

# **Selection of $B_s^0 \rightarrow \psi(2S)K_S^0$ decays via multivariate analysis**

Lukas Bertsch

lukas.bertsch@tu-dortmund.de

Tabea Hacheney

tabea.hacheney@tu-dortmund.de

Tom Troska

tom.troska@tu-dortmund.de

Start of course: 13th of June 2024

TU Dortmund University – Faculty of Physics

# Contents

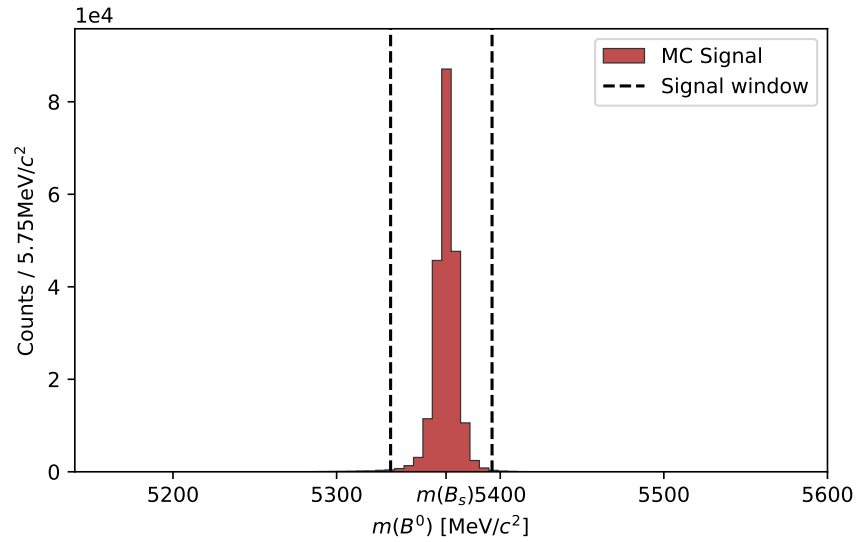
<b>1. Theorie</b>	<b>3</b>
<b>2. Durchführung</b>	<b>3</b>
<b>3. Auswertung</b>	<b>3</b>
3.1. Feature selection . . . . .	3
3.2. Training of MVA classifier . . . . .	3
3.3. Optimization of the classification threshold . . . . .	3
3.4. Evaluation of the signal yield . . . . .	3
<b>4. Diskussion</b>	<b>9</b>
<b>References</b>	<b>9</b>
<b>A. Anhang</b>	<b>10</b>
A.1. Originaldaten . . . . .	10

## 1. Theorie

[1]

## 2. Durchführung

## 3. Auswertung



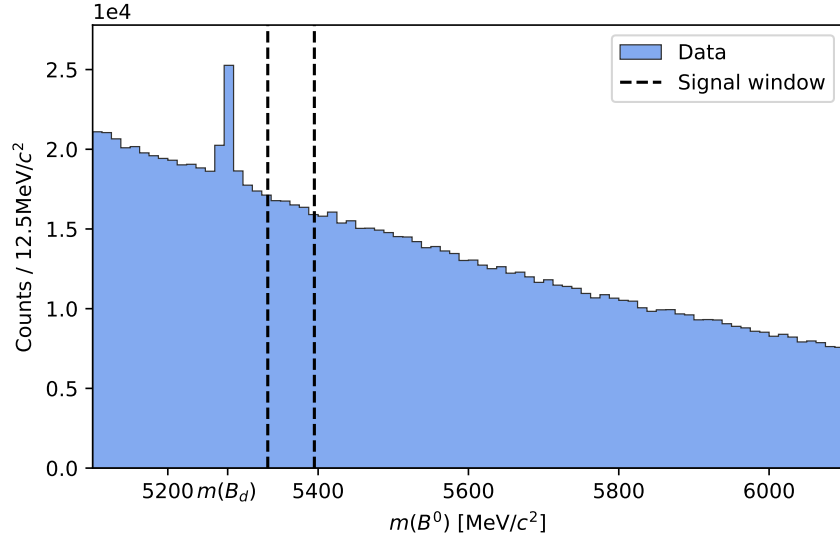
**Figure 1:** Invariant mass distribution of the  $B_s^0$  candidates for the signal channel simulation data.

### 3.1. Feature selection

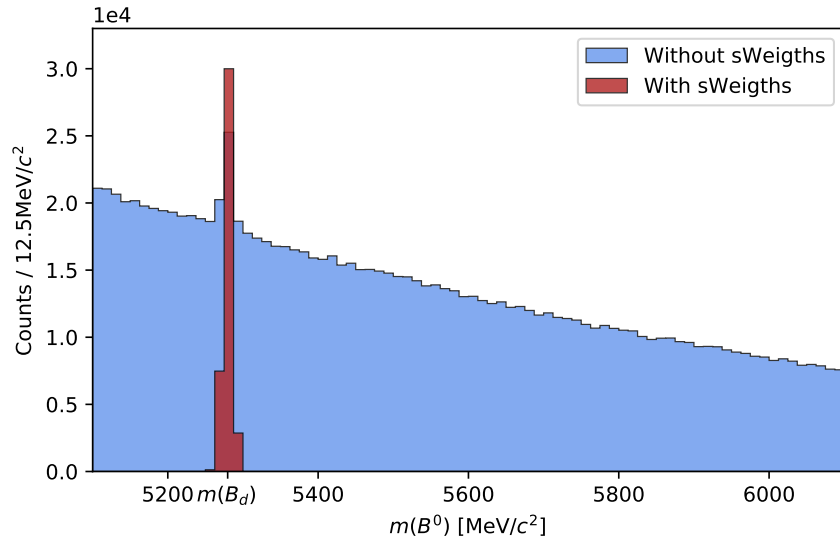
### 3.2. Training of MVA classifier

### 3.3. Optimization of the classification threshold

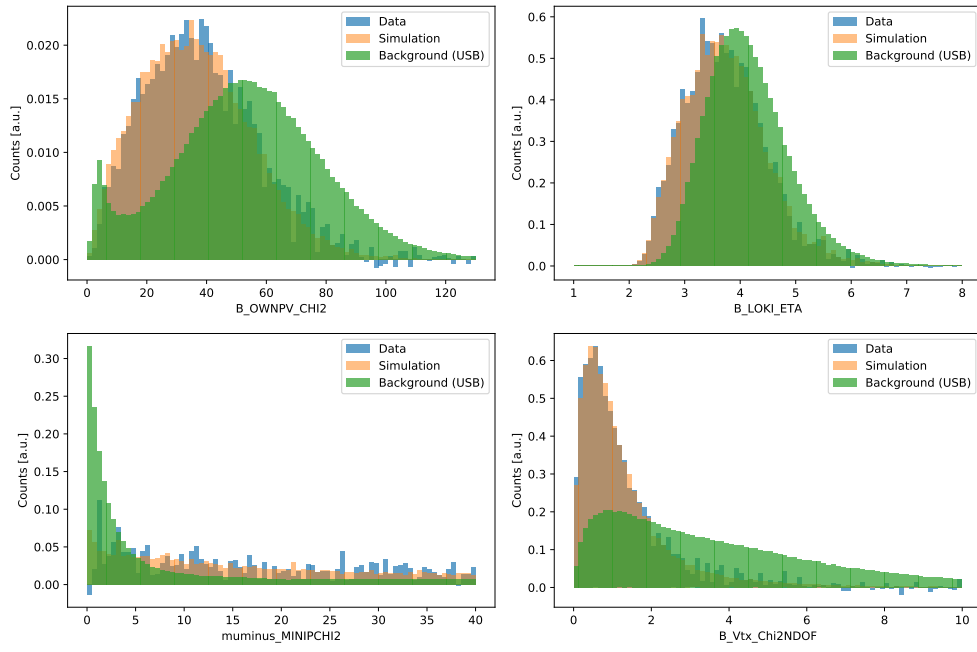
### 3.4. Evaluation of the signal yield



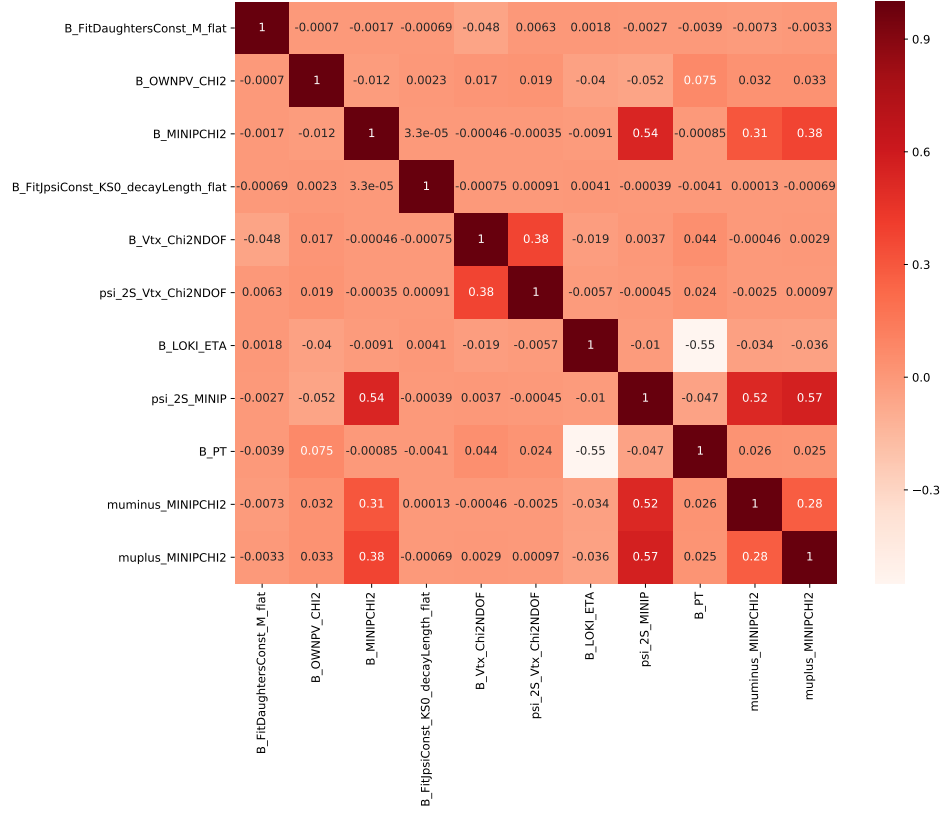
**Figure 2:** Invariant mass distribution of the  $B^0$  candidates for the recorded LHCb data.



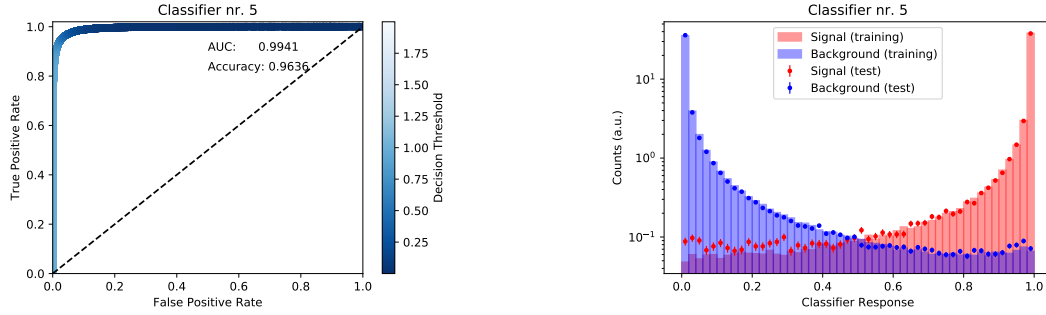
**Figure 3:** Invariant mass distribution of the  $B^0$  candidates for the recorded LHCb data and sWeights reweighted data.



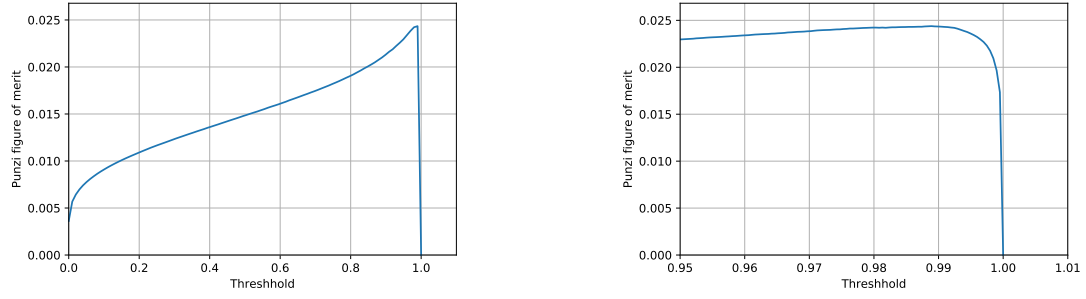
**Figure 4:** Distributions of four selected variables used in the MVA for simulation, reweighted data and background.



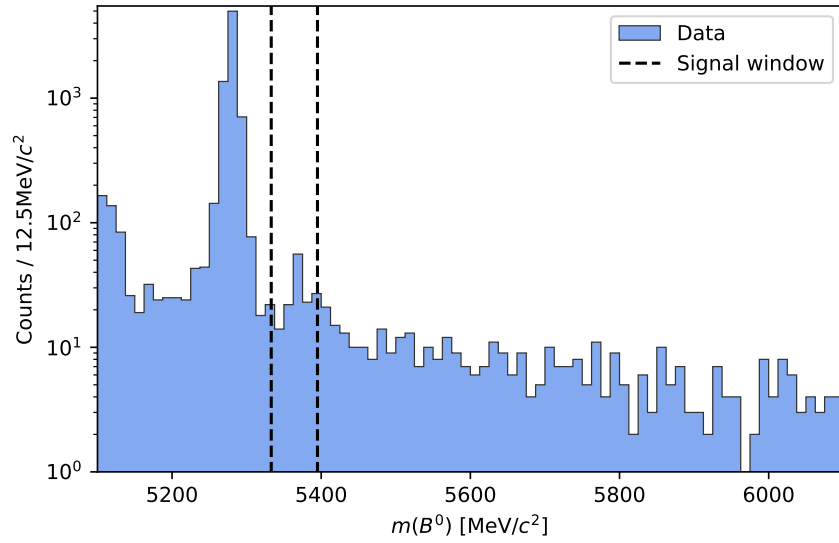
**Figure 5:** Correlations between the 10 selected variables and the reconstructed  $B^0$  mass.



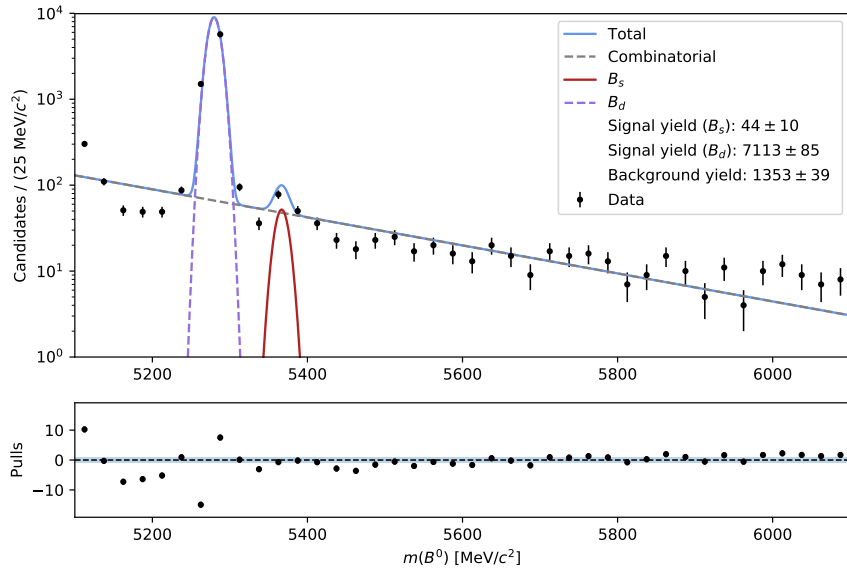
**Figure 6:** ROC curve (left) and performance on training and test dataset for one of the trained classifiers.



**Figure 7:** The Punzi figure of merit for the mean classifier response in different intervals of the threshold.



**Figure 8:** Semi logarithmic invariant mass distribution of the  $B^0$  candidates in data, after the cut on the classifier response is applied.



**Figure 9:** Fit to the invariant mass spectrum of the data in semi logarithmic depiction.



## 4. Diskussion

### References

- [1] *Versuch zum Literaturverzeichnis*. TU Dortmund, Fakultät Physik. 2022.

## **A. Anhang**

### **A.1. Originaldaten**

