SL recoil analyses Status Report

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Outline

- **Validation code**
- **Summary and outlook**

Validation

- **Start with $B \to K \nu\nu (K^+, K^0_S)$ and $B \to K^{*(+/0)} \nu\nu$ analyses**
- **The goal is to compare Fast-Sim with the BaBar full-sim analyses:**
  - Try to use the same selection
  - Compare signal and background relative/absolute efficiencies
  - Compare the shapes of the main discriminant variables
- **$B \to K \nu\nu$:**
  - 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.
- **$B \to K^* \nu\nu$:**
  - Use n-tuples from the latest BaBar analysis (Fracesco Renga's BAD-1845).
  - Will try to perform a simple cut-and-count analysis as done in BAD-293.

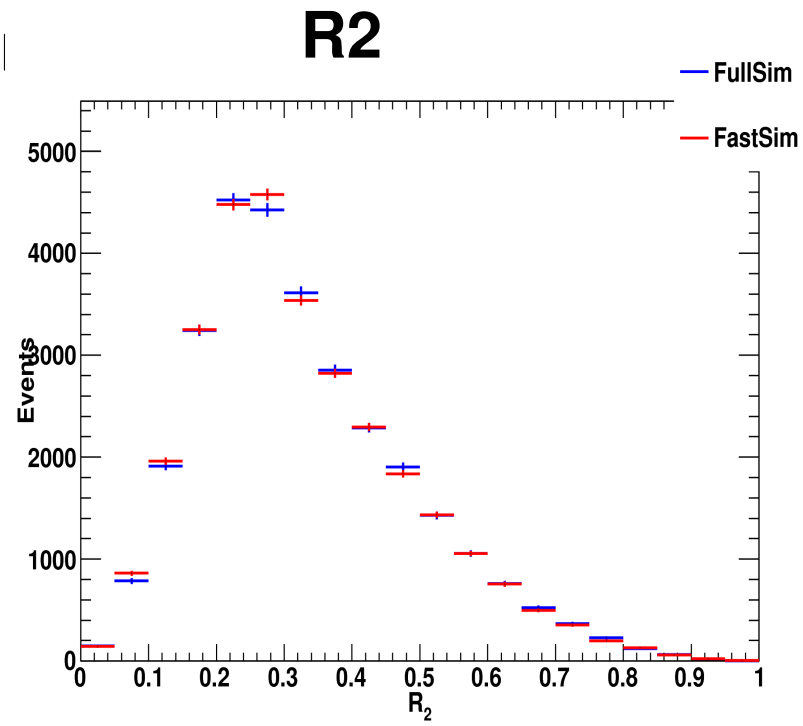
- **Will only show results about $B \to K \nu\nu$, other channels show the same features**
- **Fast-sim samples generated without Pairs, Bhabas and rad-Bhabas bkgs**
- **Status: working on a standalone validation code. Will commit it later by next week into PacUserQA**

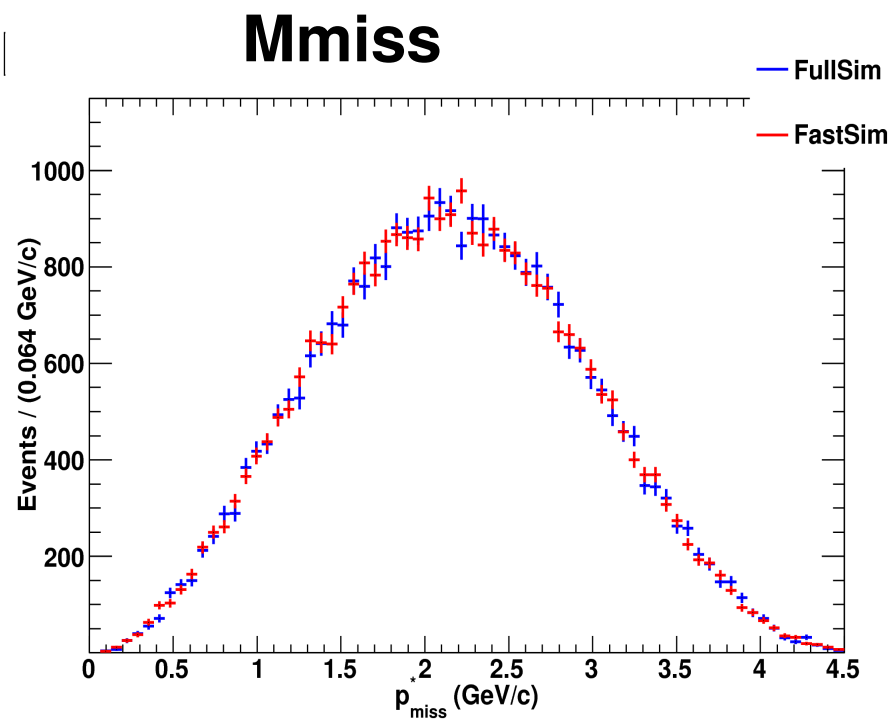
Validation: $B^+ \to K^+ \nu\nu$

- **Reminder on selection:**
  - Reconstruct Btag candidate as $B^{\pm} \to D^{(*)0} l^{\pm} \nu$
    - $D^{(*)0} \to D^0 \gamma$
    - $D^0 \to K^-\pi^+, K^-\pi^+\pi^-\pi^+, K^-\pi^+\pi^0, K^0_S\pi^+\pi^-$ (K^+: LHKaonNotAPion list, π^+: ChargedTracks)
  - Look for a charged K^+ (LHKaonTight list) the ROE with opposite charged as Btag
  - Selection cuts:
    - $R2 < 0.84$
    - $-2.5 < \mathrm{Cos}(\theta_{BDl}) < 1.1$
    - $|M_D(\mathrm{rec}) - M_D(\mathrm{PDG})| < 3\sigma$ (mass resolution)
    - $M_{Dl} > 3.0\ \mathrm{GeV}/c^2$
    - $p^*_D(\mathrm{CM}) > 0.5\ \mathrm{GeV}/c$
    - $p^*_{lep}(\mathrm{CM}) > 1.35\ \mathrm{GeV}/c$
    - $M_{miss} > 1.0\ \mathrm{GeV}/c^2$
    - $p^*_{signalK}(\mathrm{CM}) > 1.25\ \mathrm{GeV}/c$
    - $|\mathrm{Cos}(\theta[K,Dl])(\mathrm{CM})| < 0.8$
    - $E_{extra} < 250\mathrm{MeV}$

Validation: $B^+ \to K^+ \nu\nu$

Event Variables

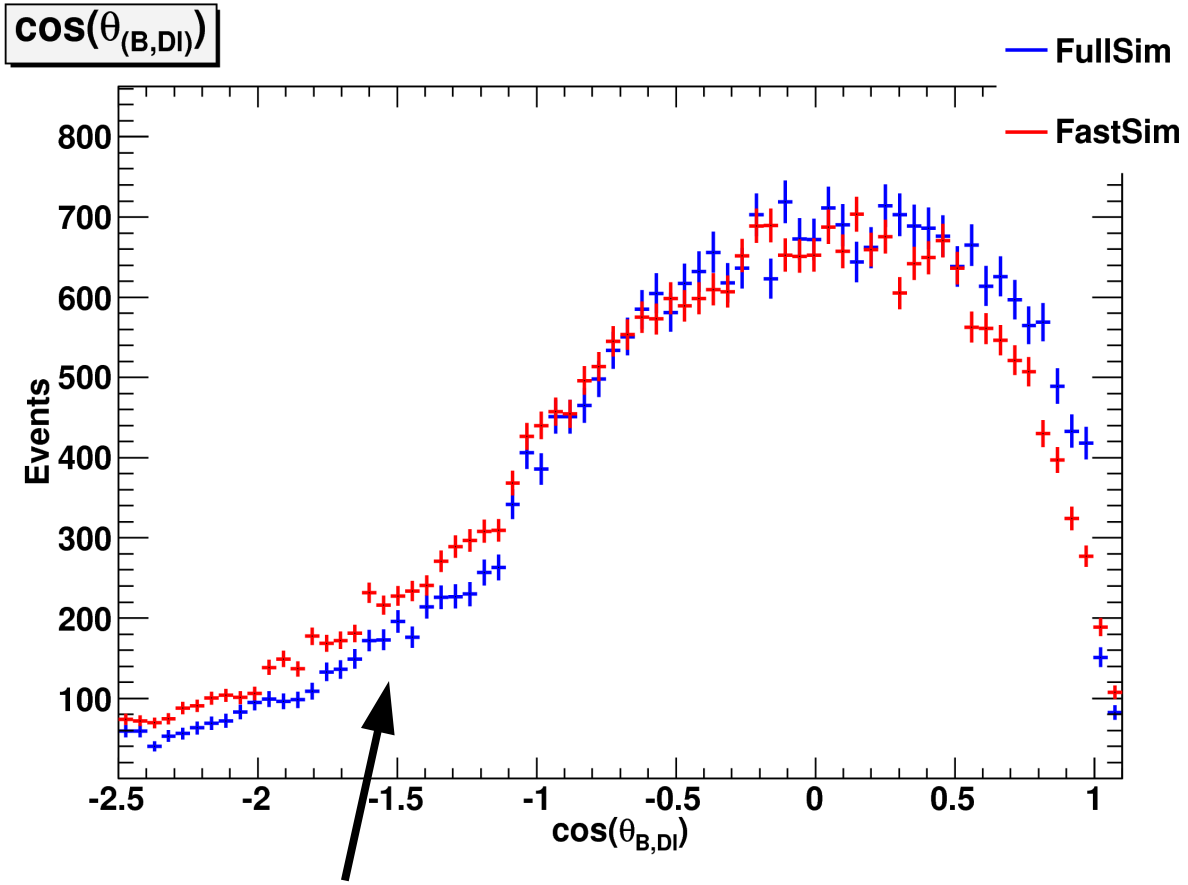




Fast-sim distributions normalized to BaBar full-sim

Validation: $B^+ \to K^+ \nu\nu$

cos(θ(BDl))



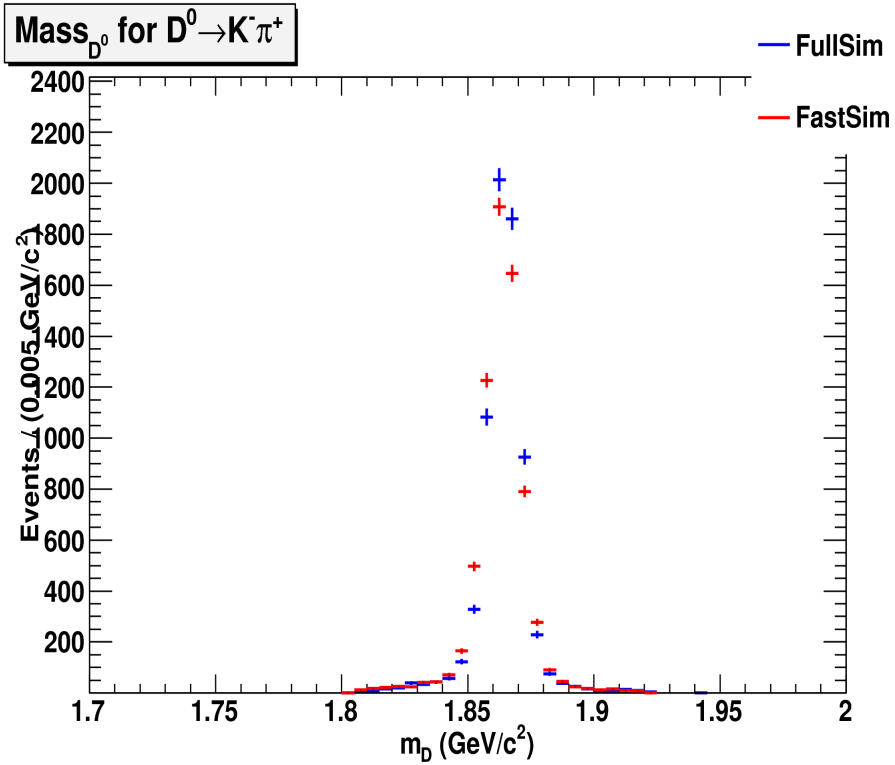
Inconsistency due to the lack of background γs

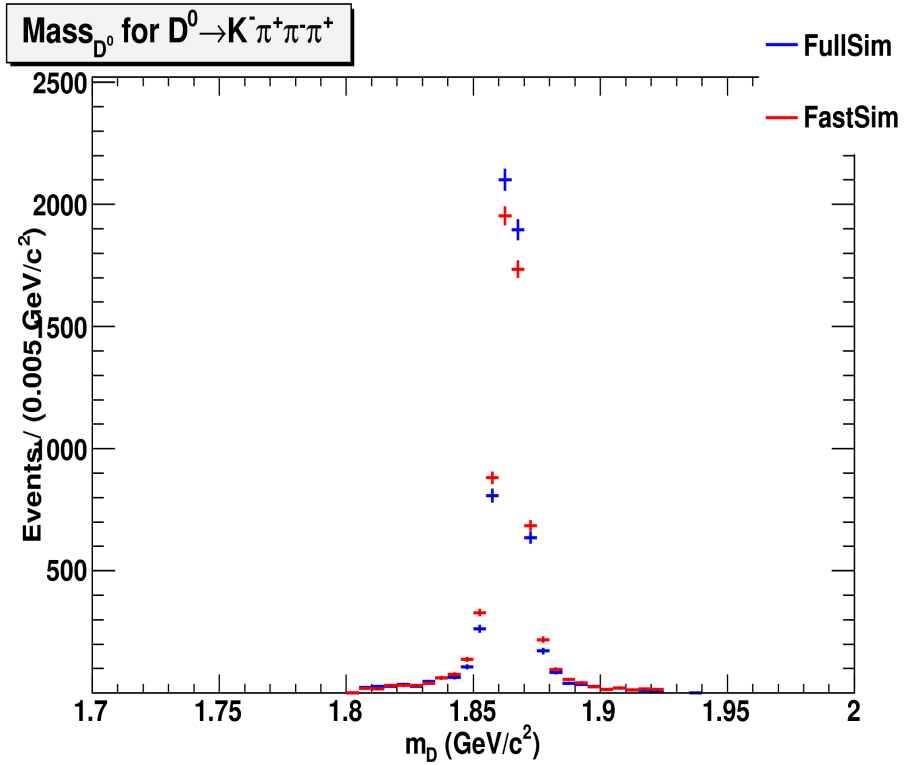
Mainly reconstruction of $D^{*0} \to D^0\gamma$ component

See leter slides.

Validation: $B^+ \to K^+ \nu\nu$

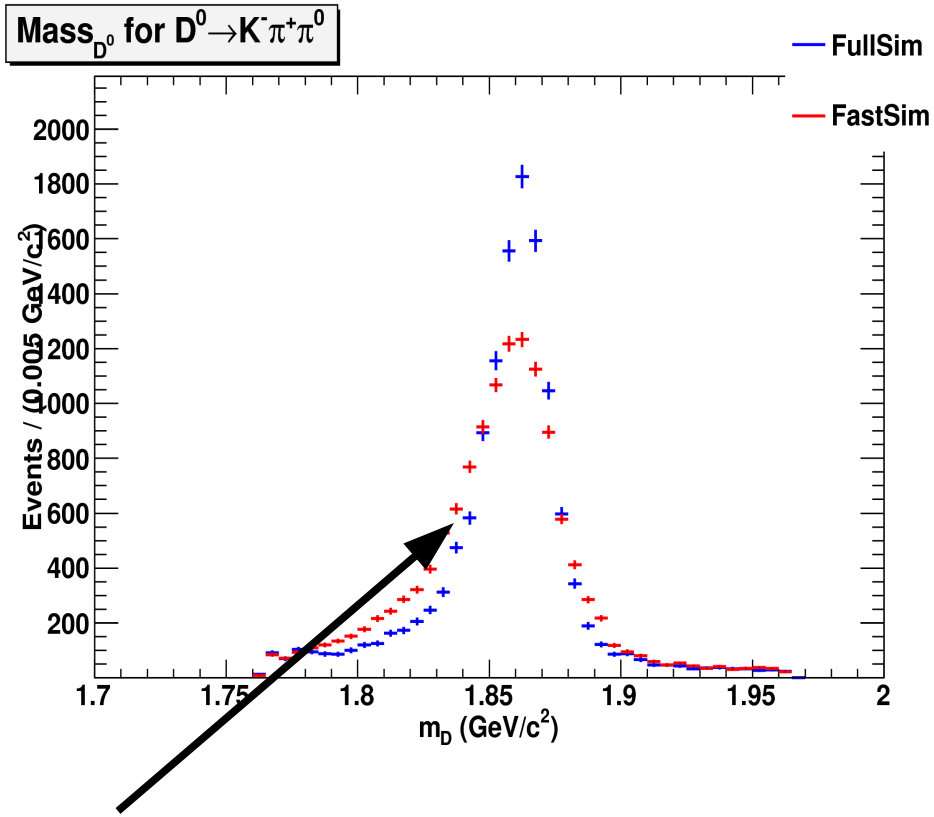
D mass

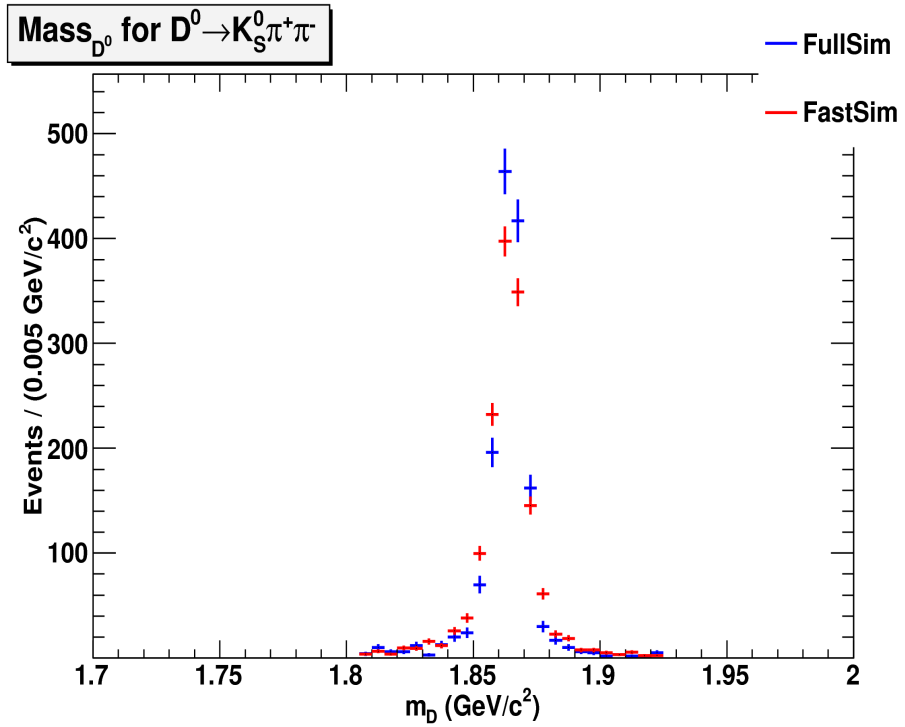




Validation: $B^+ \to K^+ \nu\nu$

D mass

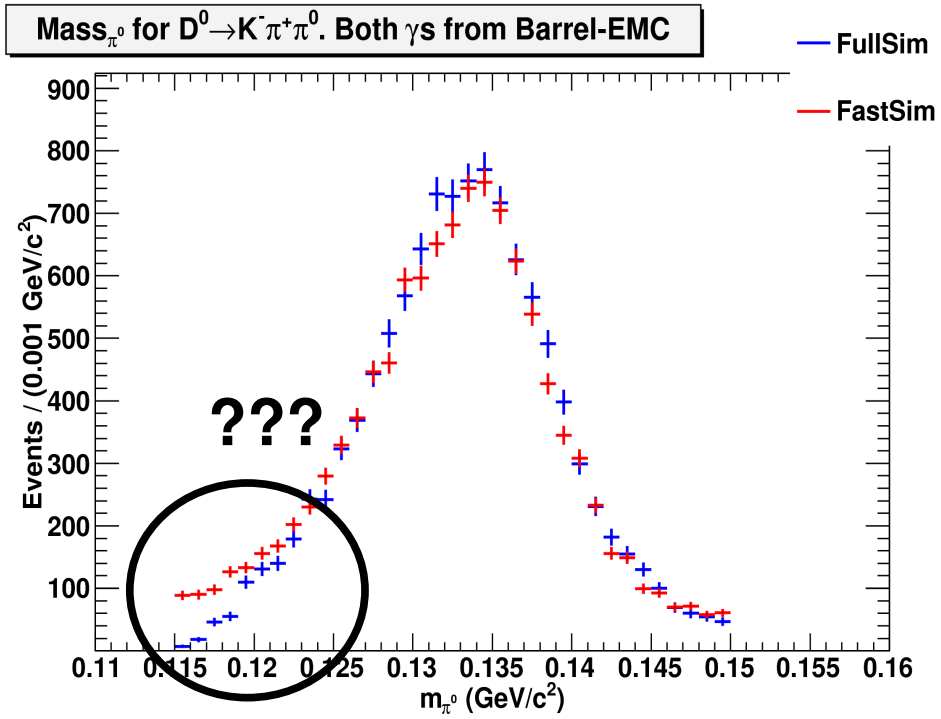


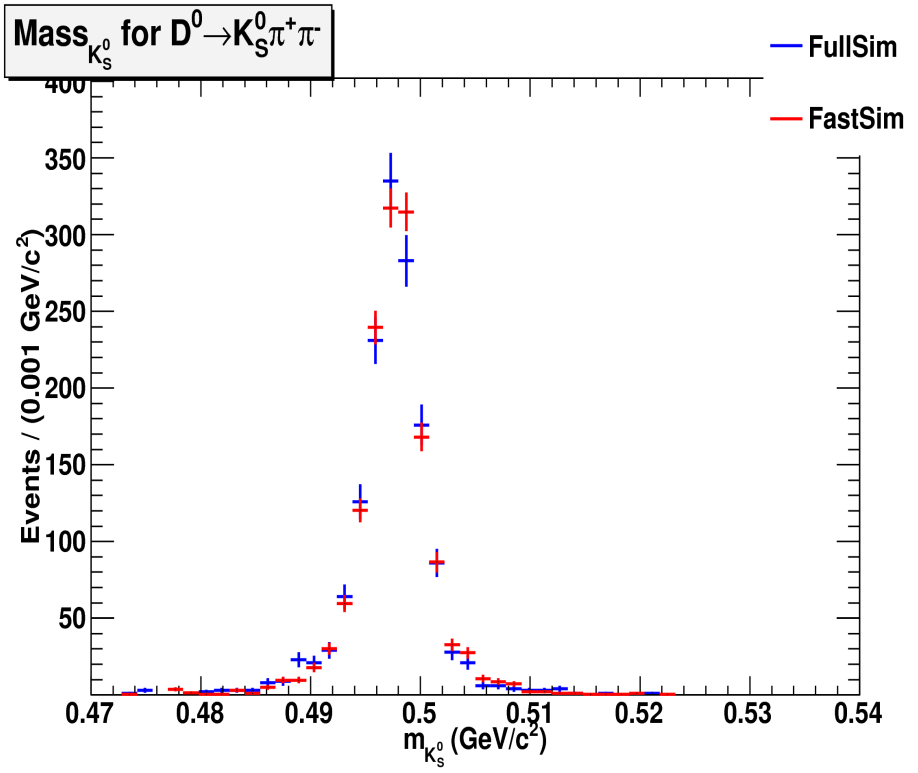


BaBar analysis do a π^0 mass fit to reconstruct D

Validation: $B^+ \to K^+ \nu\nu$

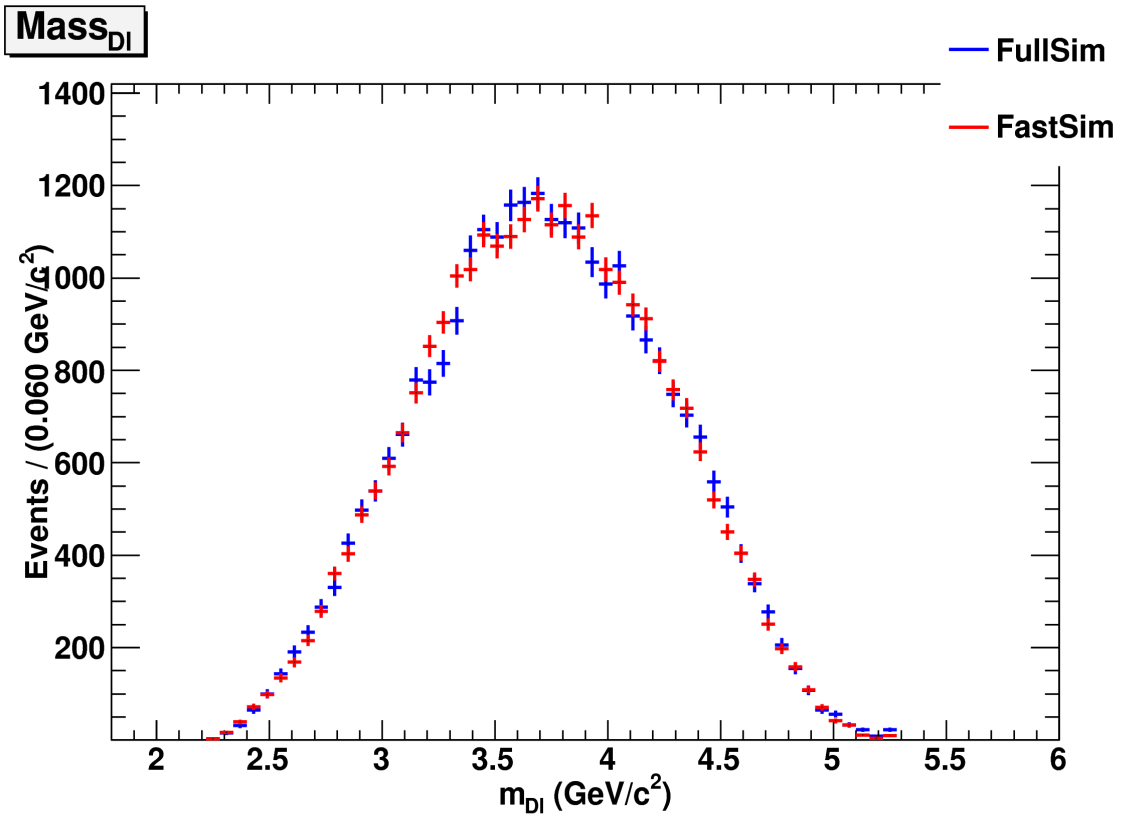
π^0 and K^0_S masses





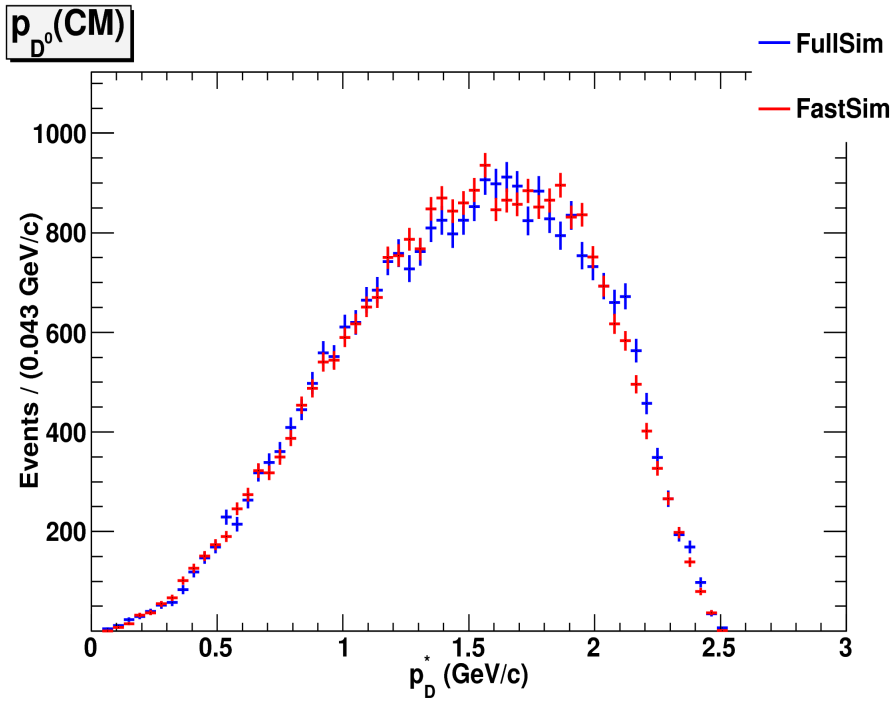
Validation: $B^+ \to K^+ \nu\nu$

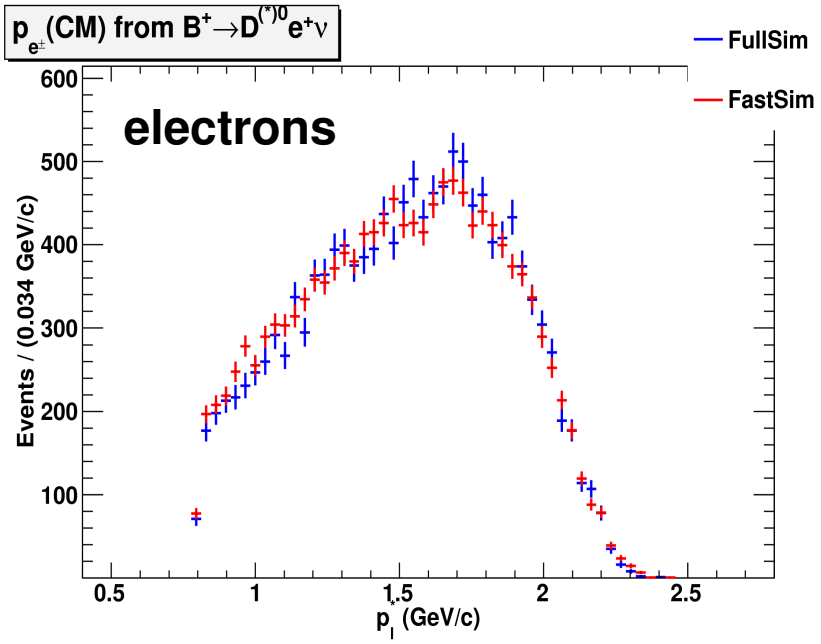
Dl mass

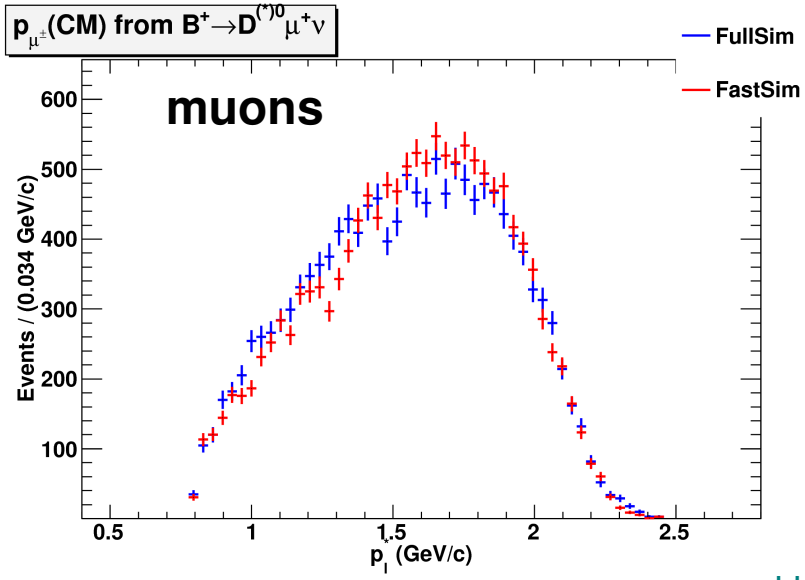


Validation: $B^+ \to K^+ \nu\nu$

D and lepton momenta in CM

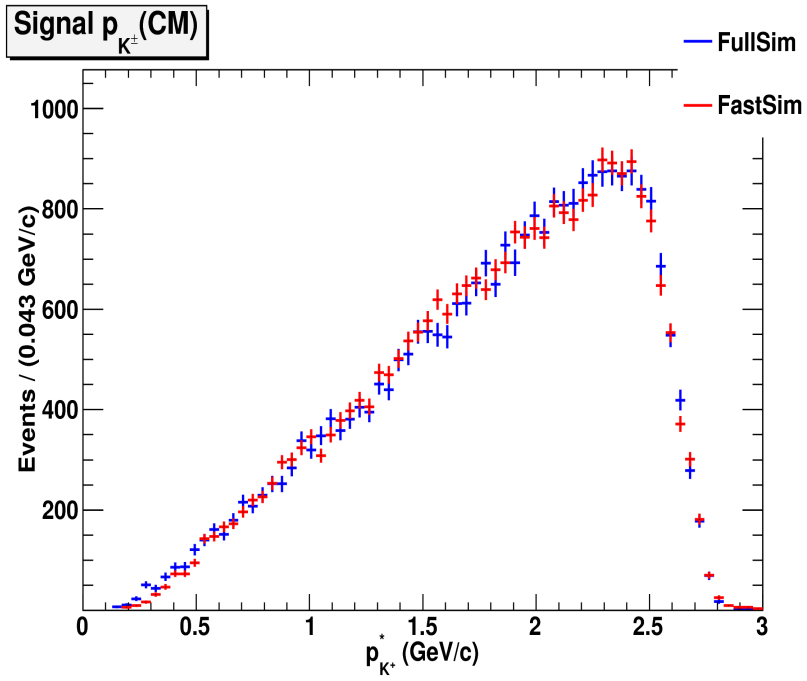


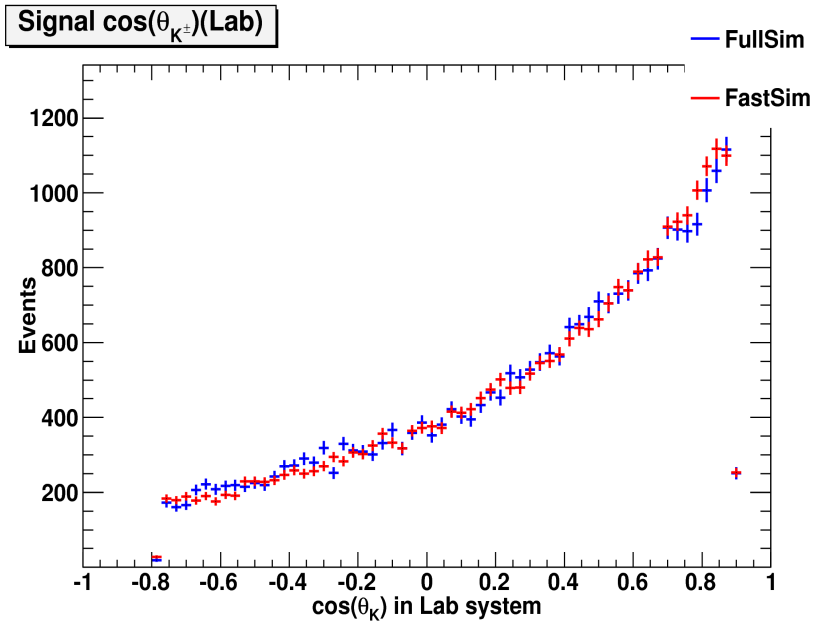


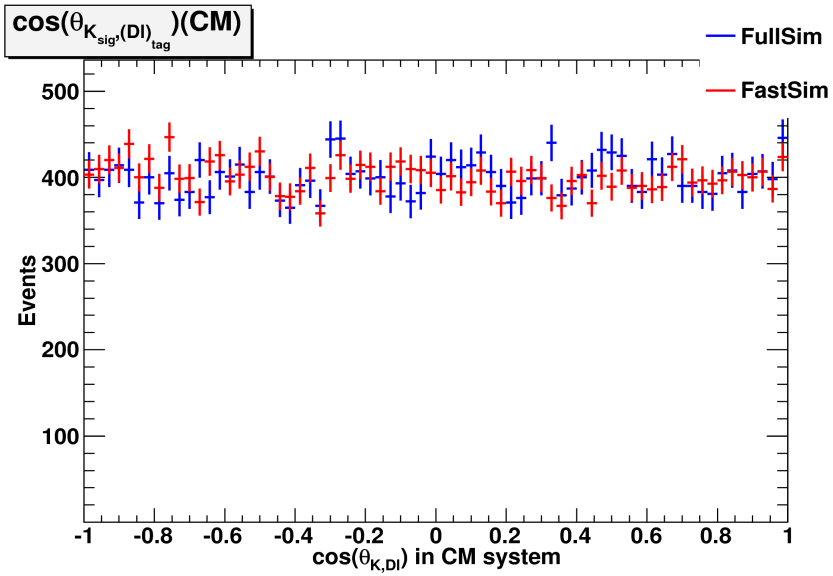


Validation: $B^+ \to K^+ \nu\nu$

Signal K related variables

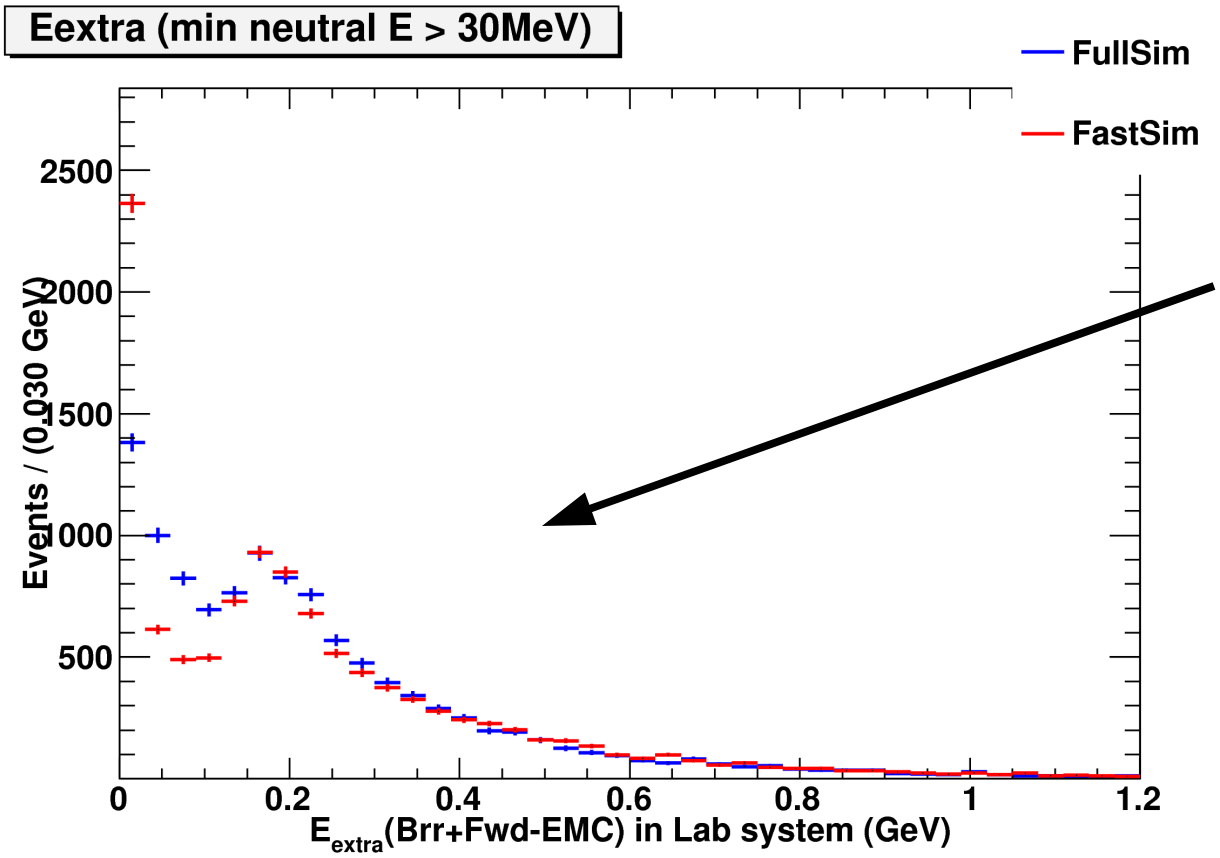






Validation: $B^+ \to K^+ \nu\nu$

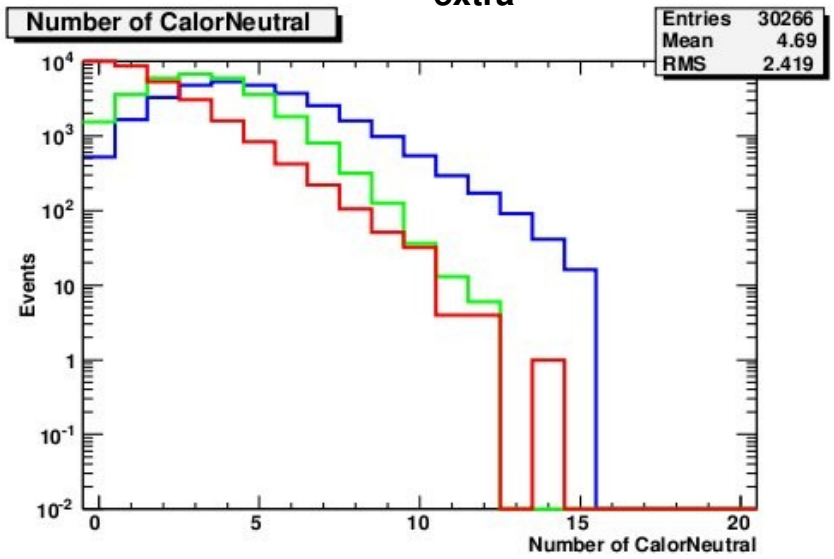
E_{extra} Variable

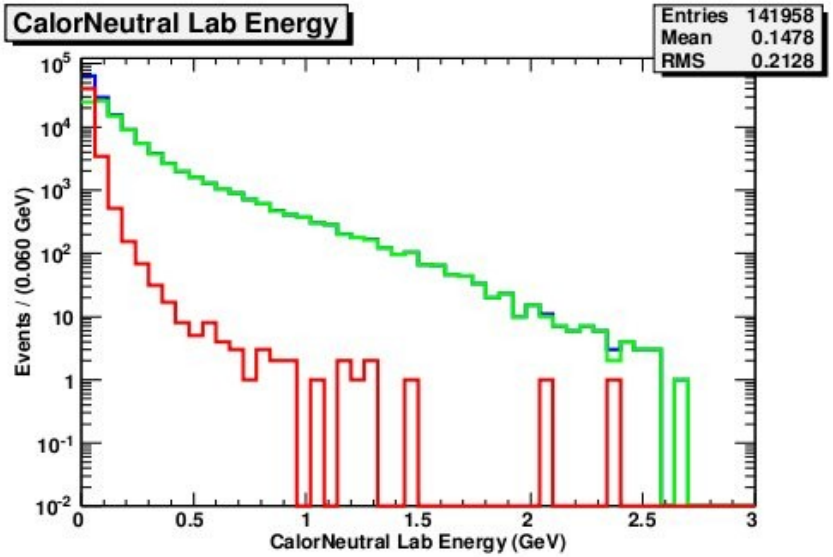


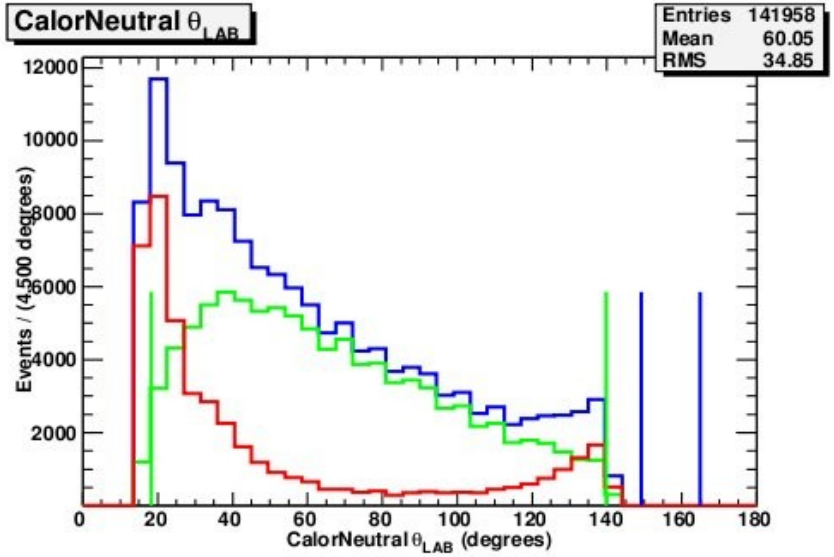
Inconsistency due to the lack of background γs

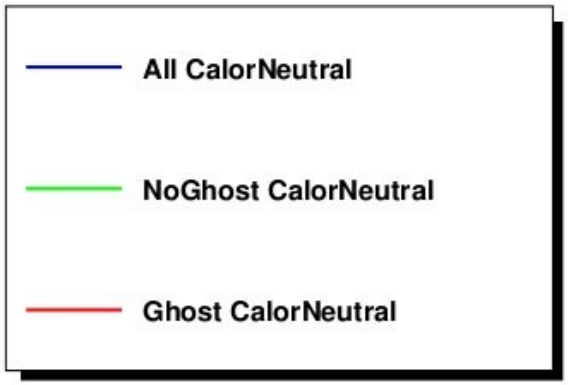
Validation: $B^+ \to K^+ \nu\nu$

E_{extra} Variable



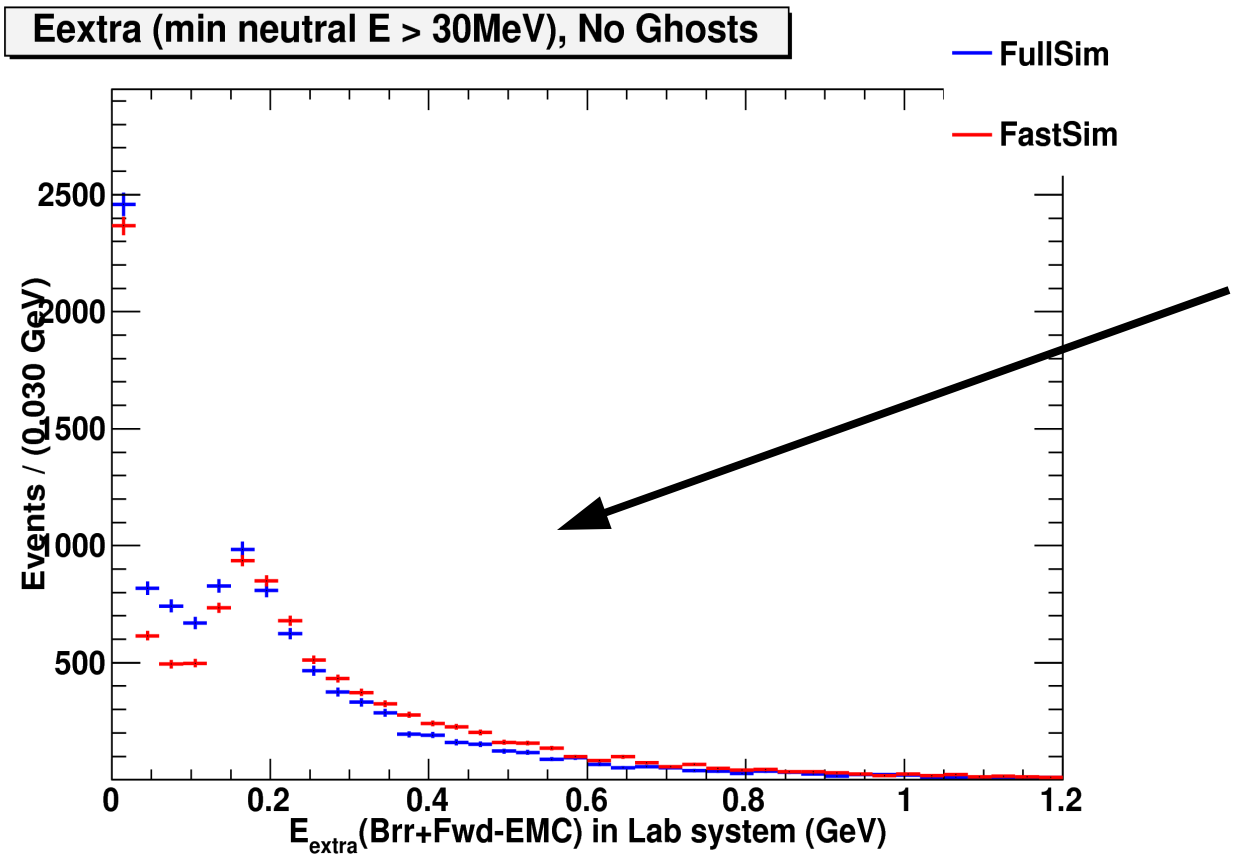






Validation: $B^+ \to K^+ \nu\nu$

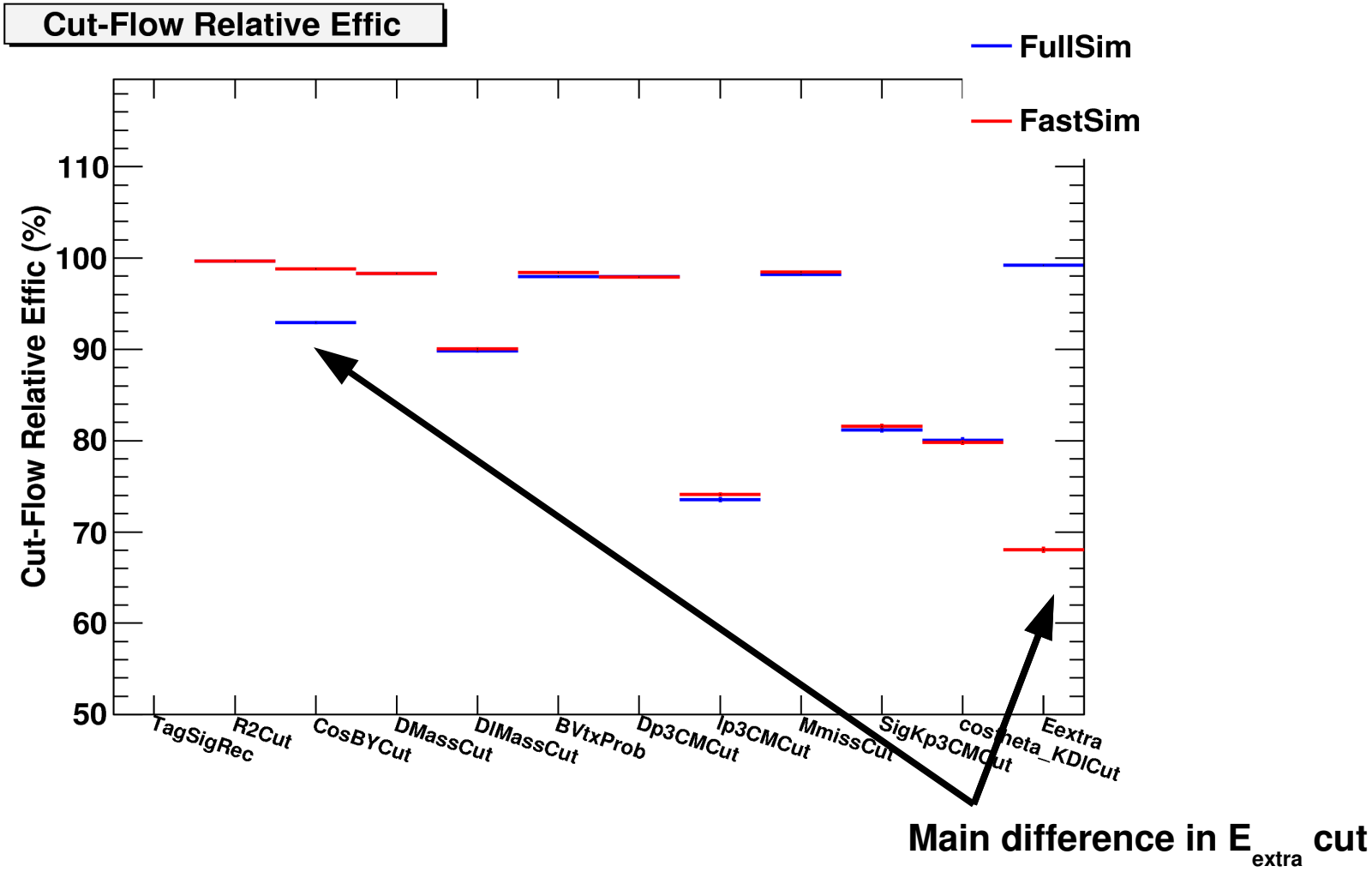
E_{extra} Variable



Inconsistency due to the lack of background γs used to reconstruct Btag candidate

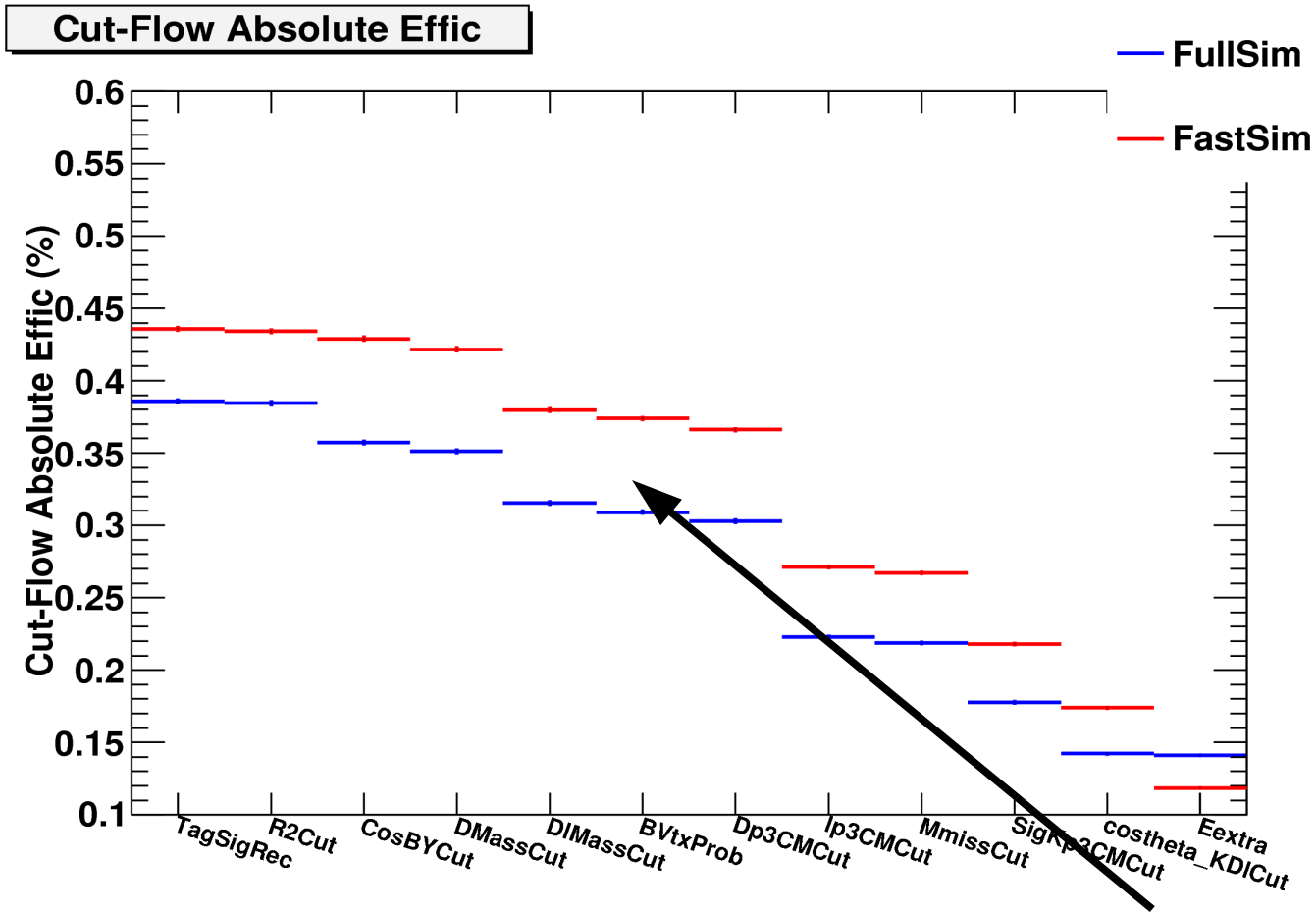
Validation: $B^+ \to K^+ \nu\nu$

Cut flow relative efficiencies



Validation: $B^+ \to K^+ \nu\nu$

Cut flow absolute efficiencies



Main differences due to reconstruction and E_{extra} cut

Summary and outlook

- **PacSemiLepRecoilUser package reproduce reasonably well BaBar full simulation**
- **Almost all shapes are well reproduced**
- **Shapes with contributions from background photons differ significantly**

  ⇒ no pair, bhabha and rad-bhabha bakcgrounds in Fast-simulation samples
- **Obtain almost the same cut flow relative efficiencies in Fast and Full simulation:**

  ⇒ main difference is E_{extra} cut
- **Absolute efficiencies in Fast-sim are higher than in Full sim**

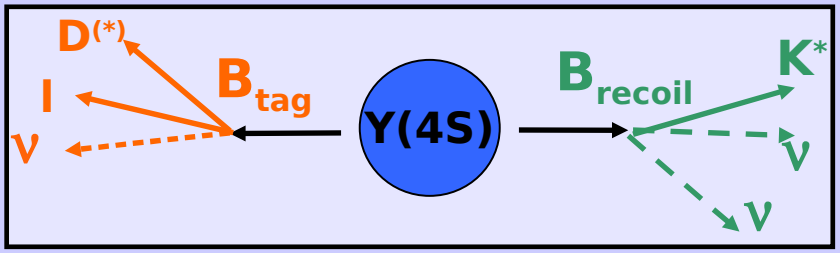
  ⇒ mainly due to the lack of background photons (need to check this)
- **Obtain similar results for other decay modes ($B^{(0/+)} \to K^{*(0/+)} \nu\nu$ and $B^0 \to K^0 \nu\nu$)**

- **Validation code almost ready to be committed**

Backup

Semileptonic Breco reconstruction philosophy

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



- Reconstruction steps:
  - Reconstruct $D^{(*)} \to$ hadrons

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

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

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

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

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

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

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

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

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

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

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

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

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

- Sample of 14 decay modes (charged + neutrals)
- Kinematics is unconstrained due to neutrinos
- Relatively high reconstruction efficiency ~2%