

FSR corrections to the process $e^+e^- \rightarrow \bar{p}p\gamma$

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in collaboration with

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1 Form Factors

2 Fits

3 FSR radiative corrections

4 Conclusions

$$F_\mu = -ie\bar{v}(p_2)(F_1^N(Q^2)\gamma_\mu - \frac{F_2^N(Q^2)}{4m_N}[\gamma_\mu, \not{Q}])u(p_1), \quad (1)$$

$$G_M^N = F_1^N + F_2^N, \quad G_E^N = F_1^N + \tau F_2^N, \quad (2)$$

where $\tau = Q^2/4m_N^2$.

$$F_{1,2}^P = F_{1,2}^S + F_{1,2}^V, \quad F_{1,2}^n = F_{1,2}^S - F_{1,2}^V. \quad (3)$$

$$F_1^s = \frac{1}{2} \frac{\sum_{n=0}^3 c_n^1 BW_{\omega_n}(s)}{\sum_{n=0}^3 c_n^1}, \quad (4)$$

$$F_1^v = \frac{1}{2} \frac{\sum_{n=0}^3 c_n^2 BW_{\rho_n}(s)}{\sum_{n=0}^3 c_n^2}, \quad (5)$$

$$F_2^s = -\frac{1}{2} b \frac{\sum_{n=0}^3 c_n^3 BW_{\omega_n}(s)}{\sum_{n=0}^3 c_n^3}, \quad (6)$$

$$F_2^v = \frac{1}{2} a \frac{\sum_{n=0}^3 c_n^4 BW_{\rho_n}(s)}{\sum_{n=0}^3 c_n^4}, \quad (7)$$

$$BW_i = \frac{m_i^2}{m_i^2 - s - im_i\Gamma_i}, \quad (8)$$

$$a = \mu_p - \mu_n - 1 \quad (9)$$

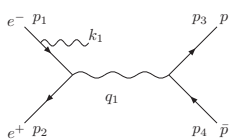
$$b = -\mu_p - \mu_n + 1 \quad (10)$$

$$F_1 \sim \frac{1}{(s)^2}, \quad F_2 \sim \frac{1}{(s)^3}. \quad (11)$$

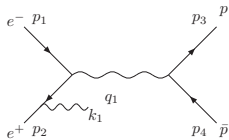
G.P.Lepage, S.J. Brodsky, Phys. Rev. D 22, 2157 (1980)

Experiment	number of points	chi-squared value	Experiment	number of points	chi-squared value
BaBar cross section	38	39.69	JLab 2010 proton ratio	3	3.63
FENICE pp cross section	5	4.42	PS 170 ratio	5	5.98
DM2 cross section	7	24.52	BaBar ratio	6	22.27
DM1 cross section	4	1.23	PS170 cross section	8	8.07
Adone cross section	1	0.46	PS170 cross section	3	1.8
BES cross section	8	13.58	E760 cross section	3	1.05
CLEO cross section	1	0.127	E835 cross section	5	3.51
JLab 2005 proton ratio	10	18.47	E835 cross section	2	0.08
JLab 2002 proton ratio	4	5.32	JLab n ratio	3	3.64
JLab 2001 proton ratio	13	9.52	BLAST n ratio	4	6.07
MAMI proton ratio	3	2.08	FENICE n cross section	4	15.26

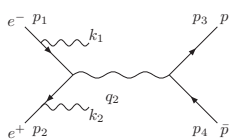
Tablica 1: Values of the chi-squared distribution for particular experiments, $\chi^2 = 191.6289$ for 140 points.



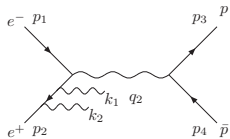
a)



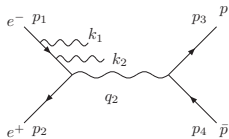
b)



c)



d)



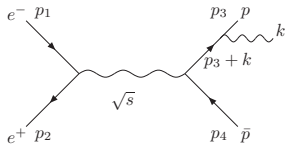
e)

$$\Delta_{final} \sim \log 2w. \quad (12)$$

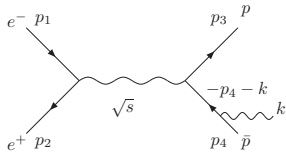
$$C_{Fc} = f(y) - f(\pi\alpha) + \frac{3\alpha}{4\pi} + 1, \quad (13)$$

where

$$f(y) = \frac{y}{1 - \exp(-x)}, y = \pi\alpha/\beta \quad (14)$$

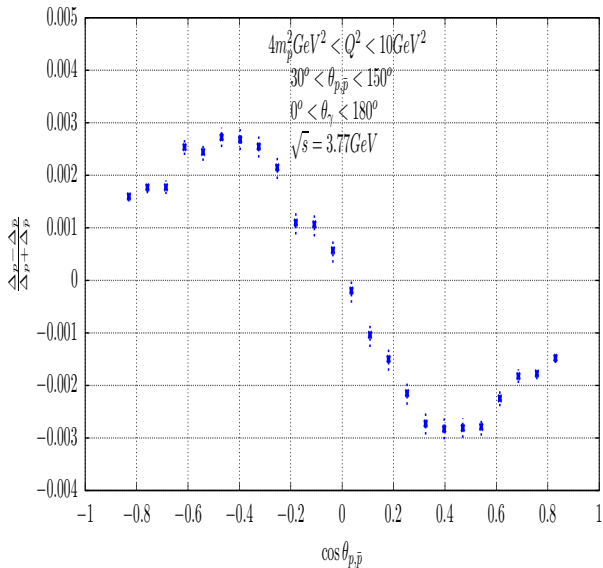


a)

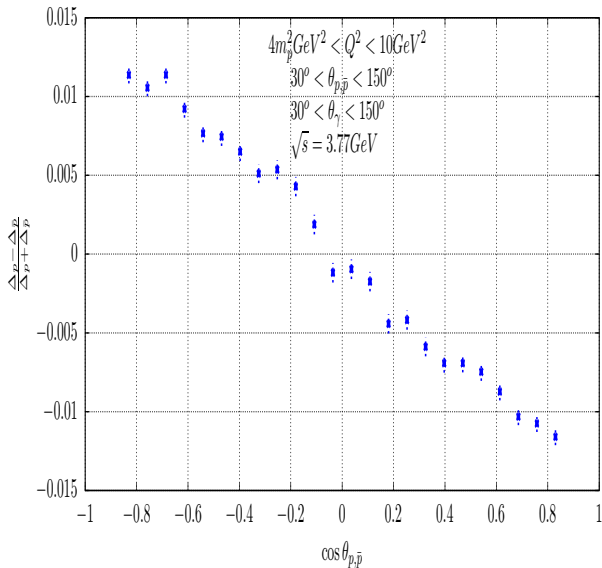


b)

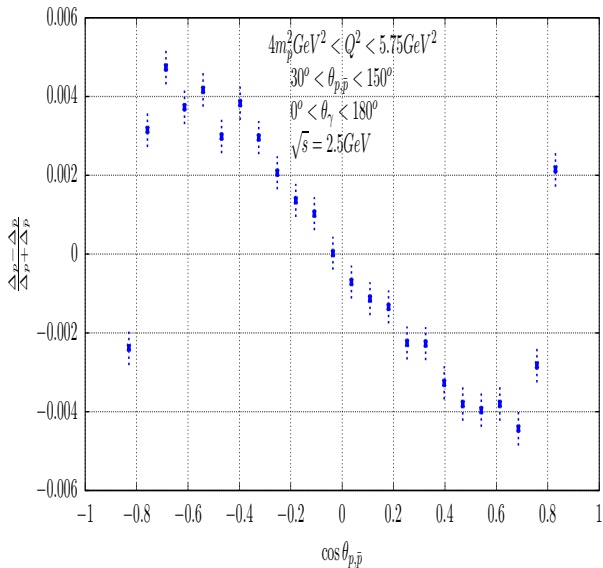
$e^+e^- \rightarrow p\bar{p}\gamma$ LO



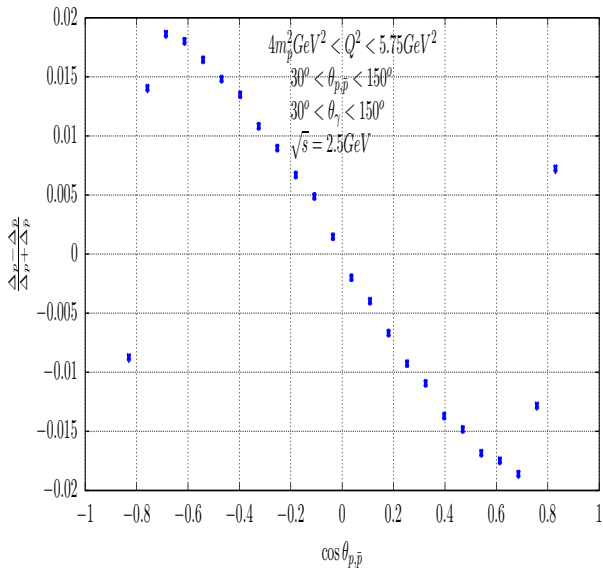
$e^+e^- \rightarrow p\bar{p}\gamma$ LO

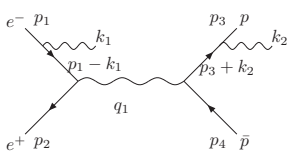


$e^+e^- \rightarrow p\bar{p}\gamma$ LO

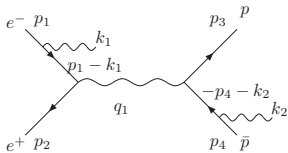


$e^+e^- \rightarrow p\bar{p}\gamma$ LO

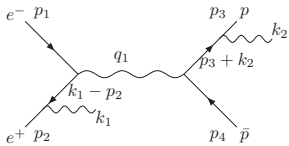




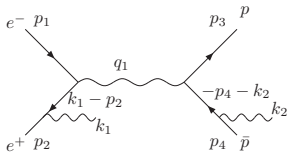
a)



b)

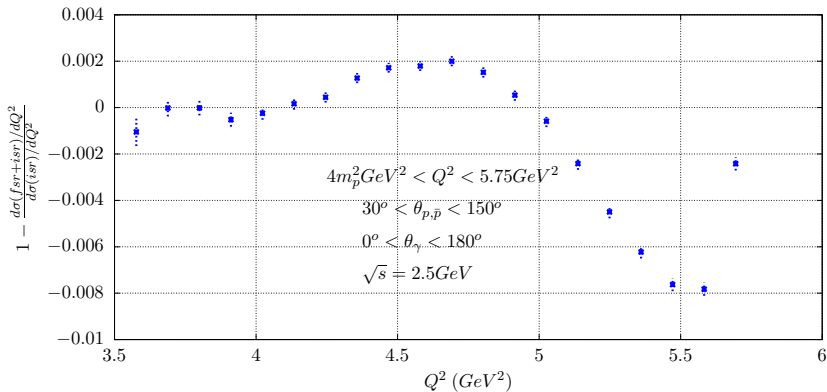


c)

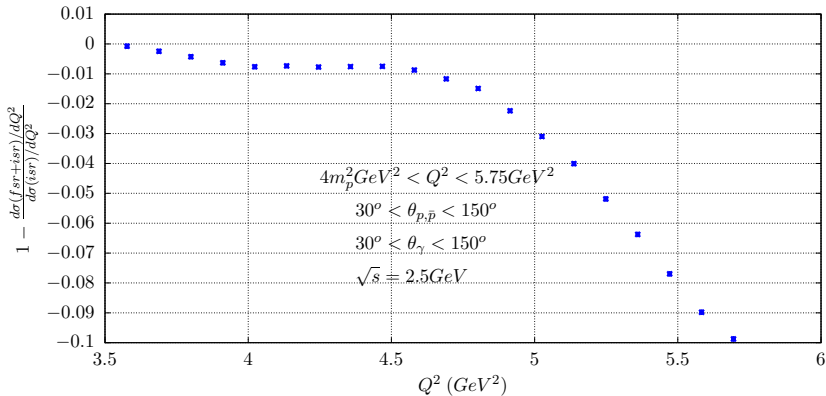


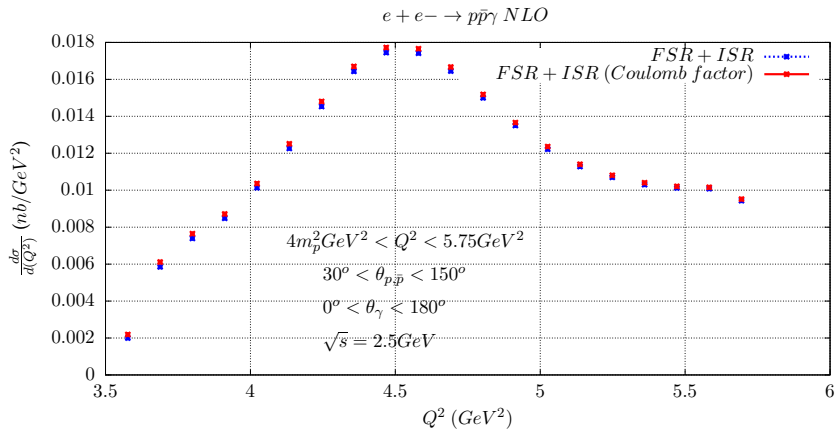
d)

$e + e^- \rightarrow p\bar{p}\gamma$ NLO

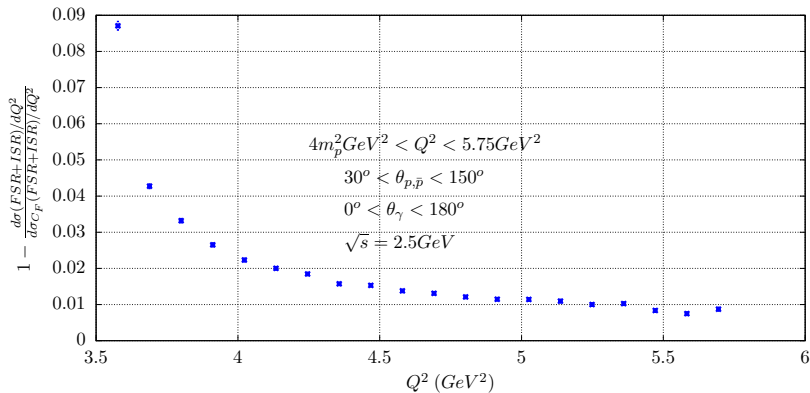


$e + e^- \rightarrow p\bar{p}\gamma$ NLO

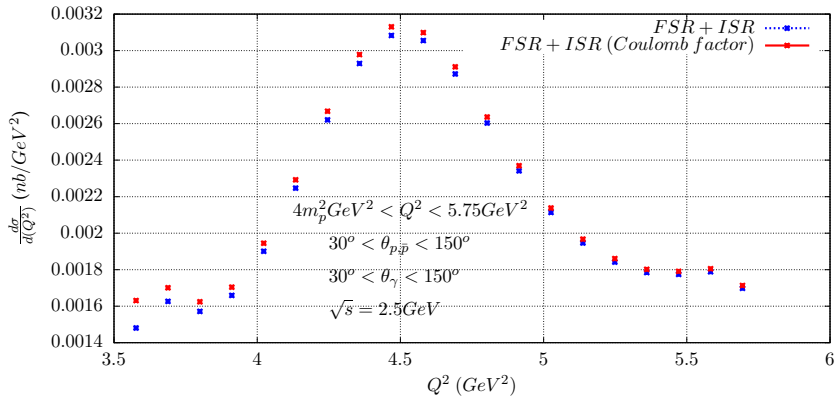




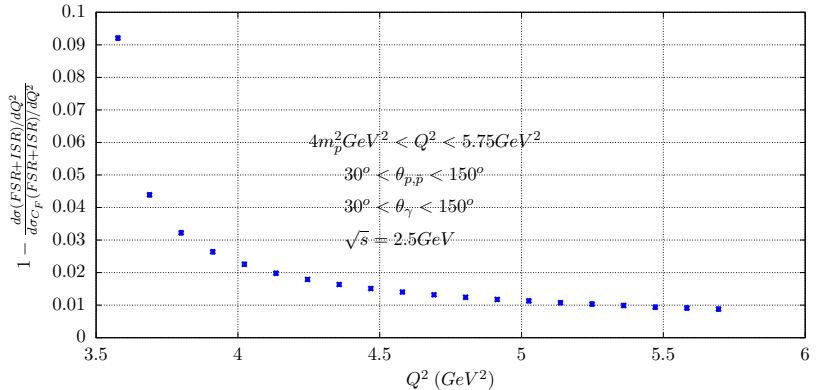
$e + e^- \rightarrow p\bar{p}\gamma$ NLO



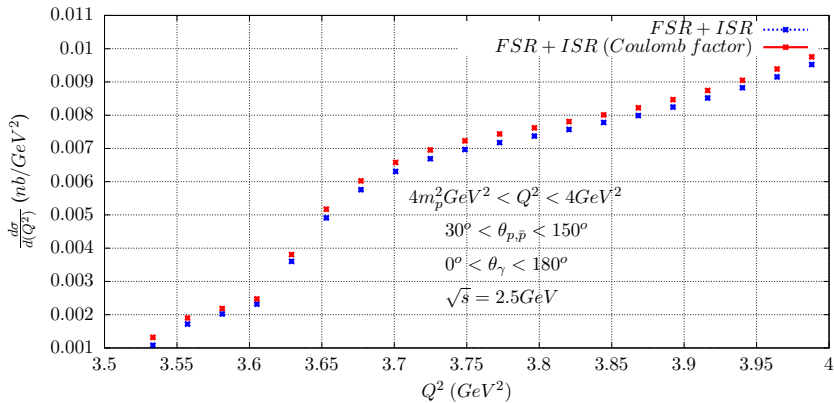
$e + e^- \rightarrow p\bar{p}\gamma$ NLO



$e + e^- \rightarrow p\bar{p}\gamma$ NLO



$e + e^- \rightarrow p\bar{p}\gamma$ NLO



1. New model of the nucleon Form Factors developed.
2. FSRNLO corrections implemented in Phokhara for $e^+e^- \rightarrow p\bar{p}\gamma$.
3. FSR radiative corrections important for precision measurements.