Had Breco analysis: PID studies

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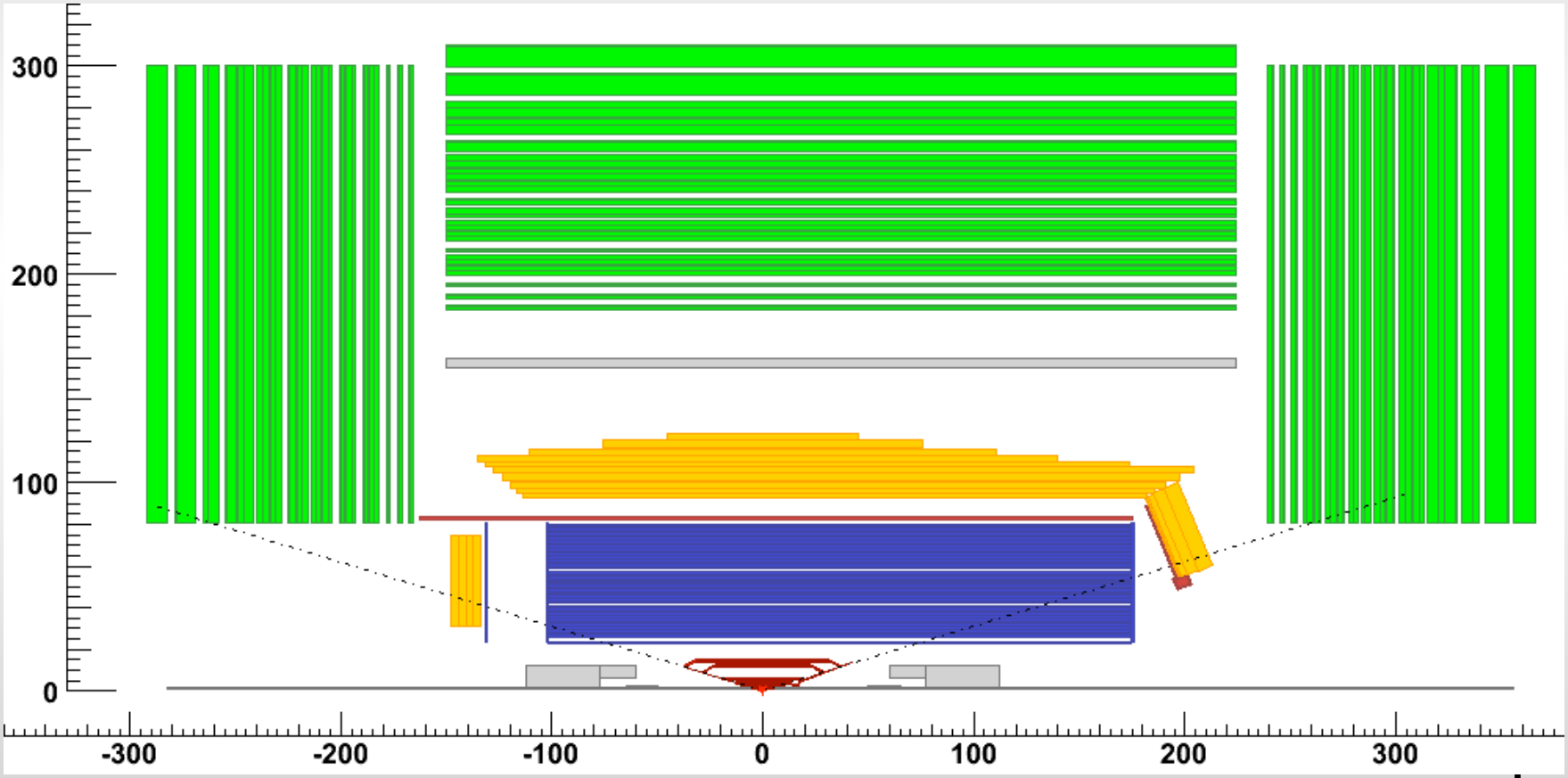
Outline

* PID studies : DG_4 samples (generic + signal), FWD TOF vs DCH for
  - Breco reconstruction efficiency comparison
  - Bsig reconreconstruction efficiency comparison ($B^+ \to K^+ \nu\nu$, $B^+ \to K^{*+} \nu\nu$, $B^+ \to K^{*0} \nu\nu$)
  - the simplest charged mode: $Breco^+ \to D^0(K^+\pi^-)\pi^+$
  - conclusions

Detector geometry used

* DetectorConfiguraztion_4
  - SVT_L0 + fwd PID + bwd EMC

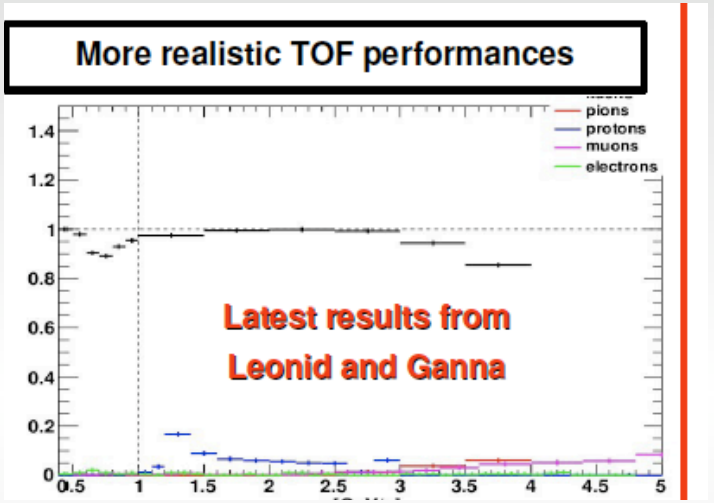


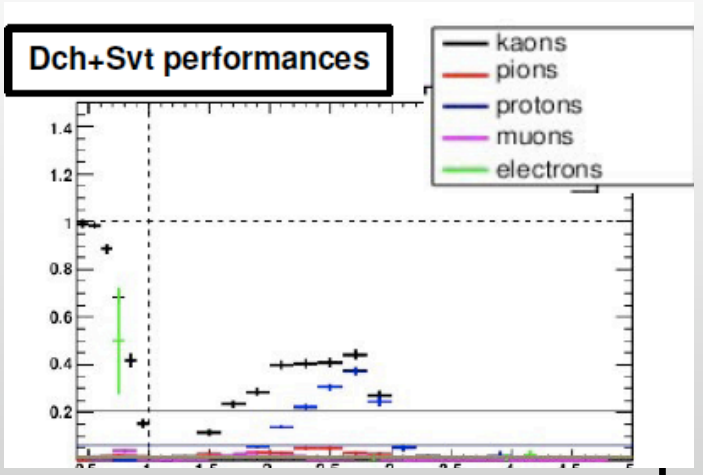
Analysis strategy

* February production tuples:
  - $B^+ \to K^{(*)} \nu\nu$ signal MC (w bkg mixing)
  - B+B- and B0B0bar generic MC (w/o bkg mixing)

* Two FWD PID configuration tested
  - DCH
  - DCH + FWD TOF

* PID selectors used : TIGHT selectors for K from both signal and tag side K PID:
  - kaons in the DIRC region: TableBased selectors (performances form BaBar)
  - kaons in the fwd region:
    * TableBased selectors with performances from TOF FullSim studies (DCH+TOF)
    * TableBased selectors with performances from BaBar (DCH)





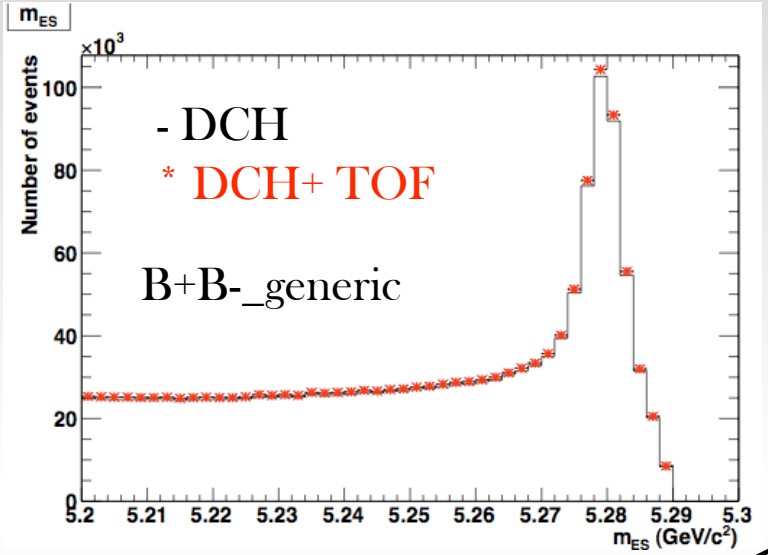
Charged Breco selection

- purity > 50% && Breco charge = ± 1

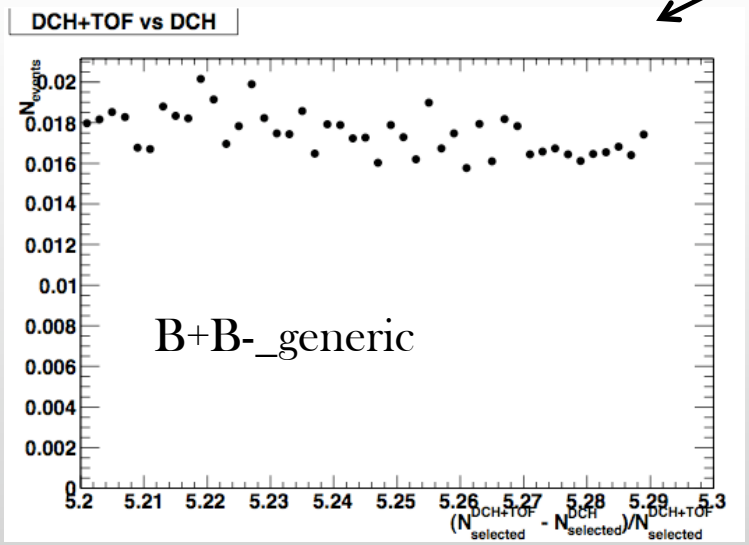
nb: $\varepsilon = N_{selected}/N_{gen}$ (not splitting combinatoric and peaking component in B+B- sample)

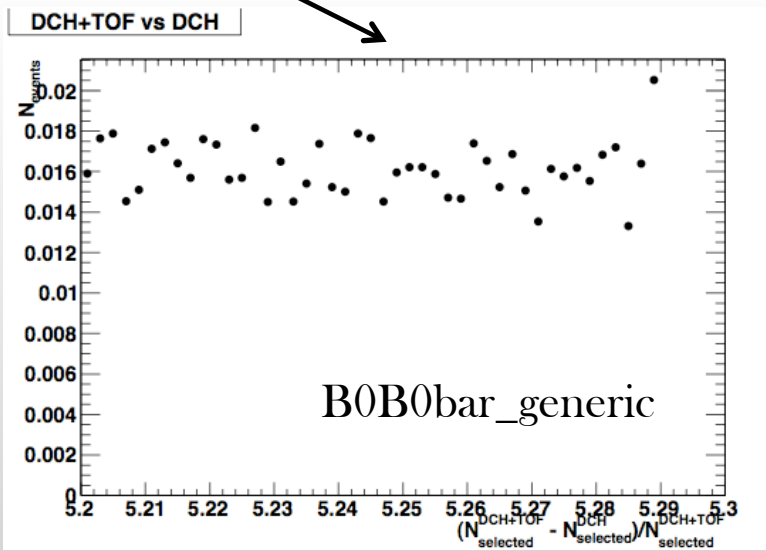
cherged breco	(N events) $\varepsilon_{DCH} * 10^{-3}$	(N events) $\varepsilon_{DCH+TOF} * 10^{-3}$	$(\varepsilon_{DCH+TOF}-\varepsilon_{DCH})/\varepsilon_{DCH+TOF}$
B+B-	(1.69645e+06) 16.273 ± 0.012	(1.72669e+06) 16.563 ± 0.012	+1.75%
B0B0bar	(867721) 8.571 ± 0.009	(882069) 8.712 ± 0.009	+1.62%
ccbar	(1.24154e+06) 12.066 ± 0.011	(1.26095e+06) 12.254 ± 0.011	+1.53%
uds	(3.57075e+06) 6.799 ± 0.003	(3.5934e+06) 6.842 ± 0.004	+0.63%
$B^+ \to K^+ \nu\nu$	(2552) 2.55 ± 0.05	(2601) 2.60 ± 0. 05	+1.92%
$B^+ \to K^{*+} \nu\nu$	(2964) 2.96 ± 0.05	(3026) 3.03 ± 0.05	+2.31%

Charged Breco mES distributions



$(N^{DCH+TOF} - N^{DCH})/N^{DCH+TOF}$





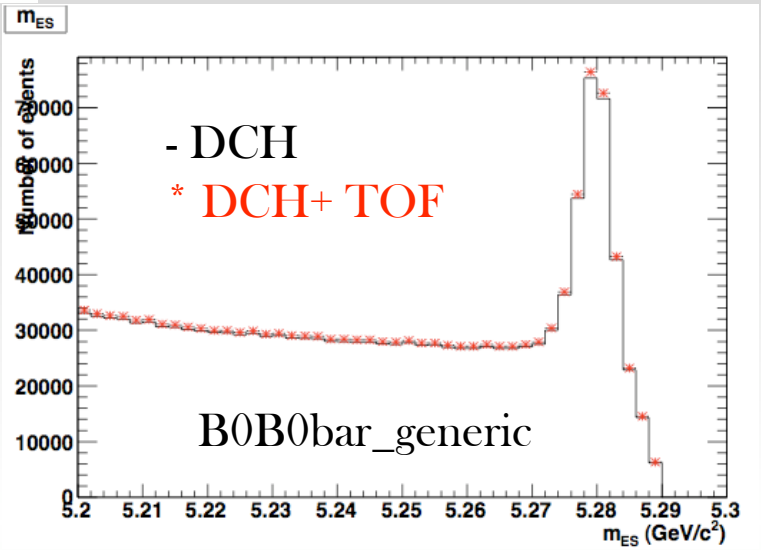
Neutral Breco selection

- purity > 50% && Breco charge = 0

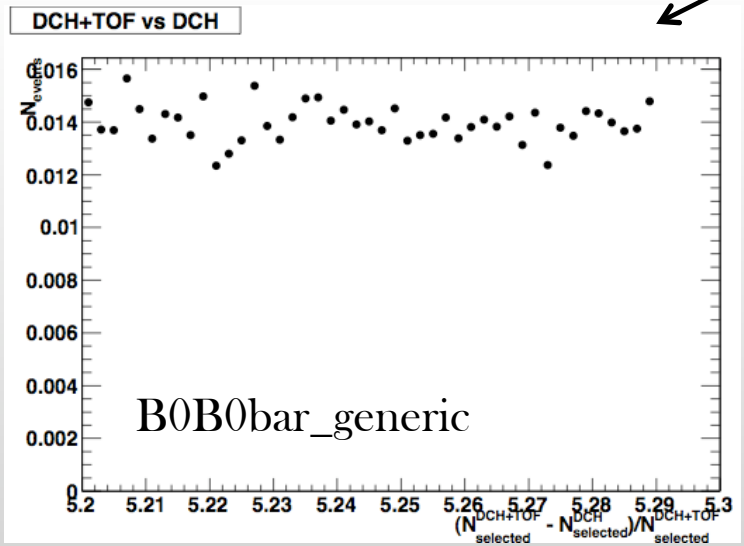
nb: $\varepsilon = N_{selected}/N_{gen}$ (not splitting combinatoric and peaking component in B0B0 sample)

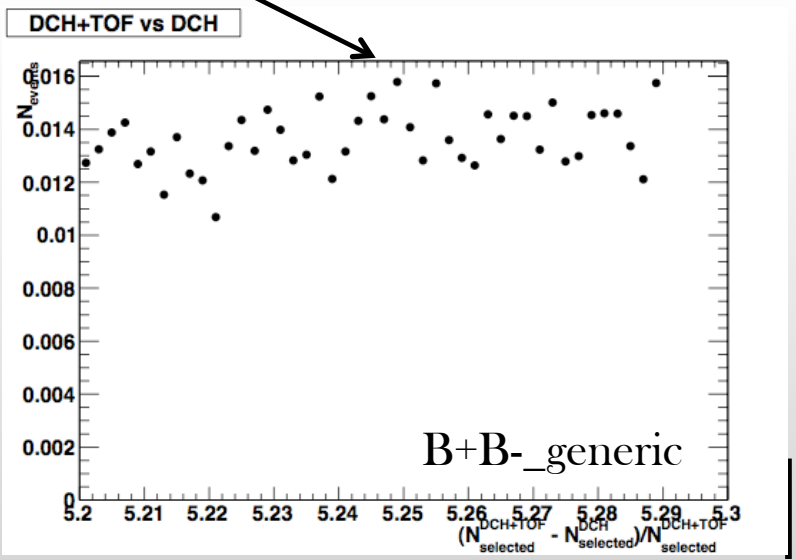
neutral breco	(N events) $\varepsilon_{DCH} * 10^{-3}$	(N events) $\varepsilon_{DCH+TOF} * 10^{-3}$	$(\varepsilon_{DCH+TOF}-\varepsilon_{DCH})/\varepsilon_{DCH+TOF}$
B+B-	(891764) 8.554 ± 0.009	(903919) 8.671 ± 0.009	+1.35%
B0B0bar	(1.77934e+06) 17.574 ± 0.013	(1.80428e+06) 17.820 ± 0.013	+1.38%
ccbar	(785827) 7.637 ± 0.008	(796134) 7.737 ± 0.008	+1.29%
uds	(764309) 1.4553 ± 0.0017	(769555) 1.4653 ± 0.0017	+0.68%
$B^0 \to K^{*0}(K^+\pi^-)\nu\nu$	(3678) 3.68 ± 0.06	(3746) 3.77 ± 0.06	+2.39%

neutral Breco mES distributions



$(N^{DCH+TOF} - N^{DCH})/N^{DCH+TOF}$





$B^+ \to K^+ \nu\nu$ selection

- purity > 50% && Breco charge = ± 1
- 5.27 < mES < 5.288 GeV/c^2
- Bsig charge + Breco charge =0
- Bsig$^+ \to K^+ \nu\nu$

	(N events) ε_{DCH} (/10^{-6})	(N events) $\varepsilon_{DCH+TOF}$ (/10^{-6})	($\varepsilon_{DCH+TOF}$-ε_{DCH})/ $\varepsilon_{DCH+TOF}$
B+B-	(953) 9.1 ± 0.3	(967) 9.3 ± 0.2	+2.15%
B0B0bar	(48) 0.47 ± 0.07	(49) 0.48 ± 0.07	+2.08%
ccbar	(342) 3.32 ± 0.18	(352) 3.42 ± 0.18	+2.92%
uds	(1432) 2.73 ± 0.07	(1448) 2.76 ± 0.07	+0.80%
$B^+ \to K^+ \nu\nu$	(994) 994 ± 31	(1011) 1011 ± 32	+1.68%

NB : N_{DCH} and $N_{DCH+TOF}$ compatible within statistical error for all samples

$B^+ \to K^{*+}(K^+\pi^0)\nu\nu$ selection

- purity > 50% && Breco charge = ± 1
- 5.27 < mES < 5.288 GeV/c^2
- -0.09 < deltaE < 0.05 GeV
- Bsig charge + Breco charge =0
- $Bsig^+ \to K^{*+}(K^+\pi^0)\nu\nu$

	(N events) ε_{DCH} (/10^{-6})	(N events) $\varepsilon_{DCH+TOF}$ (/10^{-6})	($\varepsilon_{DCH+TOF}$-ε_{DCH})/ $\varepsilon_{DCH+TOF}$
B+B-	(124) 1.19 ± 0.11	(128) 1.23 ± 0.11	+3.25%
B0B0bar	(13) 0.13 ± 0.04	(13) 0.13 ± 0.04	+0%
ccbar	(67) 0.65 ± 0.08	(68) 0.66 ± 0.08	+1.5%
uds	(189) 0.36 ± 0.03	(192) 0.37 ± 0.03	+2.7%
$B^+ \to K^{*+}\nu\nu$	(117) 117± 11	(121) 121± 11	+3.31%

NB : N_{DCH} and $N_{DCH+TOF}$ compatible within statistical error for all samples

$B^0 \to K^{*0} \nu\nu$ selection

- purity > 50% && Breco charge = 0
- 5.27 < mES < 5.288 GeV/c^2
- -0.09 < deltaE < 0.05 GeV
- Bsig charge + Breco charge =0
- Bsig$^0 \to K^{*0}(K^+\pi^-)\nu\nu$

	(N events) ε_{DCH} ($/10^{-6}$)	(N events) $\varepsilon_{DCH+TOF}$ ($/10^{-6}$)	$(\varepsilon_{DCH+TOF}-\varepsilon_{DCH})/\varepsilon_{DCH+TOF}$
B+B-	(51) 0.49 ± 0.07	(54) 0.52 ± 0.07	+5.77%
B0B0bar	(258) 2.55 ± 0.16	(261) 2.58 ± 0.16	+1.16%
ccbar	(124) 1.2 ± 0.1	(125) 1.2 ± 0.1	+0%
uds	(89) 0.169 ± 0.018	(88) 0.168 ± 0.018	-0.59%
$B^0 \to K^{*0}\nu\nu$	(364) 364 ± 19	(372) 372 ± 19	+2.15%

NB : N_{DCH} and $N_{DCH+TOF}$ compatible within statistical error for all samples

the simplest charged mode: Breco$^+ \rightarrow D^0(K^+\pi^-)\pi^+$

- purity > 50% && Breco charge = ± 1

cherged breco	(N events) $\varepsilon_{DCH} * 10^{-3}$	(N events) $\varepsilon_{DCH+TOF} * 10^{-3}$	$(\varepsilon_{DCH+TOF}-\varepsilon_{DCH})/\varepsilon_{DCH+TOF}$
B+B-	(24472) 0.2347 +/- 0.0015	(24877) 0.2386 +/- 0.0015	+1.62%
B0B0bar	(1077) 0.0106+/- 0.0003	(1087) 0.0107 +/- 0.0003	+0.92%
ccbar	(15014) 0.1459 +/- 0.0012	(15182) 0.1475 +/- 0.0012	+1.11%
uds	(122668) 0.2336 +/- 0.0007	(122918) 0.2340 +/- 0.0007	+0.17%
$B^+ \rightarrow K^+\nu\nu$	(138) 0.138 +/- 0.012	(143) 0.143 +/- 0.012	+3.50%
$B^+ \rightarrow K^{*+}\nu\nu$	(120) 0.120 +/- 0.011	(122) 0.122 +/- 0.011	+1.63%

Conclusions and next steps

* DG_4 with DHC and DG_4 with DCH+TOF configs compared
* Breco recontruction :~ 1.6% gain in BB generic samples; higher gain in signal samples (low statistics)
  - gain seem to be constant in the mES region, need to investigate this further
* Bsig selection : too low statistics to evaluate FWD TOF benefits
* $Breco^{+} \rightarrow D^{0}(K^{+}\pi^{-})\pi^{+}$ mode: at Breco reconstruction level, same results wrt all-modes sample
* further studies to evaluate if the efficiency gain is higher for (mES) peaking wrt combinatoric Breco or not (mES fits, mctruth studies,..)
* need to quantify the bkg contamination from K-misID
* (an update on bkg characterization studies may be given at Thursday FastSim meeting)

Back-up slides

To do list

* DGWG related items
  - further investigation on bkg characterization
  - PID studies comparing DG_3/DG_4 and loose/tight kaon PID

* code related items
  - fix duplicate Breco bug
  - understand some FastSim/FullSim disagreement
  - refine and commit validation code
  - wiki documentation (I've easily started writing it)

generated BaBar samples ($B \to K^* \nu\nu$ analysis)

sample	SP8 mode	generated evt ($\times 10^3$)	ϵ_{skim}(%)	equiv lumi (fb^{-1})	weight
$B^+ \to K^{*+}\nu\bar{\nu}$ signal	3656	7 767	0.56	504 350	7.600×10^{-4}
$B^0 \to K^{*0}\nu\nu$ signal	2585	5 270	0.49	342 207	7.460×10^{-4}
B^+B^- generic Run1	1235	28 924	6.8	52.59	0.3880
B^+B^- generic Run2	1235	94 808	6.8	172.38	0.3543
B^+B^- generic Run3	1235	49 618	7.0	90.21	0.3578
B^+B^- generic Run4	1235	167 994	6.9	305.44	0.3283
B^+B^- generic Run5	1235	244 192	6.7	443.98	0.2992
B^+B^- generic Run6	1235	100 818	6.9	183.30	0.3607
$B^0\bar{B}^0$ generic Run 1	1237	37 200	6.0	67.63	0.3017
$B^0\bar{B}^0$ generic Run 2	1237	103 356	5.9	187.92	0.3250
$B^0\bar{B}^0$ generic Run 3	1237	48 466	6.2	88.12	0.3663
$B^0\bar{B}^0$ generic Run 4	1237	167 332	6.0	304.24	0.3296
$B^0\bar{B}^0$ generic Run 5	1237	241 224	5.8	438.59	0.3029
$B^0\bar{B}^0$ generic Run 6	1237	102 348	5.9	186.09	0.3553
$e^+e^- \to c\bar{c}$ Run1	1005	58 900	5.5	45.31	0.4504
$e^+e^- \to c\bar{c}$ Run2	1005	168 844	5.5	129.88	0.4702
$e^+e^- \to c\bar{c}$ Run3	1005	83 974	5.6	64.60	0.4997
$e^+e^- \to c\bar{c}$ Run4	1005	252 830	5.6	194.49	0.515
$e^+e^- \to c\bar{c}$ Run5	1005	366 758	5.5	282.12	0.4710
$e^+e^- \to c\bar{c}$ Run6	1005	155 910	5.8	119.93	0.5513
$e^+e^- \to u\bar{u}$, $d\bar{d}$, $s\bar{s}$ Run1	998	47 180	3.4	22.57	0.904
$e^+e^- \to u\bar{u}$, $d\bar{d}$, $s\bar{s}$ Run2	998	130 858	3.4	62.61	0.9755
$e^+e^- \to u\bar{u}$, $d\bar{d}$, $s\bar{s}$ Run3	998	66 722	3.4	31.92	1.0017
$e^+e^- \to u\bar{u}$, $d\bar{d}$, $s\bar{s}$ Run4	998	205 204	3.5	98.18	1.0214
$e^+e^- \to u\bar{u}$, $d\bar{d}$, $s\bar{s}$ Run5	998	317 846	3.4	152.08	0.8737
$e^+e^- \to u\bar{u}$, $d\bar{d}$, $s\bar{s}$ Run6	998	127 926	3.6	61.21	1.0800
$e^+e^- \to \tau^+\tau^-$ Run1	3429	20 378	0.017	21.68	0.9412
$e^+e^- \to \tau^+\tau^-$ Run2	3429	55 546	0.017	59.09	1.0336
$e^+e^- \to \tau^+\tau^-$ Run3	3429	27 988	0.018	29.77	1.0842
$e^+e^- \to \tau^+\tau^-$ Run4	3429	90 032	0.018	95.78	1.0470
$e^+e^- \to \tau^+\tau^-$ Run5	3429	132 218	0.018	140.66	0.9446
$e^+e^- \to \tau^+\tau^-$ Run6	3429	56 436	0.023	60.04	1.1013