

Monte Carlo acceptance for pnn2

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Abstract

A compilation of UMC acceptance factors for E949 pnn2 analysis.

This note uses the same nomenclature and definitions as in Section 11.6 of K-074.v1 [1] and is intended to supplement the information that note. Table 1 gives the trigger, phase space and overall UMC acceptance for the ‘loose’ and ‘ K_{e4} -phobic’ kinematic boxes with all permutations of pion-nuclear interactions (NI) and π^+ decay-in-flight (DIF) turned on and off.

The effect of nuclear interactions alone on the trigger efficiency is

$$\frac{A_{trig}(\text{NIDIF on})}{A_{trig}(\text{NI off, DIF on})} = \frac{0.2629 \pm 0.0014}{0.3225 \pm 0.0015} = 0.8152 \pm 0.0058 \quad . \quad (1)$$

Nuclear interactions have almost no effect on the phase space acceptance for the ‘loose’ kinematic box:

$$\frac{A_{Loose}(\text{NIDIF on})}{A_{Loose}(\text{NI off, DIF on})} = \frac{0.3703 \pm 0.0030}{0.3650 \pm 0.0027} = 1.0145 \pm 0.0111 \quad (2)$$

or the ‘ K_{e4} -phobic’ kinematic box:

$$\frac{A_{Ke4}(\text{NIDIF on})}{A_{Ke4}(\text{NI off, DIF on})} = \frac{0.3008 \pm 0.0029}{0.3063 \pm 0.0026} = 0.9820 \pm 0.0126 \quad . \quad (3)$$

The overall effect of nuclear interactions on the acceptance for the ‘loose’ kinematic box is

$$\frac{A_{UMC,loose}(\text{NIDIF on})}{A_{UMC,loose}(\text{NI off, DIF on})} = \frac{0.0975 \pm 0.0009}{0.1177 \pm 0.0010} = 0.8284 \pm 0.0104 \quad (4)$$

which can be compared to the effect of nuclear interactions on the pnn1 acceptance of $0.4953 \pm 0.0077 \pm 0.0245$ from Eqn(34) of [2]. The first uncertainty is statistical and the second is systematic due to the disagreement in range measurements between data and UMC.

For completeness, we note that the trigger acceptance for the pnn1 analysis was $0.1796 \pm 0.0010 \pm 0.0084$ (Eqn.(32) of [2]) to be compared with 0.3225 ± 0.0015 for the pnn2 analysis (Table 1). The second uncertainty is a systematic assigned for the disagreement between the measured and world average $\mathcal{B}(K_{\pi 2})$. The phase space acceptances, which are evaluated after application of the trigger requirements, are almost equal at $A_{PS}(\text{pnn1}) = 0.3630 \pm 0.0029$ (Eqn.(33) of [2]) and $A_{PS}(\text{pnn2}) = 0.3650 \pm 0.0027$ (Table 1). Both the trigger and phase space acceptance is evaluated with nuclear interactions off.

References

- [1] J.Ives et. al., “Analysis of the 2/3 E949 pnn2 data”, E949 Technical Note K-074.v1.
- [2] S. Adler *et al.*, Phys. Rev. D**77**, 052003 (2008).

Table 1: The top part of the table gives the trigger acceptance (A_{trig}). The bottom part gives the phase space acceptance (A_{PS}) and overall (A_{UMC}) for the ‘loose’ and ‘ K_{e4} -phobic’ kinematic boxes. “NI on” and “DIF on” means pion-nuclear interactions and π^+ decay-in-flight are turned on, respectively.

Cut	NIDIF on		NI off, DIF on		NI on, DIF off		NIDIF off	
	Events	Acc.	Events	Acc.	Events	Acc.	Events	Acc.
KT	100000		100000		100000		100000	
TDOT2	39227		40790		38807		41036	
$3_{ct} \cdot 4_{ct} \cdot 5_{ct} \cdot 6_{ct}$	27575		33260		26998		33742	
pnn1 or pnn2	26288		32246		26243		32914	
A_{trig}	0.2629 ± 0.0014		0.3225 ± 0.0015		0.2624 ± 0.0014		0.3291 ± 0.0015	
Setup	25793	0.0000	32111	0.0000	25838	0.0000	32887	0.0000
UFATE	22688	0.8796	29890	0.9308	24446	0.9461	32887	1.0000
USTMED	22517	0.9925	29650	0.9920	24286	0.9935	32620	0.9919
USTOP_HEX	21743	0.9656	29388	0.9912	23588	0.9713	32500	0.9963
COS3D	20870	0.9598	28261	0.9617	22669	0.9610	31294	0.9629
LAYER14	20838	0.9985	28211	0.9982	22665	0.9998	31282	0.9996
ZFRF	20175	0.9682	27178	0.9634	22014	0.9713	30083	0.9617
ZUTOUT	20148	0.9987	27158	0.9993	21992	0.9990	30063	0.9993
Loose BOX	9552	0.4741	11719	0.4315	10733	0.4880	13334	0.4435
$A_{PS,Loose}$	0.3703 ± 0.0030		0.3650 ± 0.0027		0.4154 ± 0.0031		0.4054 ± 0.0027	
$A_{UMC,Loose}$	0.0975 ± 0.009		0.1177 ± 0.0011		0.1090 ± 0.0010		0.1334 ± 0.0011	
Ke4 BOX	7758	0.3851	9834	0.3621	8458	0.3846	10812	0.3596
$A_{PS,Ke4}$	0.3008 ± 0.0029		0.3063 ± 0.0026		0.3273 ± 0.0029		0.3288 ± 0.0026	
$A_{UMC,Ke4}$	0.0791 ± 0.0009		0.0988 ± 0.0010		0.0859 ± 0.0009		0.1082 ± 0.0010	