

Compton scattering CERN data

See “Compton Scattering of Quasi-Real Virtual Photons at LEP,” arxiv.org/abs/hep-ex/0504012.

x	y
−0.74	13380
−0.60	7720
−0.47	6360
−0.34	4600
−0.20	4310
−0.07	3700
0.06	3640
0.20	3340
0.33	3500
0.46	3010
0.60	3310
0.73	3330

For columns x and y we have

$$x = \cos \theta, \quad y = \frac{d\sigma}{d \cos \theta}$$

This is the differential cross section in the center of mass frame.

$$\frac{d\sigma}{d \cos \theta} = 2\pi \frac{d\sigma}{d\Omega} = \frac{\pi\alpha^2}{s} \left(\frac{\cos \theta + 1}{2} + \frac{2}{\cos \theta + 1} \right) \times (\hbar c)^2$$

Let \hat{y}_i be predicted values. The factor 10^{40} converts square meters to picobarns.

$$\hat{y}_i = \left. \frac{d\sigma}{d \cos \theta} \right|_{\cos \theta = x_i} = \frac{\pi\alpha^2}{s} \left(\frac{x_i + 1}{2} + \frac{2}{x_i + 1} \right) \times (\hbar c)^2 \times 10^{40}$$

The following table shows predicted values for $s = (40 \text{ GeV})^2$.

x	y	\hat{y}
−0.74	13380	12573
−0.60	7720	8358
−0.47	6360	6491
−0.34	4600	5401
−0.20	4310	4661
−0.07	3700	4204
0.06	3640	3884
0.20	3340	3643
0.33	3500	3486
0.46	3010	3375
0.60	3310	3295
0.73	3330	3248

The coefficient of determination R^2 measures how well predicted values fit the data.

$$R^2 = 1 - \frac{\sum (y - \hat{y})^2}{\sum (y - \bar{y})^2} = 0.97$$

The result indicates that $d\sigma$ explains 97% of the variance in the data.