$p\bar{p} \rightarrow tbH^{\pm}$ Iterative Discriminant Analysis

André Sopczak

Lancaster University

Collaborators:
Slava Bunichev, Lev Dudko, Alex Finch, Phillip Gutierrez, Sohrab Hossain, Josh Petzoldt, Arnold Pompos.
Theory:
Johan Alwall, Stefan Hesselbach, Stefano Moretti, Johan Rathsman.

Outline

- Iterative Discriminant Analysis (IDA)
- 80, 100, 130, 150 GeV charged Higgs boson masses
- Higher order corrections implemented in event generation (PYTHIA version 6.325). [J.Alwall etal, Eur. Phys. J. **C39S1**, 37 (2005)]
- $tbH^+ \rightarrow q\bar{q}\bar{b}b\tau\nu$ signal versus
  $t\bar{t} \rightarrow q\bar{q}\bar{b}b\tau\nu$ background
- Spin transfer included
- Approximation of detector response
- IDA output
- Performance comparison
- Conclusions

Iterative Discriminant Analysis (IDA) Method

A method to weight each event to optimize signal / background separation using n discriminant variables.

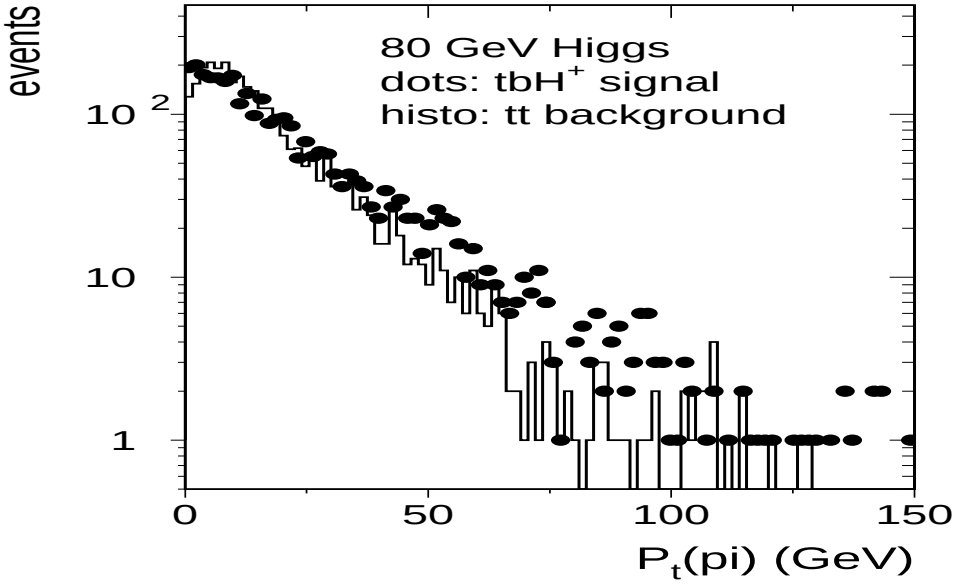
Construct: vector x containing the n variables and
$(n^2 - n)/2$ products of those variables.

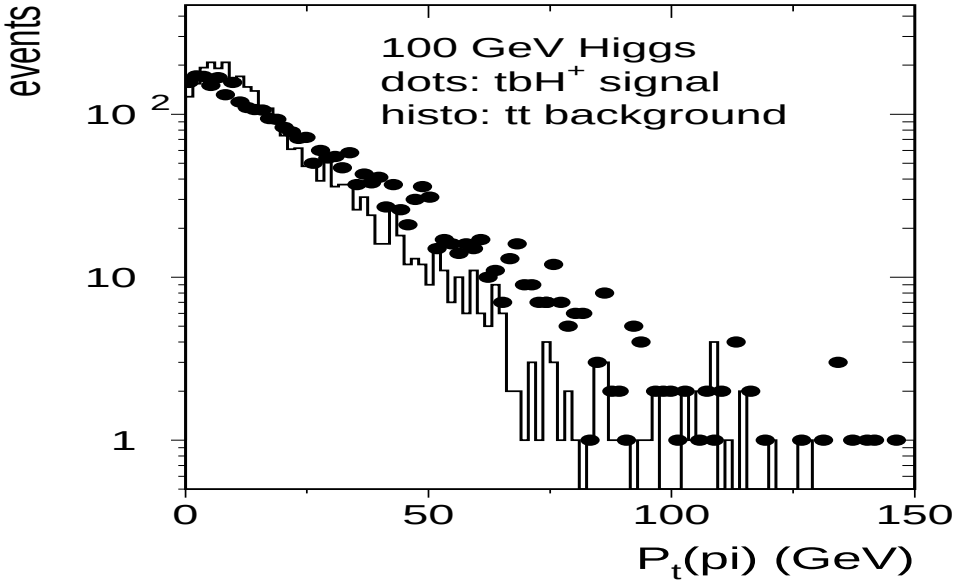
Calculate:	V	Variance matrix
	$\Delta\mu$	Difference in the mean values between signal and background
	$a = V^{-1}\Delta\mu$	
	$D^0 = x^T \cdot a \cdot x$	Provides the maximum separation between signal and background.

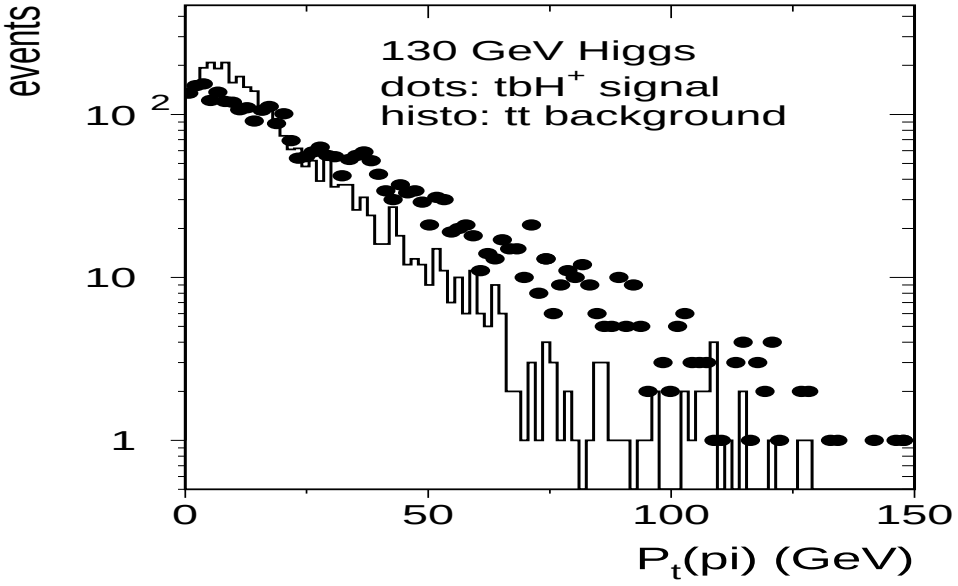
Weighted such that signal and background have equal importance.

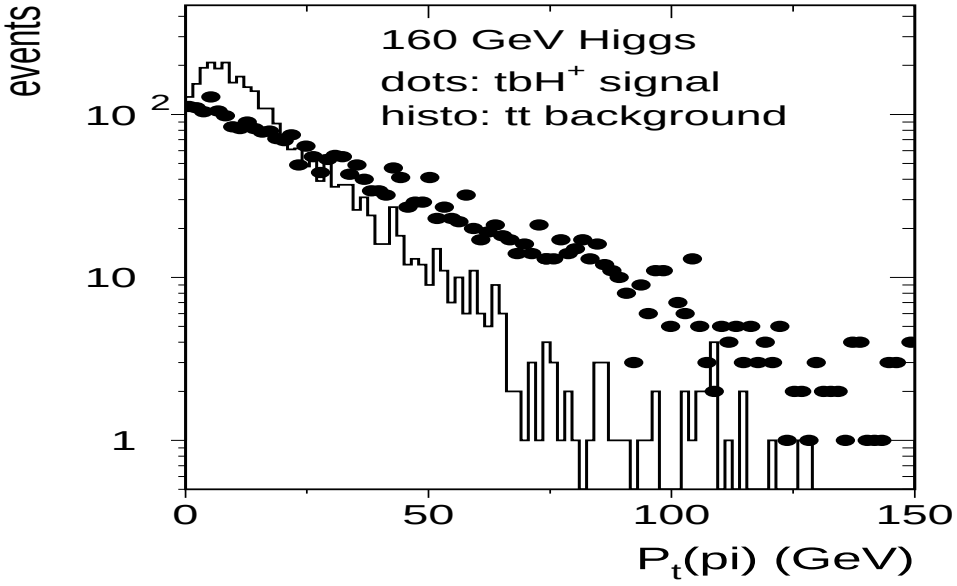
Find the value of D^0 which selects a predetermined fraction of the signal (e.g. 50%), and cut on it. Do this process once again for events passing the cut.

Input Variables









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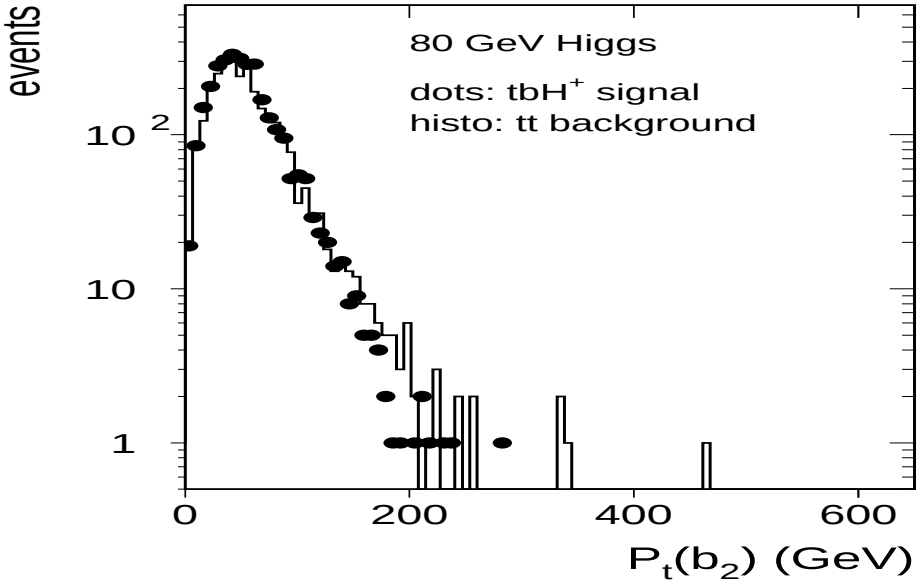

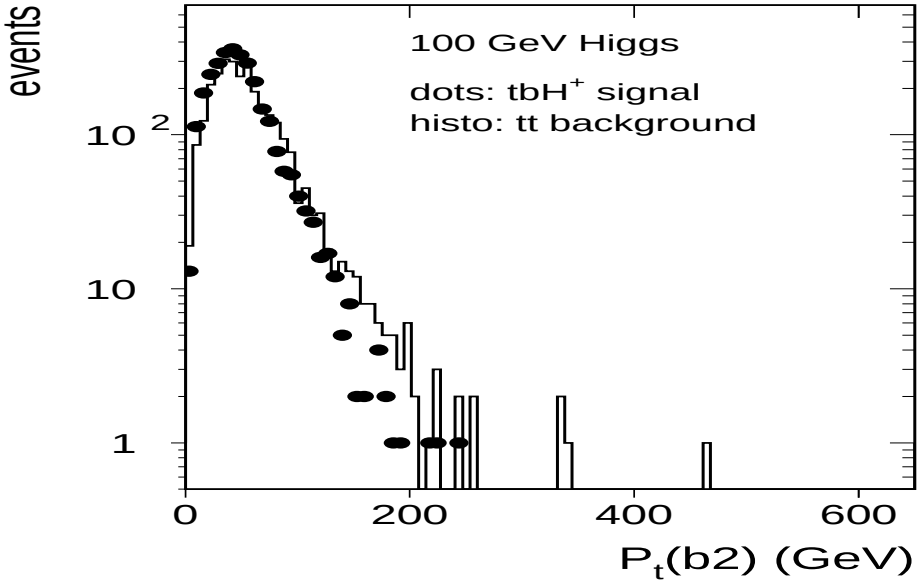

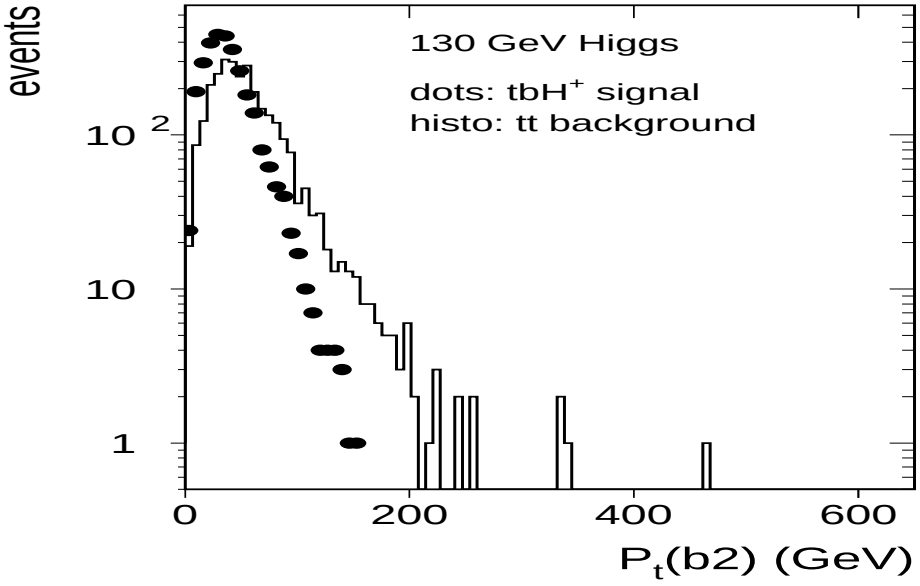

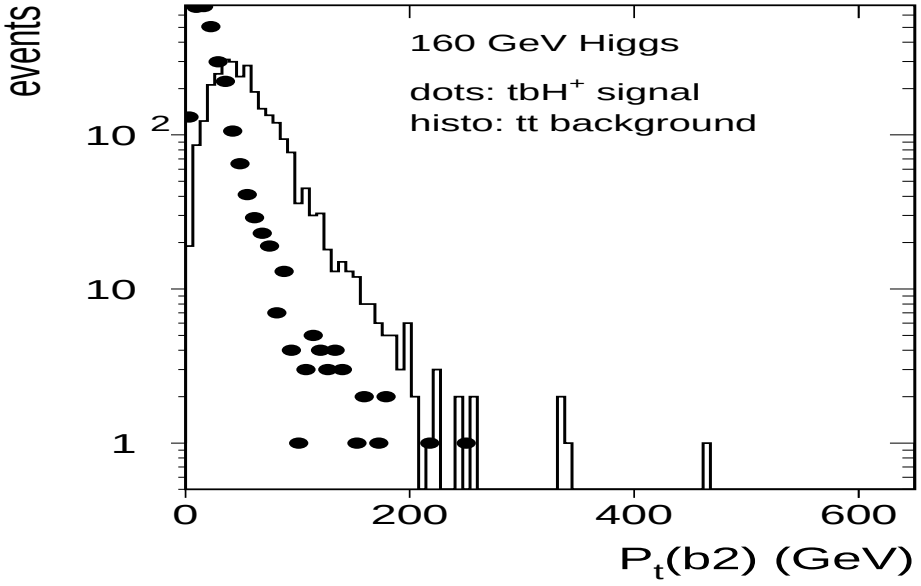

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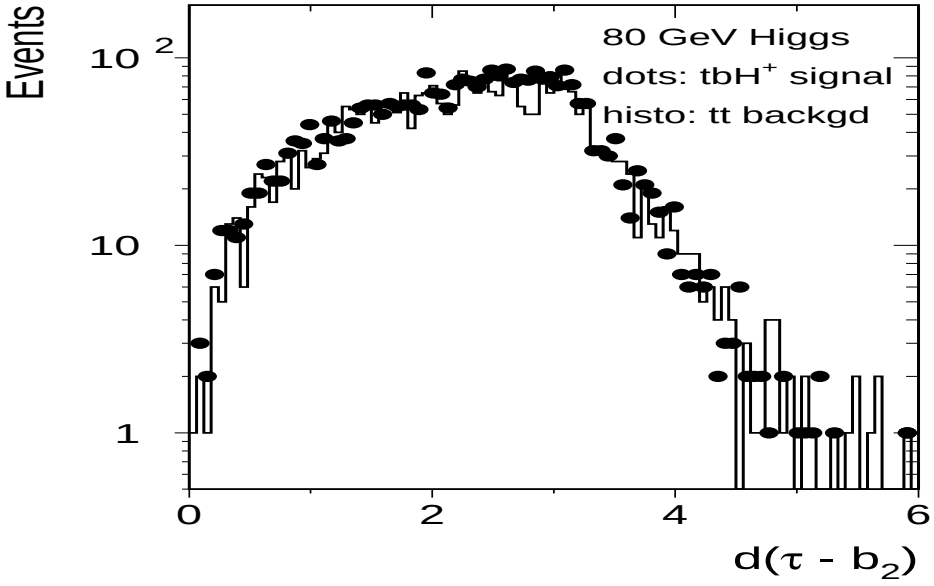

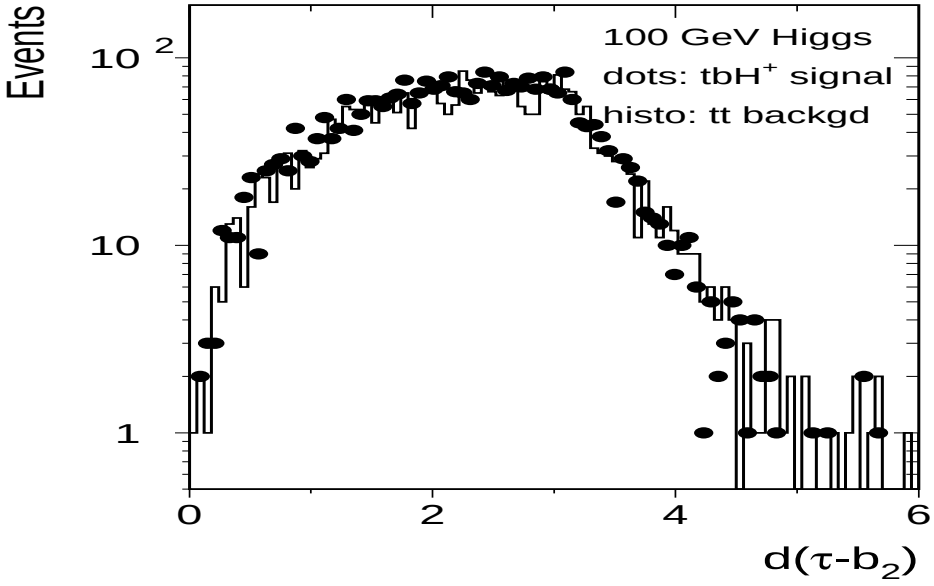

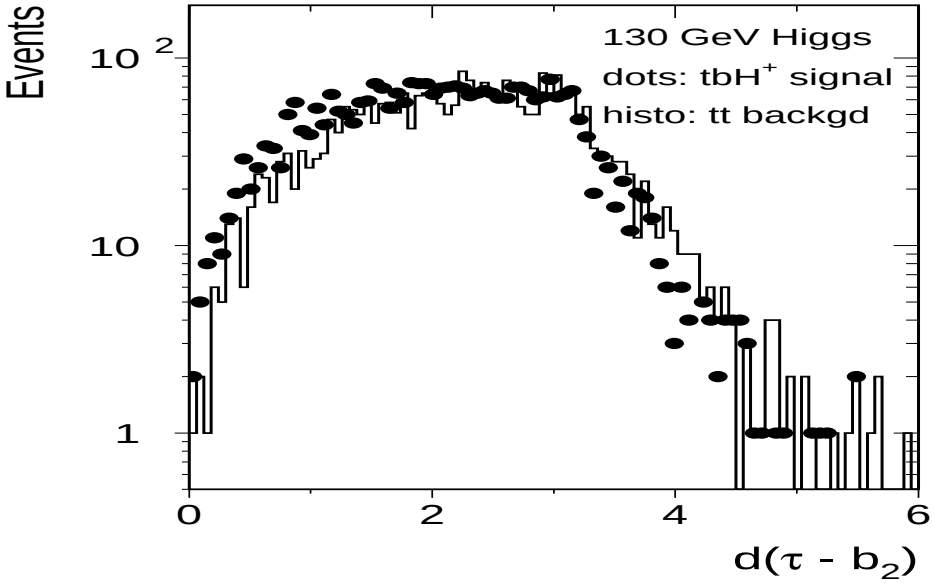

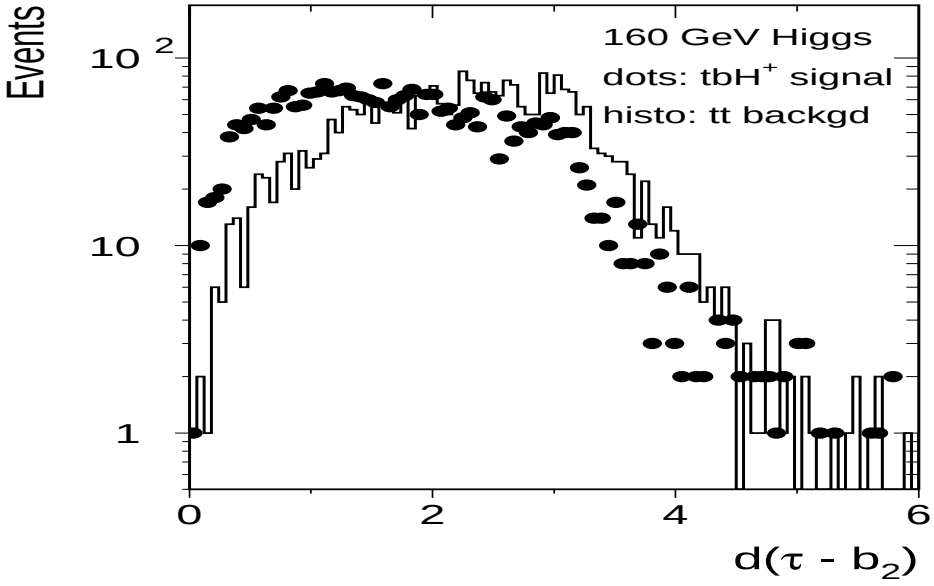

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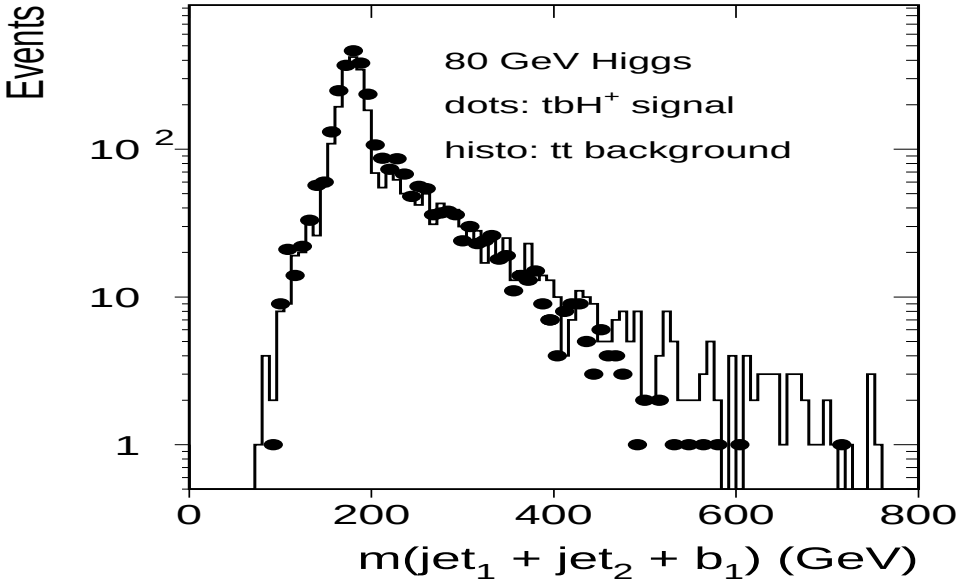
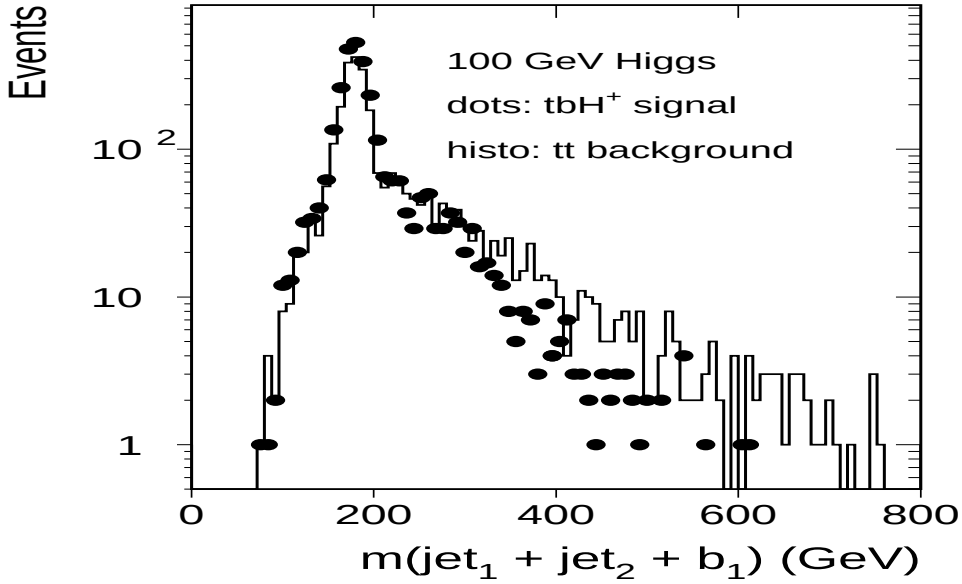
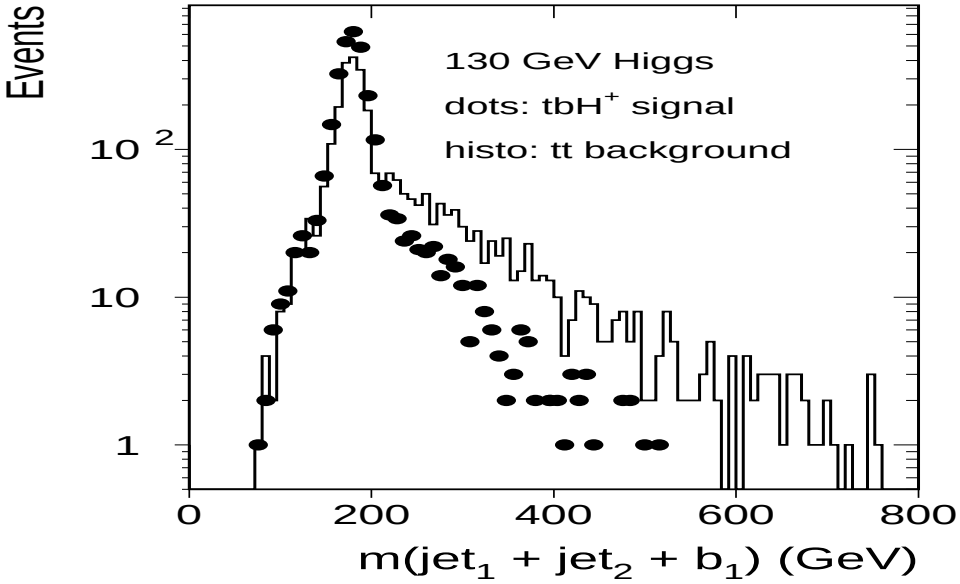
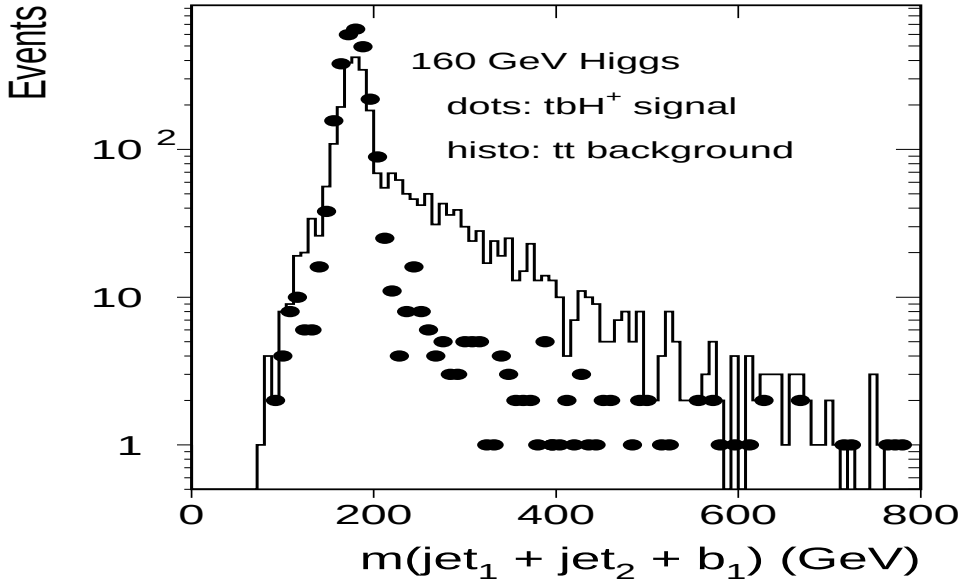
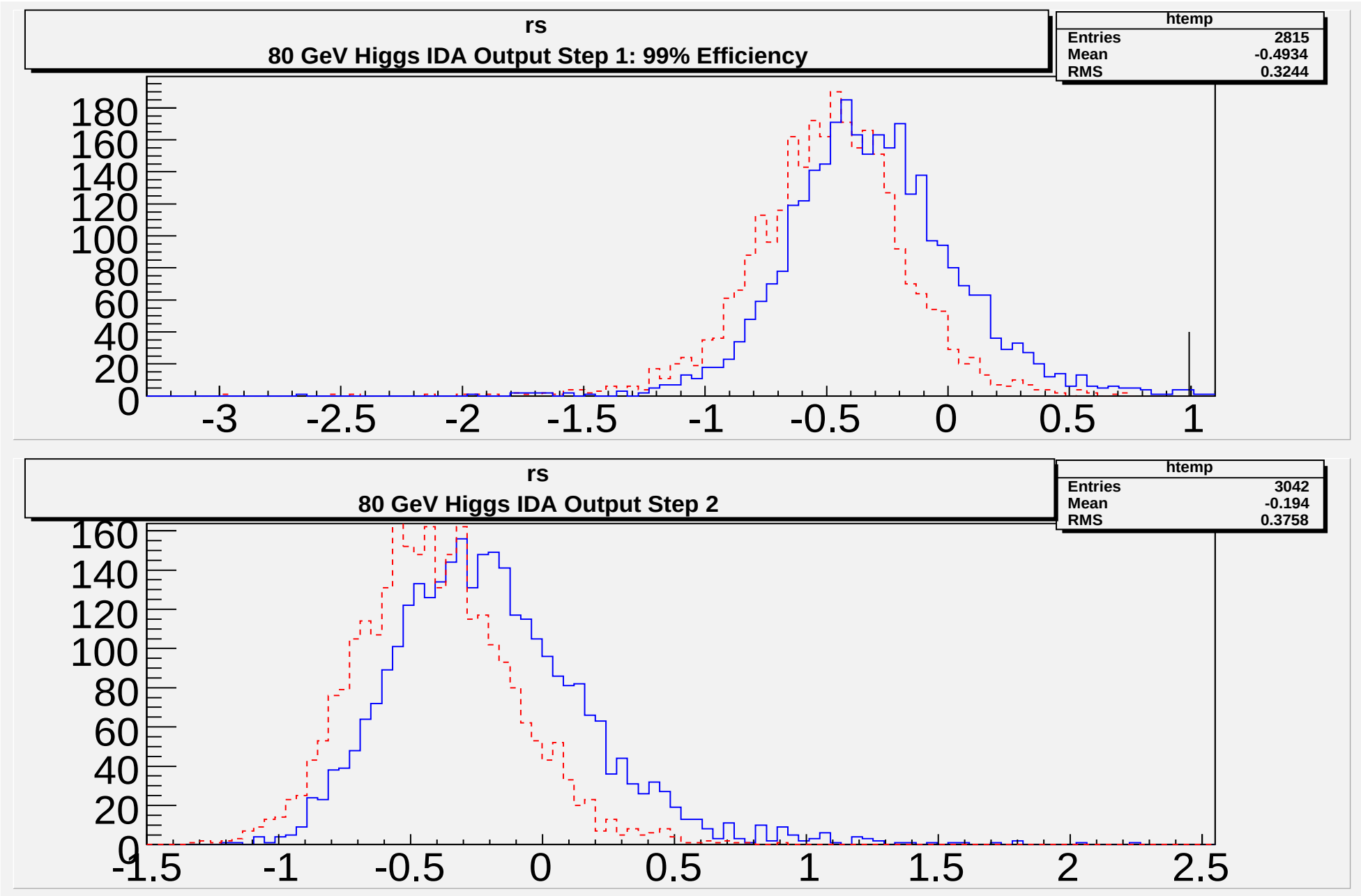




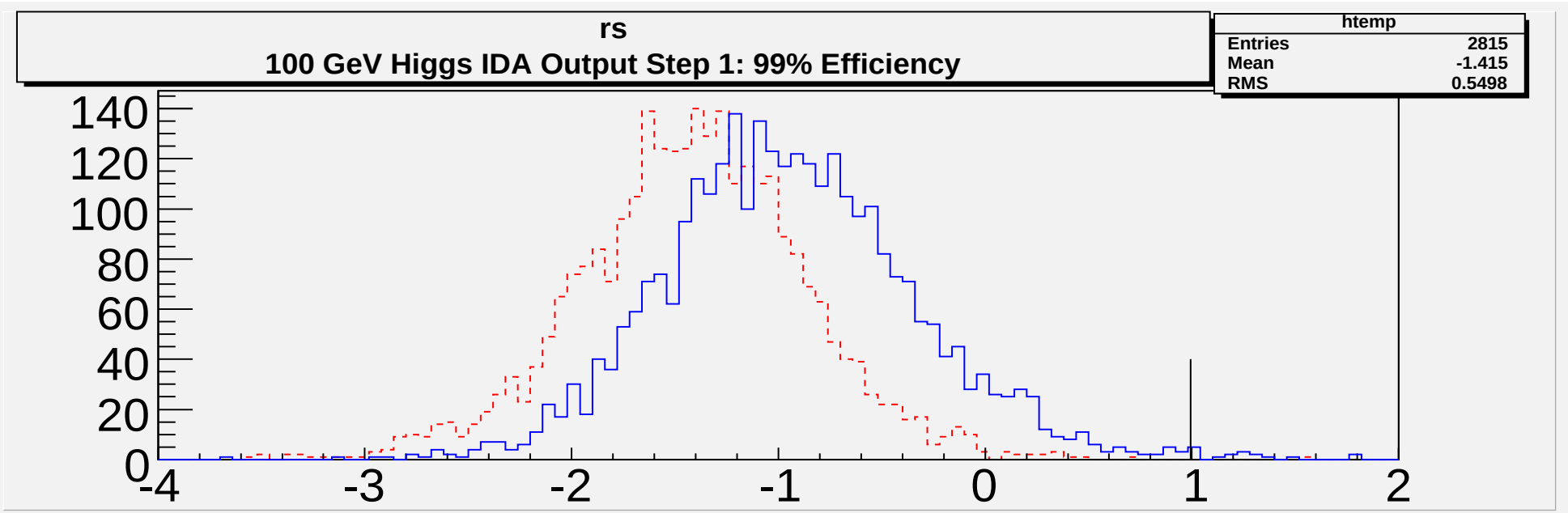


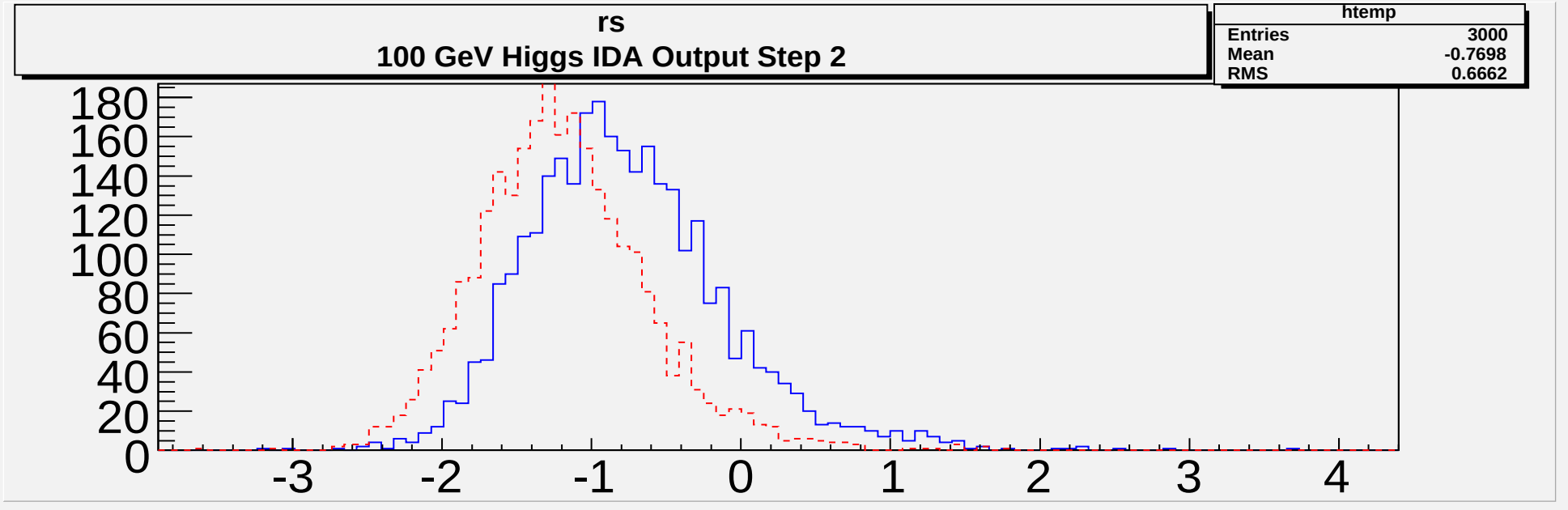


80 GeV IDA Output

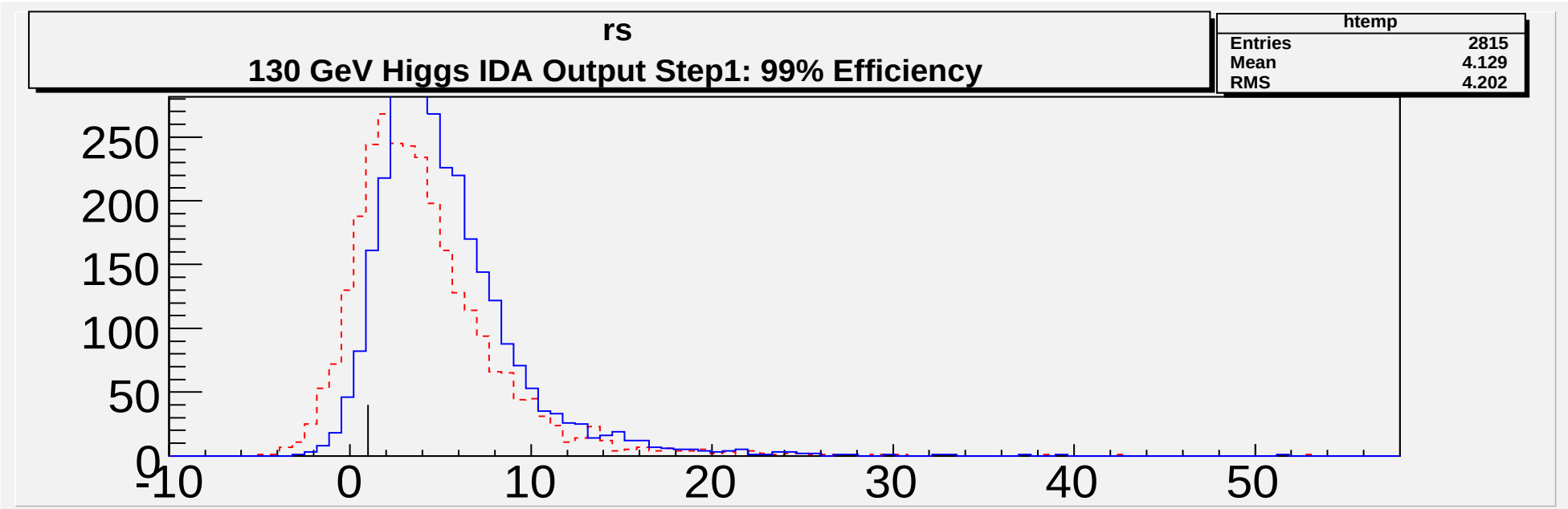


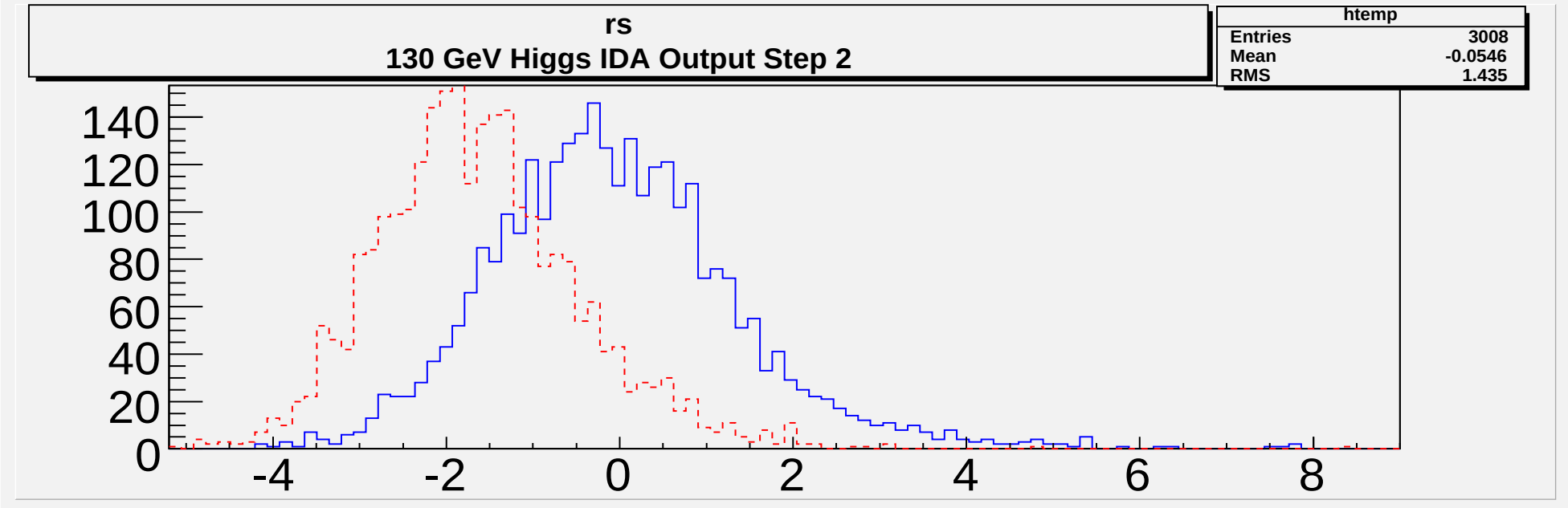
100 GeV IDA Output



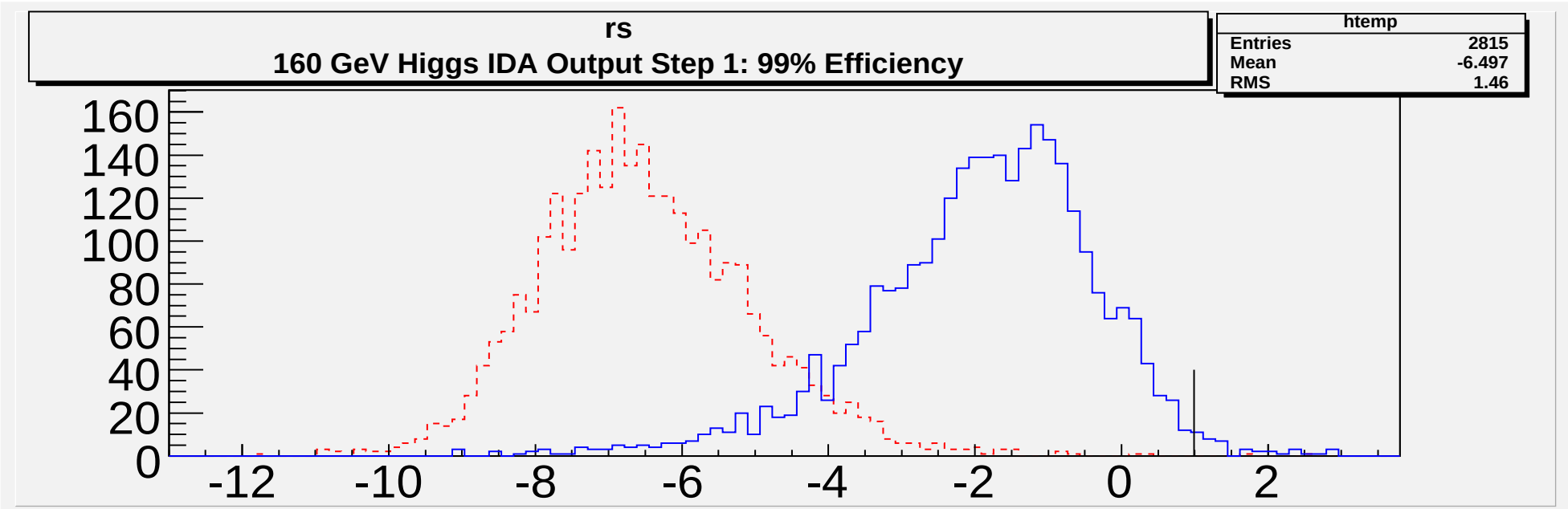


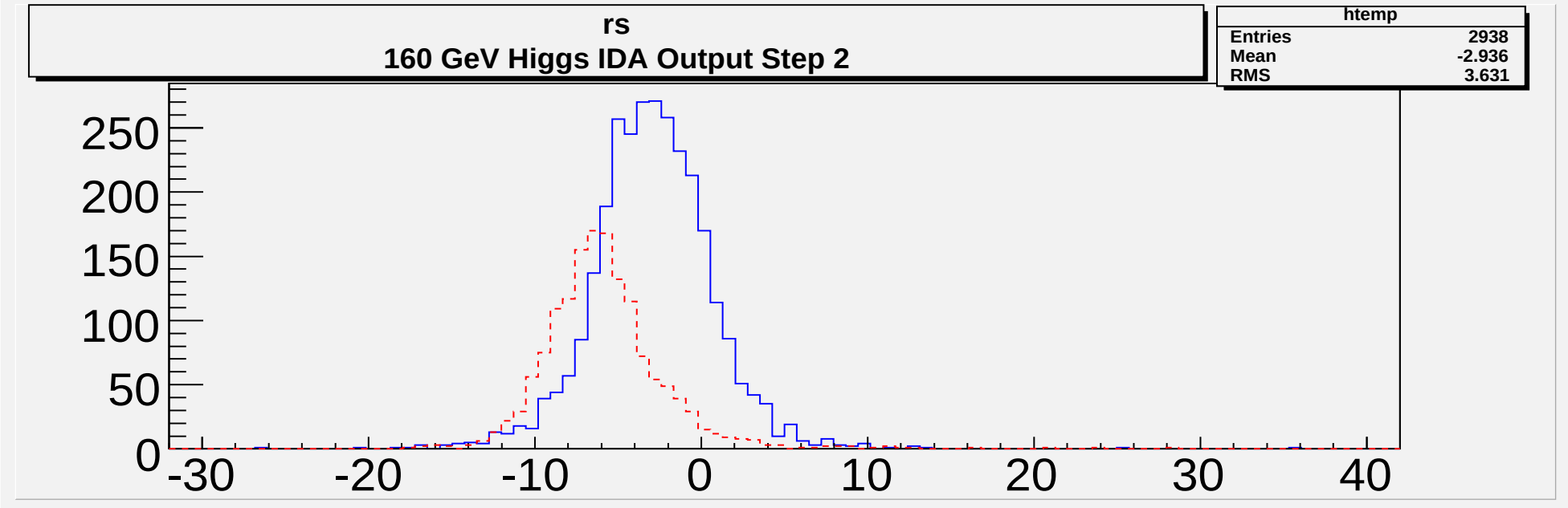
130 GeV IDA Output



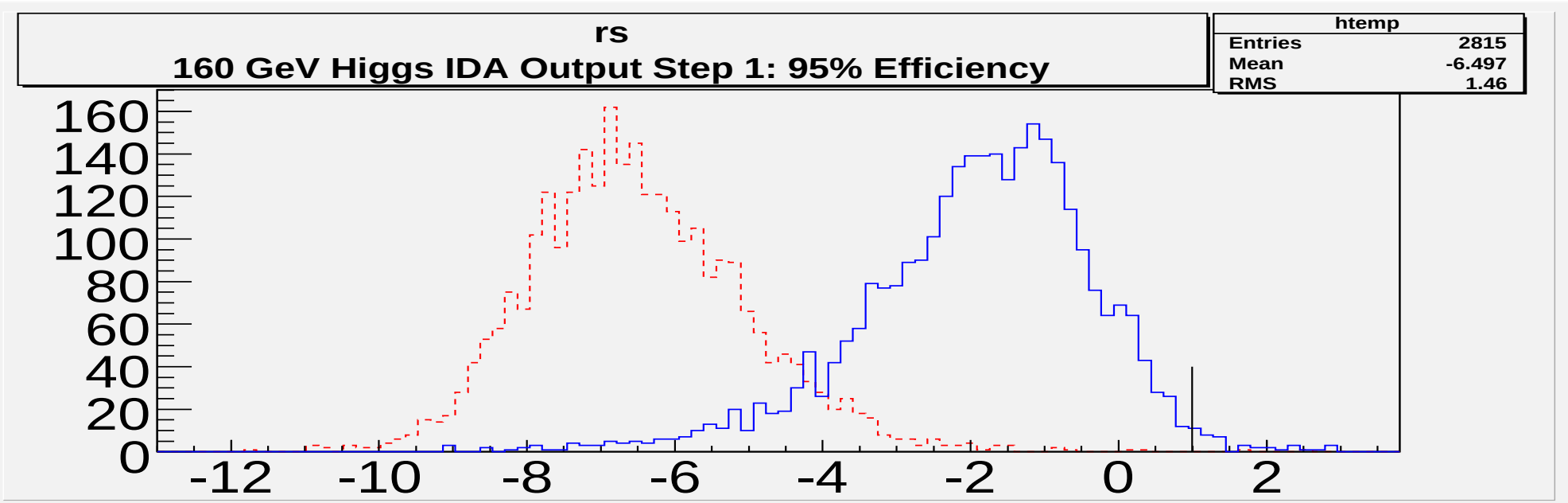


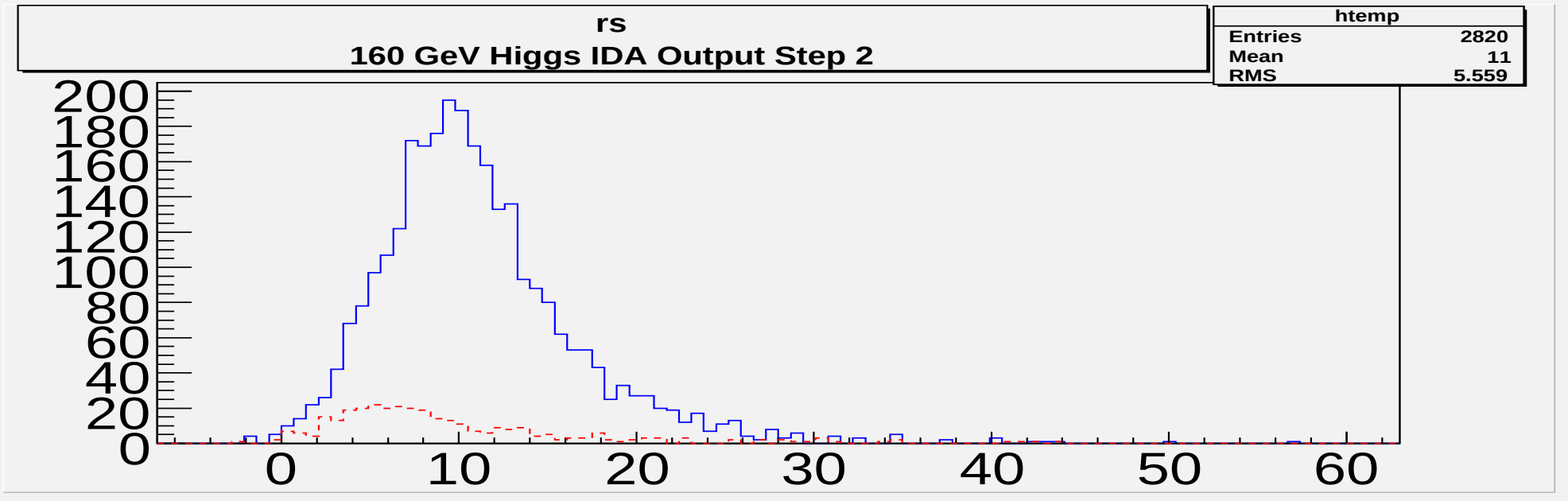
160 GeV IDA Output



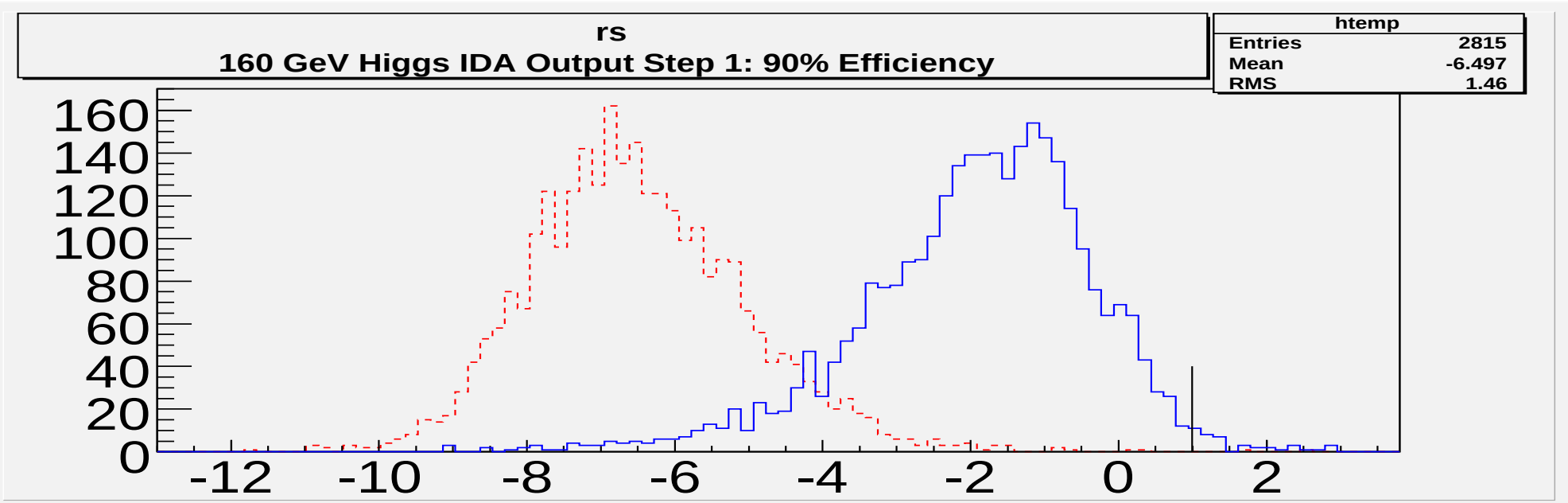


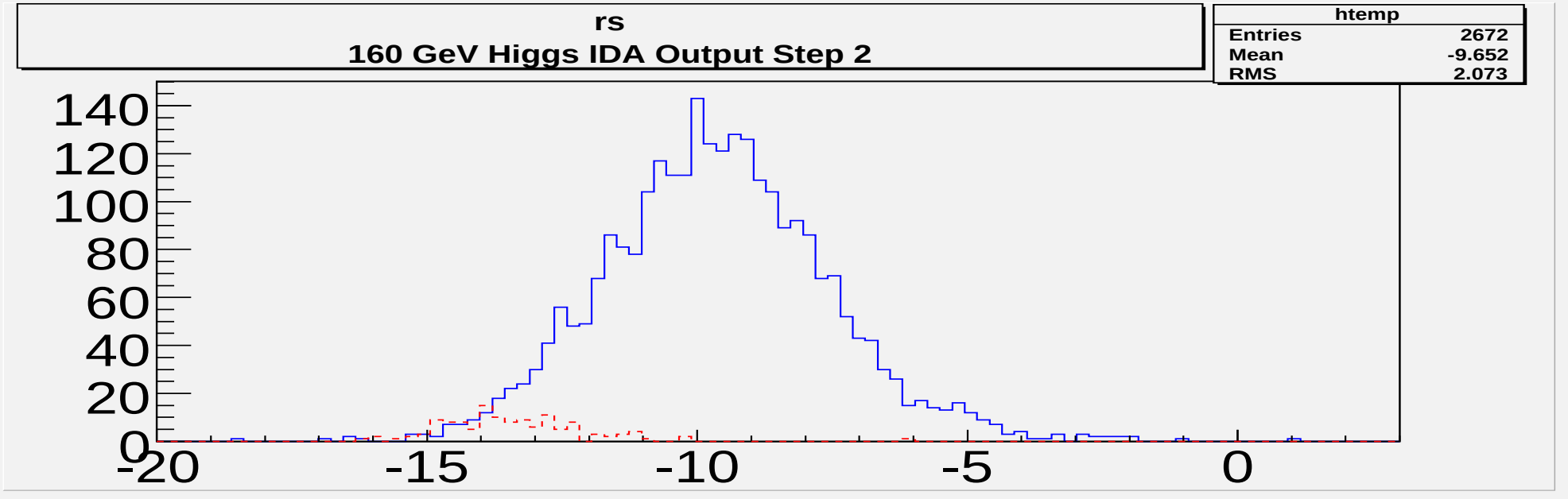
160 GeV IDA Output





160 GeV IDA Output





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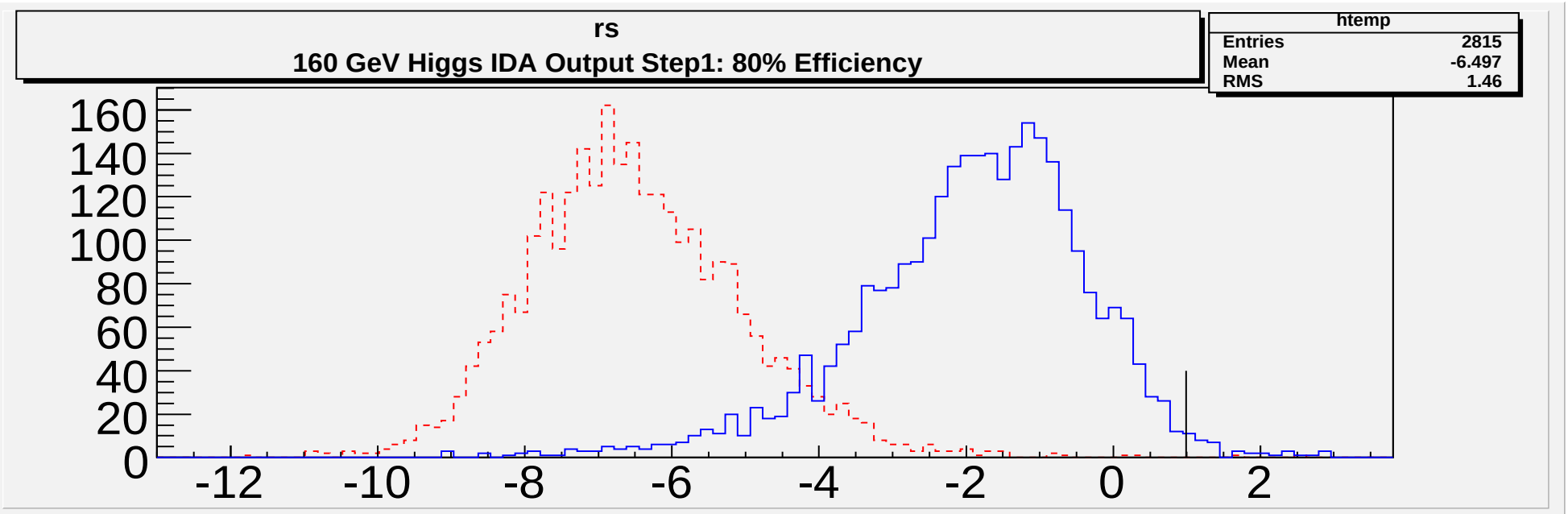
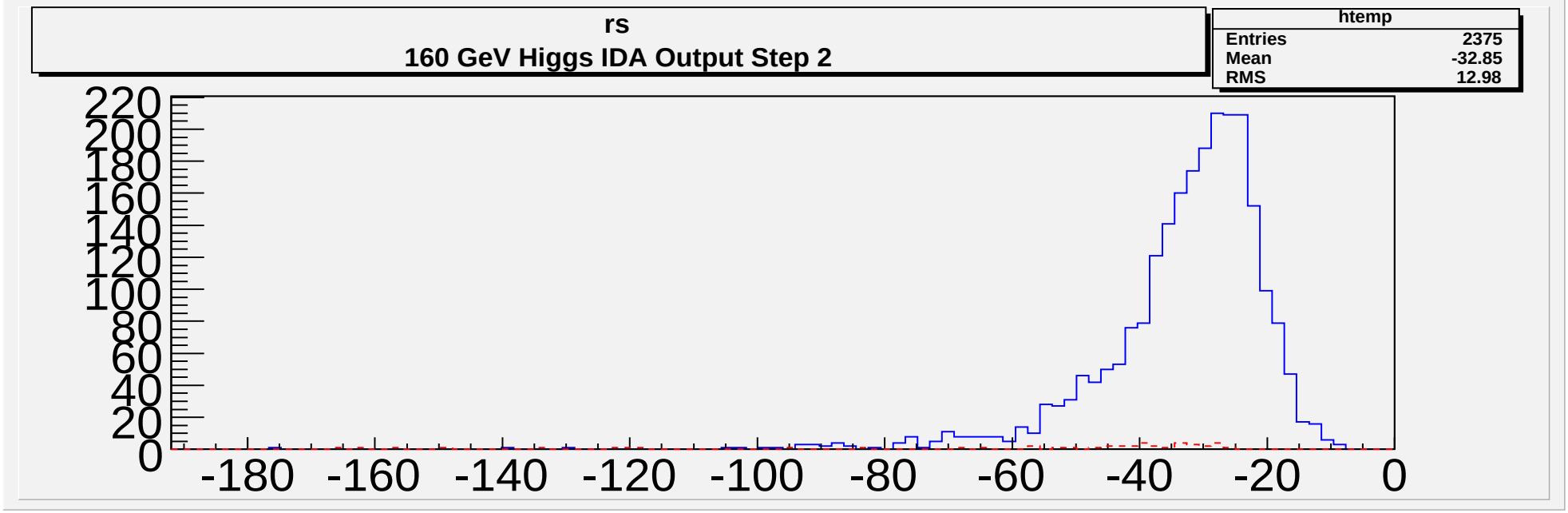
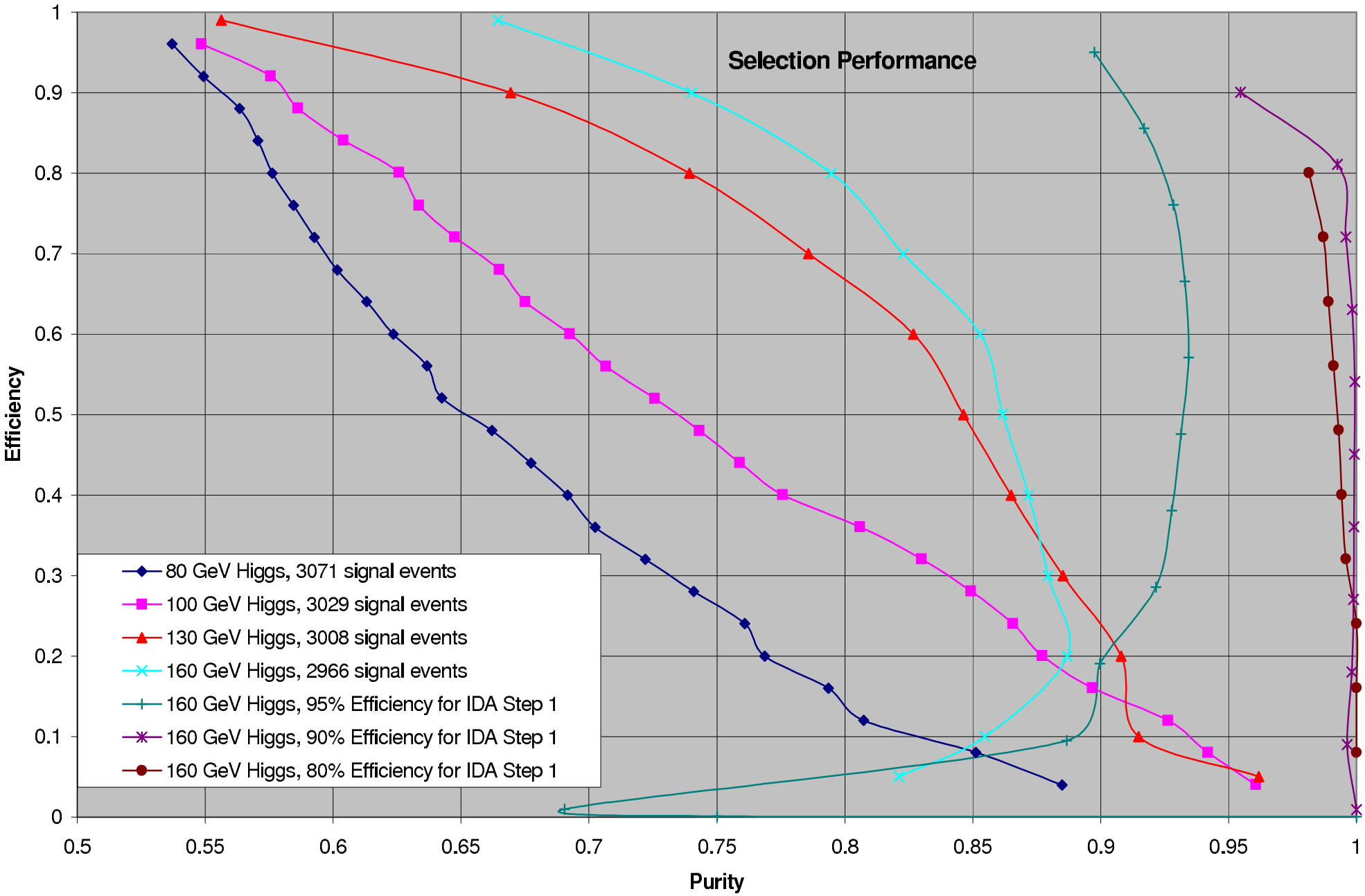




IDA Summary


Selection Performance
Efficiency
Purity
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
80 GeV Higgs, 3071 signal events
100 GeV Higgs, 3029 signal events
130 GeV Higgs, 3008 signal events
160 GeV Higgs, 2966 signal events
160 GeV Higgs, 95% Efficiency for IDA Step 1
160 GeV Higgs, 90% Efficiency for IDA Step 1
160 GeV Higgs, 80% Efficiency for IDA Step 1

Conclusions

- $p\bar{p} \rightarrow tbH^{\pm}$ fast simulation with spin transfer.
- IDA method can give sensitivity even for 80 GeV charged Higgs boson mass.
- Very good background reduction for heavier charged Higgs bosons.
- IDA with one or two steps for optimal separation.
- Under way: comparison of performence and convergence with other NN types.