TWO PHOTON QCD STUDIES FOR AN e^+e^-, $e\gamma$ AND $\gamma\gamma$ COLLIDER

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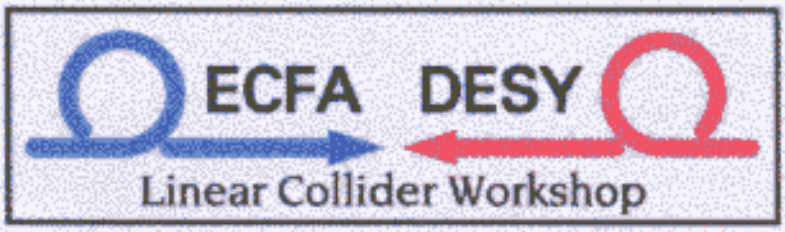
DESY, 23 SEPTEMBER

CONTENTS

- Update on F_2^γ
- Update on σ_{tot}
- Update Polarised Photon Structure

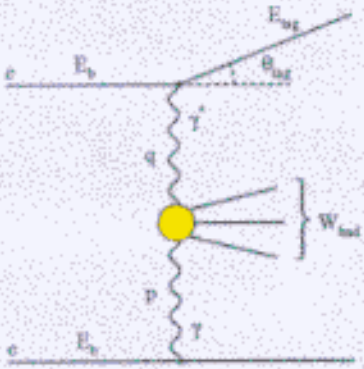
e^+e^- COLLIDER $\sqrt{s} = 500$ GEV



F_2^γ Structure Function

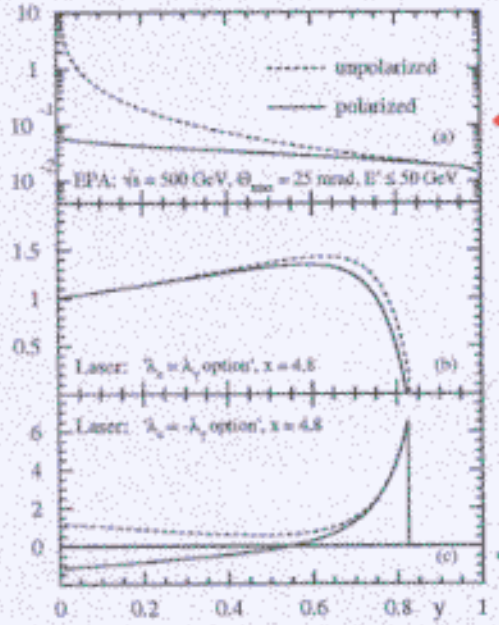
A. Vogt, D. Miller, ADR...

$$\frac{d\sigma_{e\gamma\to eX}}{dxdQ^2} = \frac{2\pi\alpha^2}{xQ^4}(1+(1-y)^2)F_2^\gamma$$



- Electron Tagging: $\Theta > 25$ mrad, $E_e > 50$GeV (Forward electron tagging $Q^2 \sim 0$)?

Photon Spectra used:

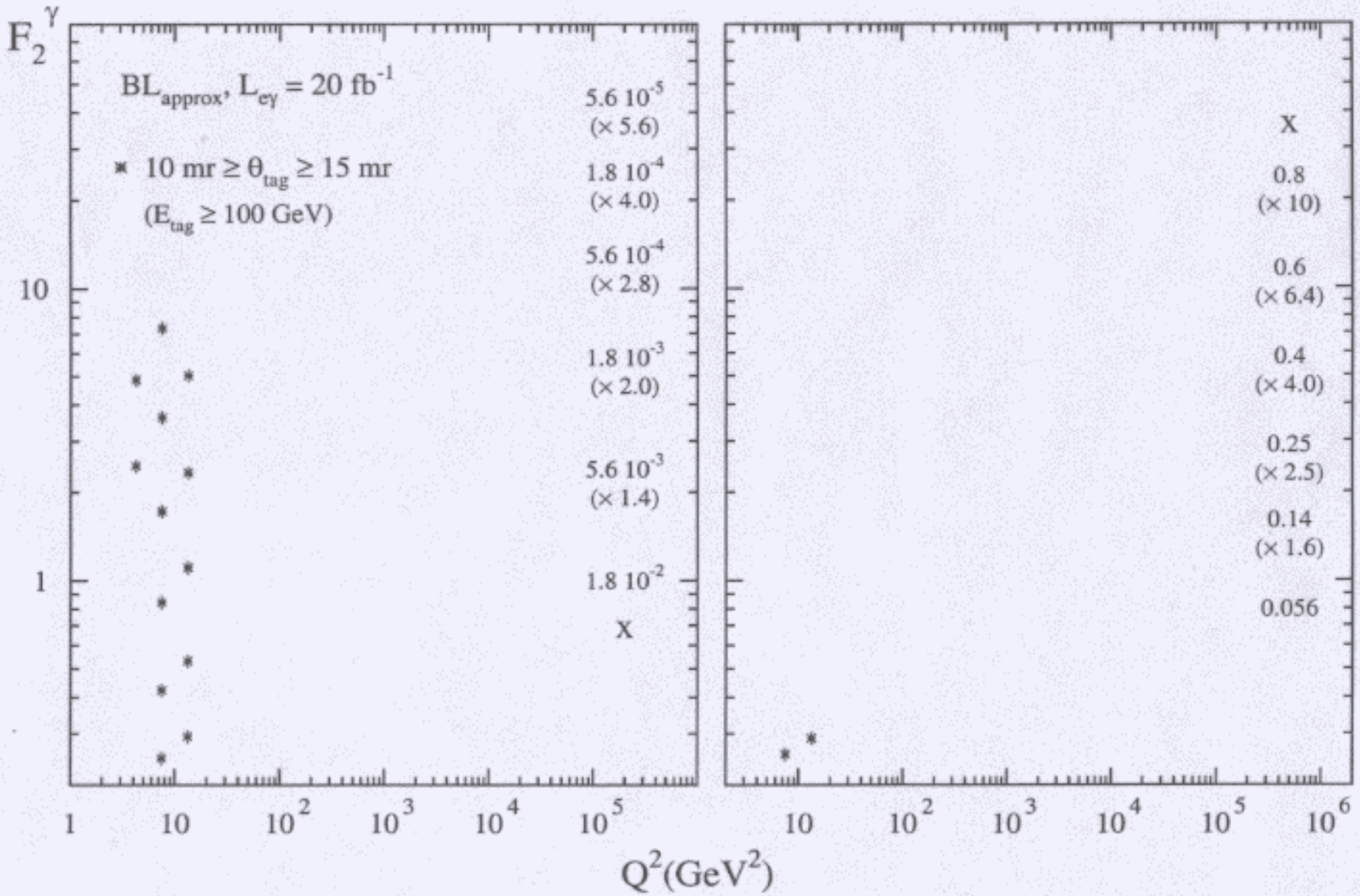


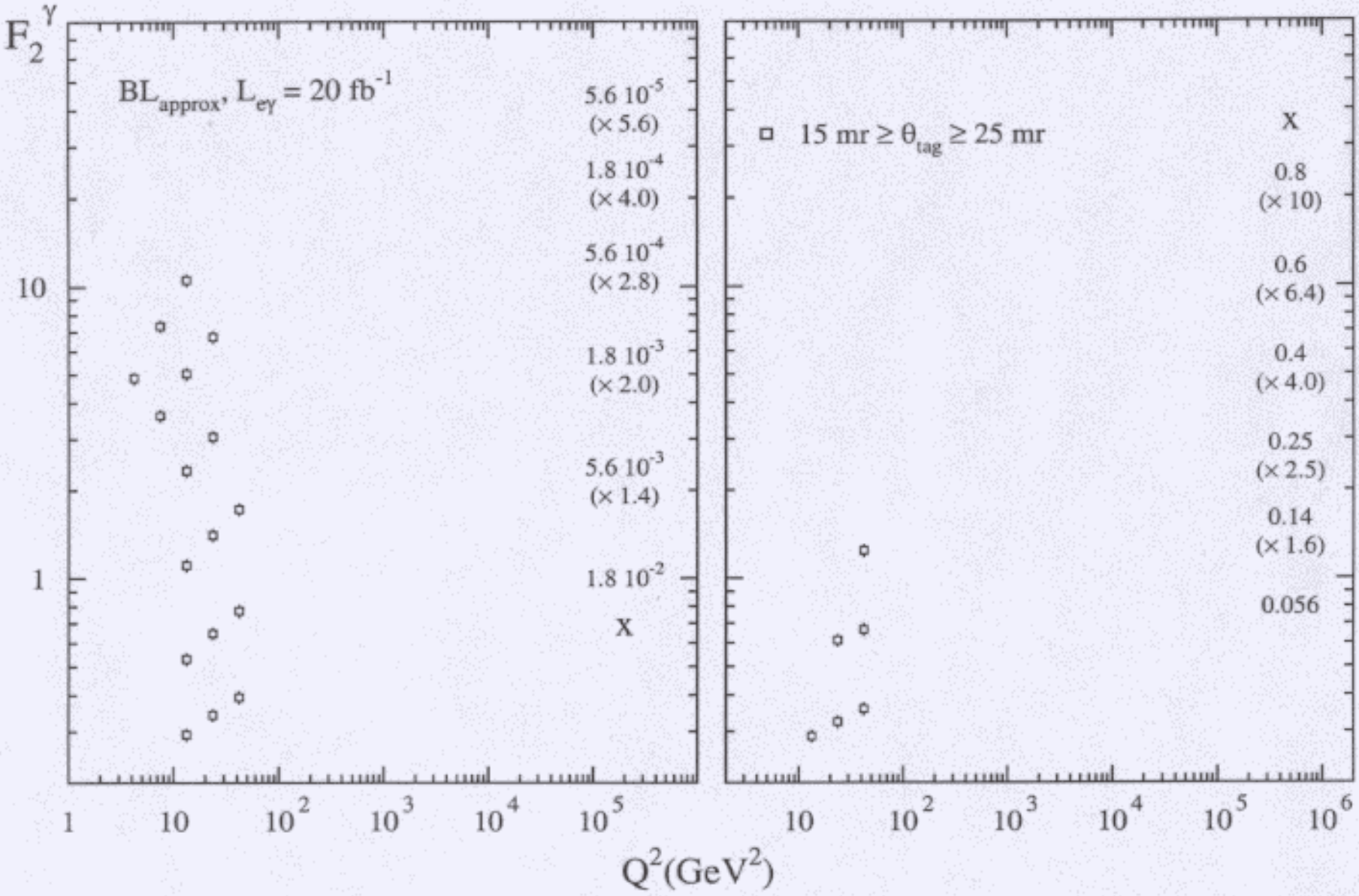
e^+e^-

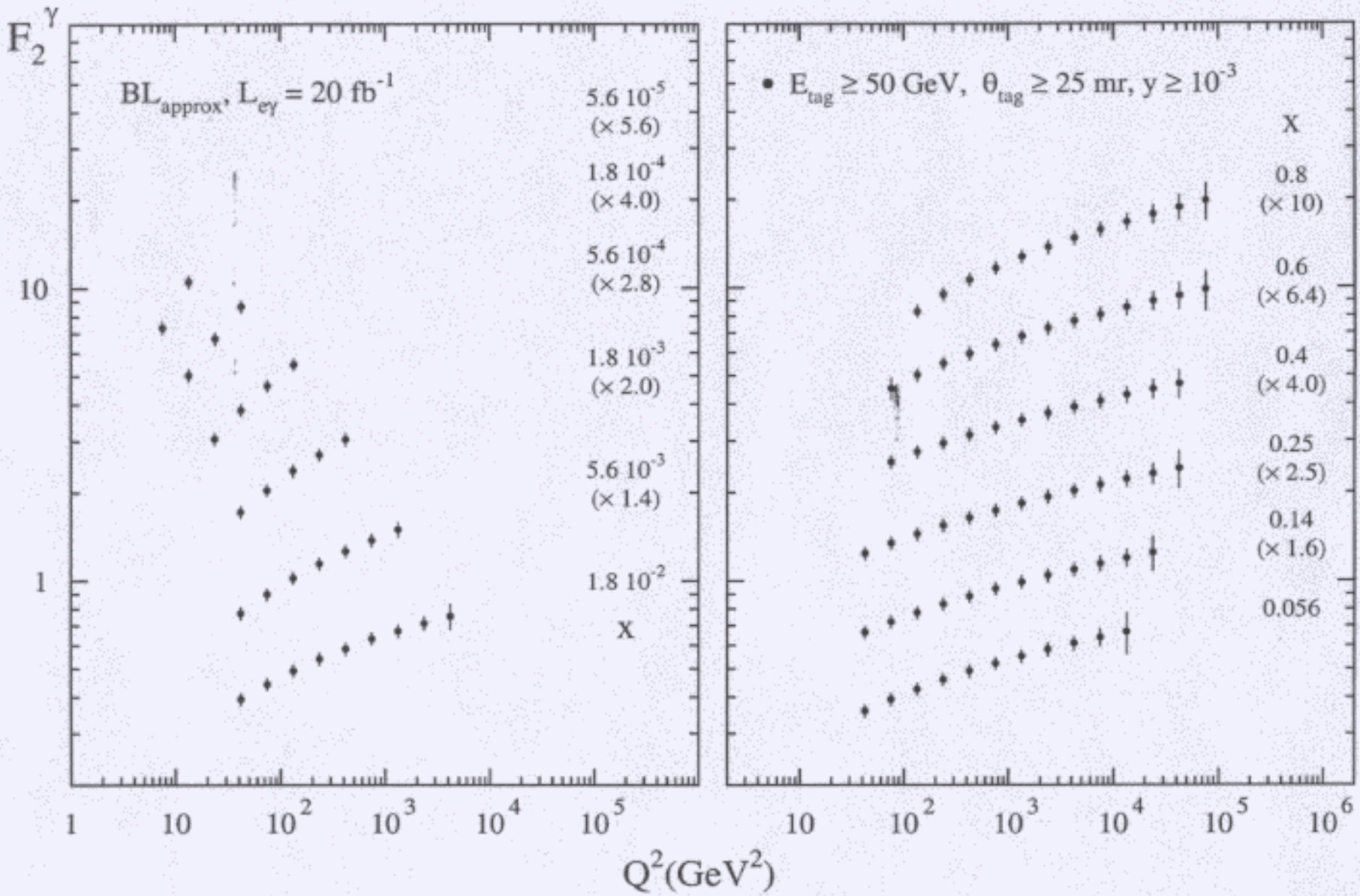
$\gamma\gamma$, $e\gamma$

STRATMANN

- e^+e^- mode: difficult, only $Q^2 > 20-50$ GeV^2 $x > 5.10^{-4}$
- $e\gamma$ mode: Low-x accessable!


F_2^γ
BL_{approx}, $L_{e\gamma} = 20\ fb^{-1}$
$10\ mr \geq \theta_{tag} \geq 15\ mr$
($E_{tag} \geq 100$ GeV)
$5.6\ 10^{-5}$
(× 5.6)
$1.8\ 10^{-4}$
(× 4.0)
$5.6\ 10^{-4}$
(× 2.8)
$1.8\ 10^{-3}$
(× 2.0)
$5.6\ 10^{-3}$
(× 1.4)
$1.8\ 10^{-2}$
X
X
0.8
(× 10)
0.6
(× 6.4)
0.4
(× 4.0)
0.25
(× 2.5)
0.14
(× 1.6)
0.056
10
1
1
10
10^2
10^3
10^4
10^5
10^6
$Q^2(GeV^2)$


F_2^γ
BL_{approx}, $L_{e\gamma} = 20\ fb^{-1}$
$5.6\ 10^{-5}$ (× 5.6)
$1.8\ 10^{-4}$ (× 4.0)
$5.6\ 10^{-4}$ (× 2.8)
$1.8\ 10^{-3}$ (× 2.0)
$5.6\ 10^{-3}$ (× 1.4)
$1.8\ 10^{-2}$
x
10
1
1 10 10^2 10^3 10^4 10^5
15 mr ≥ θ_{tag} ≥ 25 mr
x
0.8 (× 10)
0.6 (× 6.4)
0.4 (× 4.0)
0.25 (× 2.5)
0.14 (× 1.6)
0.056
10 10^2 10^3 10^4 10^5 10^6
$Q^2(GeV^2)$


F_2^γ
BL_{approx}, $L_{e\gamma} = 20\ fb^{-1}$
$5.6\ 10^{-5}$ (× 5.6)
$1.8\ 10^{-4}$ (× 4.0)
$5.6\ 10^{-4}$ (× 2.8)
$1.8\ 10^{-3}$ (× 2.0)
$5.6\ 10^{-3}$ (× 1.4)
$1.8\ 10^{-2}$
x
10
1
1 10 10^2 10^3 10^4 10^5
• $E_{tag} \geq 50$ GeV, $\theta_{tag} \geq 25$ mr, $y \geq 10^{-3}$
x
0.8 (× 10)
0.6 (× 6.4)
0.4 (× 4.0)
0.25 (× 2.5)
0.14 (× 1.6)
0.056
10 10^2 10^3 10^4 10^5 10^6
$Q^2(GeV^2)$

POLARIZED STRUCTURE FUNCTION

PROTON: POLARISED DIS $\rightarrow \Delta q$ (POL. PARTON DISTR.)

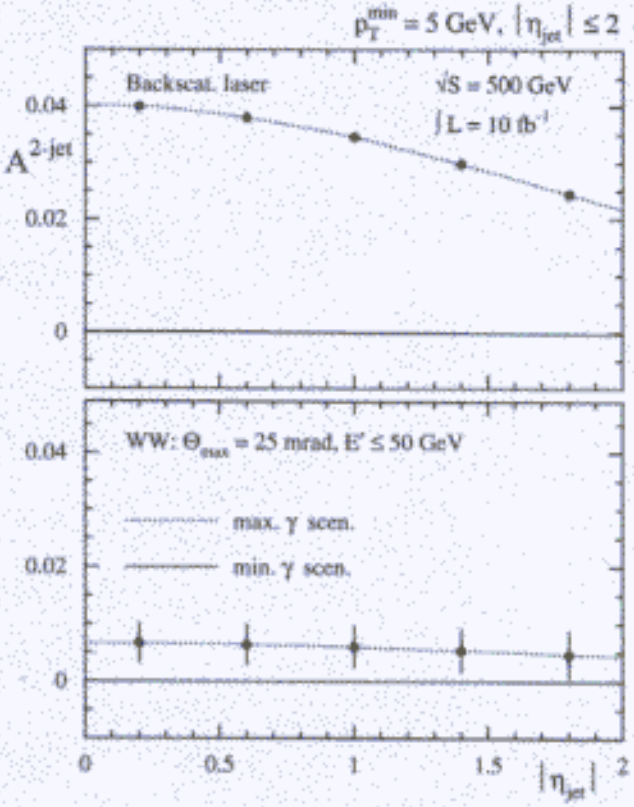
SPIN PUZZLE (EMC): SPIN PROTON $\neq \sum$ SPIN QUARKS

PHOTON: NO DATA AVAILABLE ON Δq^{γ}

LINEAR COLLIDER $\Rightarrow$ POLARIZED BEAMS

M. Stratmann, W. Vogelsang

- $g_1 (\sim F_1) \rightarrow e^+e^-$, $e\gamma$ ✓
- JETS $\rightarrow e^+e^-$ ✓ $\gamma\gamma$ ✓



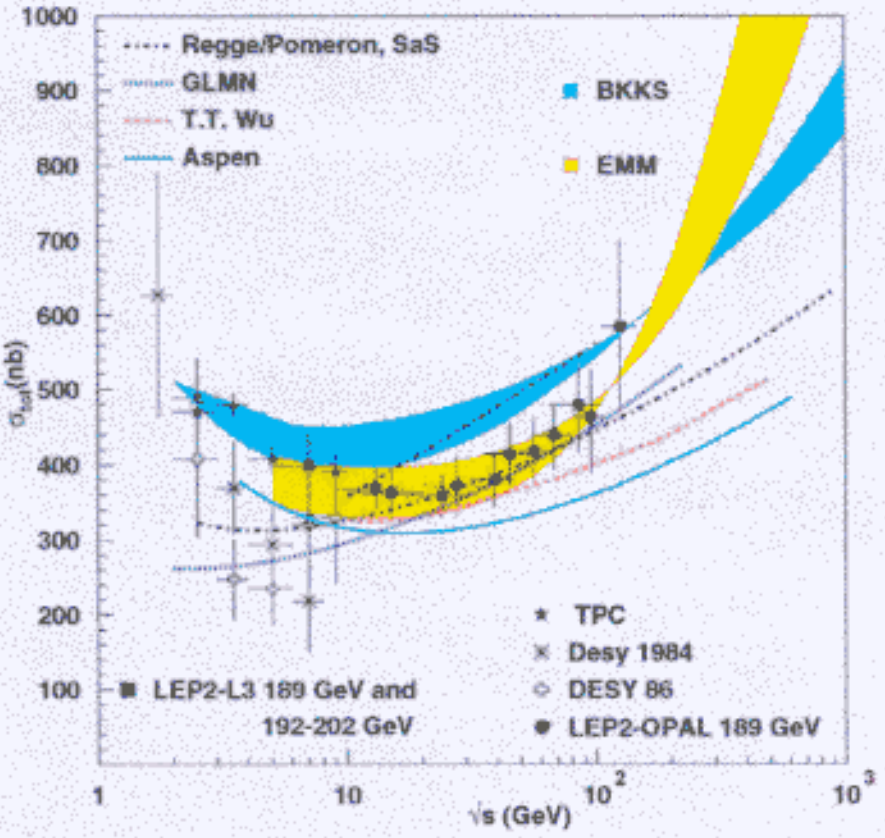
2 DIFFERENT Δq^{γ}'S

CLEAR SENSITIVITY IN $\gamma\gamma$!!

$\sigma_{tot}^{\gamma\gamma}$ TOTAL CROSS SECTION

G. PANCHERI ET AL, ADR

RISE AT THE HIGHEST ENERGIES?
STRONGER THAN pp?



- e^+e^-: W RECONSTRUCION DIFFICULT (> 10 UNITS IN η)
- $\gamma\gamma$: RUN AT DIFFERENT W VALUES

SYST. ERROR $\sim$ 5%-10% (PHOJET/SIMDET)

$\sigma^{TOT}_{\gamma\gamma}$

SELECTION

$W_{VIS} > 10$ GeV
#TRACKS > 3

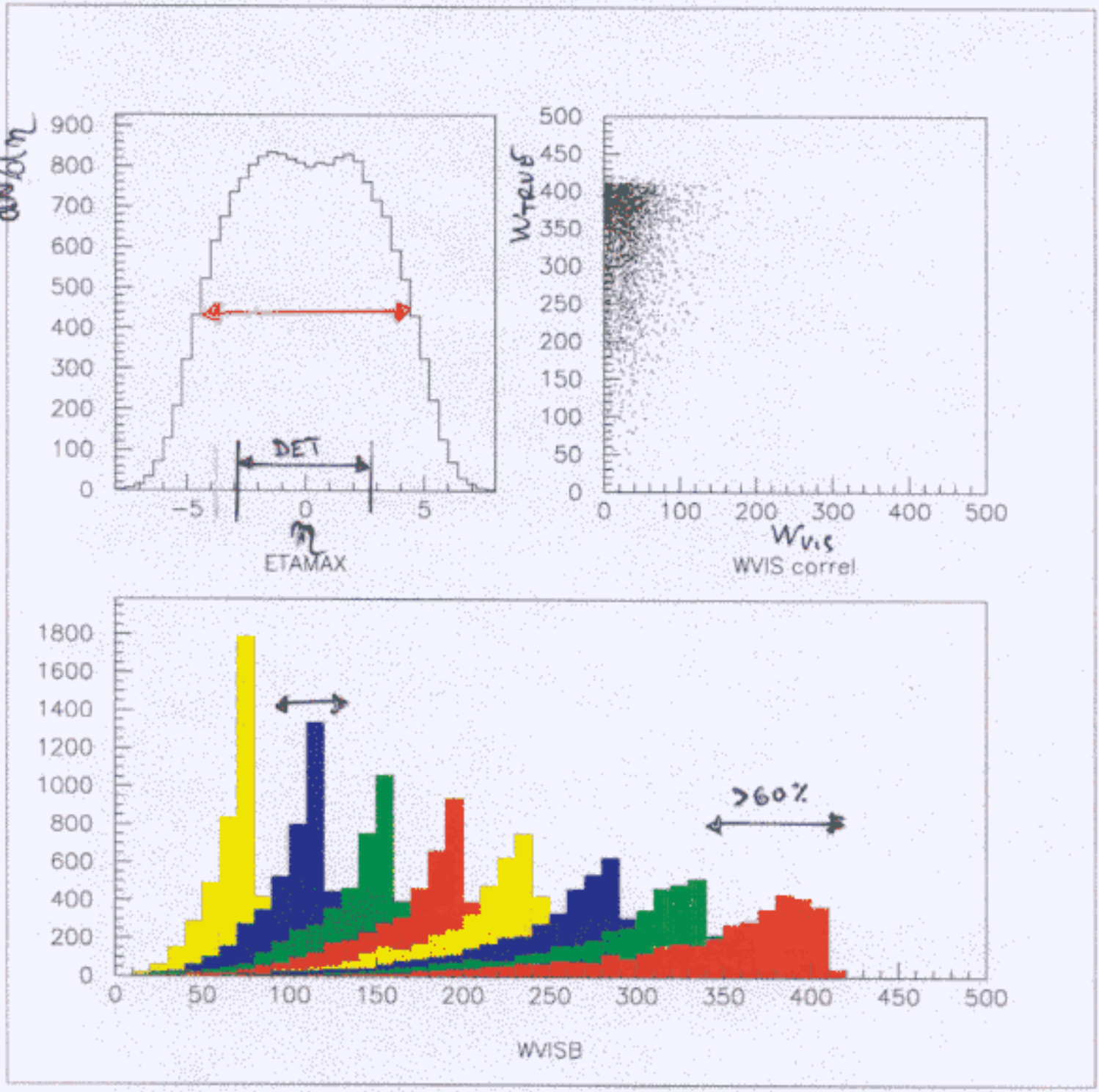
↳ ACCEPTANCE NON-DIFF > 95%
ELASTIC : ∅ %
DIFF (N-ELAS) : 35%

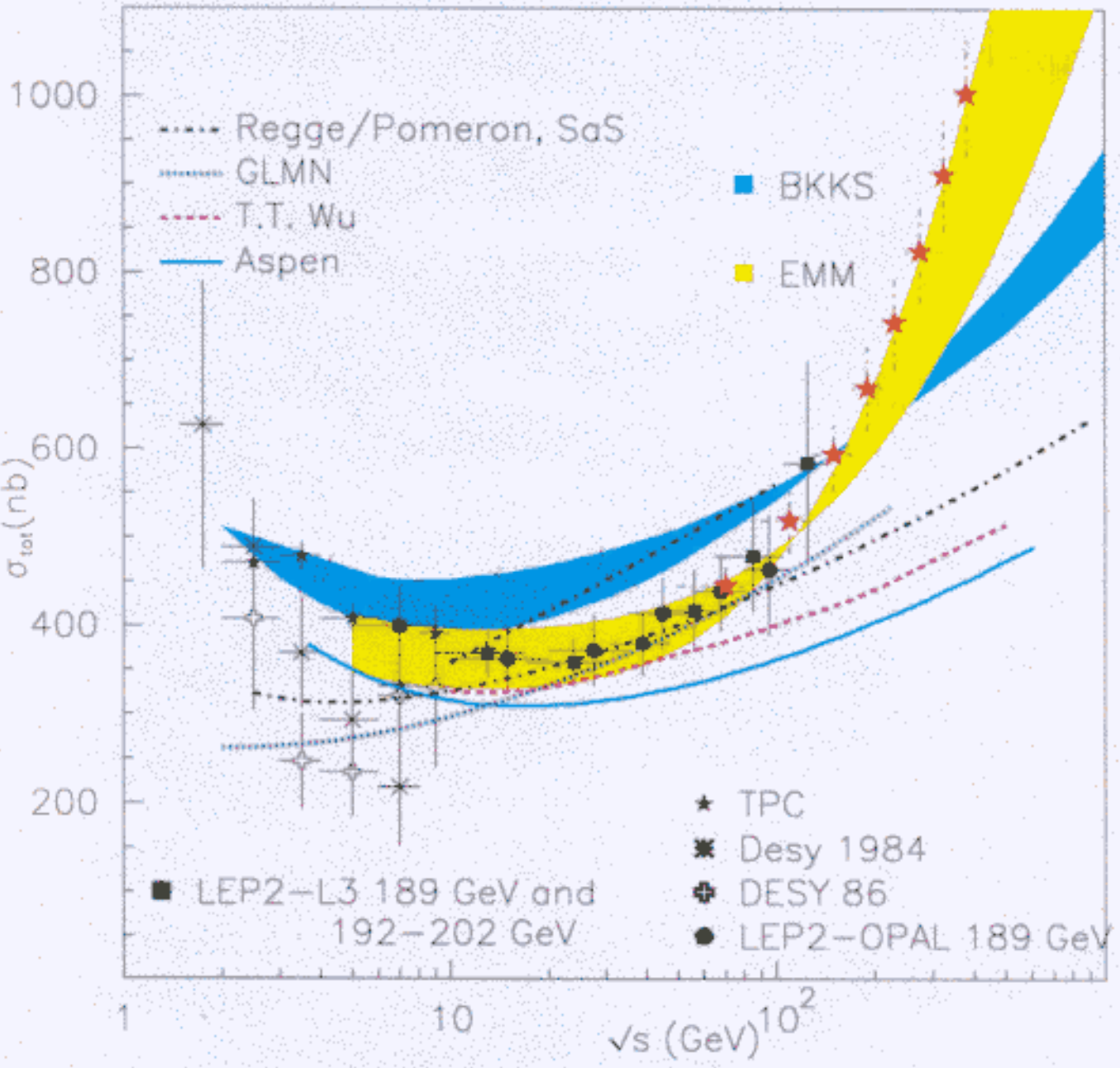
STATISTICS $5 \cdot 10^5$ EVTS / DAY (PRESCALED)

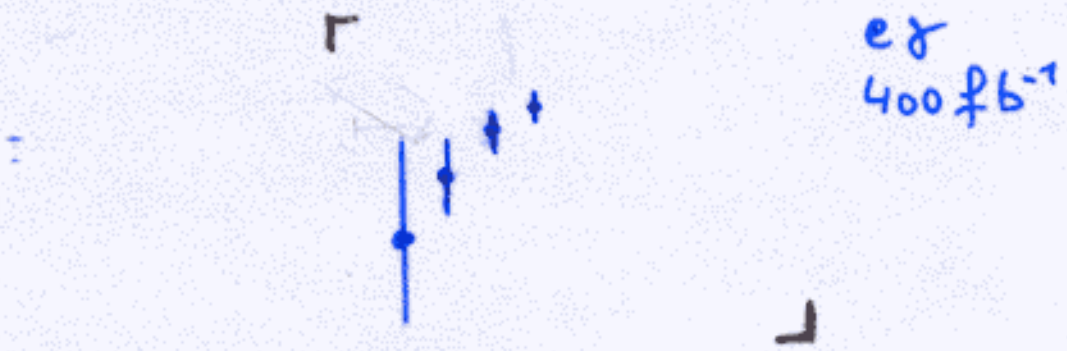
ERRORS (*)

CUTS (MODEL)	3%	(HERA / FRAGM. PAR
DIFFRACTION	3 - 8 %	(ρ^0?)
DETECTOR	3%	(~ HERA)
LUMI / SPECTRUM	3 - 4 %	SHORT RUNS
BIN CORRECTION	2 %	MODEL CHANGE
	6 - 10 %	

(*) ASSUME
ΔE_{FLOW} ~ 2%
A DIFF 10% (MEASURE)
ρ FROM REGGE FACTORIZATION (TEST AT LOW $\sqrt{s}$)


dN/dη
900
800
700
600
500
400
300
200
100
0
−5
0
5
DET
ETAMAX
WVIS
500
450
400
350
300
250
200
150
100
50
0
0
100
200
300
400
500
WVIS correl
1800
1600
1400
1200
1000
800
600
400
200
0
50
100
150
200
250
300
350
400
450
500
>60%
WVISB


1000
800
600
400
200
σ_{tot}(nb)
Regge/Pomeron, SaS
GLMN
T.T. Wu
Aspen
BKKS
EMM
TPC
Desy 1984
DESY 86
LEP2–OPAL 189 GeV
LEP2–L3 189 GeV and
192–202 GeV
1
10
10^2
$\sqrt{s}$ (GeV)


eγ
400 fb⁻¹

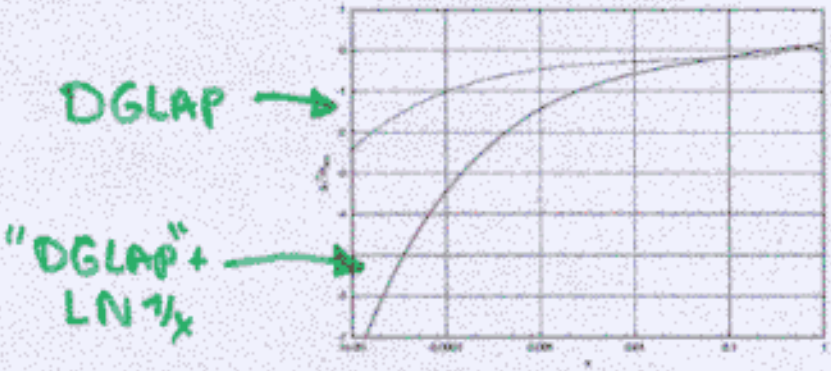
Polarized Structure Function

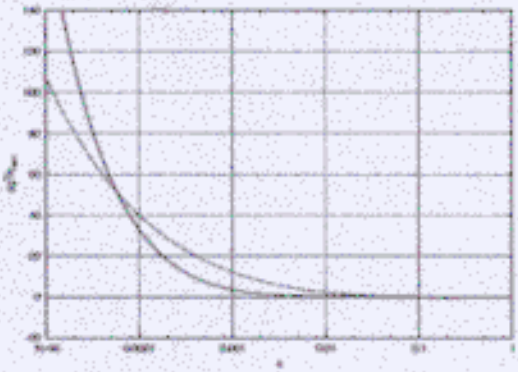
J. Kwiecinski, B. Zaija

Predictions for $g_1^\gamma(x,Q^2)$ and $\Delta g^\gamma(x,Q^2)$

- DGLAP + $\ln^2 1/x$ term (proton evolution eqns + inhomogeneous term)
- VDM non-perturbative input: $\Delta g^V(x) \sim (1-x)^3(1+ax)$

$$g_1^\gamma(x,Q^2) = \tfrac{1}{2}\sum_i e_i^2 \Delta q_i$$





- g_1 and Δg can be large at small x
- Large $\ln^2 1/x$ effects
- (Strong effect of non-pert input)