E949 Technical Note K-055

P, E, R resolution in E949 pnn2 analysis

Wang Zhe

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Abstract

Momentum (ptot), energy (etot) and range (rtot) resolutions are determined with a $K_{\pi 2}$ sample for E949, pnn2 analysis. They are $2.29 \pm 0.01^{+0.0}_{-0.04} MeV$, $3.03 \pm 0.02 \pm 0.02 MeV$ and $0.901 \pm 0.005 \pm 0.002 MeV$ respectively (The first error is statistical and the second is from the changing of fitting range).

1 p, e, r resolution from kp2 sample

A $K_{\pi 2}$ sample is selected within pnn1 and pnn2 trigger. There are no offline photon veto cuts in skim1 and skim5 stream. So skim1 and skim5 data are used as the beginning of this study. More criteria are applied further to eliminate background from $K_{\pi 2}$ events, and are described as below.

Kinetic correction determined for pnn1, FIXALL, is invoked first. All KCUTS are applied, excluding RNGMOM which potentially changes the shape of rtot. All PCUTS and TDCUTS are applied to purify $K_{\pi 2}$ sample. The majority of TGCUTS are also used to remove $K_{\pi 2}$ target scattering background and beam background (including B4TIM, B4EKZ, TGZFOOL, EPITG, EPIMAX, TGER, TARGF, DTGTTP, RTDIF, DRP, TGKTIM, TIC, TGDEDX, TGENR, PIGAP, TGLIKE, TGB4, TIMKF, KIC and PHIVTX). At last both TGPVCUT and a loose PVCUTS are inverted. Fig. 1 shows rtot vs. ptot and rtot vs. etot of the sample.

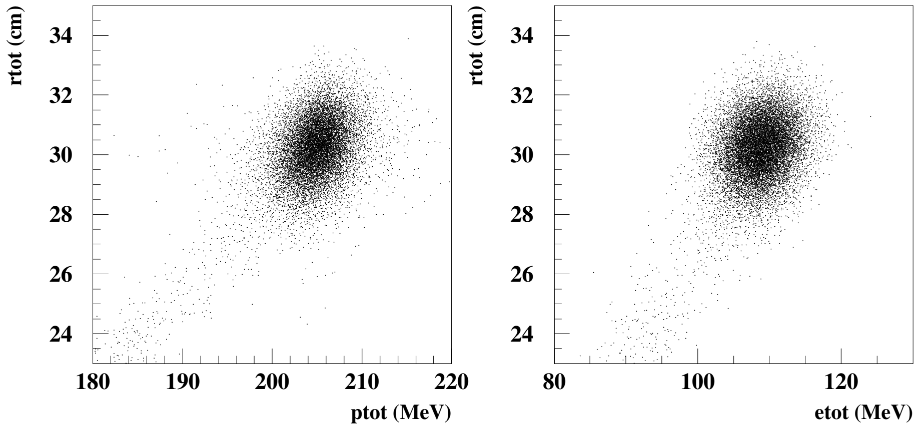

Figure 1: rtot vs. ptot (left) and rtot vs. etot (right) of $K_{\pi 2}$ sample.

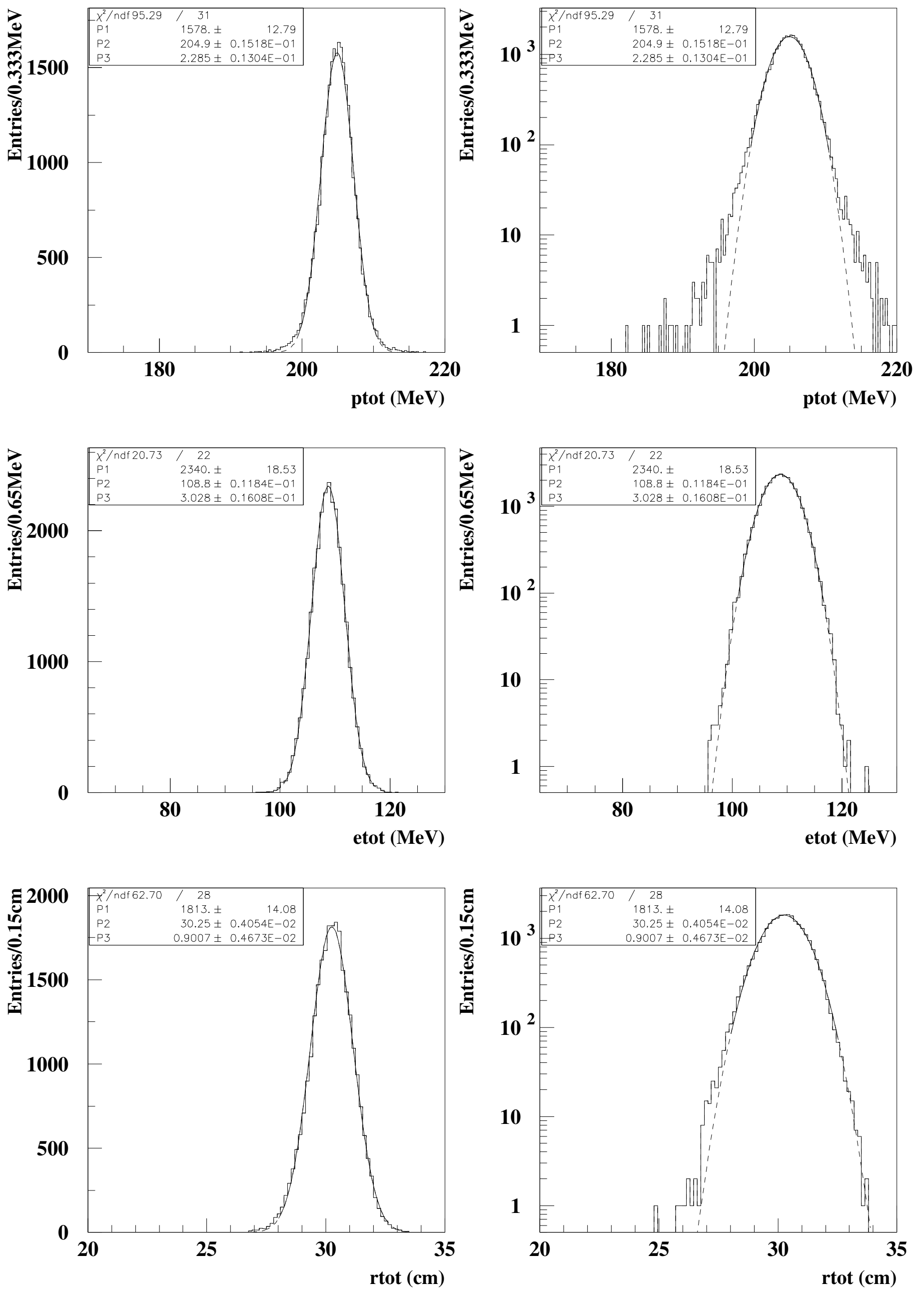

Figure 2: Projection on ptot (top), etot (middle) and rtot (bottom) of $K_{\pi2}$ sample. The right column is the same with the left but in log scale. The results of a symmetric fit within $\sim 2.5\sigma$ are shown in solid line and extrapolated as dashed line.

The projection on ptot, etot and rtot are shown in Fig. 2. When creating projection onto one variable, there are loose cuts ($\sim 3\sigma$) on the other two variables. It is $|ptot - 205.1| < 6.9MeV$, $|etot - 108.6| < 9.1MeV$ and $|rtot - 30.4| < 2.7cm$.

A simple gaussian is assumed for the core of each distribution and is used for a fit to estimate the resolution. The result of a symmetric fit within $\sim 2.5\sigma$ are also plotted in Fig. 2. The detail is summarized in Tab. 1. The truth values and resolutions in E949, pnn1 analysis (K034) are listed for reference too. Some attempts of enlarging or shrinking the fitting ranges are also made. No obvious changing in the fitting result are found, except that σ_{ptot} will be 0.04MeV less than the one shown in figure.

Table 1: Fitting result, truth and resolutions from E949, pnn1 (K034). The first error is statistical and the second is from the changing of fitting range.

	this analysis	truth & e949, pnn1
ptot(MeV)	$204.94 \pm 0.02 \pm 0.02$	205.1
σ_{ptot}	$2.29 \pm 0.01^{+0.0}_{-0.04}$	2.299 ± 0.006
etot(MeV)	$108.77 \pm 0.01 \pm 0.01$	108.6
σ_{etot}	$3.03 \pm 0.02 \pm 0.02$	2.976 ± 0.005
rtot(cm)	$30.254 \pm 0.004 \pm 0.010$	30.4
σ_{rtot}	$0.901 \pm 0.005 \pm 0.002$	0.866 ± 0.002

2 Expanding pnn2 box

With the result measured in this study the upper bound of pnn2 box can be redefined while keeping the same deviation from $K_{\pi 2}$ peak. Especially, the improvement in energy measurement are expected to gain more acceptance on pnn2 analysis. The new pnn2 box calculated is tabulated in Tab. 2 and it is very close to the one calculated with truth and pnn1 resolution (K034) (suggested by David, see Tab. 2). Thinking about the precision of this study, and given that the data was well calibrated in E949 pnn1 analysis the box definition suggested by David will continue to be used for further pnn2 study.

Table 2: Deviation, old box, suggestion of this study and suggestion from David (calculated with truth and E949, pnn1 resolution)

	dev	old box (E787)	suggestion of this study	suggestion from David
ptot(MeV)	2.5	(140, 195)	(140, 199.2)	(140, 199)
etot(MeV)	2.5	(60, 95)	(60, 101.2)	(60, 100.5)
rtot(cm)	2.75	(12, 27)	(12, 27.8)	(12, 28)