

e1-6 Vertex Correction, Selection

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Abstract

This document describes the track vertex correction and selection procedure. The track vertices of all particles are corrected. A selection on the electron and proton z-vertexes and their differences is applied.

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1 Vertex Correction, Selection

In the reconstruction software the track vertex (x, y, z) is calculated from its intersection with the sector midplane¹ of the corresponding sector. This procedure involve the assumption that the beam is centered along the z-axis. During the e1-6 experiment however the beam was not centered at $(x, y) = (0, 0)$ thus a sector-dependent offset is introduced in the vertex calculation.

1.1 Beam Offset

The displacement of the beam can be seen in Fig. 1, where the events on the window² downstream of the target were selected to fix the z position as reference. The calculated displacement [1] for the beam position is:

$$\begin{aligned} x_0 &= 0.090 \text{ cm} \\ y_0 &= -0.345 \text{ cm} \end{aligned}$$

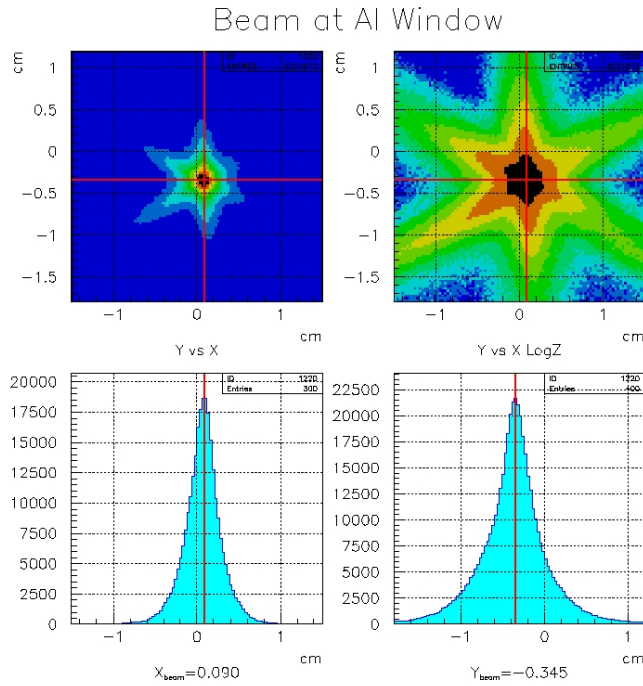


Figure 1: Top: y versus x position of the vertex at the window. Upper right: same as upper left, except plotted logarithmically. One can see that the beam spot was slightly shifted from $(0, 0)$. Bottom: the x (left) and y (right) distributions which led to the calculation: $(x_0, y_0) = (0.09, -0.345) \text{ cm}$

¹The midplane of a sector is defined by the plane that divide that sector in half and contains the beamline $(0, 0, z)$.

²A window was placed at $z = +0.5 \text{ cm}$ to help these kind of studies and to be a z-position reference.

1.2 Vertex Correction, Cut

To correct the vertex position it is sufficient to shift the midplanes so that they contain the correct beamline $(0.09, -0.345, z)$ and recalculate the intersection of the tracks with the new planes. This is illustrated in Fig. 2.

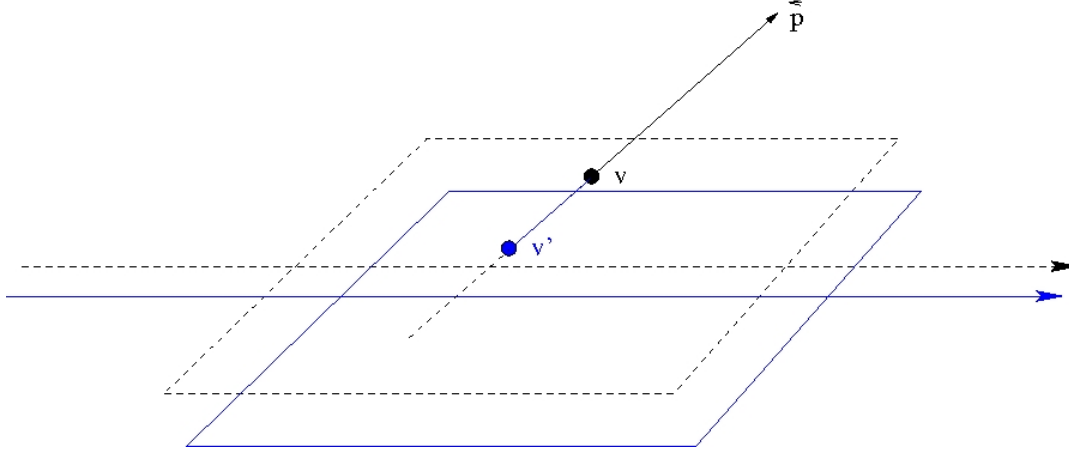


Figure 2: The vertex correction. The dashed plane is the original midplane containing the wrong beamline $(0, 0, 0)$. The point v is the intersection of the track (straight line along momentum \vec{p}) with this plane. The solid blue plane represents the corrected midplane containing $(0.09, -0.345, z)$. The correction algorithm simply intersects the same track with the corrected midplane.

The effect of the correction on the electrons and protons z position is shown in Fig. 3. After this correction, the vertex position resolution is good enough to introduce a cut on the z vertex of electron and protons in order to select events inside the target cell as follows:

$$-8 \text{ cm} \leq z \leq -0.8 \text{ cm} \quad (1)$$

The electron and proton vertices are also required to be coincident along the z axis within the reconstruction resolution, so an additional cut on $\Delta z = z_{\text{electron}} - z_{\text{proton}}$ is applied:

$$|\Delta z| < 3 \text{ cm} \quad (2)$$

The effect of the corrections and the values of the cuts are illustrated in Fig. 3 and Fig. 4.

Vertex Correction, Cut

VZ Cut: $-8.0 \leq v_z \leq -0.8$

Sector 1 (blue), Sector 2 (red), Sector 3 (green), Sector 4 (magenta), Sector 5 (cyan), Sector 6 (yellow)

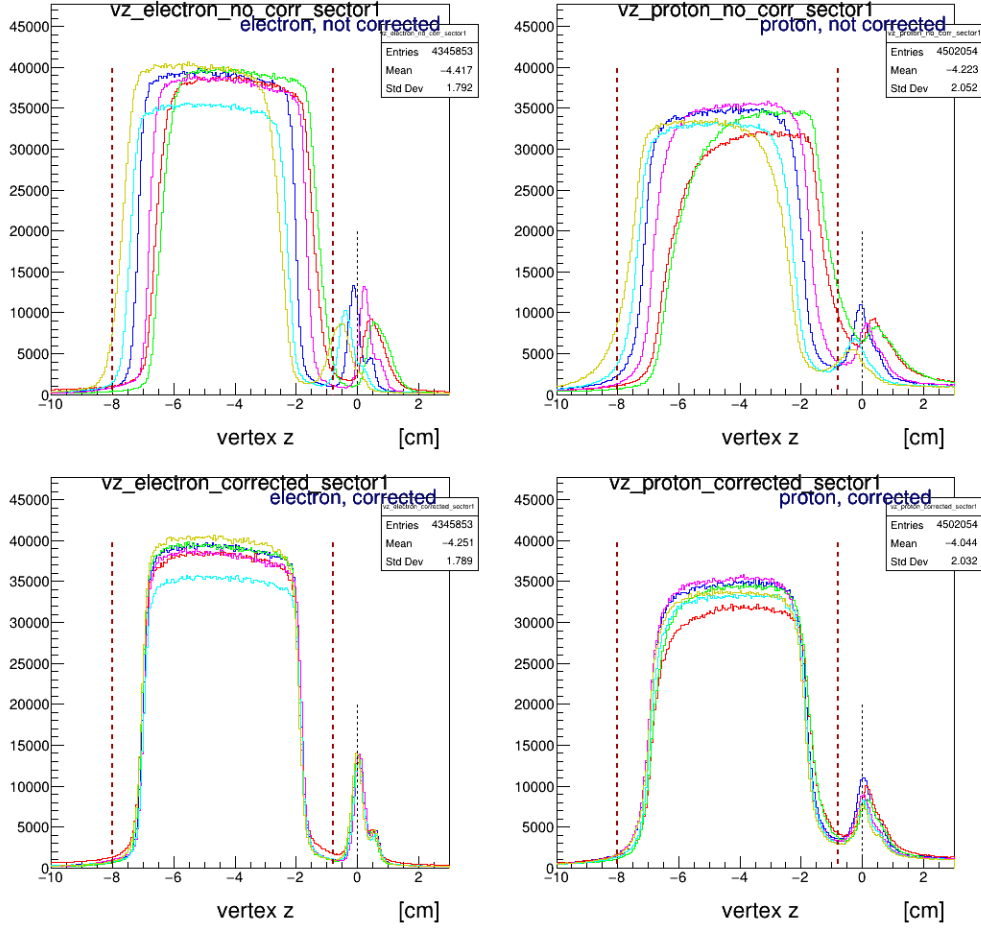


Figure 3: The effect of the correction on the electrons and protons z distributions for each sector. Top row: electron and proton z vertices, uncorrected. Bottom row: same distributions after the vertex correction. Vertical red lines: cuts of eq.1.

Vertex Correction, Cut

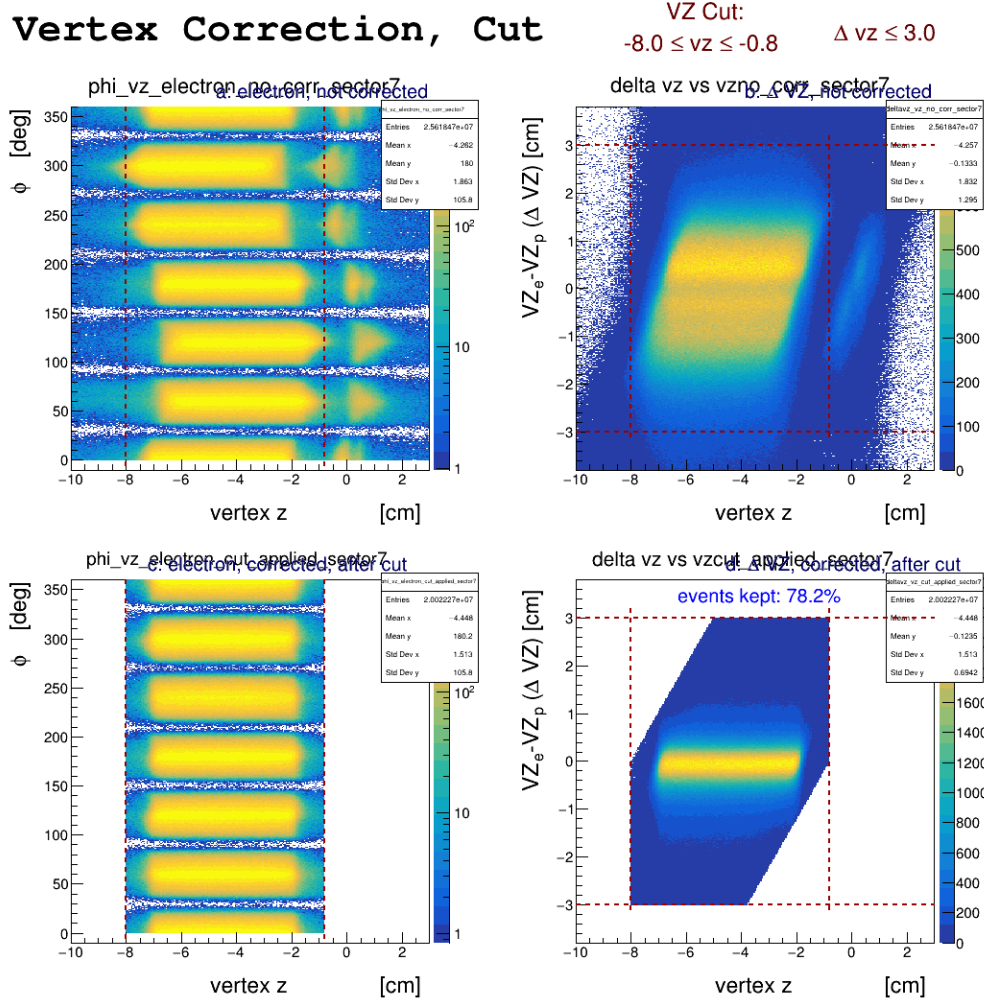


Figure 4: Top left: Δz versus $\phi_{electron}$, uncorrected. The typical sinusoidal behaviour as a function of sector is indicative of the beam displacement. Bottom left: same distributions, after the vertex correction. Top right: Δz versus $VZ_{electron}$, uncorrected. Bottom right: same distributions, after the vertex correction. Vertical red lines: cuts of eq.1. Horizontal red lines: cuts of eq.2.

References

- [1] Valeri Koubarovski, *Private Communication*.