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TD acceptance and rejection for $\pi^+\nu\bar{\nu}2$ analysis

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Abstract

A short report of what had been done for evaluation of the TD acceptance and rejection in pnn1 and pnn2 analysis's are presented.

1 TD acceptance for $\pi^+\nu\bar{\nu}2$ analysis

1.1 Verification of TD acceptance for $\pi^+\nu\bar{\nu}1$ analysis

The verification of TD acceptance for $\pi^+\nu\bar{\nu}1$ analysis had been performed by using the π_{scat} monitor sample of 2002 data. More details of how it was done previously can be found in [1] and [2] (see also [3]). A table 1 shows the previously obtained results represented in [2] and [3]. A few comments should be mentioned when regarding these results: a) not complete π_{scat} monitor sample had been used; b) a comis function that produced the results had a bug. The bug influences on the loose setup cuts. We'll return to the point below.

Cuts	Loose setup cuts		Tight setup cuts	
	Events	Acceptance	Events	Acceptance
Setup	4966	-	3203	-
FITPI (bad data)	4962	0.99919	3199	0.99875
FITPI (counting)	4117	0.82971	2701	0.84433
RSHEX2	4045	0.98251	2659	0.98445
L1.1	3090	0.76391	2035	0.76533
L1.2	2674	0.86537	1772	0.87076
TDCUT	2504	0.93642	1657	0.93510
EV5	2138	0.85383	1408	0.84973
ELVETO	2029	0.94902	1339	0.95099
TDFOOL	2028	0.99951	1339	1.00000
TDVARNN	1716	0.84615	1134	0.84690
Acceptance	0.3456 ± 0.0068		0.3590 ± 0.0086	
$A_{\pi\to\mu\to e}$	0.3523 ± 0.0077			

Table 1: π_{scat}-based TD acceptance for $\pi^+\nu\bar{\nu}1$ analysis of 2002 data (see [2] or [3]).

The comis function used to calculate the TD acceptance for $\pi^+\nu\bar{\nu}1$ analysis included the following definitions of the loose (tight) setup cut. The **loose setup cut** had been defined as

BAD_RUN, RD_TRK, STLAY, BAD_STC, TRKTIM, UTC, RDUTM, PDC, LAY14, UTC1, RANGE1, B4DEDX, $|t_{\pi} - t_{rs}| < 5$ ns, ICBIT, TARGF, DTGTTP, RTDIF, TGQUALT, TGZ-FOOL, BHTRS, CKTRS, CKTAIL, RSPV, Online PV, PVCUT, TGCUT, TGPVCUT, COS3D, LAYV4, Final box, RNGMOM, ZFRF, ZUTOUT, LAYER14, UTCQUAL, EICKIN, The **tight setup cut** was defined as the loose setup cut with 3 additional cuts: RSPV, RSDEDX and PRRF.

The table 2 shows the obtained results[1]. The biggest differences between the table 1 and table 2 are as follows: a) a ratio of the tight setup cuts to the corresponding loose setup cuts (for instance, taking the first row of the table 1 we have $3203/4966 = 0.645$, whereas considering the table 2 we have $6882/18163 = 0.379$); b) an acceptance factor in the RSHEX2 cut. The first difference is caused by the above mentioned bug. The second one is smoothed after including the RSHEX cut into the loose setup cut. The corresponding results are shown in the table 3. Since the input data were different, it is difficult to say that the inclusion of the RSHEX cut into the loose setup cut was the reason responsible for the acceptance factor in the RSHEX2 cut.

Cuts	Loose setup cuts		Tight setup cuts	
	Events	Acceptance	Events	Acceptance
Setup	18163	-	6882	-
FITPI (bad data)	18137	0.99857	6877	0.99927
FITPI (counting)	14990	0.82649	5745	0.83539
RSHEX2	14052	0.93743	5475	0.95300
L1.1	10834	0.77099	4272	0.78027
L1.2	9213	0.85038	3606	0.84410
TDCUT	8697	0.94399	3414	0.94676
EV5	7292	0.83845	2868	0.84007
ELVETO	6895	0.94556	2720	0.94840
TDFOOL	6891	0.99942	2718	0.99927
TDVARNN	5811	0.84327	2279	0.83848
Acceptance	0.3199 ± 0.0035		0.3312 ± 0.0057	
$A_{\pi \to \mu \to e}$	0.3256 ± 0.0046			

Table 2: Recalculated TD acceptance for $\pi^+\nu\bar{\nu}1$ analysis based on 2002 π_{scat} monitor trigger data.

1.2 Measurement of TD acceptance for $\pi^+\nu\bar{\nu}2$ analysis

The measurement of TD acceptance for $\pi^+\nu\bar{\nu}2$ analysis had been performed by using the same comis function as in the $\pi^+\nu\bar{\nu}1$ analysis but with a few exceptions. There were two changes in the loose setup cut: a) BOX_PNN1 $\to$ BOX_PNN2; b) LAYV4 $\to$ ($6 \leq \mathrm{LAY} \leq 18$). As before the **tight setup cut** had been defined as the new loose setup cut with 3 additional cuts: RSPV, RSDEDX and PRRF. The obtained results are presented in the table 4. The results corresponds to the case when the RSHEX cut was not included in the loose setup cut. The table 5 shows the case when the RSHEX cut was included.

[1] Here and below the acceptance value (0.3312) in the tight setup column was not corrected by the factor of 1.014 as was done in [2] and [3].

Cuts	Loose setup cuts		Tight setup cuts	
	Events	Acceptance	Events	Acceptance
Setup	17371	-	6690	-
FITPI (bad data)	17360	0.99937	6687	0.99955
FITPI (counting)	14364	0.82742	5604	0.83804
RSHEX2	14052	0.97828	5475	0.97698
L1.1	10834	0.77099	4272	0.78027
L1.2	9213	0.85038	3606	0.84410
TDCUT	8697	0.94399	3414	0.94676
EV5	7292	0.83845	2868	0.84007
ELVETO	6895	0.94556	2720	0.94840
TDFOOL	6891	0.99942	2718	0.99927
TDVARNN	5811	0.84327	2279	0.83848
Acceptance	0.3345 ± 0.0036		0.3407 ± 0.0058	
$A_{\pi\to\mu\to e}$	0.3376 ± 0.0047			

Table 3: Recalculated TD acceptance for $\pi^+\nu\bar{\nu}1$ analysis based on 2002 π_{scat} monitor trigger data, where the RSHEX cut had been included in the loose setup cut.

Cuts	Loose setup cuts		Tight setup cuts	
	Events	Acceptance	Events	Acceptance
Setup	31540	-	7802	-
FITPI (bad data)	31506	0.99892	7793	0.99885
FITPI (counting)	26052	0.82689	6596	0.84640
RSHEX2	23940	0.91893	6182	0.93724
L1.1	19711	0.82335	5143	0.83193
L1.2	16043	0.81391	4324	0.84075
TDCUT	15111	0.94191	4080	0.94357
EV5	12547	0.83032	3419	0.83799
ELVETO	11977	0.95457	3244	0.94882
TDFOOL	11953	0.99800	3241	0.99908
TDVARNN	10157	0.84975	2752	0.84912
Acceptance	0.3220 ± 0.0026		0.3527 ± 0.0054	
$A_{\pi\to\mu\to e}$	0.3374 ± 0.0040			

Table 4: TD acceptance for $\pi^+\nu\bar{\nu}2$ analysis based on 2002 π_{scat} monitor trigger data.

Cuts	Loose setup cuts		Tight setup cuts	
	Events	Acceptance	Events	Acceptance
Setup	29586	-	7495	-
FITPI (bad data)	29571	0.99949	7490	0.99933
FITPI (counting)	24421	0.82584	6344	0.84700
RSHEX2	23940	0.98030	6182	0.97446
L1.1	19711	0.82335	5143	0.83193
L1.2	16043	0.81391	4324	0.84075
TDCUT	15111	0.94191	4080	0.94357
EV5	12547	0.83032	3419	0.83799
ELVETO	11977	0.95457	3244	0.94882
TDFOOL	11953	0.99800	3241	0.99908
TDVARNN	10157	0.84975	2752	0.84912
Acceptance	0.3433 ± 0.0028		0.3672 ± 0.0056	
$A_{\pi \to \mu \to e}$	0.3552 ± 0.0042			

Table 5: TD acceptance for $\pi^+\nu\bar{\nu}2$ analysis based on 2002 π_{scat} monitor trigger data, where the RSHEX cut had been included in the loose setup cut.

	Rejection			
	range tail		band	
	all	ER box	all	ER box
SETUP	65712 (-)	20292 (-)	40389 (-)	17976 (-)
EV5	31432 (2.09)	9453 (2.15)	19926 (2.03)	9081 (1.98)
ELVETO	18603 (1.69)	5510 (1.72)	11335 (1.76)	5115 (1.78)
TDFOOL	18508 (1.01)	5478 (1.01)	11283 (1.00)	5096 (1.00)
TDVAR	137 (135 ± 11)	51 (107 ± 15)	75 (150 ± 17)	34 (150 ± 26)
Rej.	480 ± 41	398 ± 56	539 ± 62	529 ± 91

Table 6: Rejection of the 2002 TD cuts using 2/3 sample (taken from [1]).

2 Verification of the TD rejection for $\pi^+\nu\bar{\nu}1$ analysis

The verification of TD rejection for $\pi^+\nu\bar{\nu}1$ analysis had been performed by using the SKIM2 as input data stream. The previous results listed in [1] are represented in the table 6. In the above mentioned reference one can find more detailed description on how it was obtained. Here we just list the definition of the setup cut. It was defined by the following set of cuts: TRBIT_1, SKIM2, FIX_ALL, rtot > 42.0, etot > 115.0 and rtot > 33.0, PSCUT, PVCUT, FIDUCIAL, ICODEL14, UTCQUAL, TGDEDX, TGLIKE, TGB4, PIGAP, 190.0 < ptot < 250.0, IPIFLG, ptot < 229.0 and $\chi_{rm} > 2.2$ for μ band events (ptot > 229.0 for $K_{\mu 2}$ tail events). It was obtained that the results of table 6 are absolutely reproduced after applying the above mentioned setup cut and comis cut functions taken from a pnn1 repository (i.e. functions that stored in the **myfunc_dir**). Slightly another results was obtained after applying the same setup cut and comis cut functions taken from the pnn2 repository (see table 7).

	Rejection			
	range tail		band	
	all	ER box	all	ER box
SETUP	64039 (-)	19813 (-)	39611 (-)	17623 (-)
EV5	30666 (2.09)	9253 (2.14)	19541 (2.03)	8914 (1.98)
ELVETO	18157 (1.69)	5392 (1.72)	11111 (1.76)	5019 (1.78)
TDFOOL	18067 (1.01)	5362 (1.01)	11059 (1.01)	5000 (1.00)
TDVAR	135 (133.83)	51 (105.14)	73 (151.49)	34 (147.06)
Rej.	474	389	543	518

Table 7: TD rejection for $\pi^+\nu\bar{\nu}1$ analysis using 2/3 sample when applying comis cut functions taken from pnn2 repository.

Appendix

Below are directory repositories where one can find comis functions used for the corresponding TD studies and kumac-scripts supporting that functions.

- Tables 2,3: **rarekXX.triumf.ca:/home/e949/artamonov/tdacc/v03**
- Tables 4,5: **rarekXX.triumf.ca:/home/e949/artamonov/tdacc/pnn2**
- Table 6 : **rarekXX.triumf.ca:/home/e949/artamonov/tdrej/v02/tst03**
- Table 7 : **rarekXX.triumf.ca:/home/e949/artamonov/tdrej/v02**

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References

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[3] Tetsuro Sekiguchi, **Measurement of the $K^+ \to \pi^+\nu\bar{\nu}$ Branching Ratio**, thesis, KEK K-decay Report 2005-3.