CLAS-NOTE 1999-015

Sector Misalignments Determination and Beam Location using $\gamma p \to p\pi^+\pi^-$

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Abstract

I have looked into relative misalignments of sectors using three charged track time-based tracking data sets with cuts to exclude missing particles in the final state. With these three charged tracks, three different 2-particle combinations can be used to calculate relative misalignments from one sector with respect to all the remaining sectors. We find that this procedure is more sensitive to an off axis photon beam, and some other way to check sector alignment is needed.

Using three charged prong data sets we can look into CLAS misalignments of one sector relative to another. The three charged track data set consists of a proton, π^+, and π^-. By looking at differences in extrapolated z-position at closest approach to the z-axis, This, of course, assumes that the photon beam and z-axis coincide. I can look for relative misalignments in different sectors with respect to a chosen sector as reference.

$$\Delta z_{nm}^{p_1 p_2} \equiv (z_n^{p_1} - z_m^{p_2}) \tag{1}$$

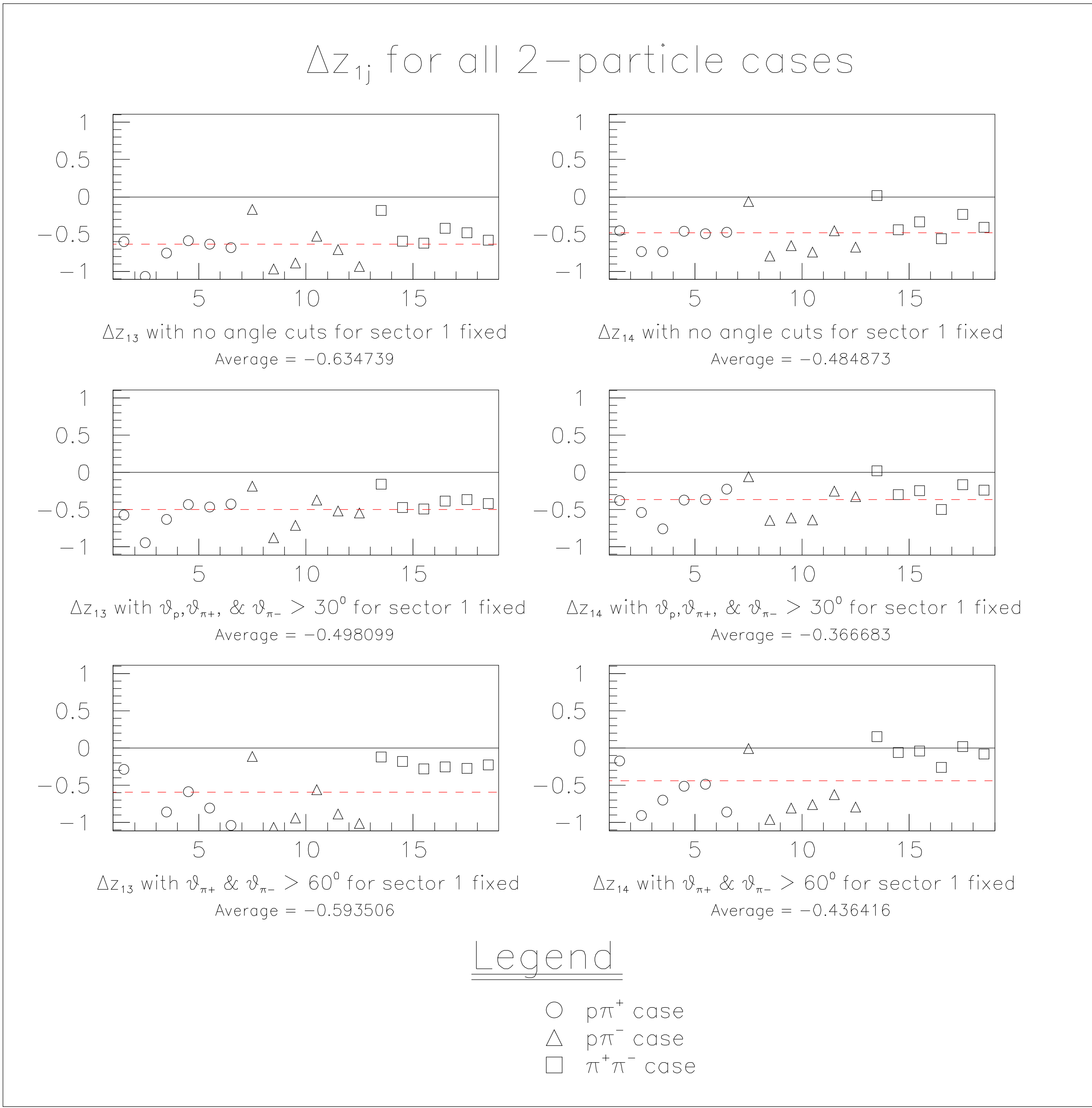
For a 2-particle combination with particles p_1 and p_2, I can calculate the quantity $\Delta z_{nm}^{p_1 p_2}$ where both n and m range from 1 through 6 on an event by event basis. This gives me a distribution representing the change in the z component of the vertex for all possible sector combinations. Next, loop over each distinct 2-particle combination and keep a table. Gaussian fits (within $\pm 3\sigma$ of mean) are performed to get a reasonably good estimation of the central position of these vertex distributions for 2-particle combinations $(\widehat{\Delta z_{nm}^{p_i p_j}})$. It is these values which are used to calculate the relative Δz for each sector with respect to a reference sector.

I arbitrarily chose sector 1 as the reference sector. I can now calculate six relative misalignment numbers from six different sector combinations. These six numbers, which depend on the 2-particle combination chosen, are obtained through the choice of sector combinations j and k where j ranges from 2 through 6 and k ranges from 1 through 6.

$$\Delta z_{1j}^{p_1 p_2} \equiv \left(\widehat{\Delta z_{1k}^{p_1 p_2}} - \widehat{\Delta z_{jk}^{p_1 p_2}}\right) = \left[(\widehat{z_1^{p_1} - z_k^{p_2}})\right] - \left[(\widehat{z_j^{p_1} - z_k^{p_2}})\right] \tag{2}$$

However, it was suggested that this effect could be the result of an off axis beam. Looking at large angles cuts for π^+ and π^- will help determine if the beam offset could be present.

Figure 2 contains calculated displacements between sector 3 and sector 4 with sector 1 as the reference. With the π^+ and π^- at large angles, the Δz for this combination approaches zero. Compared with all particles at large angles, this points to a photon beam misalignment.


Δz_{1j} for all 2−particle cases
Δz_{13} with no angle cuts for sector 1 fixed
Average = −0.634739
Δz_{14} with no angle cuts for sector 1 fixed
Average = −0.484873
Δz_{13} with $\vartheta_p, \vartheta_{\pi+}$, & $\vartheta_{\pi-} > 30^0$ for sector 1 fixed
Average = −0.498099
Δz_{14} with $\vartheta_p, \vartheta_{\pi+}$, & $\vartheta_{\pi-} > 30^0$ for sector 1 fixed
Average = −0.366683
Δz_{13} with $\vartheta_{\pi+}$ & $\vartheta_{\pi-} > 60^0$ for sector 1 fixed
Average = −0.593506
Δz_{14} with $\vartheta_{\pi+}$ & $\vartheta_{\pi-} > 60^0$ for sector 1 fixed
Average = −0.436416
Legend
$p\pi^+$ case
$p\pi^-$ case
$\pi^+\pi^-$ case