Yptar = phi_tg and xptar = theta_tg

1.11 yptar, theta_e & theta_p

This variable characterizes the deviation of the in-plane angle from its central value in the spectrometer. It is given in radians. Therefore, to get the physical value of the in-plane angle in degrees, just do:

$$\theta = \theta_c \pm \text{TMath::RadToDeg()*h\_yptar} \tag{6}$$

Where + (-) is taken for the electron (proton) arm. However, this is an approximation. The actual expression is:

$$\cos\theta = \frac{\cos\theta_c - \text{yptar}\cdot\sin\theta_c\sin\phi_0}{\sqrt{1+\text{xptar}^2+\text{yptar}^2}} \tag{7}$$

Where ϕ_0 = 270° for the right HRS and ϕ_0 = 90° for the left HRS. That is:

$$\cos\theta_{\text{LHRS}} = \frac{\cos\theta_c - \text{e\_yptar}\cdot\sin\theta_c}{\sqrt{1+\text{e\_xptar}^2+\text{e\_yptar}^2}} \tag{8}$$

$$\cos\theta_{\text{RHRS}} = \frac{\cos\theta_c + \text{h\_yptar}\cdot\sin\theta_c}{\sqrt{1+\text{h\_xptar}^2+\text{h\_yptar}^2}} \tag{9}$$

1.12 xptar

This variable characterizes the out-of-plane angle. It is given in radians. Therefore, to get the physical value of the out-of-plane angle in degrees, just do (for example, for the proton):

$$\phi = \text{TMath::RadToDeg()*h\_xptar} \tag{10}$$

Again, this is an approximation. The actual expression is:

$$\phi = \tan^{-1}\left(\frac{\sin\theta_c \sin\phi_0 + \text{yptar}\cos\theta_c}{\sin\theta_c \cos\phi_0 + \text{xptar}}\right) + \delta \cdot \sin\phi_0 \tag{11}$$

Where $\phi_0 = 270°$ for the right HRS and $\phi_0 = 90°$ for the left HRS. That is:

$$\phi_{\text{LHRS}} = \tan^{-1}\left(\frac{\sin\theta_c + \text{e\_yptar}\cos\theta_c}{\text{e\_xptar}}\right) + \delta \tag{12}$$

$$\phi_{\text{RHRS}} = \tan^{-1}\left(\frac{-\sin\theta_c + \text{h\_yptar}\cos\theta_c}{\text{h\_xptar}}\right) - \delta \tag{13}$$

where $\delta = 180\,°$ if xptar < 0 and $\delta = 0\,°$ otherwise.