$B \to K^* \nu\nu$ vs HAD tag: impact of bwd EMC and fwd PID material

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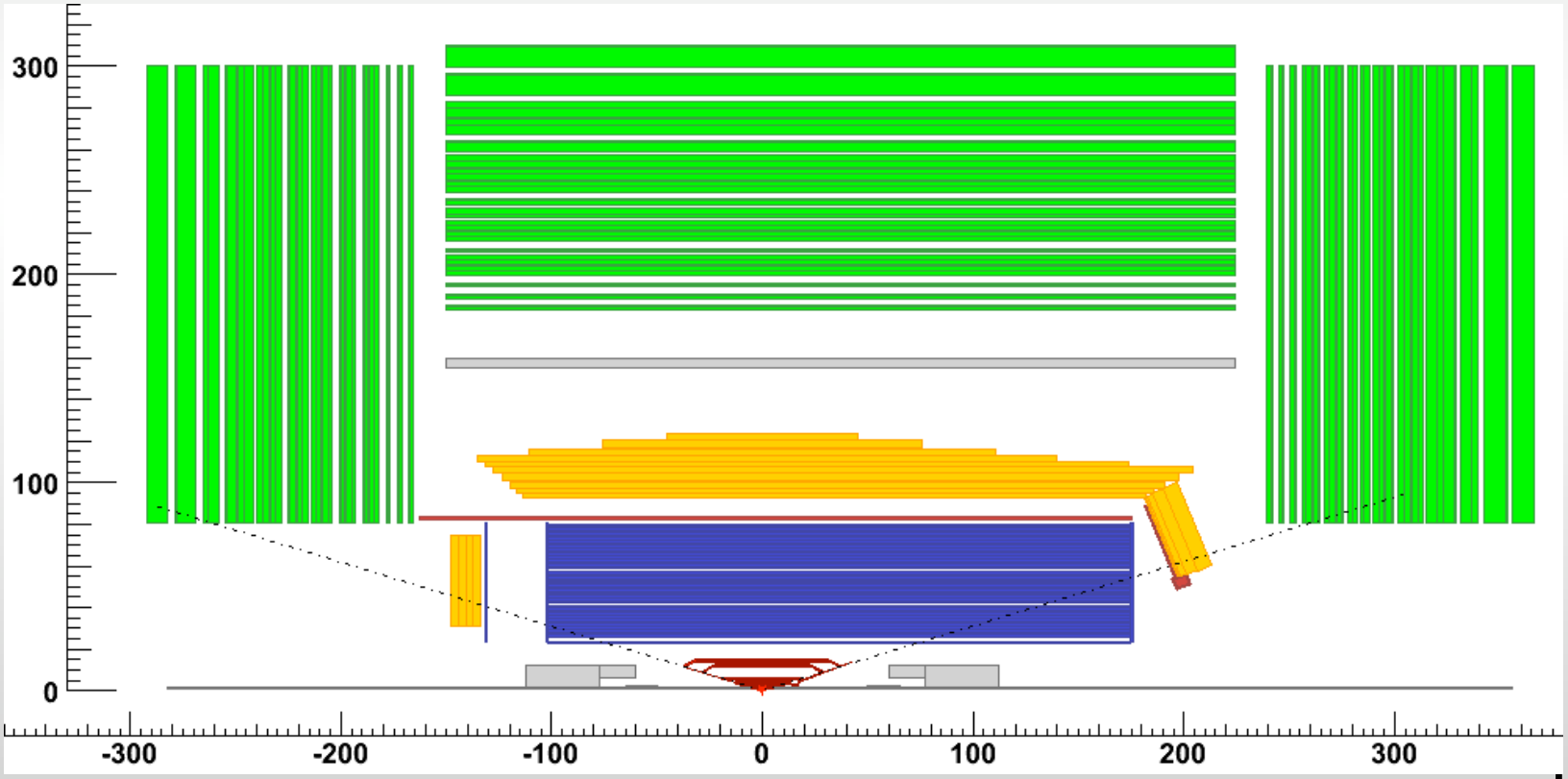
Outline

* DG configurations and samples from September production
* impact of bwd EMC used as a veto
* impact of material in front of Fwd EMC

Detector geometries

* DG_4 : SVT_L0 + fwd TOF+ bwd EMC → impact of bwd EMC
* DG_4a : as DG_4 but TOF made if Air (0-thickness TOF) → impact of TOF material in front of the EMC



Analysis strategy

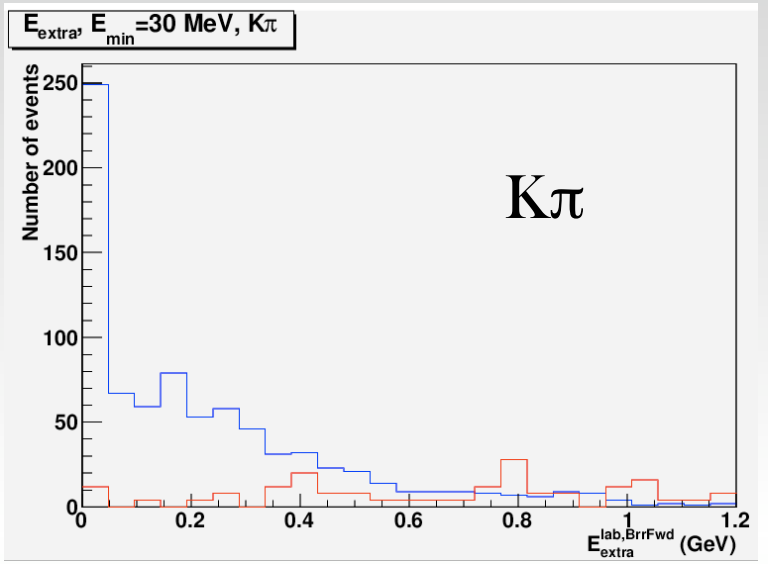
* Baseline analysis
  - DG_4_allbkgs with Fwd TOF on and Bwd EMC off
* impact of Bwd EMC:
  - DG_4_nopairs with Fwd TOF switched on and Bwd EMC switched on
  - cut on Eextra deposited in bwd EMC (+ usual cut on Eextra from Barrel+Fwd)
* impact of material in front of Fwd EMC
  - DG_4a_nopairs with Fwd TOF switched on and Bwd EMC switched off
  - first look to evaluate impact on, comparing with DG_4 results

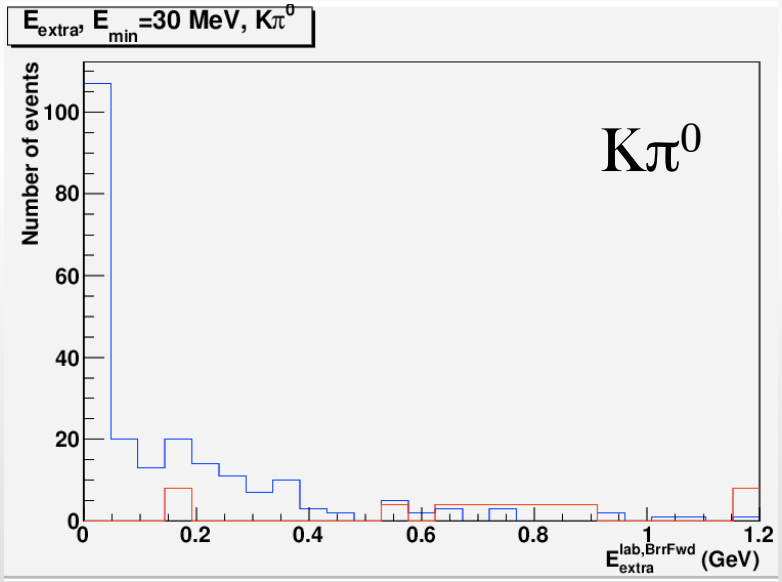
Eextra distributions : barrel + forward

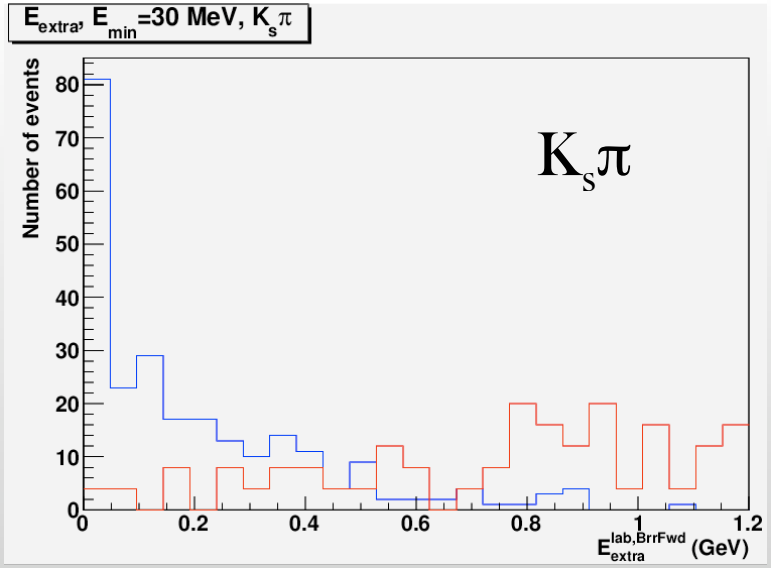
minimum gamma energy = 30 MeV

signal MC

BB cocktail





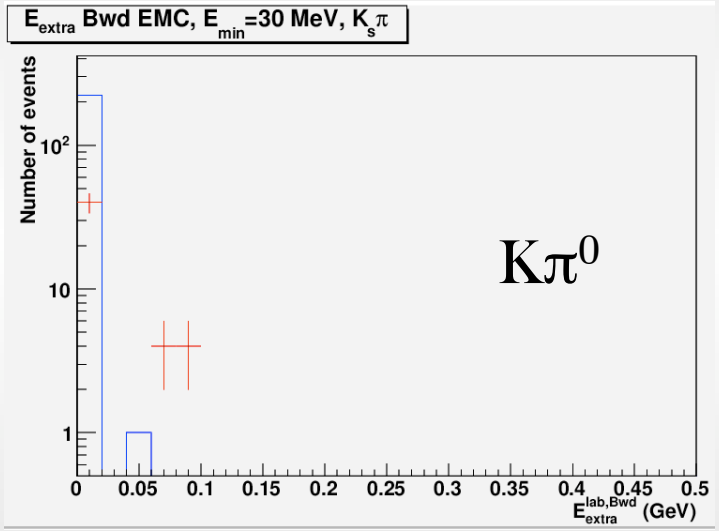


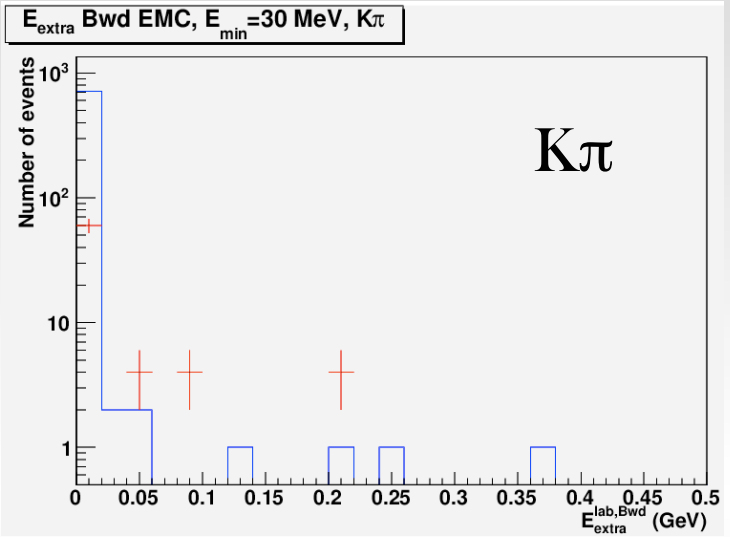
Eextra distributions : backward

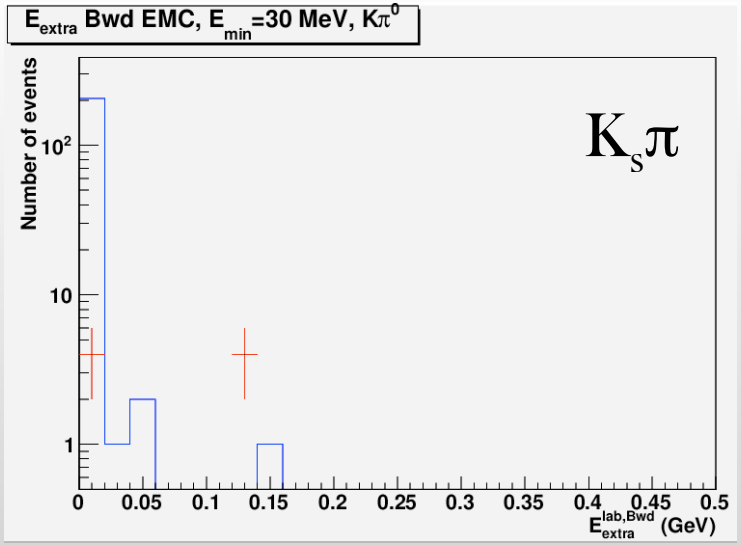
minimum gamma energy = 30 MeV

signal MC

BB cocktail

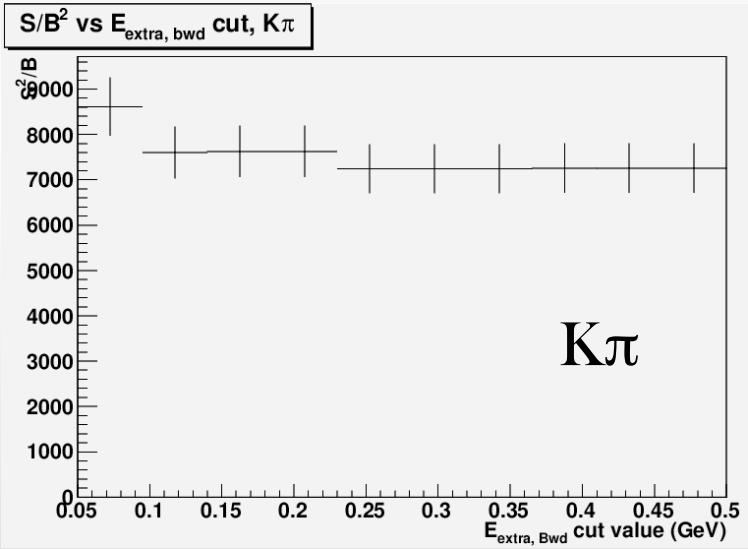


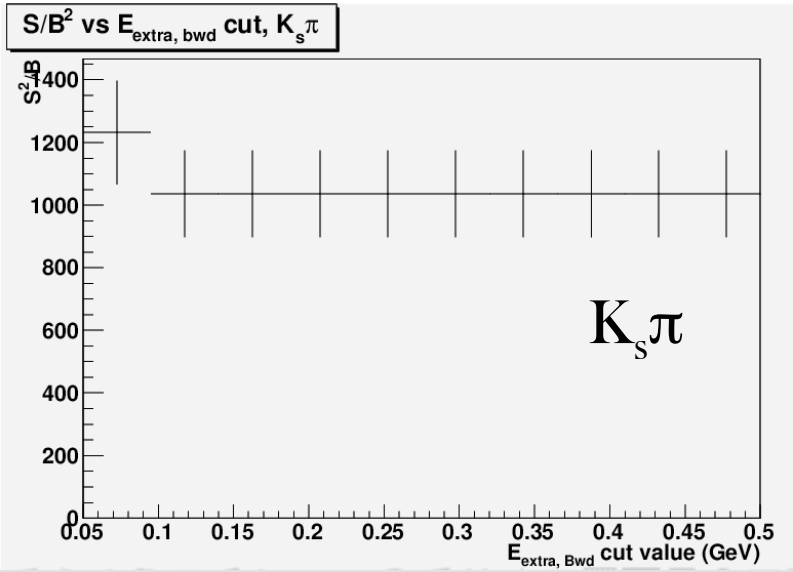




Eextra_bwd cut: optimization

* Strategy:
  - scan the region Eextra_Bwd ∈ [0.05,0.5] GeV and compute FOM = S/sqrt(B)
  - optimal cut ↔ maximum FOM





Eextra_bwd cut: results

* EextraBwd < 0.05 GeV:

$B^0 \to K^{*0}\nu\bar{\nu}$					
Sample	N_{sel}	ε_{tot}	$N_{sel,Bwd}$	$\varepsilon_{tot,Bwd}$	$\delta\varepsilon/\varepsilon$
$B^0 \to K^{*0}\nu\bar{\nu}$	727	$(24.5 \pm 0.9) \times 10^{-5}$	719	$(24.2 \pm 0.9) \times 10^{-5}$	$(-1.1 \pm 0.4)\%$
B^0 had cocktail	76	$(20 \pm 2) \times 10^{-8}$	60	$(16 \pm 2) \times 10^{-8}$	$(-21 \pm 7)\%$
$S/\sqrt{B}$		83 ± 7		93 ± 9	
$B^+ \to K^{*+}(K_s\pi^+)\nu\bar{\nu}$					
Sample	N_{sel}	ε_{tot}	$N_{sel,Bwd}$	$\varepsilon_{tot,Bwd}$	$\delta\varepsilon/\varepsilon$
$B^+ \to K^{*+}\nu\bar{\nu}$	223	$(7.1 \pm 0.5) \times 10^{-5}$	222	$(7.0 \pm 0.5) \times 10^{-5}$	$(-0.5 \pm 0.4)\%$
B^+ had cocktail	48	$(12.0 \pm 1.7) \times 10^{-8}$	40	$(10.0 \pm 1.7) \times 10^{-8}$	$(-17 \pm 7)\%$
$S/\sqrt{B}$		32 ± 4		35 ± 5	

$$\delta\left(\frac{S}{\sqrt{(B)}}\right) = \frac{\left(\frac{S}{\sqrt{(B)}}\right)_{bwd} - \left(\frac{S}{\sqrt{(B)}}\right)_{nobwd}}{\left(\frac{S}{\sqrt{(B)}}\right)_{nobwd}} = \begin{cases} K\pi : (10 \pm 3)\% \\ K_s\pi : (8 \pm 3)\% \end{cases}$$

Impact of material in front of fwd EMC
DG_4a cocktail + signal

π^0 and γ reconstruction

	DG 4	DG 4a
brr π^0 reco eff	$58.76 \pm 0.01\%$	$58.73 \pm 0.01\%$
brr π^0 truth eff	$25.40 \pm 0.01\%$	$25.45 \pm 0.01\%$
fwd π^0 reco eff	$21.81 \pm 0.08\%$	$22.17 \pm 0.08\%$
fwd π^0 truth eff	$36.4 \pm 0.2\%$	$43.8 \pm 0.2\%$
brr γ reco eff	$4.8583 \pm 0.0006\%$	$4.8159 \pm 0.0006\%$
brr γ truth eff	$5.932 \pm 0.003\%$	$5.950 \pm 0.003\%$
fwd γ reco eff	$9.231 \pm 0.004\%$	$9.213 \pm 0.004\%$
fwd γ truth eff	$7.14 \pm 0.01\%$	$7.20 \pm 0.01\%$

* efficiency reconstruction normalized to number of generated γ/π^0
* some cuts applied at reconstruction level cannot be reproduce in the mc truth; cutting on $E\gamma>50$ MeV , γ reconstruction efficiency in the fwd goes to 40%

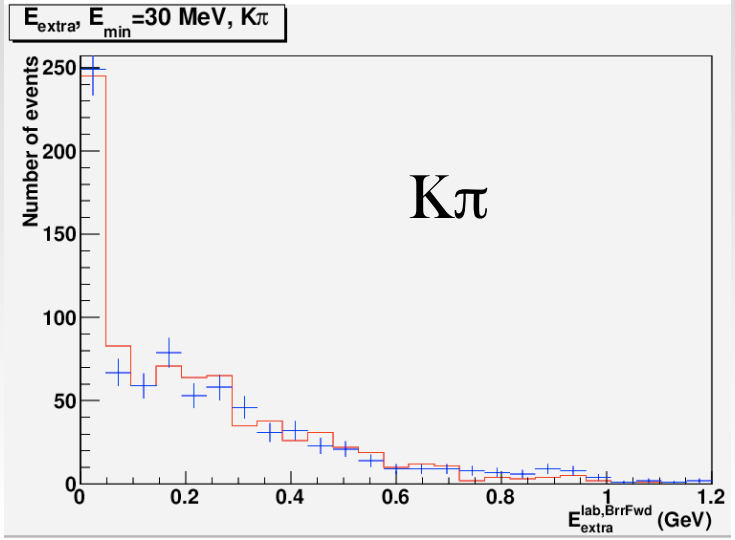
Impact on physics results (I)

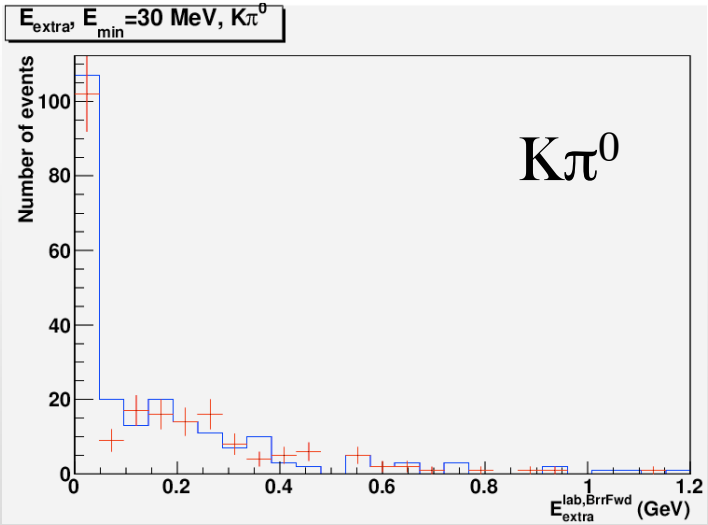
* Eextra barrel + forward distributions, before Eextra cut

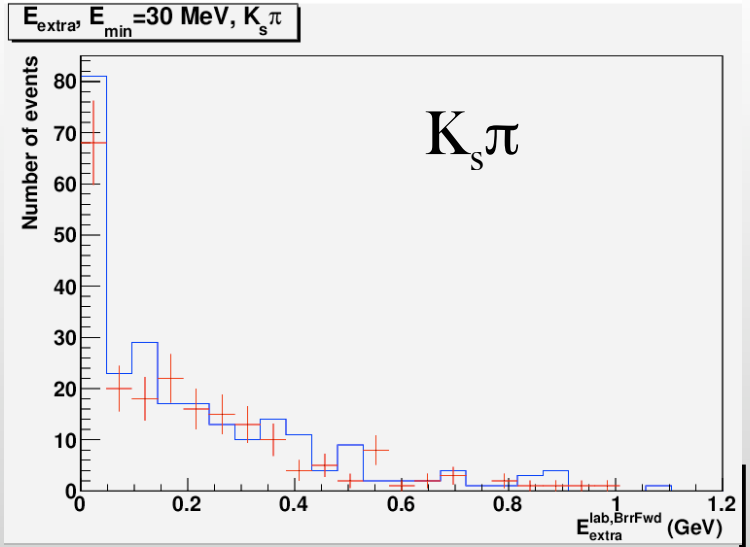
minimum gamma energy = 30 MeV

DG_4 signal MC

DG_4a signal MC





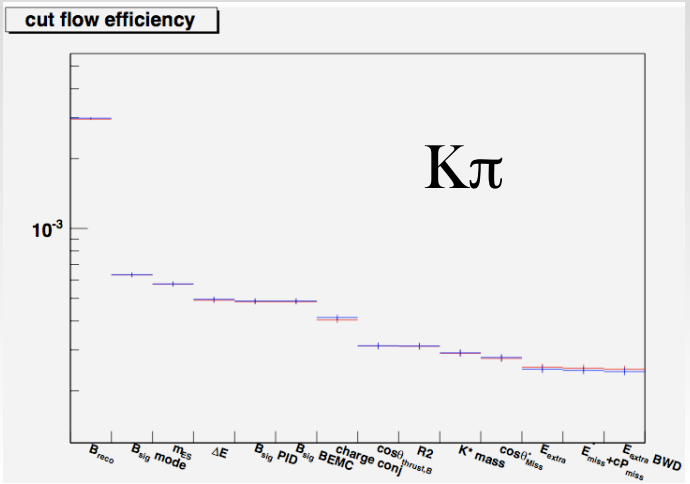


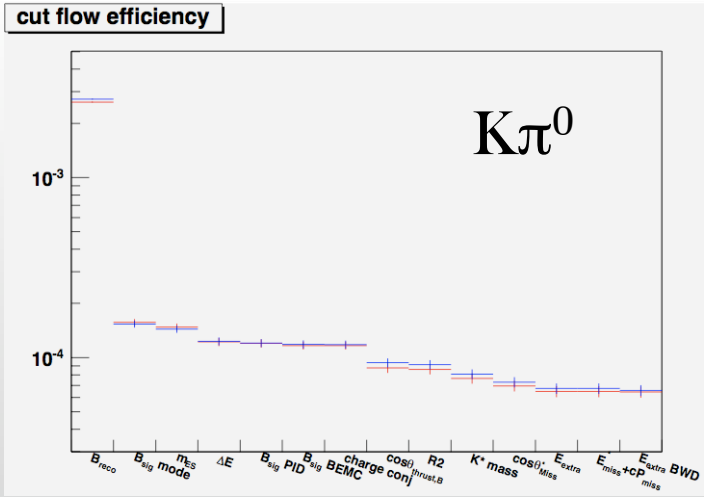
Impact on physics results (II)

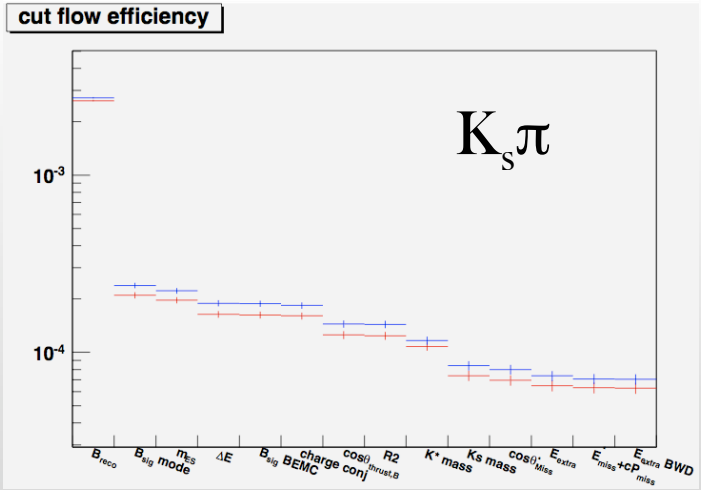
DG_4 signal MC

DG_4a signal MC

* cut flow efficiency: DG_4 and DG_4a consistent within statistical error







Conclusion

* DG studies performed using September_2010 Production

* BWD EMC
  - preliminary studies indicates a 10% enhancement in the FOM when applying the Eextra_bwd cut

* EFFECT OF MATERIAL IN FRONT OF FWD EMC
  - more studies needed to evaluate effect on gamma and π^0 reconstruction
  - physics performances doesn't seem to change on signal MC, cocktail MC needs to be studied

Back-up slides

PacHadRecoilUser code

* SemiExclusive reconstruction of Hadronic B modes

$B \to DX$

$D^0 \to K^-\pi^+$
$D^0 \to K^-\pi^+\pi^0(\gamma\gamma)$
$D^0 \to K^-\pi^+\pi^+\pi^-$
$D^0 \to K^0_S\pi^+\pi^-$

$D^+ \to K^-\pi^+\pi^-$
$D^+ \to K^-\pi^+\pi^-\pi^0$
$D^+ \to K^0_S\pi^+$
$D^+ \to K^0_S\pi^+\pi^-\pi^+$
$D^+ \to K^0_S\pi^+\pi^0$

$D^{*+} \to D^0\pi^+$
$D^{*0} \to D^0\pi^0$
$D^{*0} \to D^0\gamma$

$X = n\pi + mK + rK^0_S + q\pi^0$
$n+m+r+q<6$

* limit the number of reconstructed Breco channels
  - reconstruct only modes with purity >50%
  - generate ad-hoc BB cocktail sample instead of generic

* Available Bsig modes
  - $K^*\nu\nu$
  - $K\nu\nu$, $K_s(\pi\pi)\nu\nu$
  - $\tau\nu$, with $\tau \to e\nu\nu$, $\mu\nu\nu$, $\pi\nu$, $\rho(\pi\pi^0)\nu$, $a_1(\rho\pi)\nu$

Sample used

* 2010_September production, FastSim release V0.2.5, revs 307 and 311

Sample	Bkg conditions	$N_{events}^{analyzed}(10^6)$
DG 4		
$B^0 \to K^{*0}\nu\bar{\nu}$ vs generic B^0	allbkgs	3.06
$B^+ \to K^{*+}\nu\bar{\nu}$ vs generic B^-	allbkgs	3.33
B^0 hadronic cocktail vs generic B^0	allbkgs	150.96
B^+ hadronic cocktail vs generic B^-	allbkgs	189.28
$B^0 \to K^{*0}\nu\bar{\nu}$ vs generic B^0	nopairs	2.97
$B^+ \to K^{*+}\nu\bar{\nu}$ vs generic B^-	nopairs	3.15
B^0 hadronic cocktail vs generic B^0	nopairs	377.20
B^+ hadronic cocktail vs generic B^-	nopairs	400.00
DG 4a		
$B^0 \to K^{*0}\nu\bar{\nu}$ vs generic B^0	allbkgs	3.15
$B^+ \to K^{*+}\nu\bar{\nu}$ vs generic B^-	allbkgs	3.12
$B^0 \to K^{*0}\nu\bar{\nu}$ vs generic B^0	nopairs	3.03
$B^+ \to K^{*+}\nu\bar{\nu}$ vs generic B^-	nopairs	3.00
B^0 hadronic cocktail vs generic B^0	nopairs	376.24
B^+ hadronic cocktail vs generic B^-	nopairs	325.28

π^0 Lists

* p0 from D : “pi0AllDefault”
  - CalorNeutral
  - preFitSelectors: "Mass 0.115:0.150"
  - fittingAlgorithm: "Add4”, fitConstraints: "Mass”, "Momentum”, "PrimaryVertex”

* p0 from D*0 : “pi0SoftDefaultMass”
  - CalorNeutral
  - preFitSelectors: "Mass 0.115:0.15”, "CmsP :0.45”
  - fittingAlgorithm: "Add4”, fitConstraints: "Mass”, "Momentum”, "PrimaryVertex”

* p0 from Breco : “pi0DefaultMass”
  - CalorNeutral
  - preFitSelectors: "Mass 0.115:0.150"
  - fittingAlgorithm : “Add4”, fitConstraints: "Mass”, "Momentum”, "PrimaryVertex”

Photon list

* CalorNeutral for p0 reconstruction

* GoodPhotonsVisibleE
  - CalorNeutral
  - selection:

eRawCut set 0.050,
nCrys set 3,
latShapeCut set 0.6
thetaMin set 0.32
thetaMax set 2.44
TrkListForDeltaAlpha set ChargedTracks
electronSelector set PidLHElectrons
deltaAlphaMin set 0.08