Experiment 949
Technical Note No. K-072

$K_{\pi 2}$ Branching Ratio.

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Abstract

A measurement of the $K_{\pi 2}$ branching ratio using the current set of PNN2 analyses cuts are presented. The procedure used the results of technotes K034 [2] as control ones and the values of f_s and of $\epsilon^{ng}_{T.2}(K_{\pi 2})$ measured therein. It was shown that the $K_{\pi 2}$ branching ratio value 0.2213 ± 0.0022 in agreement with PDG2007 [6] value 0.2092 ± 0.0012, and the result obtained in previous analyses, for instance with value 0.2150 $\pm 0.0050_{STAT}$ of technotes K034 [2] or 0.219 $\pm 0.0050_{STAT}$of technotes K038 [3]. The run dependence of the $K_{\pi 2}$ branching ratio as a function of run, prescale factor and instantaneous intensity are also measured.

1 Introduction

The purpose of $K_{\pi 2}$ branching ratio measurement is well described in technote K-034 [2]. One of the main reason to make this measurement is to check up consistency and correctness of the different parts of the analyses procedure in blind PNN2 analyses before opening box to exclude possible flaws.

2 Experimental data

The $K_{\pi 2}(1)$ monitoring data set (called KP21_FINAL in current analyses) of the 2002 data taking run has been used in this analysis. Data have been taking by following trigger conditions:

$$(ONLINE\ \ TRIGGER)_{K_{\pi 2}} = KB \times T \cdot 2 \times (6_{ct} + 7_{ct}) \times \overline{19_{ct}} \tag{1}$$

and with prescales factors 163840 (runs 47737÷48045) and 131072 after run 48045. The number of $K_{\pi 2}$ events, number of beam K^+-mesons, and prescale factor versus run are shown on Fig. 1 a), b) c), correspondingly. It should be noted that a small fraction of $K_{\pi 2}(1)$ monitoring data was not used in analysis because of absence end of spill information at the moment. The runs with existing information on number of beam K^+ mesons and prescaler for $K_{\pi 2}$ events have been used. For some runs (about 50) the prescaler factor in the prescaler file wasn't defined and have been taken equal to prescaler of previous run.

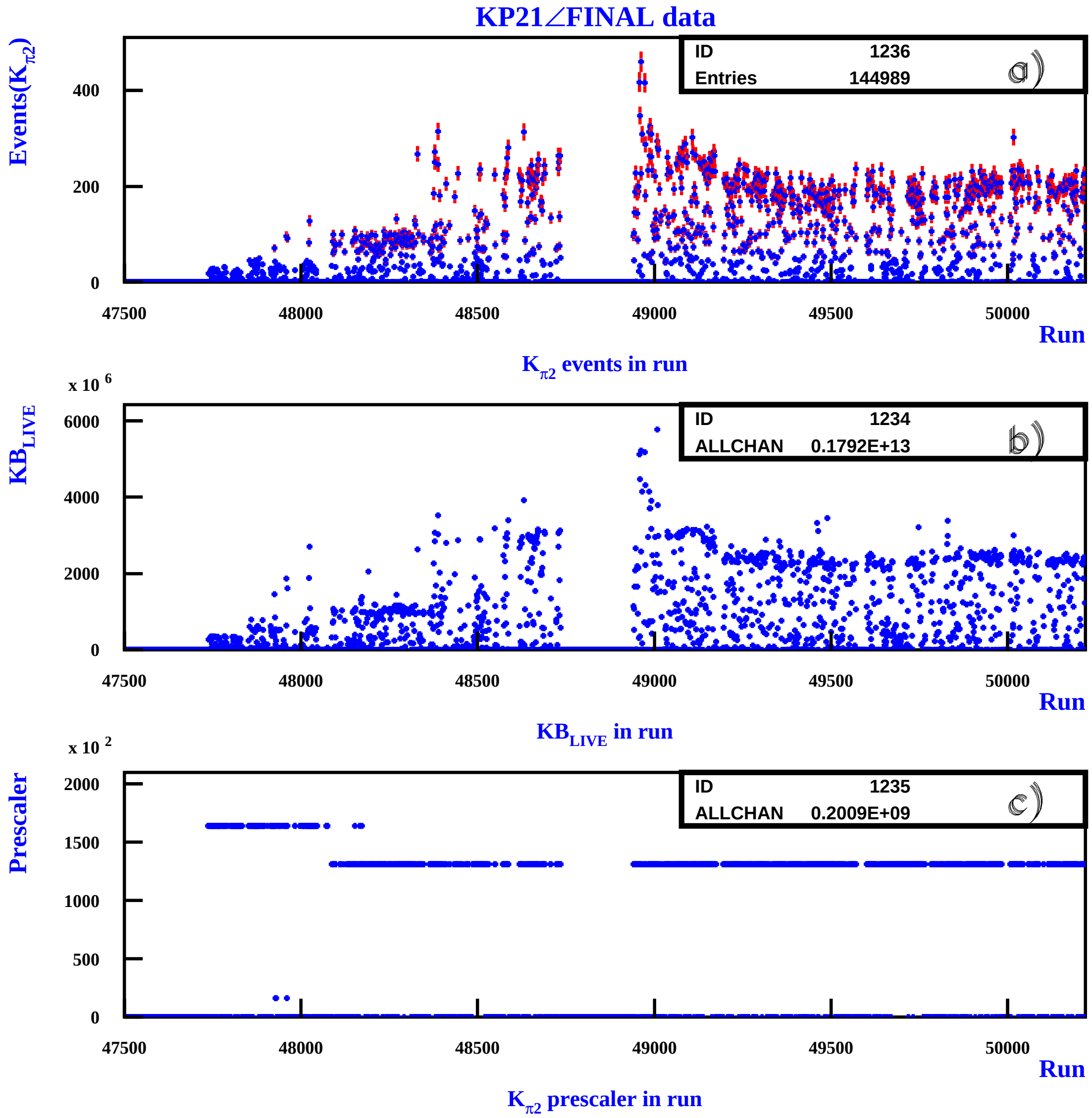

Figure 1: The $K_{\pi 2}$ a) events, b) beam K^+-mesons and c) prescale factor versus run number.

3 Description of the method

The method used for the $K_{\pi 2}$ branching ratio measurement is described in detail elsewhere [2]. The $K_{\pi 2}$ branching ratio is calculated according to following equation:

$$BR(K_{\pi 2}) \quad = \quad \frac{N_{K_{\pi 2}}}{\epsilon T \cdot 2 \cdot IC(K_{\pi 2}) \cdot (KB_{live})_{K_{\pi 2}} \cdot A_{K_{\pi 2,Br}} \cdot A^{UMC}_{K_{\pi 2,kin}} \cdot f_S \cdot A^{UMC}_{K_{\pi 2,trig}}} \qquad (2)$$

where :

$$A_{K_{\pi 2},Br} = A_{RD,Br} \times A_{RECO,Br} \times A_{REST,Br} \times A_{IPIFLG} \times A^{acc}_{\mu} \qquad (3)$$

The values of f_s, $\epsilon^{ng}_{T.2}(K_{\pi 2})$, A^{acc}_{μ} for loss due to $\overline{19}_{ct}$ condition inefficiency, and A_IPIFLG have not been measured in this analyses and have been taken from previous 2002 year PNN1 analyses [2].

4 Monte Carlo kinematic and trigger acceptances

The kinematic and trigger acceptances for $K_{\pi 2}$ events have been defined by Monte Carlo simulation and are presented on table 1. The result of previous 2002 analyses [3] are presented for comparison too (taken from table 20 on page 38 in k038 [3]). Besides cuts listed in this table and in tables 2, 3 the some cuts were applied at stage of TRIGGER cut, namely:

1). Loose cut to remove $K_{\mu 2}$ events and duplication event $(rngmom\_new3(0.) \ .LE. \ 3) \ .AND. \ (.not.cut(6))$

2). $tlay \leq 21$

3). $(ptot \ .NE. \ 0) \ .and. \ (PTOT \ .NE. \ 300)$

It should be noted that these cuts don't make any effect on UMC data sample.
KPI2BOX cut used in previous analysis is:

$$KP2BOX = (abs(rdev) \ .LT. \ 3) \ .AND. \ (abs(edev) \ .LT. \ 3) \ .AND. \ (abs(pdev) \ .LT. \ 3)$$

The detail on UMC cut definitions could be found in Appendix A.

Cut	2002 (acc.)	2007 (acc.)
KT	49997	99993
T•A	22697(0.45397)	44891(0.44894)
Reach Layer B	19090(0.84108)	37605(0.83769)
$\overline{19_{ct}}$	18797(0.98465)	36986(0.98354)
UFATE	15910(0.84641)	31222(0.84416)
USTMED	15568(0.97850)	30518(0.97745)
USTOP_HEX	13909(0.89344)	27426(0.89868)
$A^{UMC}_{K_{\pi 2},trig}$	0.27820 ± 0.00200	0.27428 ± 0.00141
UTC/RANGE	13909(1.00000)	————
RDUTM	————-	27426(1.00000)
UTCQUAL	12660 (0.91020)	26910(0.98119)
TARGET	12532 (0.98989)	————
TARGET+TGQUALT	————-	25659(0.95351)
$A^{UMC}_{K_{\pi 2},recon}$	0.90100 ± 0.00253	0.93557 ± 0.00148
KPI2STOP	12072 (0.96329)	24639(0.96025)
COS3D	11878 (0.98393)	23671(0.96071)
KPI2BOX	10840 (0.91261)	————
KPI2BOX_MOD	————-	20213(0.85391)
$A^{UMC}_{K_{\pi 2},kin}$	0.86499 ± 0.00305	0.78775 ± 0.00255
$A^{UMC}_{K_{\pi 2}}$	0.2168 ± 0.0018	0.20214 ± 0.00127

Table 1: UMC $K_{\pi 2}$ acceptance of cuts applied in the$K_{\pi 2}$ branching ratio analysis. NIDIF is on. In E949, the $(\overline{19_{ct} + 20_{ct} + 21_{ct}})$ trigger condition has been changed to $\overline{19_{ct}}$.

5 The $K_{\pi 2}$ event selection branch of cuts.

The cuts applied to $K_{\pi 2}(1)$ monitoring data to select the $K_{\pi 2}$ events in the $K_{\pi 2}$ branching ratio analysis and their acceptances are shown in table 2. The result of technical note k-038 [3] are shown also as the control result (taken from table 16 on page 34).

Cut name and difference of acceptances 2002 and 2007	$N_{K_{\pi 21}}$ 2002 (Acceptance)	$N_{K_{\pi 21}}$ 2007 (Acceptance)	$N_{K_{\pi 21}} \times Prescale \times 10^{-10}$ 2007 (Acceptance)
ALL 0.000%	84844(0.000)	1938973(0.000)	25.4999(0.000)
BAD_RUN 1.254%	84803(0.99952)	1913712(0.98697)	25.3029(0.99227)
TRIGGER 54.108%	84803(1.00000)	878246(0.45892)	11.6109(0.45888)
BAD_STR 0.009%	84388(0.99511)	873864(0.99501)	11.5521(0.99494)
RD_TRK 0.000%	84388(1.00000)	873864(1.00000)	11.5521(1.00000)
TRKTIM 0.000%	84388(1.00000)	873864(1.00000)	11.5521(1.00000)
RDUTM 0.000%	84388(1.00000)	873864(1.00000)	11.5521(1.00000)
UTCQUAL -7.029%	67194(0.79625)	757238(0.86654)	10.0093(0.86645)
TARGET+TGQUALT 5.639%	65495(0.97471)	695393(0.91833)	9.19259(0.91841)
COS3D 3.695%	64425(0.98366)	658341(0.94672)	8.70245(0.94668)
B4DEDX 0.538%	62832(0.97527)	638520(0.96989)	8.43952(0.96979)
CPITRS 0.407%	61933(0.98569)	626788(0.98163)	8.28465(0.98165)
CPITAIL 0.007%	61882(0.99918)	626228(0.99911)	8.27728(0.99911)
ICBIT 0.001%	61857(0.99960)	625970(0.99959)	8.27389(0.99959)
TIC -0.429%	61352(0.99184)	623545(0.99613)	8.24150(0.99608)
TIMCON 0.193%	60882(0.99234)	617564(0.99041)	8.16218(0.99038)
TGTCON 0.332%	60212(0.98899)	608715(0.98567)	8.04531(0.98568)
DCBIT -0.542%	51016(0.84727)	519045(0.85269)	6.86302(0.85305)
DELC -0.236%	44193(0.86626)	450851(0.86862)	5.96163(0.86866)
CKTRS 0.082%	42835(0.96927)	436628(0.96845)	5.77414(0.96855)
CKTAIL -0.042%	41570(0.97047)	423918(0.97089)	5.60547(0.97079)
BWTRS 0.088%	39270(0.94467)	400092(0.94380)	5.28988(0.94370)
RVUPV -0.090%	38354(0.97667)	391120(0.97757)	5.17075(0.97748)
TARGF 0.324%	36430(0.94984)	370232(0.94659)	4.89491(0.94665)
DTGTTP -0.018%	36422(0.99978)	370219(0.99996)	4.89474(0.99996)
RTDIF -0.031%	36039(0.98948)	366439(0.98979)	4.84457(0.98975)
TGQUALT 0.000%	36039(1.00000)	366439(1.00000)	4.84457(1.00000)
PIGAP 0.175%	35657(0.98940)	361912(0.98765)	4.78419(0.98754)
TGB4 1.362%	33611(0.94262)	336217(0.92900)	4.44510(0.92912)
KIC -0.084%	33118(0.98533)	331568(0.98617)	4.38364(0.98617)
TGGEO 0.528%	27505(0.83052)	273622(0.82524)	3.61775(0.82528)
B4EKZ 4.915%	26657(0.96917)	251738(0.92002)	3.32839(0.92002)
B4ETCON -0.064%	26523(0.99497)	250633(0.99561)	3.31343(0.99550)
TGZFOOL 1.266%	26523(1.00000)	247461(0.98734)	3.27153(0.98735)
PV_noBV 0.000%	26523(1.00000)	247461(1.00000)	3.27153(1.00000)
IPIFLG 0.181%	18688(0.70460)	173913(0.70279)	2.29944(0.70286)
KPI2BOXM 4.515%	16469(0.88126)	145410(0.83611)	1.92215(0.83592)
KP2STOP -0.099%	16405(0.99611)	144989(0.99711)	1.91660(0.99711)
RTOT40 0.000%	16405(1.00000)	144989(1.00000)	1.91660(1.00000)
$N_{K_{\pi 2}}$ 2.836%	16405(0.193)	144989(0.165)	1.91660(0.165)

Table 2: For the $K_{\pi 2}$, cuts applied in the $K_{\pi 2}$ BR analysis.

6 $K_{\pi 2}$ branching ratio acceptances

The cuts were used in definition of acceptances for $K_{\pi 2}$ are shown on table 3. In this table shown also acceptances weren't defined in this analyses and were taken from Table 23 on page 41 of technical note k-038 [3]. The noticed difference with k034 is that instead of A_{μ}^{acc}=0.9931 ± 0.0002 was used A_{BAD}=0.99463 ± 0.00025. The result calculation of $A_{K_{\pi 2},Br}$=0.3240 include this error. It means that $K_{\pi 2}$ branching ratio values are larger that has to be.

7 $K_{\pi 2}$ branching ratio

The value of $K_{\pi 2}$ branching ratio has been calculated using equation 2. The appropriate values can be found in Tables 1, 2, 3 and Fig. 1 b) and Fig. 2. The values of f_s== 0.7740± 0.0011 (equation 21 on page 40 in k038 [3] and Fig. 2) and of $\epsilon^{ng}_{T.2}(K_{\pi 2}) = \epsilon T \cdot 2 \cdot IC(K_{\pi 2})$=0.9383±0.0027 (derived from k038 [3] and table 17 on page 16 therein) have been taken from previous 2002 year PNN1 analyses [3]. In Fig.2 shown the f_S value defined by $K_{\mu 2}$ monitoring data. The first point at upper plot corresponding to runs of $K_{\pi 2}(1)$ monitoring data with prescale factor 163840.

$$
\begin{aligned}
BR(K_{\pi 2}) &= \frac{191660 \times 10^5}{0.9383 \cdot 1.792 \times 10^{12} \cdot 0.3080 \cdot 0.78775 \cdot 0.774 \cdot 0.27428} && (4)\\
&= 0.2213 \pm 0.0022 && (5)
\end{aligned}
$$

is in agreement with PDG2007 [6] value 0.2092 ± 0.0012

The run dependence of $K_{\pi 2}$ branching ratio is shown in Fig.3 a) for all runs and b) for sets of data corresponding to approximately equal number of beam K^+ defined by:

$$\sum_{i=1}^{N_{\mathrm{Spill}}} \frac{KBLIVE_i}{Prescale_i} \geq 3000$$

and plotted versus the last number in set. The calculation of $K_{\pi 2}$ branching ratio for runs with different prescale have been done using $A_{K_{\pi 2},Br}$ defined by this runs. The result are shown on Table 4.

Difference of the $K_{\pi 2}$ branching ratios for data with prescale 131072 and 163840 is 0.0311 ± 0.0053, i.e. about 5.8 standard deviation from zero. The run dependence of the $K_{\pi 2}$ branching ratios calculated independently for both values of prescale are shown in Fig. 6. The $N_{K_{\pi 21}}$ selection branch for runs with different prescale factor are shown on Table 7 to make a comparison. Statistical error on acceptances' differences has to be $\sim 0.3\%$. The rate dependence of values used in the $K_{\pi 2}$ branching ratio analyses are presented on Table 5. There is the rate dependence. Some events have scaler scal_teff equal 0. and had been neglected in the rate analyses only.

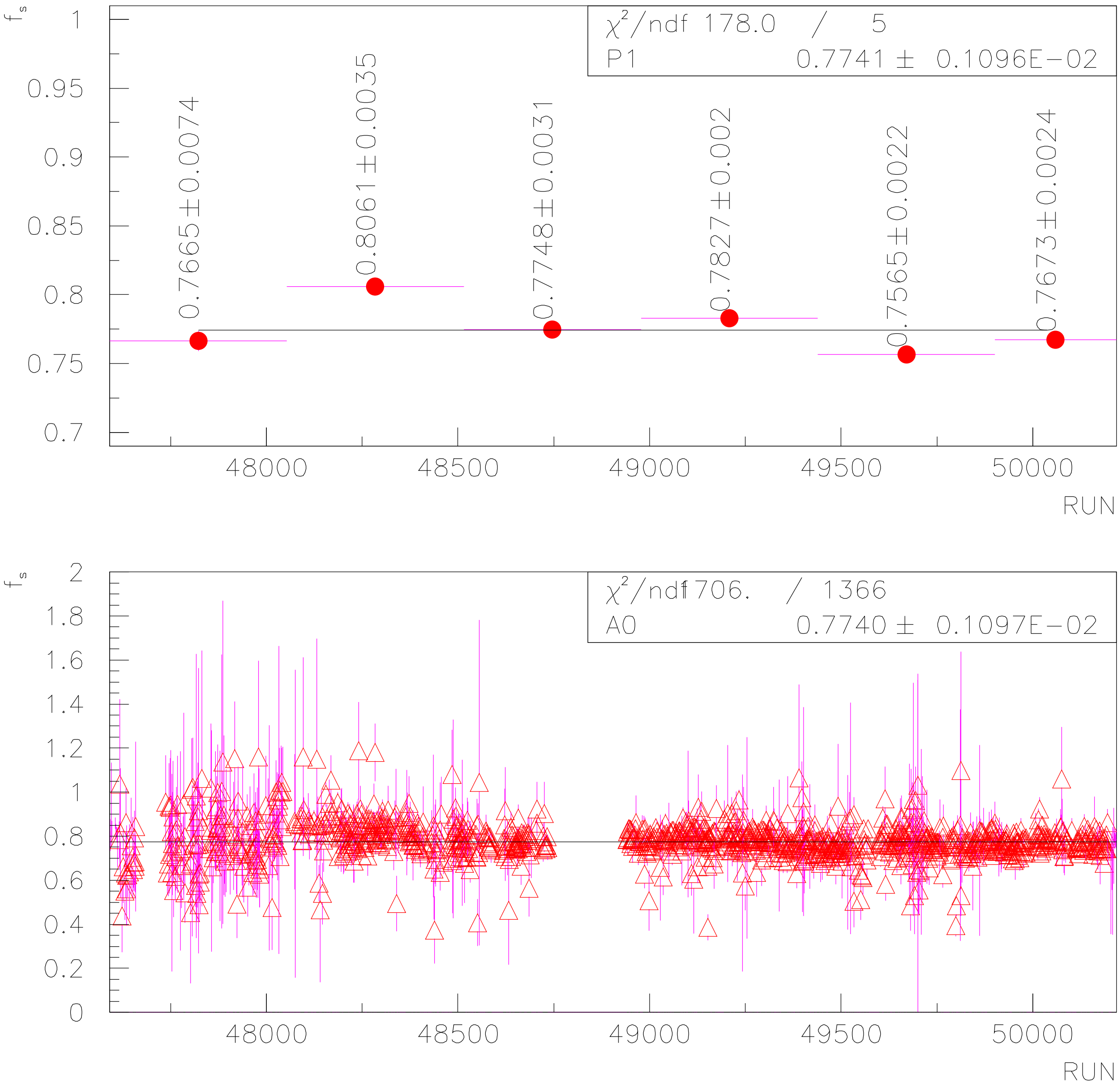

Figure 2: The f_S value versus group of run numbers.

Cut name Acc2002-Acc2007%	$N_{K_{\pi21}}$ (Acc) 2002	$N_{K_{\pi21}}$ (Acc) 2007	$N_{K_{\pi21}} \times PS \times 10^{-10}$ (Acc) 2007
$SETUP_{RD}$	51416	490579	6.48627
RD_TRK 0.000%	51416(1.00000)	490579(1.00000)	6.48627(1.00000)
TRKTIM 0.000%	51416(1.00000)	490579(1.00000)	6.48627(1.00000)
A_RD,Br 0.000%	1.00000 ± 0.00000	1.00000 ± 0.00000	1.00000 ± 0.00000
$SETUP_{RECON}$	32980	449621	5.94311
RDUTM 0.000%	32980(1.00000)	449621(1.00000)	5.94311(1.00000)
UTCQUAL -5.355%	28117(0.85255)	407402(0.90610)	5.38560(0.90619)
TARGET+TGQUALT 4.116%	27831(0.98983)	386491(0.94867)	5.10947(0.94873)
A_RECO,Br -1.572%	0.84388 ± 0.00200	0.85959 ± 0.00052	0.85973 ± 0.00052
$SETUP_{REST}$	32055	336407	4.44631
TIC 0.070%	32055(1.00000)	336173(0.99930)	4.44302(0.99926)
TIMCON 0.124%	31970(0.99735)	334866(0.99611)	4.42542(0.99604)
TGTCON 0.757%	31847(0.99615)	331041(0.98858)	4.37507(0.98862)
DCBIT 10.327%	31542(0.99042)	293685(0.88716)	3.88327(0.88759)
DELC 0.883%	27898(0.88447)	257163(0.87564)	3.40010(0.87558)
CKTRS -9.986%	24368(0.87347)	250305(0.97333)	3.30963(0.97339)
CKTAIL 0.125%	23710(0.97300)	243233(0.97175)	3.21525(0.97148)
B4DEDX -1.279%	23032(0.97140)	239389(0.98420)	3.16464(0.98426)
CPITRS -0.636%	22657(0.98372)	237015(0.99008)	3.13340(0.99013)
CPITAIL -0.872%	22442(0.99051)	236833(0.99923)	3.13101(0.99924)
TARGF 4.115%	22431(0.99951)	226972(0.95836)	3.00061(0.95835)
DTGTTP -4.295%	21467(0.95702)	226965(0.99997)	3.00052(0.99997)
RTDIF 0.935%	21462(0.99977)	224789(0.99041)	2.97168(0.99039)
TGQUALT -0.862%	21277(0.99138)	224789(1.00000)	2.97168(1.00000)
PIGAP 1.024%	21277(1.00000)	222488(0.98976)	2.94100(0.98968)
TGB4 5.875%	21098(0.99159)	207545(0.93284)	2.74379(0.93295)
KIC -3.865%	20002(0.94805)	204785(0.98670)	2.70742(0.98674)
TGGEO 16.326%	19855(0.99265)	169847(0.82939)	2.24603(0.82958)
B4EKZ -10.248%	16358(0.82387)	157338(0.92635)	2.08035(0.92623)
B4ETCON -2.463%	15886(0.97115)	156673(0.99577)	2.07138(0.99569)
TGZFOOL 0.754%	15806(0.99496)	154703(0.98743)	2.04539(0.98745)
BWTRS 4.324%	15806(1.00000)	148013(0.95676)	1.95689(0.95673)
RVUPV -2.685%	14817(0.93743)	145339(0.98193)	1.92141E+10(0.98187)
A_REST,Br 3.891%	0.46224 ± 0.00278	0.43203 ± 0.00085	0.43214 ± 0.00085
A_IPIFLG 1.100%	0.8350 ± 0.0054	0.8350 ± 0.0054	0.8350 ± 0.0054
loss due to $\overline{19}_{ct}$ A_{μ}^{acc} 0.000%	0.9931 ± 0.0002	0.9931 ± 0.0002	0.9931 ± 0.0002
$A_{K_{\pi2},Br}$ 4.140%	0.3235 ± 0.0030	0.3080 ± 0.0021	0.3080 ± 0.0021

Table 3: $K_{\pi2}$-based acceptances of cuts applied in the $K_{\pi2}$ BR analysis. The IPIFLG acceptance is measured using π_{scat}'s (counting method) similar to the $\pi\nu\bar{\nu}$ measurement of IPIFLG acceptance, except that here the π_{scat}'s are selected using KP2BOX and KP2STOP instead of BOX and LAYV4. The SETUP cuts are defined in Table 8. (similar to Table 69 on page 217 k034 or Table 11 on page 26 k038)

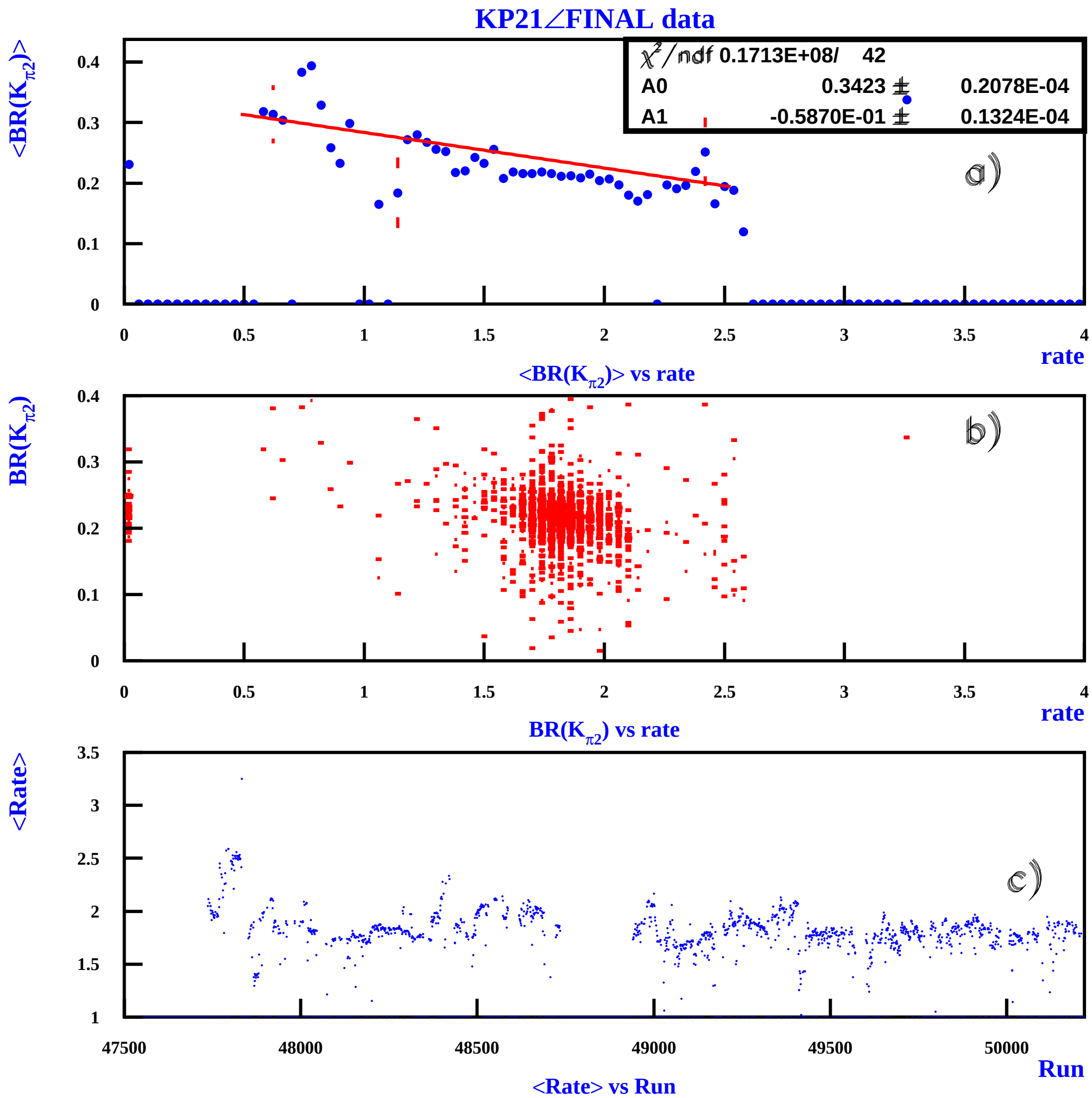

Figure 3: The $K_{\pi 2}$ branching ration a) average versus average rate in run and b) versus average rate in run c) shows the average rate in run

Name of value	All runs	Prescale 163840	Prescale 131072
$K_{\pi 2}$ Events	144989	2973	141926
$< Prescale >$	131926	163840	131072
$KB_{LIVE} \times 10^{-12}$	1.79229	0.052475671	1.737988
$A_{K_{\pi 2},Br}$	0.3080 ± 0.0021	0.3136 ± 0.0049	0.3078 ± 0.0021
$K_{\pi 2}$ branching	0.2213 ± 0.0022	0.1905 ± 0.0051	0.2216 ± 0.0016

Table 4: $K_{\pi 2}$ branching ratio results

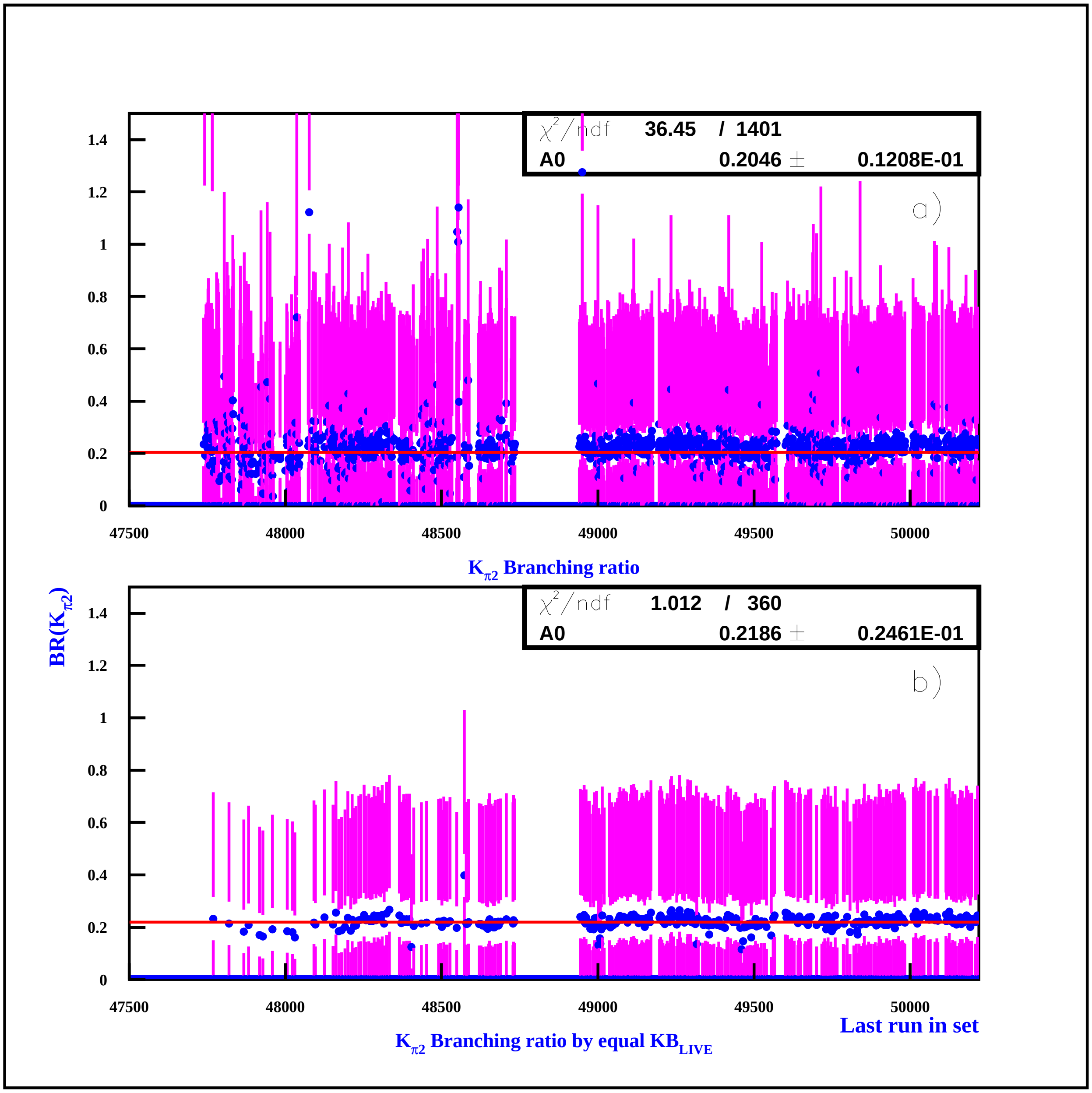

Figure 4: The $K_{\pi 2}$ branching ration a) versus run number and b) versus last run in set of data with approximately the same beam K^+ mesons.

Name of value	Rate region				
	All rates	0.00÷1.70	1.70÷1.85	1.85÷2.00	> 2.0
$K_{\pi 2}$ BR	0.2212 ± 0.0022	0.2284 ± 0.0025	0.2208 ± 0.0023	0.2194 ± 0.0023	0.2187 ± 0.0024
$A_{K_{\pi 2},BR}$	0.3081 ± 0.0021	0.3248 ± 0.0026	0.3088 ± 0.0023	0.3034 ± 0.0023	0.2989 ± 0.0025
$A_{RECO,BR}$	0.8597 ± 0.0005	0.8709 ± 0.0012	0.8608 ± 0.0009	0.8564 ± 0.0009	0.8524 ± 0.0014
$A_{REST,BR}$	0.4321 ± 0.0009	0.4497 ± 0.0021	0.4326 ± 0.0014	0.4273 ± 0.0015	0.4228 ± 0.0022
$KB_{LIVE} \times 10^{-12}$	1.792	0.280	0.639	0.594	0.279
Events	144989.	24716.	52010.	47141.	21116.
Events $\times PS \times 10^{-5}$	191660.	32602.	68366.	62050.	28635.
Trigger	878246.	138934.	312610.	290840.	135834.
Trigger $\times PS \times 10^{-5}$	1161090.	183250.	410936.	383023.	183845.
Events/Trigger	0.1651	0.1779	0.1664	0.1621	0.1555
Events× PS/Trigger× PS	0.1651	0.1779	0.1664	0.1620	0.1558

Table 5: $K_{\pi 2}$ branching ratio rate dependence

Name of value	Rate region				
	All rates	0.00÷1.70	1.70÷1.85	1.85÷2.00	> 2.0
$K_{\pi 2}$ BR	0.1905 ± 0.0051	0.2115 ± 0.0077	0.1765 ± 0.0065	0.1812 ± 0.0058	0.2003 ± 0.0068
$A_{K_{\pi 2},BR}$	0.3136 ± 0.0049	0.3462 ± 0.0105	0.3140 ± 0.0099	0.3126 ± 0.0082	0.2915 ± 0.0084
$A_{RECO,BR}$	0.8538 ± 0.0037	0.8733 ± 0.0076	0.8484 ± 0.0081	0.8590 ± 0.0064	0.8375 ± 0.0073
$A_{REST,BR}$	0.4429 ± 0.0060	0.4780 ± 0.0135	0.4464 ± 0.0131	0.4389 ± 0.0107	0.4198 ± 0.0113
$KB_{LIVE} \times 10^{-12}$	0.052	0.009	0.012	0.017	0.014
Events	2973.	635.	621.	926.	791.
Events $\times PS \times 10^{-5}$	4871.	1040.	1017.	1517.	1296.
Trigger	18535.	3547.	3793.	5749.	5445.
Trigger $\times PS \times 10^{-5}$	30368.	5811.	6214.	9419.	8921.
Events/Trigger	0.1604	0.1790	0.1637	0.1611	0.1453
Events× PS/Trigger× PS	0.1604	0.1790	0.1637	0.1611	0.1453

Table 6: $K_{\pi 2}$ branching ratio rate dependence for run with prescaler 163840.

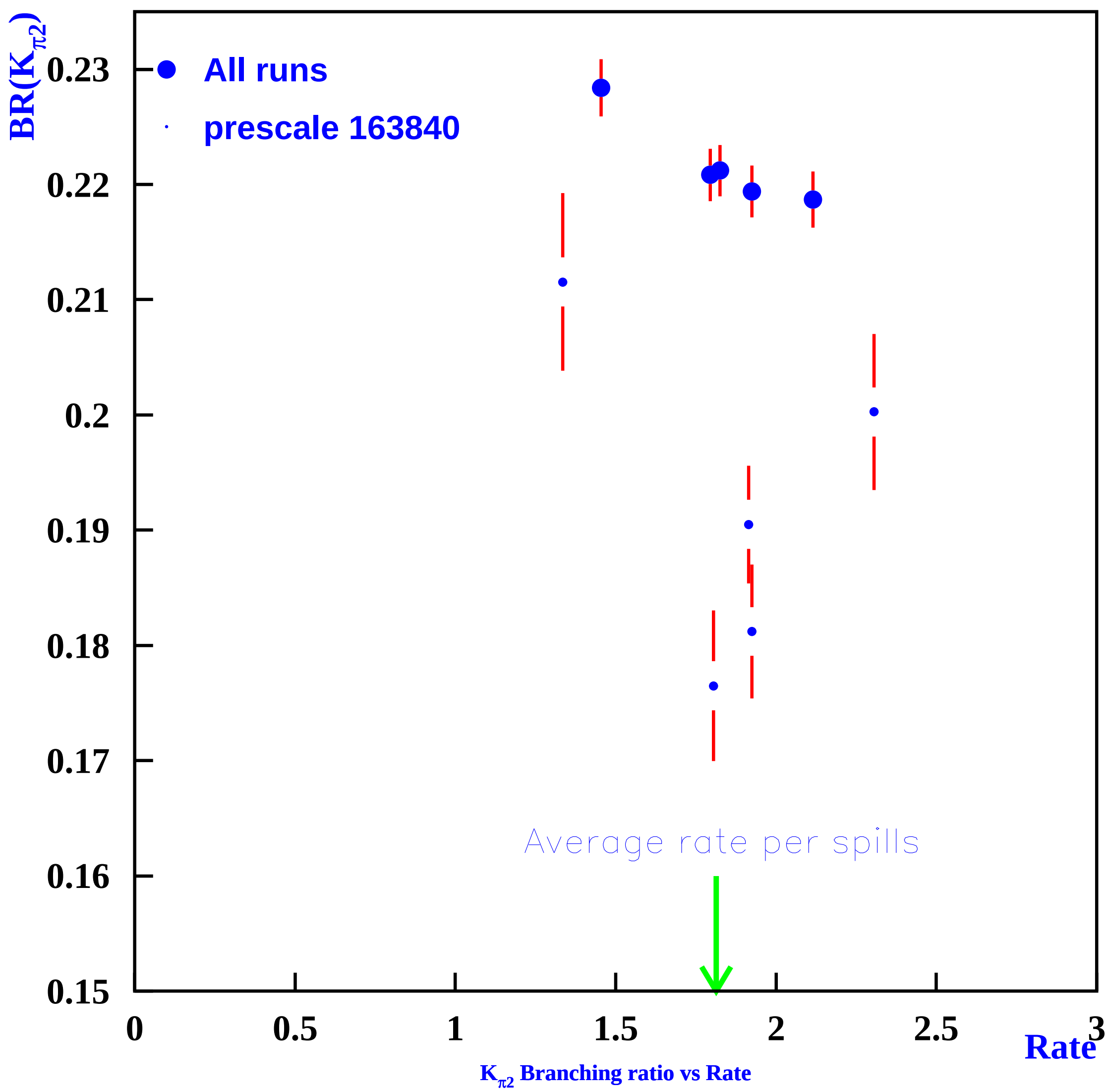

Figure 5: The $K_{\pi 2}$ branching ratio versus rate region for all runs (left panel) and for run with prescaler 163840 (right panel).

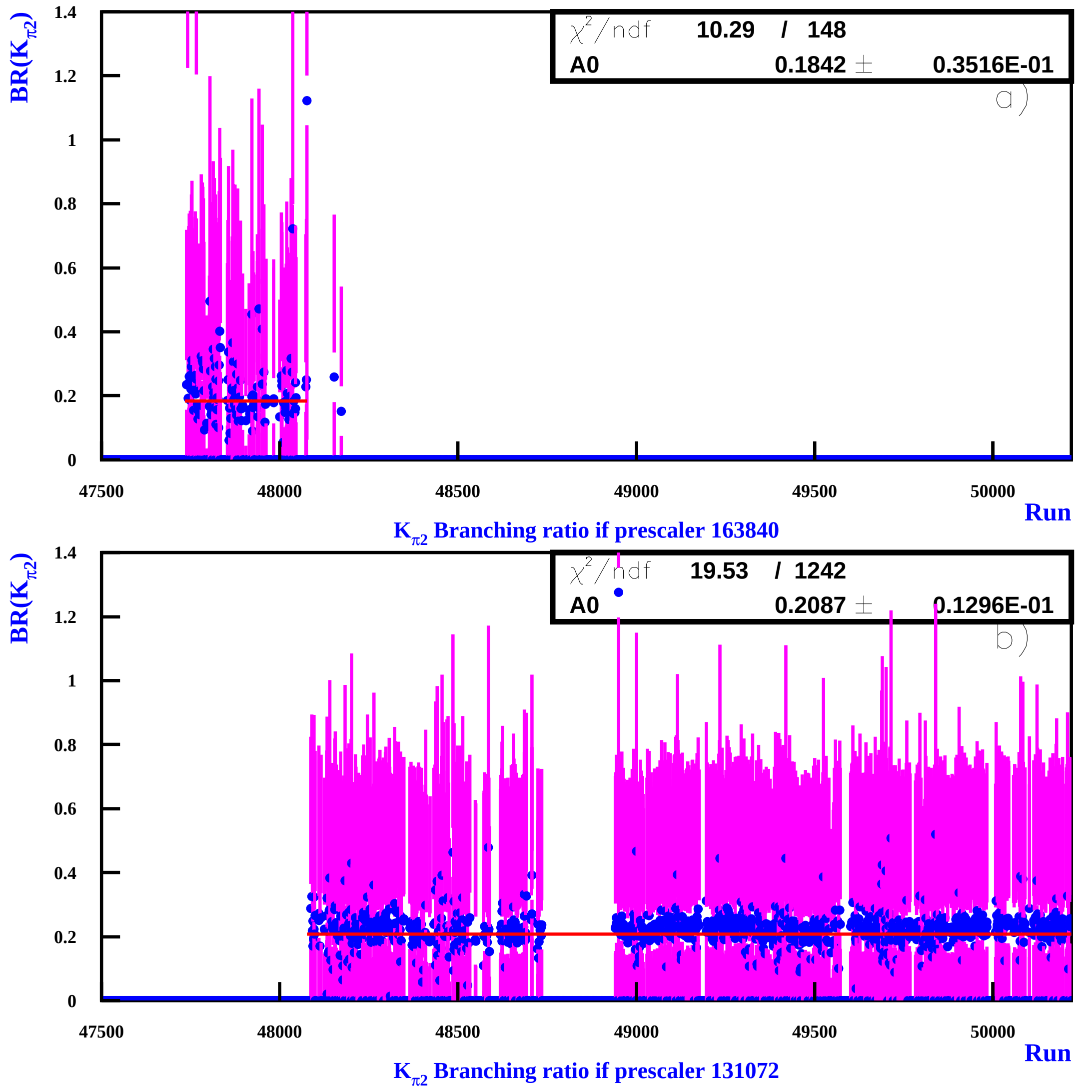

Figure 6: The $K_{\pi 2}$ branching ration versus run number a) for runs with prescaler 163840 and b) for runs with prescaler 131072

Cut name	$N_{K_{\pi 21}}$	
	163840	131072
TRIGGER+Prescaler	18535	859195
BAD_STR -1.839%	18109(0.97702)	855246(0.99540)
RD_TRK 0.000%	18109(1.00000)	855246(1.00000)
TRKTIM 0.000%	18109(1.00000)	855246(1.00000)
RDUTM 0.000%	18109(1.00000)	855246(1.00000)
UTCQUAL -0.729%	15563(0.85941)	741238(0.86670)
TARGET+TGQUALT 0.643%	14390(0.92463)	680603(0.91820)
COS3D -0.804%	13510(0.93885)	644454(0.94689)
B4DEDX 0.247%	13136(0.97232)	625022(0.96985)
CPITRS 0.562%	12967(0.98713)	613466(0.98151)
CPITAIL 0.028%	12959(0.99938)	612914(0.99910)
ICBIT 0.011%	12955(0.99969)	612660(0.99959)
TIC -0.117%	12890(0.99498)	610302(0.99615)
TIMCON 0.068%	12775(0.99108)	604443(0.99040)
TGTCON 0.184%	12615(0.98748)	595759(0.98563)
DCBIT 3.939%	11243(0.89124)	507499(0.85185)
DELC -3.480%	9383(0.83456)	441201(0.86936)
CKTRS 0.076%	9094(0.96920)	427275(0.96844)
CKTAIL -0.284%	8804(0.96811)	414865(0.97096)
BWTRS -0.026%	8307(0.94355)	391554(0.94381)
RVUPV -0.624%	8070(0.97147)	382826(0.97771)
TARGF 0.431%	7673(0.95081)	362341(0.94649)
DTGTTP 0.004%	7673(1.00000)	362328(0.99996)
RTDIF 0.004%	7595(0.98983)	358630(0.98979)
TGQUALT 0.000%	7595(1.00000)	358630(1.00000)
PIGAP 0.239%	7519(0.98999)	354183(0.98760)
TGB4 1.425%	7090(0.94295)	328929(0.92870)
KIC -0.042%	6989(0.98576)	324383(0.98618)
TGGEO 0.635%	5811(0.83145)	267649(0.82510)
B4EKZ 0.488%	5374(0.92480)	246216(0.91992)
B4ETCON -0.027%	5349(0.99535)	245138(0.99562)
TGZFOOL -0.751%	5242(0.98000)	242075(0.98750)
PV_noBV 0.000%	5242(1.00000)	242075(1.00000)
IPIFLG -0.642%	3651(0.69649)	170158(0.70291)
KPI2BOXM -1.890%	2985(0.81758)	142334(0.83648)
KP2STOP -0.115%	2973(0.99598)	141926(0.99713)
RTOT40 0.000%	2973(1.00000)	141926(1.00000)
$N_{K_{\pi 2}}$ -0.479%	2973	141926

Table 7: $K_{\pi 2}$ **selection branch for runs with prescale 131072 and 163840**

8 Discussion of the results.

The result on the $K_{\pi 2}$ branching ration has been obtained according to procedure of technical note K034 [2] but using new cuts' branch developed for PNN2 analyses. The values of f_s, $\epsilon^{ng}_{T.2}(K_{\pi 2}) = \epsilon T \cdot 2 \cdot IC(K_{\pi 2})$, A^{acc}_{μ}, and A_{IPIFLG} apllyed for $K_{\pi 2}$ branching ration calculation were not be calculated in this analyses and have been taken from previous 2002 year PNN1 analyses [3]. The result is consistent with PDG value in error bars' limits.

The rate dependence is observed. The runs with larger prescale equal to 163840 (the earliest in the run of data taking) have lower value of $K_{\pi 2}$ branching ration (more than 6 standard deviation from value obtained for run with prescale 131082 that is majority of data). The reason of it isn't understood well enough.

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Appendix A : UMC cut definitions.

The following cuts have been used in the calculation of Monte Carlo kinematic and trigger acceptances for $K_{\pi 2}$ branching ratio measurement.

UMC cut definitions

- **T•A ≡ T•2** This trigger condition is applied in UMC codes and the acceptance is printed into logfile.
- **Reach layer B** The inner nine layers of 19 mm thick counters were ganged together into 3 superlayers reffered as the A, B and C having 4,3 and 2 layers of scintillator, respectively. [4] So the requirement has to be layv4 ≥ 6. But really this requirement means $(6_{ct} + 7_{ct})$ by Zhe Wang and applied in UMC codes like T•2. So I supposed that it was ≡ lct(6).and.lct(7)=.true. in UMC codes.
- $\overline{19_{ct}}$ μ-veto (see for detail in [2] p.207).
- **UFATE** [1] requires that the pion stopped without decaying or interacting, this is why it has no acceptance loss for the NIDIF-off case.
- **USTMED** requires that the pion stopped in the RS scintillator.
- **USTOP_HEX** The offline reconstructed stopping counter agrees with the real one.
- **UTC/RANGE** The track reconstructed in UTC matches with those reconstructed in Range Stack and Target [1]. It is **RDUTM** cut now.
- **UTCQUAL** The UTCQUAL cuts require a track with a minimum of four z position measurements in UTC.
  A second requirement is a minimum value of 10^{-5} for the likelihood function constructed from the number of used xy hits, the number of UTC layers and the number of unused xy hits in each super layer (see for detail in [2] p.71).
- **TARGET** is SWATH CCD reconstruction cut.
  TARGET ≡ ITGQUAL ≥ 2 in PNN1 and ITGQUAL ≥ 9 in PNN2.
- **KP2STOP** requires the stopping layer to be between layers 8 and 15 inclusive.
- **COS3D** Cut any event with a dip angle outside the effective detection region $-0.5 < cos3d < 0.5$.
- **KPI2BOX** is a 3σ cut on the $K_{\pi 2}$ range, energy and momentum.

KPI2BOX_MOD used now is:

$$199. < ptot < 215. \quad (6)$$

$$28. < rtot < 35. \quad (7)$$

$$100.5 < etot < 115. \quad (8)$$

[1] UFATE, USTMED and USTOP_HEX [5] are cuts based on UMC truth variables.

Appendix B : Setup cuts for $K_{\pi 2}$ acceptance measurements.

$K_{\pi 2}$ SETUP	component cuts
$SETUP_{RD}$	TRIGGER, ICBIT, $t_{IC} - t_{Ck} > 5$ ns [a], B4DEDX, UTC, TARGET
$SETUP_{recon}$	TRIGGER, ICBIT, $t_{IC} - t_{Ck} > 5$ ns, B4DEDX, CPITRS, CPITAIL, CKTRS, CKTAIL, BWTRS, RVUPV, A_{RD} cuts,
$SETUP_{rest}$	TRIGGER, ICBIT, A_{RD} cuts,A_{recon} cuts, KP2BOX, KP2STOP, IPIFLG, COS3D.

[a] $t_{IC} - t_{Ck} > 5$ ns $\equiv$ ICTIME-CKTBM

Table 8: Setup cuts used in the $K_{\pi 2}$-based acceptance measurement and used in $K_{\pi 2}$ BR analysis.(Table 58 on page 201 tn-k034)

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[6] **http:
pdg.bnl.gov/2007/listings/s010.pdf**