e1-6 Electron Fiducial Cuts

M. Ungaro, K. Joo

June 21, 2023

Abstract

This document describes the identification and removal of CLAS regions of low/zero efficiency and of border effects not reproducible by GSIM.

Contents

TODO: SC Cuts and some DC sectors still show L/R asymmetries !

1 Fiducial Cuts

1.1 Introduction

Some Detector inefficiencies are not perfectly reproduced with GSIM and need to be removed with fiducial cuts. We consider two different approaches to identify fiducial regions:

- Cuts on the lab coordinates ϕ, θ, p
- Cuts on Detector Coordinates

1.2 Cuts on the lab coordinates ϕ, θ, p

The fiducial cut in the lab coordinates has been determined during the π^0 analysis in the $\Delta(1232)$ region [2]. For each sector, an empirical cut on ϕ is introduced as a function of theta and momentum:

$$\phi \;\leq\; \Delta\phi\,(\theta, p)$$

which is aimed to define regions of phase space whose distributions are flat in ϕ. After careful study [1], the mathematical form of the cut depends on 6 parameters C_i and assumes the form:

$$\begin{aligned} \Delta\phi &= C_4\,(\sin(\theta - \theta_{cut}))^{\,E} \\ E &= C_3\,p^{\,C_5} \\ \theta_{cut} &= C_1 + \tfrac{C_2}{p+C_6} \end{aligned}$$

The ϕ vs θ distribution was plotted for 10 different momentum bins from 1.6 to 4.6 GeV. Fig. 1 shows one example ($p = 1.9 - 2.2$ GeV) of such distributions. The ϕ distributions are also plotted for θ slices one degree wide as in Fig. 2 and the C_i parameters are adjusted empirically.

Figure 1: ϕ versus θ for sector 1 and $p = 1.6 - 1.9$ GeV after the electron ID. Left: before fiducial cut. Right: before fiducial cut (box/gray) and after fiducial cut (color contour).

Figure 2: ϕ distributions (sector 3) for different θ and $p = 1.9 - 2.2$ GeV. Black: before fiducial cut. Red: after fiducial cut. Čerenkov inefficiency (section **??**) is responsible for some irregularities at $\phi = 0$ (for example at $\theta = 35.5^0 - 36.5^0$) while drift chambers and time of flight inefficiency (section **??**) causes other irregularities (for example at $\theta = 42.5^0 - 43.5^0$).

Table 1 shows the 6 parameters obtained. Fig. 3 shows the fiducial cut as a function of p, θ and ϕ for sector 1.

Sector	C_1	C_2	C_3	C_4	C_5	C_6
1	12.0	20.0	0.32	32.0	0.416667	0.14
2	//	20.7	0.36	34.0	//	//
3	//	20.2	0.32	32.0	//	//
4	//	20.5	0.32	32.0	//	//
5	//	20.5	0.29	32.0	//	//
6	//	20.0	0.32	32.0	//	//

Table 1: The 6 parameters for electron fiducial cut for each of the 6 sectors. Only C_2, C_3, C_4 are sector dependent.

Figure 3: The electron fiducial cut for sector 1. The cut starting point moves back as the momentum increases (and θ decreases). This causes the cut to narrow up with momemtum because electrons are detected near the lower edges of the detectors.

References

[1] K. Park, Volker Burkert, *Private Communication.*

[2] M.Ungaro, π^0 *elctroproduction from* $\Delta(1232)$ *at high momentum transferred with CLAS*