

# Two-Photon Exchange Effect Studied with Neural Networks Analytical Form of the Parametrizations

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The analytical form of the fits:

$$\frac{G_M(Q^2)}{\mu_p G_D(Q^2)} = \sum_{i=3}^7 w_{i,15} f_{act}(Q^2 w_{0,i} + w_{2,i}) + w_{14,15} \quad (1)$$

$$\frac{G_E(Q^2)}{G_D(Q^2)} = \sum_{i=3}^7 w_{i,16} f_{act}(Q^2 w_{0,i} + w_{2,i}) + w_{14,16}$$

$$\frac{\Delta C_{2\gamma}(Q^2, \epsilon)}{G_D^2(Q^2)} = \sum_{i=3}^{13} w_{i,17} f_{act}(Q^2 w_{0,i} + \epsilon w_{1,i} + w_{2,i}) + w_{14,17} \quad (2)$$

$$G_D(Q^2) = \frac{1}{(1 + Q^2/0.71)^2} \quad (3)$$

$$f_{act}(x) = \frac{1}{1 + \exp(-x)} \quad (4)$$

$$w_{3,17} = -0.7994$$

$$w_{4,17} = 0.9775$$

$$w_{5,17} = 4.70641$$

$$w_{6,17} = -0.5378$$

$$w_{7,17} = 0.20026$$

$$w_{8,17} = 0.08842$$

$$w_{9,17} = -5.25238$$

$$w_{10,17} = 6.91219$$

$$w_{11,17} = -4.09499$$

$$w_{12,17} = 1.53302$$

$$w_{13,17} = -1.29911$$

$$w_{14,17} = -2.32656$$

$$w_{3,16} = 0.87769$$

$$w_{4,16} = -1.42417$$

$$w_{5,16} = 5.31229$$

$$w_{6,16} = -7.03220$$

$$w_{7,16} = 1.16534$$

$$w_{14,16} = 1.64949$$

$$w_{3,15} = 0.06206$$

$$\begin{aligned}w_{4,15} &= -0.16708 \\w_{5,15} &= -2.05062 \\w_{6,15} &= -3.18562 \\w_{7,15} &= 1.43697 \\w_{14,15} &= 4.91944\end{aligned}$$

$$\begin{aligned}w_{0,13} &= 0.01442 \\w_{1,13} &= 0.15599 \\w_{2,13} &= 0.34353\end{aligned}$$

$$\begin{aligned}w_{0,12} &= 0.14829 \\w_{1,12} &= 0.50796 \\w_{2,12} &= -0.91625\end{aligned}$$

$$\begin{aligned}w_{0,11} &= 0.41505 \\w_{1,11} &= -0.13263 \\w_{2,11} &= 1.80434\end{aligned}$$

$$\begin{aligned}w_{0,10} &= -0.44004 \\w_{1,10} &= 0.65672 \\w_{2,10} &= 3.66358\end{aligned}$$

$$\begin{aligned}w_{0,9} &= 0.37908 \\w_{1,9} &= 0.33989 \\w_{2,9} &= 1.25938\end{aligned}$$

$$\begin{aligned}w_{0,8} &= 0.01100 \\w_{1,8} &= 0.05041 \\w_{2,8} &= 0.68383\end{aligned}$$

$$\begin{aligned}w_{0,7} &= 1.02290 \\w_{2,7} &= 0.97734\end{aligned}$$

$$\begin{aligned}w_{0,6} &= 3.26523 \\w_{2,6} &= 3.63669\end{aligned}$$

$$\begin{aligned}w_{0,5} &= 0.71814 \\w_{2,5} &= 2.42620\end{aligned}$$

$$\begin{aligned}w_{0,4} &= 0.25270 \\w_{2,4} &= -1.60333\end{aligned}$$

$$\begin{aligned}w_{0,3} &= -1.22837 \\w_{2,3} &= 1.44729 \\w_{1,3} &= 0,\end{aligned}$$

$$w_{1,4} = 0,$$

$$w_{1,5} = 0$$

$$w_{1,6} = 0$$

$$w_{1,7} = 0.$$

Notice that the  $Q^2$  in above formulae is meant to be in units of  $\text{GeV}^2$ .

The form-factor and TPE parametrizations are obtained for  $Q^2 \in (0, 10 \text{ GeV}^2)$  and  $\epsilon \in (0, 1)$ .