B_{reco} studies in FastSim: status report

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Outline

* Implementation of dedicated packages for B_{reco} reconstruction in FastSim:

  – PacSemiExclUser

  – PacSemiLepUser

  > n.b. the names of the packages may change in PacSemiLepRecoilUser and PacHadRecoilUser

* pending problems

  – HAD: reading UsrData, efficiency loss bteween V3 and V9

  – SL: unexpected gain in efficiency in V9 wrt BaBar FullSim (and previous FastSim versions)

B_{reco} in FastSim

* Reconstruction of SL and HAD B_{reco} modes implemented in FastSim

$$B \to D l \nu X \qquad \boxed{X = \gamma, \pi}$$

SL

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

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

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

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

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

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

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

$$B \to D X$$

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

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

$$\boxed{\begin{array}{c} X = n\pi + mK + r K_S^0 + q\pi^0 \\ n + m + r + q < 6 \end{array}}$$

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

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

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

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

$$D^+ \to K_S^0 \pi^+$$

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

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

$$D^+ \to K_S^0 \pi^+ \pi^- \pi^+$$

$$D^0 \to K_S^0 \pi^+ \pi^-$$

$$D^+ \to K_S^0 \pi^+ \pi^0$$

HAD

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Philosophy

AIM: Provide two packages to perform recoil analysis in semileptonic and hadronic B_{reco} samples

STEPS:

* emulate the skims
    - BToDlnu skim $\rightarrow$ BToDlnuSequence.tcl
    - BSemiExcl skim $\rightarrow$ BSemiExclSequence.tcl

* setup FastSim compatible version of reconstruction and selection code
    - BTauNuSemiLepUser $\rightarrow$ PacSemiLepUser
    - BTauNuSemiExclUser $\rightarrow$ PacSemiExclUser

* write documentation

* commit packages in FastSim V9

Skim emulation (I)

* Two tcl's implemented inspired to FilterTools code
  - BToDlnuSequence.tcl → FilterTools/BToDlnuPath.tcl
  - BSemiExclSequence.tcl → FilterTools/BSemiExclPath.tcl

* Main changes wrt BaBar code:
  - need to include by hand CompositionSequences and SimpleComposition
    sequences

* As the BaBar skims, select SL and HAD B_{reco} samples using proper hadron
  and lepton lists but do not dump collections

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Skim emulation (II)

Changes in some CompositionSequences and SimpleComposition sequences to remove PID requirements in some standard lists not supported in FastSim.

HAD : CompositionSequences/CompSemiExclAddSequence.tcl

      CompositionSequences/CompSemiExclSequence.tcl

      SimpleComposition/SmpD0ProdSequence.tcl

      SimpleComposition/SmpDcProdSequence.tcl

      SimpleComposition/SmpJPsiProdSequence.tcl

SL : CompositionSequences/CompBToDlnuProdSequence.tcl

      CompositionSequences/CompBToDlnuSequence.cc

      CompositionSequences/CompBToDlnuSequence.tcl

      CompositionSequences/CompPi0Sequence.cc

      CompositionSequences/CompPi0Sequence.tcl

      SimpleComposition/SmpCharmlessProdSequence.tcl

      SimpleComposition/SmpDcProdSequence.tcl

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Skim emulation (II)

Changes in some CompositionSequences and SimpleComposition sequences to remove PID requirements in some standard lists not supported in FastSim.

HAD : CompositionSequences/CompSemiExclAddSequence.tcl

Evaluating if we want to make "permanent" changes in svn or include proper modules and tcl's in the PacSemi*User packages

CompositionSequences/CompPi0Sequence.cc

CompositionSequences/CompPi0Sequence.tcl

SimpleComposition/SmpCharmlessProdSequence.tcl

SimpleComposition/SmpDcProdSequence.tcl

PacSemiLepUser and PacSemiExclUser (I)

*   Implemented two packages inspired to BaBar code

- PacSemiLepUser → BtnSemiLepUser
- PacSemiExclUser → BtnSemiExclUser

*   They contain:

- main analysis tcl on which run the executable
- tcl for skim emulation
- tcl for PID selection: Truth-based PID currently used, three different lists for barrel, fw and bw to make PID studies
- tcl and .cc / .hh for signal and tag side reconstruction and selection
- tcl for BTupleMaker settings
- README

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Known Problems

*   HAD Recoil, PacSemiExclUser:

    –   UsrData problem: not able to access UsrData created in other packages

        -   can not make mode-by-mode studies

        -   can not apply a mode-based selection on ΔE

    – B_{reco} reconstruction efficiency loss: when moving to the frozen FastSim V3 (and following), -60% in B_{reco} reconstruction efficiency wrt previous FastSim versions and FullSim

*   SL Recoil, PacSemiLepUser

    –   efficiency "gain": when moving to FastSim V4 and V9 the B_{reco} reconstruction efficiency is +25-30% wrt BaBar Full simulation

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HAD: UsrData problem

*   need to read a UsrData created at skim-level in BaBar which contains info on B_{reco} (i.e decayMode, purity,....)

*   Not feasible due to incompatibility between BetaMiniSequence and FastSim
- tried to find a work around without success
- will try to include a new class which build the UsrData inside PacSemiExclUser in order to avoid reading the UsrData created elsewhere

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HAD: Breco reconstruction efficiency loss (I)

* Results presented at Warwick:

- quite good agreement between FastSim and FullSim efficiencies (discrepancy due to difficulties in reproducing BaBar, need to fix UsrData problem)

- using FastSim V3 (NOT THE FROZEN VERSION) $\rightarrow$V3'

	FastSim	FullSim		FastSim
neutral B_{reco}	4.46×10^{-3}	3.3×10^{-3}		4.89×10^{-3}
charged B_{reco}	4.29×10^{-3}	4.5×10^{-3}		4.86×10^{-3}

BaBar config   SuperB config

* since FastSim V3 (FROZEN VERSION) : 60% drop in Breco reconstr. eff. (same in V4 and V9)

	FastSim		FastSim
neutral B_{reco}	1.88×10^{-3}		1.88×10^{-3}
charged B_{reco}	1.97×10^{-3}		1.96×10^{-3}

BaBar config   SuperB config

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HAD: Breco reconstruction efficiency loss (II)

* Two inconsistency:

1. $\sim$ -60% B_{reco} efficiency in BaBar configuration
   $\sim$ -70% B_{reco} efficiency in SuperB configuration

2. different behavior when passing from BaBar to SuperB configs.

   V3' $\rightarrow$ SuperB efficiency = 110% BaBar efficiency

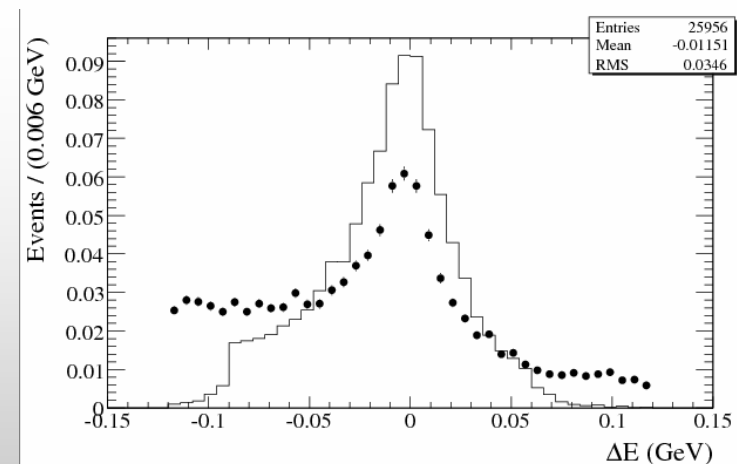   V9 $\rightarrow$ SuperB efficiency $\sim$ BaBar efficiency

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HAD: Breco reconstruction efficiency loss (III)

Plots for two tag side variables, no selection on the signal side applied:

* mES : higher tails, lower peak
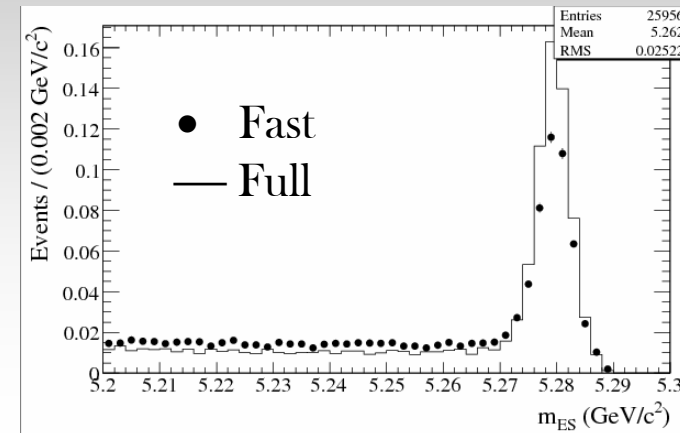
* ΔE : disagreement in the shape due to unapplied selection in FastSim (unreadable UsrData)

* smaller statistics with higher background contamination wrt FullSim (m_{ES} plot)

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SL: efficiency "gain" (I)

all the numbers
in BaBar config

* Results presented at Warwick:

good agreement between Fast and Full Simulation (BaBar config)

	FastSim	FullSim
neutral B_{reco}	19.3×10^{-3}	20.0×10^{-3}
charged B_{reco}	19.4×10^{-3}	19.3×10^{-3}

* unexpected gain in B_{reco} reconstruction efficiency when moving to FastSim V4 and V9

* also $B \rightarrow K^*\nu\nu$ signal selection

efficiency increase wrt full Sim:

    –   +40% $K^{*0}\nu\nu$

    –   +50% $K^{*+}\nu\nu$

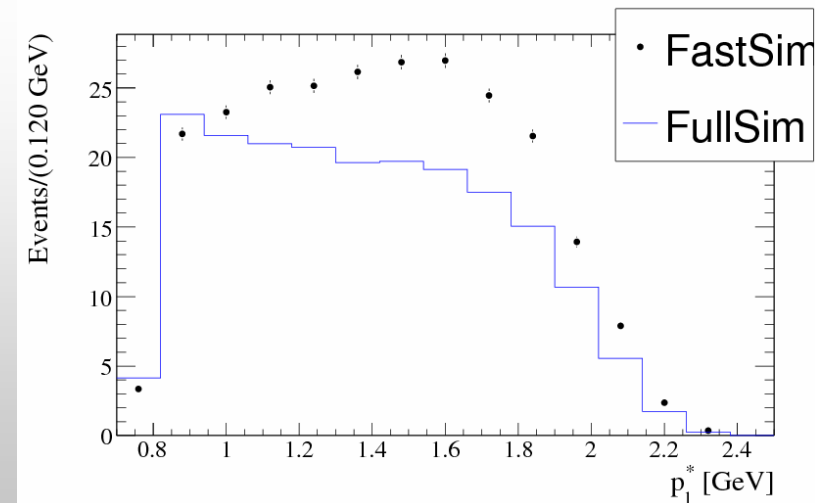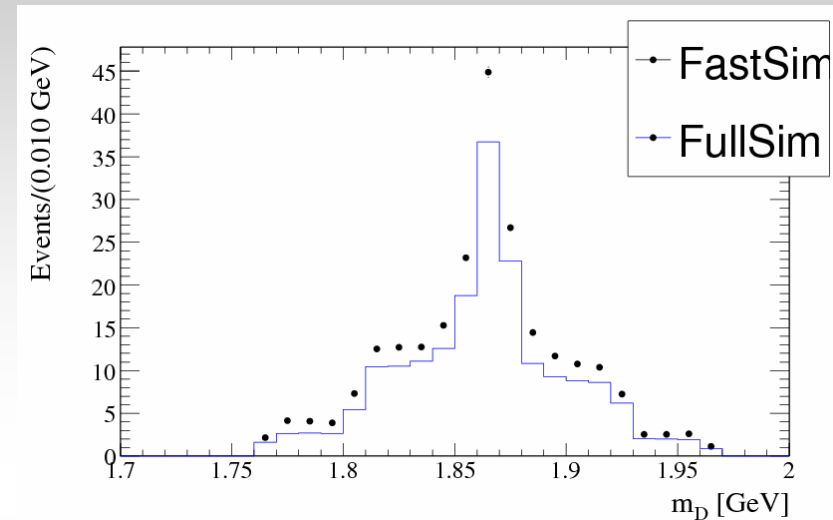|	FastSim
neutral B_{reco}	24.9×10^{-3}
charged B_{reco}	25.6×10^{-3}

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SL: efficiency "gain" (II)

Plots for two tag side variables, no selection on the signal side applied:

* D mass: apart from normalization , good agreement in the shape between fast and full

* lepton spectrum: big discrepancy both in shape and in normalization; shape similar to what obtained when applying a selection in the signal side

→ sample with higher and cleaner statistics

Conclusion

* FastSim Packages for SL and HAD Breco reconstruction set up and almost ready to be committed

* Pending issue related to

 – PacSemiExclUser code $\leftrightarrow$ UsrData problem, incompatibility between BetaMiniSequence and FastSim

 – Simulation / Reconstruction (?) $\leftrightarrow$ unexpected behaviour in efficiency both for SL and HAD samples

Back-up slides

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