$B_s^0 \to \mu^+\mu^-$ Cross Check Analysis

M. De Mattia

March 26, 2013

Abstract

The aim of this analysis note is to provide supporting material for the cross check analysis for the search for $B_s^0 \to \mu^+\mu^-$ and $B^0 s \to \mu^+\mu^-$ decays. It follows closely the documentation provided in [1] and includes direct comparison to the results in that note.

1 Datasets

The datasets used are shown in table **??**.

The events are selected using the same triggers as described in the reference [1].

The analysis is based on a boosted decision tree (BDT) algorithm to select $B_s^0 \to \mu^+\mu^-$ events from the background. A preselection is applied to the data and MC samples to reduce the size and remove outliers that might confuse the BDT training. The signal is taken from the $B_s^0 \to \mu^+\mu^-$ MC sample, while the background is taken from the sidebands in the data sample.
Despite the availability of the full 2012 dataset, in order to allow a direct comparison with the results in [1] this study is limited to runs <= 203002. The dataset is split in three different categories according the remainder of "event number%3".

2 Selection

The same preselection as in [1] is used. The muons are chosen to pass global muon prompt tight selection (GM_PT).

Official MC datasets
BsToMuMu_BsFilter_8TeV-pythia6-evtgen/Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM
Data /MuOnia/Run2012A-13Jul2012-v1/AOD /MuOnia/Run2012A-recover-06Aug2012-v1/AOD /MuOnia/Run2012B-13Jul2012-v1/AOD /MuOnia/Run2012C-24Aug2012-v1/AOD /MuOnia/Run2012C-PromptReco-v2/AOD /MuOnia/Run2012C-EcalRecover_11Dec2012-v1/AOD /MuOnia/Run2012D-PromptReco-v1/AOD

rank	variable	separation				
1	alpha	5.224e-01	alpha	5.201e-01	alpha	5.221e-01
2	closetrk	4.053e-01	closetrk	4.071e-01	closetrk	4.060e-01
3	fls3d	3.453e-01	fls3d	3.465e-01	fls3d	3.454e-01
4	docatrk	3.200e-01	docatrk	3.163e-01	iso	3.179e-01
5	iso	3.148e-01	iso	3.134e-01	docatrk	3.171e-01
6	pvips	1.951e-01	pvips	1.958e-01	pvips	1.933e-01
7	pvip	1.630e-01	pvip	1.643e-01	pvip	1.612e-01
8	maxdoca	1.112e-01	maxdoca	1.146e-01	maxdoca	1.128e-01
9	chi2/dof	9.549e-02	chi2/dof	9.809e-02	chi2/dof	9.981e-02
10	eta	2.645e-02	eta	2.690e-02	eta	2.592e-02
11	pt	1.145e-02	pt	1.168e-02	pt	1.099e-02

The distributions of the variables used for the BDT training are shown in Figures 1 and 2.

References

[1] U. Langenegger et al. AN-12-358: "Search for $B_s \to \mu^+\mu^-$ and $B_s^0 \to \mu^+\mu^-$ with the 2011 and 2012 data". Technical report, CMS Collaboration, 2012.

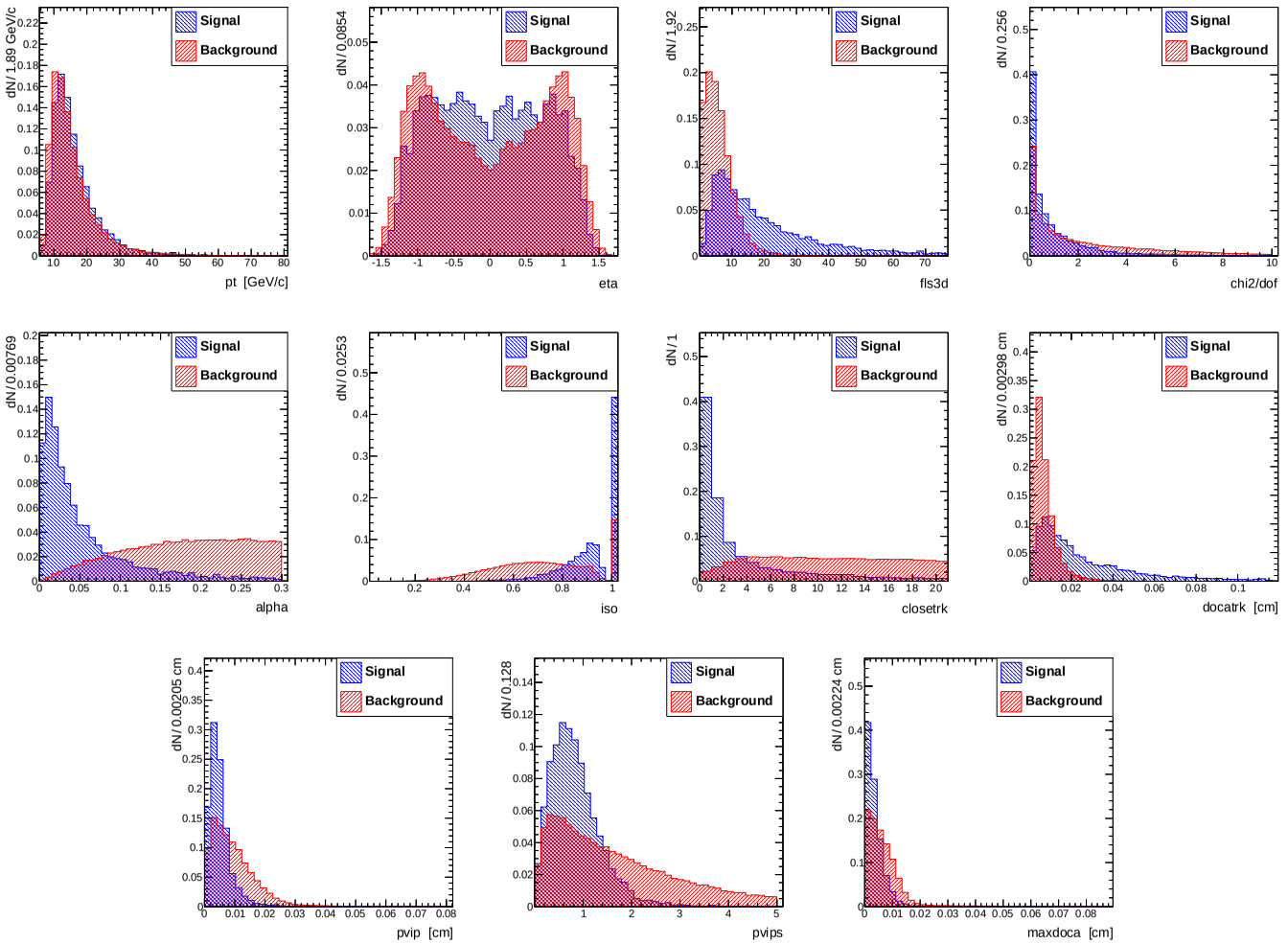

Figure 1: Standard TMVA plot of the input variables for the barrel BDT for signal (blue) and background (red). The background is extracted from data dimuon sidebands.

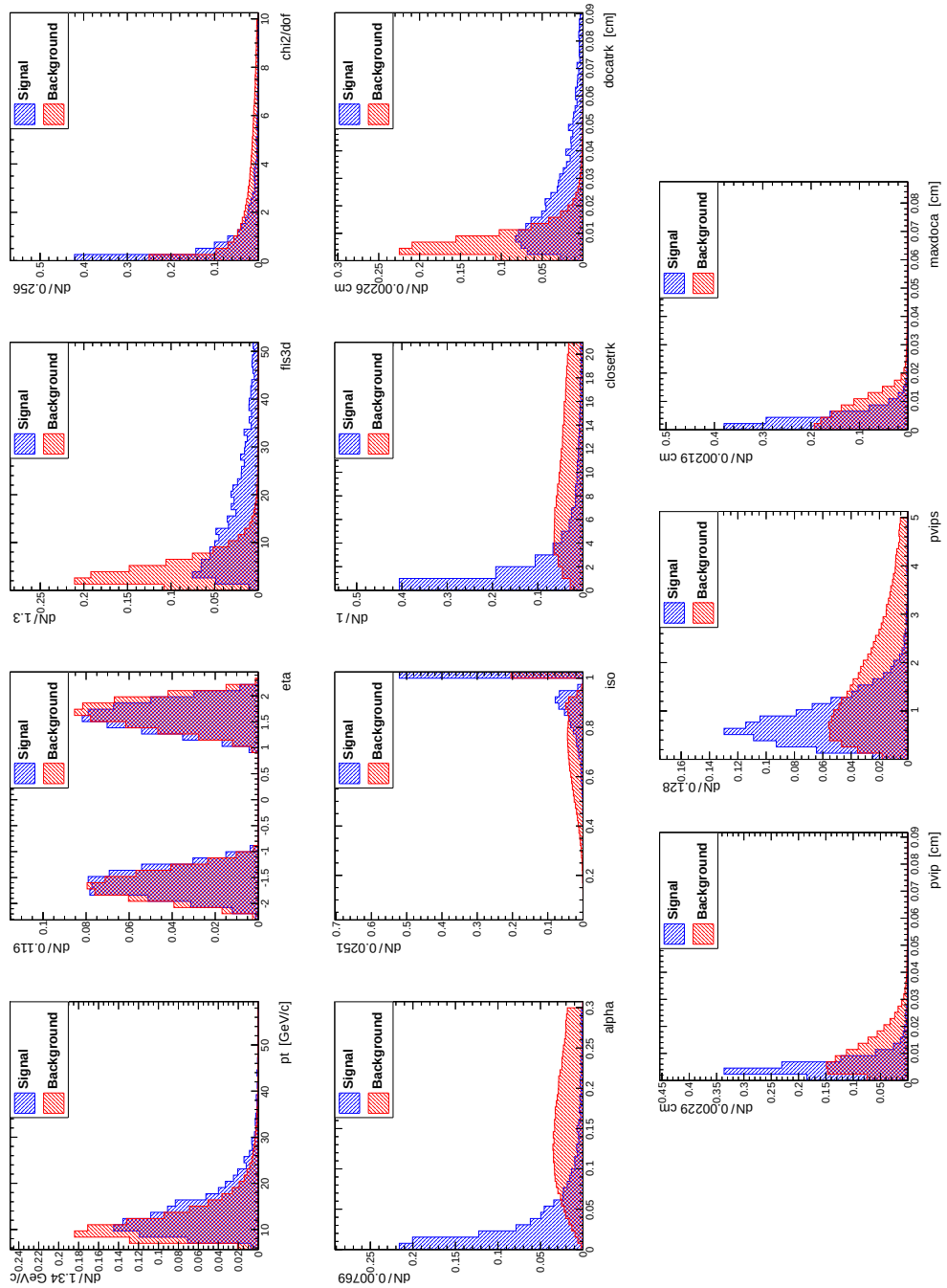

Figure 2: Standard TMVA plot of the input variables for the endcaps BDT for signal (blue) and background (red). The background is extracted from data dimuon sidebands.

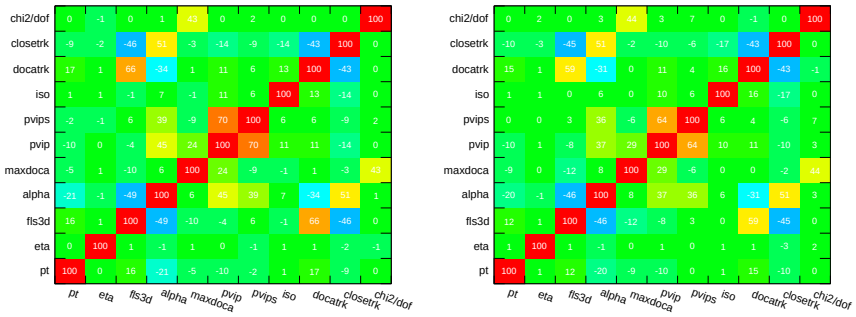

Figure 3: Correlation matrix for signal events in the barrel (left) and the endcap (right).

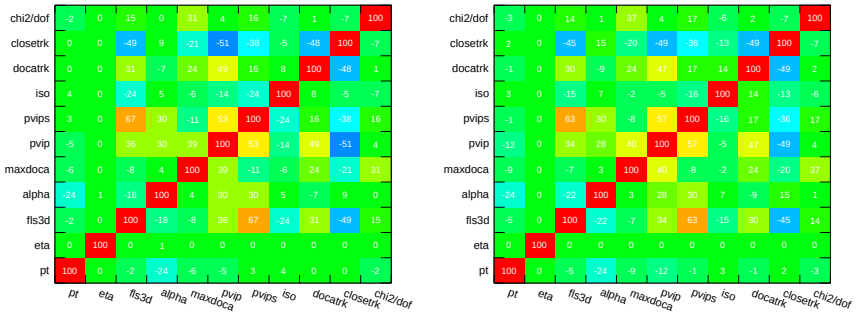

Figure 4: Correlation matrix for background events in the barrel (left) and the endcap (right).