

Preliminary considerations on B flavor-tagging

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B Flav Tagging

Determination of the flavour of the neutral B meson

The effective tagging efficiency:

$$Q = \epsilon(1 - 2w)^2$$

w mistag fraction

ϵ tagging efficiency

depends on:

- Acceptance of the Detector
- PID Performance
- Tagging Algorithm

- * just started to work on this item for SuperB
- * some preliminary ideas for a "SuperB" B Tagger (SBTag) are shown, any suggestion is welcome!!

From BaBar to SuperB (preliminary ideas)

SBTag:

- (1) reuses the core of the B tagging code from Babar
- (2) reuses the NN infrastructure of Tag08
(same inputs, subtaggers, etc)
- (3) relies on available "SuperB" muon, electron and kaon selectors
- (4) revises tightness of PID selection to optimize B flav-tag performance

1. B Tagging Code

The core of the B Tagging code is in these packages:

- BTaggingTools
- BTaggingUser
- BTaggingSequences
- etc...

First steps:

- copy the core of the B Tagging code from BaBar packages, rename and adapt it for FastSim
- PacTagging package?

2. Input to NN

- check if we can run the adapted code on $B \rightarrow \pi\pi$ MC events and dump the discriminating variables required as input to the NN
- not interested in training the NN at this stage, we just need that the adapted code for FastSim works
- when reliable PID selectors will be available \rightarrow training NN

Tag name	Network arch.	Discriminating variables	Training target
Electron	4:12:1	$p^*, E_{90}^W, \cos \theta_{miss}, q$	Classify B^0 versus \bar{B}^0
Muon	4:12:1	$p^*, E_{90}^W, \cos \theta_{miss}, q$	Classify B^0 versus \bar{B}^0
KinLep	3:3:1	$p^*, E_{90}^W, \cos \theta_{miss}$	Recognize leptons from direct decays
Kaon	5:10:1	$K1, K2, K3, nK_s, \Sigma P_t$	Classify B^0 versus \bar{B}^0
SlowPion	3:10:1	$p^*, \cos \theta_{thrust}, \mathcal{L}_K$	Recognize true slow pions
MaxPstar	3:6:1	$p^*, doca_{xy}, \cos \theta$	Recognize fast tracks
KPi	3:10:1	Kaon tag, SlowPi tag, $\cos \theta_{k,\pi}$	Recognize pairs of true kaons and slow pions
FSC	6:12:1	$\cos SlowFast, p_{Slow}^*, p_{Fast}^*, \cos SlowThrust, \cos FastThrust, \mathcal{L}_{KSlow}$	Recognize fast-slow correlated tracks
Lambda	6:14:1	$M_\Lambda, \chi^2, \cos \theta, \text{flight length}, p_\Lambda, p_{proton}$	Recognize lambda decays
Tag04/Tag08	10:20:1	All of the above tags	Classify B^0 versus \bar{B}^0

3. B Tagging Lists

- PID selectors and criteria for the B Tagging lists in BaBar are in BetaPid/PidTaggingMicroSequence.tcl, .cc, .hh

	S B Tag	Crit.	Tag08	Crit
Muon	?	?	PidMuonBDTSelector	LFR
Electron	?	?	PidKMSelector	L
Kaon	?	?	PidKaonBDTSelector +KKM SuperLoose	NP

(talk by Nicolas on March 11)

- Example selectors written:

PacPidFirstElectronSelector	} 'LH'-type selectors PID barrel (DIRC) only so far Need tuning/code improvement
PacPidFirstKaonSelector	
PacPidFirstPionSelector	
PacPidTruthBasedSelector	→ MC-truth based

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To do List

- Adapt the B tagging code of BaBar for FastSim (work in progress)
- Use available "SuperB" PID Selectors to create the B Tagging Lists without any optimization on the tightness criteria
- Generate and reconstruct the usual MC events used to train the NN architecture of BaBar.
- Check if we can dump all the required variables to be used as inputs to the NN and look at their distributions.