Gaussian Fit Algorithm

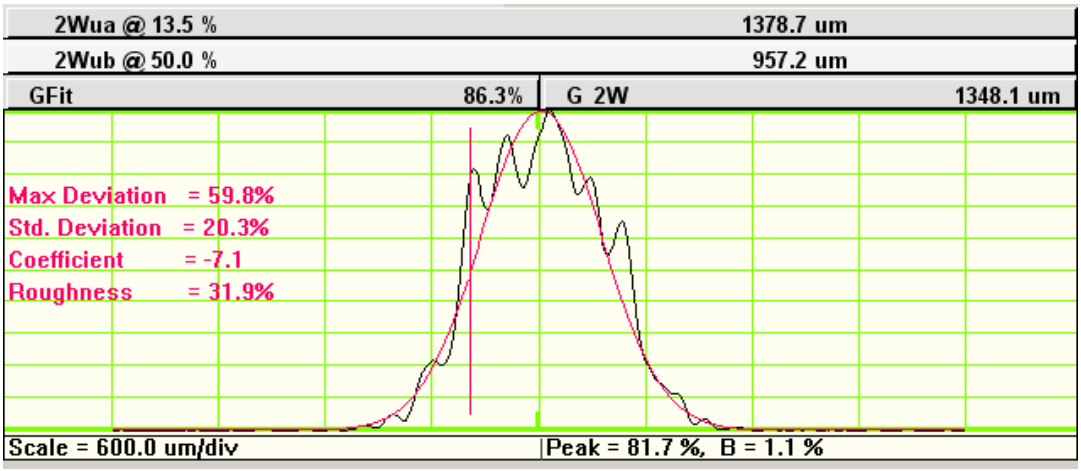
Rev. 0311A, 17 Nov. 2003

- ❑ **Show Gaussian fit**. A **Gfit** results line appears over the **2W** results and a red line Gaussian appears superimposed over the profile. The Gaussian fit is based upon:
  - Determination and subtraction of the baseline. (True for all modes of operation.)
  - An iterated least squares fit that starts from the actual 13.5% diameter
  - A centroid that remains the same as that of the actual beam.
  - An area under the fitted Gaussian always equals the area under the actual beam profile. i.e. an equal power requirement.

    If the area under the curve is 'A', defined as the baseline-corrected total of the individual ADC values for each sample, and the actual 13.5% diameter is 2W, then the initial height in ADC units is set to:

    $$H = A.(2/2W).(2/\pi)^{0.5} = 1.596.A/2W.$$

  - Currently for all levels above 5%. [Will shortly change to a profile width that includes 99% (default) of the power in the profile. As with the 4σ diameter, **Ctrl Alt S** will allow you to set a different percentage for the included power.]
  - A fit algorithm that, *whilst keeping the area under the curve constant*, iteratively adjusts the height and width of the Gaussian until the Least Squares difference between the actual profile and the Gaussian profile is minimized.



  - **G 2W** is the calculated diameter of the fitted Gaussian.
  - **Gfit** in **%** is calculated as:

    100 x [1 - [(Sum of absolute differences)/(Gaussian profile area)]]

□ **Show Top-Hat fit** The Top Hat fit:

- Determines and subtracts the baseline. (True for all modes of operation).
- Determines the '50% of peak' edges of the profile. Defines the center (as opposed to centroid) of the beam as the midpoint between these two points.

- Determines the Least Squares level of the central 80% of this region. It plots a straight line at this mean level, and defines it as 100% for the purpose of subsequent TopHat fit calculations.
- Shows the Top-Hat fit in % as: 100[1- (Total area of |deviations|/Area under line)].

□ **Show max deviation** For both the Gaussian and Top Hat fits, a vertical red line appears on the graph at the point of maximum deviation, and the **Max Deviation = xx.x%** and **Std. Deviation = xx.x%** are overwritten in red on the graph.

TIP: On slower PCs, to speed up the processing, do not show these options.

Additional information is given by the alternative 'Gaussian Fit Coefficient' and the 'Gaussian Roughness coefficient', defined as follows:

- Find the average difference between the Actual point, Pj, and the fitted Gaussian, Gj.

$A = [\text{Sum } (Pj - Gj)] / N$ (N is the # of points)

- For each point determine the difference, Dj, from the average of the deviation:

$Dj = (Pj - Gj) - A$

- Determine the sum of Dj^2: $S = \text{Sum } (Dj^2)$

- Determine the Gaussian Fit **Coefficient**, C, as follows: $C = 1 - ((S/N^{0.5})/N)$

- Determine the Gaussian Fit **Roughness**, R %, as follows: $R = 100 \times [\text{Max } (Pj - Gj)]/[\text{Max } (Pj)]$