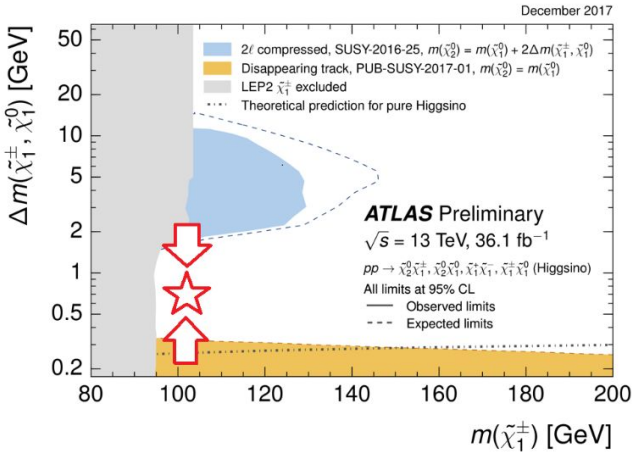
Soft Lepton Pairs in Compresed Higgsino Searches

UHH CMS SUSY meeting 15.7.2019 - Moritz

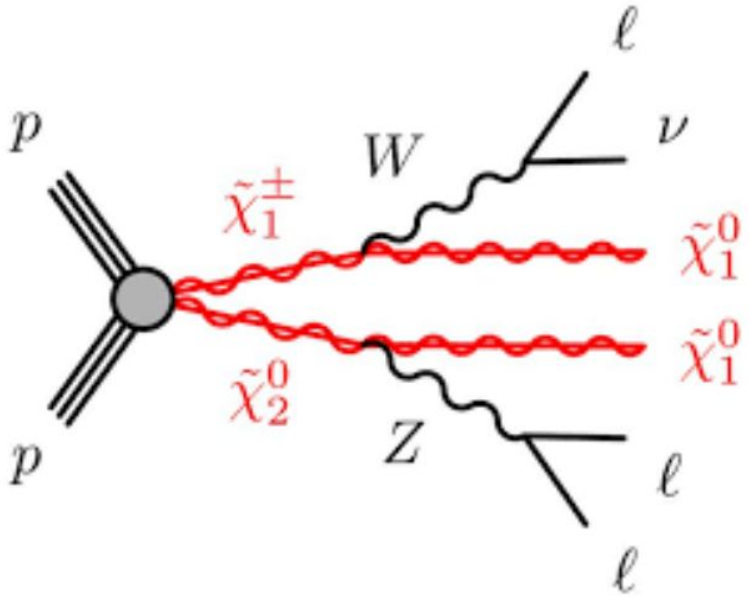
Introduction

for **Δm**(2nd neutralino, LSP) ≈ 0.5 - 1 GeV:

- **ctau**(2nd neutralino) ≈ 0.1 - 1 mm
- leptons very **soft** (pT < 2 GeV)



arXiv:1712.08119



arXiv:1712.08119 [hep-ex]

Reconstruction efficiencies

Matching of gen. leptons to PF-candidates and tracks:

- 2 PF-cand. matches → ≈ **20%**
- 1 Pf-cand. match, other track-matched → ≈ **10%**
- 2 track matches → ≈ **2%**

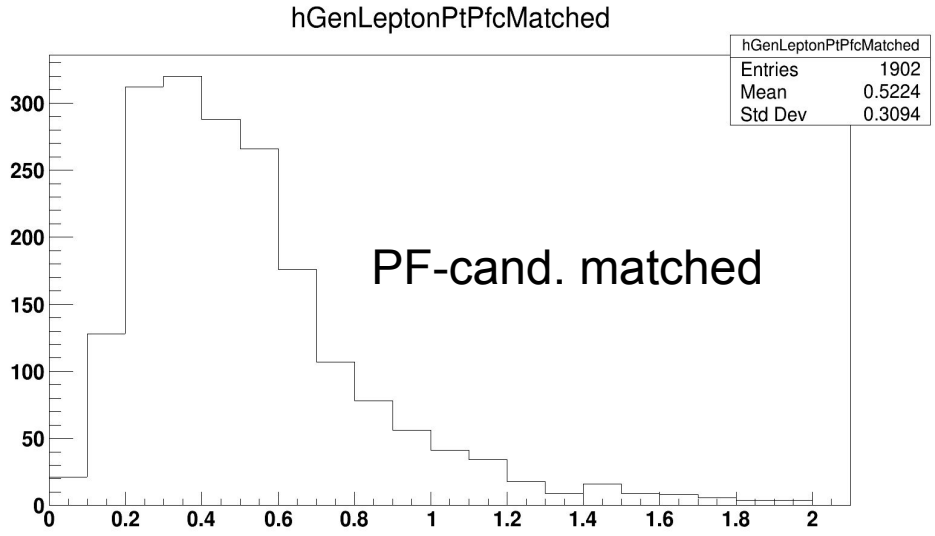
Overall **reconstruction efficiency**: ≈ **30%**

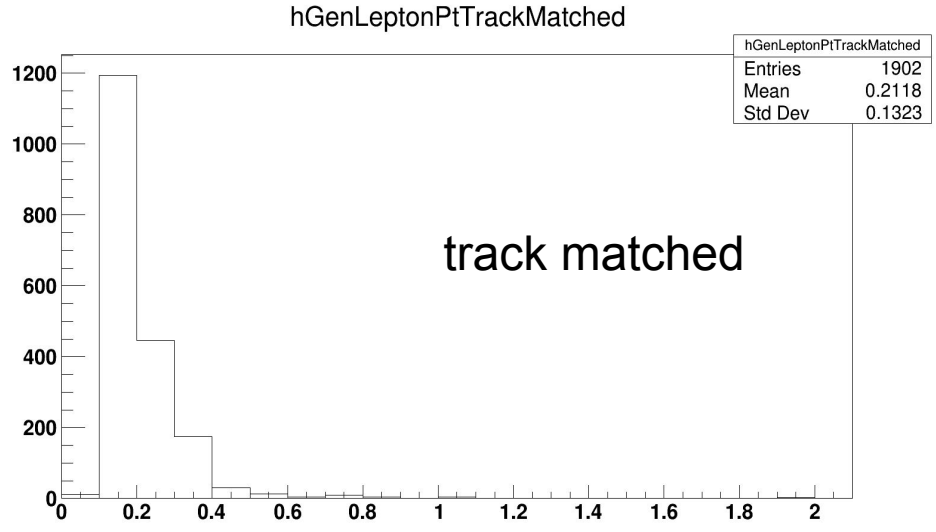
→ Improvement by using **tracks** and not only PF-candidates

1 PF-cand. & 1 track category

90%: PF-cand. matched to **higher pT** lepton

pT of gen. lepton:





How to distinguish signal from background in event?

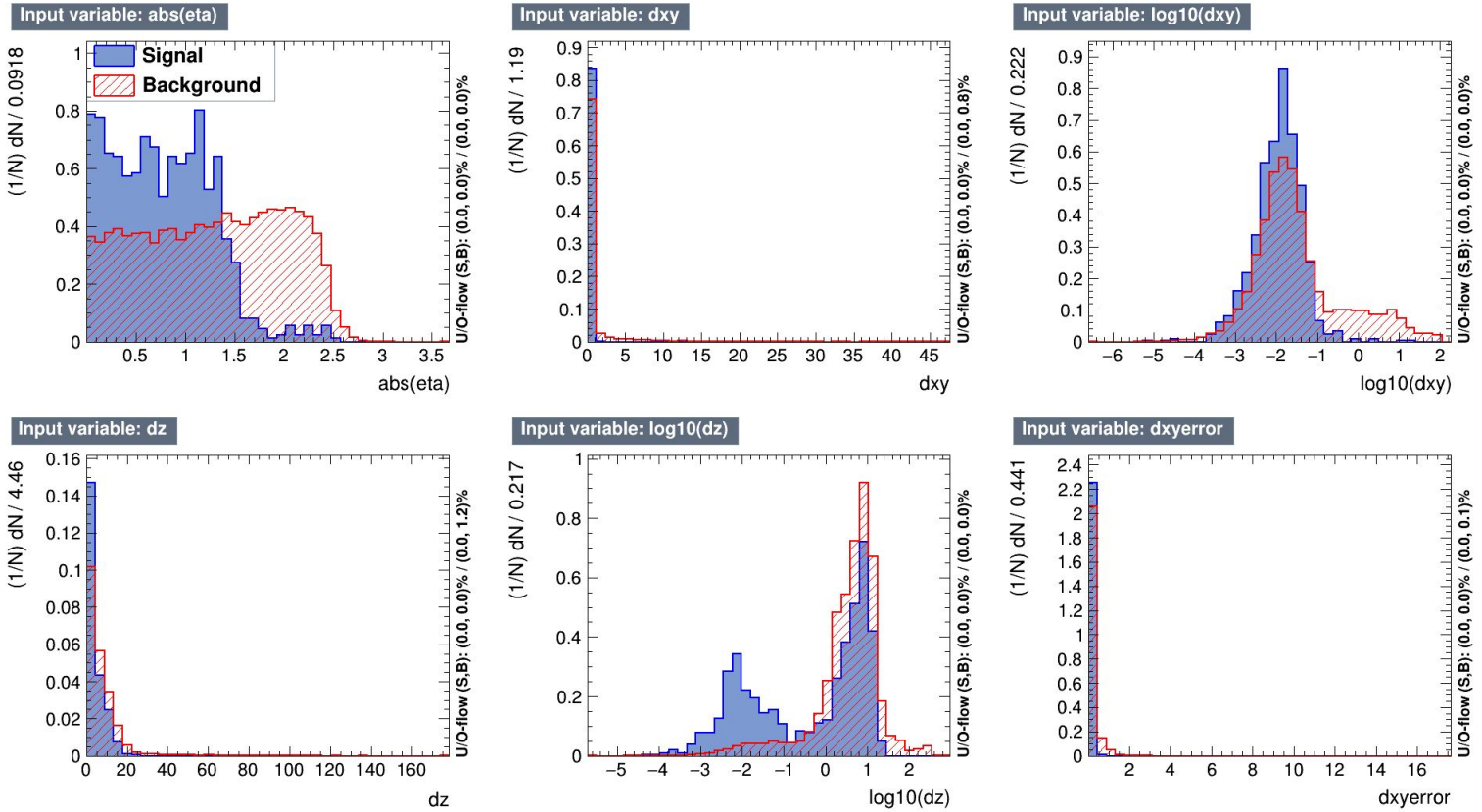
Preselection for **tracks**: pT < 2 GeV, N(valid hits) > 0, N(dof) > 0

Signal: matched track

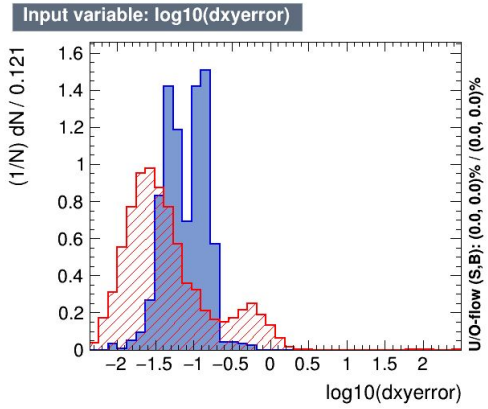
Background: all other tracks (up to 1000 per event)

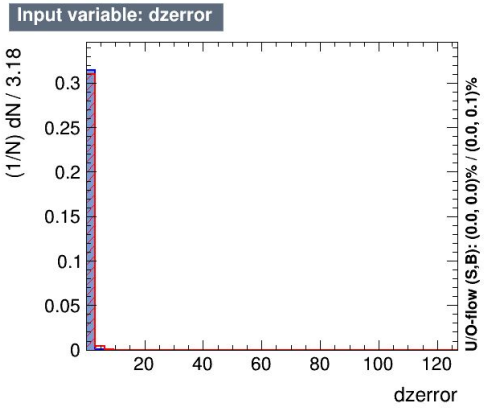
→ train BDT

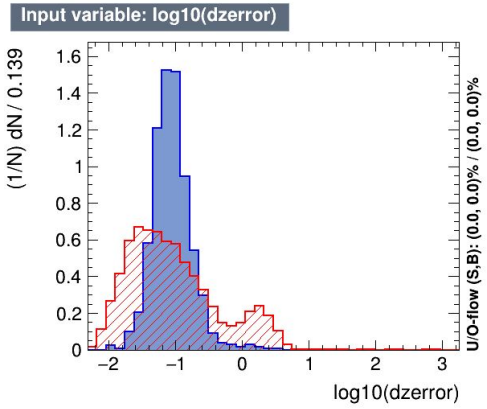
Input variables 1

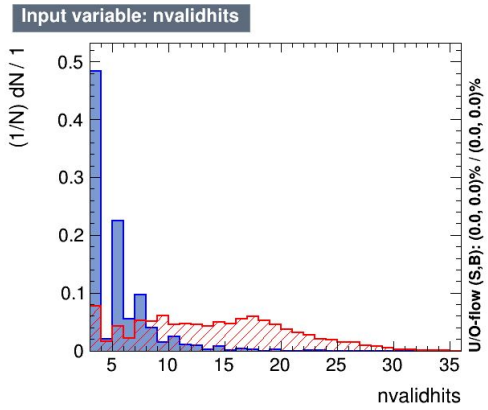


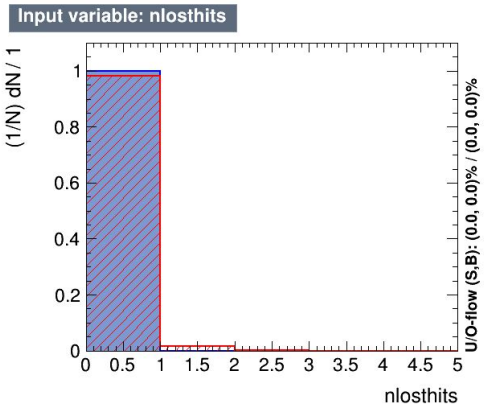
Input variables 2

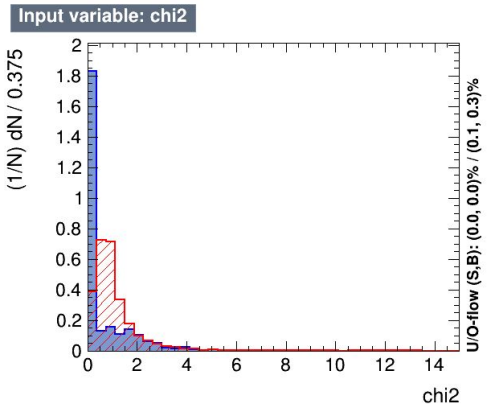




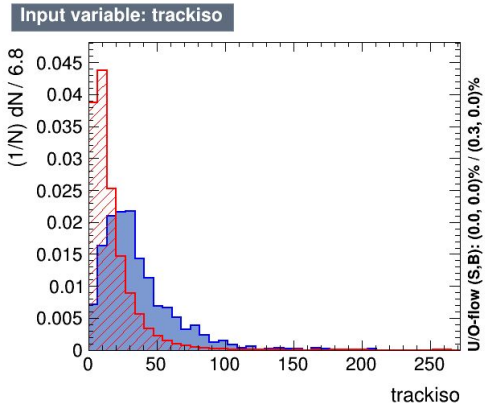


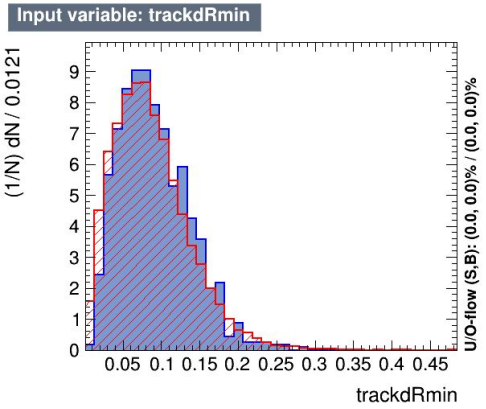


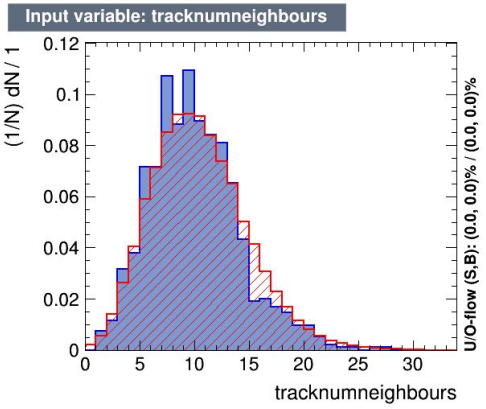


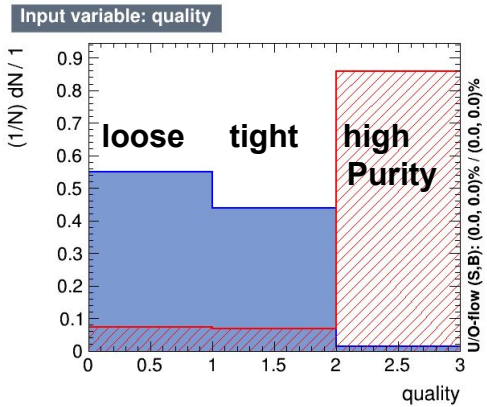


Input variables 3





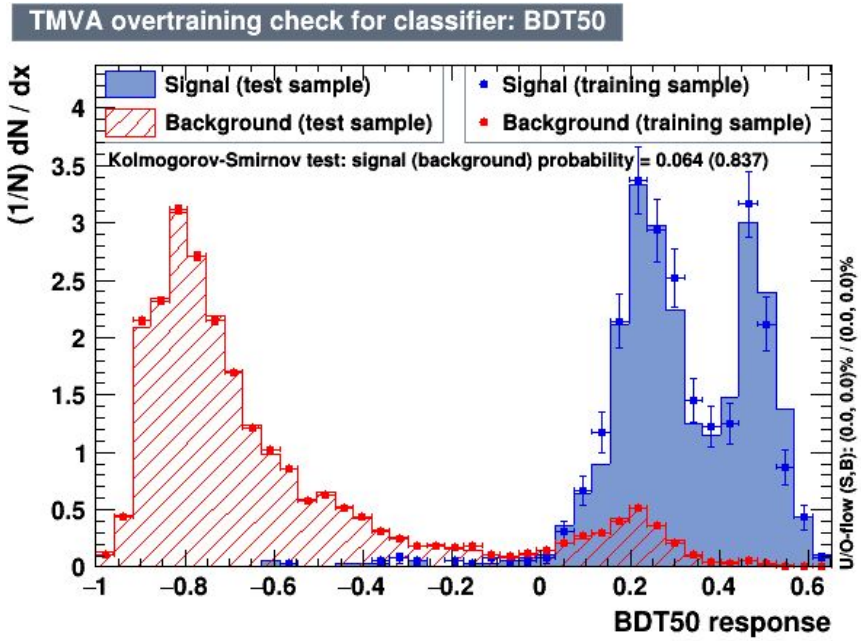


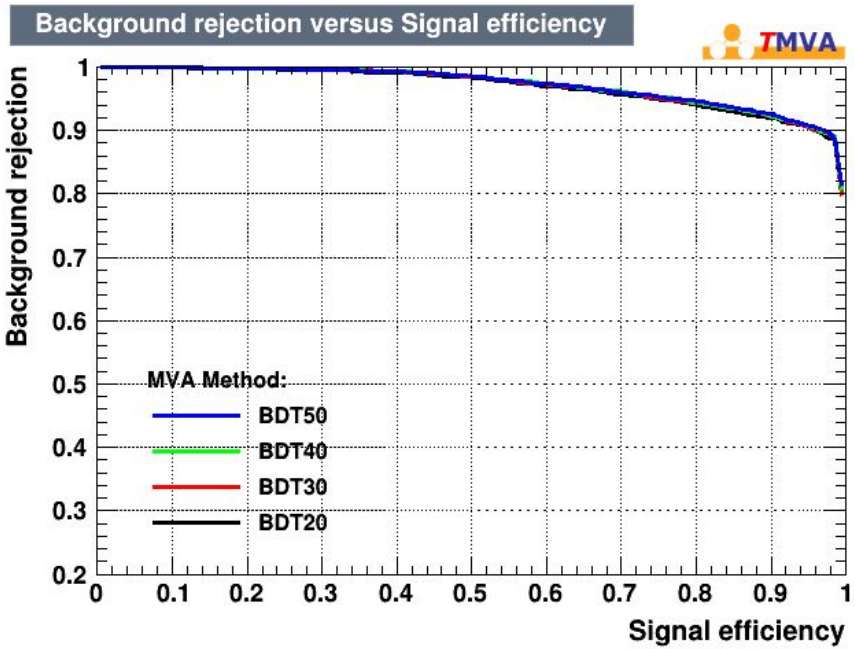


signal tracks almost never pass “highPurity” criteria

→”inverted” track quality preselection ??

BDT output


TMVA overtraining check for classifier: BDT50
Signal (test sample)
Background (test sample)
Signal (training sample)
Background (training sample)
Kolmogorov-Smirnov test: signal (background) probability = 0.064 (0.837)
(1/N) dN / dx
BDT50 response
U/O-flow (S,B): (0.0, 0.0)% / (0.0, 0.0)%

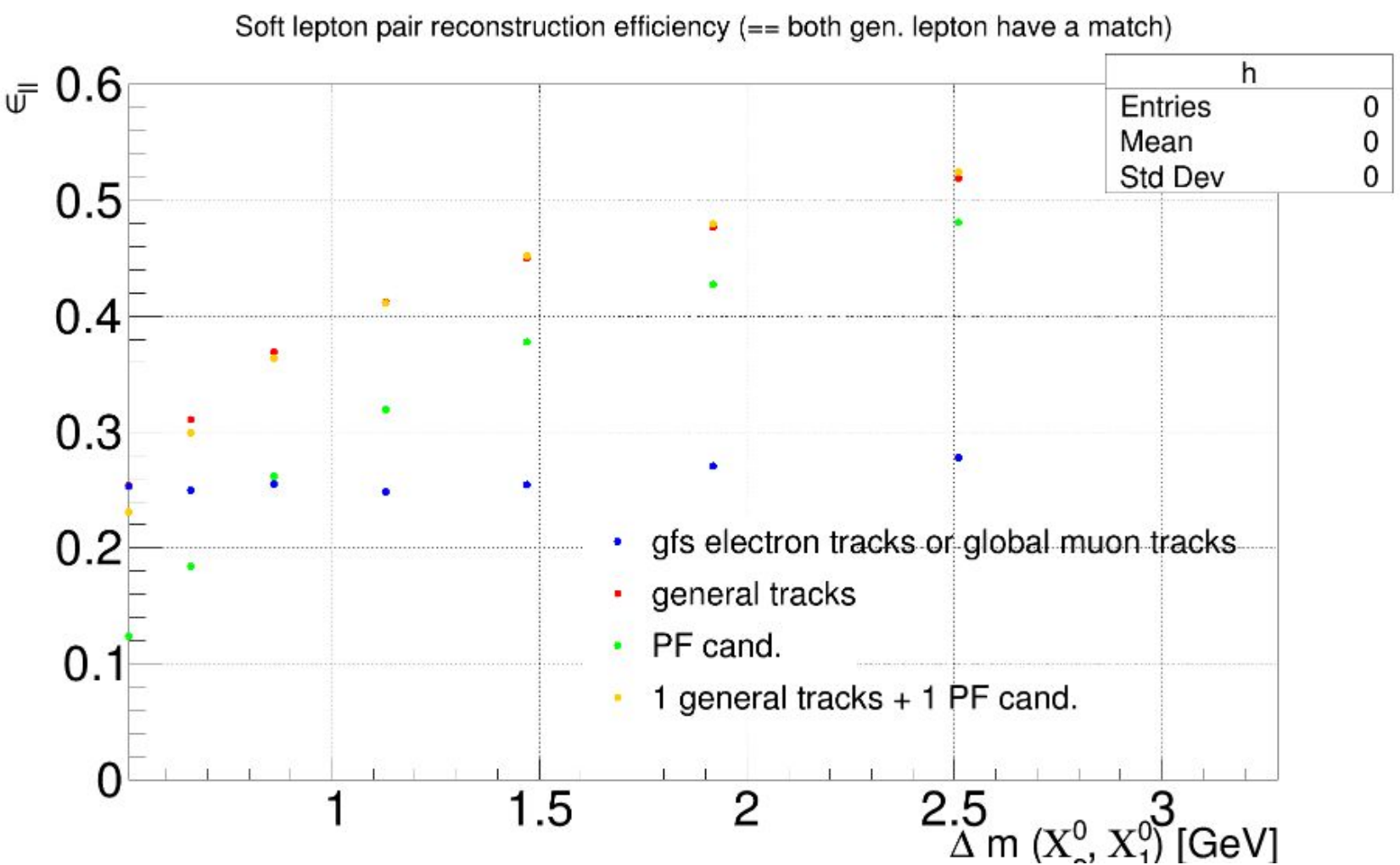

Background rejection versus Signal efficiency
TMVA
Background rejection
Signal efficiency
MVA Method:
BDT50
BDT40
BDT30
BDT20

Outlook

- look at matched PF-cands. vs background
- look at 2 PF-cand and 2 track category

- Alex: find common **vertex** for track/PF-cand.

Backup


Soft lepton pair reconstruction efficiency (== both gen. lepton have a match)
h
Entries 0
Mean 0
Std Dev 0
ϵ_{ll}
0.6
0.5
0.4
0.3
0.2
0.1
0
1
1.5
2
2.5
3
Δ m (X^0_2, X^0_1) [GeV]
gfs electron tracks or global muon tracks
general tracks
PF cand.
1 general tracks + 1 PF cand.

BDT options, 1900 signal, 100000 background

"NTrees=" + ntrees,

"MaxDepth=3",

"BoostType=AdaBoost",

"AdaBoostBeta=0.5",

"SeparationType=GiniIndex",

"nCuts=20",

"PruneMethod=NoPruning"