FastSim Samples Bkg Composition for $B \to \tau\nu_\tau$ Analysis

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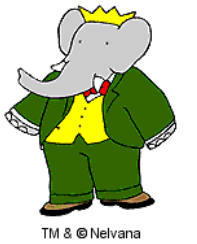
FastSim Meeting

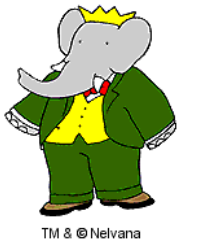
http://www.hep.caltech.edu/~arakitin/tex/2010.Apr.27.SuperB/talk.pdf

Strategy



- FastSim ntuples produced at CNAF contain multiple hadronic tag and signal B candidates
- All reconstructed tag B's are paired up with all non-overlapping signal B's
- Our task:
  - ☞ to select the best tag B candidate (by smallest ΔE)
  - ☞ to select the best signal B candidate:
    - if we have muon candidate – choose muon
    - if no muon – choose electron
    - if no electron – choose $\rho \to \pi\pi^0$
    - if no suitable π^0 – choose $a_1 \to 3\pi$
    - if no a_1 – choose π
    - if no π – skip the event
- We'll look at decay modes of
  - all tag B's
  - best tag B's
  - best tag B's having best sig B
- for signal (B+B-_taunu_DX) and background (B+B-_generic) MC samples for all three detector geometries

Decay mode coding



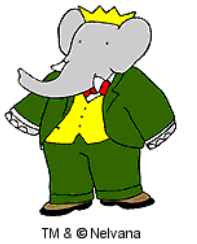
Each tag B decay coded by a 5-digit number: 3-digit charm decay + 2-digit B decay

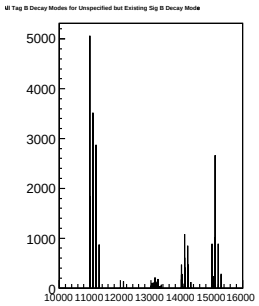
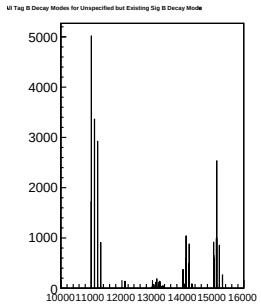
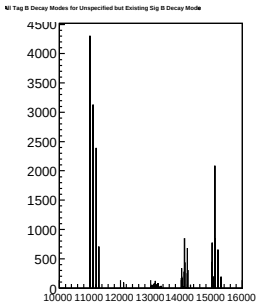
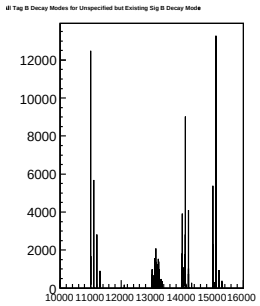
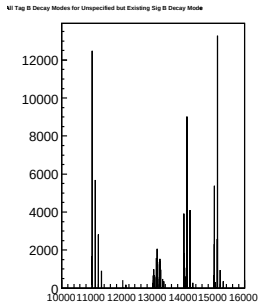
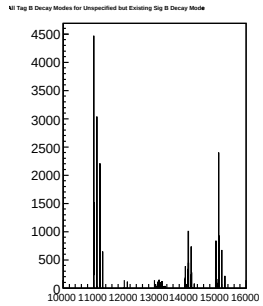
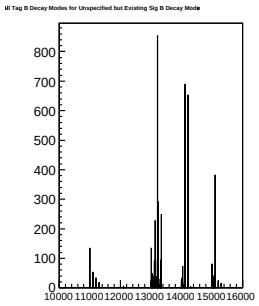
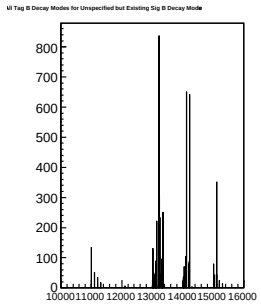
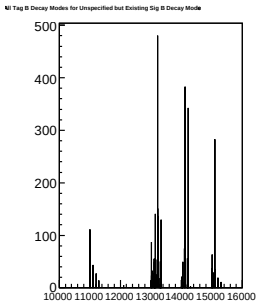
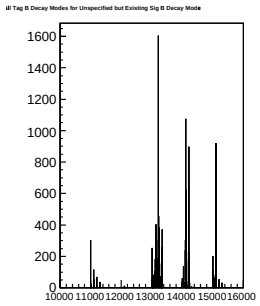
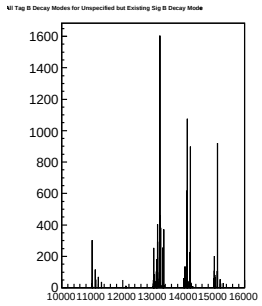
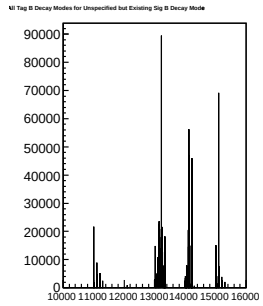
`http://www.slac.stanford.edu/BFROOT//www/Physics/Analysis/AWG/EHBDOC/skims/modesID.txt`

	$D^0 \to K\pi$	$D^0 \to K\pi\pi^0$	$D^0 \to K\pi\pi\pi$	$D^0 \to K_S\pi$	
D^0	110	111	112	113	
$D^{*\pm}, D^{*\pm} \to D^0\pi_s^\pm$	120	121	122	123	
$D^{*0}, D^{*0} \to D^0\pi^0$	140	141	142	143	
$D^{*0}, D^{*0} \to D^0\gamma$	150	151	152	153	
	$D^\pm \to K_S\pi$	$D^\pm \to K\pi\pi$	$D^\pm \to K_S\pi\pi^0$	$D^\pm \to K\pi\pi\pi^0$	$D^\pm \to K_S\pi\pi^0$
$D^\pm$	130	131	132	133	134
$D^{*0}, D^{*0} \not\to D^\pm$	–	–	–	–	–
$D^{*\pm}, D^{*\pm} \to D^\pm\pi^0$	??	??	??	??	??
$D^{*\pm}, D^{*\pm} \to D^\pm\gamma$	??	??	??	??	??

Different B decays range from 01 to 53

All tag B's

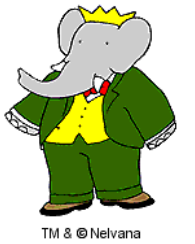


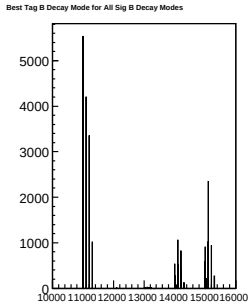
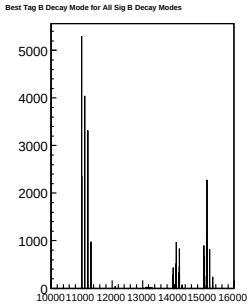
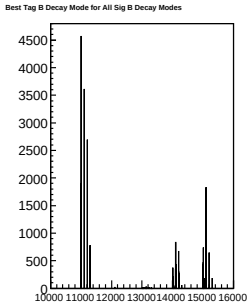
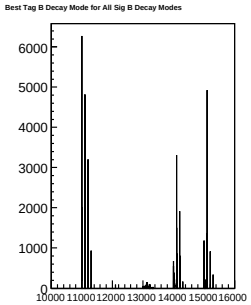
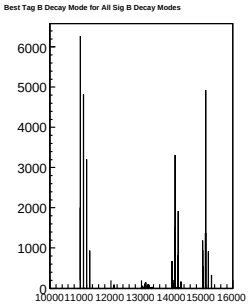
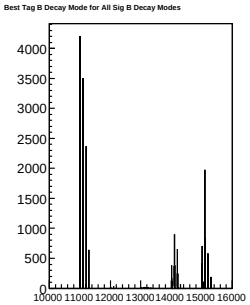
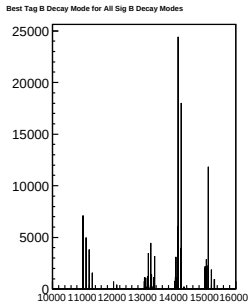
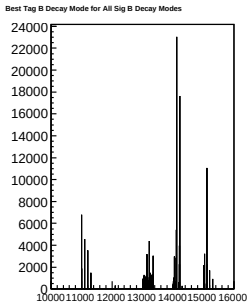
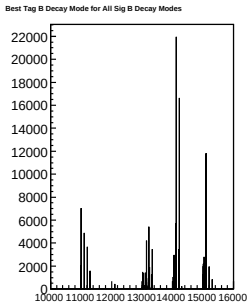
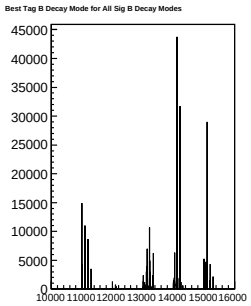
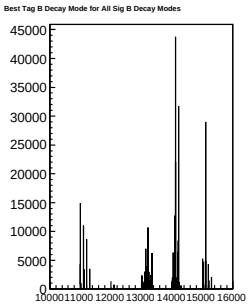
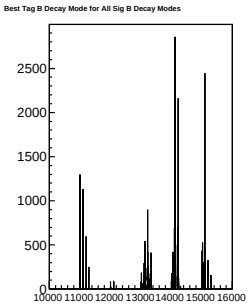
	November			February		
	SuperB w/Bwd	No Bwd	BaBar	SuperB w/Bwd	No Bwd	BaBar
$\tau\nu DX$ sig. MC						
B^+B^- gen. MC						

Reconstructed tag B decay mode "spectrum" peaks at:

- pure D^0 (11000) for signal MC
- pure $D^{\pm}$ (13000) for background MC with smaller peaks at D^{*0} (14000 and 15000)

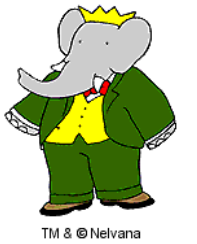
Min. ΔE tag B's only

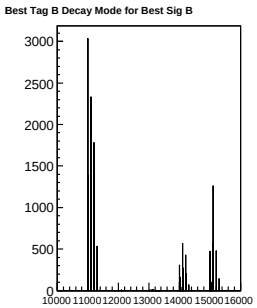
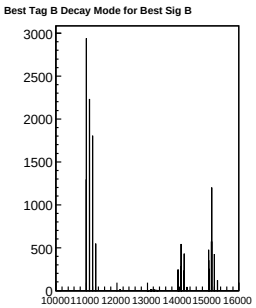
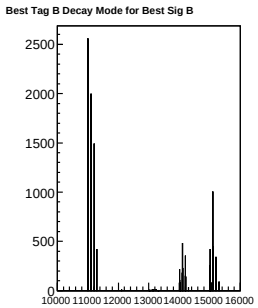
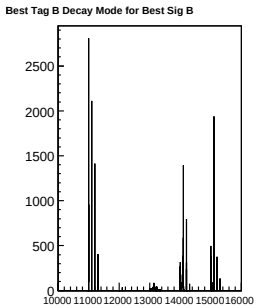
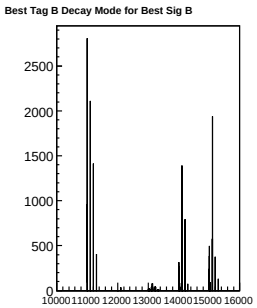
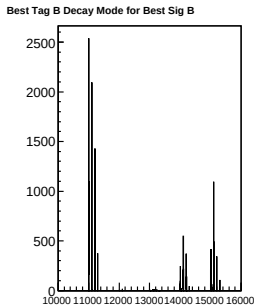
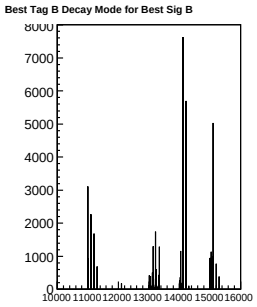
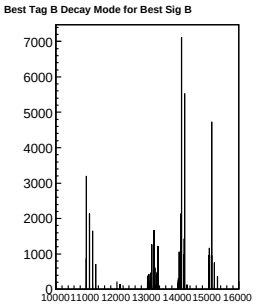
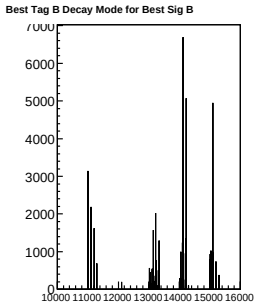
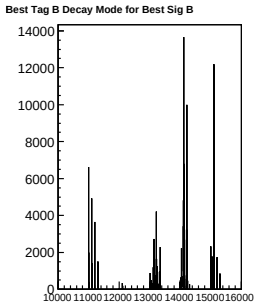
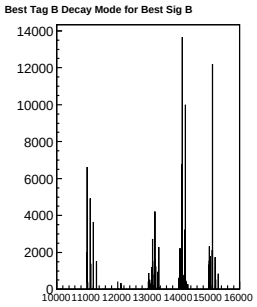
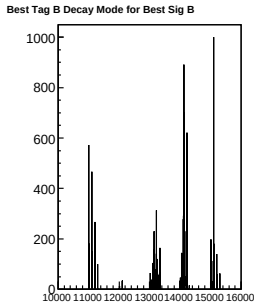


	November			February		
	SuperB w/Bwd	No Bwd	BaBar	SuperB w/Bwd	No Bwd	BaBar
$\tau\nu DX$ sig. MC						
B^+B^- gen. MC						

- Min. ΔE requirement kills pure $D^{\pm}$ (13000) for bkg MC
- The D^{*0} peaks (14000 and 15000) scaled down, but become the highest ones
- Sig MC spectrum remains unchanged

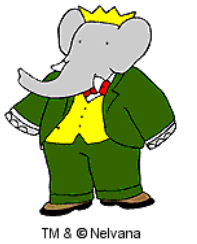
Min. ΔE tag B's having best sig B



	November			February		
	SuperB w/Bwd	No Bwd	BaBar	SuperB w/Bwd	No Bwd	BaBar
$\tau\nu DX$ sig. MC						
B^+B^- gen. MC						

Requirement to have best signal B scales the peaks down, but doesn't change the spectrum shape much

Interesting decays



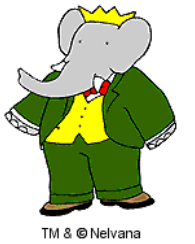
List of tag B decay modes comprising more than 5% of total number of rec'd tag B's (SuperB w/Bwd only):

	November		February	
	All tag B's	Min. ΔE	All tag B's	Min. ΔE
$\tau\nu DX$ sig. MC	11001	11001	11003	11001
	11003	11003	11101	11003
	11101	11101	11201	11101
	11201	11201	14103	11201
	15103	15103	15103	14103
				15103
B^+B^- gen. MC	11003	11003	14122	14122
	14122	14122	14124	14222
	14222	14222	14222	15103
	15103	15103	15103	

Legend for this table is available at

`http://www.slac.stanford.edu/BFROOT//www/Physics/Analysis/AWG/EHBDOC/skims/modesID.txt`

Conclusion



- The reconstructed tag B decay mode "spectrum" is different for sig and bkg MC. Why?
- Min. ΔE requirement sculpts this spectrum significantly
- The list of the most populated decay modes is given