Breco in FastSim: first studies on PID devices geometry

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Outline

* Implementation of Breco reconstruction in FastSim

* PID devices geometry

Why studying Breco

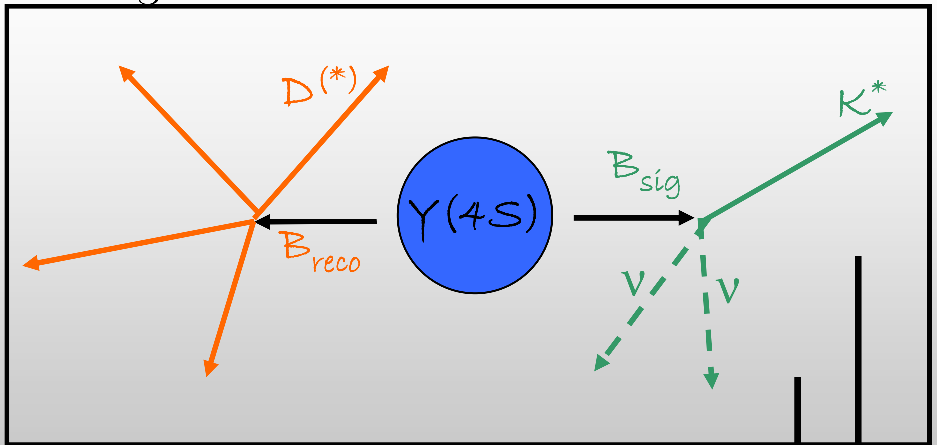
- In many BaBar analysis, one of the 2 B's is reconstructed in hadronic or semileptonic modes:

SL Breco	HAD Breco
$B \to D^{(*)} l \nu$	$B \to D^{(*)} n_1 \pi\ n_2 K\ n_3\ K_s\ n_4\ \pi^0$

reconstruction efficiency $O(10^{-3})$

- High statistic and clean sample
- Allow to search for rare decays with missing energy (RECOIL TECNIQUE)
  - $B \to \tau\nu$
  - $B \to K^{(*)}\nu\ \nu$
  - $B \to$ invisible
  - .....

golden channels for the physics program



Reconstructed modes

$B \to Dl\nu X$ $\quad (X = \gamma, \pi)$

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

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

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

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

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

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

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

$B \to DX$

$$X = n\pi + mK + rK^0_S + q\pi^0, \quad n+m+r+q<6$$

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

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

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

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

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

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

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

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

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

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

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

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

* Reconstruction of SL and HAD Breco modes implemented in FastSim (v0.0.1)
* High track (K,π) multiplicity sample → can be used to study the performance of particle ID and the impact of new PID devices

Sample and variables used

- Study BB events in which
  - the Breco has been reconstructed in SL or HAD modes
  - the Bsig has decayed in a low multiplicity final states

  (→ signal signature for a generic analysis on the recoil, in which a rare decay is searched for)

- generate and reconstruct $\nu\bar{\nu}K^{0*} \leftarrow B^0 \bar{B}^0 \rightarrow$ generic
- study the distribution of two variables:
  - SL reconstruction: m_D D invariant mass
  - HAD reconstruction: $m_{ES} = \sqrt{E_{beam}^2 - |p_B^*|^2}$

Implementation of a "raw" PID

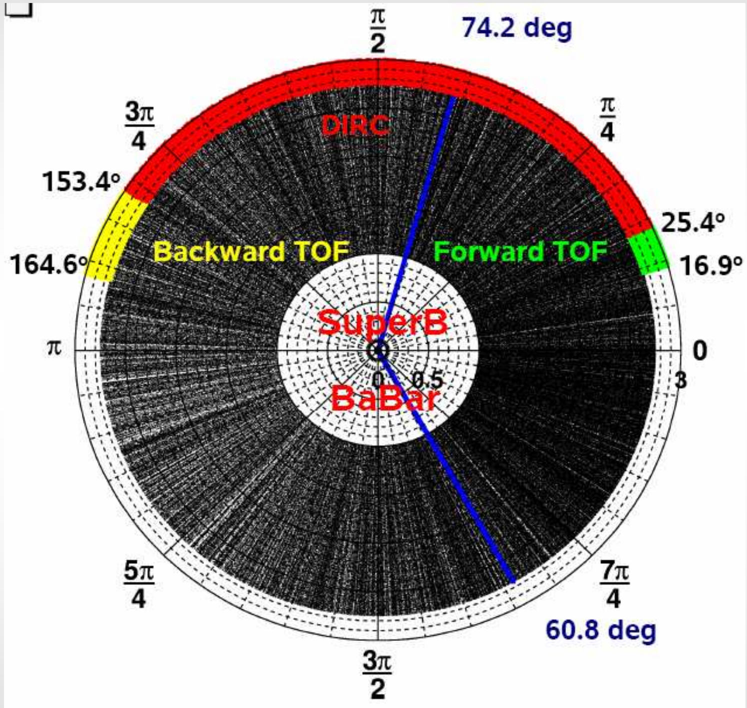
* Implementation of PID selector in FastSim : ongoin
* Study effects of the kaon and pion PID by using MC-truth information
  - choose a K and a π selector assuming the BaBar performancies

selector	efficiency	misID
Kaon: KLHTight	85%	1% (with pion)
Pion: piLHVeryLoose	99%	20% (with kaon)

  - for each reconstructed Breco check the a K has been correctely reconstructed using MC truth info: if yes accept the K with a probability = K eff. of a given selector
    If the K has been misidentified as a π, accept the hadron with a probability = K-π misID of a given selector
  - iterate for each K associated to the Breco and do the same for all π
  - select the B candidate if all the daughters have been accepted

PID devices geometry (I)

* different PID device coverage (by Leonid)



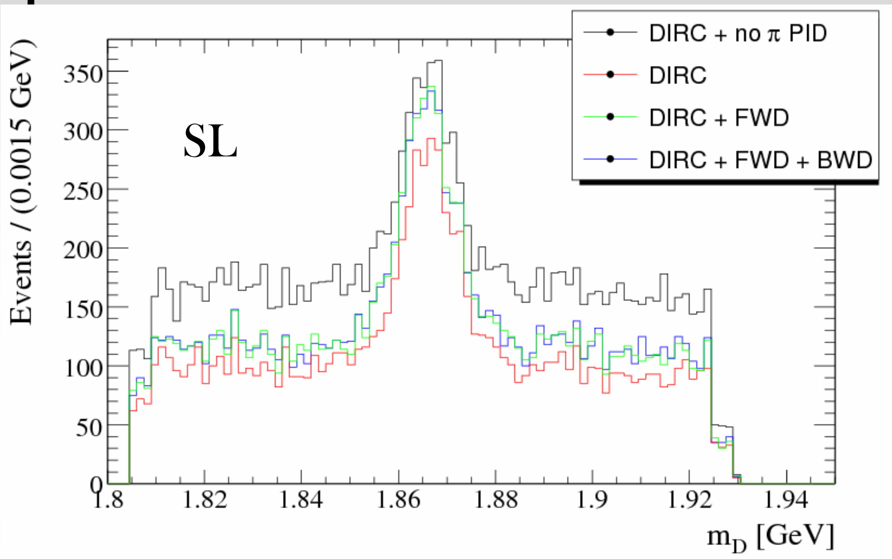
* Study the impact of the three devices by selecting Breco candidates with all tracks crossing:
  - DIRC
  - DIRC + FW TOF
  - DIRC + FW TOF + BW TOF

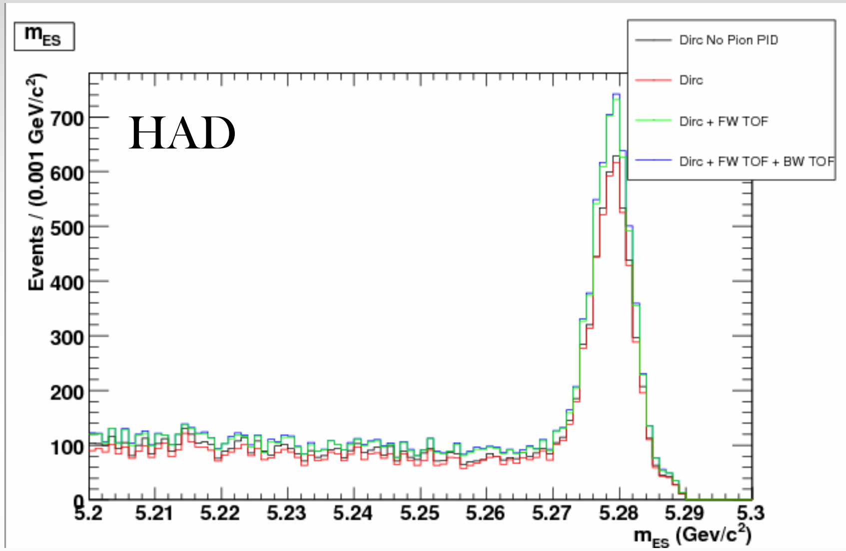
  implemented by cutting in θ_{Lab}

* "geometric" gain wrt DIRC-only by adding:
  - FW TOF : 6.1%
  - BW TOF : 0.6%

PID devices geometry (II)

* π VeryLoose, K Tight





HAD RECONSTRUCTION	signal region m_{ES}>5.27GeV/c^2	sideband: m_{ES}<5.26GeV/c^2
K PID + Dirc	5140	5514
K PID + π PID + Dirc	5023	5005
K PID + π PID + Dirc + Fw TOF	5969	6273
K PID + π PID + Dirc + Fw TOF + BW TOF	6045	6386

Conclusions and next steps

* Reconstruction of HAD and SL Breco implemented in FastSim
* First studies to understand the impact of the PID device geometry on physics (FW and BW TOF)

Next steps:

- study the effects of different "raw" PID and compare HAD and SL reconstruction
- use PID selectors implemented in FastSim
- Reconstruct signal side (i.e. $B \to K^* \nu\nu$)
- study signal side PID
- study signal side related distributions: i.e. Extra energy deposited in the EMC $\to$ inputs for EMC geometry (hermeticity) and performances (energy resolution)

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