1 Background Estimation

The background is calculated as an average of the specified background channels. In this calculation the range is automatically adjusted, so that only integer multiplies of the proton beam period is used to average out correlated background fluctuations. The background per channel is given by:

$$BG = \frac{1}{n}\sum^{n} N_i \tag{1}$$

The error of this background estimation is

$$\Delta BG = \frac{1}{n}\sqrt{\sum^{n} N_i}\ , \tag{2}$$

but is not taken into account for the final error estimation of the asymmetry or the histogram fit.

2 Background Substraction and Error of the Histogram Entries

The background is subtracted (if not fitted) before further processing of the data from the raw histograms, e.g. :

$$F = F_{Raw} - BG \tag{3}$$

The error of F is calculated in the following way:

$$\Delta F = \sqrt{F + BG} = \sqrt{F_{Raw}} \tag{4}$$

It has been checked, that if the error is calculated with the usual Gaussian error propagation

$$\Delta F = \sqrt{\Delta F_{Raw}^2 + \Delta BG^2} = \sqrt{F + BG + \Delta BG^2}\ , \tag{5}$$

too large errors are produced in calculation of asymmetry errors.

Remark: Anyway it is good to chose the range were the background is estimated as large as possible to reduce the error of this estimation. At least it should be larger than your rebinning.

3 Asymmetry and Errors

The asymmetry is calculated like this:

$$A = \frac{\alpha F - B}{\alpha\beta F + B} \tag{6}$$

The error on A is calculated using the usual Gaussian error propagation:

$$\begin{aligned}\Delta A &= \frac{\alpha}{(\alpha\beta F + B)^2}\sqrt{(1+\beta)^2 \cdot (\Delta F^2 \cdot B^2 + \Delta B^2 \cdot F^2) +} \\ &\qquad \overline{((\beta F + 1)B\frac{\Delta\alpha}{\alpha})^2 + ((FB - \alpha F^2)\Delta\beta)^2} \end{aligned} \tag{7}$$

If α and β are constant, this reduces to:

$$\Delta A = \frac{\alpha}{(\alpha\beta F + B)^2}\sqrt{(1+\beta)^2 \cdot (\Delta F^2 \cdot B^2 + \Delta B^2 \cdot F^2)} \tag{8}$$