



Hadronic recoil analysis: code status

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From Sept. to Nov. production: to do list



* PacHadRecoilUser package in FastSim V0.1.2,
used both in Sept and Nov production

* To do list for the Nov. production:

- bugs to be fixed:
 - bad assignment of **kaon lund** for kaon coming from B
 - crash related to **Dirc** code, due to track with very small momentum (i.e. $p=2.26e-212$) passed to the **DIRC** reconstruction
→ **ROLF fixed this, THANKS!**
- **filter** to speed up the reconstruction
- **clean up** the code, to disable unused modules and make it more user-friendly
- add **B_{sig} modes**
- implement code for **validation**
- **documentation**



Lund assignment bug

- * no reconstructing events with $B \rightarrow D^{(*)}K + K_s/\pi(0)$
 - $BR(B \rightarrow DK) / BR(B \rightarrow D\pi) \approx 0.1$

- * from efficiency studies: the $B \rightarrow D^{(*)}K + K_s/\pi(0)$ modes should be in the reconstructed sample but the π lund is assigned to K (i.e. $B \rightarrow DK$ falls in the $B \rightarrow D\pi$ category)

- * kaon list used: `TableBasedKaonLHTightSelection(_TOF)`
 - same list used for kaons in the signal side, lund correctly assigned
 - the wrong lund assignment for K from Breco should happen when merging K and π lists in one of the Breco reconstruction steps

- * couldn't fix it before the Nov. production, investigation ongoing



Filters (I)

* Dave asked to add a filter to speed up Had Breco reconstruction

* Some ideas:

- cuts on **invariant masses** (as done in PacTwoBodyUser and PacS2bUser): the masses one can cut on are m_D and m_{ES} → most of the reconstruction done at this point
- **generator level** filter to retain only events in which there is at least one generated $B \rightarrow D$ → according to BaBar Breco code expert, may induce bias
- a very loose filter on **track and cluster multiplicity** (some modes have up to 10 tracks and up to 6 neutrals) → according to BaBar Breco code expert, may induce bias



Filters (II)

Final choice: limit the number of reconstructed Breco channels according to their purity

- Breco mode classification:
 - neat : purity > 80%
 - clean : 50% < purity < 80%
 - dirty : 8% < purity < 50%

- Sept production: neat+clean+dirty modes reconstructed;

efficiency per mode:

	B+B- generic	B0B0bar generic
neat	3.24×10^{-4}	1.50×10^{-4}
clean	1.12×10^{-2}	6.59×10^{-3}
dirty	6.08×10^{-2}	3.53×10^{-2}

- in some BaBar analysis (i.e. $B \rightarrow \tau \nu$) only the cleanest Breco modes are used; same will be probably done with the high SuperB statistics

- for the November production, reconstruct only neat+clean modes



Bsig channels in Nov. production (I)

- * For the Sept. production only $B_{sig} \rightarrow K^* \nu \nu$ reconstruction implemented
- * For the Nov. prod., added
 - $K \nu \nu$, $K_s(\pi \pi) \nu \nu$
 - $\tau \nu$, with $\tau \rightarrow e \nu \nu$, $\mu \nu \nu$, $\pi \nu$, $\rho(\pi \pi^0) \nu$, $a_1(\rho \pi) \nu$
- * Output of the production: one ntuple containing the info on all the Bsig modes reconstructed in the recoil of a Had Breco
- * More than one Upsilon per event:
 - $\Upsilon 1 \rightarrow \text{Breco1 Bsig1}$
 - $\Upsilon 2 \rightarrow \text{Breco1 Bsig2}$
 - $\Upsilon 3 \rightarrow \text{Breco2 Bsig1}$
 - $\Upsilon 4 \rightarrow \text{Breco3 Bsig1}$
 - $\Upsilon 5 \rightarrow \text{Breco3 Bsig2}$
 - * select best Breco according to smallest ΔE
 - * if more than one Bsig is associated to the best Breco, select the one corresponding to the searched Bsig channel



November production

Generic MC samples produced by Dave using PacProduction package

- machine background included: turn on 50X beamstrahlung (nominal 400X) with neutrons enabled

* Samples:

- three detector configurations: DG_BaBar, DG_1, DG_4
- background MC samples
- signal MC samples:

$B^+ \rightarrow K^+ \nu \nu, B^+ \rightarrow K^{*+} \nu \nu,$

$B^0 \rightarrow K^{*0} \nu \nu;$

10^6 generated events for each sample, for each DG

Detector Geometry	Generator	N requested	Analysis	Requestor	Status	N produced
DG_1	B0B0bar_generic	50x10 ⁶	All	Dave	Complete	53.1 x10 ⁶
DG_1	B+B-_generic	50x10 ⁶	All	Dave	Complete	49.4x10 ⁶
DG_1	ccbar	50x10 ⁶	DstD0ToKspipi, HadRecoil	Rolf, Elisa	Complete	49.9x10 ⁶
DG_1	uds	100x10 ⁶	HadRecoil	Elisa	Complete	49.9x10 ⁶
DG_1	B+B-_tau_DX	1x10 ⁶	BtoTauNu	Chih-hsiang	Complete	1x10 ⁶
DG_4	B0B0bar_generic	50x10 ⁶	All	Dave	Complete	48.3x10 ⁶
DG_4	B+B-_generic	50x10 ⁶	All	Dave	Complete	48.7x10 ⁶
DG_4	ccbar	50x10 ⁶	HadRecoil	Elisa	Complete	49.8x10 ⁶
DG_4	uds	100x10 ⁶	HadRecoil	Elisa	Complete	49.3x10 ⁶
DG_4	B+B-_tau_DX	1x10 ⁶	BtoTauNu	Chih-hsiang	Complete	1x10 ⁶
DG_BaBar	B0B0bar_generic	50x10 ⁶	HadRecoil	Elisa	Complete	50x10 ⁶
DG_BaBar	B+B-_generic	50x10 ⁶	HadRecoil	Elisa	Complete	50x10 ⁶
DG_BaBar	ccbar	50x10 ⁶	DstD0ToKspipi, HadRecoil	Rolf, Elisa	Complete	50x10 ⁶
DG_BaBar	B+B-_tau_DX	1x10 ⁶	BtoTauNu	Chih-hsiang	Complete	1x10 ⁶



Fast Sim DG_BaBar vs BaBar Full Sim (I)

SuperB FastSim:

- B+B-, B0B0bar, ccbar MC samples
- BaBar beams and detector geometry

* BaBar FullSim, Run3:

- B+B- : 49766000 gen. events
- B0B0bar : 50556000 gen. events
- ccbar : 83974000 gen. events

* Differences in reconstructed Breco modes

- BaBar FullSim: additive modes wrt FastSim, i.e. $B \rightarrow J/\psi X$, new **D** modes as seeds \rightarrow cut on **B** and **D** mode to reject most of them
- BaBar FullSim: neat+clean+dirty sample \rightarrow cut on purity

* Selection applied:

- at least one reconstructed Breco; if #Breco > 1, best candidate $\leftrightarrow |\Delta E| \min$
- $-0.09 < \Delta E < 0.05 \text{ GeV}$
- $5.270 < m_{ES} < 5.288 \text{ GeV}/c^2$



Fast Sim DG_BaBar vs BaBar Full Sim (II)

charged Breco	B0B0bar		BpBm		ccbar	
	FullSim	FastSim	FullSim	FastSim	FullSim	FastSim
≥ 1 Breco	0.0037	0.0054	0.0100	0.0115	0.0088	0.0079
deltaE cut	0.0028	0.0043	0.0081	0.0093	0.0063	0.0057
mES cut	0.0004	0.0007	0.0034	0.0032	0.0008	0.0007
$\epsilon_{\text{Fast}}/\epsilon_{\text{Full}}$	1.66		0.95		0.94	

neutral Breco	B0B0bar		BpBm		ccbar	
	FullSim	FastSim	FullSim	FastSim	FullSim	FastSim
≥ 1 Breco	0.0083	0.0133	0.0031	0.0057	0.0038	0.0054
deltaE cut	0.0070	0.0116	0.0025	0.0048	0.0029	0.0043
mES cut	0.0020	0.0028	0.0003	0.0006	0.0003	0.0005
$\epsilon_{\text{Fast}}/\epsilon_{\text{Full}}$	1.40		1.92		1.57	

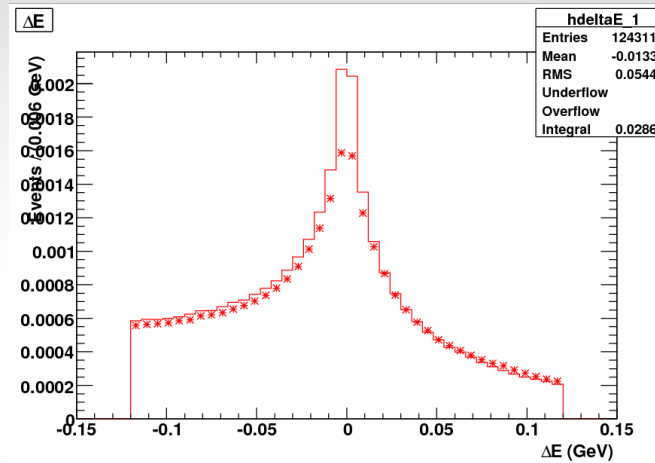
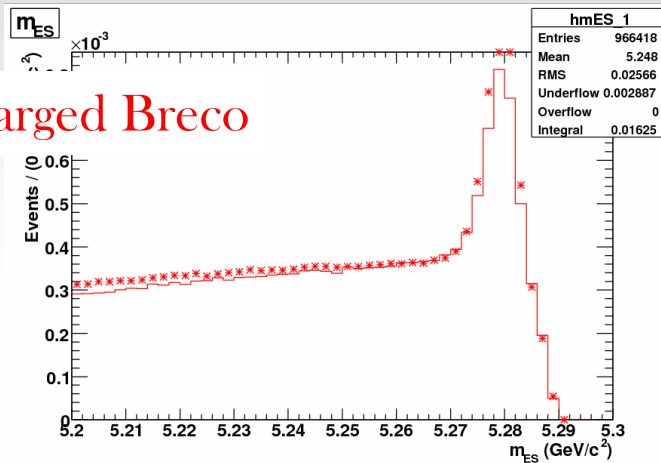


Fast Sim DG_BaBar vs BaBar Full Sim (III)



* m_{ES} and ΔE before the selection

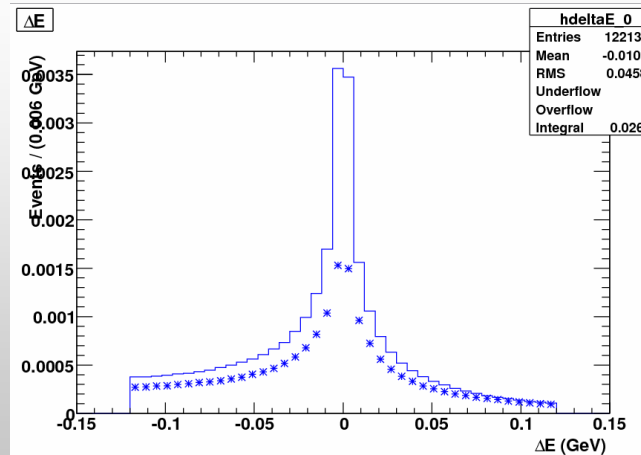
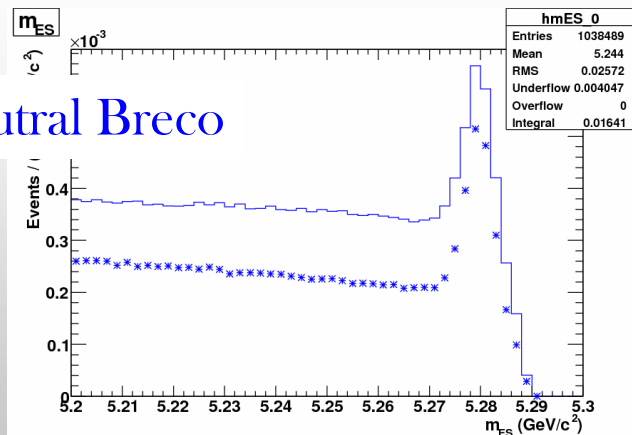
charged Breco



* BaBar FullSim
— FastSim DG_BaBar

◆ ccbar + B0B0 + B+B-

neutral Breco



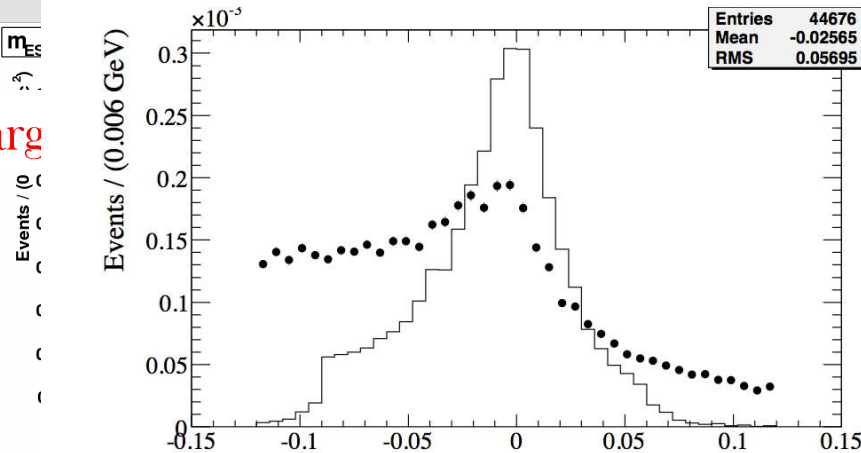
◆ ccbar + B+B- +B0B0



Fast Sim DG_BaBar vs BaBar Full Sim (III)



charg



big improvement in the ΔE shape agreement!

BaBar

B+B-

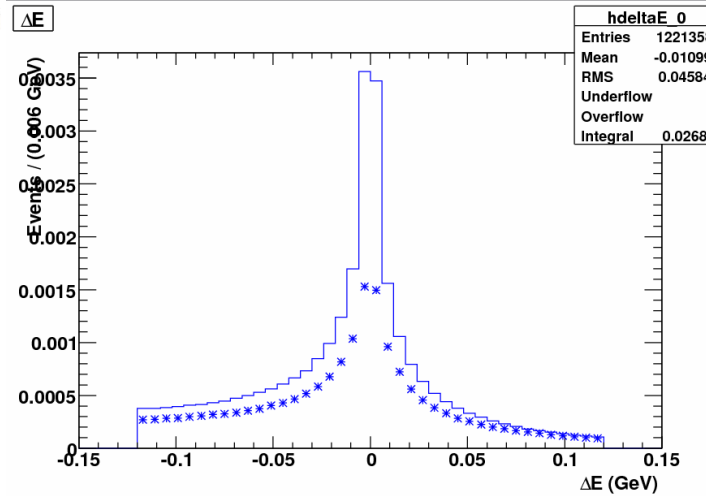
FastSim V0.0.3
@ Warwick Physics
Workshop

● FastSim
— FullSim

* FastSim
— FastSim
FastSim V0.1.2

neut

Events / (0.006 GeV)



BOBO



Pending and new to do list items

* new issues:

- some rootuple variables not filled properly: i.e. R_2 , Ks block
- presence of cloned Υ candidates \rightarrow multiple Breco candidates with same m_{ES} , ΔE , decayMode,.. appended to the Breco lists: problem when merging lists?

2 Υ candidate:
same Breco,
different Bsig
 \rightarrow OK

13 Υ candidate:
2 sets of candidates
- 5 cand with $m_{ES} = 5.279$ GeV,
same Bsig
- 8 cand with $m_{ES} = 5.280$ GeV,
same Bsig
 \rightarrow they should be just 2 Breco cand!

TagB infos

SigB reconstructed mode

Row	Instance	YTagB_mES	YTagB_dec	YTagB_del	YSigB_Rec
0	0	5.2749037	11201	0.0004190	0
1	0	5.2806448	11003	0.0109066	3
2	0	5.2842249	11001	0.0118611	3
3	0	5.2806205	15301	0.0575902	3
3	1	5.2806205	15301	0.0575902	4
4	0	5.279006	15101	-0.044755	0
4	1	5.279006	15101	-0.044755	0
4	2	5.279006	15101	-0.044755	0
4	3	5.279006	15101	-0.044755	0
4	4	5.279006	15101	-0.044755	0
4	5	5.2803258	15103	0.0711883	0
4	6	5.2803258	15103	0.0711883	0
4	7	5.2803258	15103	0.0711883	0
4	8	5.2803258	15103	0.0711883	0
4	9	5.2803258	15103	0.0711883	0
4	10	5.2803258	15103	0.0711883	0
4	11	5.2803258	15103	0.0711883	0
4	12	5.2803258	15103	0.0711883	0



*

Pending and new to do list items

new issues:

- some rootuple **variables not filled properly**: i.e. R_2 , K_s block
- presence of **cloned Υ candidates** \rightarrow multiple Breco candidates with same m_{ES} , ΔE , decayMode,.. appended to the Breco lists: problem when merging lists?

*

pending issue:

- wrong **lund for kaon** coming from breco
- improve **Bsig reconstruction** (i.e. implement best tau candidate selection at reconstruction level)
- still some **clean up** to do

- implement code for **validation**
- write **documentation** for FastSim wiki user manual



Conclusion

- * Hadronic Breco code in quite good shape
- * implemented $B_{sig} \rightarrow K_{(s)} \nu \nu$, $\tau \nu$ reconstruction (+ $B_{sig} \rightarrow K^* \nu \nu$)
- * background and signal MC samples produced @ the Nov. Production
- * ntuples analyzed for DG and physics studies
- * still some work to do to fix bugs, improve the code, add validation tools and documentation



Back-up slides