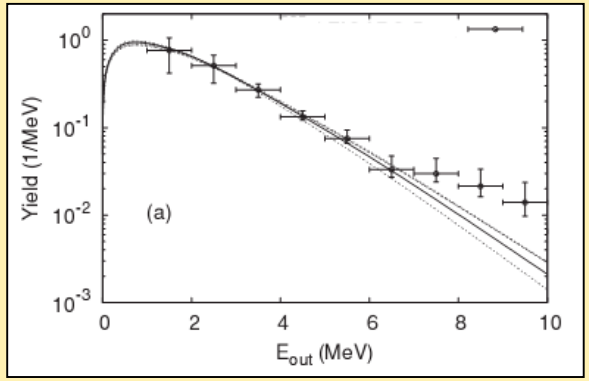
Center of Nuclear Physics Data

Memo CP- F/010

Estimation of digitizing error in program InpGraph

S.Taova, G.Pikulina, S.Dunaeva, S.Abramovich

Russian Federal Nuclear Center-VNIIEF



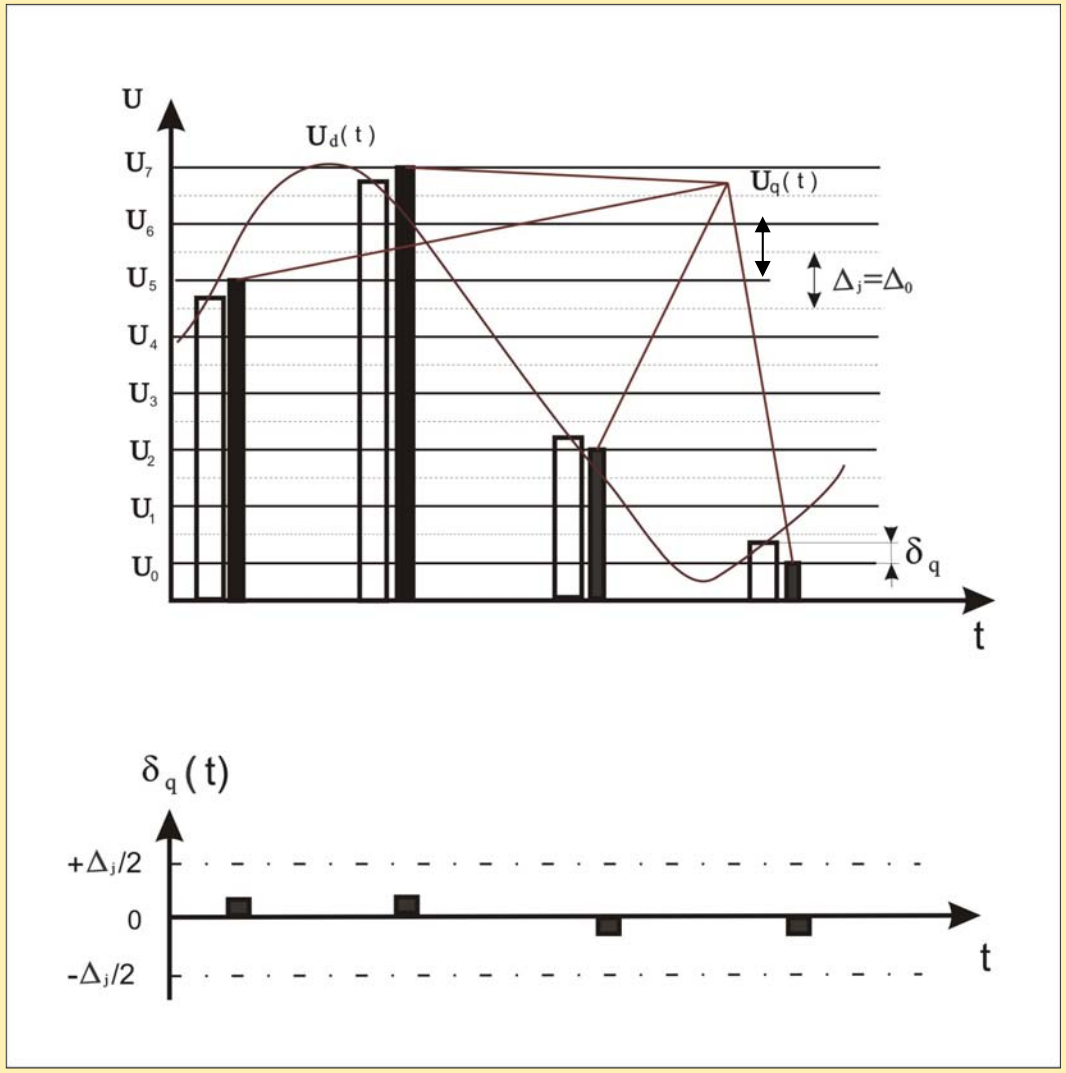
Digitizing accuracy in old version of InpGraph

$$\delta_x = \sqrt{\frac{\sum_{i=1}^{nx}(\bar{x}_i - x_i)^2}{n-1}}; \quad \delta_y = \sqrt{\frac{\sum_{i=1}^{ny}(\bar{y}_i - y_i)^2}{n-1}}$$

x_i – value for the i-th tics of x axis (1<=i<=nx) received from the digitization tool;
$\bar{x}_i$ - corresponding true value printed on the tics of x axis;
δ_x– value of standard deviation on x axis;
$\bar{y}_i$ – value for the i-th tics of y axis (1<=i<=ny) received from the digitization tool;
y_i – corresponding true value printed on the tics of y axis;
δ_y – value of standard deviation on y axis;
n – number of tics on each axis.

Digitizing error (δ_{std}) was a value of standard deviation of the digitized value and true value on tics

Quantization means a replace of continuous set of values with a set of quantized values (continuous image is replaced with a set of discrete cells (pixels)).



$$U_j - \Delta_j/2 \le U_d \le U_j + \Delta_j/2$$

$$\delta_q(t) = U_q(t) - U_d(t)$$

$$-\Delta_j/2 \le \delta_q \le \Delta_j/2$$

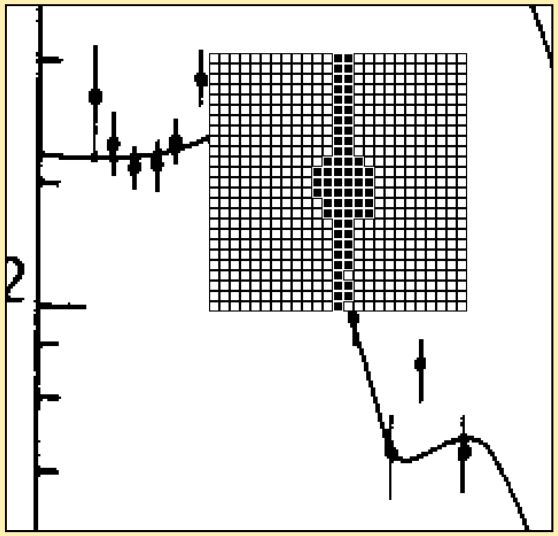
$$Max\ \delta_q = \Delta_j/2$$

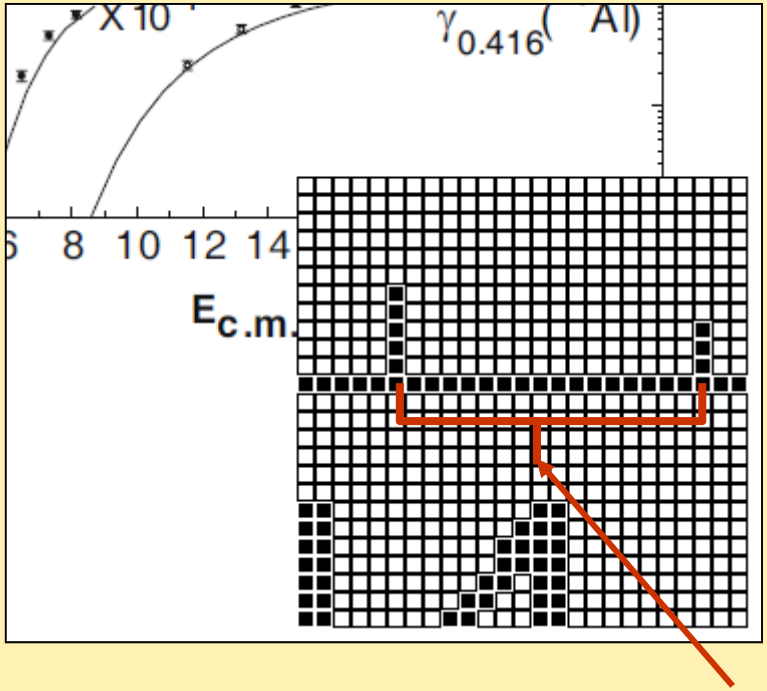
U_d – dynamic value

U_q – quantized value

δ_q – quantization error

Quantization of image_





N = 17

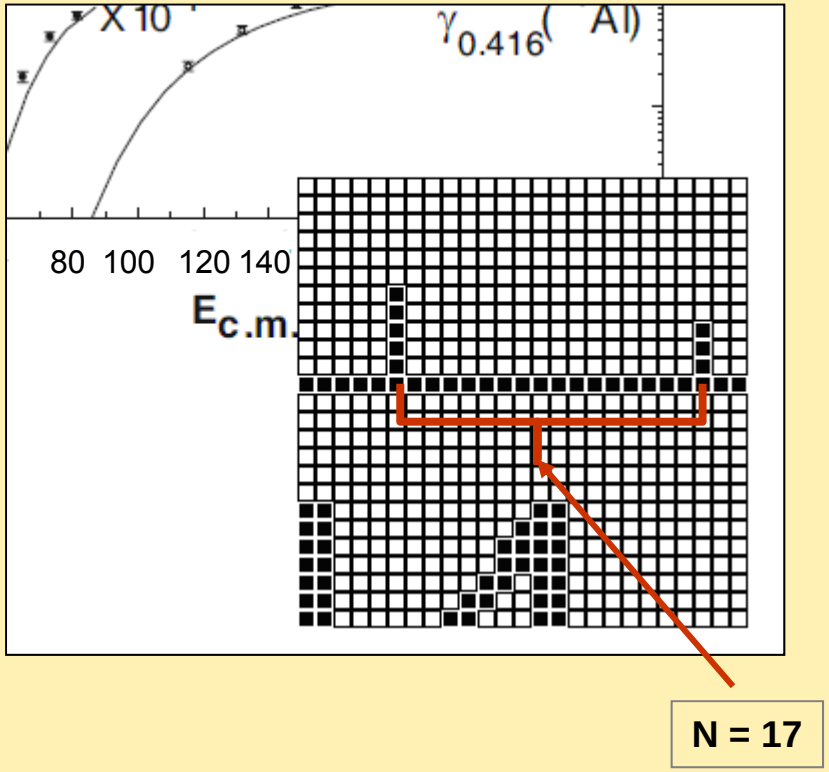
$$\Delta = \frac{E_2 - E_1}{N} = \frac{15-14}{17} = 0.0588 \ \ MeV,$$

$\delta_q = \Delta/2 = 0.0588/2 = 0.0294$ MeV

E1 and *E2* - true values of the neighboring tics

N - number of pixels between these tics_

Note: Quantization error depends on a scale_



$$\Delta = \frac{E_2 - E_1}{N} = \frac{150 - 140}{17} = 0.588 \ \ MeV,$$

$\delta_q = \Delta/2 = 0.588/2 = 0.294$ MeV

E1 and *E2* - true values of the neighboring tics

N - number of pixels between these tics_

InpGraph

X-axis digitizing error:

δ_{std} - 0.068 KEV;

δ_q - 0.14 KEV;

Y-axis digitizing error:

δ_{std} - 0.58 MB;

δ_q - 1.3 MB.

$$Digitizing\_error = \sqrt{\delta_{std}^{\ 2} + \delta_q^{\ 2}}$$

Digitizing error = Max (δ_{std}, δ_q)

Note

Quantization error depends on a scale

Digitizing error = Max (δ_{std}, δ_q)