The factors of two in the time difference resolution

Blake Leverington

February 29, 2008

In KLOE's beam tests [1, 2] they quote their time difference as

$$\Delta T_{KLOE} = \frac{1}{2}\frac{\sum_i E_i(T_{A,i} - T_{B,i})}{\sum_i E_i} \tag{1}$$

which results in a time resolution of $\sigma(T \text{ or } \Delta T) =\sim 50ps/\sqrt{E(GeV)}$. Notice that they have the sum over the geometric mean of the energy where

$$E_i = \sqrt{E_{N,i} \cdot E_{S,i}} \tag{2}$$

After re-examining the the analysis code, the results I have so far reported have followed the form

$$\Delta T_{GlueX} = \frac{1}{2}\left(\frac{\sum_i T_{N,i}E_{N,i}}{\sum_i E_{N,i}} - \frac{\sum_i T_{S,i}E_{S,i}}{\sum_i E_{S,i}}\right) \tag{3}$$

which resulted in a time difference resolution of

$$\sigma_{\Delta T_{GlueX}} = \frac{74ps}{\sqrt{E(GeV)}} \oplus 33ps. \tag{4}$$

In the case of $E_N = E_S$ then $\Delta T_{GlueX} = \Delta T_{KLOE}$ and all is good.

Re-analysis of the Run 2334 at 90° with a fast analysis code on the ASCII data file bcal02334.ascii using Eq. 3, as seen in Fig. 1 results in a timing resolution of $76ps/\sqrt{E(GeV)} + 53ps$. Similar analysis with Eq. 1, as seen in Fig. 2 results in a timing resolution of $79ps/\sqrt{E(GeV)} + 50ps$. A slower but possibly more thorough analysis lowers the floor term to $33ps$, as stated previously.

References

[1] J. Lee-Franzini et al., The KLOE electromagnetic calorimeter, 1995, Nucl. Instrum. Meth. A360, 201-205.

[2] A. Antonelli et al., The electromagnetic calorimeter of the KLOE experiment at DAΦNE 1996, Nucl. Instrum. Meth. A379, 511-514.

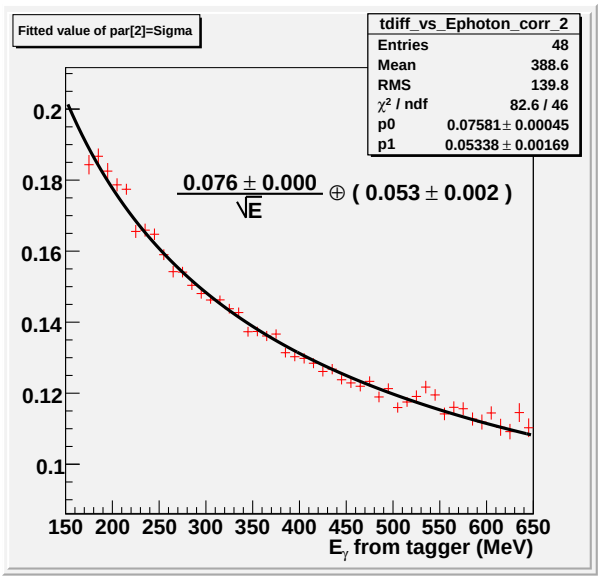

Figure 1: The time difference resolution using Eq. 3.

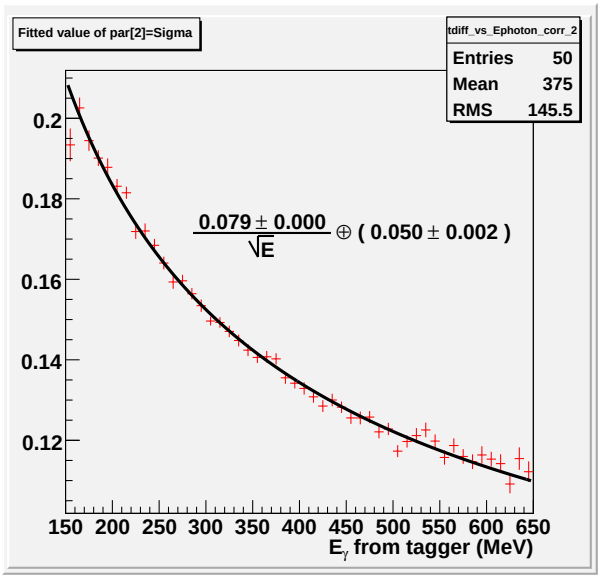

Figure 2: The time difference resolution using Eq. 1.