Updated study of HAD recoil $B \rightarrow K^* \nu\nu$ vs bwd EMC

Elisa Manoni – INFN PG

Joint detector geometry WG-FastSim-EMC session

Elba Meeting, 05/31/2011

Outline

- Samples
- Reminder of LNF results
- Physics results

- Analysis strategy and Patch validation discussed by Alejandro

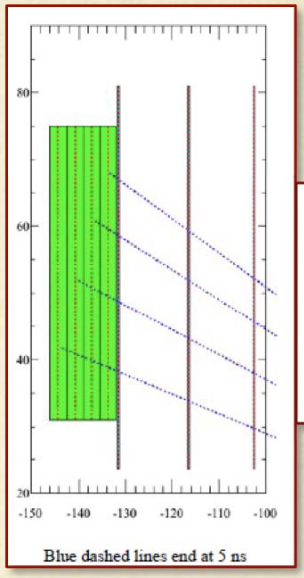
Samples

- September2010 FastSim production

Sample	Bkg conditions	$N_{events}^{analyzed}(10^6)$
DG 4		
$B^0 \to K^{*0}\nu\bar{\nu}$ 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

Bugs and fixes

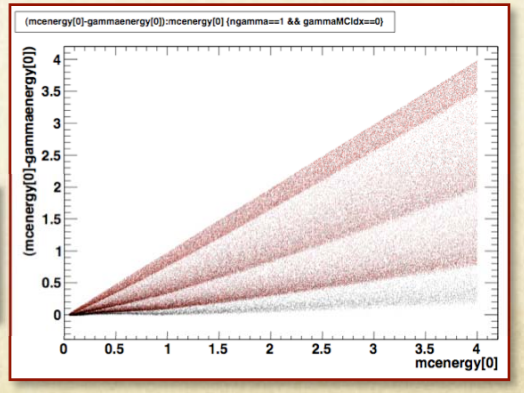
- Bugs related to neutral energy reconstruction in September 2010 production:
  - EMC energy smearing switched off
  - bug in Fast Simulation timing description for Bwd Emc



(Chih-hsiang)

- Now both effects have been incorporated in the patch described by Alejandro

$E_{true} - E_{reco}$ vs E_{true}, truth-matching required



LNF results : smearing bug fix

SMEARING OFF			
$B^0 \to K^{*0}\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^0 \to K^{*0}\nu\bar{\nu}$	786	778	$(99.98 \pm 0.36)\%$
B^0 had cocktail	181	143	$(79.0 \pm 3.0)\%$
$\Delta Sign/Sign$	$(11.4 \pm 1.9)\%$		
$B^+ \to K^{*+}(K_S\pi^+)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	233	232	$(99.57 \pm 0.43)\%$
B^+ had cocktail	136	114	$(83.8 \pm 3.2)\%$
$\Delta Sign/Sign$	$(8.7 \pm 1.9)\%$		
$B^+ \to K^{*+}(K^+\pi^0)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	227	222	$(97.8 \pm 1.0)\%$
B^+ had cocktail	75	65	$(86.7 \pm 3.9)\%$
$\Delta Sign/Sign$	$(5.0 \pm 2.4)\%$		

SMEARING ON			
$B^0 \to K^{*0}\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^0 \to K^{*0}\nu\bar{\nu}$	786	778	$(99.98 \pm 0.36)\%$
B^0 had cocktail	181	146	$(80.7 \pm 2.9)\%$
$\Delta Sign/Sign$	$(10.2 \pm 1.8)\%$		
$B^+ \to K^{*+}(K_S\pi^+)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	233	232	$(99.57 \pm 0.43)\%$
B^+ had cocktail	136	114	$(83.8 \pm 3.2)\%$
$\Delta Sign/Sign$	$(8.7 \pm 1.9)\%$		
$B^+ \to K^{*+}(K^+\pi^0)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	227	221	$(97.4 \pm 1.1)\%$
B^+ had cocktail	75	65	$(86.7 \pm 3.9)\%$
$\Delta Sign/Sign$	$(4.6 \pm 2.4)\%$		

- Smearing has a negligible effect
- Since the smearing is incorporated in the new Patch, our reference number for the Sept2010 production will be the ones in the "SMEARING OFF" table

Figure of Merit & Caveat for HAD analysis

- Apply all the cuts from the BaBar analysis but the one in Eextra_barrel,fwd to increase statistics
- Figure of Merit
  - Significance =S/sqrt(S+B)
  - ΔSignificance/Significance = (Sig_bwd - Sig_nobwd)/Sig_nobwd
  - in the limit S<<B:

    ΔSignificance/Significance = (ε_sig/sqrt(ε_bb)) - 1

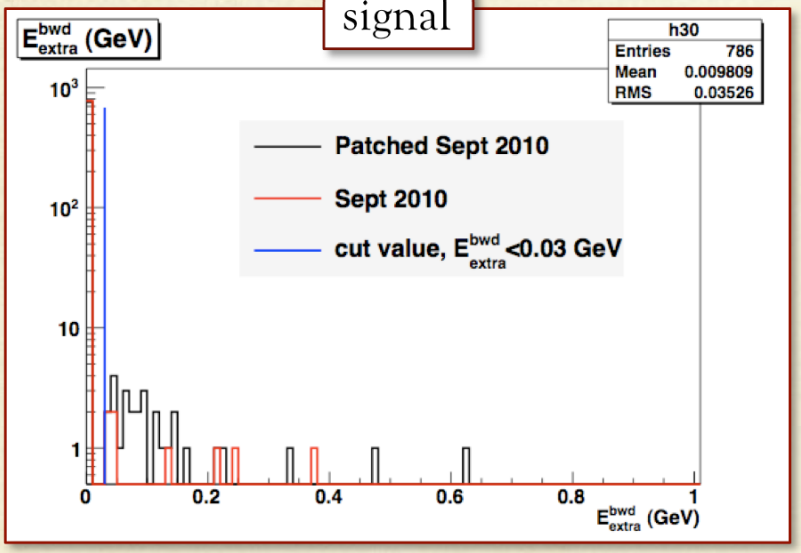
  being ε_sig (ε_bb) the marginal efficiency of the Eextra_bwd cut in signal (BBbar) MC sample

- HAD analysis: very low statistics for BB cocktail samples
  - bigger statisical error on ΔSignificance/Significance wrt SL analysis
  - systematic error due patch algorithm (1% in signal and cocktail efficiency) translate in a negligible uncertainty on ΔSignificance/Significance

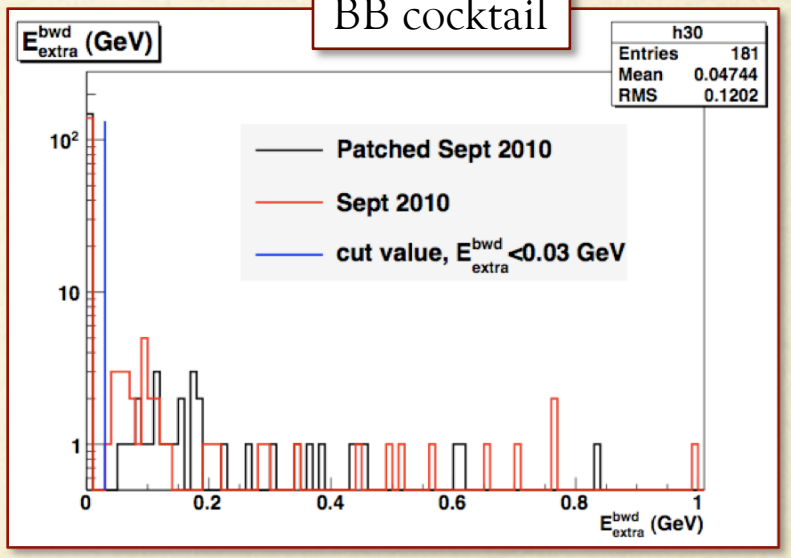
$B \to K^{*0}(K\pi)\nu\nu$

- $E_{\gamma min}$ = 30 MeV, E^{bwd}_{extra} < 30 MeV

signal



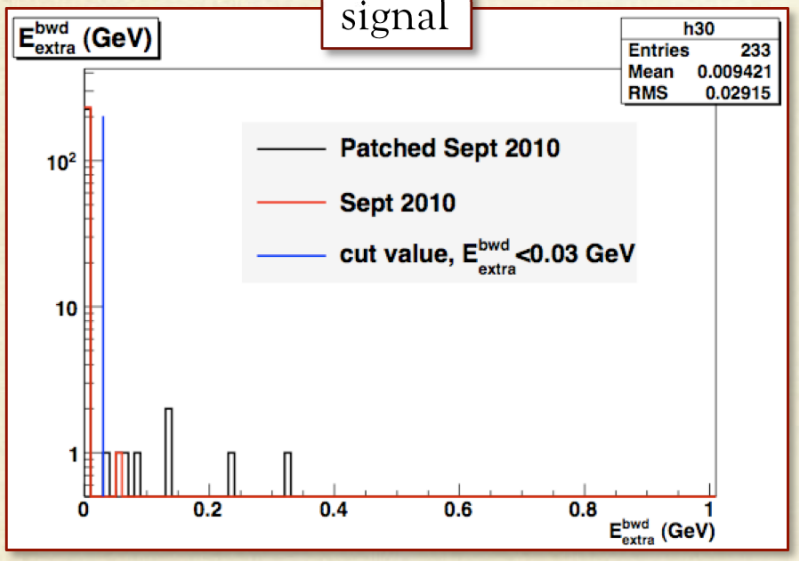
BB cocktail



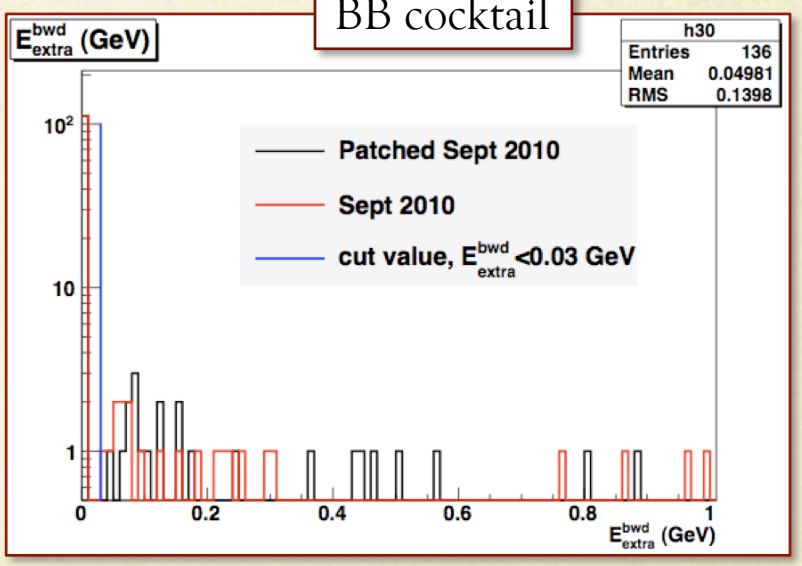
$B \to K^{*+}(K_s\pi)\nu\nu$

- $E_{\gamma min}$ = 30 MeV, E^{bwd}_{extra} < 30 MeV

signal



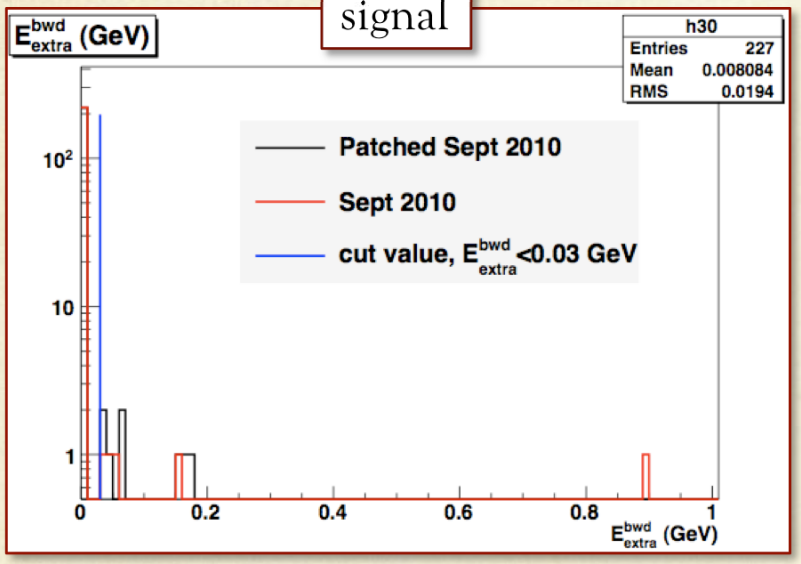
BB cocktail



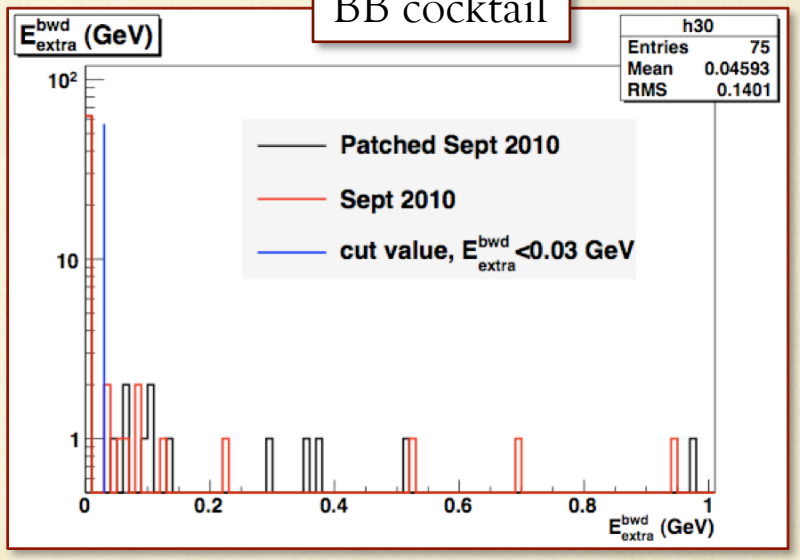
$B \rightarrow K^{*+}(K\pi^0)\nu\nu$

- $E_{\gamma min}$ = 30 MeV, E^{bwd}_{extra} < 30 MeV

signal



BB cocktail



BWD EMC physics impact: summary

SEPT 2010			
$B^0 \to K^{*0}\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^0 \to K^{*0}\nu\bar{\nu}$	786	778	$(99.98 \pm 0.36)\%$
B^0 had cocktail	181	143	$(79.0 \pm 3.0)\%$
$\Delta Sign/Sign$	$(11.4 \pm 1.9)\%$		
$B^+ \to K^{*+}(K_S\pi^+)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	233	232	$(99.57 \pm 0.43)\%$
B^+ had cocktail	136	114	$(83.8 \pm 3.2)\%$
$\Delta Sign/Sign$	$(8.7 \pm 1.9)\%$		
$B^+ \to K^{*+}(K^+\pi^0)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	227	222	$(97.8 \pm 1.0)\%$
B^+ had cocktail	75	65	$(86.7 \pm 3.9)\%$
$\Delta Sign/Sign$	$(5.0 \pm 2.4)\%$		

PATCHED			
$B^0 \to K^{*0}\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^0 \to K^{*0}\nu\bar{\nu}$	786	763	$(97.1 \pm 0.6 + 1)\%$
B^0 had cocktail	181	148	$(81.7 \pm 2.9 + 1)\%$
$\Delta Sign/Sign$	$(7.3 \pm 1.8 - 0.5)\%$		
$B^+ \to K^{*+}(K_S\pi^+)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	233	226	$(97.0 \pm 1.2 + 1)\%$
B^+ had cocktail	136	113	$(83.1 \pm 3.2 + 1)\%$
$\Delta Sign/Sign$	$(6.2 \pm 2.1 - 0.5)\%$		
$B^+ \to K^{*+}(K^+\pi^0)\nu\bar{\nu}$			
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	227	222	$(97.8 \pm 1.0 + 1)\%$
B^+ had cocktail	75	64	$(85.3 \pm 4.1 + 1)\%$
$\Delta Sign/Sign$	$(5.9 \pm 2.5 - 0.5)\%$		

- New results almost compatible with old ones
- Change in FOM due to small fluctuation on the number of selected event

Our conclusions

SL Analyses

Summary on $\delta(S/\sqrt{(S+B)})$ gain due to Bwd-EMC ($E\gamma(min) > 30MeV$):

- $B^+ \to \tau^+\nu$: (3.98 ± 0.08)% (previous) → **(6.08 ± 0.11 - 0.69(sys))% (current)**
- $B^+ \to K^+\nu\nu$: (5.41 ± 0.10)% (previous) → **(5.75 ± 0.98 - 0.64(sys))% (current)**
- $B^0 \to K^0\nu\nu$: (3.69 ± 0.36)% (previous) → **(6.00 ± 0.42 - 0.63(sys))% (current)**
- $B^+ \to K^{*+}\nu\nu$: (4.47 ± 0.15)% (previous) → **(6.95 ± 0.16 - 0.66(sys))% (current)**
- $B^0 \to K^{*0}\nu\nu$: (7.96 ± 0.40)% (previous) → **(9.07 ± 0.41 - 0.68(sys))% (current)**

HAD Analyses

PATCHED

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

Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^0 \to K^{*0}\nu\bar{\nu}$	786	763	$(97.1 \pm 0.6 + 1)\%$
B^0 had cocktail	181	148	$(81.7 \pm 2.9 + 1)\%$
$\Delta Sign/Sign$	$(7.3 \pm 1.8 - 0.5)\%$		

$B^+ \to K^{*+}(K_S\pi^+)\nu\bar{\nu}$

Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	233	226	$(97.0 \pm 1.2 + 1)\%$
B^+ had cocktail	136	113	$(83.1 \pm 3.2 + 1)\%$
$\Delta Sign/Sign$	$(6.2 \pm 2.1 - 0.5)\%$		

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

Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	227	222	$(97.8 \pm 1.0 + 1)\%$
B^+ had cocktail	75	64	$(85.3 \pm 4.1 + 1)\%$
$\Delta Sign/Sign$	$(5.9 \pm 2.5 - 0.5)\%$		

Our conclusions

SL Analyses

Summary on $\delta(S/\sqrt{(S+B)})$ gain due to Bwd-EMC ($E\gamma(min) > 30MeV$):

- $B^+ \to \tau^+\nu$: (3.98 ± 0.08)% (previous) → **(6.08 ± 0.11 - 0.69(sys))% (current)**
- $B^+ \to K^+\nu\nu$: (5.41 ± 0.10)% (previous) → **(5.75 ± 0.98 - 0.64(sys))% (current)**
- $B^0 \to K^0\nu\nu$: (3.69 ± 0.36)% (previous) → **(6.00 ± 0.42 - 0.63(sys))% (current)**
- $B^+ \to K^{*+}\nu\nu$: (4.47 ± 0.15)% (previous) → **(6.95 ± 0.16 - 0.66(sys))% (current)**

BWD EMC USED AS VETO DEVICE
→ 6-10% GAIN IN SIGNIFICANCE IN RECOIL ANALYSES studied in these 2 talks

$B^+ \to K^{*+}\nu\bar{\nu}$	233	226	$(97.0 \pm 1.2 + 1)\%$
B^+ had cocktail	136	113	$(83.1 \pm 3.2 + 1)\%$
$\Delta Sign/Sign$	$(6.2 \pm 2.1 - 0.5)\%$		

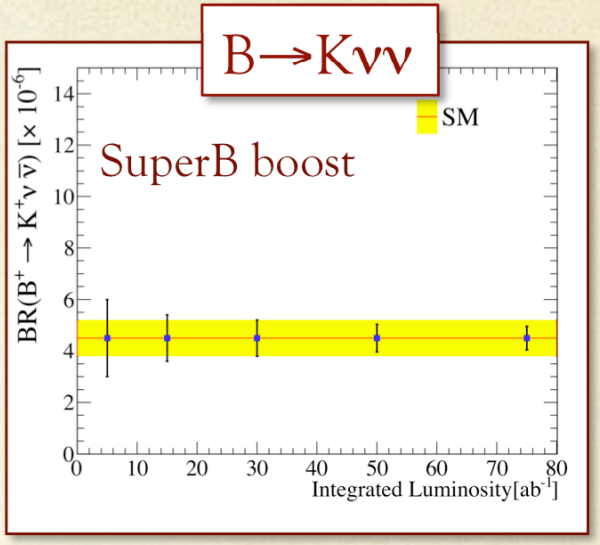
$B^+ \to K^{*+}(K^+\pi^0)\nu\bar{\nu}$

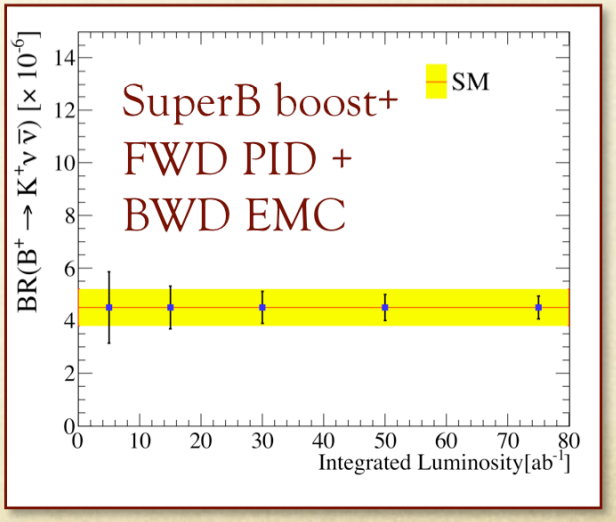
Sample	N_{sel}	$N_{sel,Bwd}$	ε
$B^+ \to K^{*+}\nu\bar{\nu}$	227	222	$(97.8 \pm 1.0 + 1)\%$
B^+ had cocktail	75	64	$(85.3 \pm 4.1 + 1)\%$
$\Delta Sign/Sign$	$(5.9 \pm 2.5 - 0.5)\%$		

PRELIMINARY

Conclusions translated in BF measurements (I)

- assume SM branching fraction,
- +2.5-5% gain in signal selection efficiency due to FWD PID
- -2% reduction in signal selection efficiency
  -15% reduction in background selection efficiency due to BWD EMC
- 3σ significance @
  - SuperB-boost : 5 ab^{-1}
  - SuperB+boost+ PID +EMC : 4 ab^{-1} with ~ 30% precision on $\mathcal{B}$
- 75 ab^{-1} SuperB boost + PID + EMC precision : ~ 10%





PRELIMINARY

Conclusions translated in BF measurements (I)

- assume SM branching fraction,
- +2.5-5% gain in signal selection efficiency due to FWD PID
- -2% reduction in signal selection efficiency
  -15% reduction in background selection efficiency due to BWD EMC
- 3σ significance @
  - SuperB-boost : 50 ab^{-1}
  - SuperB+boost+ PID +EMC : 42 ab^{-1} with ~ 30% precision on $\mathcal{B}$
- 75 ab^{-1} SuperB boost + PID + EMC precision : ~ 10%

$B \to K^* \nu\nu$