E949 Technical Note K-068

Changes in the TGCUTS with the new processing

Ilektra A. Christidi, Stony Brook

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Abstract

This note summarizes the changes in the performance of the TGCUTS with the new ntuples. An overall drop of about 14% in the rejection of those cuts was observed using the newly processed 1/3 data, which is partly due to a bug fix in SWATHCCD and partly due to changes in the CCDPULSE fitter.

As can be seen by comparing tables 1 and 2, the Kp2 TG scatter background has gone up to 0.587 after the 1/3 reprocessing ("07 ntuples"), from 0.374 that it was before ("06 ntuples"), for CLASS 12. Given that the PV rejection has stayed the same within statistics, the difference can be traced to the normalization branch (tables 3 and 4), at the bottom of which 498 events survive now, up from 321 before.

CLASS	PNN2BOX				KP2BOX		
	bef. PV	af. PV	rejection	bg (3/3)	bef. PV	af. PV	rejection
1	1	1	1.0±0.0	0.000±0.000	41452	25	1658.1±331.5
2	24306	10	2430.6±768.5	0.396±0.126	155731	129	1207.2±106.2
3	2236	2	1118.0±790.2	0.862±0.610	58097	56	1037.4±138.6
4	3153	1	3153.0±3152.5	0.306±0.306	49282	37	1331.9±218.9
5	28694	11	2608.6±786.4	0.369±0.112	183491	151	1215.2±98.9
6	3147	2	1573.5±1112.3	0.612±0.433	78114	69	1132.1±136.2
7	27976	8	3497.0±1236.2	0.275±0.098	96070	72	1334.3±157.2
8	169	1	169.0±168.5	5.732±5.750	8214	7	1173.4±443.3
9	23281	9	2586.8±862.1	0.372±0.124	173350	145	1195.5±99.2
10	11583	4	2895.8±1447.6	0.333±0.166	30208	28	1078.9±203.8
11	23	1	23.0±22.5	43.773±44.774	2034	2	1017.0±718.8
12	25788	10	2578.8±815.3	0.374±0.118	164645	133	1237.9±107.3
13	2642	2	1321.0±933.7	0.730±0.516	63157	59	1070.5±139.3

Table 1: The rejection branch for the Kp2 TG scatter background, for the 06 ntuples: PV rejection for the PNN2 and KP2 boxes, and respective background, for the 12 classes.

Much of this difference can be attributed to the CCDBADFIT and CCDPUL cuts (from now on refered to collectively as CCDPUL), whose rejection went from 9.41 down to 6.31. However, big

CLASS	PNN2BOX				KP2BOX		
	bef. PV	af. PV	rejection	bg (3/3)	bef. PV	af. PV	rejection
1	1	1	1.0±0.0	0.000±0.000	56196	35	1605.6±271.3
2	25828	10	2582.8±816.6	0.579±0.183	155269	134	1158.7±100.1
3	2547	3	849.0±489.9	1.762±1.018	56918	55	1034.9±139.5
4	4469	3	1489.7±859.8	1.004±0.580	67715	48	1410.7±203.5
5	31681	13	2437.0±675.8	0.613±0.170	193431	163	1186.7±92.9
6	3661	3	1220.3±704.3	1.225±0.708	79626	72	1105.9±130.3
7	24498	6	4083.0±1666.7	0.366±0.150	92462	65	1422.5±176.4
8	267	1	267.0±266.5	5.617±5.628	11173	9	1241.4±413.6
9	25085	11	2280.4±687.4	0.655±0.198	181864	157	1158.4±92.4
10	10840	4	2710.0±1354.8	0.551±0.276	29393	28	1049.8±198.3
11	50	1	50.0±49.5	30.490±30.804	2853	3	951.0±548.8
12	27944	11	2540.4±765.8	0.588±0.178	167727	143	1172.9±98.0
13	3051	3	1017.0±586.9	1.470±0.850	62835	59	1065.0±138.6

Table 2: The rejection branch for the Kp2 TG scatter background, for the 07 ntuples: PV rejection for the PNN2 and KP2 boxes, and respective background, for the 12 classes.

part of this change is expected due to the acceptance gain of these cuts of $0.4144/0.2990 = 1.386$, which should give a rejection of 6.79 ± 0.19 (the correlation between the 06 and 07 samples has been taken into account for the error). Therefore, there is a pure rejection loss of this cut by $6.31/6.79 = 0.929 \pm 0.028$,which might be worth investigating.

Multiplying the 06 background by the same CCDPUL acceptance gain factor, a background of 0.517 is expected in 07, lower by a factor of 1.14 ± 0.03 from what is measured. The contribution of the CCDPUL rejection loss is $6.79/6.31 = 1.076$, not quite enough to explain all the increase in the background, which is also due to the loss of rejection of the rest of the TGCUTS.

The rejection of the set of all TGCUTS without CCDBADFIT and CCDPUL, (B4EKZ to ANGLI in the normalization tables) has dropped from 13.40 ± 0.23 to 12.12 ± 0.21, a factor of 1.106 (the errors do not take into account the correlation between the samples, so the difference is really significant). This change is most likely due to a bug fix in the part of SWATHCCD that mends pion fibers into the initial list for the track fitter to use. As Benji put it, "A hit initially a kaon deemed out of time with the rest of the cluster is mended into the pion list. However, the energy of the hit was not stored correctly and thus we were using stale info. When the pion likelihood function was applied the energy used was incorrect and we were able to accept some high energy fibers. The bug will remove some hits that are okay and add hits that are not okay." An obvious effect of the bug fix is removing unnaturally high energy pion fibers (based on which many TGCUTS would have cut events), and naming them photon fibers, like they should be.

This change seems to have a dramatic effect on the EPITG rejection, but this is misleading, as this cut just happens to be close to the top of the list. When it is applied after all other TGCUTS, it has a rejection of 1.020 for the 06 ntuples, and 1.019 for the 07 ones, so practiacally the same. Trying to pin down the 10% rejection loss of the TGCUTS to a few cuts has been in vain, as comparing the "last" columns of the 06 and 07 normalization branches shows: it seems that it is the collective effect of the rejection of many cuts changing by a bit which causes the overall drop, which would make it quite tedious to recover this rejection by tuning them.

The overall acceptance of those same cuts, in the meanwhile, seems to be unchanged, based on Benji's acceptance tables [1] (if the change in every cut is really small, a line-by-line comparison would not reveal a difference): 0.396756 for the 06 ntuples vs 0.397348 for the 07 ones. Remember, the CCDPUL acceptance is not included in this number. Therefore, the idea that the rejection we lost due to the bug fix in SWATHCCD should be recovered in acceptance, does not seem to quite float. What we do gain though is a bit of rejection for the TGPV (from 1.40 to 1.49, a factor of 1.06) as expected from (correctly) calling high energy fibers photons.

So, breaking down the effect of the CCDPUL cut and the rest of the TGCUTS on the increase of Kp2 TG scatter background, one could say that they contribute almost equally. The former might be recovered by tuning the CCDPUL cut, whereas the latter, while understood based on the SWATHCCD bug fix, we might have to live with.

References

[1] `www.phy.bnl.gov/e949/software/meetings/bnl/1may07/Acceptance_new_ntuples_1May2007.pdf`

CUT	No box	PNN2BOX		KP2BOX
		sequential	last	
	30993416			
BAD_RUN,KERROR	30154820			
SKIM5,RECON	10479460			
PSCUT06	3111233			
DELCO3	3092258			
TDCUT02	722005			
KINCUT06	423083			
$\overline{PVCUT}$		40479		339852
B4EKZ(IC)		28900 (1.40066)	3519 (1.16485)	309672
TGZFOOL		28493 (1.01428)	3584 (1.01847)	304698
EPITG		16370 (1.74056)	3596 (1.02188)	267644
EPIMAXK		16370 (1)	3519 (1)	267644
TARGF		13935 (1.17474)	3616 (1.02756)	258575
DTGTTP		13935 (1)	3519 (1)	258567
RTDIF		13830 (1.00759)	3543 (1.00682)	256357
DRP		13640 (1.01393)	3532 (1.00369)	255478
TGKTIM		13400 (1.01791)	3542 (1.00654)	252974
EIC		13121 (1.02126)	3596 (1.02188)	248770
TIC		13121 (1)	3519 (1)	248769
TGEDGE		12903 (1.0169)	3557 (1.0108)	246451
TGDEDX		12150 (1.06198)	3575 (1.01591)	244940
TGENR		11888 (1.02204)	3583 (1.01819)	238446
PIGAP		11706 (1.01555)	3532 (1.00369)	236757
TGB4		10586 (1.1058)	3714 (1.05541)	225417
KIC		10581 (1.00047)	3522 (1.00085)	225311
PHIVTX		7958 (1.32961)	3897 (1.10742)	217973
OPSVETO		7004 (1.13621)	3979 (1.13072)	208390
TGLIKE		6599 (1.06137)	3642 (1.03495)	201726
TIMKF		5313 (1.24205)	4462 (1.26797)	177357
NPITG		5313 (1)	3519 (1)	177357
ALLKFIT		4935 (1.0766)	3832 (1.08895)	166471
TPICS		4931 (1.00081)	3524 (1.00142)	166444
EPIONK		4672 (1.05544)	3678 (1.04518)	158645
CHI567		3832 (1.21921)	3960 (1.12532)	136002
VERRNG		3243 (1.18162)	4202 (1.19409)	127552
CHI5MAX		3033 (1.06924)	3777 (1.07332)	118897
ANGLI		3021 (1.00397)	3533 (1.00398)	118810
CCDBADFIT		2435 (1.24066)	0 (0)	94913
CCDPUL		321 (7.58567)	0 (0)	41427

Table 3: The normalization branch for the Kp2 TG scatter background, for the 06 ntuples: events after setup cuts and TGCUTS and their rejection (in brackets), for every TGCUT applied sequentially or last, for PNN2 and KP2 boxes.

CUT	No box	PNN2BOX sequential	PNN2BOX last	KP2BOX
	12856573			
BAD_RUN,KERROR	12525587			
SKIM5,RECON	8156752			
PSCUT06	2730052			
DELCO3	2713349			
TDCUT02	699267			
KINCUT06	409159			
$\overline{PVCUT}$		38078		330814
B4EKZ(IC)		27242 (1.39777)	3687 (1.17346)	301449
TGZFOOL		26853 (1.01449)	3755 (1.01844)	296595
EPITG		16889 (1.58997)	3759 (1.01953)	260545
EPIMAXK		16889 (1)	3687 (1)	260545
TARGF		14397 (1.17309)	3789 (1.02766)	251761
DTGTTP		14397 (1)	3687 (1)	251753
RTDIF		14287 (1.0077)	3713 (1.00705)	249613
DRP		14091 (1.01391)	3699 (1.00325)	248758
TGKTIM		13852 (1.01725)	3713 (1.00705)	246332
EIC		13560 (1.02153)	3763 (1.02061)	242238
TIC		13560 (1)	3687 (1)	242237
TGEDGE		13343 (1.01626)	3725 (1.01031)	239972
TGDEDX		12547 (1.06344)	3746 (1.016)	238494
TGENR		12277 (1.02199)	3751 (1.01736)	232184
PIGAP		12091 (1.01538)	3701 (1.0038)	230556
TGB4		10860 (1.11335)	3896 (1.05669)	216849
KIC		10854 (1.00055)	3690 (1.00081)	216747
PHIVTX		8128 (1.33538)	4097 (1.1112)	209500
OPSVETO		7100 (1.14479)	4204 (1.14022)	200239
TGLIKE		6691 (1.06113)	3821 (1.03634)	193841
TIMKF		5448 (1.22816)	4623 (1.25386)	172474
NPITG		5448 (1)	3687 (1)	172474
ALLKFIT		5202 (1.04729)	3905 (1.05913)	166539
TPICS		5198 (1.00077)	3692 (1.00136)	166511
EPIONK		4906 (1.05952)	3900 (1.05777)	158435
CHI567		4037 (1.21526)	4130 (1.12015)	135866
VERRNG		3377 (1.19544)	4452 (1.20749)	127354
CHI5MAX		3150 (1.07206)	3958 (1.0735)	118701
ANGLI		3142 (1.00255)	3697 (1.00271)	118633
CCDBADFIT		2860 (1.0986)	0 (0)	107477
CCDPUL		498 (5.74297)	0 (0)	56161

Table 4: The normalization branch for the Kp2 TG scatter background, for the 07 ntuples: events after setup cuts and TGCUTS and their rejection (in brackets), for every TGCUT applied sequentially or last, for PNN2 and KP2 boxes.