Had Breco code: status report

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Outline

* Code issues:
  - K lund bug
  - multiple Breco candidates
  - $B \to \tau\nu$ and $B \to K^{(*)}ll$ reconstruction
  - warning messages
  - variables not properly filled
  - validation code
  - modify code to use bwd ECM as veto device (see Alejandro's talk)

* Physics studies:
  - BaBar FullSim vs FastSim comparison with new BaBar dataset
  - $B \to D\pi$, $D \to K\pi$ studies
  - signal efficiency studies with higher statistics (wrt frascati)
  - B-D vertex separation studies

* Wiki documentation

Discussed in this talk

Code related issues

Lund assignment bug

* $B \to D^{(*)}K + Ks/\pi^{(0)}$ modes not reconstructed due to a bug in the kaon lund assignment (all tracks form Breco had the pion lund)
* kaon list used: TableBasedKaonLHTightSelection(_TOF)

→ fixed by fixing bug in PacPid/PacPidTableBasedSelector and PacPid/PacPidTruthBasedSelector

multiple Breco candidates (I)

* events with 'semi-identical' breco candidates, i.e. same m_{ES}, ΔE, decayMode but different E^*_{Breco} (!!)

* occurs only for modes with π^0, i.e. $B \to D^* \pi\pi^0$, $B \to Dk\pi^0 ks$

* the 'semi-identical' candidates are not clones:

Direct daughters differ, as follows:

Direct Daughter 0 cand uid 10050 other uid 10050 cand lundid 211 other lundid 211

Direct Daughter 1 cand uid 10051 other uid 10051 cand lundid 211 other lundid 211

Direct Daughter 2 cand uid 10052 other uid 10052 cand lundid 321 other lundid 321

Direct Daughter 3 cand uid 10053 other uid 10053 cand lundid 211 other lundid 211

Direct Daughter 4 cand uid 10063 other uid 10063 cand lundid 22 other lundid 22

Direct Daughter 5 cand uid 10070 other uid 10068 cand lundid 22 other lundid 22

→ use different gammas to reconstruct the π^0 (so m_{ES} and ΔE should be different between the two cands)

multiple Breco candidates (II)

* such events are accompanied by the warning msg

UsrWriteBSemiExcl::UsrWriteBRecoBase.hh(63):Cannot put mES = 5.25414 for candidate 0x12d1cff0 in the UsrCandBlock

* looking at old BaBar-hn: it should happen if the two candidates are clones and as a consequence the instruction candBlock.put(cand, mES) fails
* in this case cands are not clones, and a ntuple level the i^{th} cand own the UsrVariables (mES, ΔE,...) of the first

* mail sent to BaBar Breco experts

$B \to \tau\nu$ and $B \to K^{(*)}ll$ reconstruction

$B \to \tau\nu$:

* τ modes implemented in PacHadRecoilUser:
  - 1-prong : $e\nu\nu$, $\mu\nu\nu$, $\pi\nu$
  - 3-prong : $\rho(\pi\pi^0)\nu$, $a_1(\rho^0(\pi\pi)\pi)\nu$

(probably only1-prong decay will be reconstructed with the high SuperB lumi)

* no best τ selection applied so far (in one event, if more than one τ mode is reconstructed, i.e. $B \to \tau(\pi)\nu$, $B \to \tau(\rho)\nu$, multiple Υ are saved), is it needed?

$B \to K^{(*)}ll$

* code to be implemented .. feasible for February production?

warning messages

November production: three kinds of warning messages related to PacHadRecoilUser code

* UsrWriteBSemiExcl::UsrWriteBRecoBase.hh(63):Cannot put mES = 5.27535 for candidate 0x127ed828 in the UsrCandBlock
  - related to the multiple candidate problem

* BToDstarTrigger::SmpListMaker.cc(229):Output list "D0ToK3PiLoose" reached maximum allowed length of 1000 candidates. This is the LAST MESSAGE of this kind.
  - in SmpListMaker::reachedMaxNumberOfCandidates, maxnumberofwarnings set to 10, it can be reduced.

* BToDstarTrigger::TrkGammaVertex.cc(147):parallel point not parallel!
  - in TrkGammaVertex, e^+-e- pairs are paired to find a common vertex (i.e. gamma conversion)
  - in these events the common vertex is not found
  - investigation ongoing

r2 variable and hanging jobs

R2

* at the moment BtaTupleMaker is asked to dump R2 and R2All (eventTagsFloat set "R2All R2")
* variables always set to 0 (R2) or -9999 (R2All)
* trying to add them as user variables

hanging jobs

* in the past it was noticed that running PacProductionApp and enabling only the HadRecoil analysis, jobs were hanging; PacHadRecoilApp was instead running successfully
* updating the release (V0.1.3) in the last few days, also PacHadRecoilApp jobs hangs (run HadRecoil analyses only using PacProductionApp and enabling some other analysis, (i.e. DstD0ToKspipi)
* Dave is investigating

Physics studies

@ Frascati: 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 (BTauNuSemiExclUser "equivalent" to PacHadRecoilUser):
  - 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
    → cut on B and D mode to reject most of them
  - BaBar FullSim: neat+clean+dirty sample → cut on purity
* Selection applied:
  - at least one reconstructed Breco; if #Breco > 1, best candidate ↔ $|\Delta E|$min
  - $-0.09 < \Delta E < 0.05$ GeV
  - $5.270 < m_{ES} < 5.288$ GeV/c^2

@ Frascati: 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
$\varepsilon_{Fast}/\varepsilon_{Full}$	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
$\varepsilon_{Fast}/\varepsilon_{Full}$	1.40		1.92		1.57	

update : 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 sample produced by McGill group for BaBar Leptonic Analysis, thanks to Steve and Dana (BRecoilUser and BRecoilTools):
  - B+B- : 56.035.000 gen. events
  - B0B0bar : 57.888.000 gen. events
  - ccbar : 88.321.000 gen. events

* Differences in reconstructed Breco modes
  - "Frascati" BaBar sample produced with BSemiExclAddSkim, McGill BaBar sample uses BSemiExcl skim as implemented in FastSim
  - (both " Frascati" and McGill) BaBar FullSim: neat+clean+dirty sample → cut on purity

* Selection applied:
  - at least one reconstructed Breco; if #Breco > 1, best candidate ↔ max purity + mode by mode ΔE cut
    (was: "best candidate ↔ |ΔE|min")
  - $-0.09<\Delta E<0.05$ GeV
  - $5.270<m_{ES}<5.288$ GeV/c^2

update: Fast Sim DG_BaBar vs BaBar Full Sim (II)

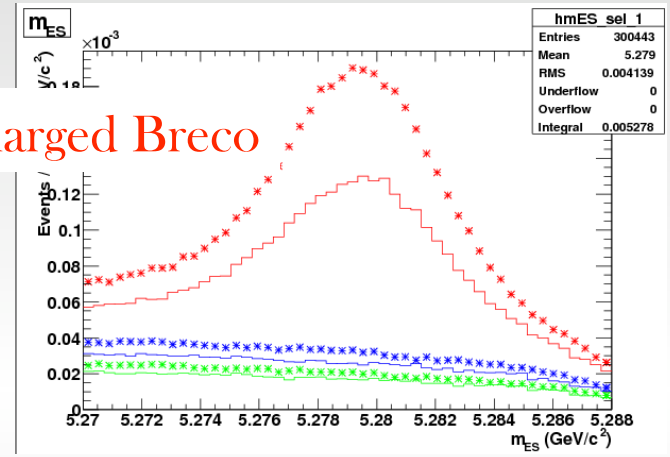
charged Breco	B0B0bar		BpBm		ccbar	
	FullSim	FastSim	FullSim	FastSim	FullSim	FastSim
≥ 1 Breco	0.0033	0.0030	0.0091	0.0072	0.0047	0.0043
deltaE cut	0.0031	0.0029	0.0086	0.0071	0.0043	0.0042
mES cut	0.0006	0.0004	0.0038	0.0026	0.0006	0.0005
$\varepsilon_{Fast}/\varepsilon_{Full}$	0.77		0.70		0.84	

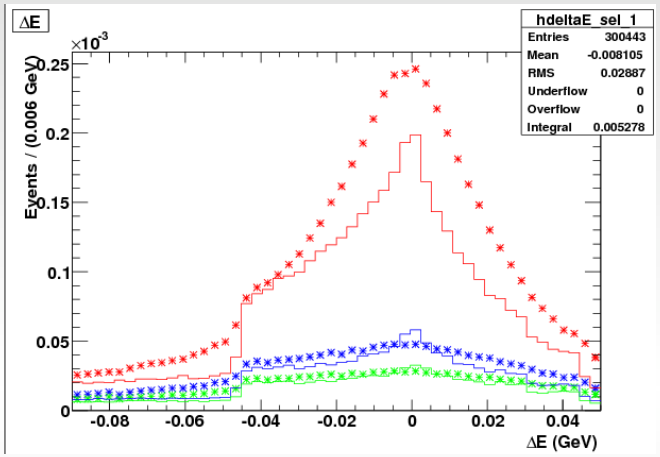
neutral Breco	B0B0bar		BpBm		ccbar	
	FullSim	FastSim	FullSim	FastSim	FullSim	FastSim
≥ 1 Breco	0.0109	0.0099	0.0042	0.0041	0.0035	0.0035
deltaE cut	0.0103	0.0097	0.0040	0.0040	0.0032	0.0034
mES cut	0.0033	0.0025	0.0006	0.0005	0.0004	0.0004
$\varepsilon_{Fast}/\varepsilon_{Full}$	0.76		0.80		0.89	

Update: Fast Sim DG_BaBar vs BaBar Full Sim (III)

m_{ES} and ΔE after the selection

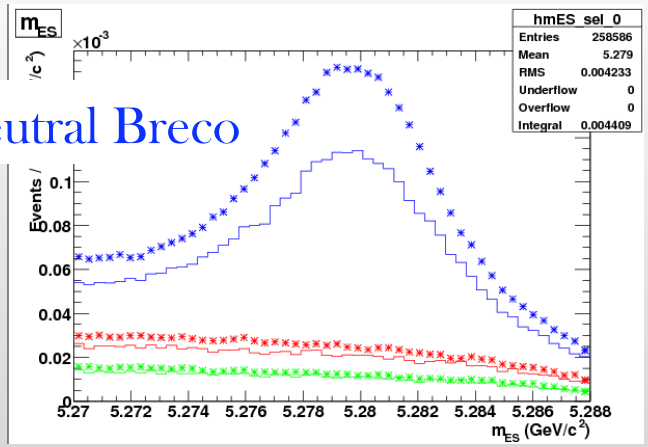
charged Breco

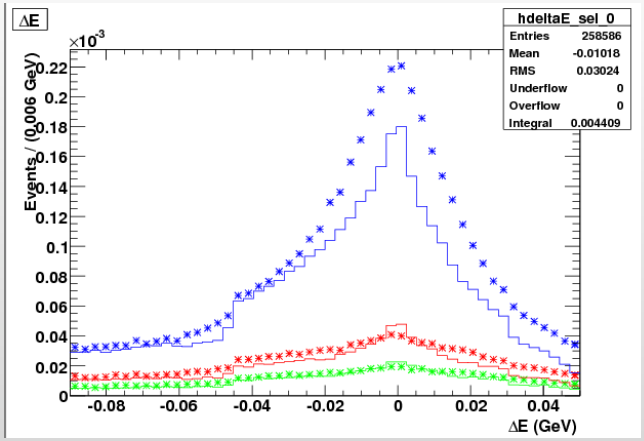




* BaBar FullSim
— FastSim DG_BaBar
♦ccbar + B0B0 + B+B-
♦ccbar + B0B0
♦ccbar

neutral Breco

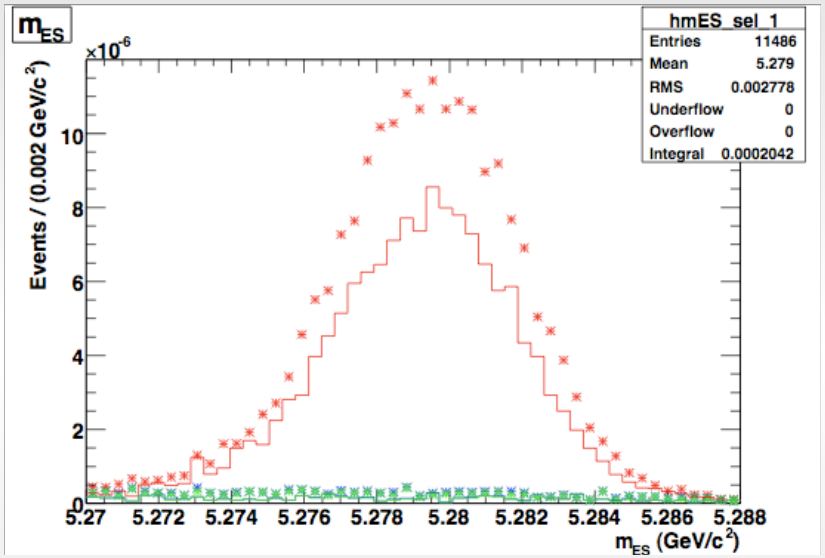


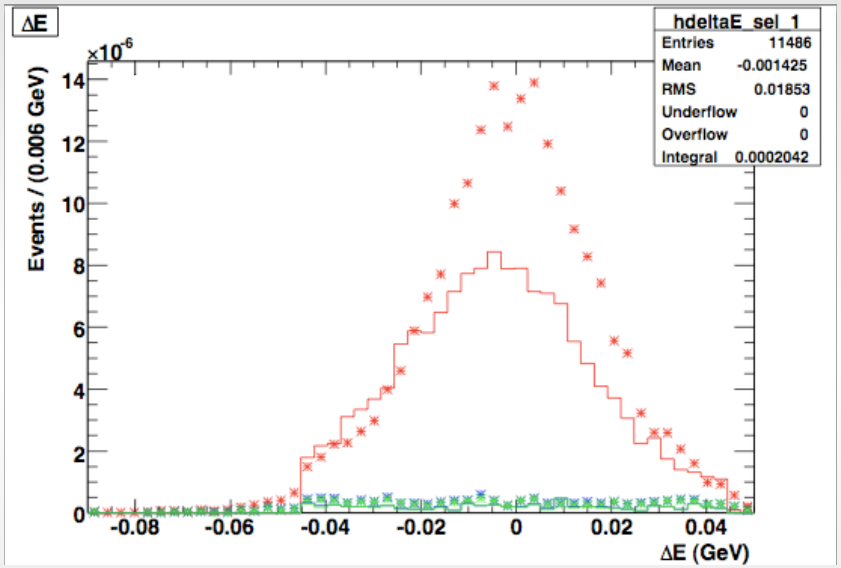


♦ccbar + B+B- +B0B0
♦ccbar + B+B-
♦ccbar

the simplest mode: $B^- \to D^0(K^+\pi^-)\pi^-$

m_{ES} and ΔE before the selection





* BaBar FullSim
— FastSim DG_BaBar

B^+B^- sample: $\varepsilon_{Fast}/\varepsilon_{Full} = 0.73$

♦ccbar + B0B0 + B+B-
♦ccbar + B0B0
♦ccbar

possible sources of disagreement

* a mode by mode ΔE cut is applied both in the McGill sample (BRecoilTools + BRecoilUser) and in PacHadRecoilUser but the mode splitting is different between the two.

* best candidate selection is slightly different (this shouldn't be the biggest effect)

* cutting on purity, only some decay modes are retained;
  due to the k lund bug, B→DKX events falls in the B→DπX class,
  in particular B→D2Kπ (purity>50%) become B→D3π (purity<50%)
  I have computed that 8% of $B^+ \to D^0 X$ events and 11% of $B^0 \to D^- X$ events
  are lost + other losses in the B→D*X modes

→ need to repeat the study after the klund bug fix

To-do-list and conclusions

To-do-list : code issues

* bug on K lund finally fixed

* thinks to be fixed before the production:
  - multiple Breco candidates +++
  - warning msgs +++
  - modify code to implement to use bwd EMC as veto device +++
  - R2 added as Usr Variables ++
  - $B \to \tau\nu$ reconstruction optimization? ++
  - $B \to K^{(*)}ll$ reconstruction implementation? ++
  - validation code ++

To-do-list: Physics studies + documentation

* Repeated FullSim vs FastSim comparison using MCGill sample (same skim as the one in use in BaBar): want to make a small production of generic BB event to check the agreement after the k lund bug fix

* pending items:
  - signal efficiency studies for $B \to K^{(*)} \nu\nu$ with higher statistics (wrt frascati)
  - B-D vertex separation studies (are the variables in the ntuples ok for SVTers to study L0 option?)
  - write Wiki documentation

Back-up slides

Hadronic Breco reconstruction in FastSim (I)

* SemiExclusive reconstruction implemented in FastSim: PacHadRecoilUserPackage
* Package based on BaBar BTauSemiExclUser code

* It contains:
  - main analysis tcl on which run the executable
  - tcl for skim emulation (based on FilterTools/BSemiExclPath.tcl)
  - tcl for PID selection (TableBasedXXXSelection selectors based on BaBar run6-r24c PID tables)
  - tcl and .cc / .hh for signal and tag side reconstruction and selection:

    $B_{sig} \to K\nu\nu$, $K^*\nu\nu$, $\tau\nu$ available
  - tcl for BtaTupleMaker settings
  - README

Hadronic Breco reconstruction in FastSim (II)

* Breco side: limit the number of reconstructed modes channels according to their purity
  - Breco mode classification: neat : purity > 80% , $\varepsilon_{neat} \approx O(10^{-4})$
    clean : 50% < purity < 80% , $\varepsilon_{clean} \approx O(10^{-3}\text{-}10^{-2})$
    dirty : 8%<purity<50% , $\varepsilon_{dirty} \approx O(10^{-2})$
  - in some BaBar analysis (i.e. $B \to \tau\nu$) only the cleanest Breco modes are used; same will be probably done with the high SuperB statistics

→ reconstruct only neat+clean modes

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

Bsig channels in Nov. production

* For the Sept. production only Bsig $\rightarrow K^{*}\nu\nu$ 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:
  - $\Upsilon 1 \rightarrow$ Breco1 Bsig1
  - $\Upsilon 2 \rightarrow$ Breco1 Bsig2
  - $\Upsilon 3 \rightarrow$ Breco2 Bsig1
  - $\Upsilon 4 \rightarrow$ Breco3 Bsig1
  - $\Upsilon 5 \rightarrow$ 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