
# Hadronic recoil analysis: code status

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# PacHadRecoilUser code status

* code in V0.2.1 used for the February production

* limit the number of reconstructed Breco channels according to their purity (>50%)
  - Breco mode classification: neat : purity > 80%
    clean : 50% < purity < 80%
    dirty : 8%<purity<50%clean + neat

* Available Bsig modes
  - $K^*\nu\nu$
  - $K\nu\nu$ , $K_s(\pi\pi)\nu\nu$
  - $\tau\nu$ , with $\tau \rightarrow e\nu\nu$, $\mu\nu\nu$, $\pi\nu$, $\rho(\pi\pi^0)\nu$, $a_1(\rho\pi)\nu$


# From Nov. to Febr. production: to do list

* To do list for the Nov. production:

- bugs to be fixed:
  - bad assignment of kaon lund for kaon coming from B → bug in PacPid now fixed
  - multiple and identical Breco candidates
  - fill R2 variable

- add UsrVariable to separate infos from bwd and barrel+fwd emc

- implement code for validation

- documentation for wiki page

# multiple Breco candidates

* events with 'semi-identical' breco candidates, i.e. same $m_{ES}$, $\Delta E$, decayMode but different $E^*_{Breco}$
* only for modes with $\pi^0$, i.e. $B \to D^* \pi\pi^0$, $B \to Dk\pi^0 ks$
* related warning msg

  UsrWriteBSemiExcl::UsrWriteBRecoBase.hh(63):Cannot put mES = 5.25414 for candidate 0x12d1cff0 in the UsrCandBlock
* from BaBar-hn: two candidates considered as clones and candBlock.put( cand, mES ) fails
* 'semi-identical' candidates are not clones:

  → use different gammas to reconstruct the $\pi^0$ ($m_{ES}$ and $\Delta E$ should be different between the two); at ntuple level: the $i^{th}$ cand owns the UsrVariables (mES, $\Delta E$,...) of the first
* no chance to fix this for the February production

# February production

* two SuperB Detector Geometry used + BaBar geometry (and beams) to compare Fast Sim with BaBar Full Sim

* Generic samples (B+B-_generics, B0B0bar_generics, uds, ccbar)
  - DG_BaBar: w background, 50million evts
  - DG_3: w background (25M evts) + w/o background on (530M evts)
  - D_4: w background on (28million evts) + background on (830M evts)

* Signal Samples:

done JOBS

| Geometry | Generator | tcl | Total Number of Jobs | Total Number of Events |
|---|---|---|---|---|
| DG_BaBar | B+B-_K+nunu | MixBaBarBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_BaBar | B0B0bar_K0nunu | MixBaBarBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_3 | B+B-_K+nunu | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_3 | B0B0bar_K0nunu | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_4 | B+B-_K+nunu | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_4 | B0B0bar_K0nunu | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| Total | | | 60 | 6 000 000 |

done JOBS

| Geometry | Generator | tcl | Total Number of Jobs | Total Number of Events |
|---|---|---|---|---|
| DG_BaBar | B+B-_Kstar+nunu | MixBaBarBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_BaBar | B0B0bar_KstarOnunu_Kpi | MixBaBarBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_3 | B+B-_Kstar+nunu | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_3 | B0B0bar_KstarOnunu_Kpi | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_4 | B+B-_Kstar+nunu | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| DG_4 | B0B0bar_KstarOnunu_Kpi | MixSuperbBkg_NoPair.tcl | 10 | 1 000 000 |
| Total | | | 60 | 6 000 000 |

in this talk:
- signal MC samples w bkg
- generic MC samples w/o bkg

# Fast Sim DG_BaBar vs BaBar Full Sim (I)

* SuperB FastSim:
  - B+B-, B0B0bar, ccbar, uds MC samples
  - $B^+ \to K^+ \nu\nu$, $B^+ \to K^{*+} \nu\nu$, $B^0 \to K^{*0} \nu\nu$ signal MC samples
  - BaBar beams and detector geometry

* BaBar FullSim (same code and same "skim" as in FastSim):
  - B+B- : $49{,}766 \times 10^3$ gen. evts
  - B0B0bar : $50{,}556 \times 10^3$ gen. evts
  - ccbar : $83{,}974 \times 10^3$ gen. evts
  - uds : $66{,}892 \times 10^3$ gen evts

  } Run3

  - $B^+ \to K^+ \nu\nu / B^+ \to K^{*+} \nu\nu / B^0 \to K^{*0} \nu\nu$: 7,845/7,8510/6,282 x $10^3$ gen evts

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

# Breco efficiencies, generic samples (I)

ε= nsel/nbreco(purity >0.5, abs(charge)==0/1, pid requirements)
(see back up for stat errors on efficiencies)

| neutral Breco | B0B0bar | | BpBm | | ccbar | | uds | |
|---|---|---|---|---|---|---|---|---|
| | FullSim | FastSim | FullSim | FastSim | FullSim | FastSim | FullSim | FastSim |
| mES cut | 0.254 | 0.209 | 0.116 | 0.111 | 0.125 | 0.101 | 0.125 | 0.121 |
| deltaE cut | 0.223 | 0.184 | 0.093 | 0.091 | 0.088 | 0.081 | 0.088 | 0.087 |
| $\varepsilon_{Fast}/\varepsilon_{Full}$ | 0.85 | | 0.98 | | 0.92 | | 0.99 | |

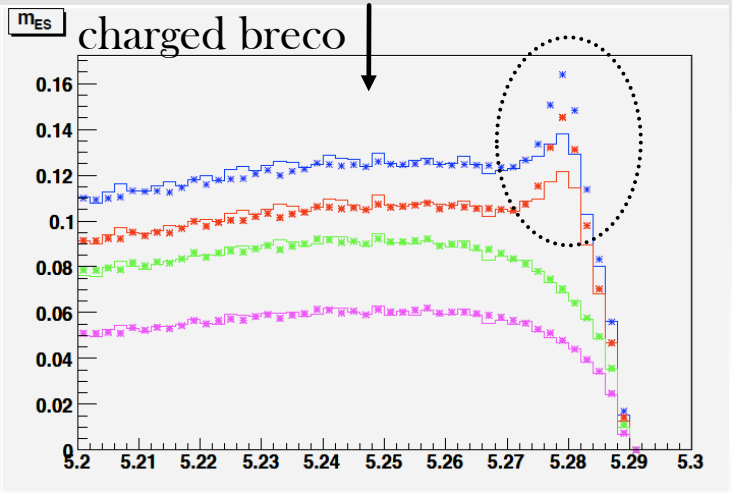
| charged Breco | B0B0bar | | BpBm | | ccbar | | | |
|---|---|---|---|---|---|---|---|---|
| | FullSim | FastSim | FullSim | FastSim | FullSim | FastSim | FullSim | FastSim |
| mES cut | 0.152 | 0.140 | 0.336 | 0.289 | 0.126 | 0.128 | 0.139 | 0.137 |
| deltaE cut | 0.118 | 0.110 | 0.309 | 0.241 | 0.089 | 0.090 | 0.096 | 0.094 |
| $\varepsilon_{Fast}/\varepsilon_{Full}$ | 0.93 | | 0.78 | | 1.01 | | 0.98 | |

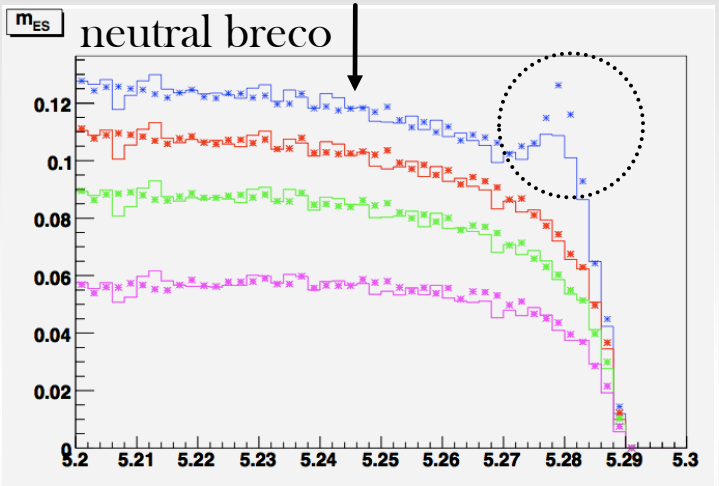
loosing efficiency in the "signal sample": B0B0bar for neutral Breco and B+B- for charged Breco

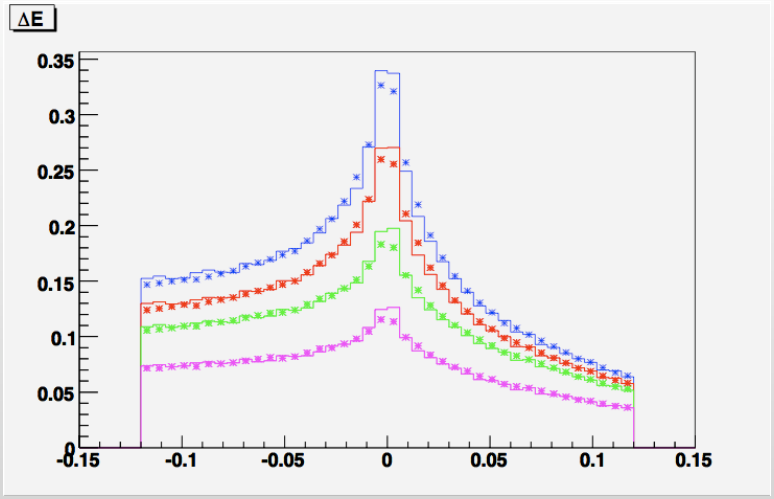
# Breco shapes, generic samples

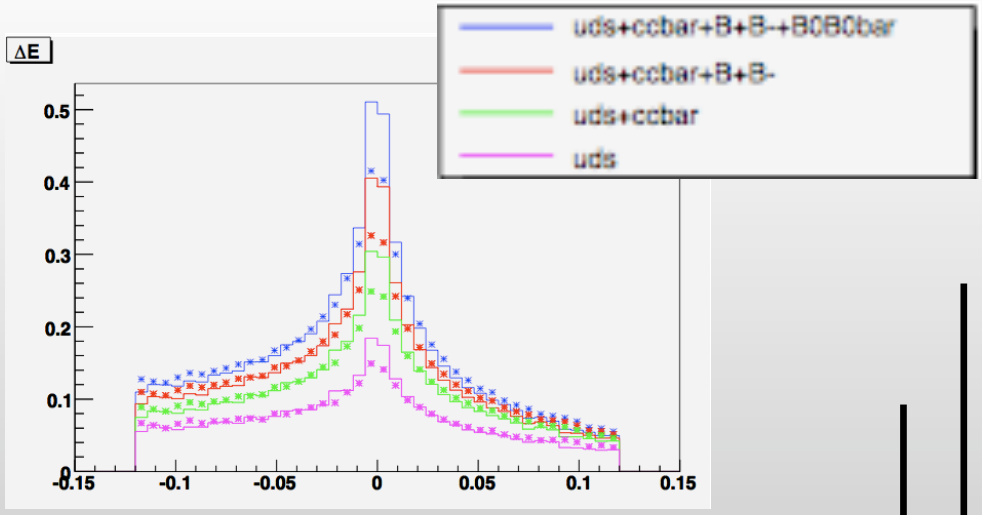
* $m_{ES}$ and $\Delta E$ before the selection

* FullSim
_ FastSim



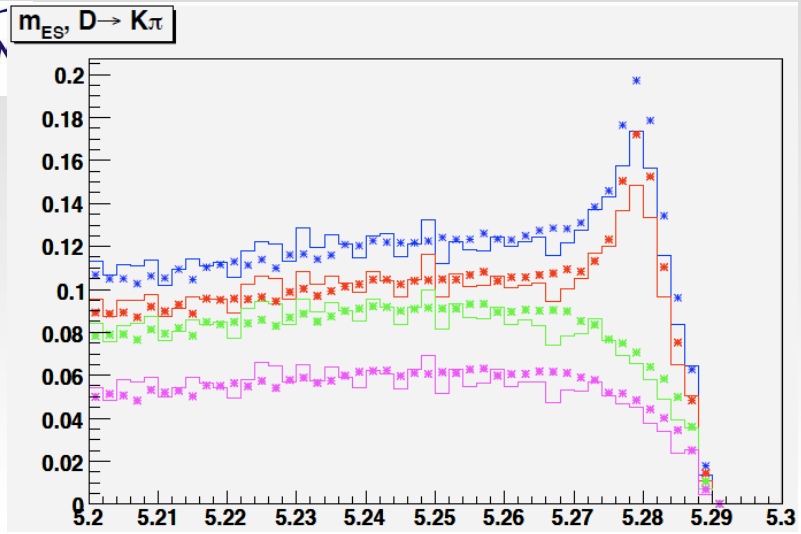



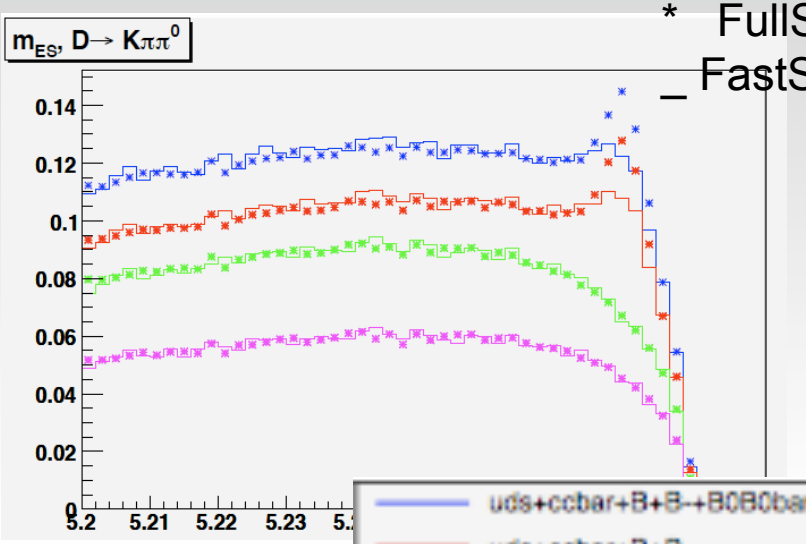



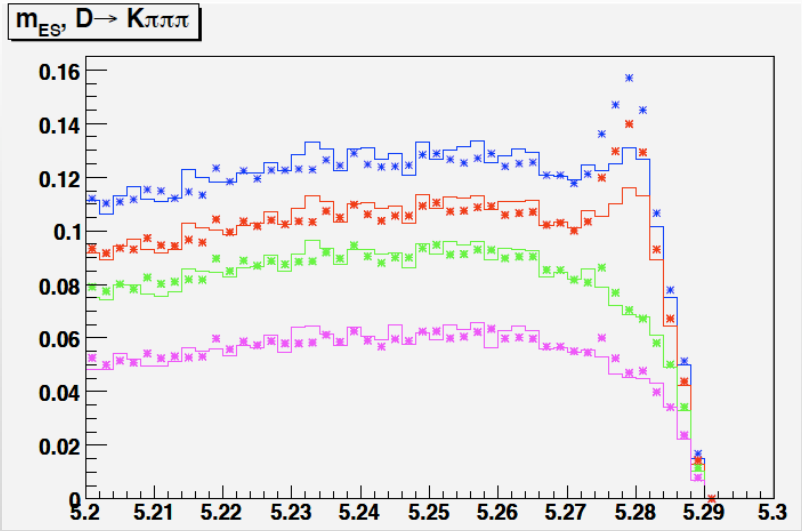



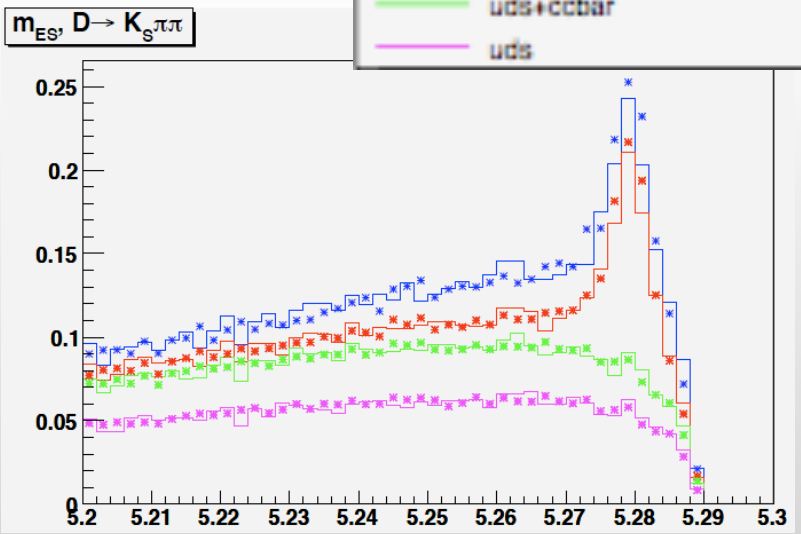
# Mode by mode study; charged Breco (I)

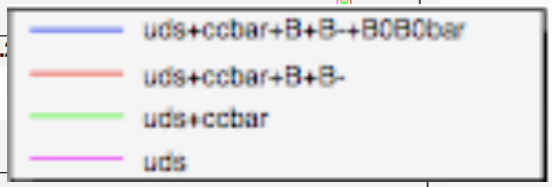
* FullSim
_ FastSim



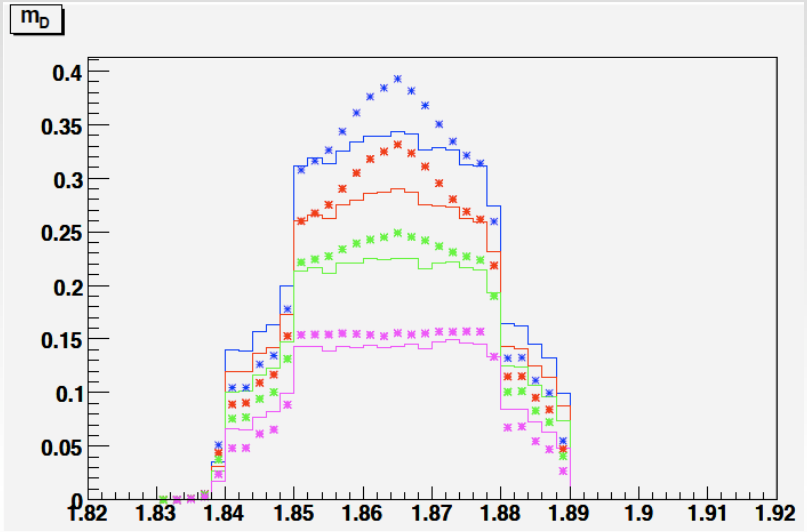



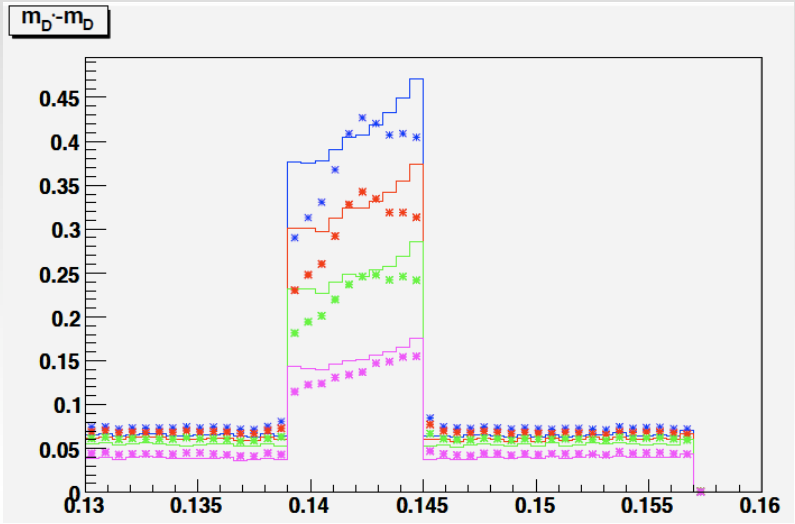



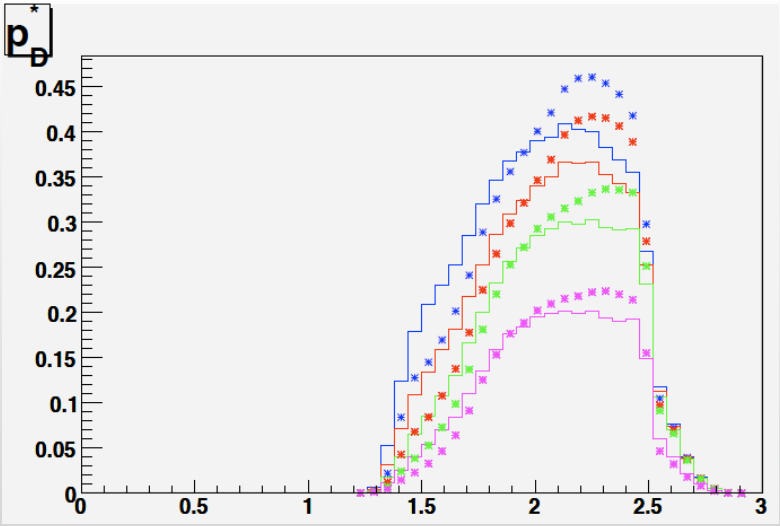



# D kinematics

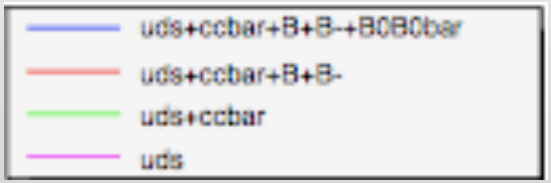


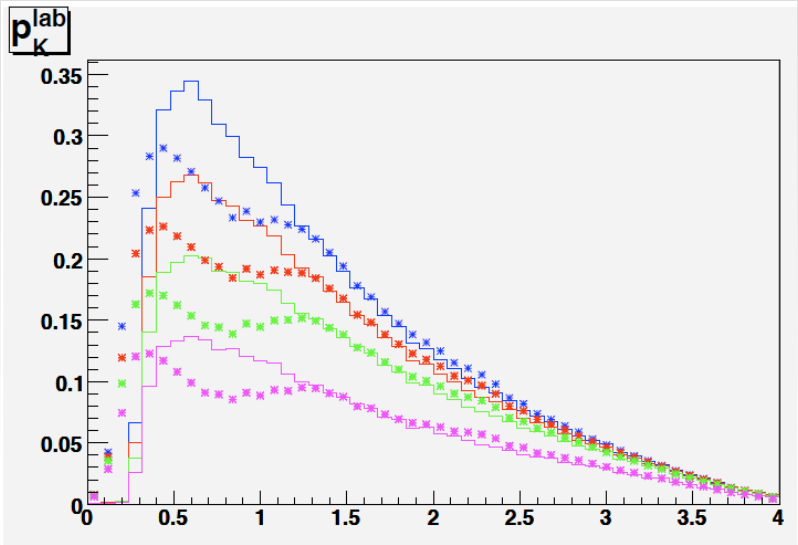

* plots for charged Breco samples
* slightly better agreement in the neutral

* FullSim
_ FastSim

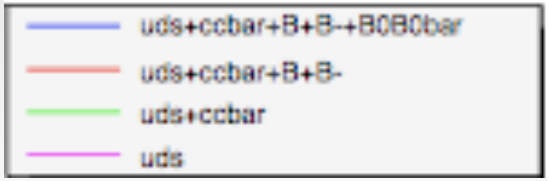


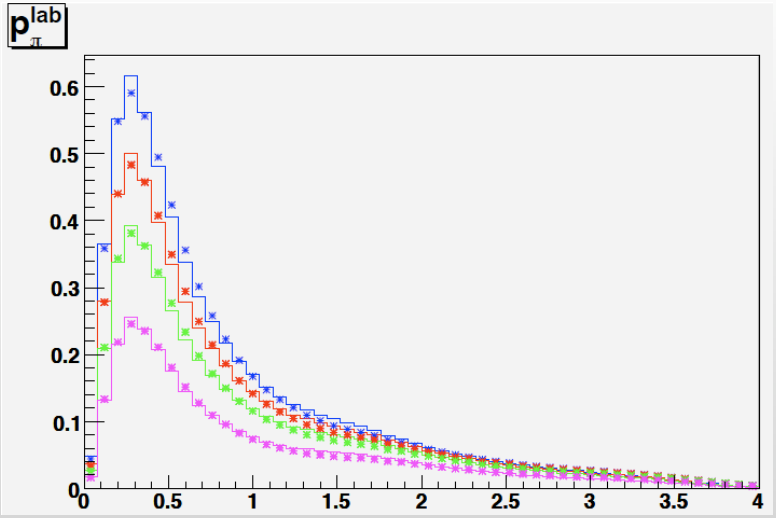
# B and D Daughters (I)

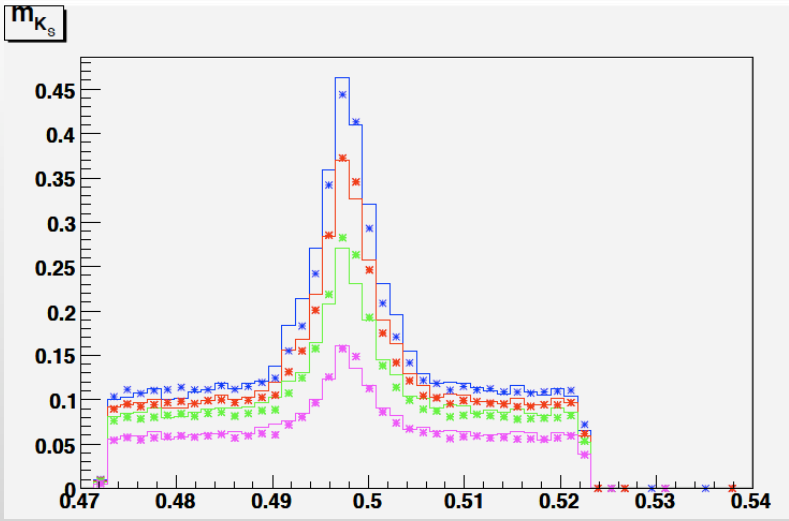
* charegd Breco




* FullSim
_ FastSim

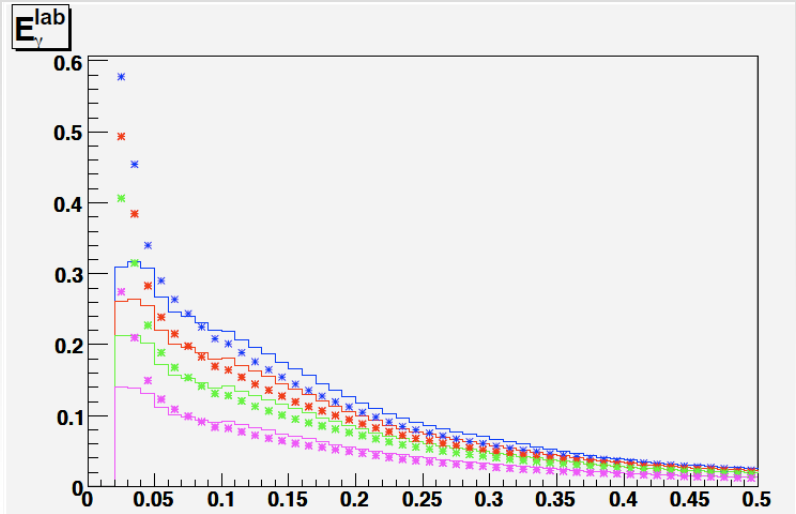


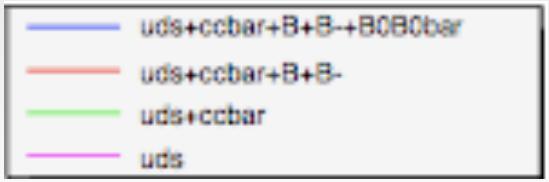



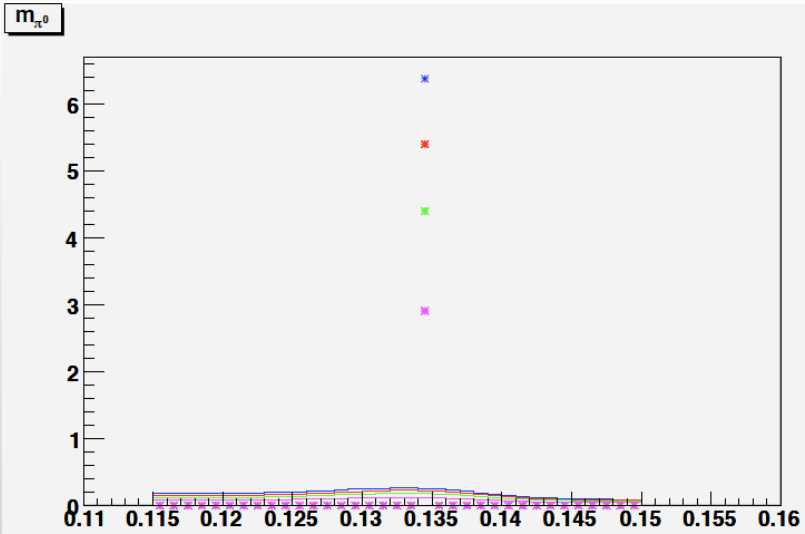
# B and D Daughters (II)

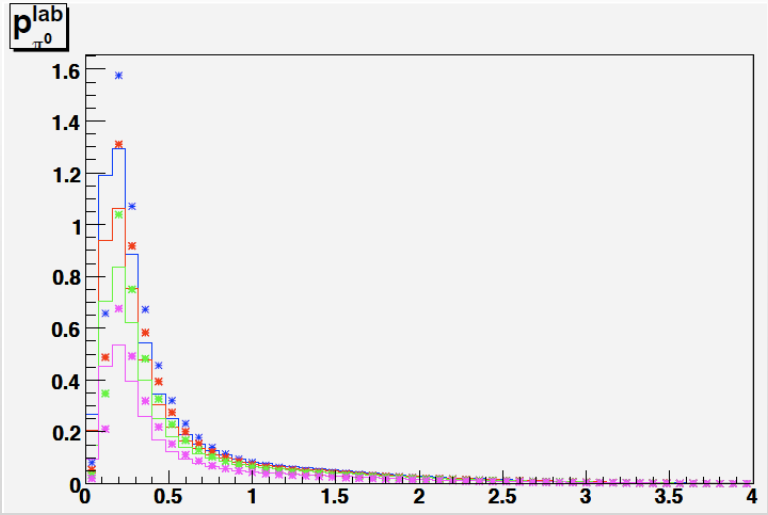
* charegd Breco



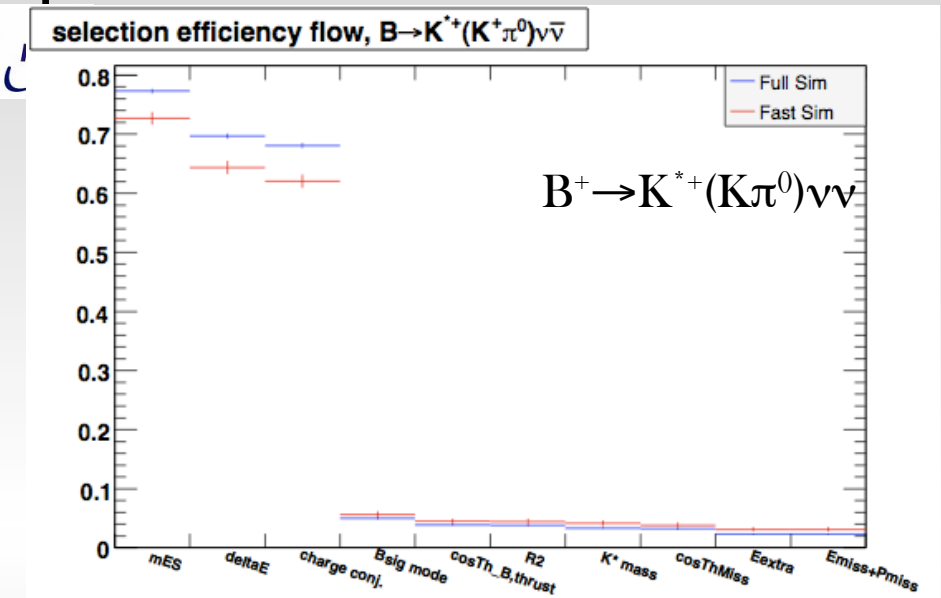

* FullSim
_ FastSim

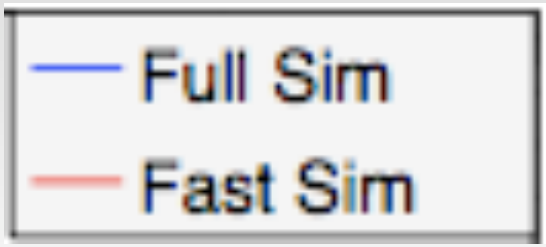


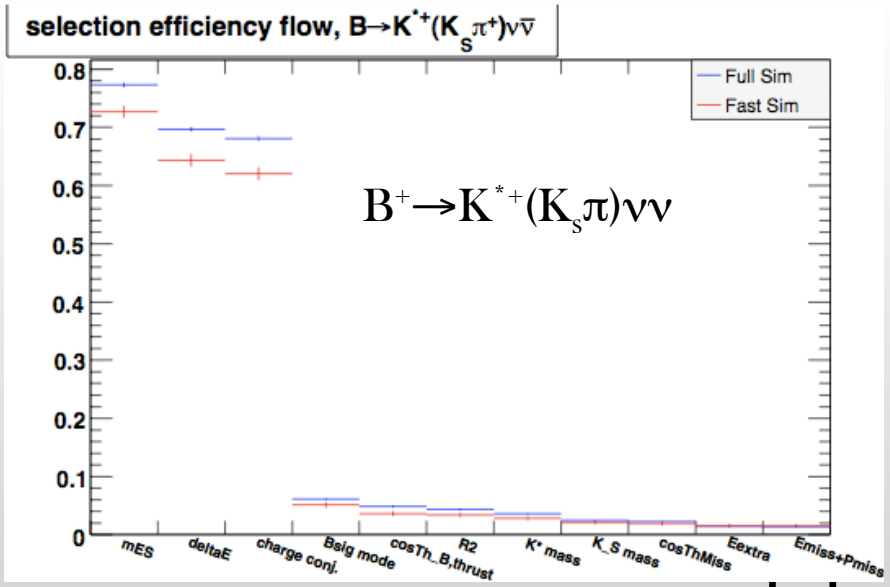



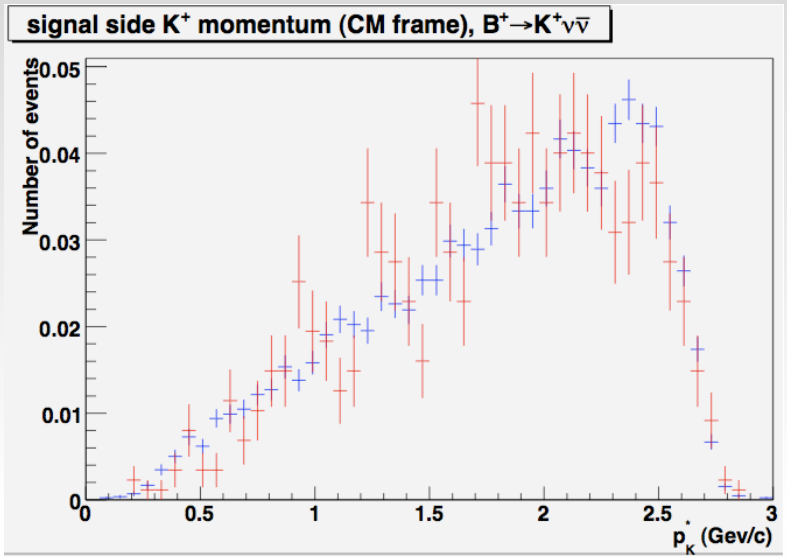
# Bsig efficiencies, signal samples

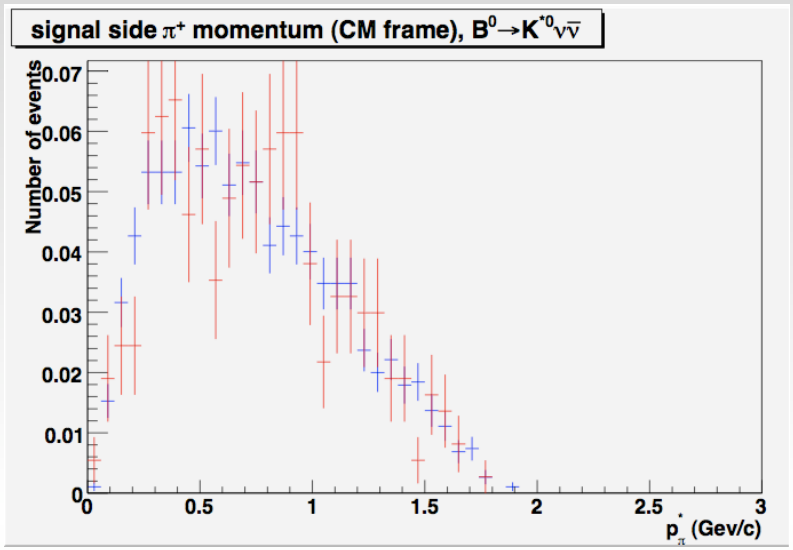


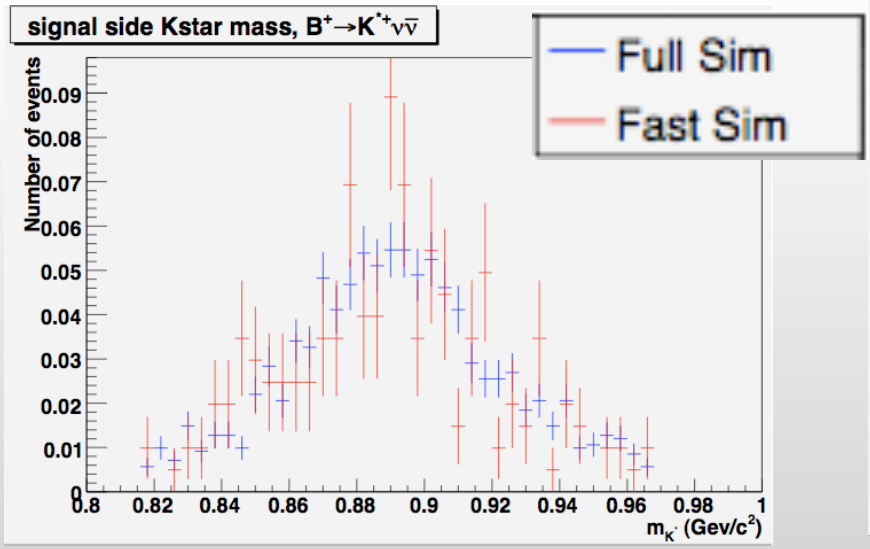



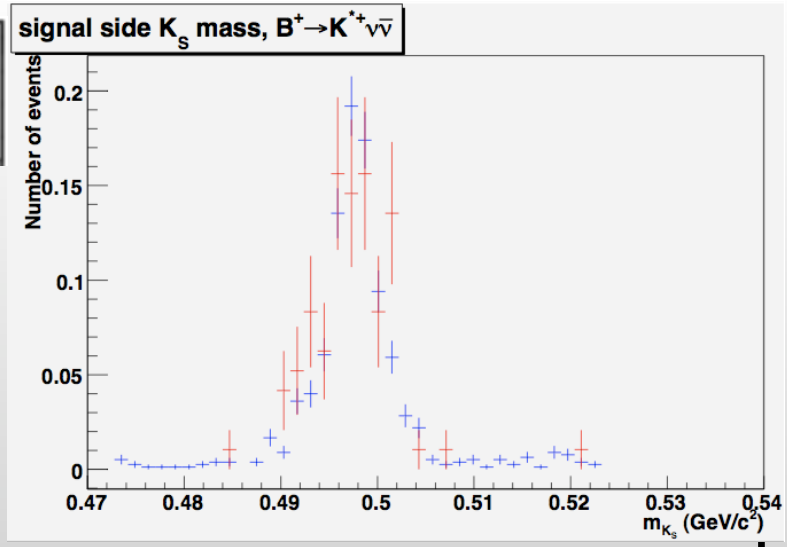



# Bsig shapes: signal MC samples (I)

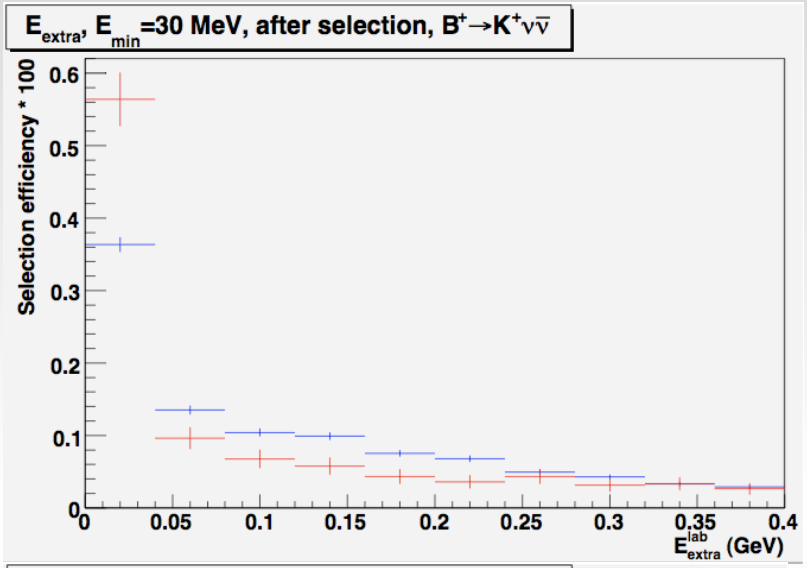


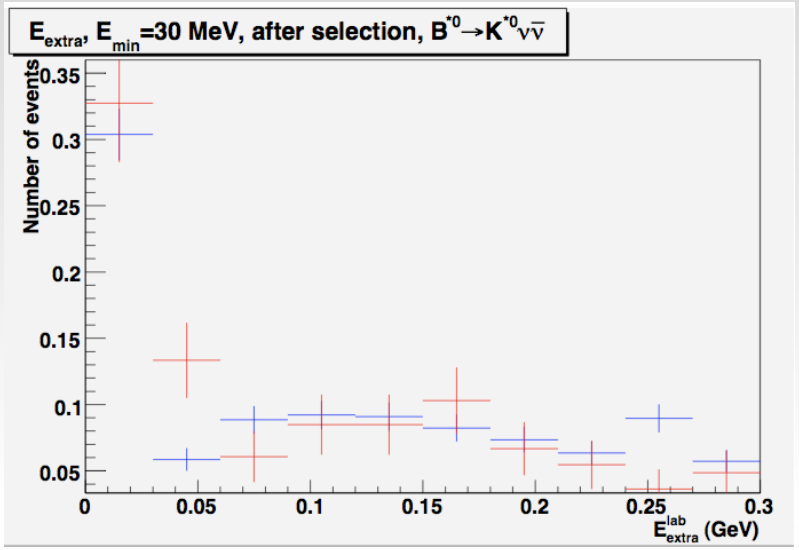



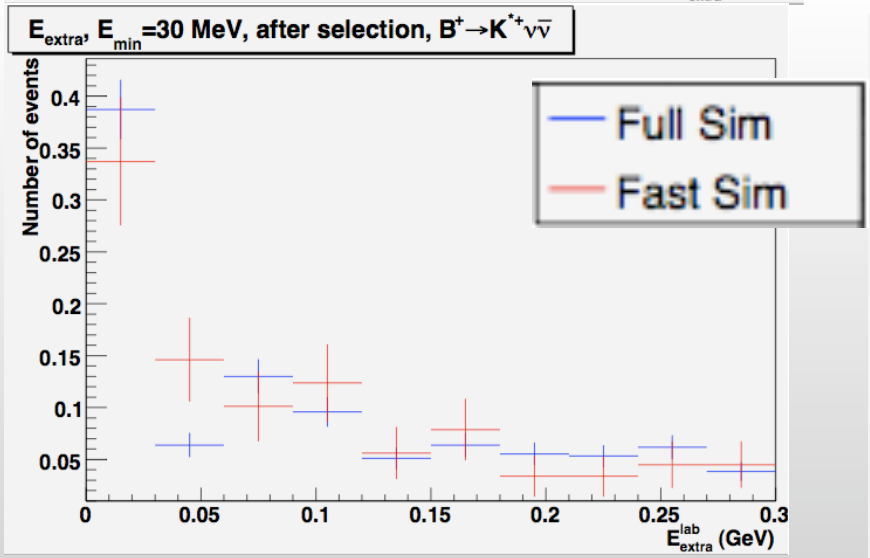



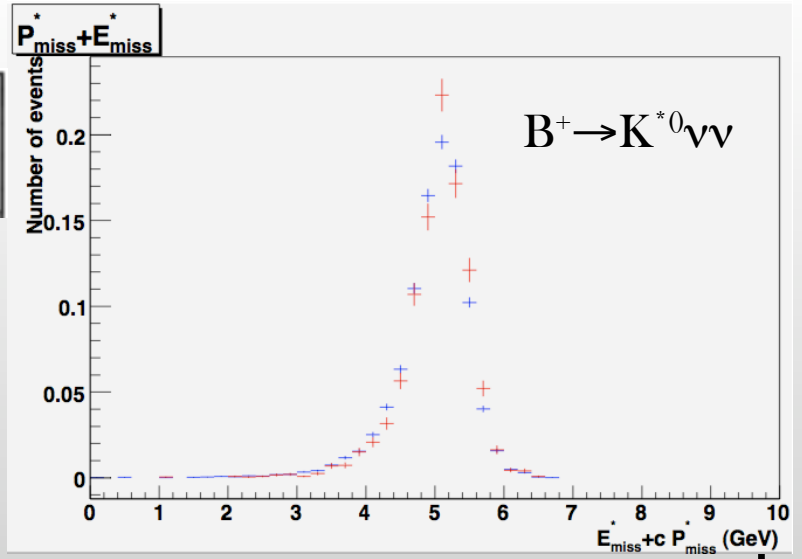



# Bsig shapes: signal MC samples (II)



# Conclusion and Outlook

* Hadronic Breco code in quite good shape

* background and signal MC samples produced during Feb. Production
* ntuples analyzed for DG and physics studies

* quite good agreement between Fast Sim and Full Sim both for signal and generic samples:
  - some investigation on D kinematics and neutral reconstruction needed

* still some work to do to fix bugs, add Bsig channels ($B \to K^{(*)}ll$, $B \to K^{(*)}\gamma$?), add validation tools and documentation

* Higher statistics generic and signal samples (w bkg mixing) needed for physiscs studies (i.e. background impact on neutral energy reconstruction)


# Back-up slides