CLAS Collaboration Meeting, Hadron Spectroscopy

Development of a New 2pi Event Generator Based on JLab-Moscow Model: Reasons, Status, and Prospects

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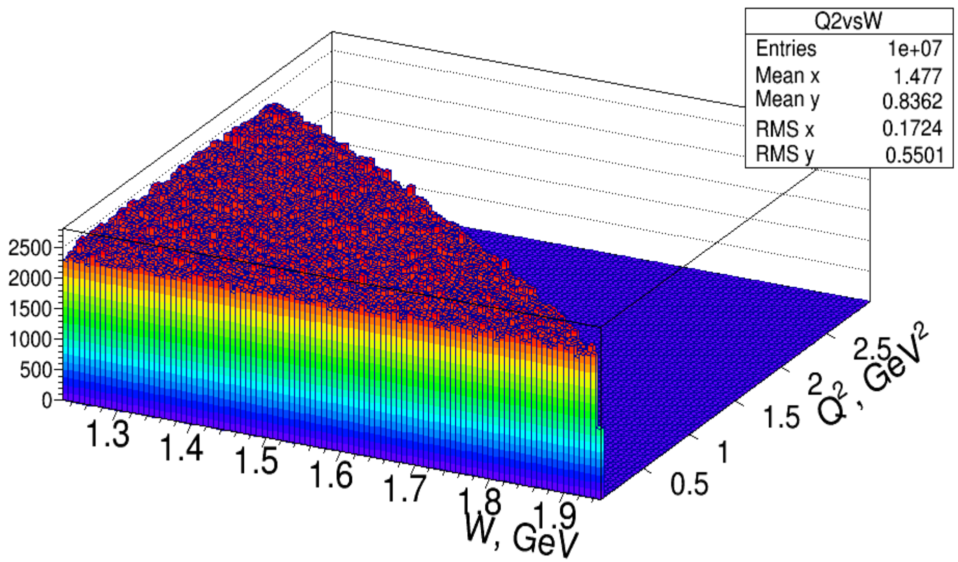
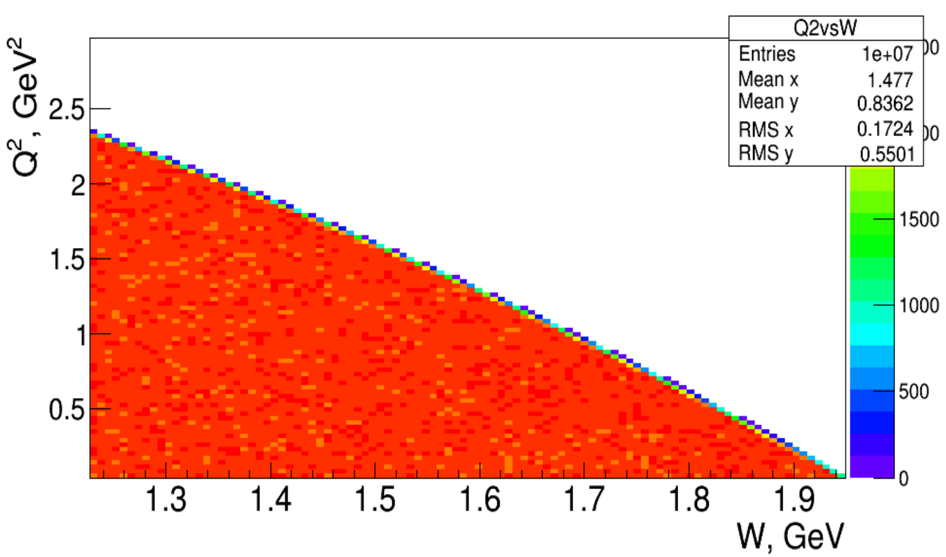
Reasons and Prospects

- Based on JM15 + newest data
- Written on C++
- New EG will work up to W = 3 GeV and at extremely low Q^2 (available with CLAS12, when FT in use)
- New EG will provide output both in BOS- and LUND-format (EVIO also if needed)
- Takes into account cross section change with beam energy
- Allows to obtain cross section value from EG
- EG generates flat distributions and applies the cross section as weight to each event

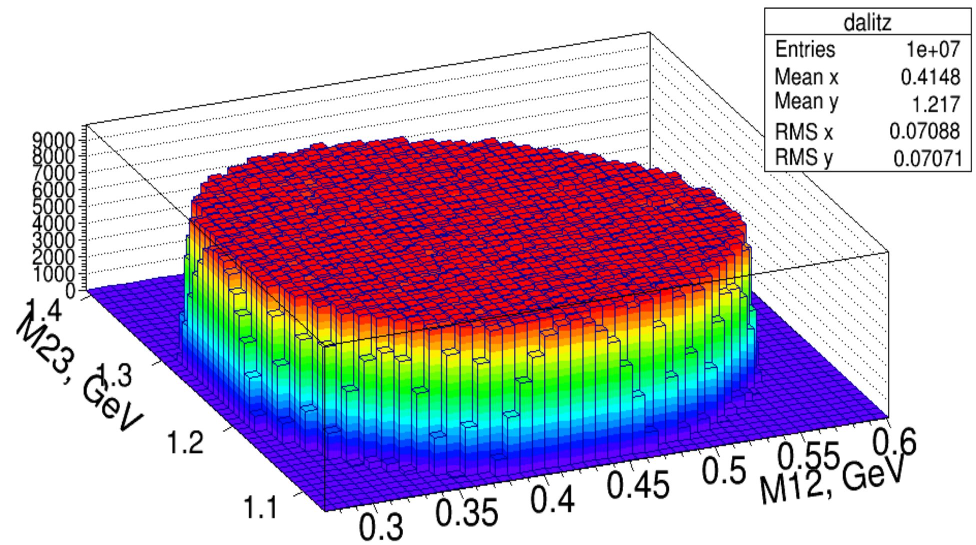
Flat Generation

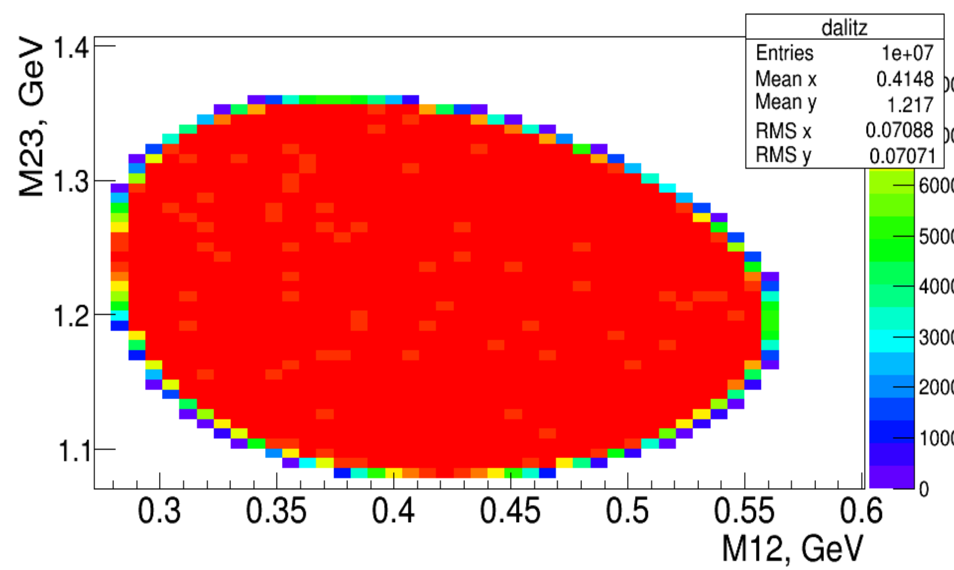
For Ebeam = 2 GeV:





For W = 1.5 GeV:





2π Kinematics

From experiment

From JM model (fit to the data)

$$\frac{d^7\sigma_e}{dW\,dQ^2 d^5\tau} = \Gamma_v \frac{d^5\sigma_v}{d^5\tau}$$

$$d^5\tau = dM_{\pi^+p}\,dM_{\pi^+\pi^-}\,d\Omega_{\pi^-}\,d\alpha_{[\pi^-p][\pi^+p']}$$

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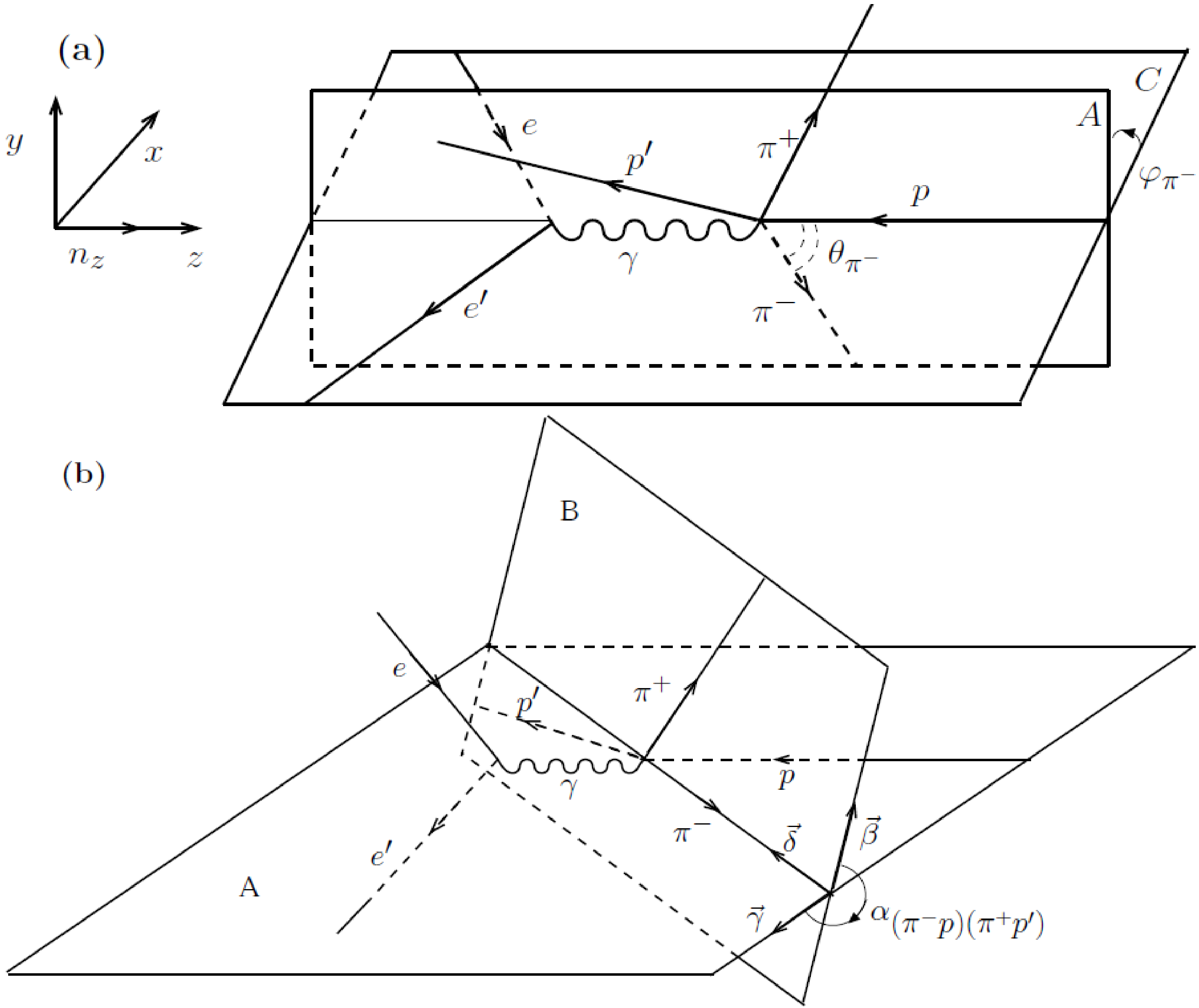
2π Kinematics



Electroproduction:

1) CLAS data at E_{beam} = 2.445, E_{beam} = 4 GeV

M. Ripani et al. [CLAS Collaboration], Phys. Rev. Lett. 91, 022002 (2003)

V. I. Mokeev et al. [CLAS Collaboration], Phys. Rev. C 86, 035203 (2012)

2) CLAS data at E_{beam} = 1.515 GeV

G. V. Fedotov et al. [CLAS Collaboration], Phys. Rev. C 79, 015204 (2009)

Photoproduction:

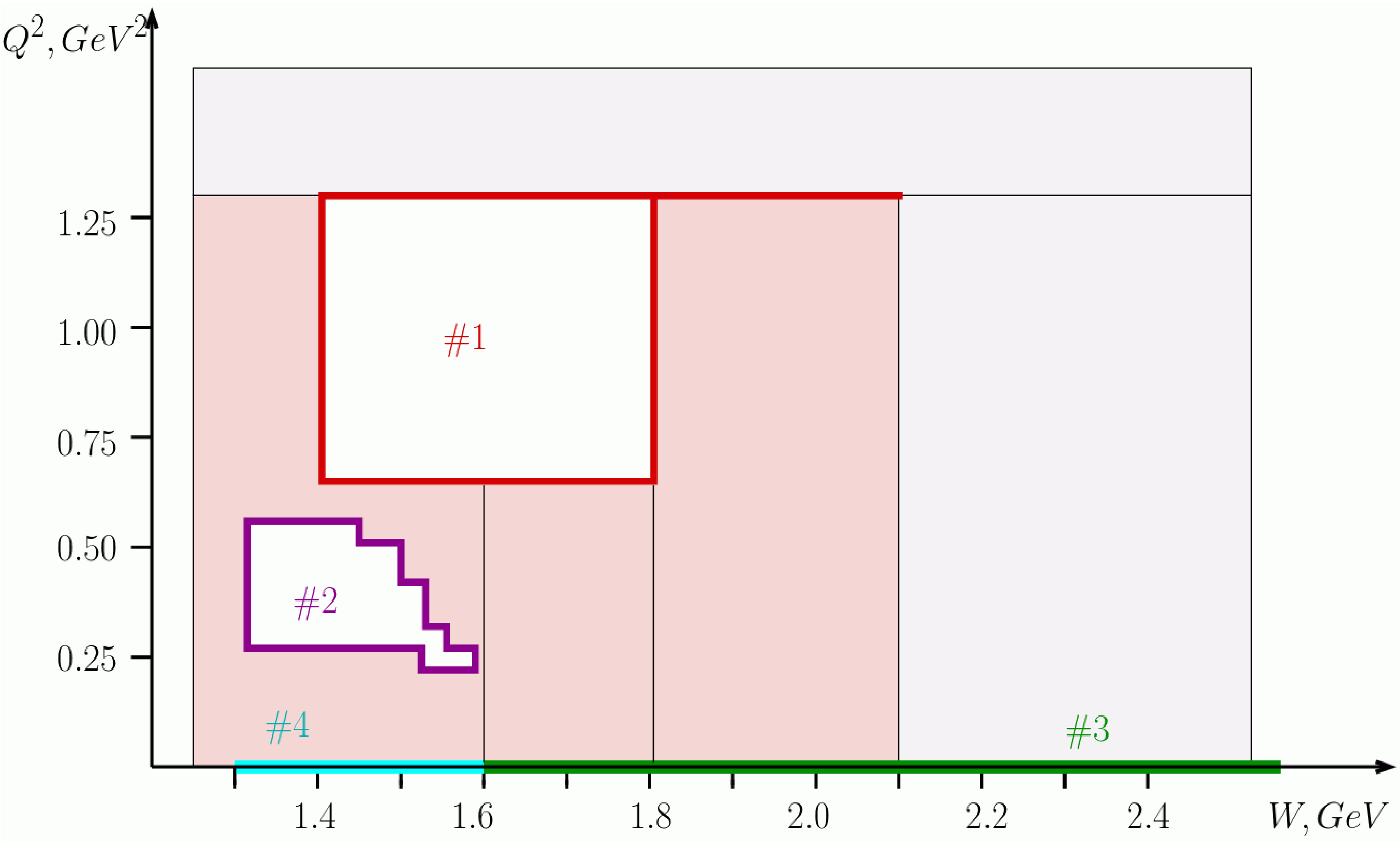
3) CLAS g11a experiment

E. Golovach et.al. CLAS ANALYSIS NOTE (under review).

4) SAPHIR Eur. Phys. J. A 23, 317 (2005).

ABBHM Collab., Phys. Rev. 175, 1669 (1968)

Data Included



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Cross Section Formula

For unpolarized electron beam:

$$\frac{d^5\sigma_v}{d^5\tau} = \frac{d^5\sigma_T}{d^5\tau} + \varepsilon_L \frac{d^5\sigma_L}{d^5\tau} + \varepsilon_T \left(\frac{d^5\sigma_{TT}}{d^5\tau} cos\, 2\varphi + \frac{d^5\sigma'_{TT}}{d^5\tau} sin\, 2\varphi \right) + $$
$$+ \sqrt{2\varepsilon_L(1+\varepsilon_T)} \left(\frac{d^5\sigma_{TL}}{d^5\tau} cos\, \varphi + \frac{d^5\sigma'_{TL}}{d^5\tau} sin\, \varphi \right)$$

$\int d\alpha$

$\int d\varphi$

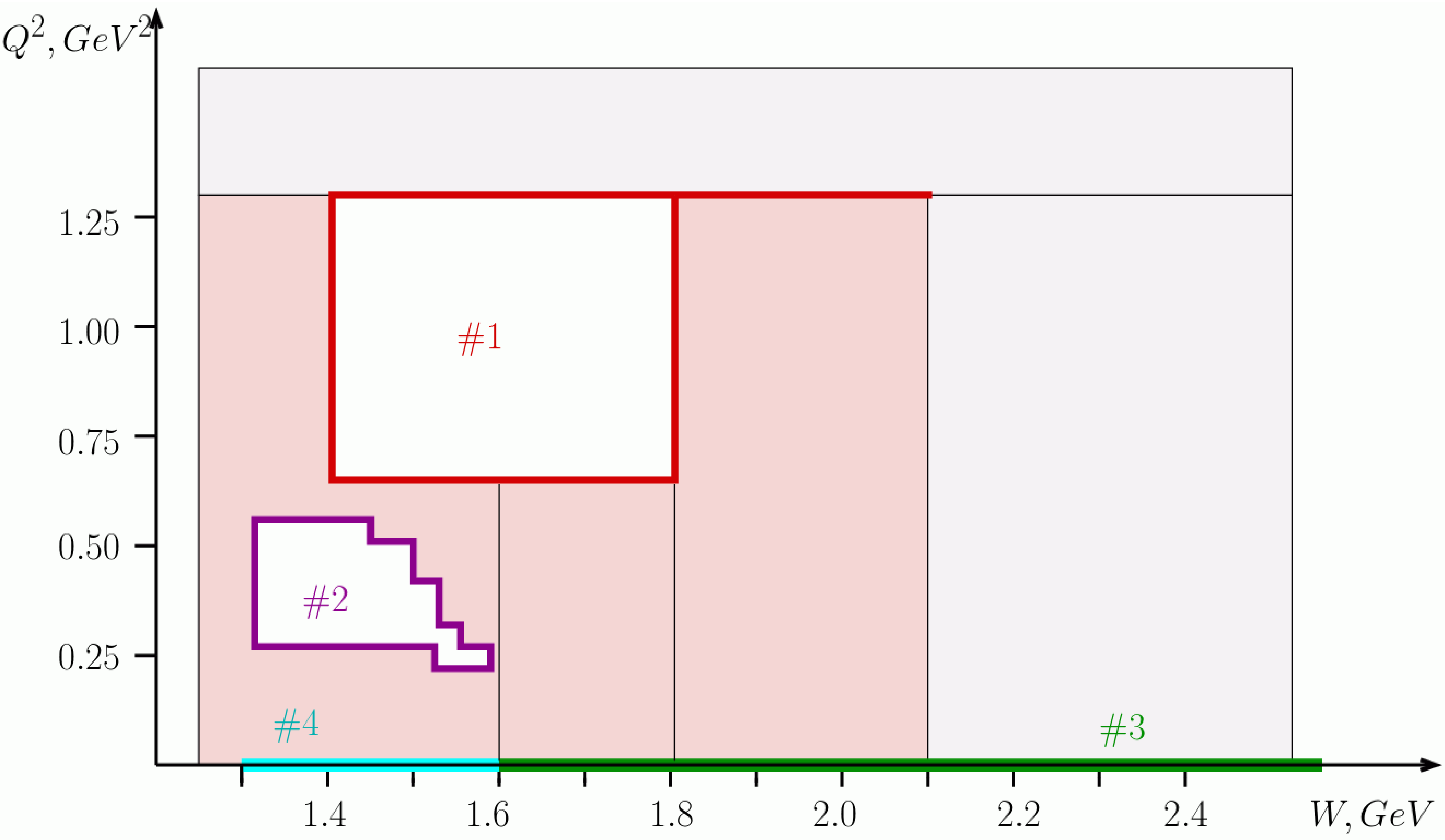
$$\frac{d^4\sigma_v}{d^4\tau} = \frac{d^4\sigma_T}{d^4\tau} + \varepsilon_L \frac{d^4\sigma_L}{d^4\tau} + \varepsilon_T \frac{d^4\sigma_{TT}}{d^4\tau} cos\, 2\varphi + \sqrt{2\varepsilon_L(1+\varepsilon_T)} \frac{d^4\sigma_{TL}}{d^4\tau} cos\, \varphi$$

$$\frac{d^4\sigma_v}{d^4\tau} = \frac{d^4\sigma_T}{d^4\tau} + \varepsilon_L \frac{d^4\sigma_L}{d^4\tau}$$

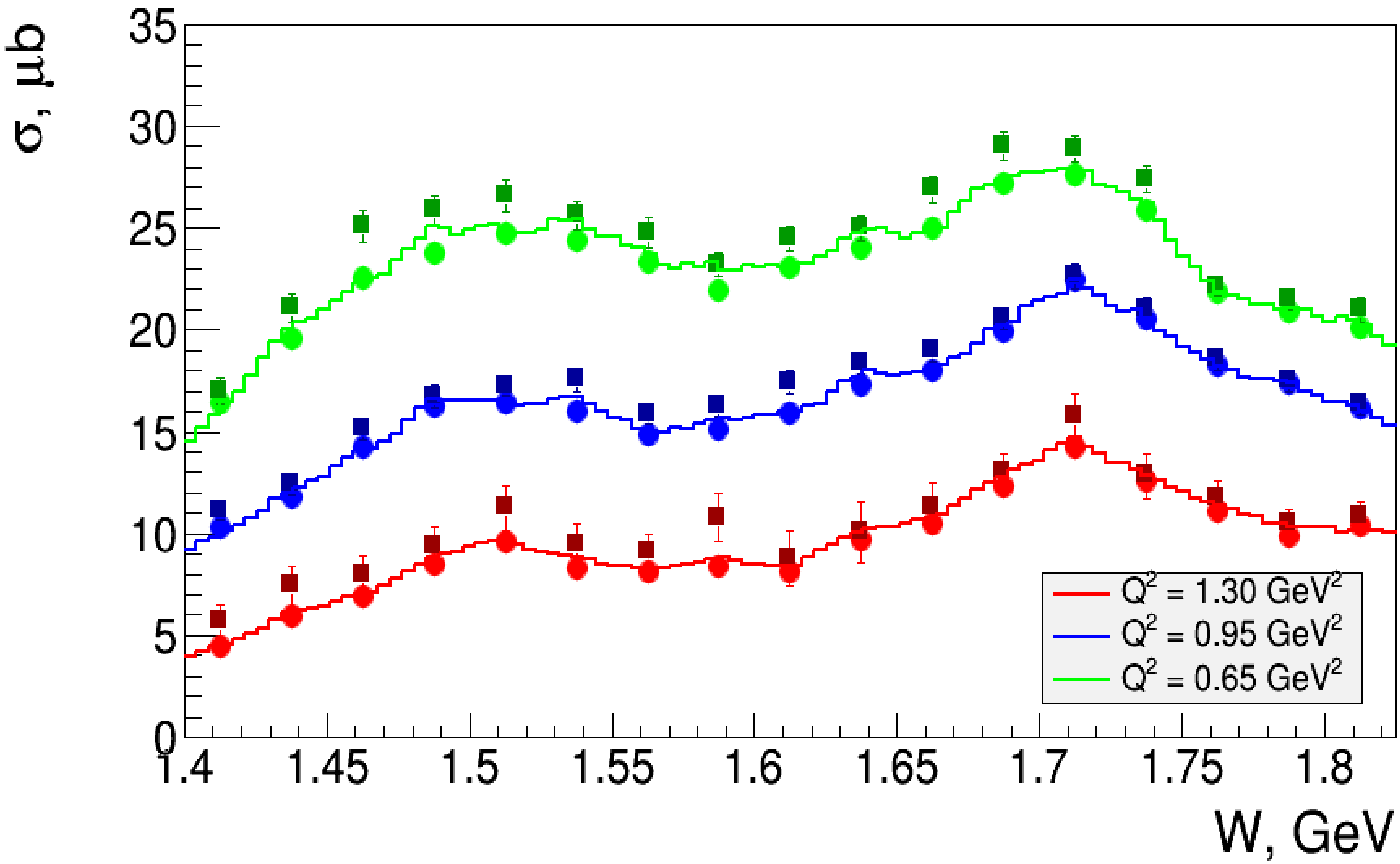
$\mathbf{Q^2 \to 0}$

$$\frac{d^4\sigma}{d^4\tau} = \frac{d^4\sigma_T}{d^4\tau}$$

Data Included

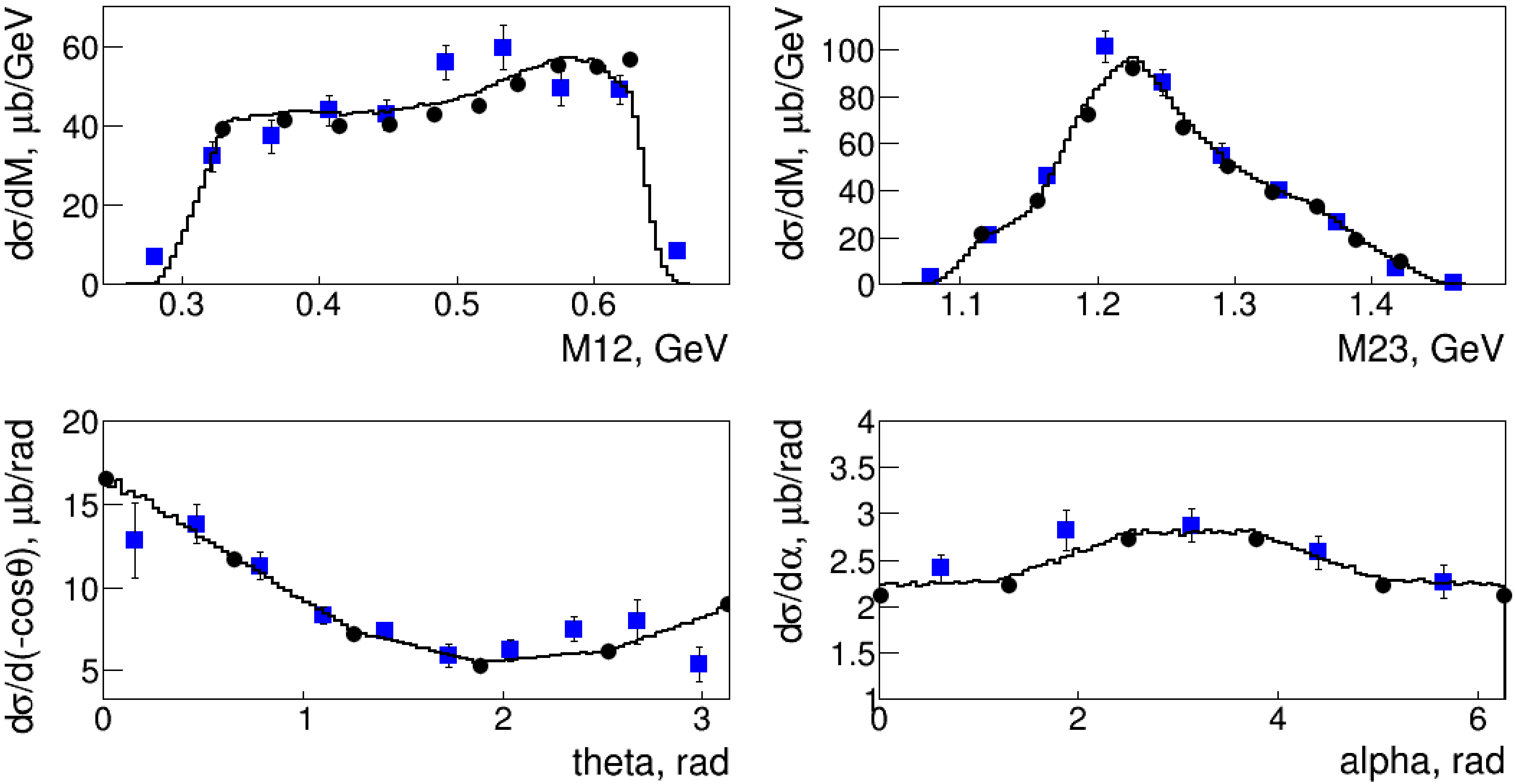


W-Dependences of Integrated Cross Sections



Squares – exp. data, circles – JM model, curves – EG

1-Fold Differential Cross Sections at W = 1.5875 GeV, Q^2 = 0.95 GeV^2



Squares – exp. data, circles – JM model, curves – EG

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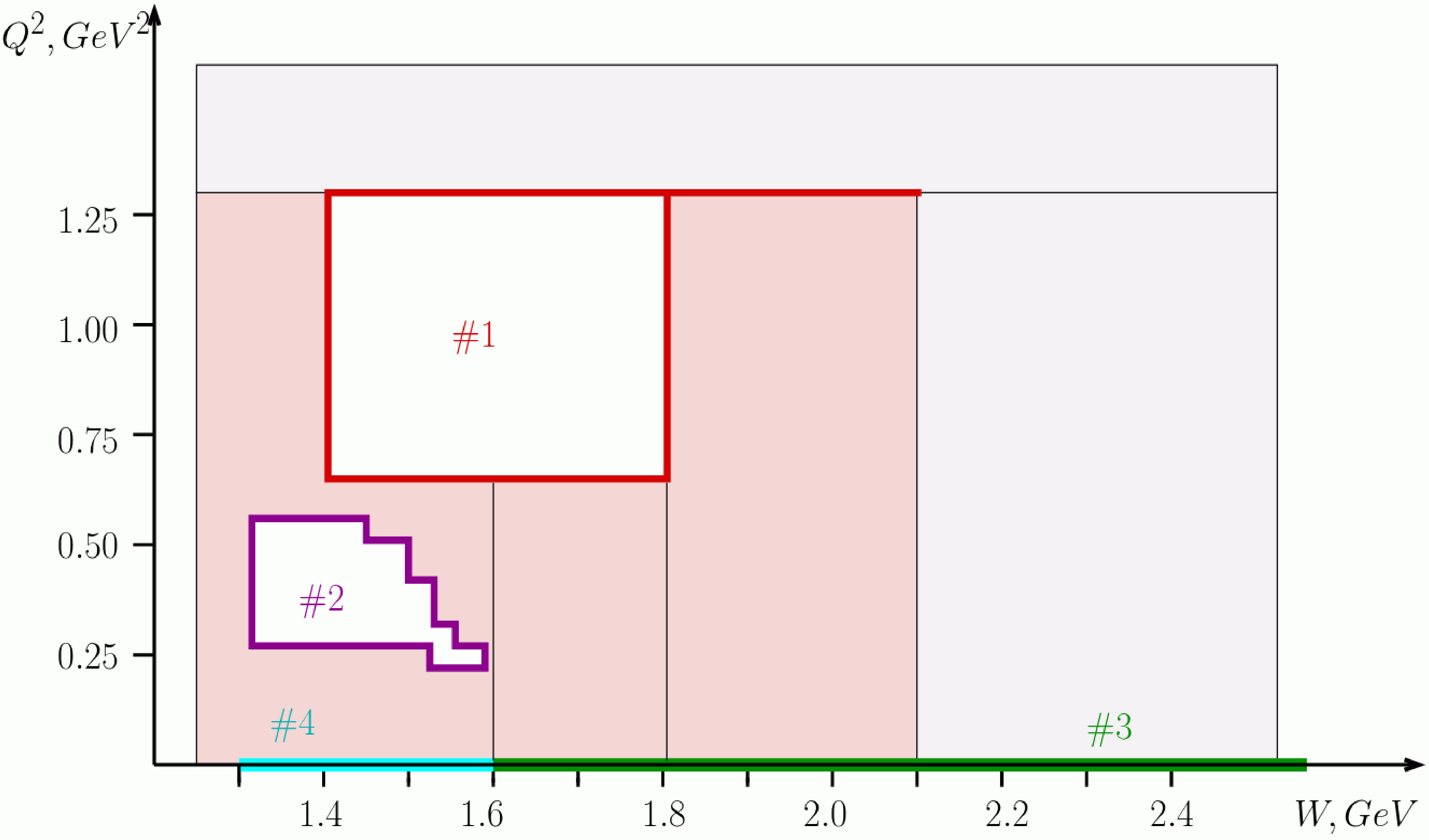
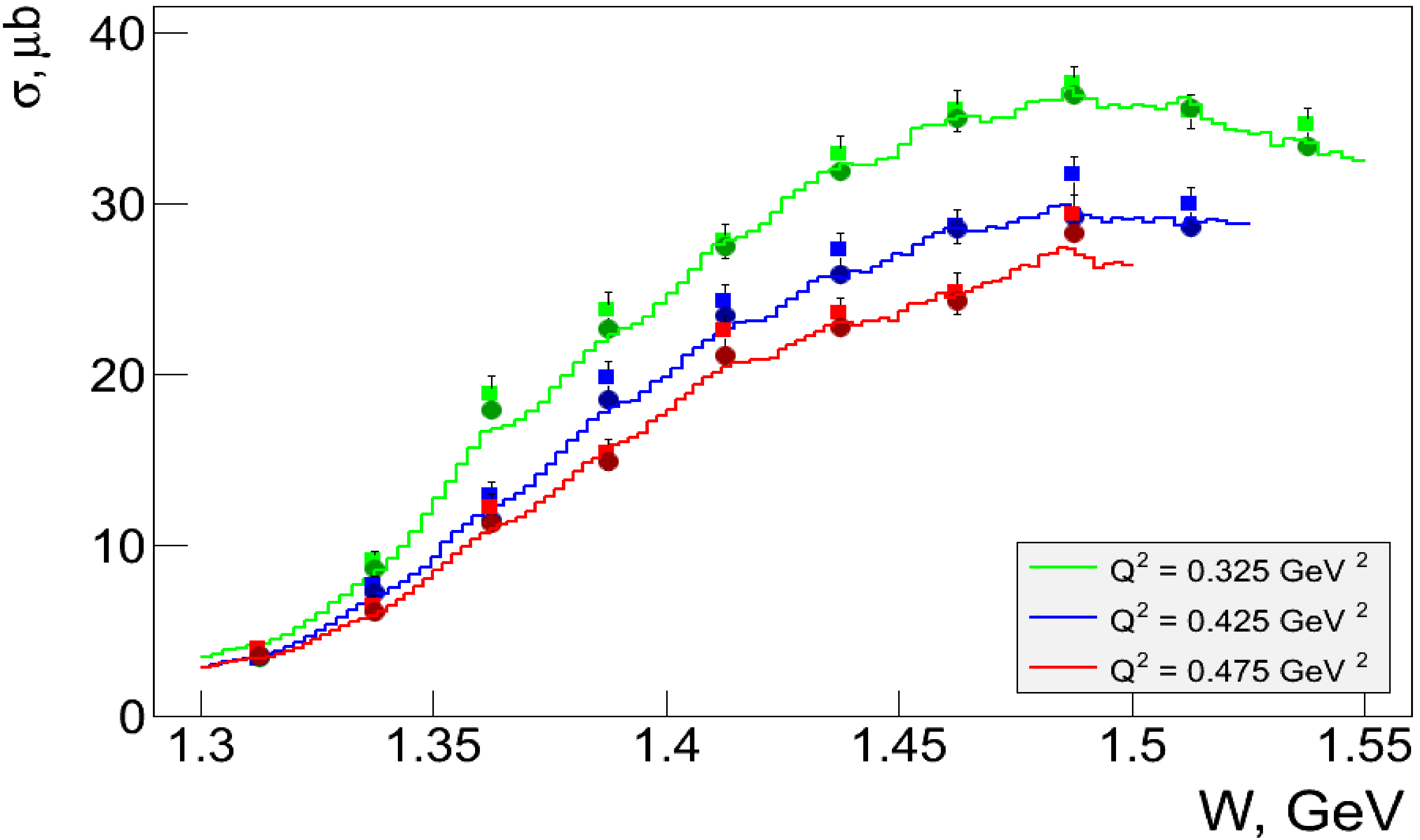
Data Included



W-Dependences of Integrated Cross Sections



Squares – exp. data, circles – JM model, curves – EG

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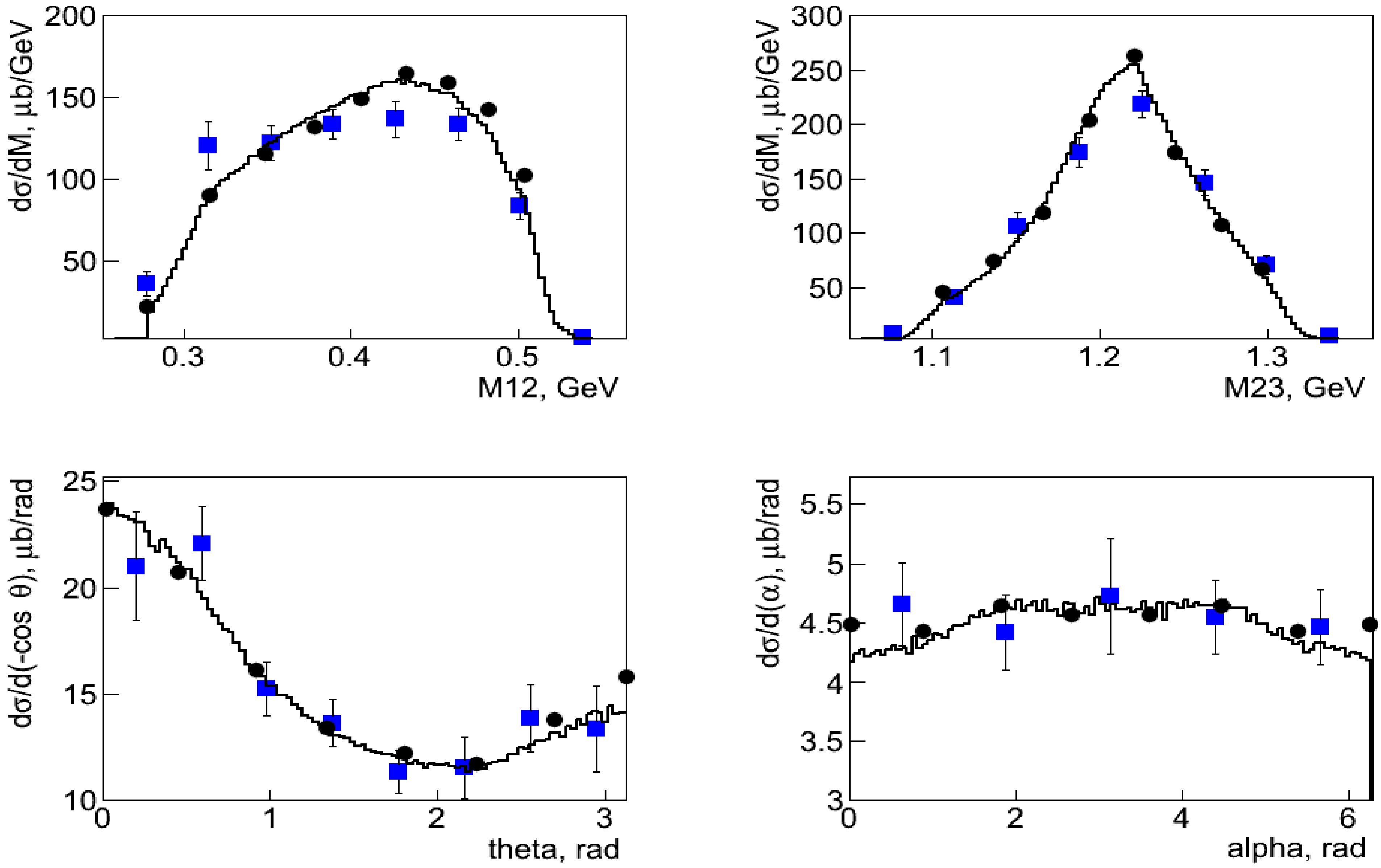
1-Fold Differential Cross Sections at W = 1.4625 GeV, Q^2 = 0.425 GeV^2



Squares – exp. data, circles – JM model, curves – EG

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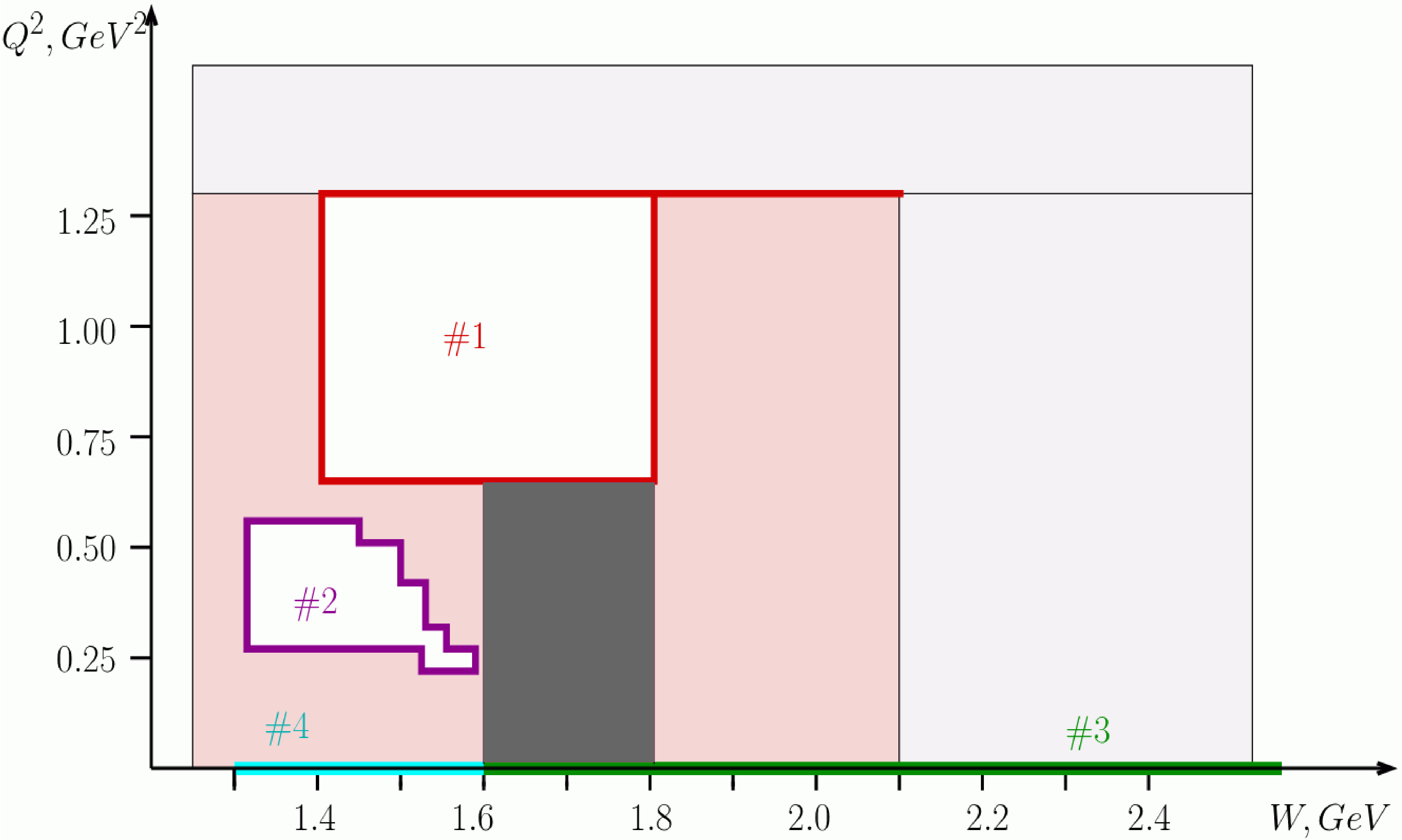
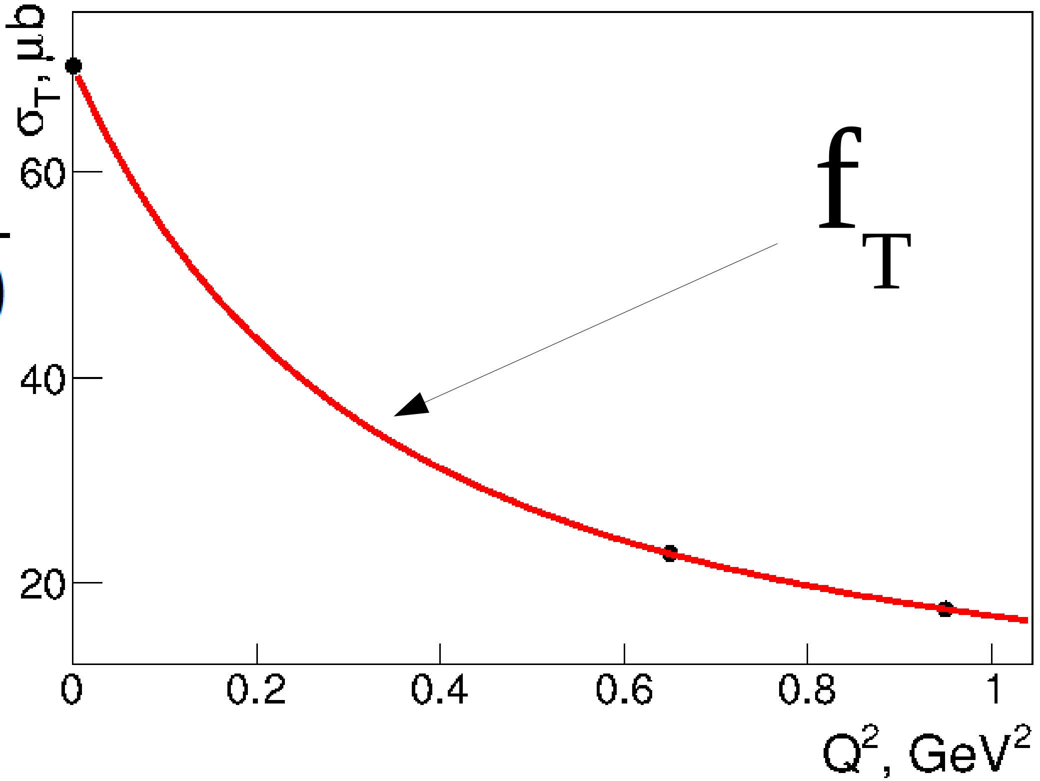
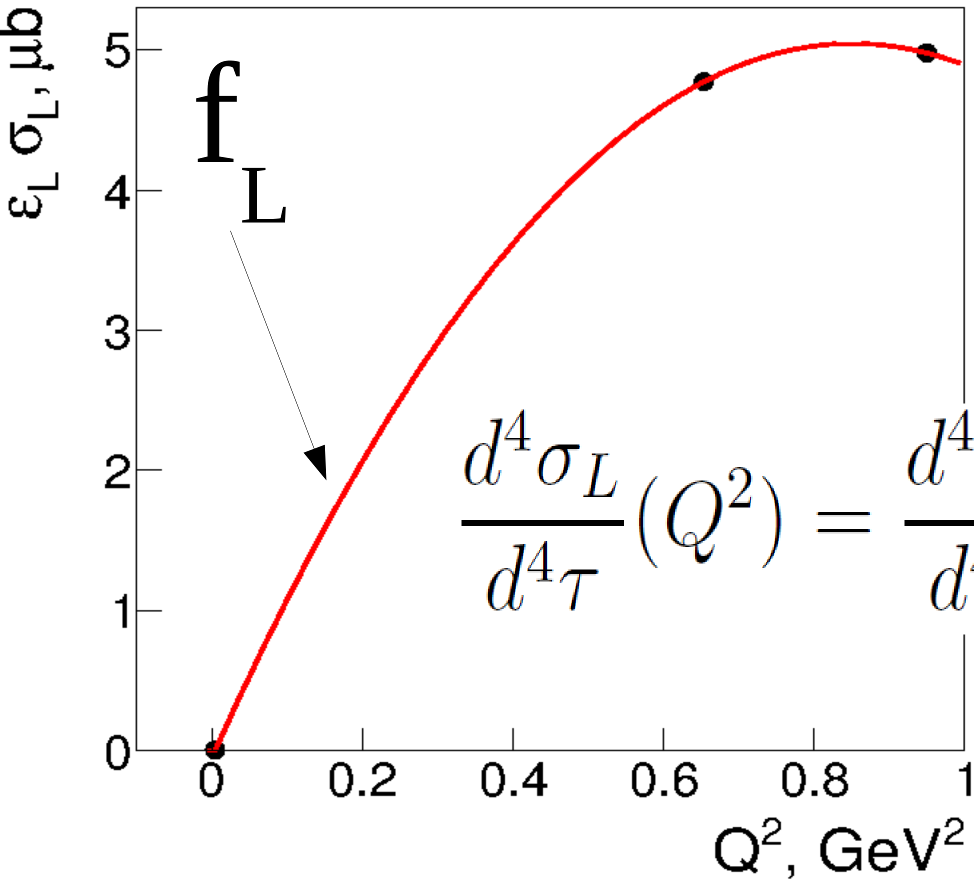
Data Included



σ_T and σ_L Fit , W = 1.7125 GeV

$$\frac{d^4\sigma_T}{d^4\tau}(Q^2) = \frac{d^4\sigma_T}{d^4\tau}(0.65)\frac{f_T(Q^2)}{f_T(0.65)}$$

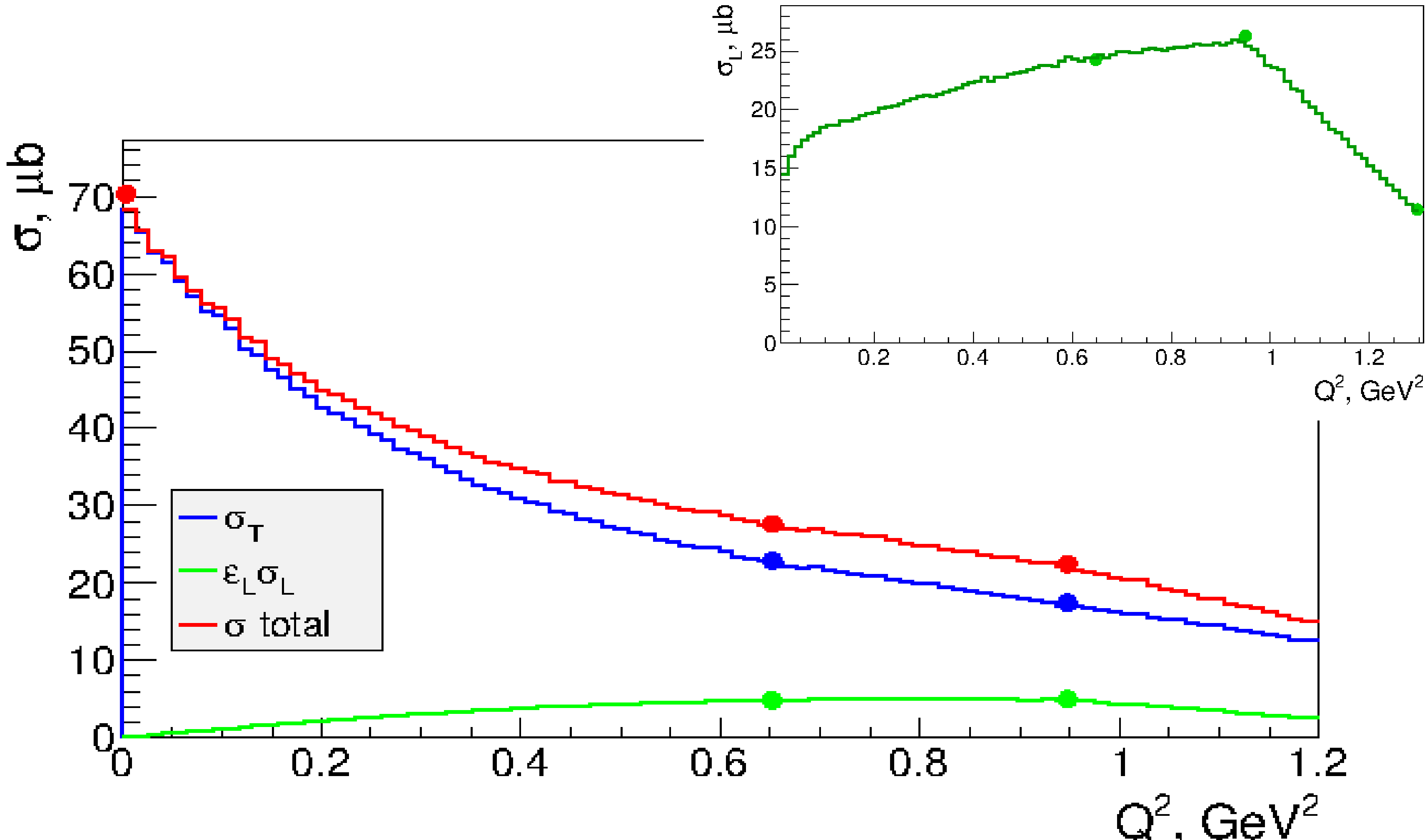




$$\frac{d^4\sigma_L}{d^4\tau}(Q^2) = \frac{d^4\sigma_L}{d^4\tau}(0.65)\frac{f_L(Q^2)}{f_L(0.65)}\frac{\varepsilon_L(2.445, 0.65)}{\varepsilon_L(2.445, Q^2)}$$

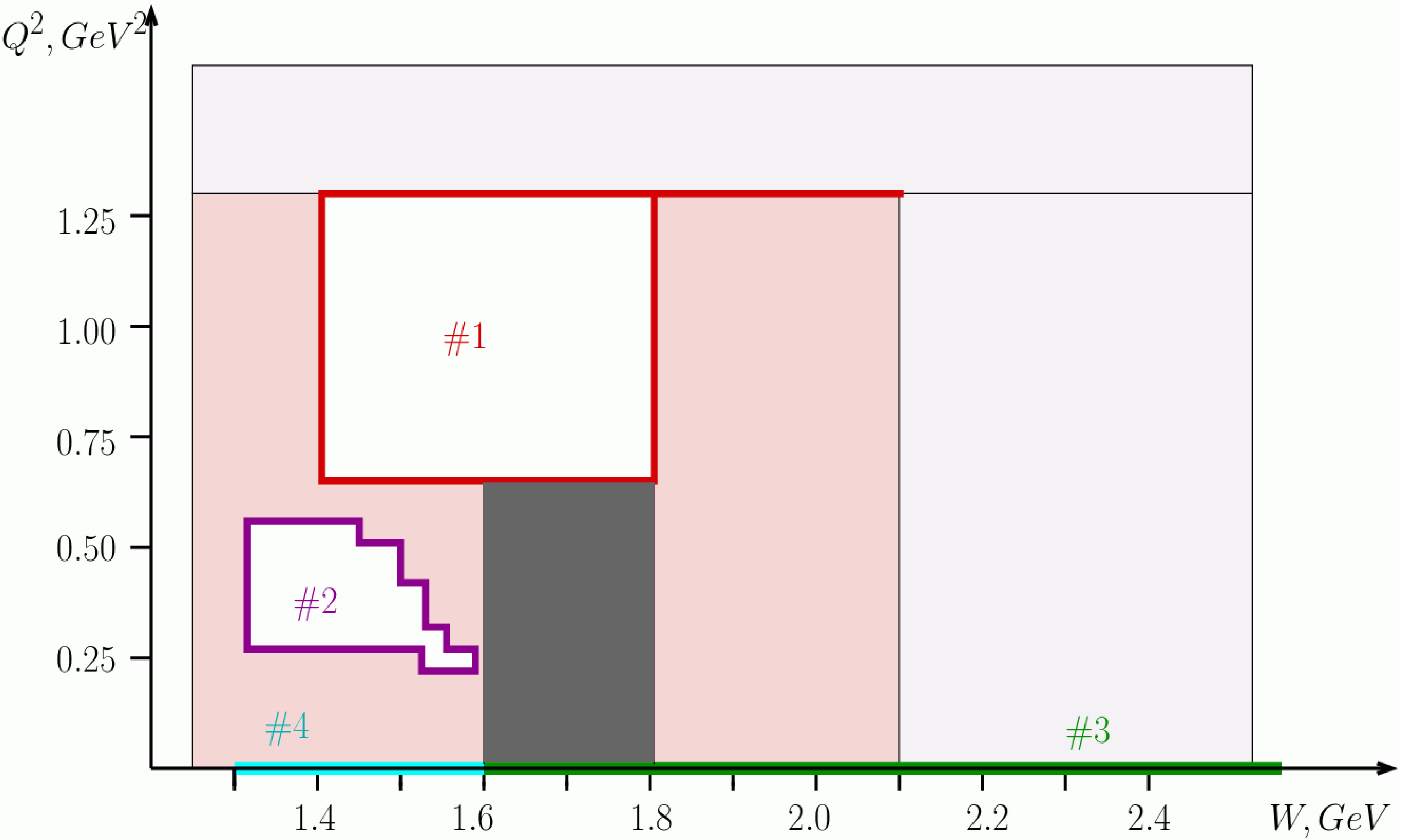
Points – integrated values from JM model, curves – the fit

W = 1.7125 GeV



Circles – JM model, curves – EG

Data Included



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Mixing Differential Cross Sections at W: 1.6 – 1.8 GeV and Q^2: 0 – 0.65 GeV^2

$$\frac{d^4\sigma_T}{d^4\tau}(Q^2) = \frac{Q^2}{0.65} \times \frac{d^4\sigma_T}{d^4\tau}(0.65) \times \frac{f_T(Q^2)}{f_T(0.65)} +$$

$$+ \frac{0.65 - Q^2}{0.65} \times \frac{d^4\sigma_T}{d^4\tau}(0) \times \frac{f_T(Q^2)}{f_T(0)}$$

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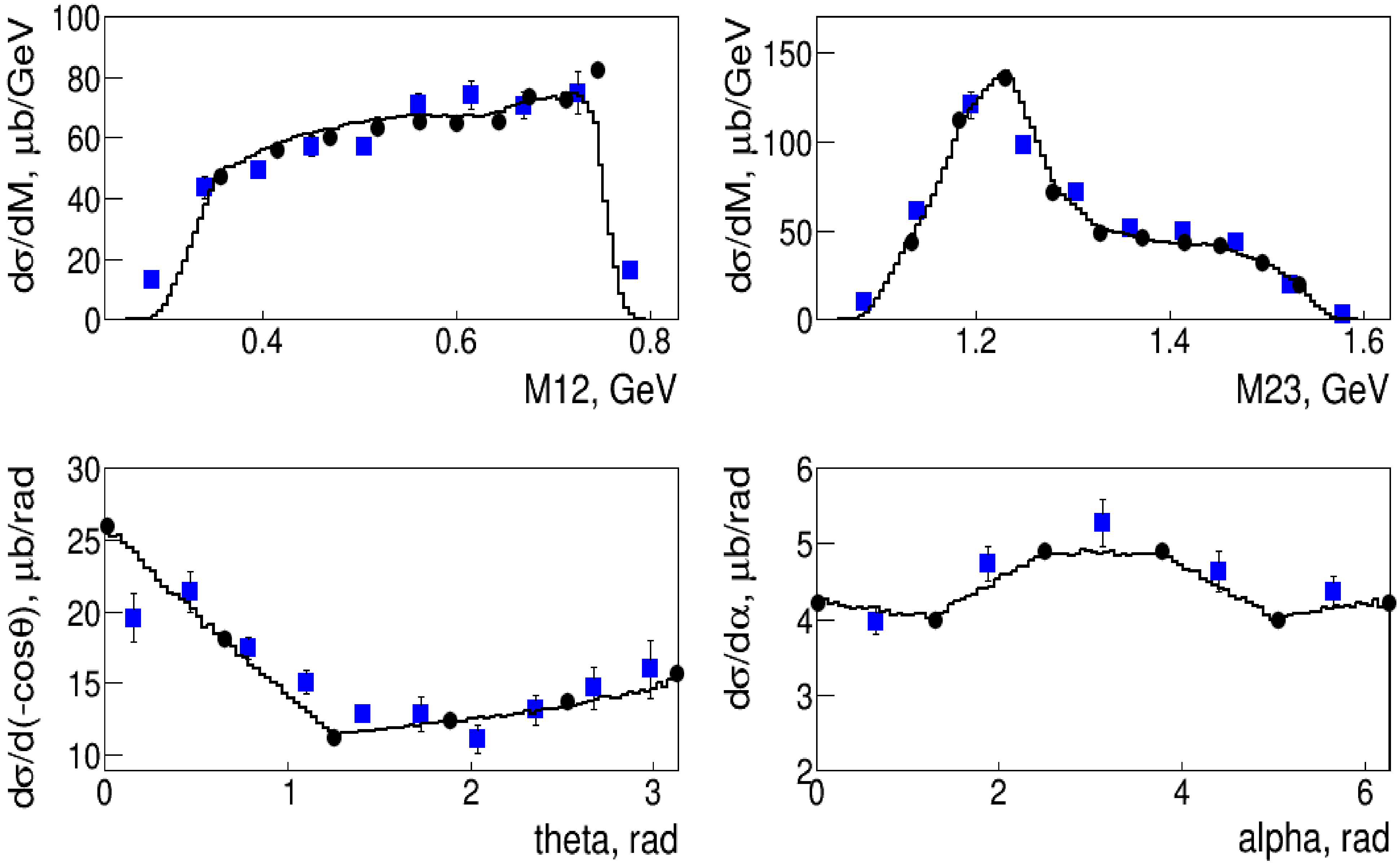
1-Fold Differential Cross Sections at W = 1.7125 GeV, Q^2 = 0.65 GeV^2



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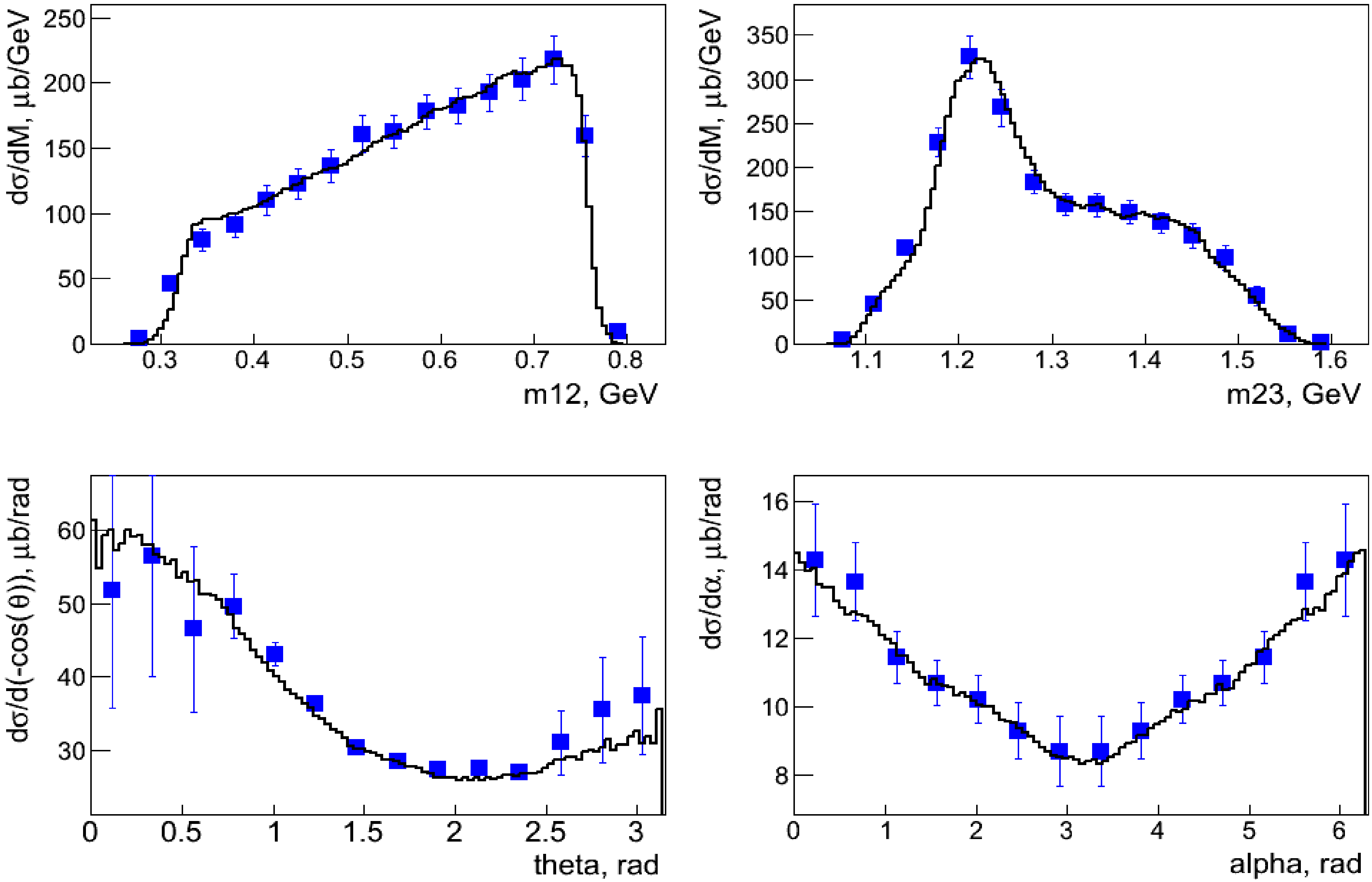
Squares – exp. data, circles – JM model, curves – EG

1-Fold Differential Cross Sections at W = 1.7125 GeV, $Q^2 = 0.0003$ GeV^2



Squares – exp. data, curves – EG

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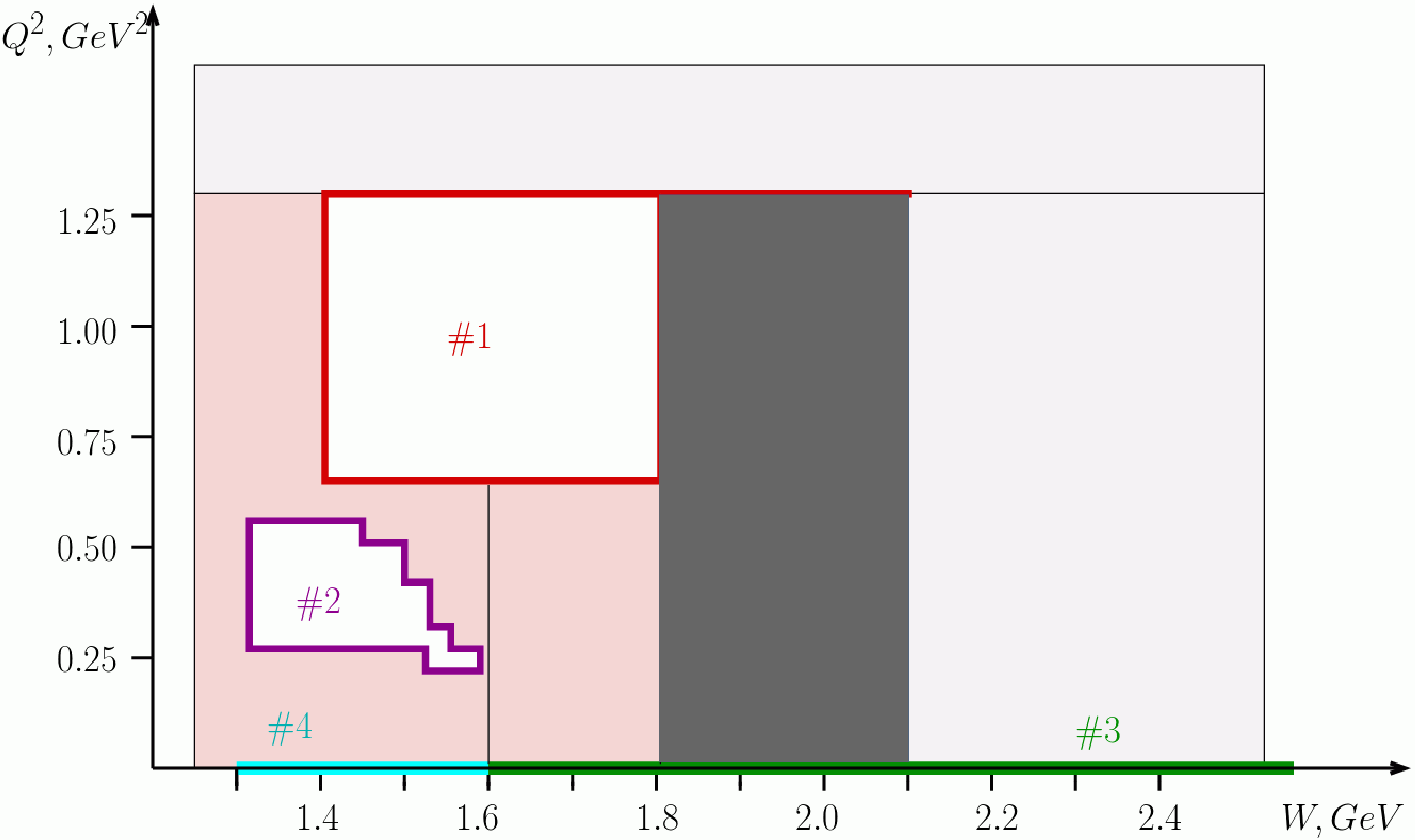
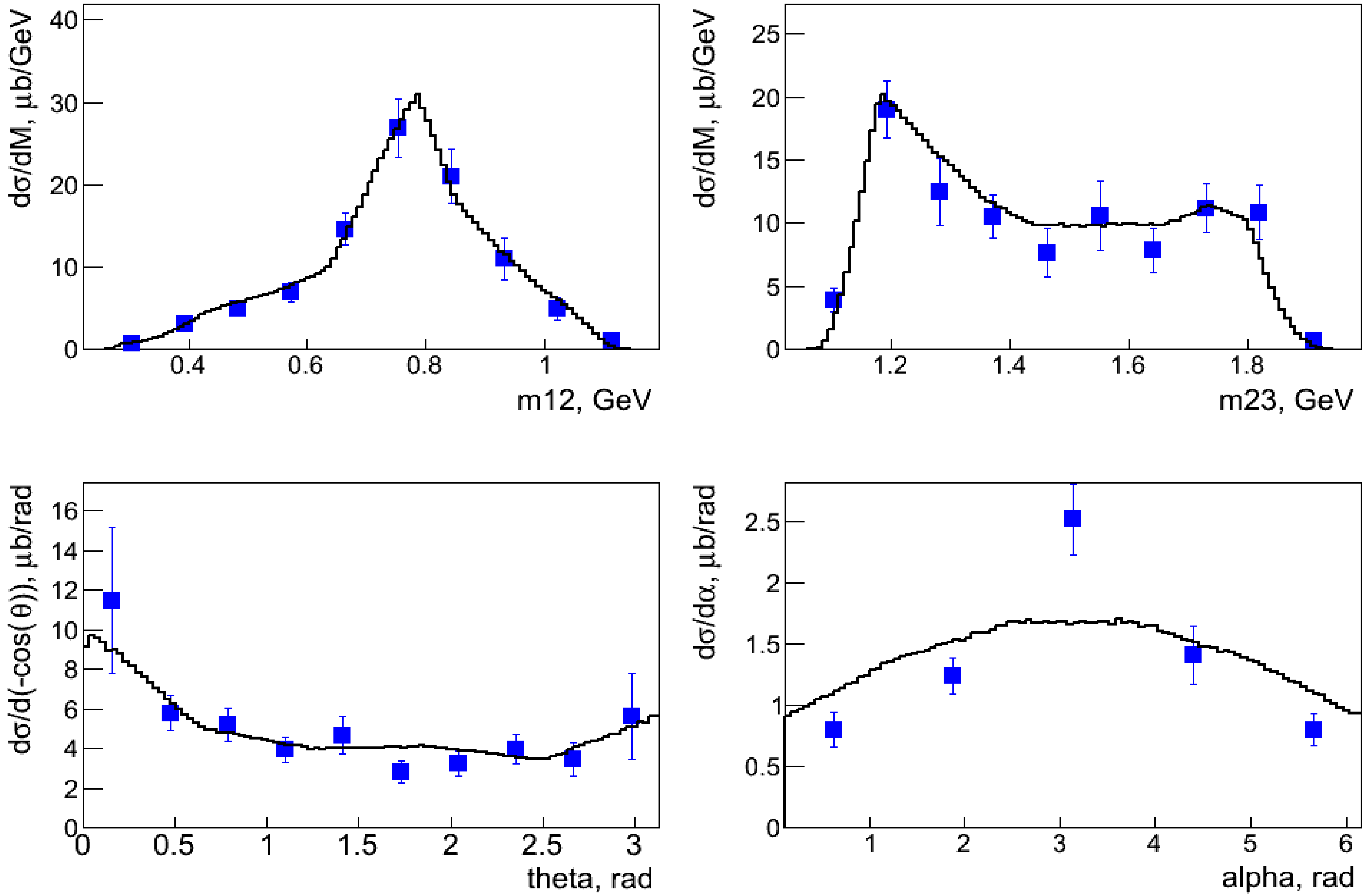
Data Included

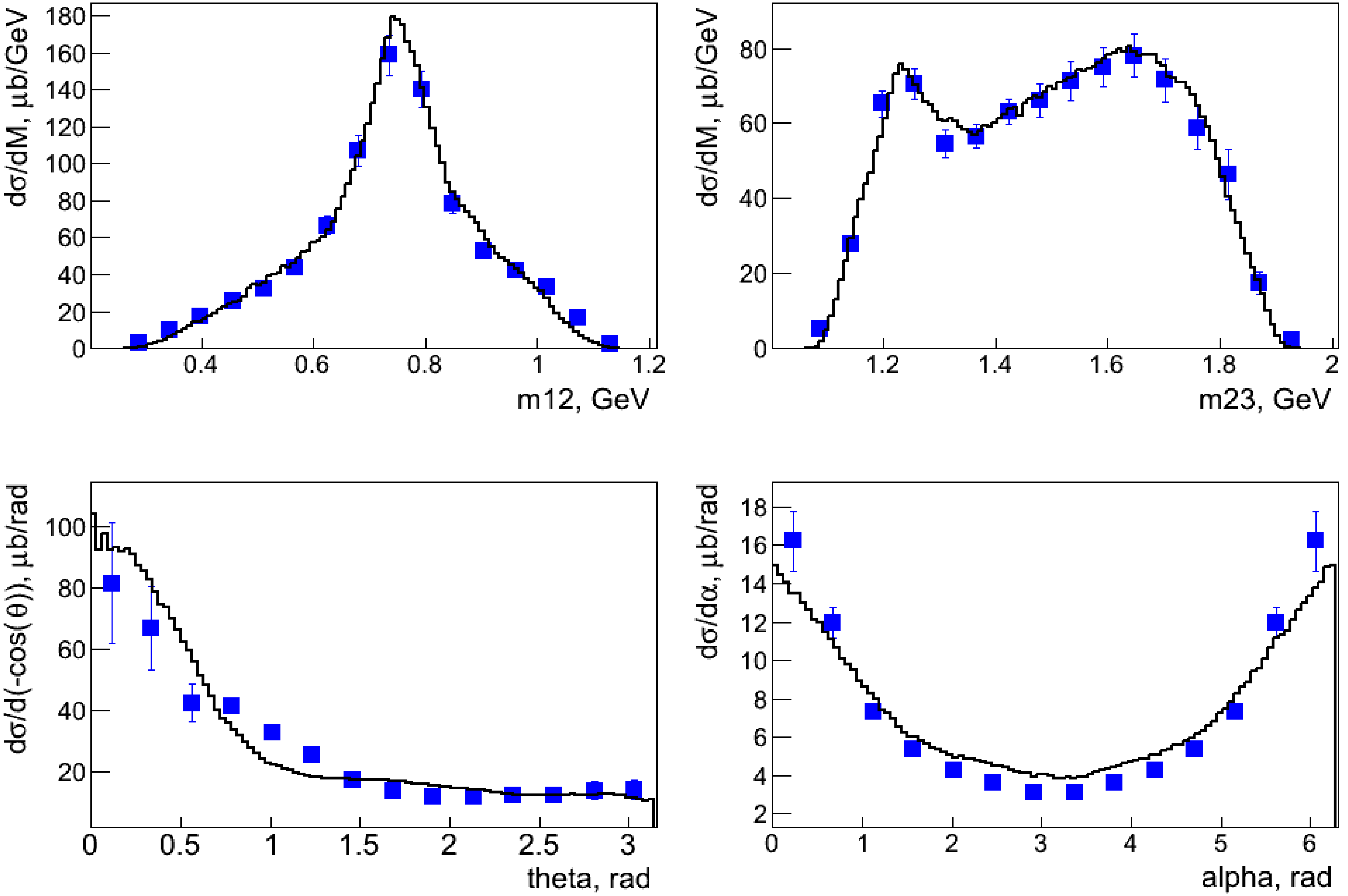


1-Fold Differential Cross Sections at $W = 2.0625$ GeV, $Q^2 = 1.3$ GeV^2



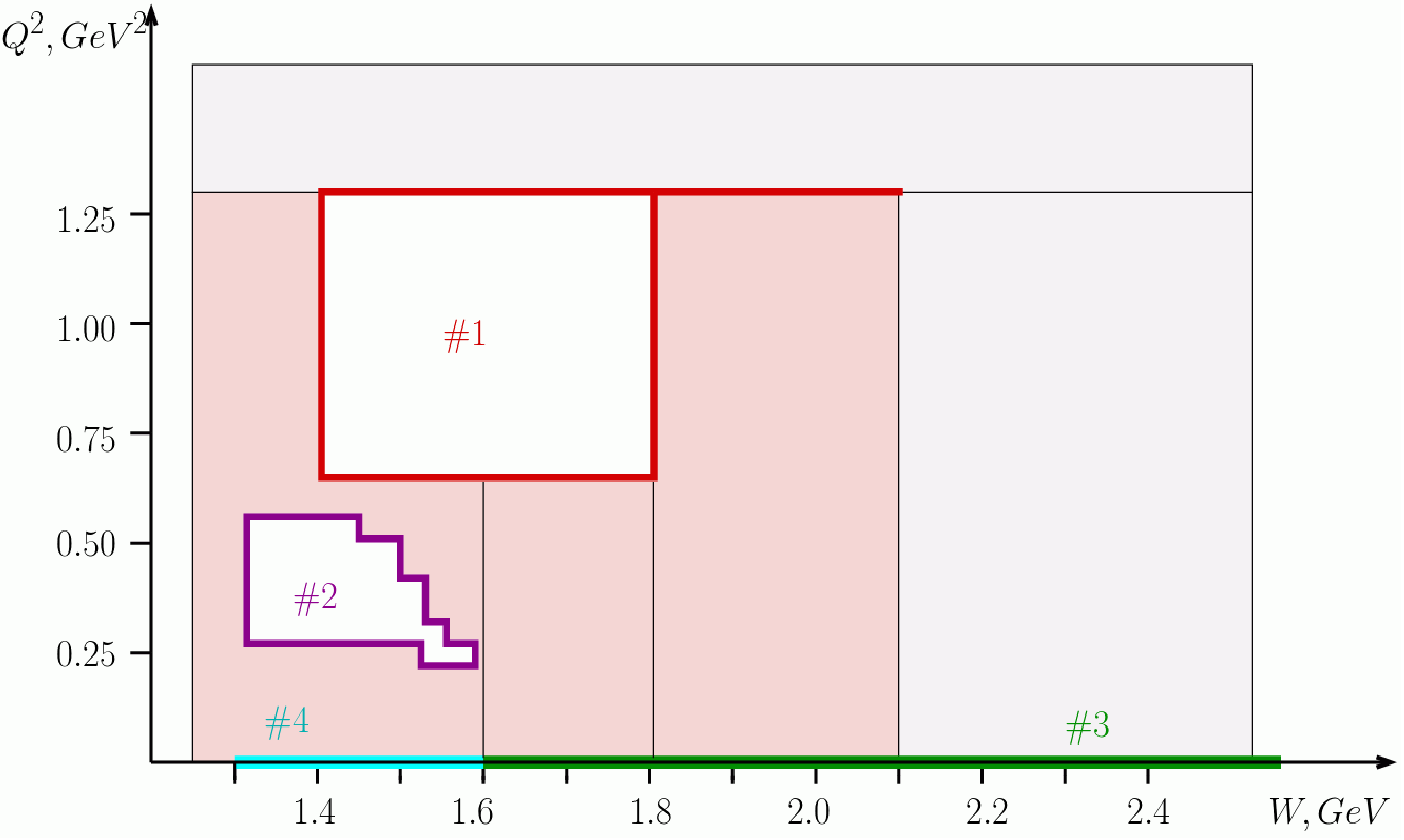
Squares – exp. data, curves – EG

1-Fold Differential Cross Sections at W = 2.0625 GeV, $Q^2 = 0.0003$ GeV^2

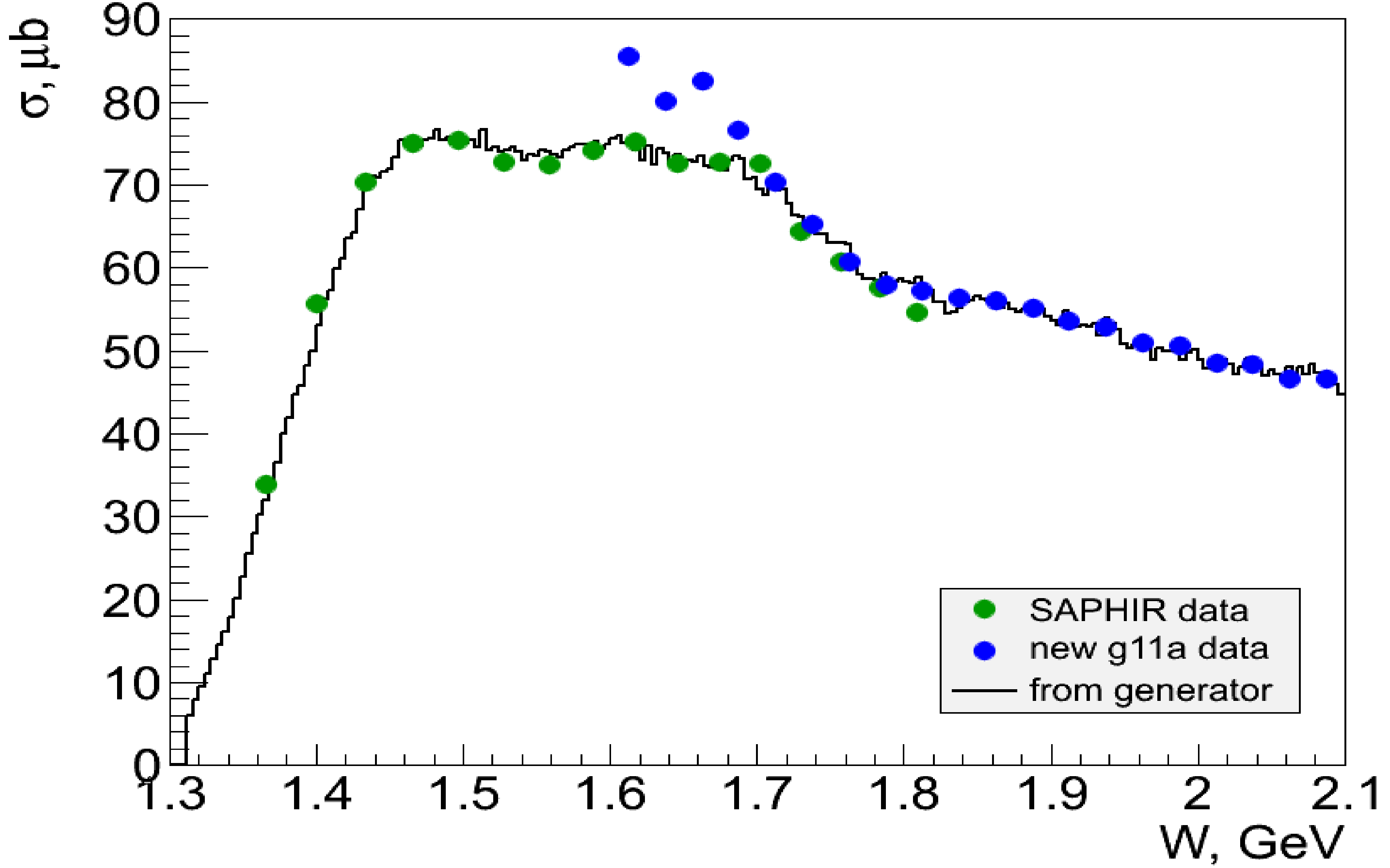


Squares – exp. data, curves – EG

Data Included



W-Dependence of Integrated Cross Section at $Q^2 = 0.0003\ GeV^2$



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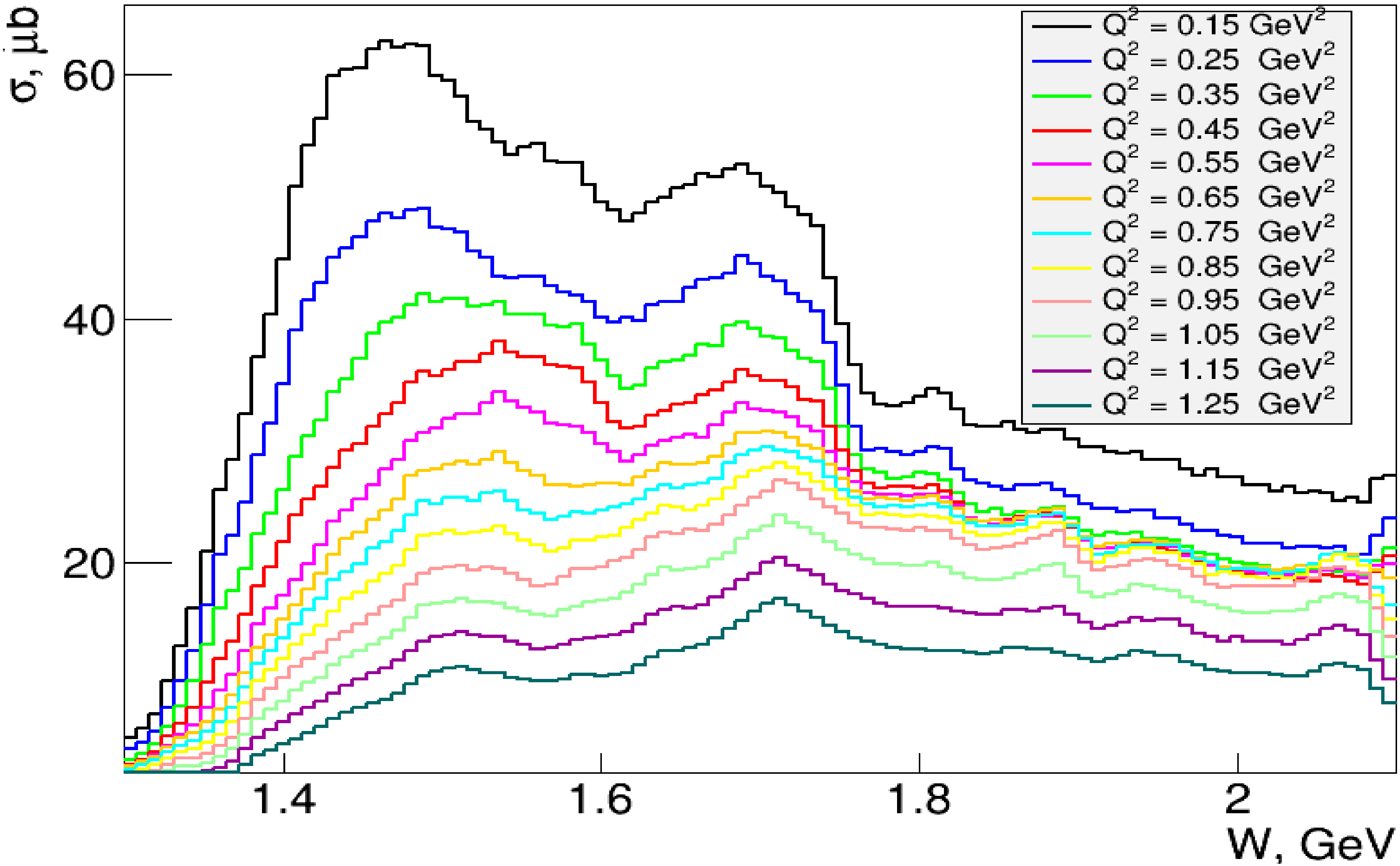
W-Dependences of Integrated Cross Sections at Different Q^2-Bins for E_{beam} = 11 GeV



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Conclusion & Outlooks

- EG works well in the region W: 1.2375 – 2.0875 GeV and Q^2: 0.0003 – 1.3 GeV^2 and is able to reproduce the shape change of differential cross sections.

- Extension toward W > 2.0875 GeV
- Extrapolation to the $Q^2 > 1.3$ GeV^2
- Add radiative effects
- Pass through the reconstruction procedure

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