



Weekly report

Fangyi Guo



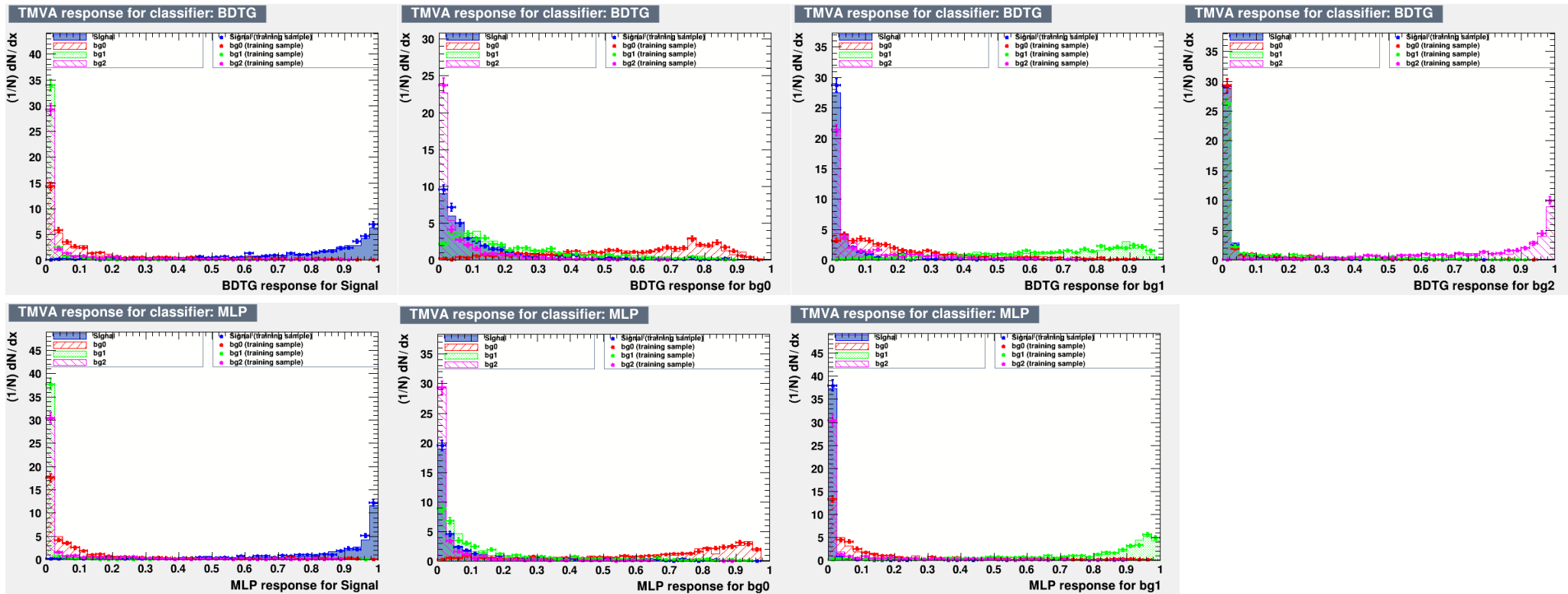
中國科學院高能物理研究所

Institute of High Energy Physics Chinese Academy of Sciences

ML application with VBF events

- Multi-class training with TMVA: [root/tutorials/tmva/TMVA_Multiclass.C](#)
 - Run with tutorial: 1 signal, 3 backgrounds, 4 input variables. BDTG and MLP.

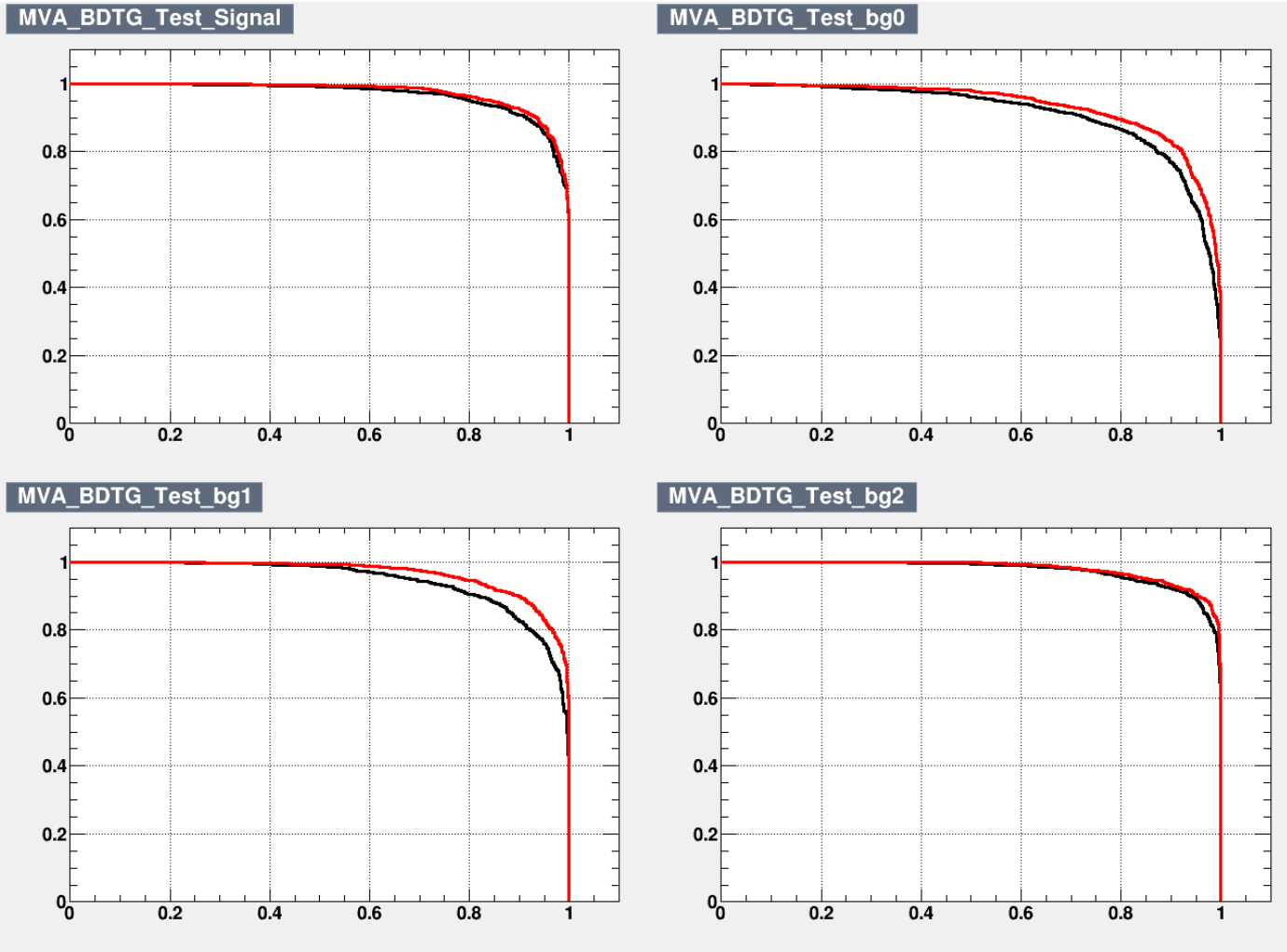
```
TMVA::Factory *factory = new TMVA::Factory( "TMVAMulticlass", outputFile,
                                           "!V:!Silent:Color:DrawProgressBar:Transformations=I;D;P;G,D:AnalysisType=multiclass" );
```



ML application with VBF events



- Multi-class training with TMVA: `root/tutorials/tmva/TMVAMulticlass.C`



ROC for signal and backgrounds.
red: MLP.
black: BDTG

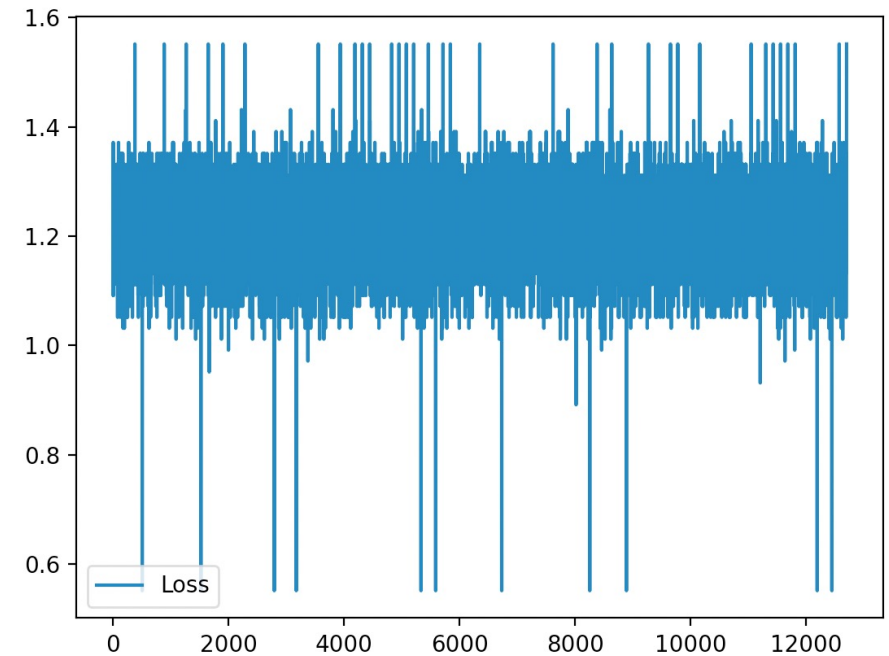
ML application with VBF events



• Training with Pytorch:

- python 3.9 + pytorch, MLP from git for 3-classification.
- Input with high-level info: 8 variables.
- Net needs optimization.

```
MLP(  
  (hidden1): Linear(in_features=8, out_features=6, bias=True)  
  (act1): ReLU()  
  (hidden2): Linear(in_features=6, out_features=8, bias=True)  
  (act2): ReLU()  
  (hidden3): Linear(in_features=8, out_features=3, bias=True)  
  (act3): Softmax(dim=1)  
)  
Accuracy: 0.331
```

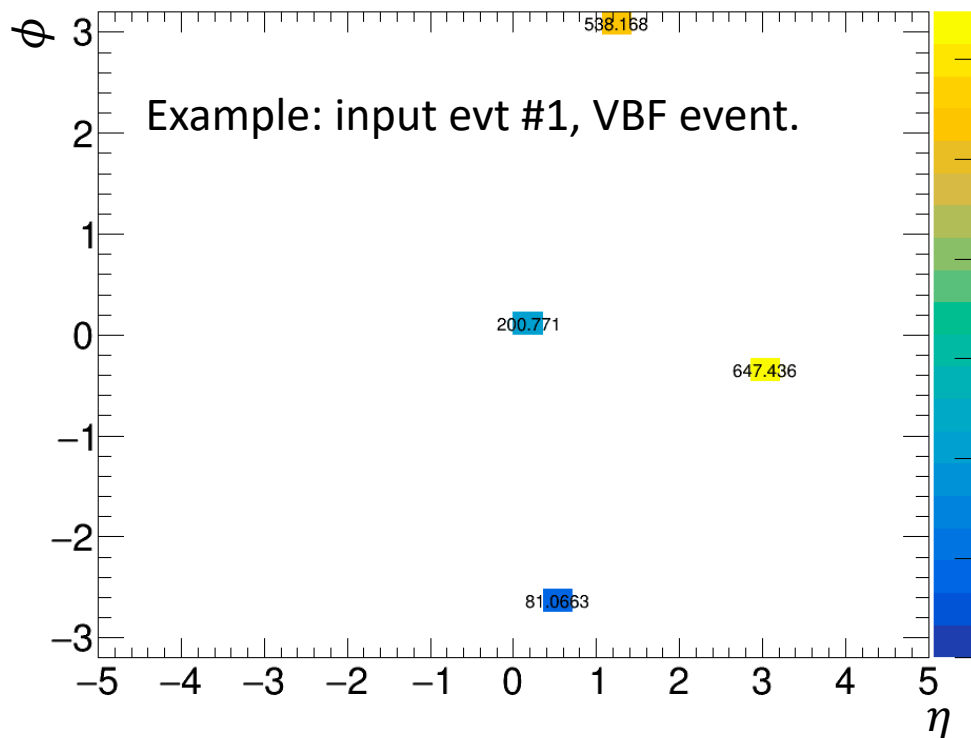


ML application with VBF events



• Training with Pytorch:

- python 3.9 + pytorch, CNN for 3-classification.
- Input with plot: event map $[\eta, \phi]$ of gamma/jet.
- Net needs optimization.



```
CNN
(conv1): Sequential(
  (0): Conv2d(1, 16, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
  (1): ReLU()
  (2): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
)
(conv2): Sequential(
  (0): Conv2d(16, 32, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
  (1): ReLU()
  (2): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
)
(out): Linear(in_features=1568, out_features=3, bias=True)
)
```


ML application with VBF events



• Training with Pytorch:

- python 3.9 + pytorch, CNN for 3-classification.
- Input with plot: event map $[\eta, \phi]$ of gamma/jet.
- Net needs optimization.

```
Epoch: 0 | train loss: 8.6740 | test accuracy: 0.32
Epoch: 0 | train loss: 1.2027 | test accuracy: 0.32
Epoch: 0 | train loss: 1.1296 | test accuracy: 0.34
Epoch: 1 | train loss: 1.1102 | test accuracy: 0.42
Epoch: 1 | train loss: 1.1067 | test accuracy: 0.38
Epoch: 1 | train loss: 1.0875 | test accuracy: 0.36
Epoch: 2 | train loss: 1.1321 | test accuracy: 0.36
Epoch: 2 | train loss: 1.1115 | test accuracy: 0.30
Epoch: 2 | train loss: 1.0895 | test accuracy: 0.40
Epoch: 3 | train loss: 1.1087 | test accuracy: 0.32
Epoch: 3 | train loss: 1.0925 | test accuracy: 0.42
Epoch: 3 | train loss: 1.0915 | test accuracy: 0.34
Epoch: 4 | train loss: 1.0878 | test accuracy: 0.38
Epoch: 4 | train loss: 1.1135 | test accuracy: 0.32
Epoch: 4 | train loss: 1.0809 | test accuracy: 0.36
```