

SL recoil analyses Status Report

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Outline

- **What is new in the PacSemiLepRecoilUser code**
 - **Use of Bwd-EMC as a veto device**
 - **New UsrData variables**
- **Validation code**
- **Summary and outlook**

Bwd-EMC as a veto device

■ Now user can decide how to use Bwd-EMC

⇒ Veto device

⇒ Extension of Barrel-Fwd EMC

- Define UserData variables: YSigBUUsesBwdEMCGamma (YTagBUUsesBwdEMCGamma) is equal to one if Bsig (Btag) candidate is reconstructed using neutrals from Bwd-EMC
- Define two kind ofEventData variables (R2All, missing mass, momentum, ...), which include or exclude Bwd-EMC neutrals
- Still define two E_{extra} variables:
 - $E_{\text{extra}}(\text{Barrel-Fwd}) = \Sigma(\text{extra neutrals on Barrel-Fwd EMC})$
 - $E_{\text{extra}}(\text{Bwd}) = \Sigma(\text{extra neutrals on Bwd EMC})$
 - $E_{\text{extra}}(\text{Total}) = E_{\text{extra}}(\text{Barrel-Fwd}) + E_{\text{extra}}(\text{Bwd})$

Vertex variables and Rec-dec-channel

- **Added UsrData variables related with the vertexing of Btag and Dtag candidates:**
 - Btag/Dtag: - nDof (YTagBBVtxNdof/YTagBDVtxNdof)
 - Chi2 (YTagBBVtxChisq/YTagBDVtxChisq)
 - Prob (YTagBBVtxProb/YTagBDVtxProb)
 - vertex position (YTagBBVtx{X,Y,Z}/YTagBDVtx{X,Y,Z})
 - Also added significance of B and D vertex separation: YtagBVtxBDSign.
⇒ Useful to study improvements with SVT L0 option
- **User can decide which signal(tag)-side decay channels to store in the n-tuple
Just need to cut on YSiglsRecod (YTagBDDecMode) variable
(See backup slides for a list of options)**

Validation

- Start with $B \rightarrow K \nu \nu (K^+, K^0_s)$ and $B \rightarrow K^{*(+0)} \nu \nu$ analyses
- The goal is to compare Fast-Sim with the BaBar full-sim analyses:
 - Try to use the same selection
 - Compare signal and background efficiencies
 - Compare the shapes of the main discriminant variables
 - Status: working on a standalone validation code. Will commit it later to PacUserQA.
- $B \rightarrow K \nu \nu$:
 - Use n-tuples from the latest BaBar analysis (BAD-2123).
 - Will try to perform a simple cut-and-count analysis as done in BAD-293.
- $B \rightarrow K^* \nu \nu$:
 - Use n-tuples from the latest BaBar analysis (Francesco Renga's BAD-1845).
 - Will try to perform a simple cut-and-count analysis as done in BAD-293.

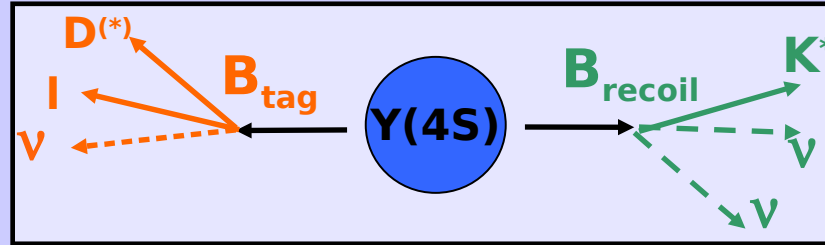
Summary and outlook

- **PacSemiLepRecoilUser package is in V0.2.0**
- **The code has been debugged and cleaned from memory leak errors**
- **Several improvements have been performed:**
 - Several decay channels can be stored on the same n-tuple
 - ⇒ Useful for performing background studies (e.g. BB and qq background)
 - Several levels of truth-matching implemented both on signal and tag sides
 - ⇒ useful for studying reconstruction effects (fake tracks and neutrals, SxF,...)
 - User can decide which signal(tag)-side decay modes to store in the n-tuple
 - User can decide at n-tuple level which strategy to use for Bwd-EMC
 - Btag/Dtag vertex variables have been added as UsrData
 - Added Significance of B-D vertex separation to study improvements with SVT L0
- **Still need to:**
 - Finish validation and implement validation inside PacUserQA
 - Finish documentation: README and Wiki
- **The code is in a good shape for the February Production!**

Backup

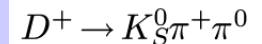
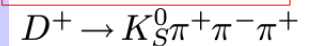
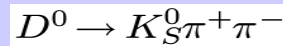
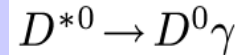
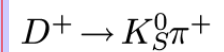
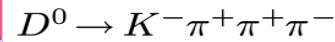
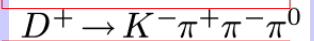
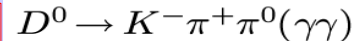
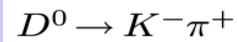
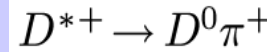
Semileptonic Breco reconstruction philosophy

Search for $B \rightarrow D^{(*)} l \nu$



Reconstruction steps:

- Reconstruct $D^{(*)} \rightarrow \text{hadrons}$



- Use $D^{(*)}$ and add lepton (e^\pm, μ^\pm) to form a $D^{(*)} l$ candidate

Sample of 14 decay modes (charged + neutrals)

Kinematics is unconstrained due to neutrinos

Relatively high reconstruction efficiency $\sim 2\%$

Semileptonic Breco in FastSim (I)

- Semileptonic reconstruction implemented in FastSim V0.1.3: **PacSemiLepRecoilUser**
- Package based on **BaBar BtauNuSemiLepUser** code
- **PacSemiLepRecoilUser** contains:
 - main analysis tcl to run executable
 - tcl for DI reconstruction (BtoDInuSequence_KplusNuNu.tcl)
 - tcl for tag-side reconstruction refinements
(PsiTagBReconstruction_Kpnunu.tcl, PsiTagBSelection_Kpnunu.tcl)
 - tcl for PID lists: - for K , π , μ use tablebased selectors (BaBar run6-r24c PID tables)
- for e use NoDeDxFirstElectronSelection (E/p cut based)
 - tcl and .cc/.hh for signal reconstruction and selection:
 $B \rightarrow K^+ \nu \nu$, $K_S^0 \nu \nu$, $K^* \nu \nu$, $\tau \nu$ (one-prong) are now available
 - tcl for BtaTupleMaker settings
 - README
- **Package status:**
 - Fixed bugs memory leaks that prevented to be in Sep and Nov test productions
 - Need to implement validation code and to write documentation (README)

Semileptonic Breco in FastSim (II)

Latest code improvements:

- Several decay channels can be now reconstructed and stored in same n-tuple:

$B \rightarrow K^+ \nu \nu, K^0_s \nu \nu, K^{*0} \nu \nu, \tau (\rightarrow e \nu \nu, \mu \nu \nu, \pi \nu) \nu$

- Added UsrData variable **YsigBIsRecod** which tells the reconstructed mode

YsigBIsRecod = -1 \Rightarrow no signal candidate

0 \Rightarrow debugging

1,2,3,4,5 \Rightarrow τ modes ($\tau \rightarrow e \nu \nu, \mu \nu \nu, \pi \nu, \rho \nu, a_1 \nu$)

6,7,8 \Rightarrow $K^{*+} \nu \nu$ modes ($K^{*+} \rightarrow K^0_s (\rightarrow \pi^+ \pi^-) \pi^+, K^0_s (\rightarrow \pi^0 \pi^0) \pi^+, K^+ \pi^0$)

9,10,11 \Rightarrow $K^{*0} \nu \nu$ modes ($K^{*0} \rightarrow K^+ \pi^-, K^0_s (\rightarrow \pi^+ \pi^-) \pi^0, K^0_s (\rightarrow \pi^0 \pi^0) \pi^0$)

12,13,14 \Rightarrow $K \nu \nu$ modes ($K^+ \nu \nu, K^0_s (\rightarrow \pi^+ \pi^-) \nu \nu, K^0_s (\rightarrow \pi^0 \pi^0) \nu \nu$)

- Added UsrData variable **YsigBMatchedTauMode** with truth decay mode (similar values as YsigBIsRecod)
- Added UsrData variable **YSigBTruthMatchUp** with different truth-matching levels. Useful for studying reconstruction effects (fake tracks and neutrals, SxF, ...)

YSigBTruthMatchUp = 1 \Rightarrow Brec daughters do match MC-truth

2 \Rightarrow Brec daughters come from same true B

3 \Rightarrow rec and true decay modes match

4 \Rightarrow strict truth-match

Similar IsRecod and TruthMatch variables are defined for the tag-side