Error propagation to the CFFs

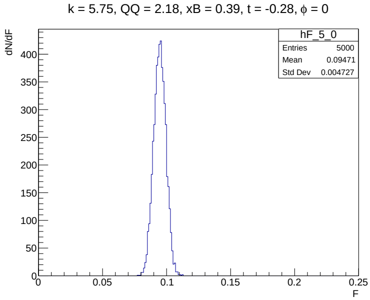
Liliet Calero Diaz

October 2, 2020

CFFs standard deviation:
one at a time at fixed F variance

Use 5% variance in F and look at the resulting standard deviation in each of the CFFs **one at a time**, fixing the other two.

1. 5K F values were generated at each of the 36 angles of ϕ from 0 to 2π for given CFFs that had no errors.



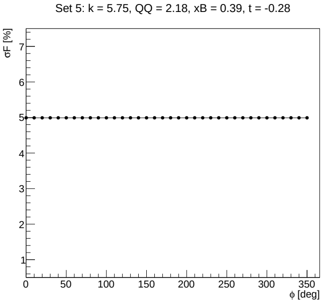


Figure: F distribution example (left) and generated F fixed variance for every ϕ angle (right) at the 5^{th} kinematic setting.

CFFs standard deviation:
one at a time at fixed F variance

2. For every F value, compute $\mathfrak{Re}\mathcal{H}$, fixing $\mathfrak{Re}\mathcal{E}$ and $\mathfrak{Re}\widetilde{\mathcal{H}}$ to the values used in step 1, using the following equations:

$$F = F_{BH} + F_{dvcs} + F_I$$

$$\frac{\Gamma}{Q^2|t|}\left[A^I_{UU}\left(F_1\mathfrak{Re}\mathcal{H} + \tau F_2\mathfrak{Re}\mathcal{E}\right) + B^I_{UU}G_M\left(\mathfrak{Re}\mathcal{H} + \mathfrak{Re}\mathcal{E}\right) + C^I_{UU}G_M\mathfrak{Re}\widetilde{\mathcal{H}}\right]$$

$$\mathfrak{Re}\mathcal{H} = \frac{Q^2|t|/\Gamma\left(F - F_{BH} - F_{dvcs}\right) - \left(A^I_{UU}\tau F_2 + B^I_{UU}G_M\right)\mathfrak{Re}\mathcal{E} - C^I_{UU}G_M\mathfrak{Re}\widetilde{\mathcal{H}}}{A^I_{UU}F_1 + B^I_{UU}G_M}$$

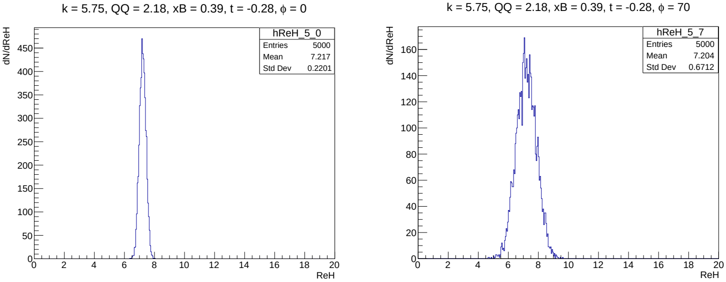


Figure: $\mathfrak{Re}\mathcal{H}$ distribution example for two different angles at the 5^{th} kinematic setting.

CFFs standard deviation:
one at a time at fixed F variance

3. Analogous to step 2, solve the above equations for $\Re e\mathcal{E}$ and $\Re e\widetilde{\mathcal{H}}$ respectively for every F value.
4. Obtain σ from the CFFs distribution at the different angles for each kinematic setting.

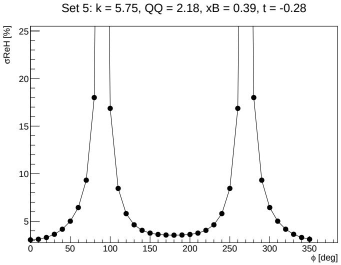


Figure: $\Re e\mathcal{H}$ standard deviation for the 5^{th} set obtained one at a time, fixing σF to 5%.

CFFs standard deviation:
one at a time at fixed F variance

- Strong dependence of the CFFs variation with ϕ, increasing asymptotically at the singularities $\phi_g = 90^\circ$ and $\phi_g = 270^\circ$.
- If the variation of F is 5%, for the analyzed kinematics, the standard deviation of $\Re e\mathcal{H}$ and $\Re e\mathcal{E}$ satisfies:
$$|\phi - \phi_g| \geqslant 10^\circ \implies \sigma CFFs \leqslant 20\%$$
- Variations smaller than the 5% set for F can be achieved for $\Re e\mathcal{H}$ and $\Re e\mathcal{E}$ at around $|\phi - \phi_g| \geqslant 40^\circ$.

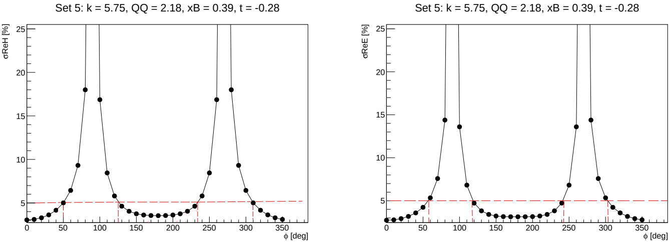


Figure: $\Re e\mathcal{H}$ (left) and $\Re e\mathcal{E}$ (right) standard deviation for the 5^{th} set obtained one at a time, fixing σF to 5%.

CFFs standard deviation:
one at a time at fixed F variance

- There is a large propagated error to $\Re e\widetilde{\mathcal{H}}$, resulting in a variation always greater than about 30% with:

$$|\phi - \phi_g| \geqslant 40^\circ \implies 30\% \leqslant \sigma CFFs \leqslant 200\%$$

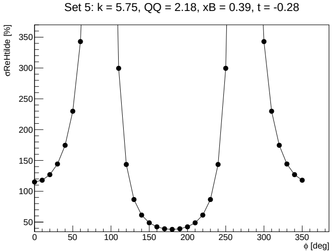


Figure: $\Re e\widetilde{\mathcal{H}}$ standard deviation for the 5^{th} set obtained one at a time, fixing σF to 5%.

CFFs standard deviation:
one at a time at fixed F variance

- The figure bellow reflects the obtained results, where the deviation from the CFFs values used to to generate F (expected values) is consistently large for $\Re e\widetilde{\mathcal{H}}$ when compared to $\Re e\mathcal{H}$ and $\Re e\mathcal{E}$; given by the spreading of the standard deviation of $\Re e\widetilde{\mathcal{H}}$.
- $\Re e\mathcal{H}$ and $\Re e\mathcal{E}$ deviation from the expected value are comparable, falling within 0.3% for $|\phi - \phi_g| \geqslant 20^\circ$.
- $\Re e\mathcal{H}$ and $\Re e\mathcal{E}$ deviation flips around the expected value, while the mean of $\Re e\widetilde{\mathcal{H}}$ distribution in ϕ is always greater than the expected value.

These results are valid for all kinematic settings.

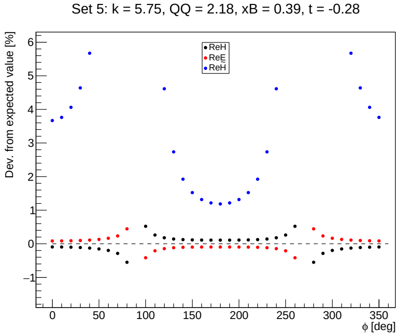


Figure: Deviation from the CFFs values used to generate F for the 5^{th} set.