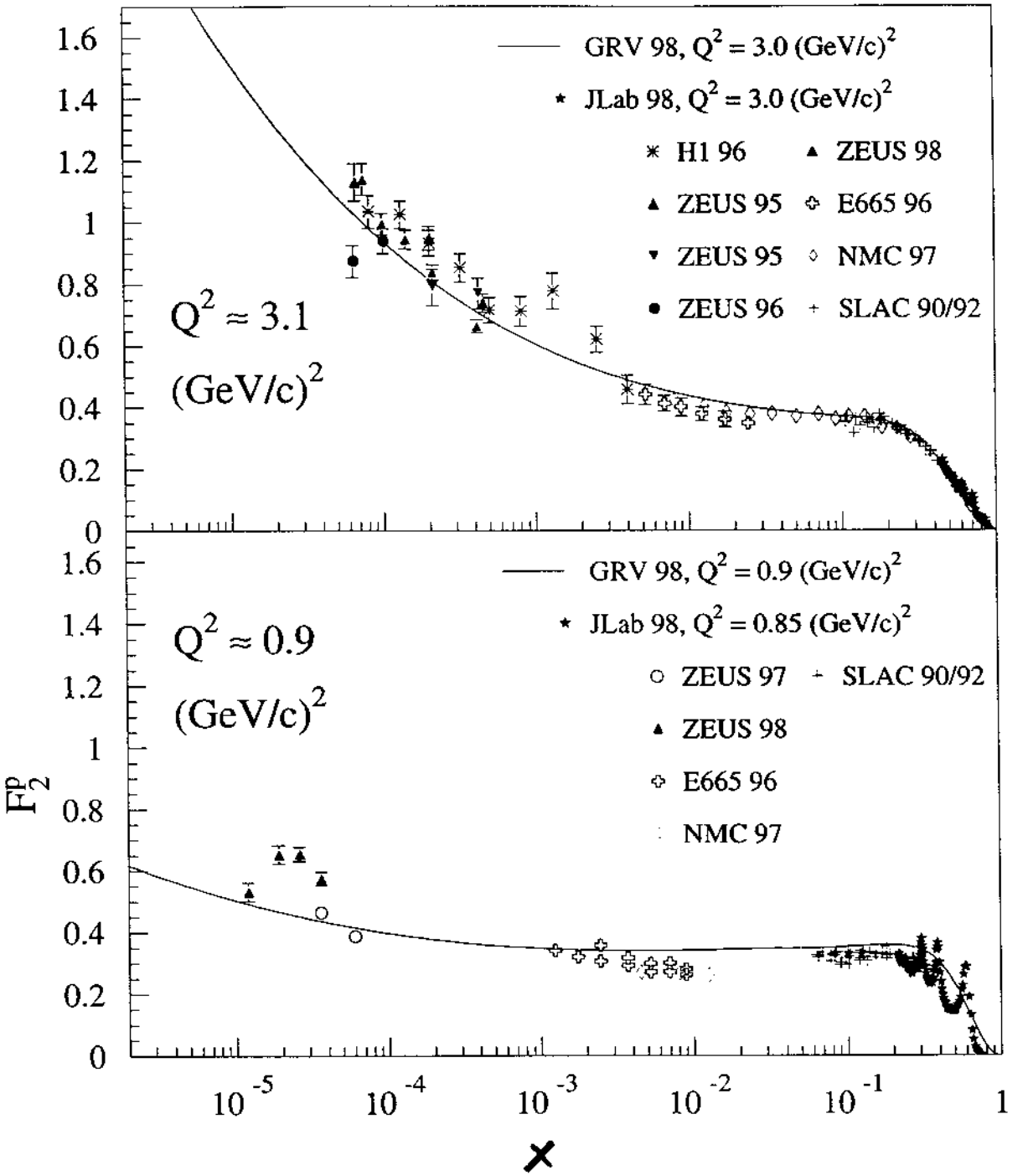
$$(Q^2 \to \infty \quad \xi \to x)$$

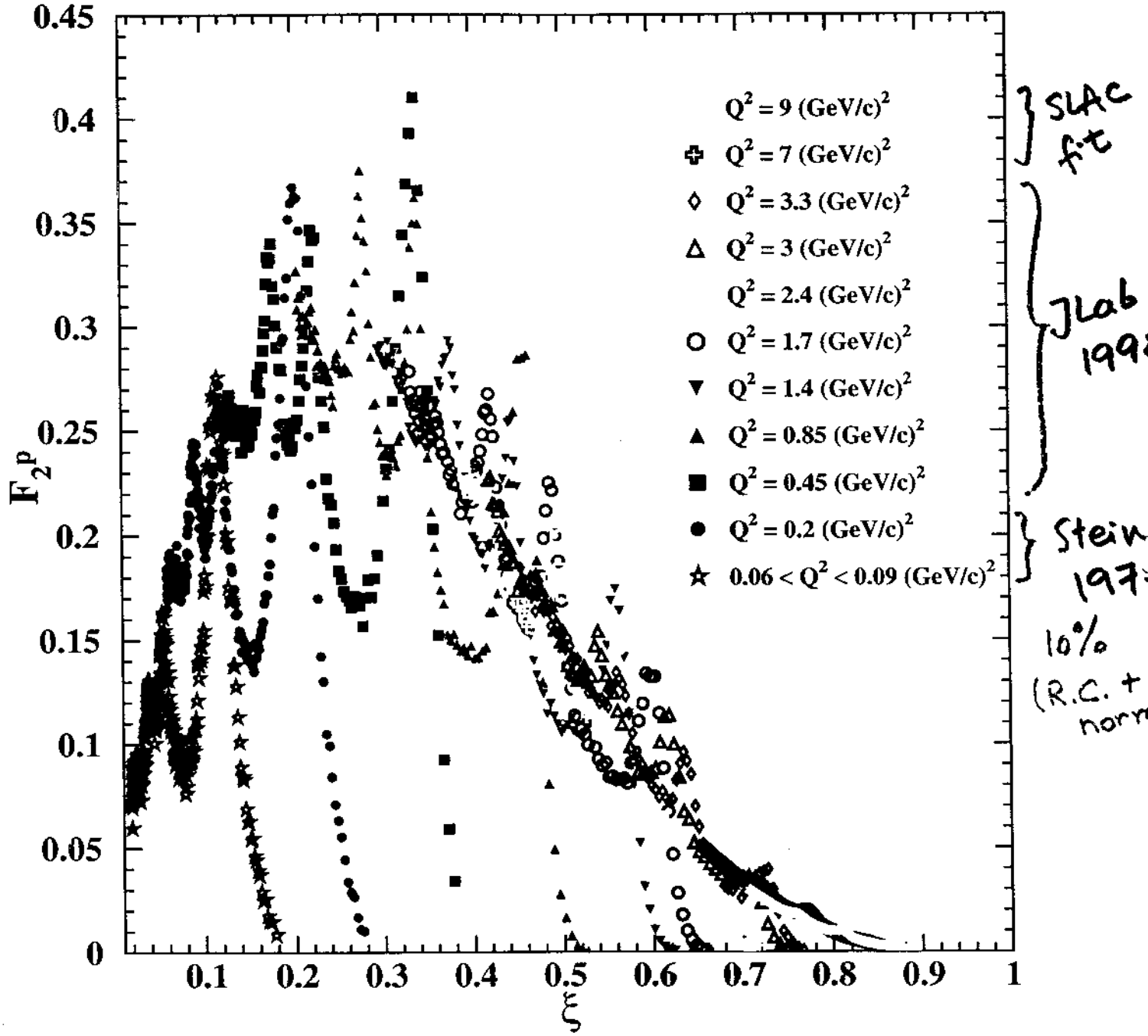
$$\frac{d^2\sigma}{d\Omega\, dE'} = \frac{4\alpha^2 E'^{\,2}}{Q^4}[2\,W_1(\nu, Q^2)\,\sin^2(\theta/2) + \underbrace{W_2(\nu, Q^2)}_{F_2 = \nu W_2}\,\cos^2(\theta/2)]$$




0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
F_2^p
ξ
$Q^2 = 9$ (GeV/c)^2
$Q^2 = 7$ (GeV/c)^2
$Q^2 = 3.3$ (GeV/c)^2
$Q^2 = 3$ (GeV/c)^2
$Q^2 = 2.4$ (GeV/c)^2
$Q^2 = 1.7$ (GeV/c)^2
$Q^2 = 1.4$ (GeV/c)^2
$Q^2 = 0.85$ (GeV/c)^2
SLAC model
JLab 1998

Bloom-Gilman Duality




0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
F_2^p
0.1
0.2
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0.4
0.5
0.6
0.7
0.8
0.9
1
ξ
$Q^2 = 9$ (GeV/c)^2
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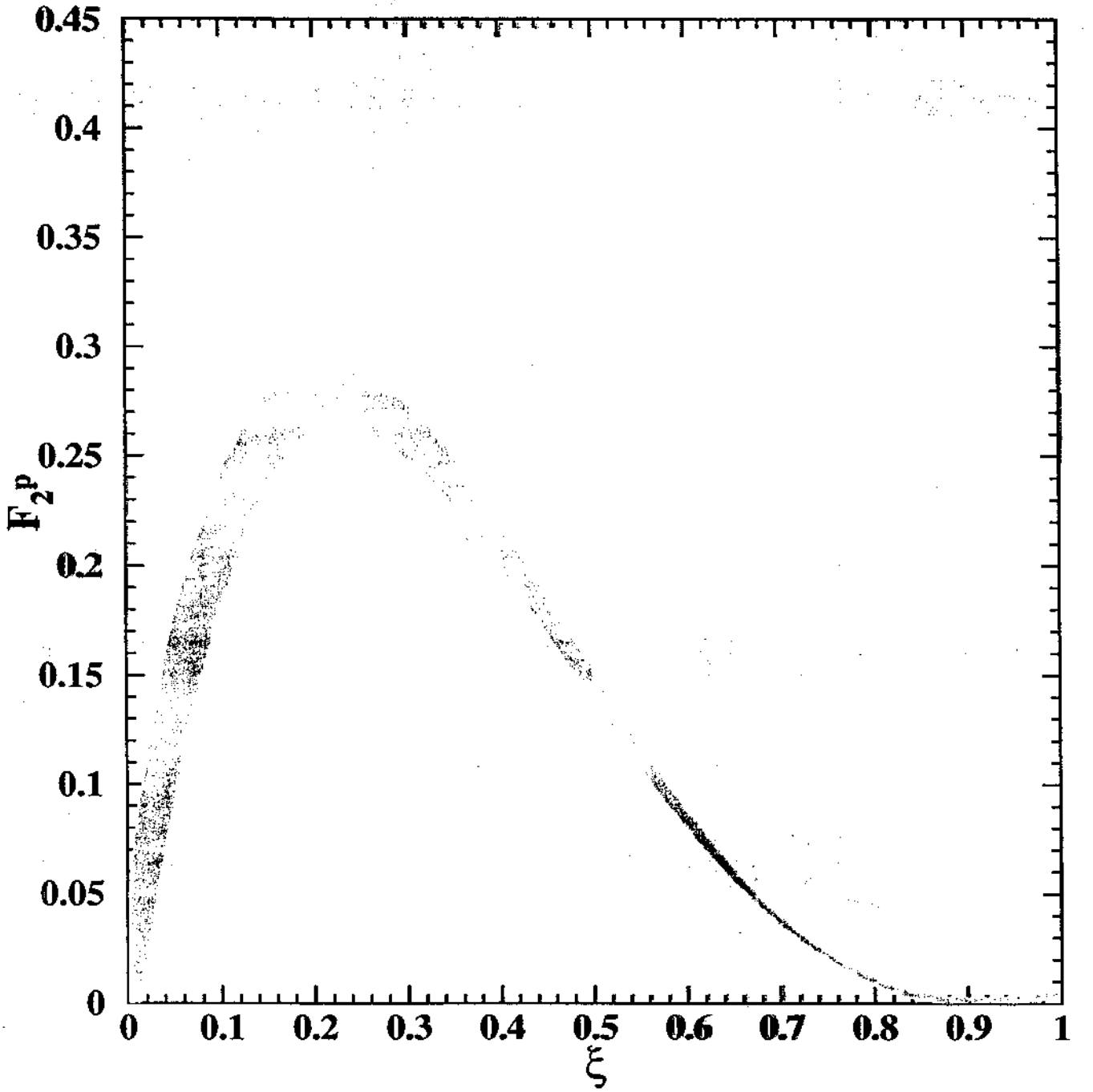
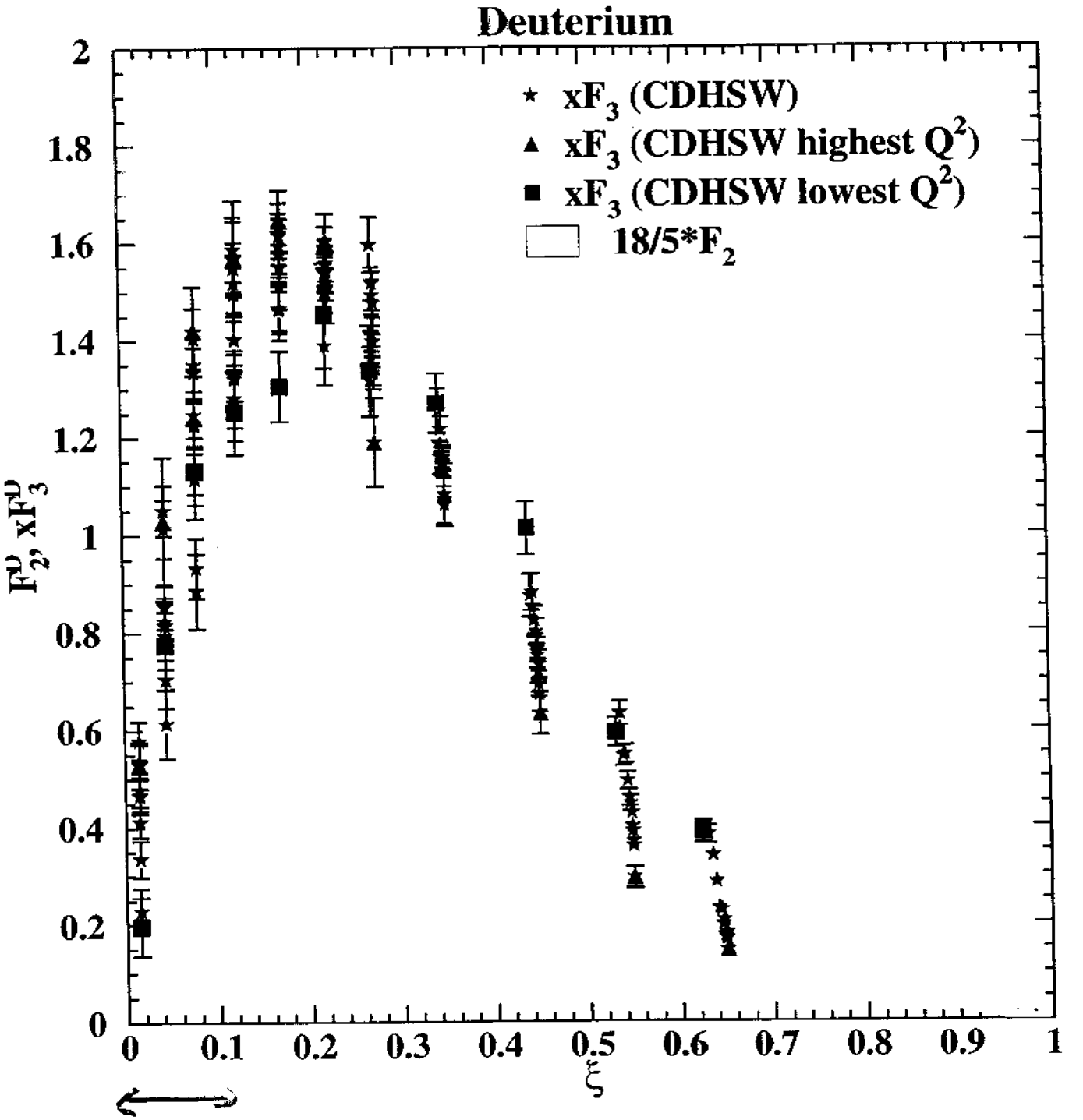
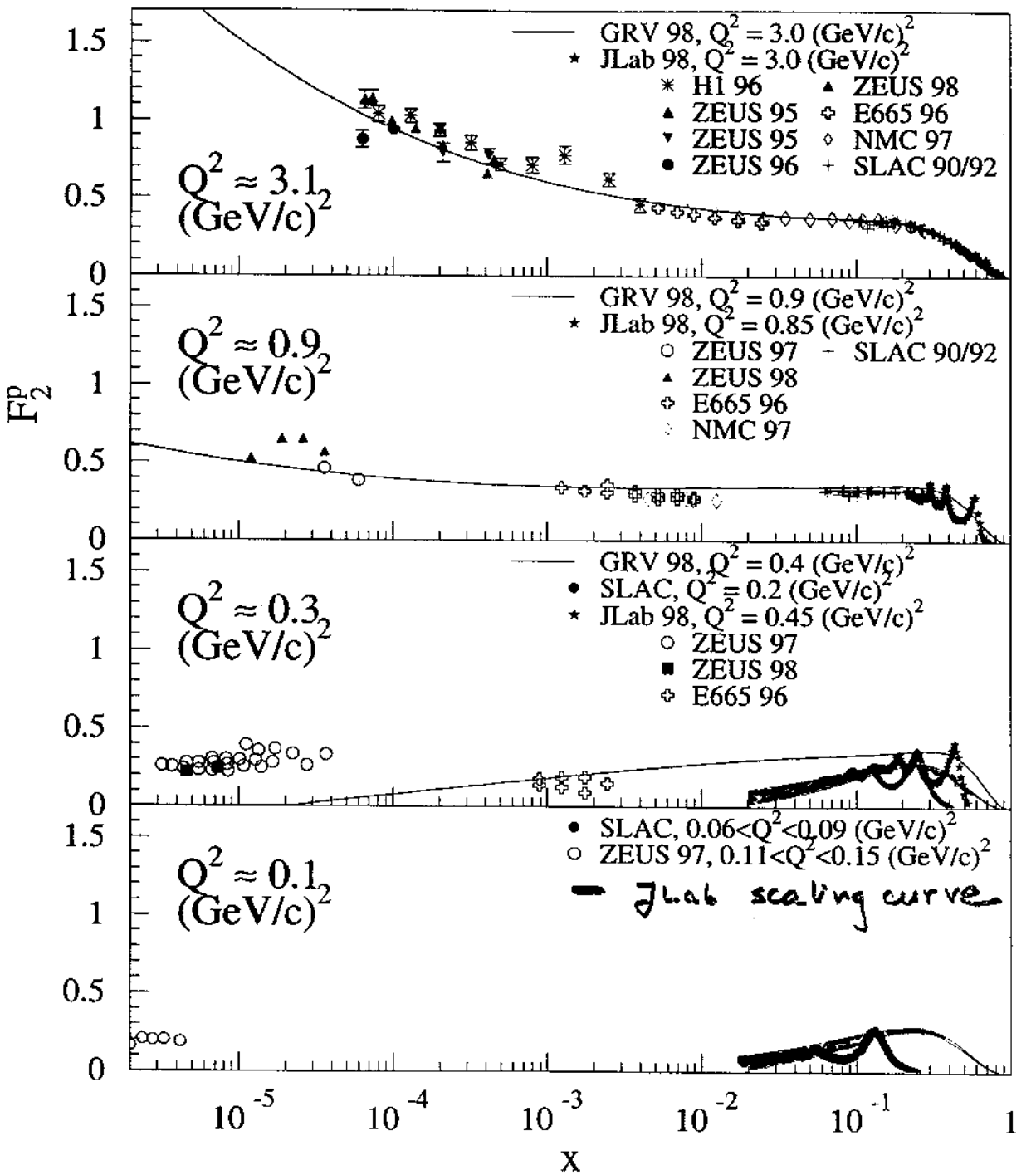
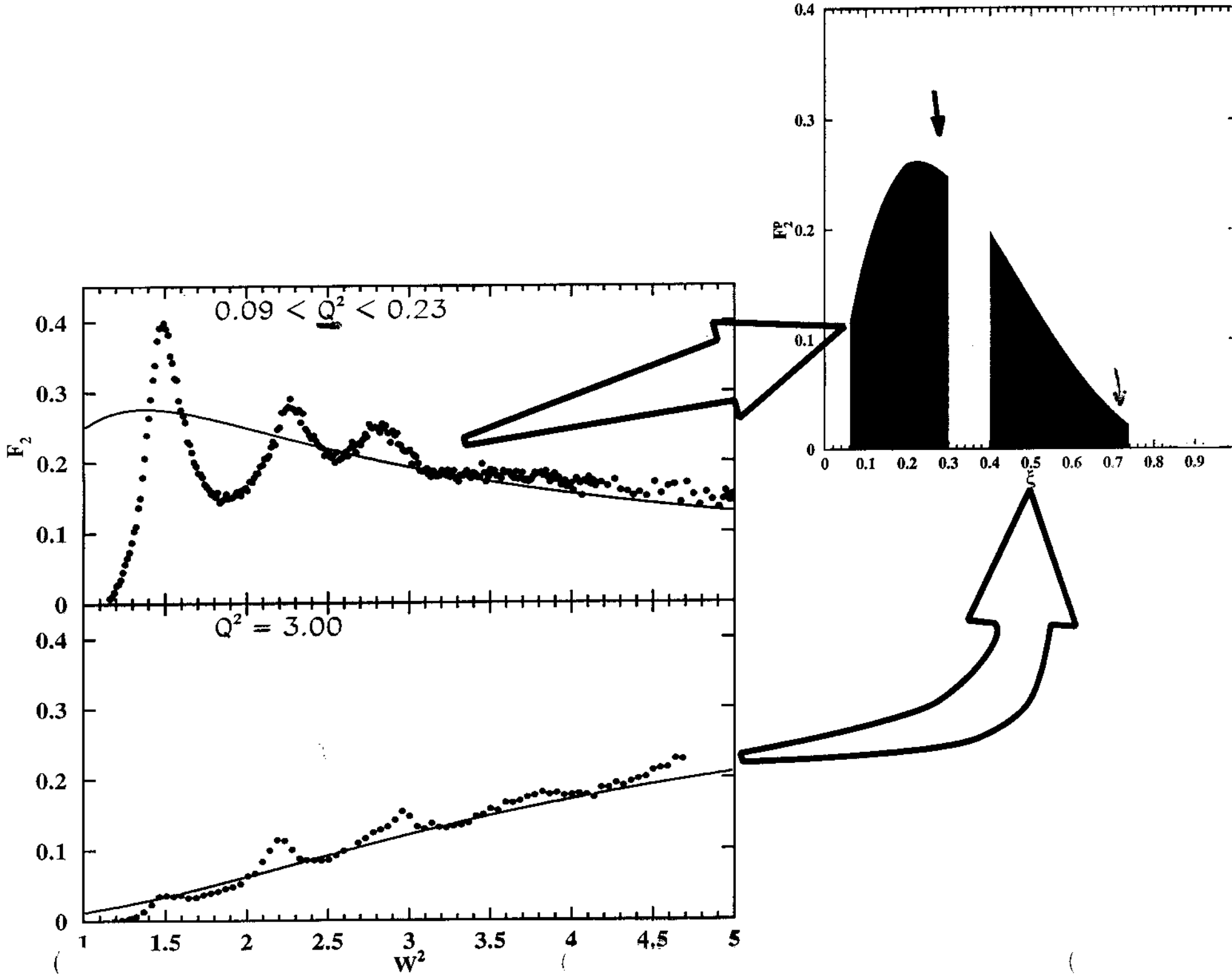
$Q^2 = 1.7$ (GeV/c)^2
$Q^2 = 1.4$ (GeV/c)^2
$Q^2 = 0.85$ (GeV/c)^2
$Q^2 = 0.45$ (GeV/c)^2
$Q^2 = 0.2$ (GeV/c)^2
$0.06 < Q^2 < 0.09$ (GeV/c)^2
SLAC fit
JLab 1998
Stein 1972
10% (R.C. + norm)

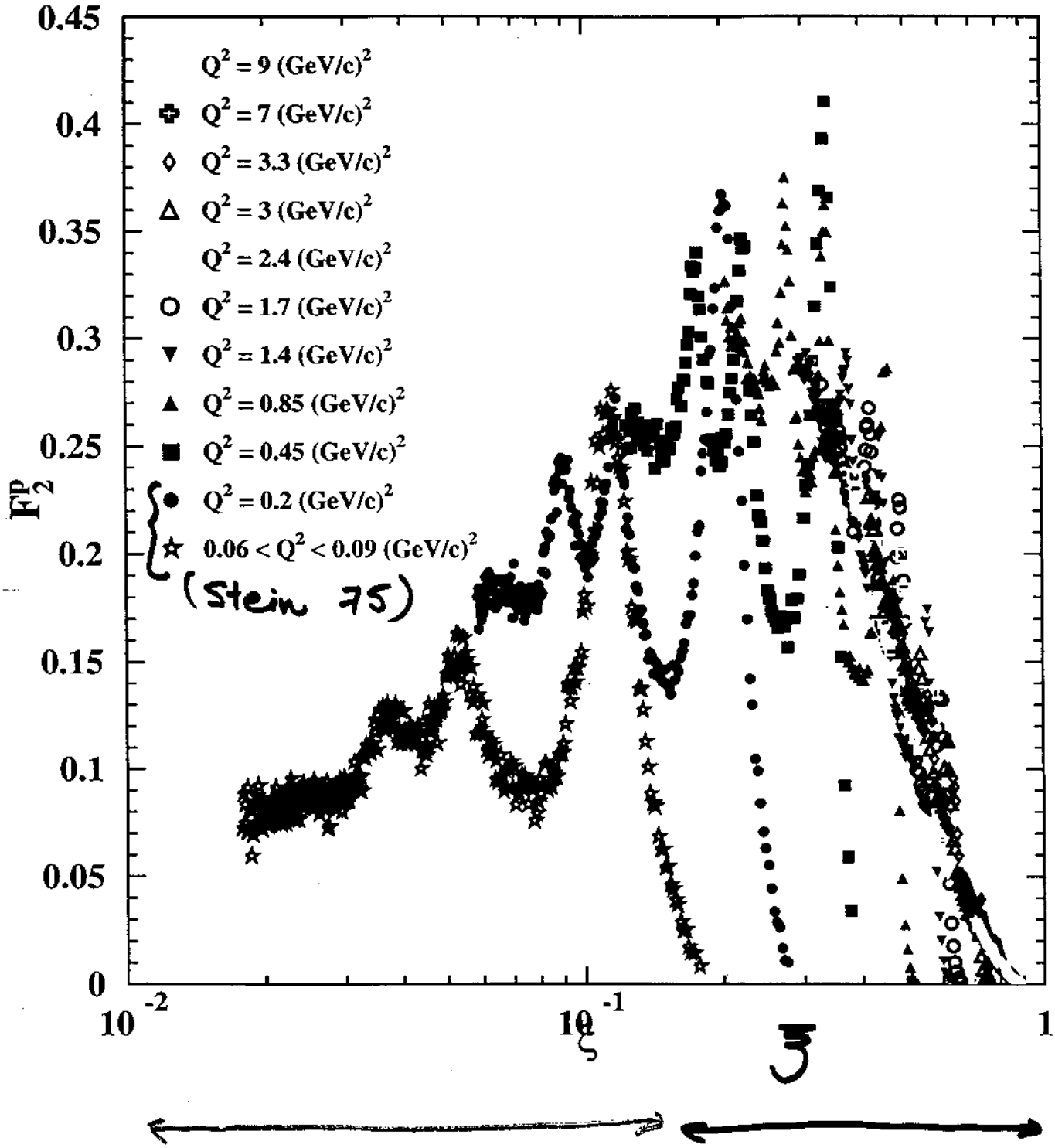
Scaling curve



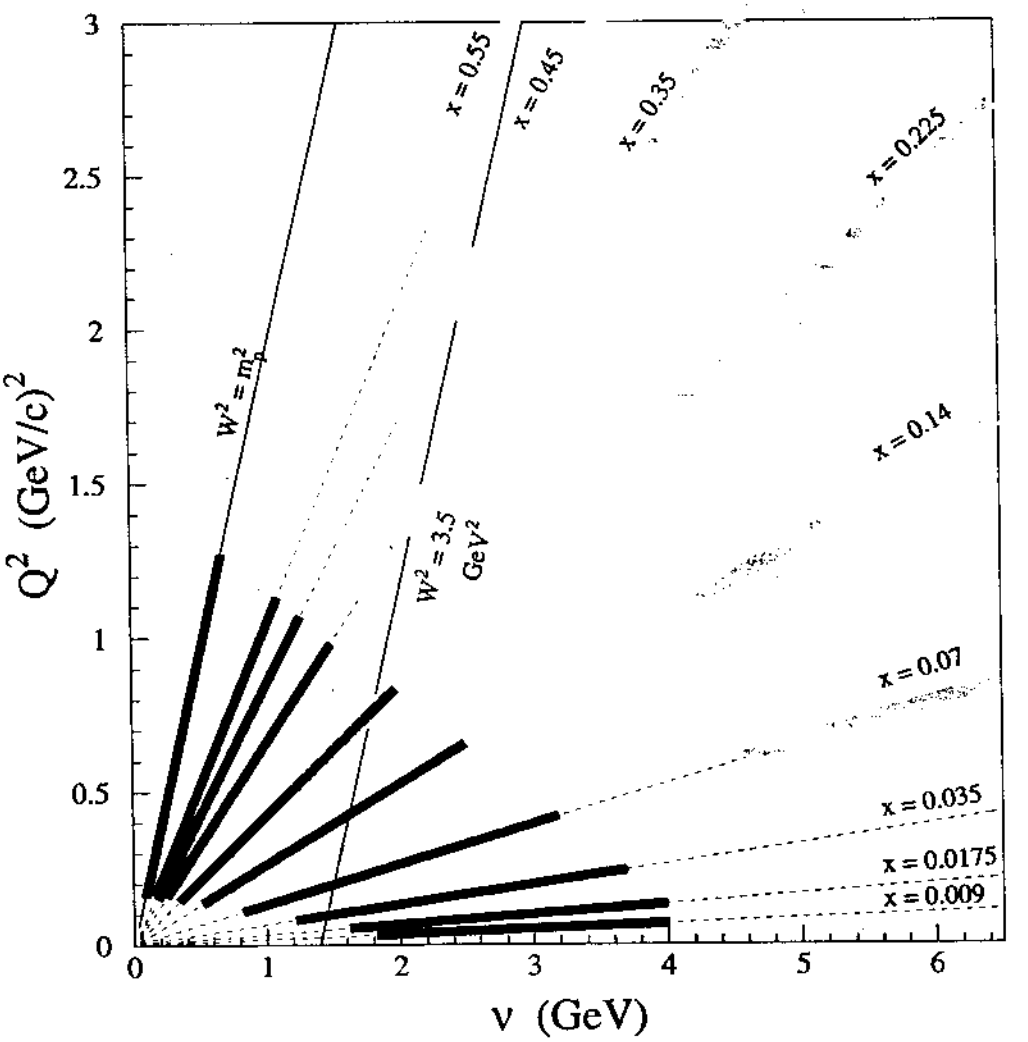

Deuterium
xF3 (CDHSW)
xF3 (CDHSW highest Q2)
xF3 (CDHSW lowest Q2)
18/5*F2
F2D, xF3D
ξ
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0.1
0.3
0.5
0.7
0.9


GRV 98, $Q^2 = 3.0$ (GeV/c)^2
JLab 98, $Q^2 = 3.0$ (GeV/c)^2
H1 96
ZEUS 98
ZEUS 95
E665 96
ZEUS 95
NMC 97
ZEUS 96
SLAC 90/92
$Q^2 \approx 3.1$ (GeV/c)^2
GRV 98, $Q^2 = 0.9$ (GeV/c)^2
JLab 98, $Q^2 = 0.85$ (GeV/c)^2
ZEUS 97
SLAC 90/92
ZEUS 98
E665 96
NMC 97
$Q^2 \approx 0.9$ (GeV/c)^2
GRV 98, $Q^2 = 0.4$ (GeV/c)^2
SLAC, $Q^2 = 0.2$ (GeV/c)^2
JLab 98, $Q^2 = 0.45$ (GeV/c)^2
ZEUS 97
ZEUS 98
E665 96
$Q^2 \approx 0.3$ (GeV/c)^2
SLAC, $0.06<Q^2<0.09$ (GeV/c)^2
ZEUS 97, $0.11<Q^2<0.15$ (GeV/c)^2
JLab scaling curve
$Q^2 \approx 0.1$ (GeV/c)^2
F_2^p
x


0.09 < Q² < 0.23
Q² = 3.00
F₂
W²
F₂ᵖ
ξ


0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
F_2^p
$Q^2 = 9$ (GeV/c)^2
$Q^2 = 7$ (GeV/c)^2
$Q^2 = 3.3$ (GeV/c)^2
$Q^2 = 3$ (GeV/c)^2
$Q^2 = 2.4$ (GeV/c)^2
$Q^2 = 1.7$ (GeV/c)^2
$Q^2 = 1.4$ (GeV/c)^2
$Q^2 = 0.85$ (GeV/c)^2
$Q^2 = 0.45$ (GeV/c)^2
$Q^2 = 0.2$ (GeV/c)^2
$0.06 < Q^2 < 0.09$ (GeV/c)^2
(Stein 75)
10^{-2}
10^{-1}
1
ξ
ξ

Kinematics



— kinematic region of this experiment

Proposed Kinematics

E_b (GeV)	θ_e (deg.)	E' (GeV)	x	Q^2 (GeV/c)^2	ε
4.4	16.0	0.4–3.9 (22 settings)	0.016–1	0.13–1.42	0.18–0.95
4.4	10.5	0.4–3.9 (22 settings)	0.007–1	0.05–0.61	0.18–0.98
3.3	10.5	0.4–3.1 (20 settings)	0.007–1	0.04–0.36	0.24–0.98
2.2	10.5	0.4–2.2 (17 settings)	0.008–1	0.03–0.16	0.35–0.98

Take data on Hydrogen
Deuterium

Activity	Time (hours)
Data acquisition	68
Configuration changes	70
Beam energy changes	18
Checkout	12
Total	**168 (7 days)**

+1 (TAC)

Table 2: Beam time request for the proposed experiment.