isolated lepton finder

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idea to select a isolated lepton (e/μ)

i) lepton ID: electron or muon

- energy ratio deposited in ECal, HCal, Yoke
- general PID: dE/dx + shower profile

ii) vertex: prompt or secondary

- d0, z0 significance: d0/δd0, z0/δz0

iii) isolation: not from jets

- relatively high P
- almost empty around

status of available tools

i) lepton ID: electron or muon

- energy ratio deposited in ECal, HCal, Yoke ✔
- general PID: dE/dx + shower profile to be added

ii) vertex: prompt or secondary

- d0, z0 significance: d0/δd0, z0/δz0 ✔

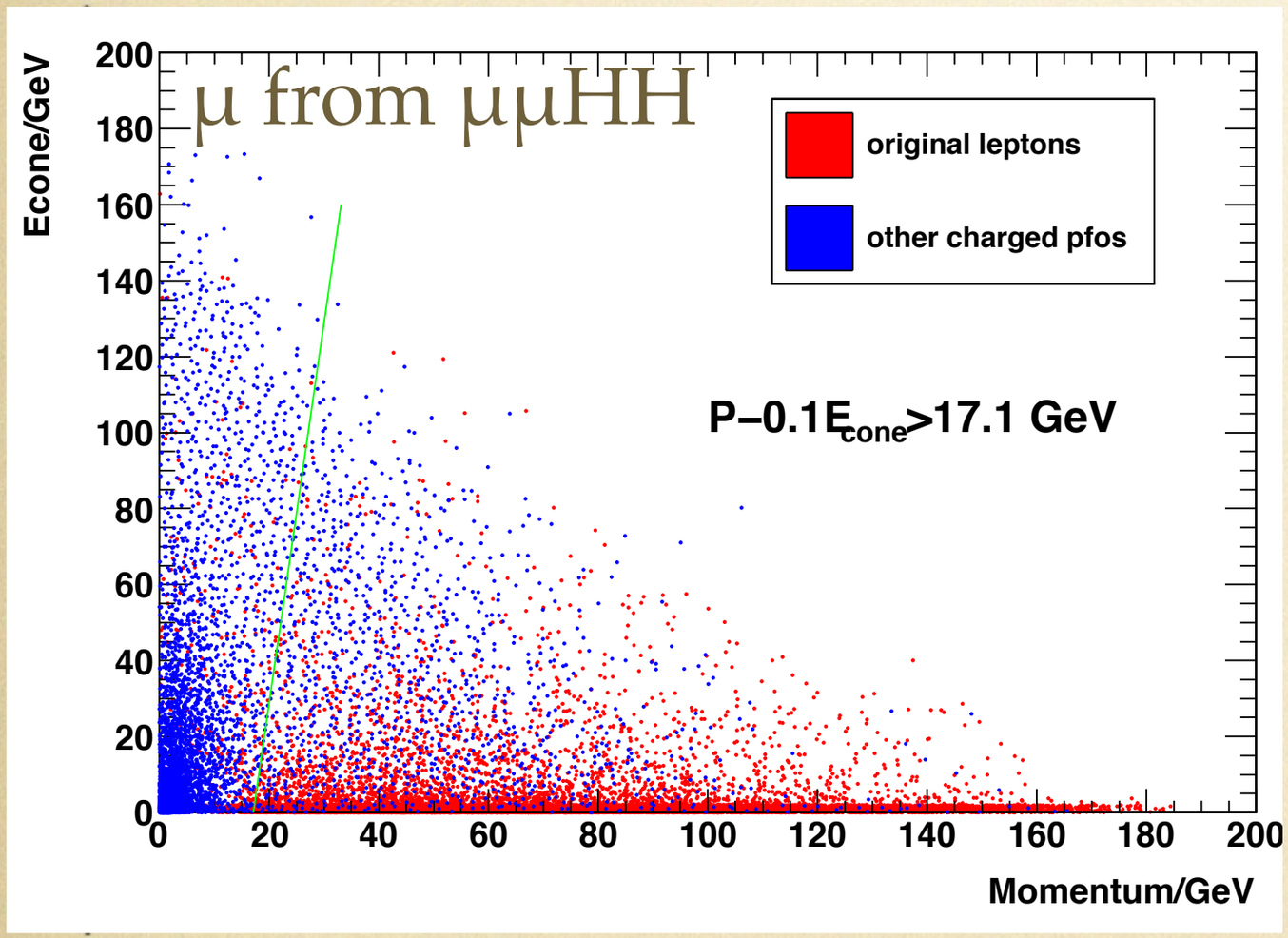
iii) isolation: not from jets ✔

- relatively high P
- almost empty around

several algorithms exist

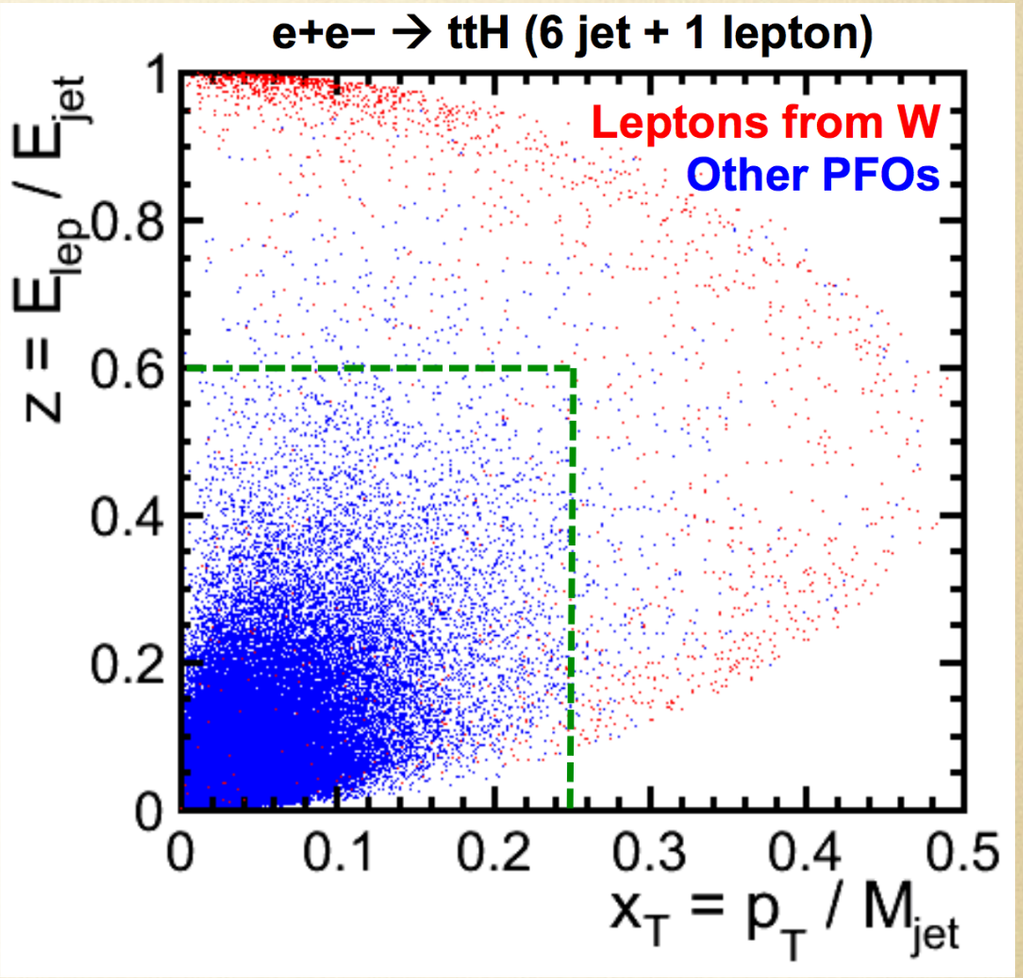
two isolation algorithms in DBD

cone based



(Ryo/Junping/Tomohiko)

jet based



(M.Amjad/LAL group)

both available during DBD, in MarlinReco/Analysis/IsolatedLeptonFinder

performance of isolated lepton finder (llHH)

electron ID	muon ID
Eecal/Etot > 0.9	Eyoke > 1.2
0.5 < Etot/P < 1.3	Etot/P < 0.3
from primary vertex	from primary vertex
P > 12.2 + 0.87Econe	P > 12.6 + 4.62Econe

(Etot = Eecal + Ehcal)

isolation

efficiency of two isolated lepton selection
(DBD ZHH analysis)

Eff (%)	eeHH	μμHH	bbbb	eνbbqq	μνbbqq
DBD	85.7	88.4	0.028	1.44	0.1
LoI	81.9	85.4	0.43	2.71	1.94

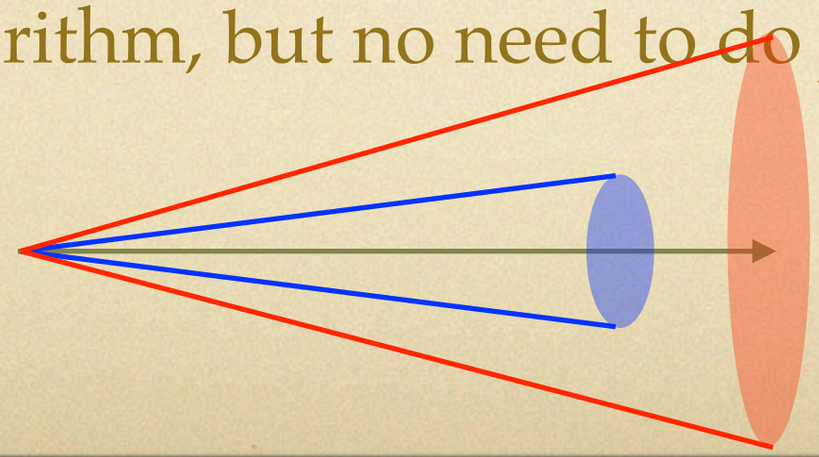
both cone based, Eyoke and impact parameters were not used in LoI

main contamination:

- For electron: charged pion (in exchange with nuclei in ECAL —> neutral pion —> two photons —> very like electron); electron from b-jets (larger IP).
- For muon: high momentum charged pion (escape from HCAL and reach the Yoke); muon from b-jets (larger IP).

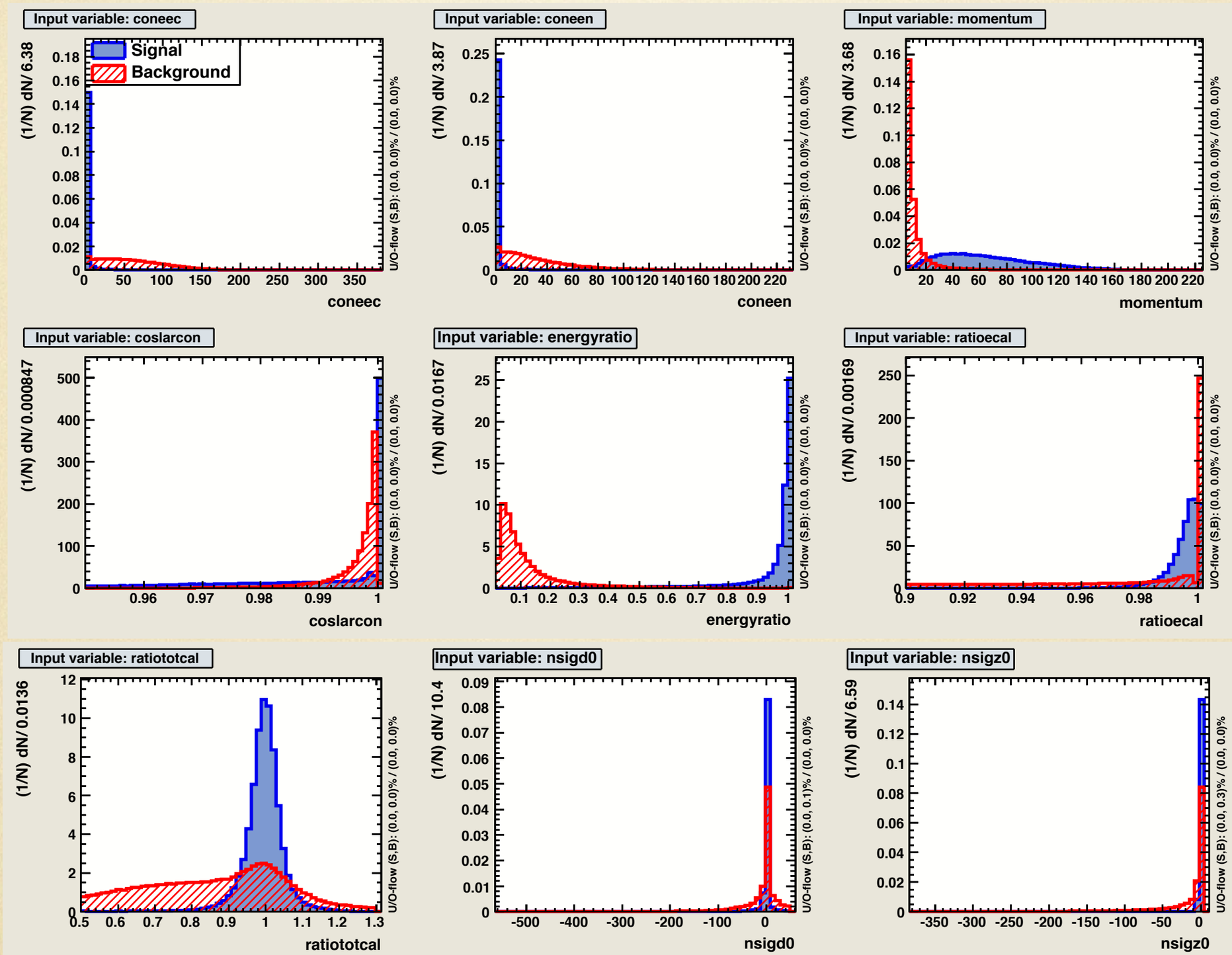
idea for further suppression:

- utilize d0, z0, cone energy, momentum, Eecal/Ehcal more effectively —> MVA
- introduce a larger cone to magnify the jet influence —> E(lep)/E(jet) and angle between them (similar with in LAL algorithm, but no need to do jet clustering)

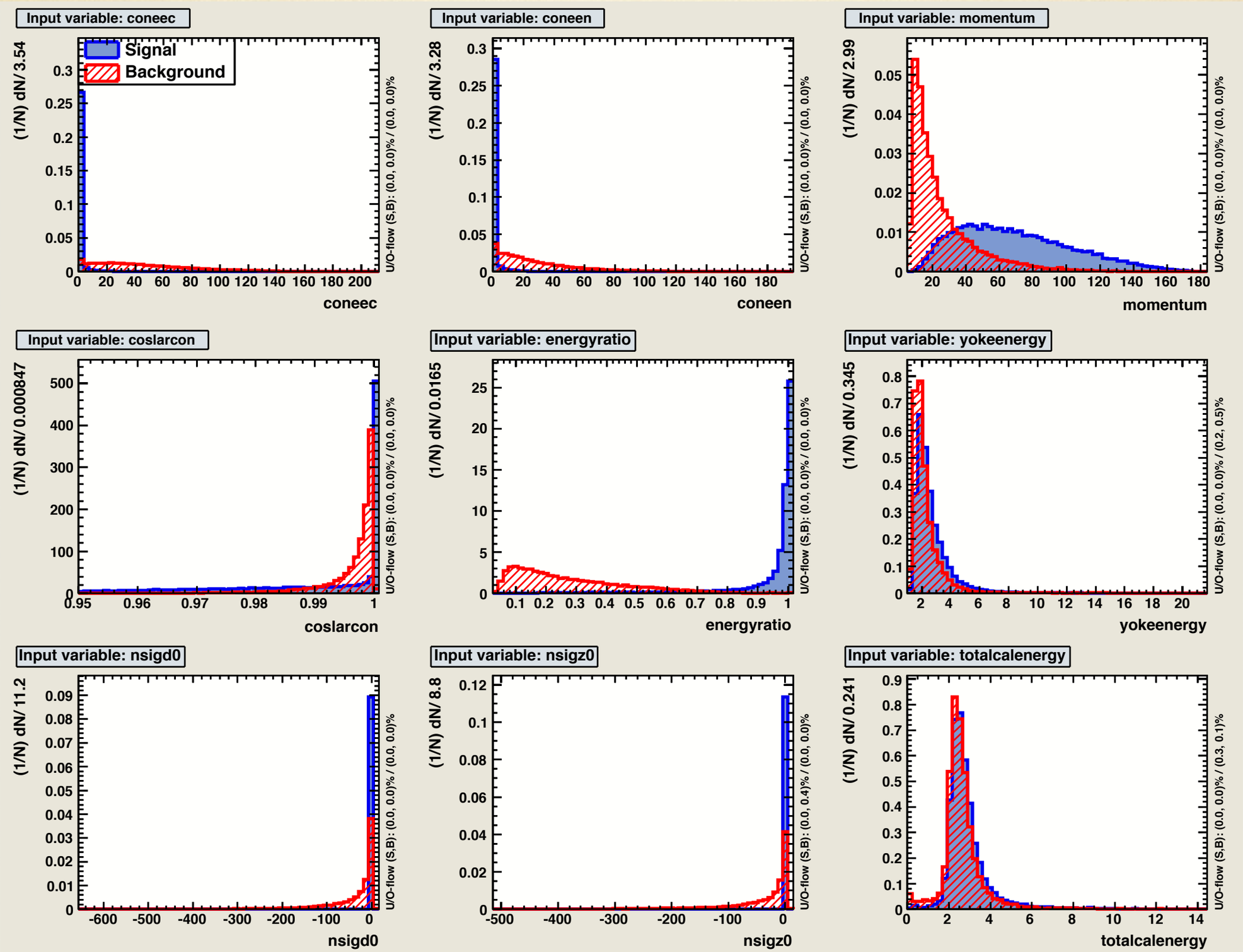


cos=0.98, 95

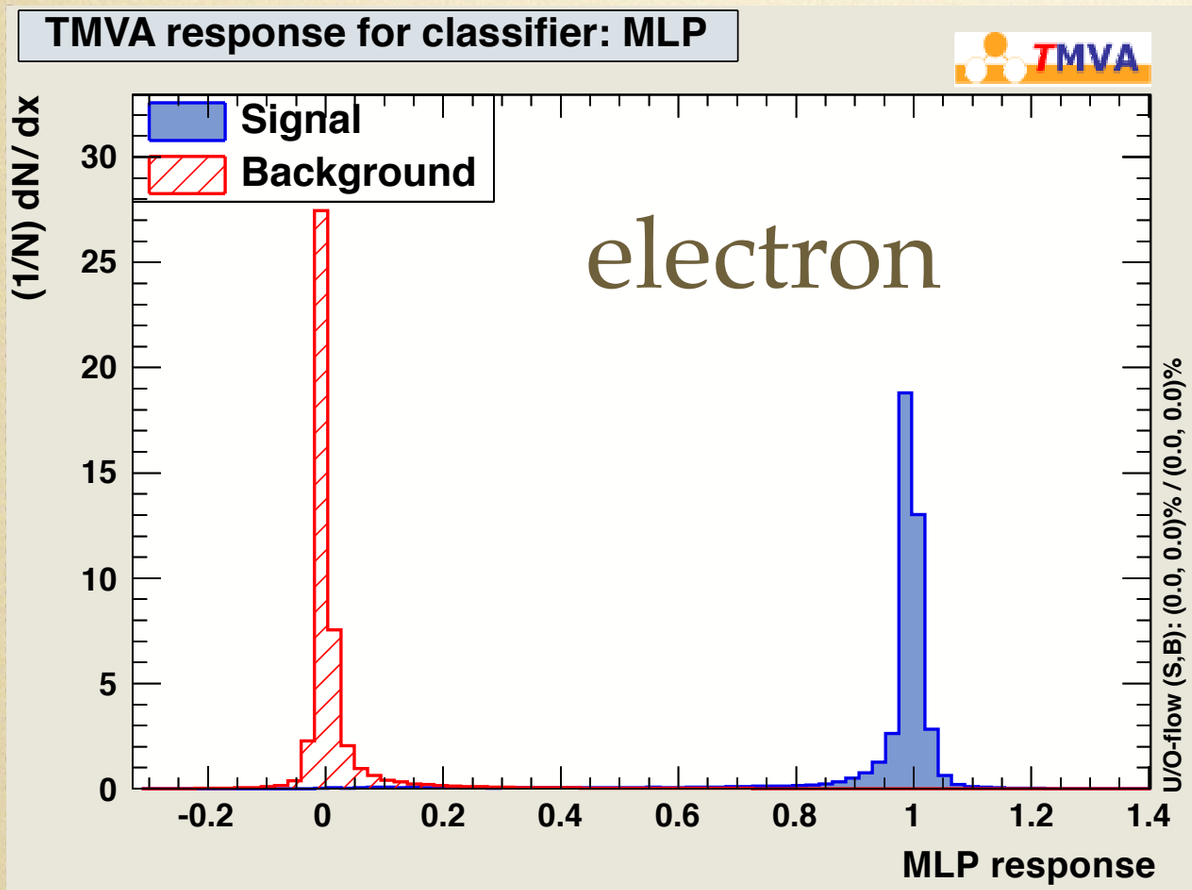
input variables: electron

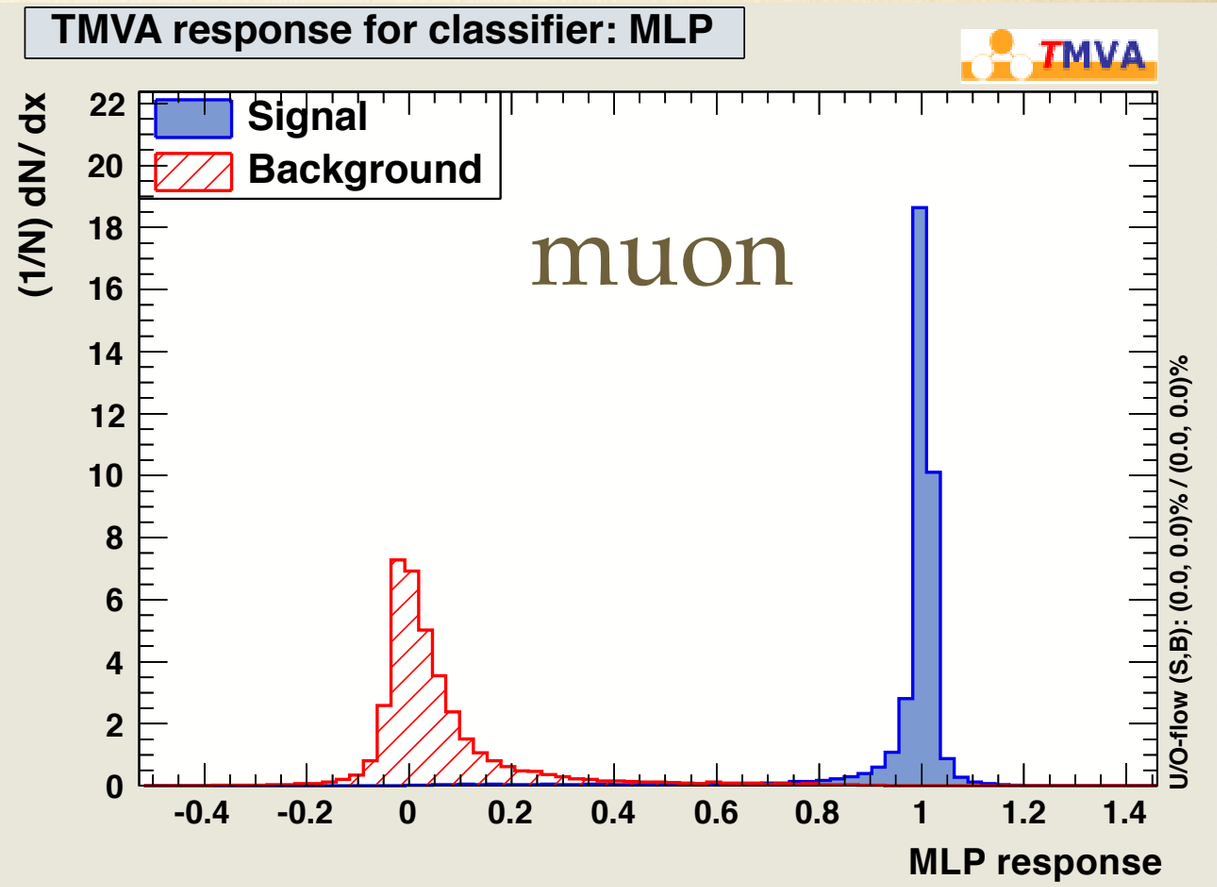


input variables: muon



neural-net output (tagging)





lepton tagging is associated to the selected lepton collection, can be optimized in final selection

performance of new isolated lepton tagging

efficiency of two isolated lepton selection

(DBD ZHH analysis)

Eff (%)	eeHH	μμHH	bbbb	eνbbqq	μνbbqq
NEW	87.0	89.1	0.0017	0.32	0.020
DBD	85.7	88.4	0.028	1.44	0.10
LoI	81.9	85.4	0.43	2.71	1.94

performance is a factor 3~4 better for one lepton selection, ~one order better for lepton pair. see detail in Claude's ZHH analysis

Available Processors

to appear in MarlinReco/Analysis/IsolatedLeptonTagging

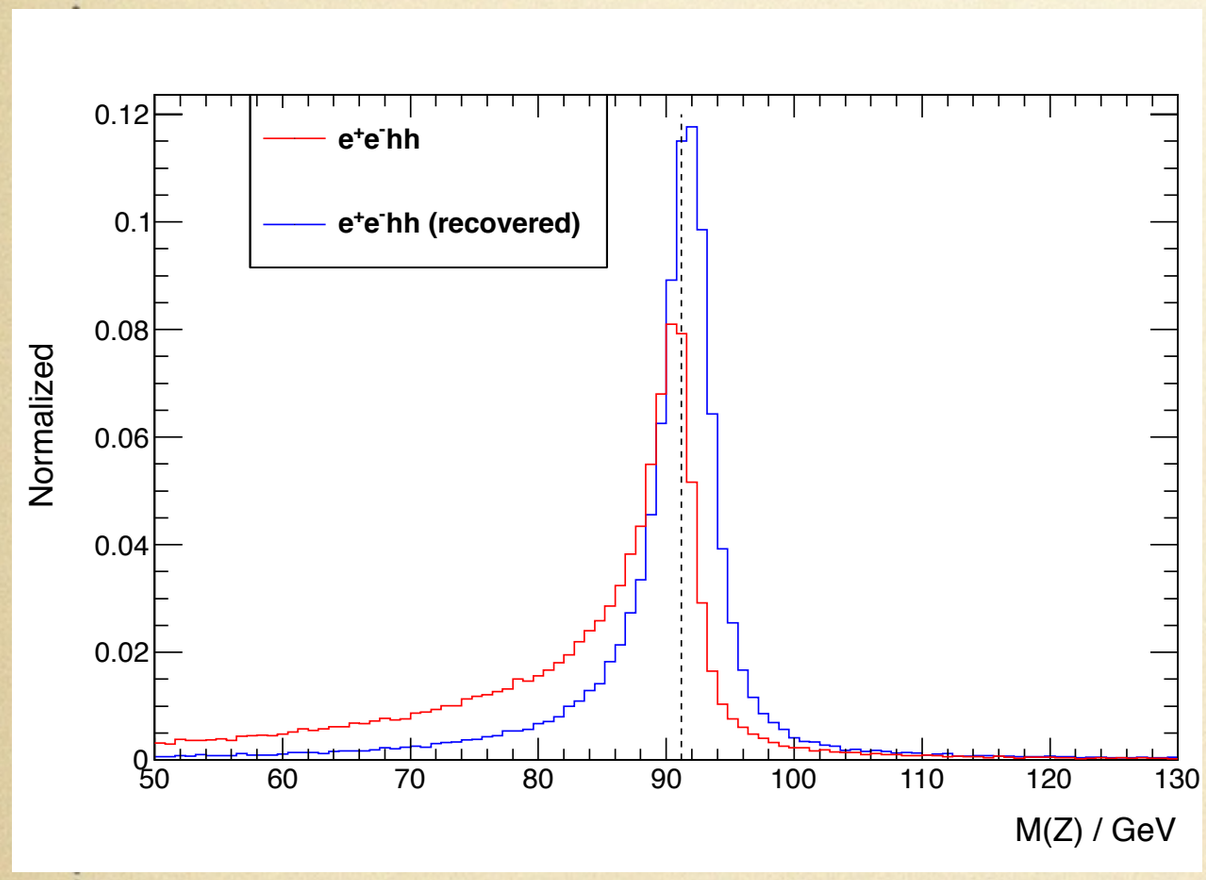
(Claude/Junping)

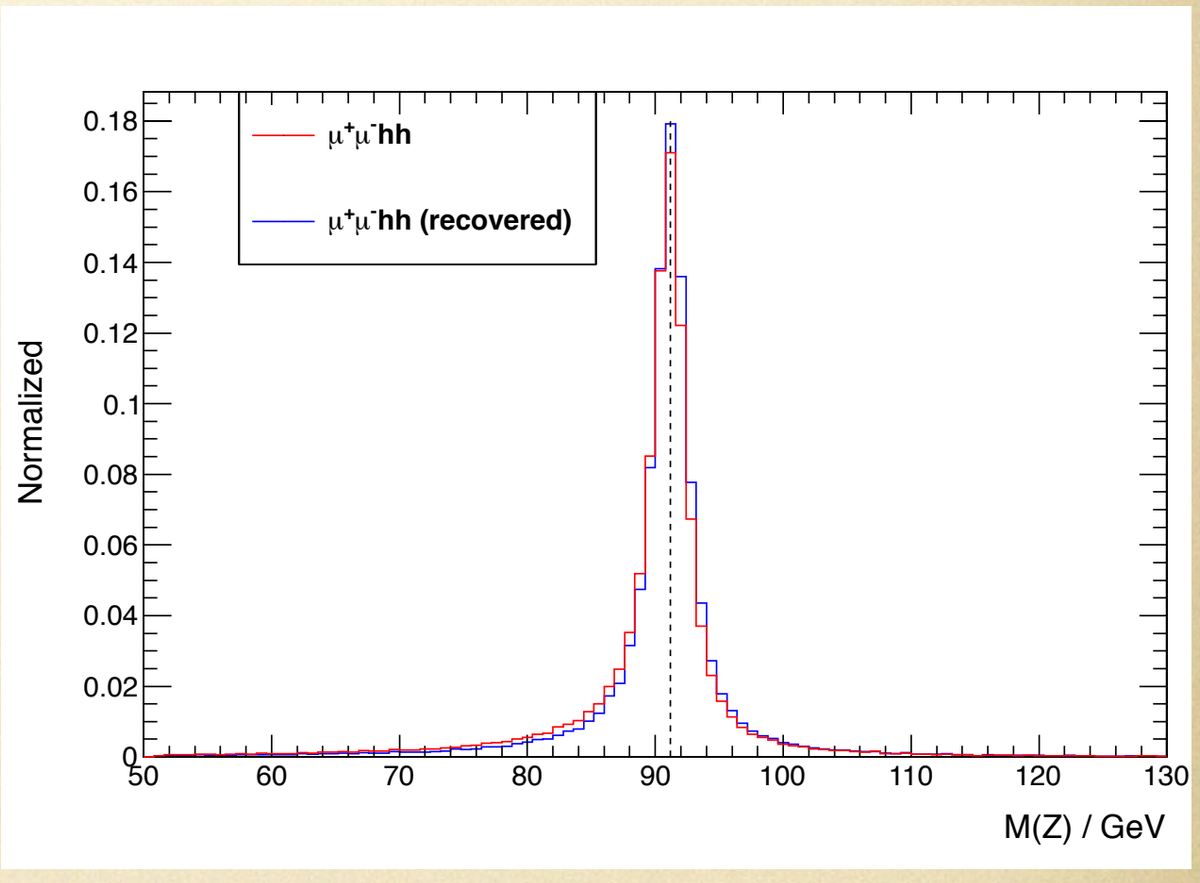
- for one isolated lepton selection: trained using lvbbqq and bbbb samples. use IsolatedLeptonTaggingProcessor
- for isolated lepton pair (from Z) selection (provide as examples): several training available (weak dependence), for ZH and ZHH, e.g. ZHHll4JLeptonSelectionProcessor, ZHllXLeptonSelectionMVAProcessor

in processor of pair selection, also available sophisticated BS/FSR recovery

currently being used by many analyses: leptonic recoil, self-coupling, Higgsino, anomalous HVV coupling, etc.

example of BS/FSR recovery





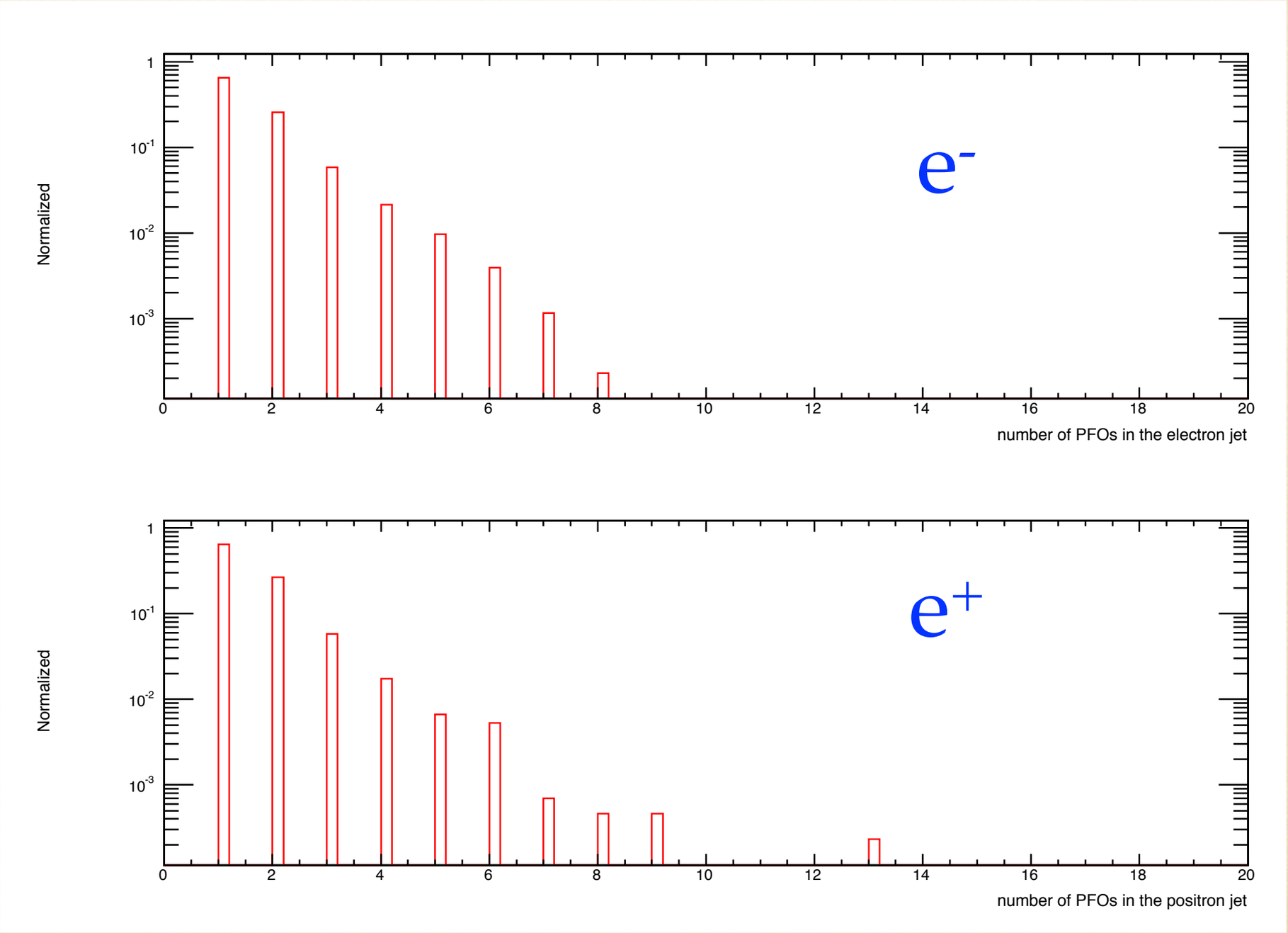
other similar MVA based isolated lepton finder

- developed in ZHH, H—>WW* analysis by Masakazu, shower profile is include
- developed in ttH analysis by Y.Sudo, isolated tau is include
- next step: to combine/optimise input variables

backup

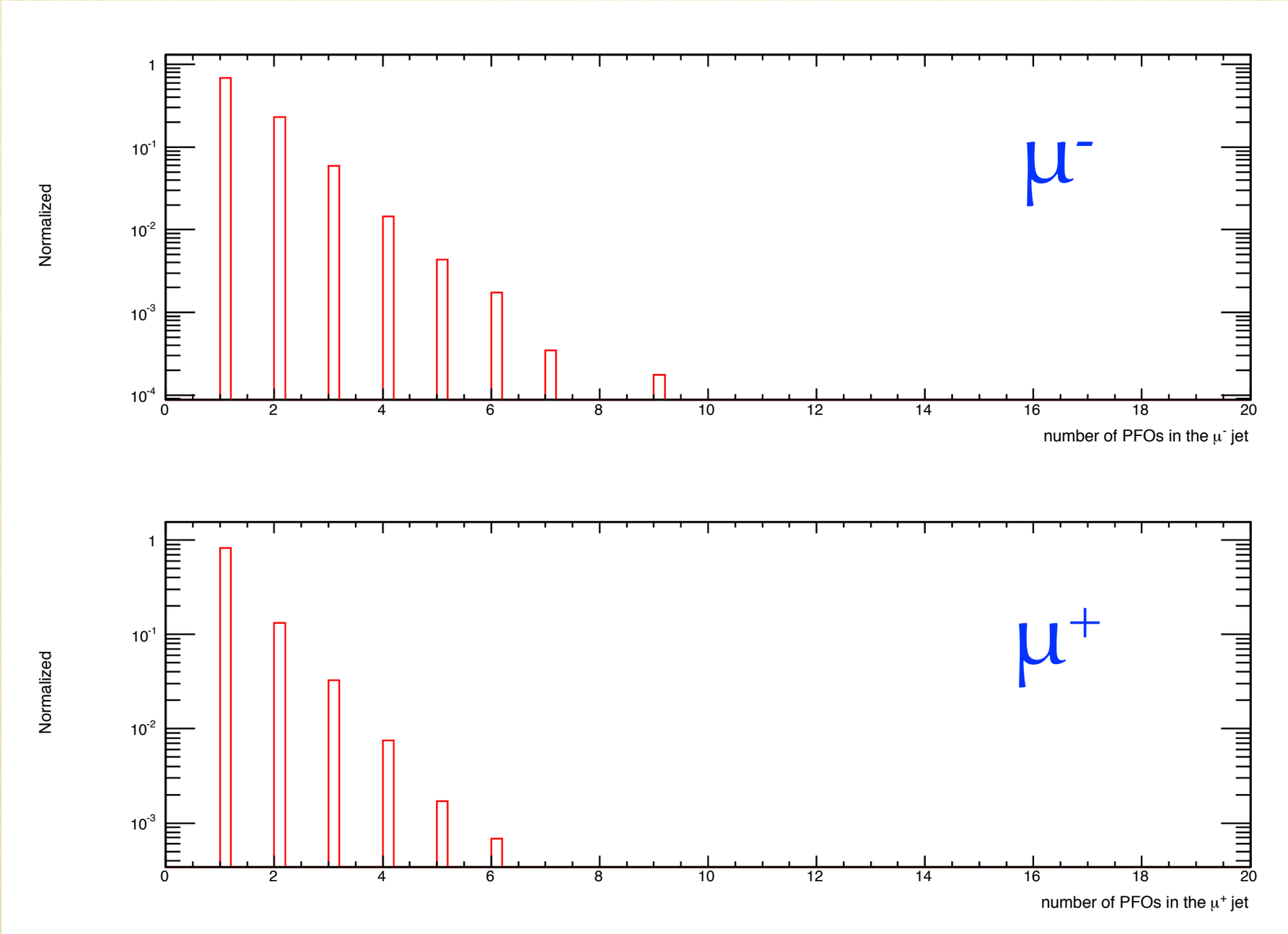
number of PFOs in a charged lepton jet

(from cheated jet clustering) eeHH



number of PFOs in a charged lepton jet

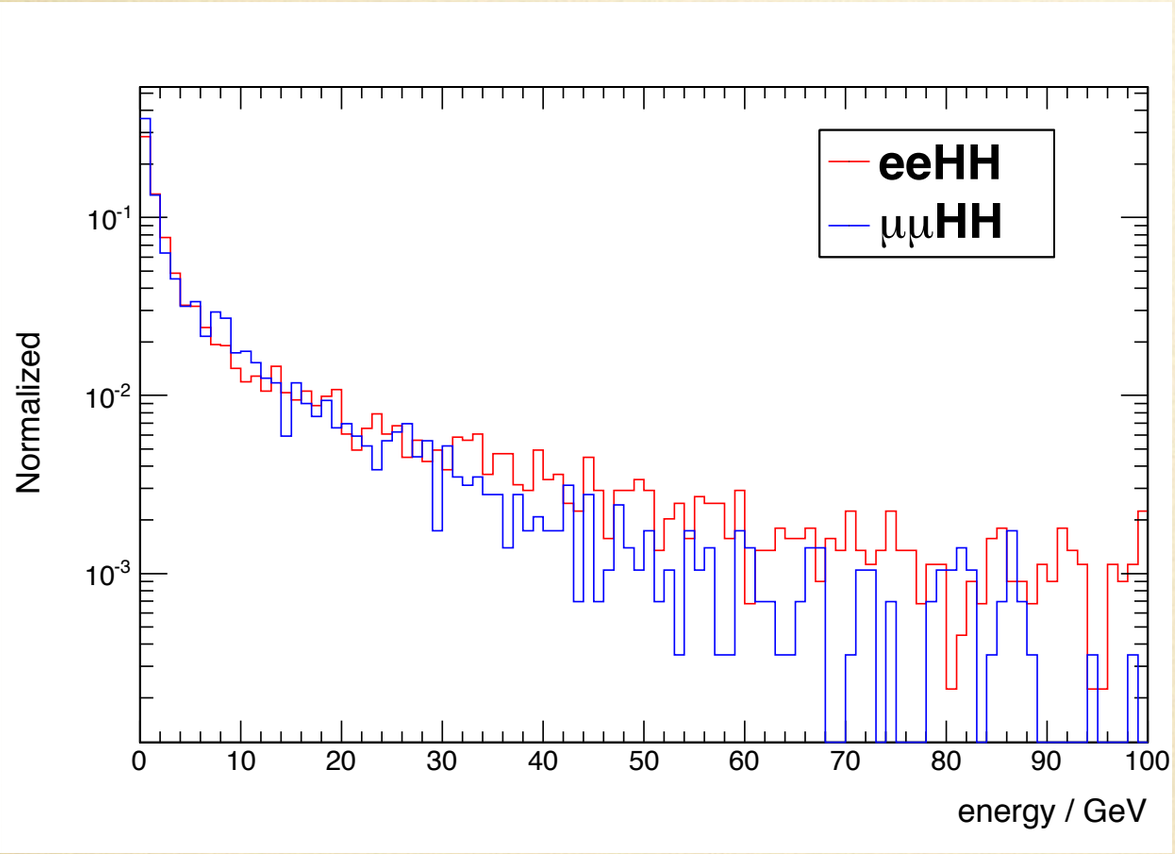
(from cheated jet clustering) μμHH



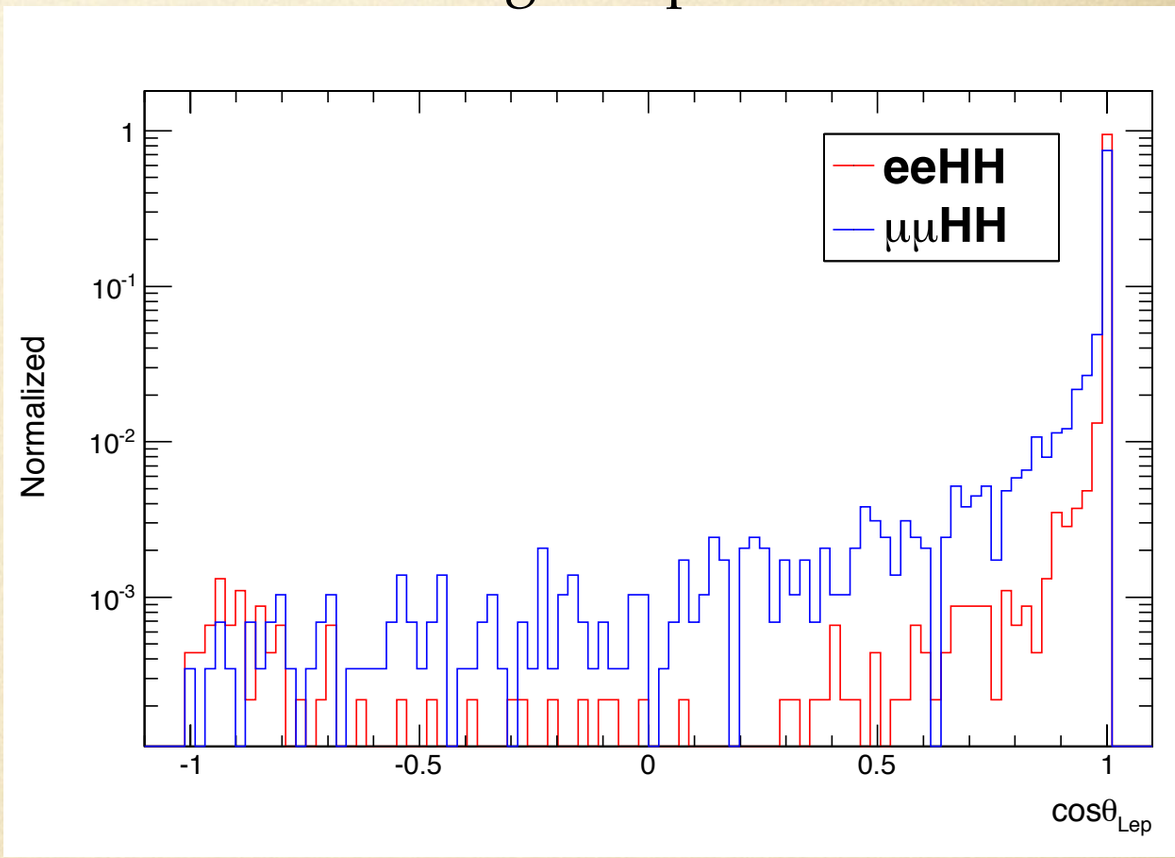
look into the charged lepton jet

(from cheated jet clustering)

energy of the neural PFOs



angle between the neural PFO and the charged lepton



over 90% of the neural PFOs are inside the cone $\cos\theta_{\mathrm{Cone}} = 0.998$