Revised UMC Acceptance Calculation

Tetsuro Sekiguchi

- What's problem?
- Recalculation
- $\mathcal{B}(\mathrm{K}^+ \to \pi^+ f)$ upper limit

What's problem?

UMC acceptance in the previous version

Cuts	$\pi\nu\bar{\nu}$ NIDIF on	$\pi\nu\bar{\nu}$ NIDIF off	πf NIDIF on	πf NIDIF off
SETUP	23387	26323	24066	22567
UFATE	20945 (0.8956)	24734 (0.9396)	21105 (0.8770)	21344 (0.9458)
USTMED	20785 (0.9924)	24566 (0.9932)	20911 (0.9908)	21139 (0.9904)
(snip)	-	-	-	-
BOX 2	6426 (0.3539)	8886 (0.4142)	10748 (0.9026)	12472 (0.9387)
BOX 3	7123 (0.3923)	9755 (0.4547)	10748 (0.9026)	12472 (0.9387)
A_{UMC}	0.2748 ± 0.0029	0.3376 ± 0.0029	0.4466 ± 0.0032	0.5527 ± 0.0033
A'_{UMC}	0.3046 ± 0.0030	0.3706 ± 0.0030	0.4466 ± 0.0032	0.5527 ± 0.0033

- UFATE acceptance (NIDIF off) was incorrect (should be 100%)
- NIDIF off $\rightarrow$ actually it was turned ON !

$\Downarrow$

Turn off and recalculate the acceptance

Acceptance recalculation

To Do

(for $K^+ \to \pi^+ \nu\bar{\nu}$and $K^+ \to \pi^+ f$)

- $A_{trig} \Leftarrow A_{trig}(NIDIFoff)$
- $A_{UMC} \Leftarrow A_{UMC}(NIDIFoff)$
- $A_{nidif} \Leftarrow \frac{A_{trig}(NIDIFon)}{A_{trig}(NIDIFoff)} \times \frac{A_{UMC}(NIDIFon)}{A_{UMC}(NIDIFoff)}$
- Total acceptance may change??

Recalculation

Cuts	$\pi\nu\bar{\nu}$ NIDIF on	$\pi\nu\bar{\nu}$ NIDIF off	πf NIDIF on	πf NIDIF off
SETUP	23387	26920	24066	23504
UFATE	20945 (0.8956)	26920 (1.0000)	21105 (0.8770)	23504 (1.0000)
(snip)	-	-	-	-
BOX 2	6426 (0.3539)	9773 (0.4119)	10748 (0.9026)	14174 (0.9486)
BOX 3	7114 (0.3918)	10727 (0.4522)	10748 (0.9026)	14174 (0.9486)
A_{UMC}	0.2748 ± 0.0029	0.3630 ± 0.0029	0.4466 ± 0.0032	0.6030 ± 0.0032
A'_{UMC}	0.3042 ± 0.0030	0.3985 ± 0.0030	0.4466 ± 0.0032	0.6030 ± 0.0032

Revised UMC Acceptance

For NIDIF on

There is a small correction in the extended box acceptance.

A'_{UMC}: $0.3046 \pm 0.0030 \rightarrow 0.3042 \pm 0.0030$

For NIDIF off

	$K^+ \rightarrow \pi^+ \nu\bar{\nu}$			$K^+ \rightarrow \pi^+ f$		
	old	new		old	new	
A_{trig}	0.1758	0.1796	$\times 1.022$	0.3769	0.3919	$\times 1.040$
A_{UMC}	0.3376	0.3630	$\times 1.075$	0.5527	0.6030	$\times 1.091$
A'_{UMC}	0.3706	0.3985	$\times 1.075$	0.5527	0.6030	$\times 1.091$
A_{nidif}	0.5440	0.4953	$\times 0.910$	0.5193	0.4577	$\times 0.881$

$A_{trig}(NIDIFoff)$ and $A_{UMC}(NIDIFoff)$ increased

$\Rightarrow$ A_{nidif} decreased

- UMC acceptance changed by $\sim$10%
- How about the total acceptance?

Total Acceptance ($K^+ \to \pi^+ \nu\bar{\nu}$)

	$K^+ \to \pi^+ \nu\bar{\nu}$			
	standard		extended	
	old	new	old	new
A_{trig}	0.1758±0.0010	0.1796±0.0010	0.1758±0.0010	0.1796±0.0010
$A_{\bar{\mu}}^{acc}$	0.9959±0.0006	0.9959±0.0006	0.9959±0.0006	0.9959±0.0006
A_{UMC}	0.3376±0.0029	0.3630±0.0029	0.3787±0.0033	0.3985±0.0030
A_{nidif}	0.5440±0.0085	0.4953±0.0077	0.5440±0.0085	0.4953±0.0077
$A_{K\mu 2}$	0.3812±0.0012	0.3812±0.0012	0.4165±0.0013	0.4165±0.0013
$A_{K\pi 2}$	0.8785±0.0029	0.8785±0.0029	0.8785±0.0029	0.8785±0.0029
$A_{\pi_{scat}}$	0.6161±0.0085	0.6161±0.0085	0.6161±0.0085	0.6161±0.0085
A_{TD}	0.3523±0.0077	0.3523±0.0077	0.3946±0.0086	0.3946±0.0086
$\epsilon T \cdot 2 \cdot IC$	0.9358±0.0011	0.9358±0.0011	0.9358±0.0011	0.9358±0.0011
f_s	0.7740±0.0011	0.7740±0.0011	0.7740±0.0011	0.7740±0.0011
$A\epsilon$	0.00219±0.00007	0.00219±0.00007	0.00287±0.00009	0.00287±0.00009
$A\epsilon \cdot f_s$	0.00169±0.00005	0.00169±0.00005	0.00222±0.00007	0.00222±0.00007
K_{Blive} (10^{12})	1.77	1.77	1.77	1.77
S.E.S (10^{-10})	3.34±0.11	3.34±0.11	2.55±0.08	2.55±0.08

Total acceptance didn't change because the change in UMC acceptance was cancelled out.

Total Acceptance ($K^+ \to \pi^+ f$)

	$K^+ \to \pi^+ f$			
	standard		extended	
	old	new	old	new
A_{trig}	0.3769±0.0022	0.3919±0.0020	0.3769±0.0022	0.3919±0.0020
$A_{\bar{\mu}}^{acc}$	0.9959±0.0006	0.9959±0.0006	0.9959±0.0006	0.9959±0.0006
A_{UMC}	0.5913±0.0032	0.6030±0.0032	0.5913±0.0032	0.6030±0.0032
A_{nidif}	0.5193±0.0062	0.4577±0.0054	0.5193±0.0062	0.4577±0.0054
$A_{K\mu 2}$	0.3812±0.0012	0.3812±0.0012	0.4165±0.0013	0.4165±0.0013
$A_{K\pi 2}$	0.8785±0.0029	0.8785±0.0029	0.8785±0.0029	0.8785±0.0029
$A_{\pi_{scat}}$	0.6161±0.0085	0.6161±0.0085	0.6161±0.0085	0.6161±0.0085
A_{TD}	0.3523±0.0077	0.3523±0.0077	0.3946±0.0086	0.3946±0.0086
$\epsilon T \cdot 2 \cdot IC$	0.9358±0.0011	0.9358±0.0011	0.9358±0.0011	0.9358±0.0011
f_s	0.7740±0.0011	0.7740±0.0011	0.7740±0.0011	0.7740±0.0011
$A\epsilon$	0.00733±0.00022	0.00733±0.00022	0.00960±0.00029	0.00889±0.00026
$A\epsilon \cdot f_s$	0.00567±0.00017	0.00567±0.00017	0.00743±0.00022	0.00688±0.00020
K_{Blive} (10^{12})	1.77	1.77	1.77	1.77
S.E.S (10^{-10})	1.00±0.03	1.00±0.03	0.76±0.02	0.82±0.02

What's wrong with $A\epsilon \cdot f_s$ and S.E.S for the extended BOX?

Extended BOX acceptance

Extended BOX(BOX') ≡ (KIN'+TD+PV) or (KIN+TD'+PV) or (KIN+TD+PV')

	standard	extended	
$A_{KIN'}(\propto A_{UMC})$	0.3630	0.3985	×1.10
$A_{TD'}$	0.3523	0.3946	×1.12
$A_{PV'}(\propto A_{K\mu 2})$	0.3812	0.4165	×1.09

For $K^+ \to \pi^+ \nu\bar{\nu}$,

$$A_{BOX'} = (\underset{1\times1}{1} + \underset{\text{KIN'}}{\underline{0.10}} + \underset{\text{TD'}}{\underline{0.12}} + \underset{\text{PV'}}{\underline{0.09}}) \times A_{BOX}$$

$$= 1.31 \times A_{BOX}$$

For $K^+ \to \pi^+ f$,

there is no acceptance gain by KIN'

$$A_{BOX'} = 1.21 \times A_{BOX}$$

In the actual case,

	$K^+ \to \pi^+ \nu\bar{\nu}$		$K^+ \to \pi^+ f$	
	old	new	old	new
standard	0.00169	0.00169	0.00567	0.00567
extended	0.00222	0.00222	0.00743	0.00688
	×1.31	×1.31	×1.31	×1.21

Previous calculation for $K^+ \to \pi^+ f$ extended BOX was incorrect

$\mathcal{B}(K^+ \to \pi^+ f)$ upper limit

Acceptance for the $K^+ \to \pi^+ f$ extended BOX changed

$\to$ The upper limit for $\mathcal{B}(K^+ \to \pi^+ f)$ will also change

	E787	E949	
		old	new
S.E.S (10^{-10})	0.257	0.760	0.822
S.E.S(combined) (10^{-10})		0.192	0.196
90% upper limit (10^{-10})		0.749	0.762

- 90% upper limit = $\underline{3.89}$ $\times$ S.E.S(combined)
  (From the Poisson limit with 1 signal event and no background)
- Upper limit changed from $\underline{0.749\times10^{-10}(7.3\times10^{-10}?)}$ to $\underline{0.762\times10^{-10}}$