Impact of Bwd EMC (and background) on B->K$^{(*)}\nu\nu$ against hadronic Breco

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Outline

* Hadronic Breco and February production

* Comparison between SuperB Detector geometry # 3 (DG_3) and SuperB Detector geometry # 4 (DG_4), w/o BWD EMC
  - Breco side
  - $B \to K^{(*)}\nu\nu$ signal side analysis

Hadronic Breco reconstruction in FastSim

* Aim: collect as many as possible fully reconstructed B mesons in order to study the property of the recoil (≈1100 B decay modes)
* SemiExclusive reconstruction: $B \rightarrow D(^*)X$, $X=n\pi\ mK\ pK_s\ q\pi^0$ and $n+m+r+q<6$, no requirements on intermediate resonances
* Reconstruction steps:
  - reconstruct D→ hadrons

$D^{*+} \rightarrow D^0\pi^+$	$D^0 \rightarrow K^-\pi^+$	$D^+ \rightarrow K^-\pi^+\pi^-$
$D^{*0} \rightarrow D^0\pi^0$	$D^0 \rightarrow K^-\pi^+\pi^0(\gamma\gamma)$	$D^+ \rightarrow K^-\pi^+\pi^-\pi^0$
$D^{*0} \rightarrow D^0\gamma$	$D^0 \rightarrow K^-\pi^+\pi^+\pi^-$	$D^+ \rightarrow K^0_S\pi^+$
	$D^0 \rightarrow K^0_S\pi^+\pi^-$	$D^+ \rightarrow K^0_S\pi^+\pi^-\pi^+$
		$D^+ \rightarrow K^0_S\pi^+\pi^0$

  - use D as a seed and add X to have a system compatible with the B hypotesys

* Signal box defined by using:
* Cut on purity (>=50%) to speed up production

$$m_{ES} = \sqrt{E^{*2}_{beam} - p^{*2}_B}$$

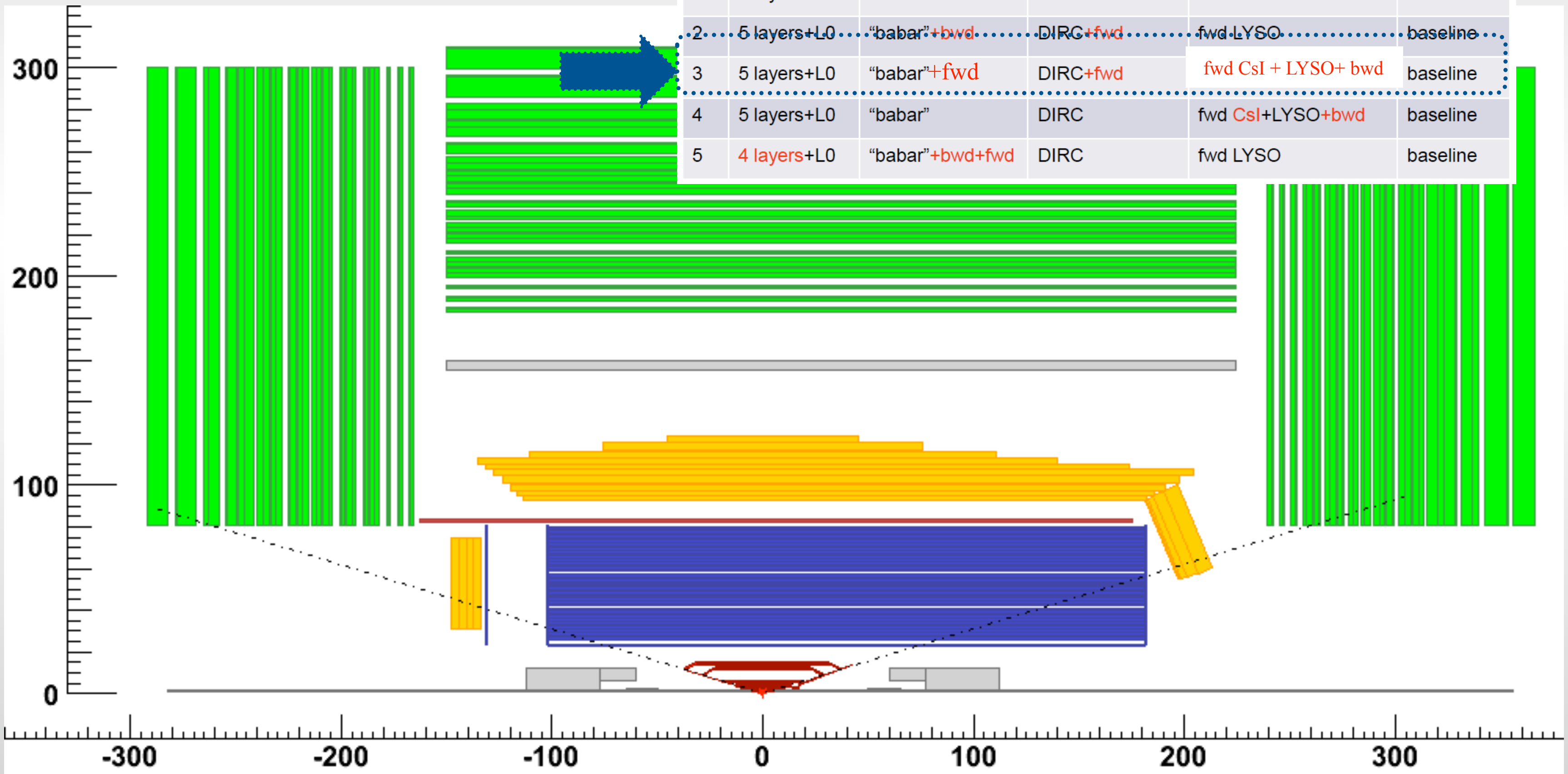
$$\Delta E = E^*_B - E^*_{beam}$$

* Bsig side: $K^+\nu\nu$, $K_s(\pi^+\pi^-)\nu\nu$, $K^{*+}(K_s\pi^+, K^+\pi^0)\nu\nu$, $K^{*0}(K^+\pi^-)\ \nu$, $\tau^+\nu$, with $\tau^+ \rightarrow e^+\nu\nu$, $\mu^+\nu\nu$, $\pi^+\nu$, $\rho^+(\pi^+\pi^0)\nu$, $a_1^+(\rho^0\pi^+)\nu$

Detector geometries (I)

* DetectorConfiguraztion_3
  - SVT_L0 + fwd DCH+ bwd EMC

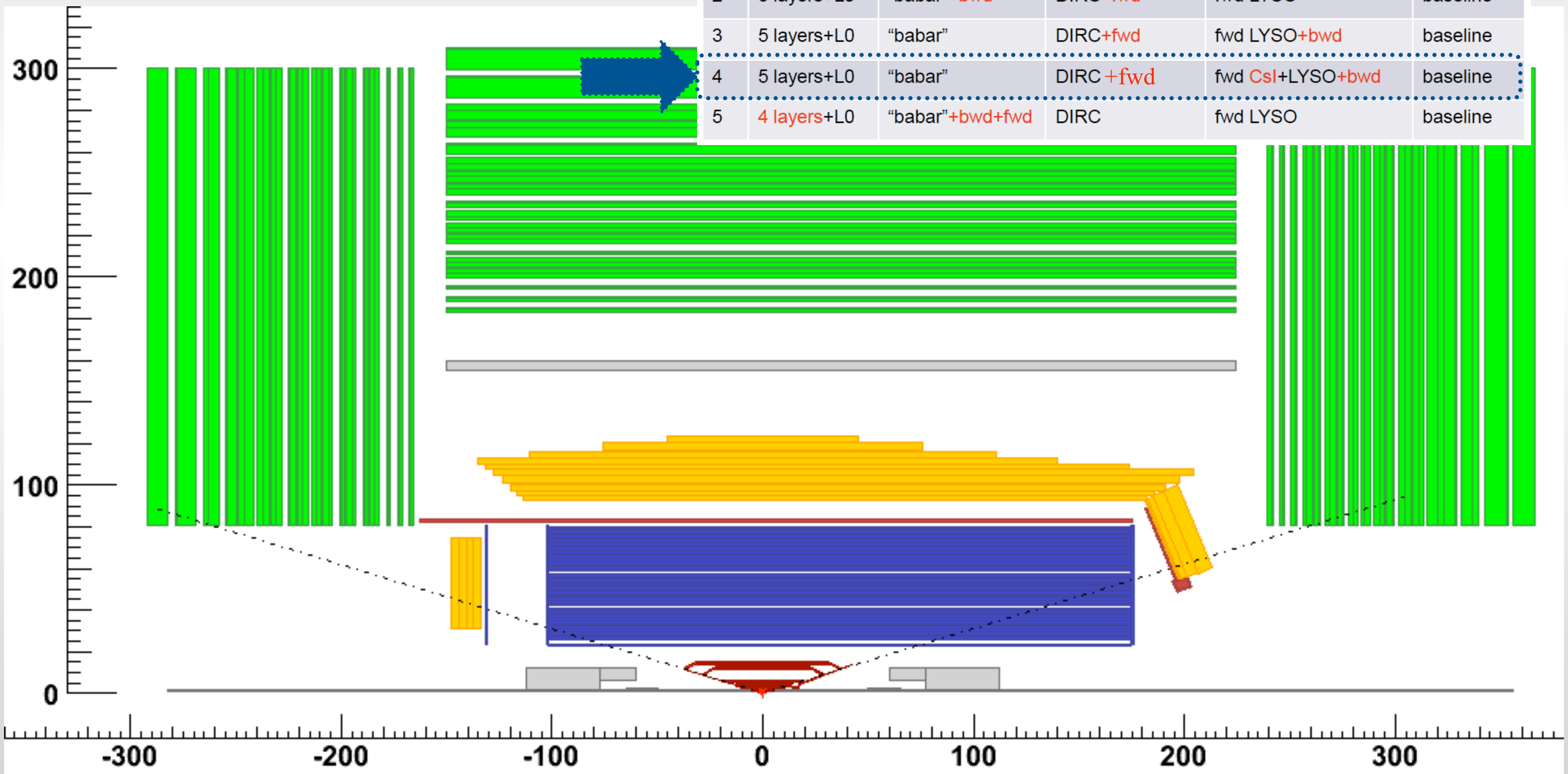
	SVT	DCH	PID	EMC	IFR
0	5 layers+L0	"babar"	DIRC	fwd LYSO	baseline
1	5 layers+L0	"babar"+bwd+fwd	DIRC	fwd LYSO	baseline
2	5 layers+L0	"babar"+bwd	DIRC+fwd	fwd LYSO	baseline
3	5 layers+L0	"babar"+fwd	DIRC+fwd	fwd CsI + LYSO+ bwd	baseline
4	5 layers+L0	"babar"	DIRC	fwd CsI+LYSO+bwd	baseline
5	4 layers+L0	"babar"+bwd+fwd	DIRC	fwd LYSO	baseline



Detector geometries (II)

- DetectorConfiguraztion_4
  - SVT_L0 + fwd PID + bwd EMC

	SVT	DCH	PID	EMC	IFR
0	5 layers+L0	"babar"	DIRC	fwd LYSO	baseline
1	5 layers+L0	"babar"+bwd+fwd	DIRC	fwd LYSO	baseline
2	5 layers+L0	"babar"+bwd	DIRC+fwd	fwd LYSO	baseline
3	5 layers+L0	"babar"	DIRC+fwd	fwd LYSO+bwd	baseline
4	5 layers+L0	"babar"	DIRC +fwd	fwd CsI+LYSO+bwd	baseline
5	4 layers+L0	"babar"+bwd+fwd	DIRC	fwd LYSO	baseline



Analysis strategy

* Use signal MC (with background) + generic MC (no background)

* Compare DG_3 vs DG_4
  - PID in the fwd region weaker in DG_3 (dE/dx) then in DG_4 (dE/dx+TOF)
  - material in front of fwd EMC lower in DG_3

* Use bwd EMC as VETO device:
  - reject candidates with neutrals reconstructed in bwd EMC
  - apply BaBar selection
  - require zero EExtraNeutralBwd

* pid device angular acceptance: 20°(tracking)$<\theta_{lab}<$ 144.4 (DIRC)

* Apply BaBar Analysis cuts for $B^+ \to K^+ \nu\nu$, $B^+ \to K^{*+} \nu\nu$, $B^0 \to K^{*0} \nu\nu$ and compare efficiencies for Breco and Bsig selection

SuperB Fast Simulation: DG_3 vs DG_4

neutral Breco efficiencies, generic samples

(see back up for stat errors on efficiencies)

neutral Breco	B0B0bar		BpBm		ccbar		uds	
	DG_3	DG_4	DG_3	DG_4	DG_3	DG_4	DG_3	DG_4
nBreco>=1	0.0197	0.0199	0.0098	0.0098	0.0080	0.0085	0.0017	0.0017
mES cut	0.0040	0.0040	0.0011	0.0010	0.0008	0.0008	0.0002	0.0002
delatE cut	0.0036	0.0036	0.0009	0.0009	0.0006	0.0007	0.0001	0.0001
	DG_BaBar		DG_BaBar		DG_BaBar		DG_BaBar	
	0.0029		0.0007		0.0005		0.0001	
$(\varepsilon_{DG3}-\varepsilon_{DGbbr})/\varepsilon_{DGbbr}$	+0.24		+0.28		+0.20		--	

charged Breco efficiencies, generic samples

(see back up for stat errors on efficiencies)

charged Breco	B0B0bar		BpBm		ccbar		uds	
	DG_3	DG_4	DG_3	DG_4	DG_3	DG_4	DG_3	DG_4
nBreco>=1	0.0087	0.0086	0.0171	0.0170	0.0118	0.126	0.0075	0.0074
mES cut	0.0012	0.0012	0.0048	0.0048	0.0015	0.0016	0.0010	0.0010
delatE cut	0.0010	0.0010	0.0042	0.0041	0.0011	0.0012	0.0007	0.0007
	DG_BaBar		DG_BaBar		DG_BaBar		DG_BaBar	
	0.0008		0.0035		0.0009		0.0006	
$(\varepsilon_{DG3}-\varepsilon_{DGbbr})/\varepsilon_{DGbbr}$	+0.25		+0.20		+0.22		+0.17	

* DG_3 and DG_4 almost equivalent: now using loose PID in the fwd
will test with thighter selectors

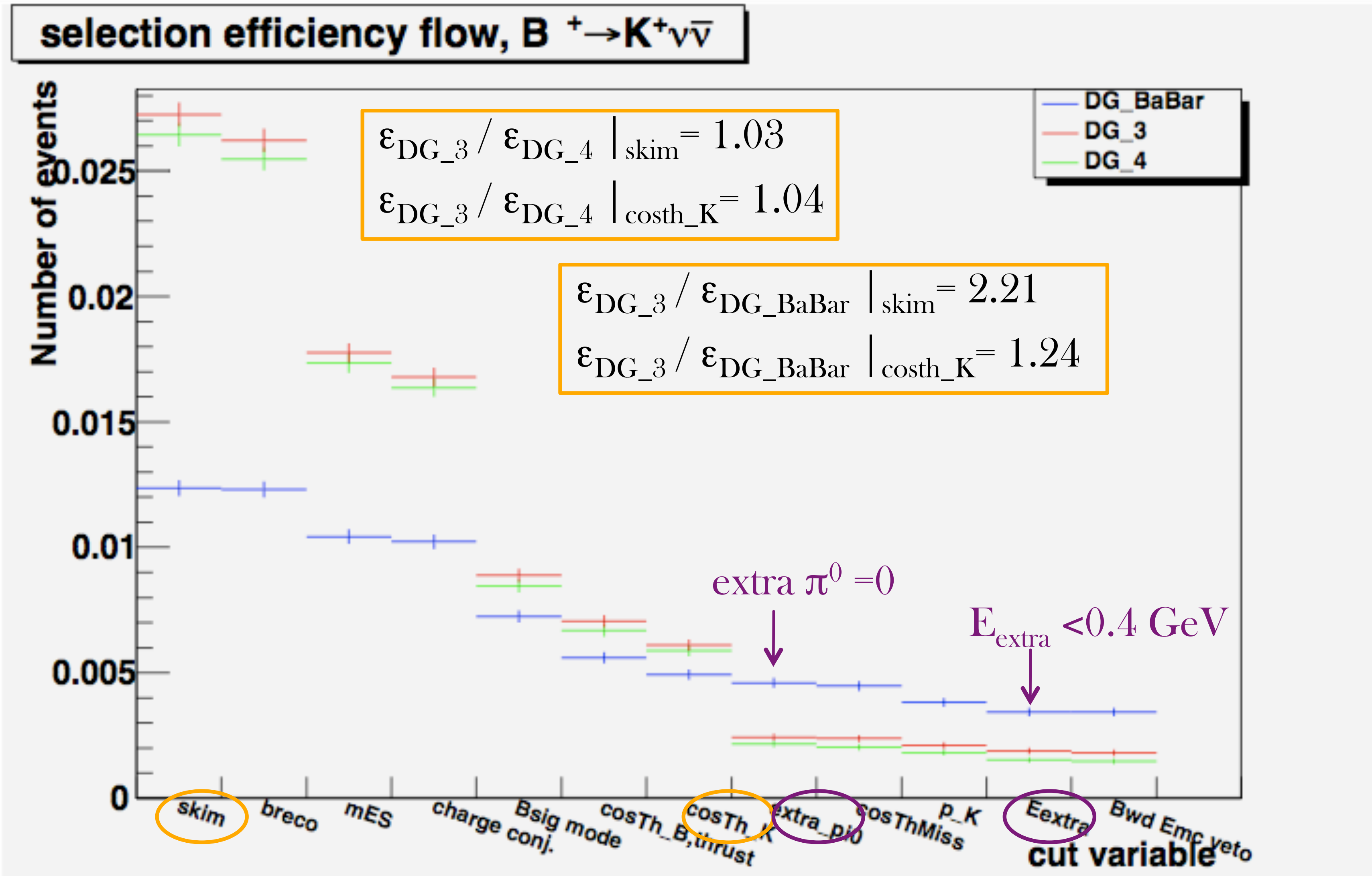
$B^+ \rightarrow K^+ \nu\nu$ signal MC : selection efficiency (I)

* BaBar-like cut and count analysis

$Q_{tag} = \pm 1$
$5.270 < m_{ES} < 5.288$ GeV/c^2
$|\cos\theta_{Breco,Thrust}| < 0.85$

K candidate from Bsig
$|\cos\theta^*_{trk}| < 0.85$
$N_{extraTrk} < 3$
$E_{extra} < 0.4$ GeV
$N_{\pi 0} = 0$
$p_K^B > 1.1$ Gev/c
$-0.85 < \cos\theta_{pmiss} < 0.9$

$B^+ \to K^+ \nu\nu$ signal MC: selection efficiency(II)



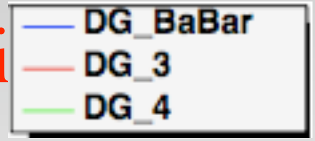
$\varepsilon_{DG\_3} / \varepsilon_{DG\_4} |_{skim} = 1.03$

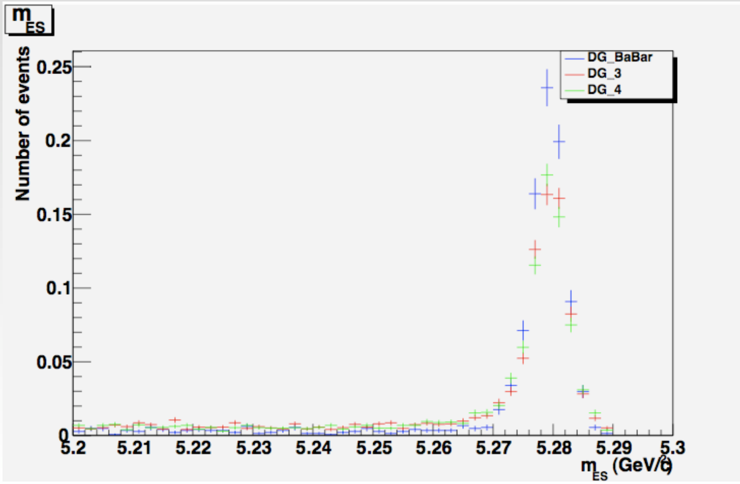
$\varepsilon_{DG\_3} / \varepsilon_{DG\_4} |_{costh\_K} = 1.04$

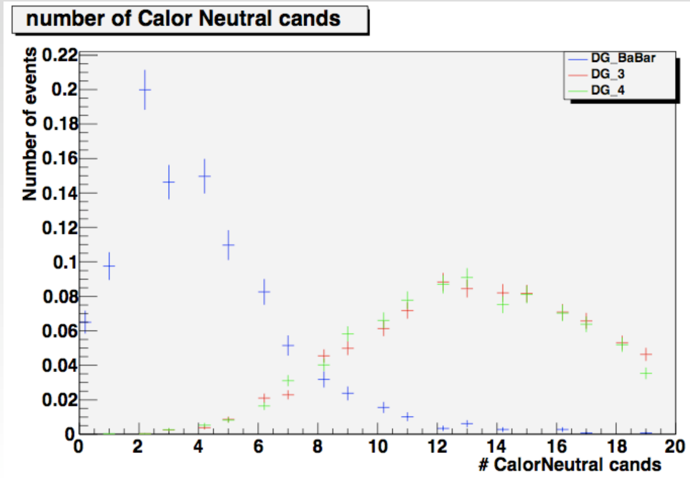
$\varepsilon_{DG\_3} / \varepsilon_{DG\_BaBar} |_{skim} = 2.21$

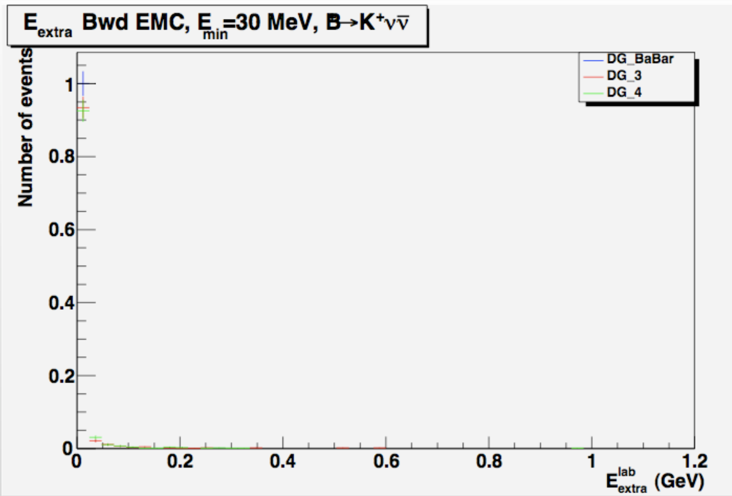
$\varepsilon_{DG\_3} / \varepsilon_{DG\_BaBar} |_{costh\_K} = 1.24$

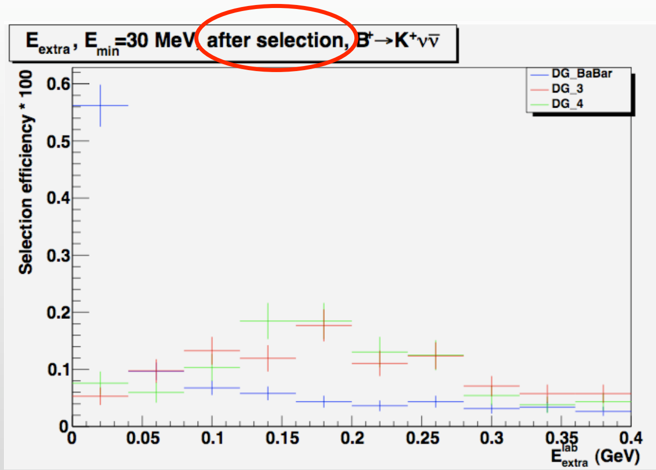
$B^+ \to K^+ \nu\nu$ signal MC: some distributi











$B \to K^* \nu\nu$ signal MC: selection efficiency (I)

* BaBar-like cut and count analysis

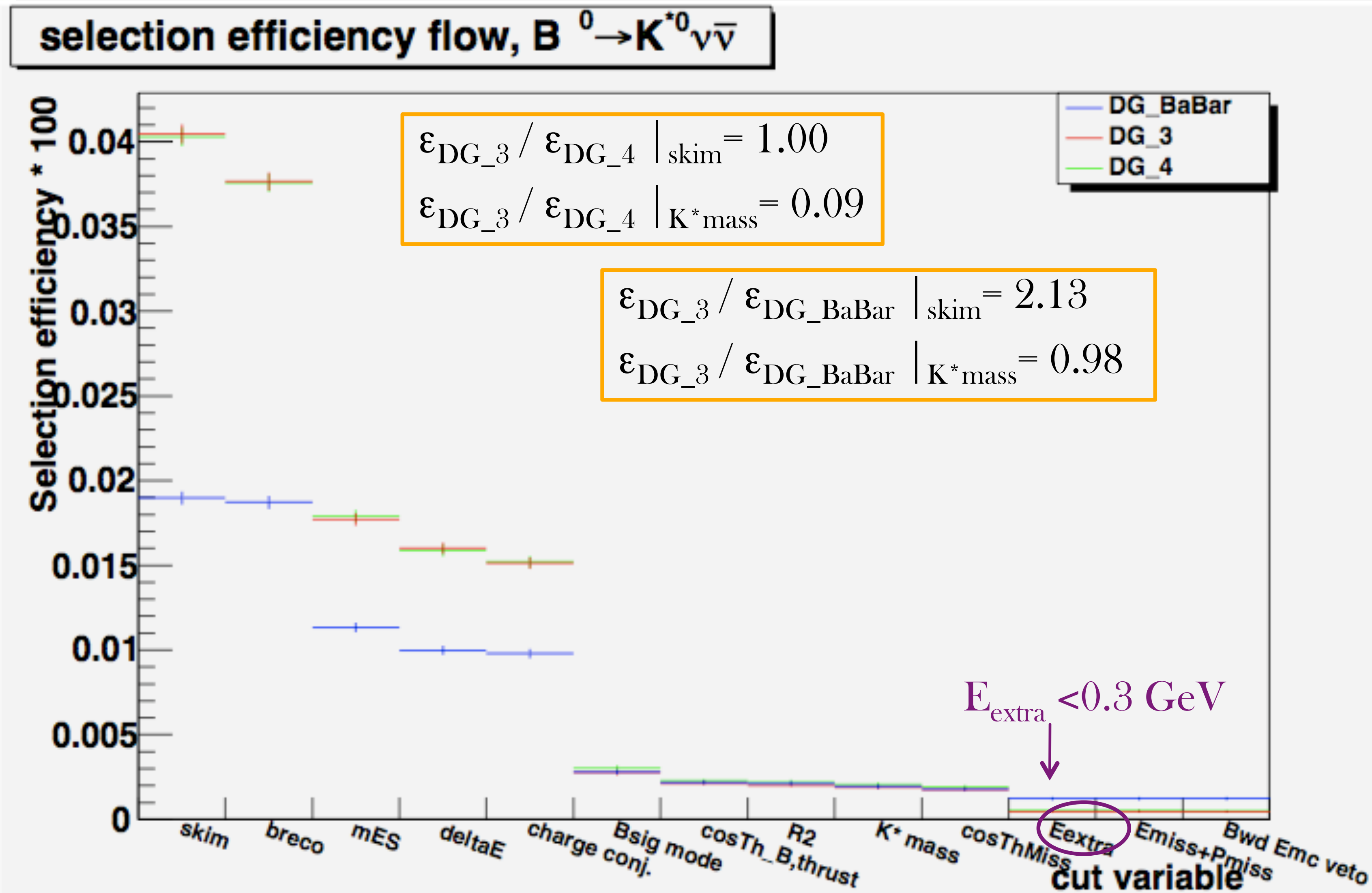
B_{sig}-B_{reco} charge correlation
$5.270 < m_{ES} < 5.288$ GeV/c^2
$-0.09 < \Delta E < 0.05$ GeV
$|\cos\theta_{Breco,Thrust}| < 0.9$

channel	selection criteria
$K^{*\pm} \to K^{\pm} \pi^0$	$0.03 < R_2 < 0.70$ $0.004 < \lvert\cos\theta^*_{thrust}\rvert < 0.84$ $0.84 < m_{K^*} < 0.95$ GeV/c^2 $-0.78 < \cos\theta^*_{miss} < 0.93$
$K^{*\pm} \to K^0_S (\pi^+ \pi^-) \pi^{\pm}$	$0.0 < R_2 < 0.49$ $0.0 < \lvert\cos\theta^*_{thrust}\rvert < 0.85$ $0.86 < m_{K^*} < 0.95$ GeV/c^2 $0.49 < m_{K^0_S} < 0.50$ GeV/c^2 $-0.82 < \cos\theta^*_{miss} < 0.82$
$K^{*0} \to K^- \pi^+$	$0.06 < R_2 < 0.53$ $0.002 < \lvert\cos\theta^*_{thrust}\rvert < 0.85$ $0.85 < m_{K^*} < 0.97$ GeV/c^2 $-0.86 < \cos\theta^*_{miss} < 0.90$

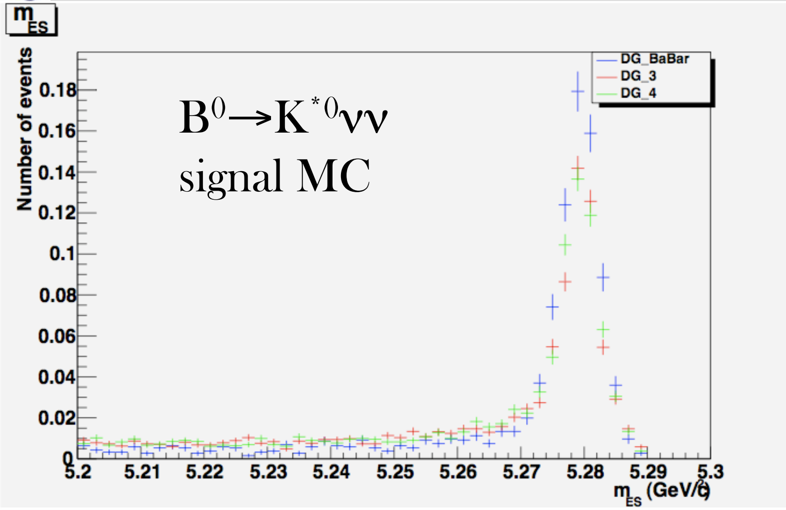
E^*miss+cp^*miss>4.5GeV
Eextra<0.3GeV

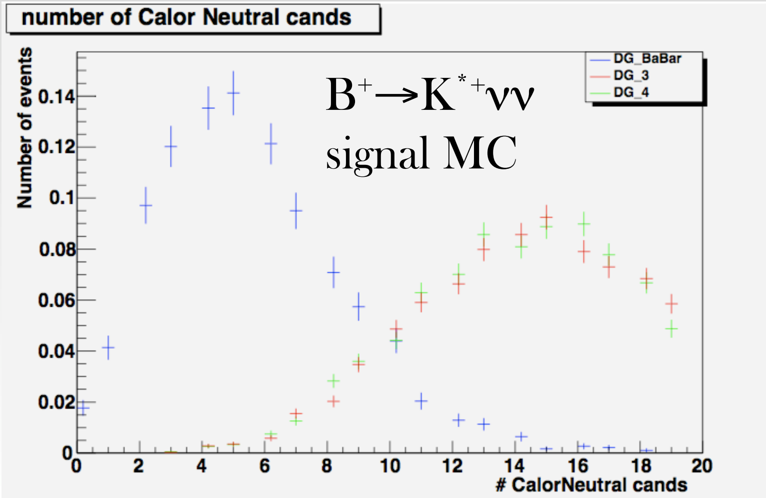
n.b.: very small stat, ε (after K^*mass cut)
compared in next pages consistent within stat error

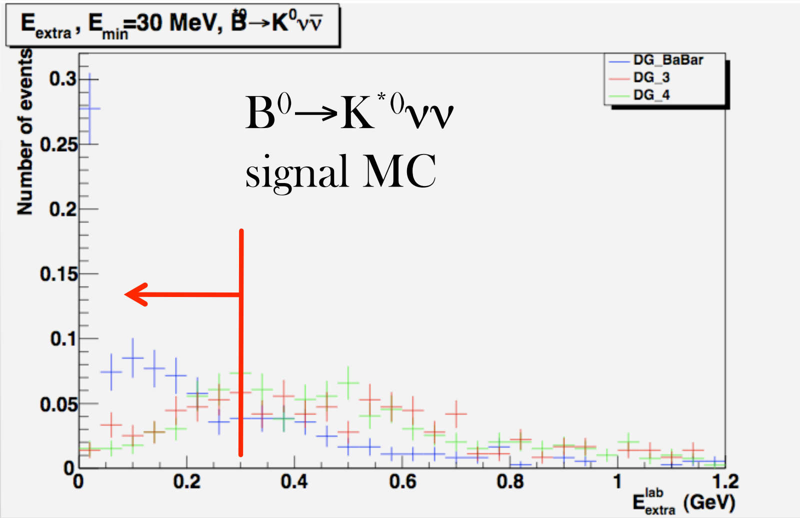
$B^0 \rightarrow K^{*0}(K\pi)\nu\nu$ signal MC: selection efficiency (II)

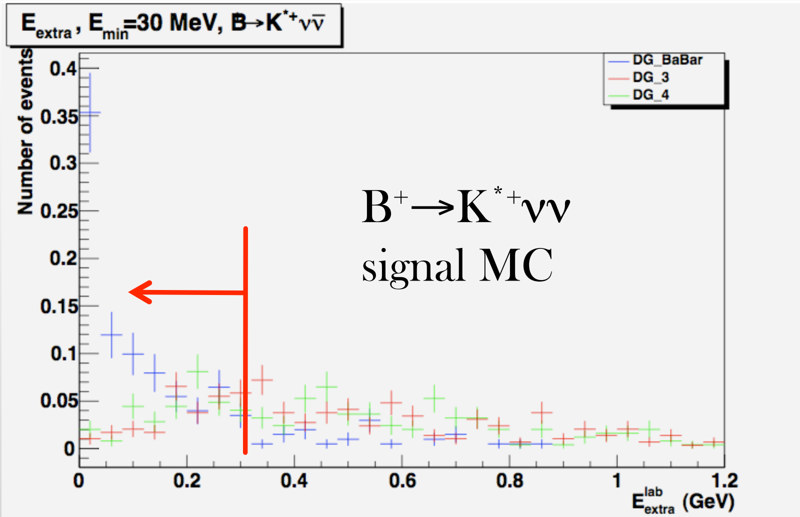


B→K*νν signal MC: some distributions









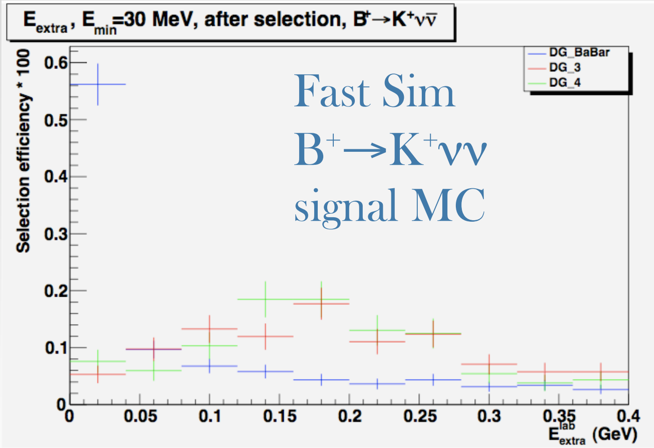
Remarks on Eextra shape

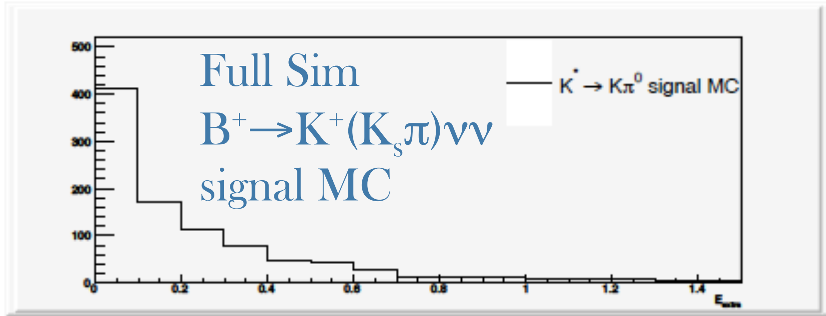
* background (radiative BhaBha) dramatically increase the number of reconstructed neutrals → Eextra shifts at high values, loosing the bin 0 discriminating power
(apply a cut on the maximum gamma energy?)

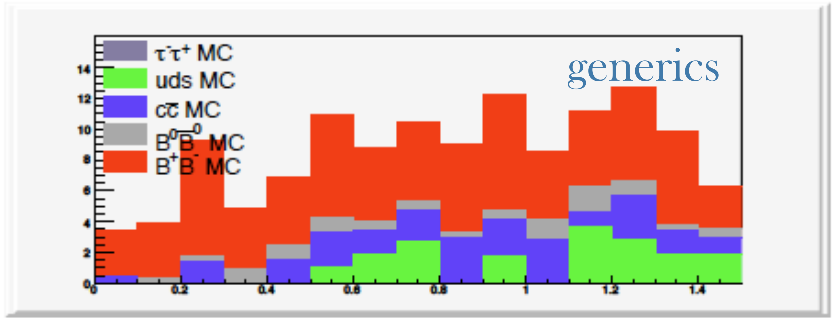
* in this production, not enough generic statistics with machine in, to study the bkg Eextra shape (probably shifted → need to enlarge the signal region to be more discriminant)

* not enough signal statistics to quantify the benefits from the Bwd EMC veto

- bkg studies to find minimum photon energy for the bwd
- optimize Eextra_bwd cut







Conclusions

* PacHadRecoilUser used in February production; in this talk
  - generic Mc samples w/o background
  - signal MC samples : $B \to K^{+}\nu\nu$, $B \to K^{*0}\nu\nu$, $B \to K^{*+}\nu\nu$ with background

* test SuperB detector geometry configuration
  - DG_4 and DG_3 seems to be equivalent
  - adding radiative bhabha, the Eextra shape in signal-MC is less signal-like
  - need a high statistic generic sample, mixed with bkg, to evaluate generic Eextra shape
  - some attempts to improve this ($E_{max,\gamma}$? may be not useful since it's more a neutral multiplicity issue)
  - not enough statistics to test the impact of bwd EMC

Back-up slides

neutral Breco efficiencies, generic samples

*** fast sim:

B0B0Bar : mES cut = 0.2095+/-0.0010
de cut = 0.1840+/-0.0010

B+B- : mES cut = 0.1110+/-0.0011
de cut = 0.0909+/-0.0010

cc : mES cut = 0.1013+/-0.0012
de cut = 0.0812+/-0.0011

uds : mES cut = 0.1213+/-0.0021
de cut = 0.0879+/-0.0006

*** full sim:

B0B0Bar : mES cut = 0.2548+/-0.0009
de cut = 0.2279+/-0.0008

B+B- : mES cut = 0.1156+/-0.0009
de cut = 0.0929+/-0.0008

cc : mES cut = 0.0967+/-0.0006
de cut = 0.0740+/-0.0005

uds : mES cut = 0.1246+/-0.0015
de cut = 0.0877+/-0.0004

charged Breco efficiencies, generic samples

*** fast sim:

B0B0Bar : mES cut = 0.1403+/-0.0013
de cut = 0.1096+/-0.0012

B+B- : mES cut = 0.2895+/-0.0012
de cut = 0.2416+/-0.0012

cc : mES cut = 0.1284+/-0.0011
de cut = 0.0902+/-0.0009

uds : mES cut = 0.1370+/-0.0011
de cut = 0.09387+/-0.0003

*** full sim:

B0B0Bar : mES cut = 0.15187+/-0.0010
de cut = 0.1183+/-0.0009

B+B- : mES cut = 0.3557+/-0.0003
de cut = 0.3094+/-0.0003

cc : mES cut = 0.1263+/-0.0005
de cut = 0.0889+/-0.0004

uds : mES cut = 0.1395+/-0.0006
de cut = 0.0961+/-0.0002