Study of the Higgs Self-coupling at the ILC

Junping Tian (KEK)

Physics and Software Meeting
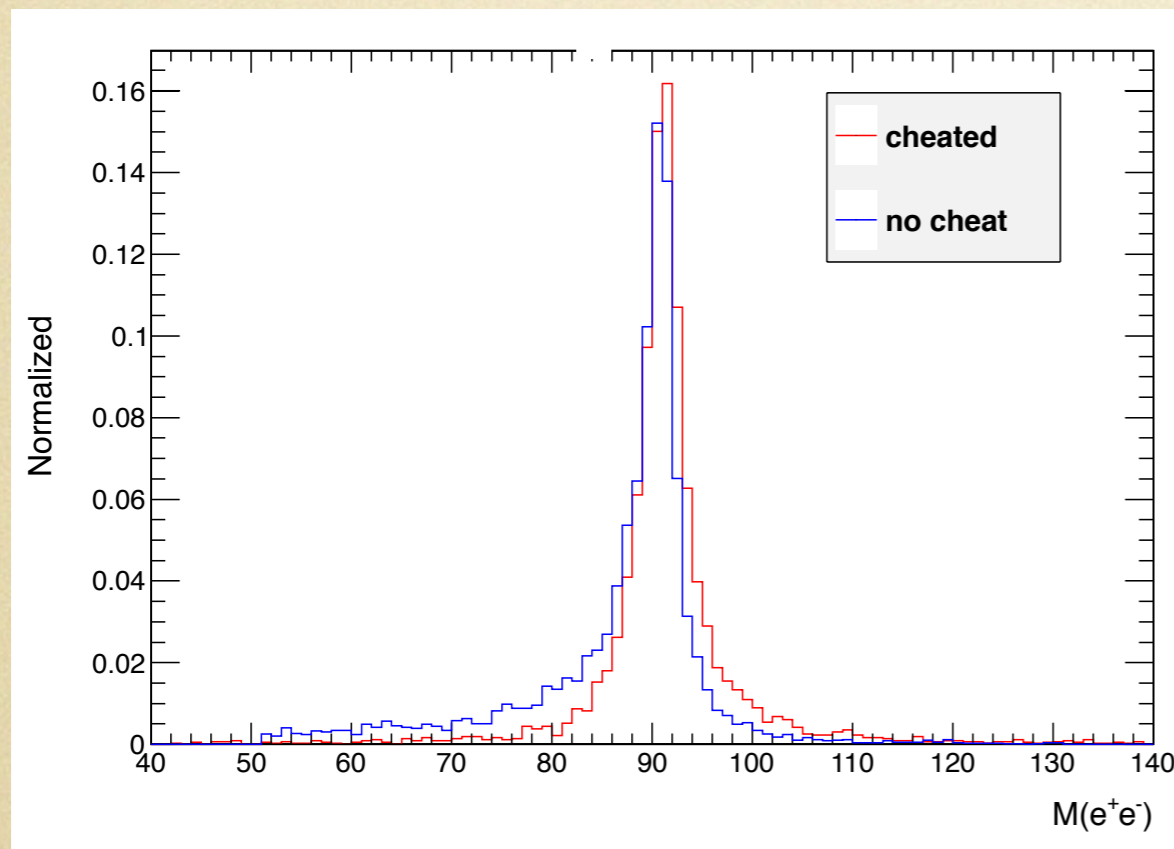
Oct. 28, 2011

preliminary results of cheated jet clustering (llHH)
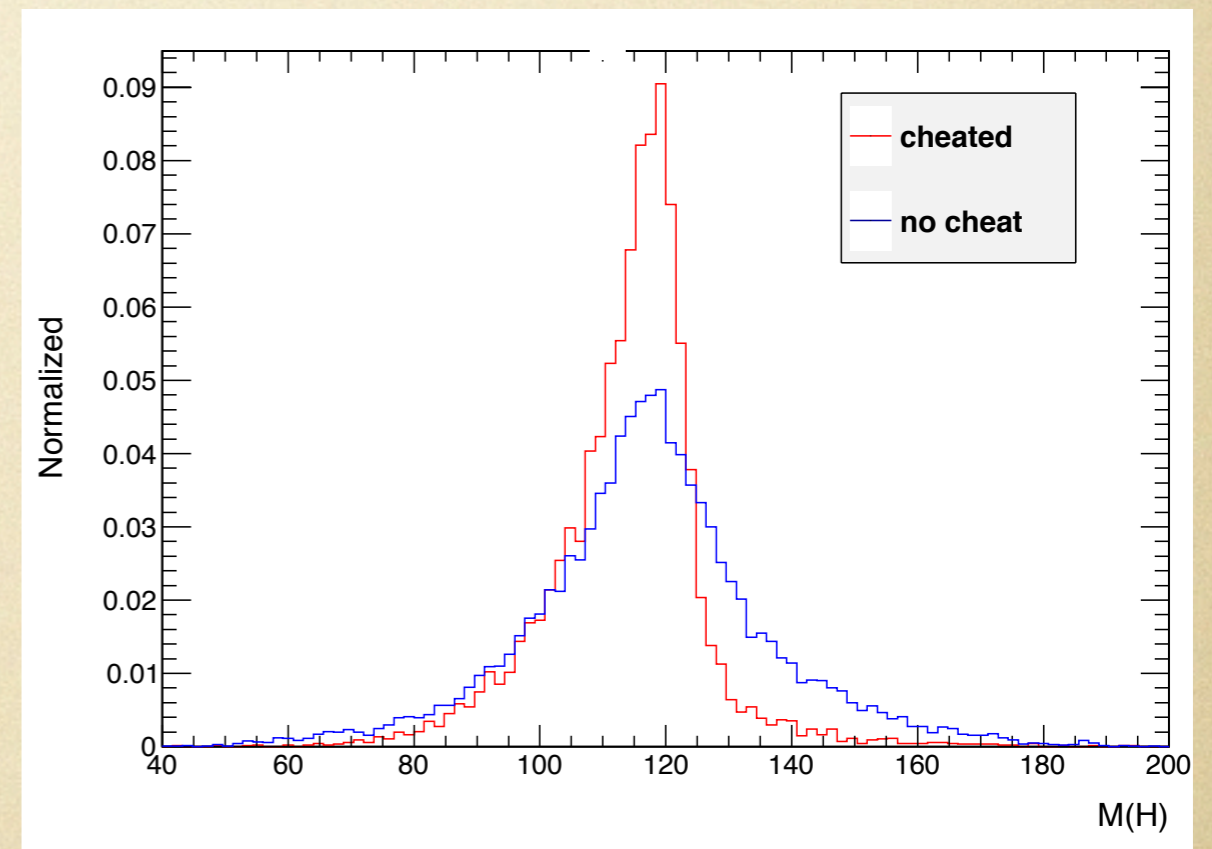
strategy

✦ all PFOs are clustered with SatoruJetFinderWithCheatProcessor_6Jet

✦ the jets with the smallest and second smallest number of PFOs are assigned as the two charged leptons

✦ the other four jets are paired using the realistic pairing algorithm
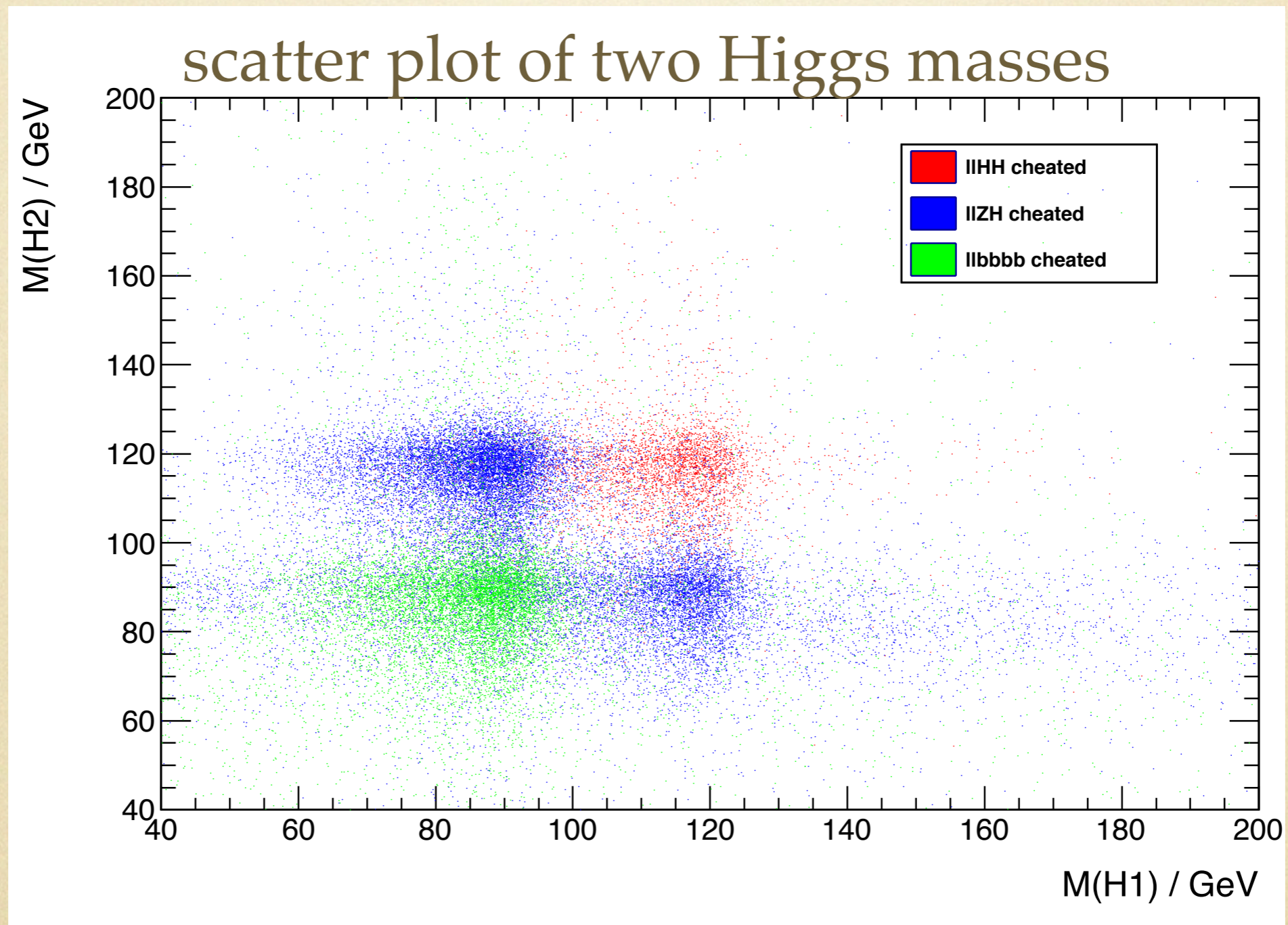
Invariant mass of Z

Invariant mass of Higgs

two Higgs are combined

comparison with dominant backgrounds

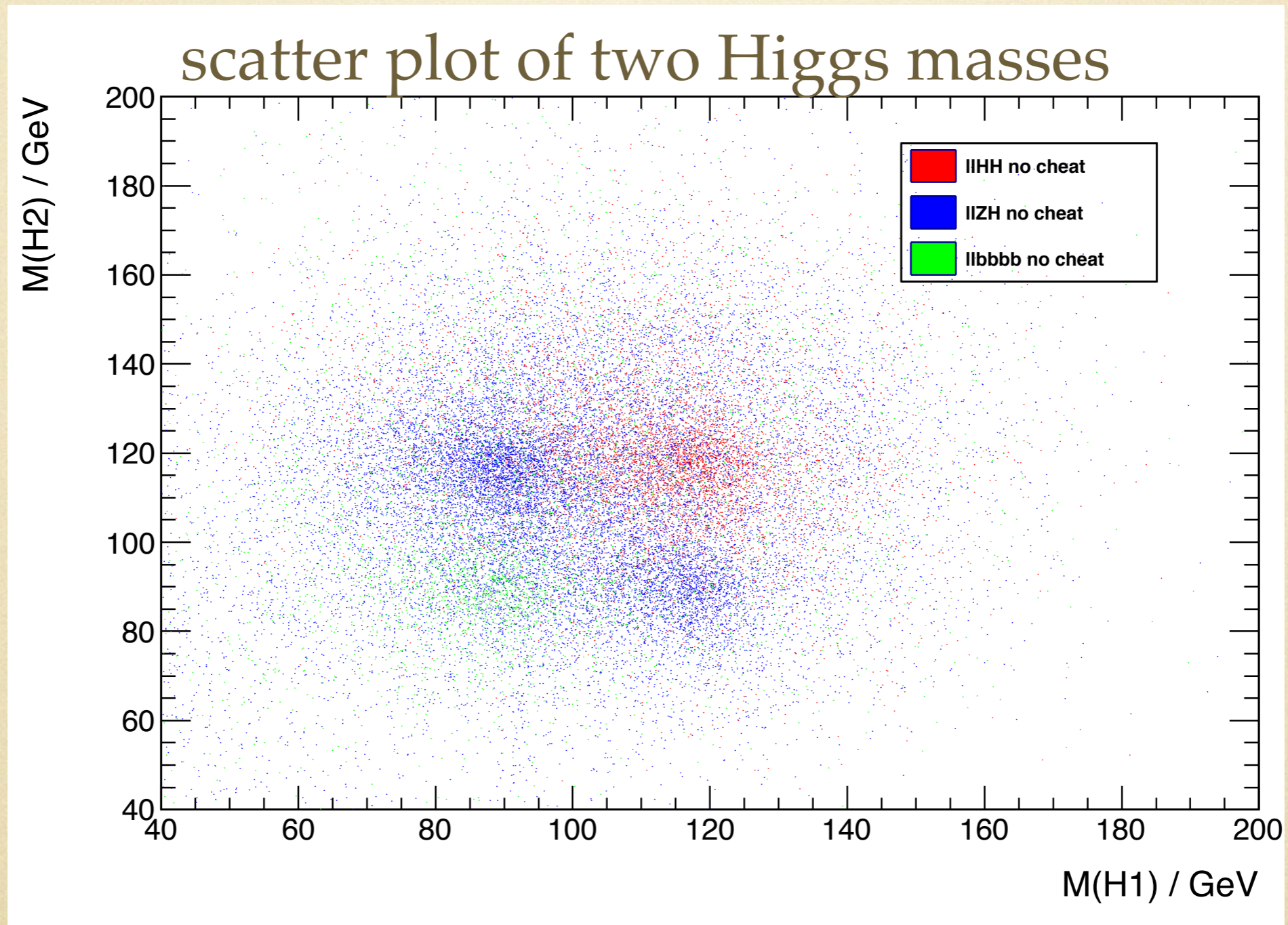all with the cheated jet clustering   llHH mode: (ZZH and ZZZ)

scatter plot of two Higgs masses

Legend:
- llHH cheated
- llZH cheated
- llbbbb cheated

Axes: M(H2) / GeV (vertical), M(H1) / GeV (horizontal)

perfect separation!

comparison with dominant backgrounds

all with real jet clustering   llHH mode: (ZZH and ZZZ)

scatter plot of two Higgs masses

Legend:
- llHH no cheat (red)
- llZH no cheat (blue)
- llbbbb no cheat (green)

Axes: M(H2) / GeV vs M(H1) / GeV

much worse!

performance of the neural-net
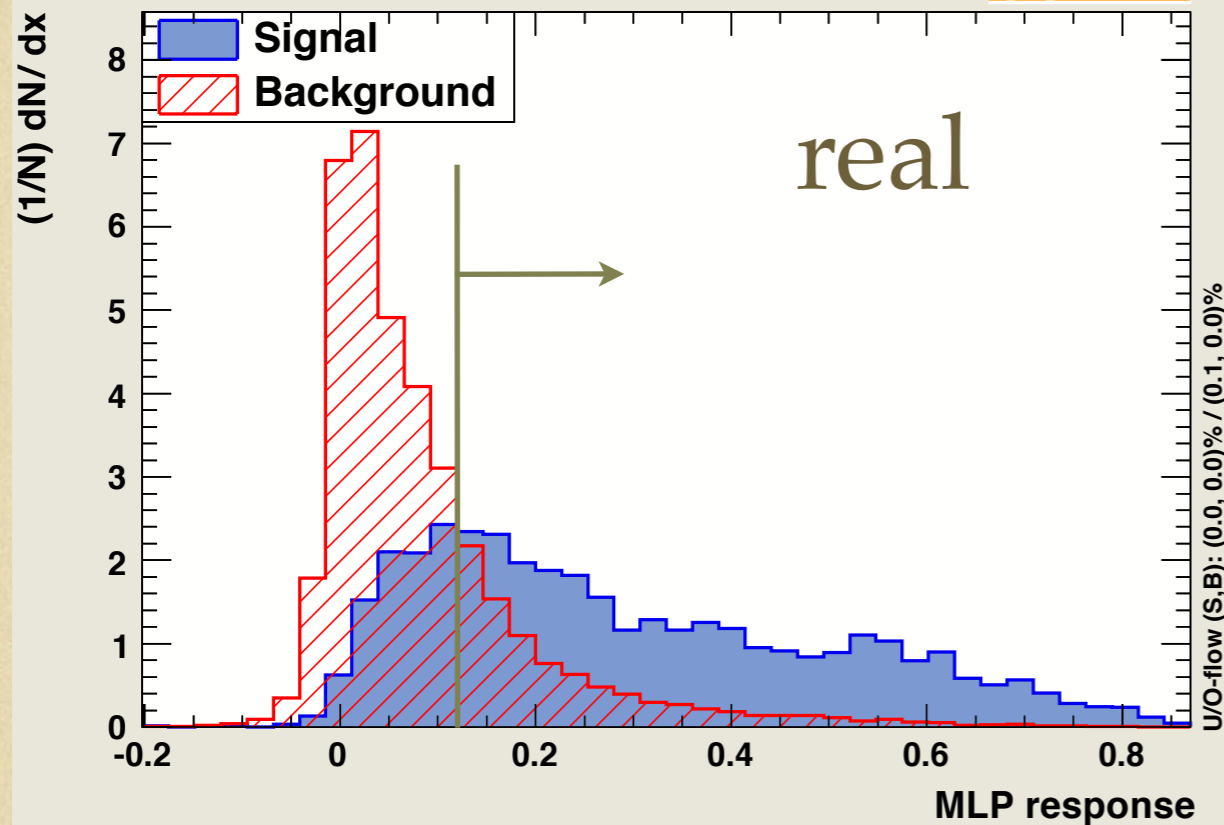
llHH mode: (only for llZH suppression)

keep the signal efficiency as same
as that in previous analysis (75%)
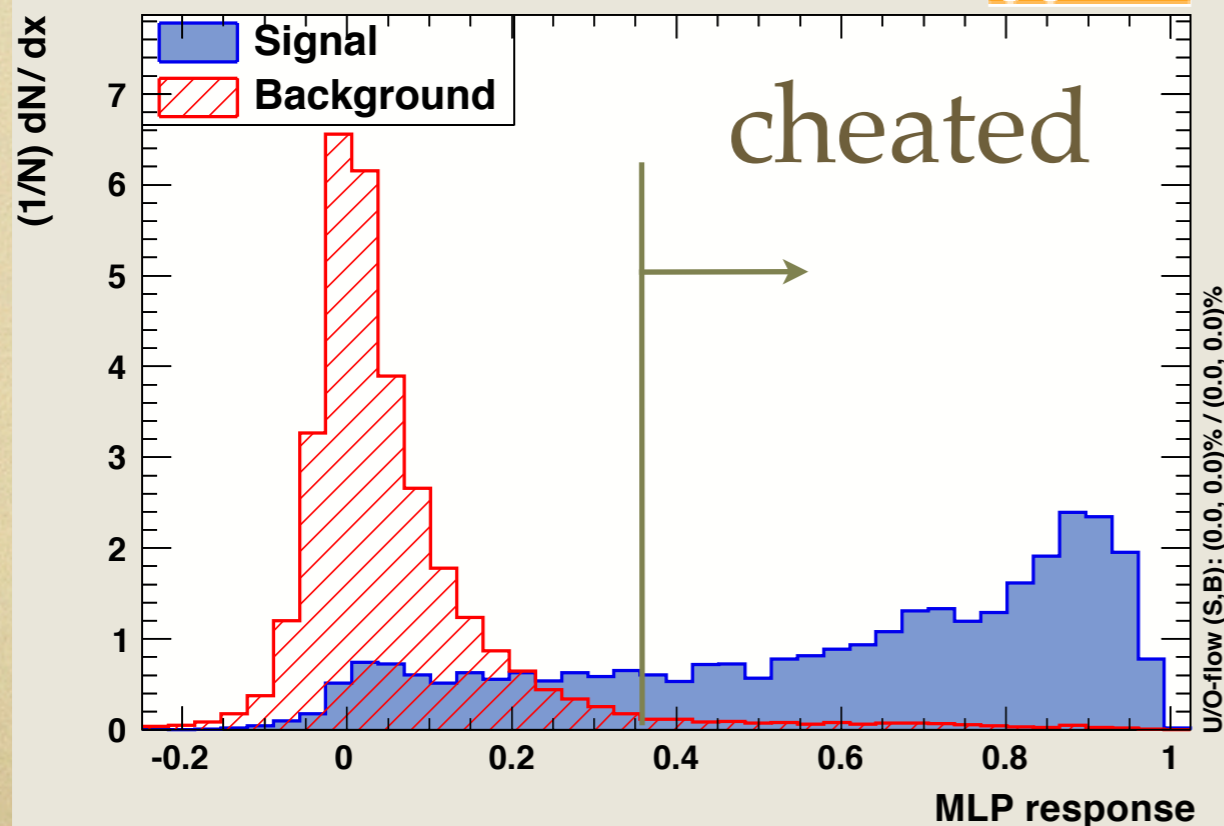
23% (real)

efficiency of llZH:

3.8% (cheated)

large room for the improvement of
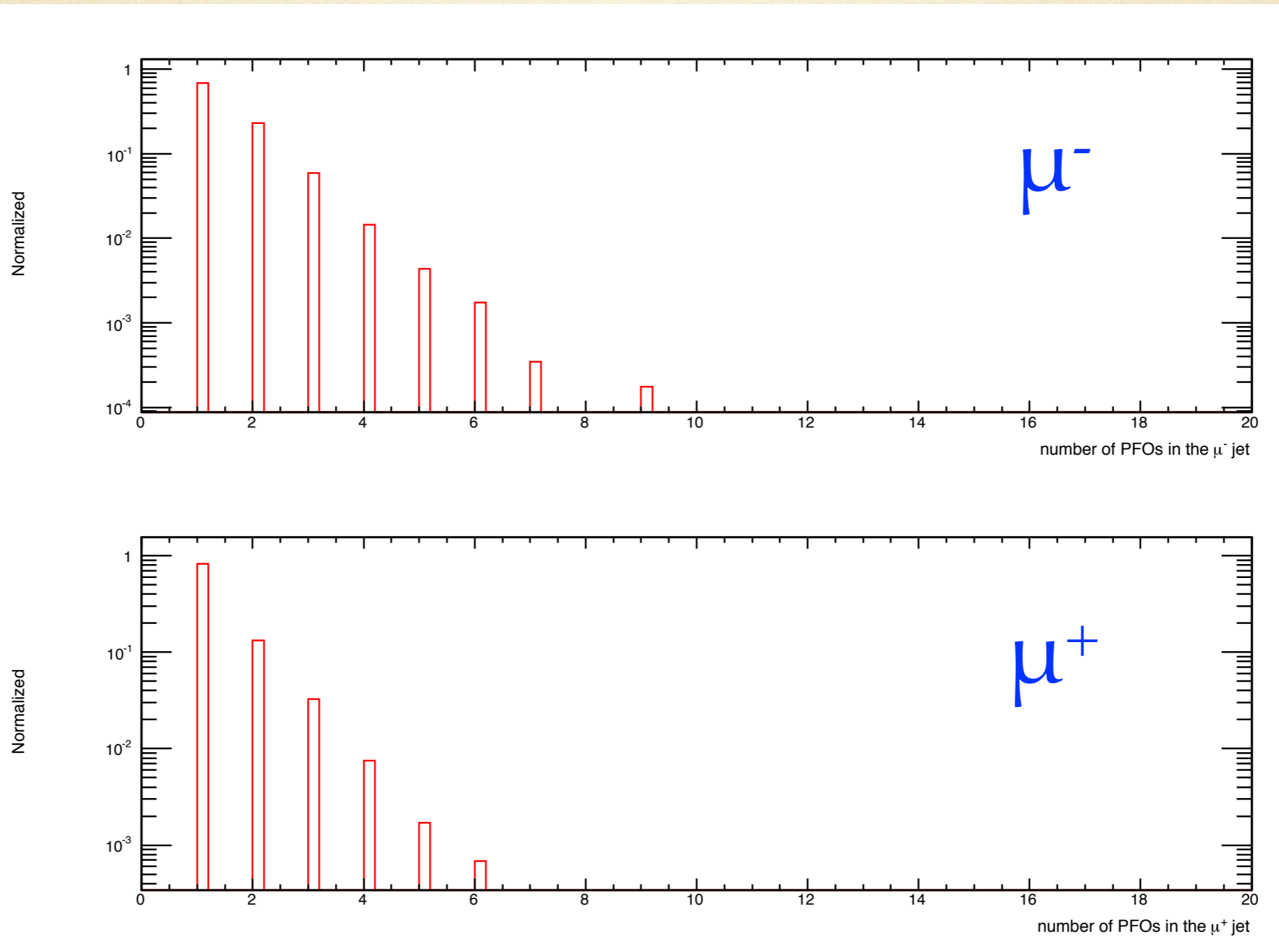jet clustering!

5

(from cheated jet clustering)   eeHH
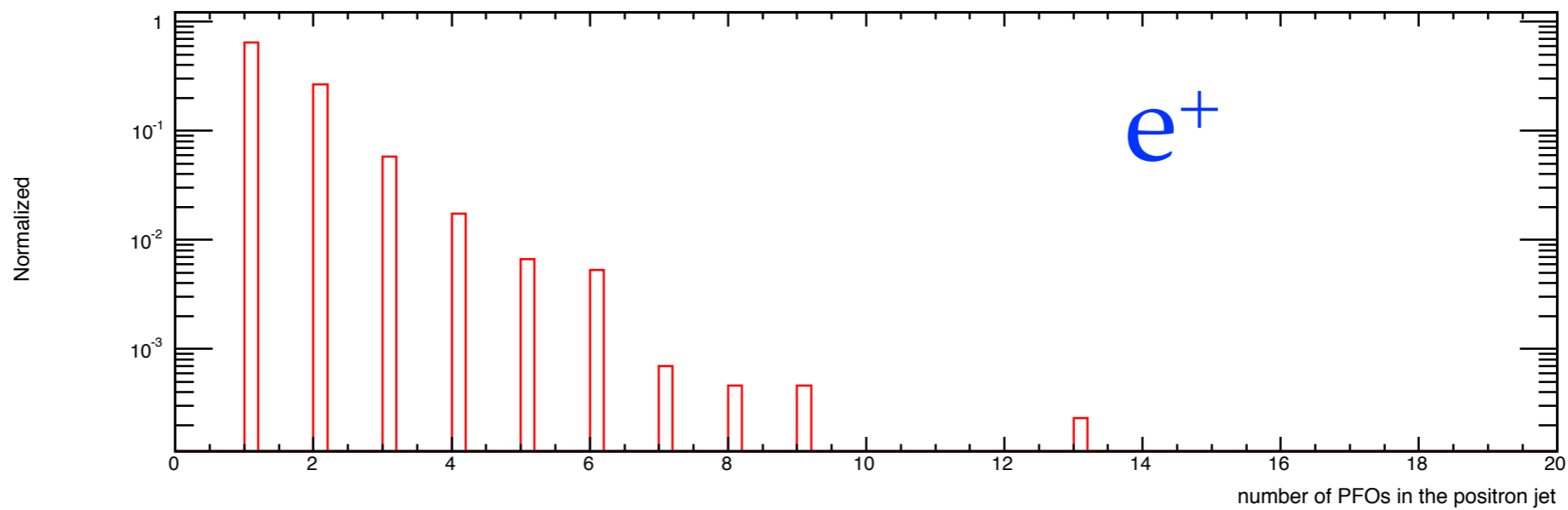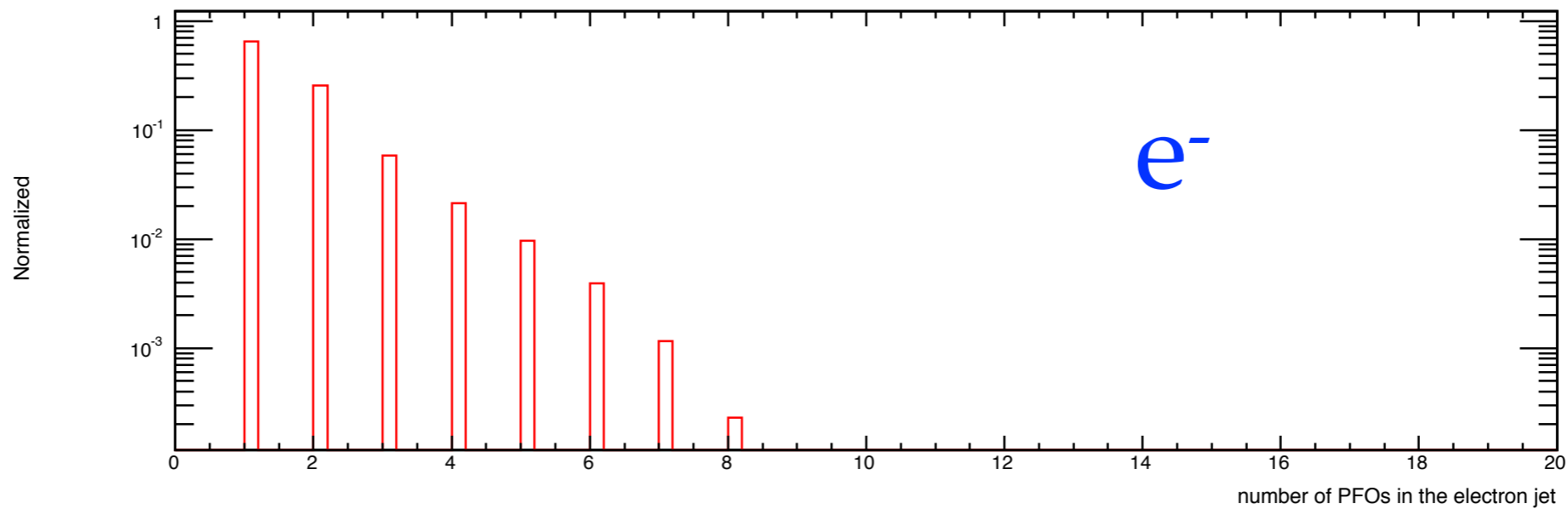
number of PFOs in a charged lepton jet

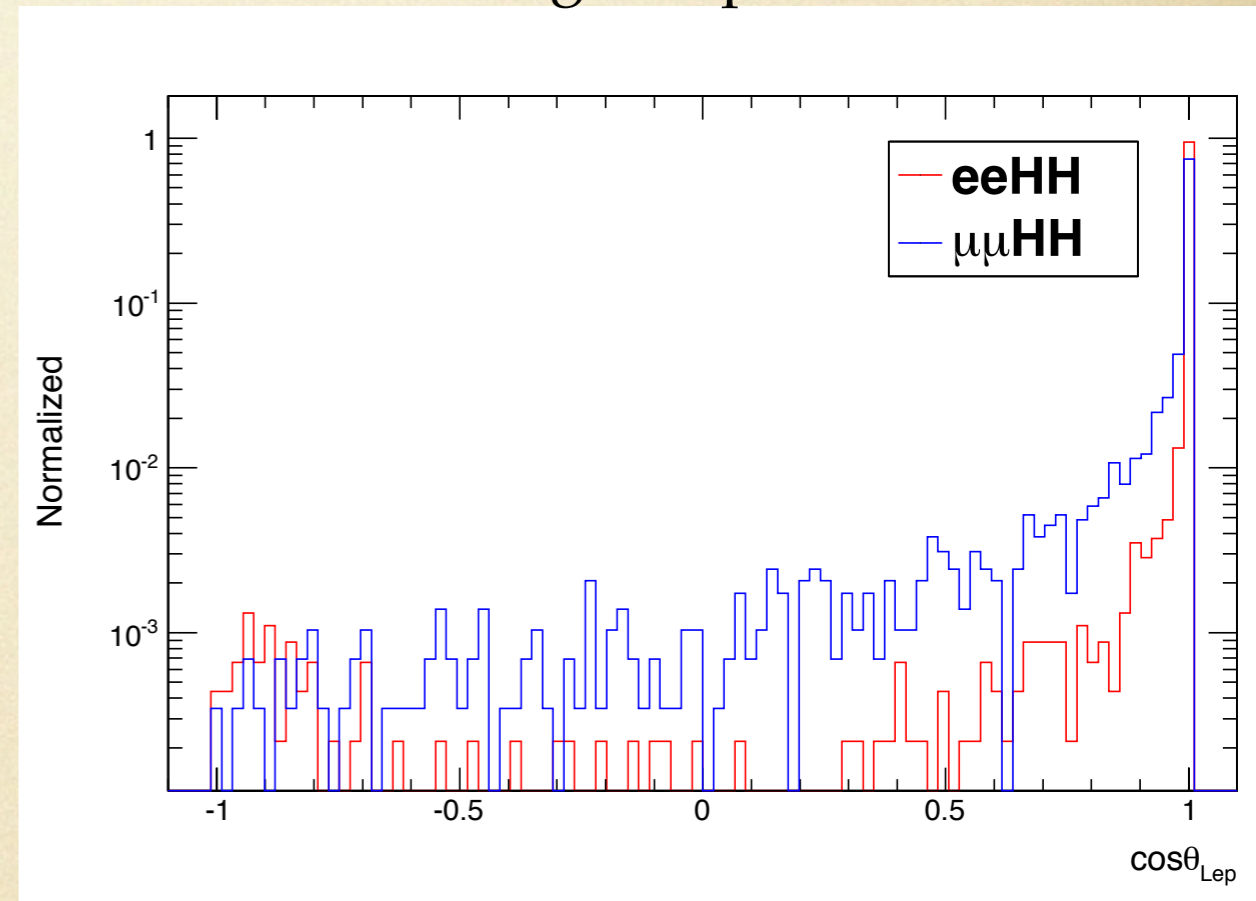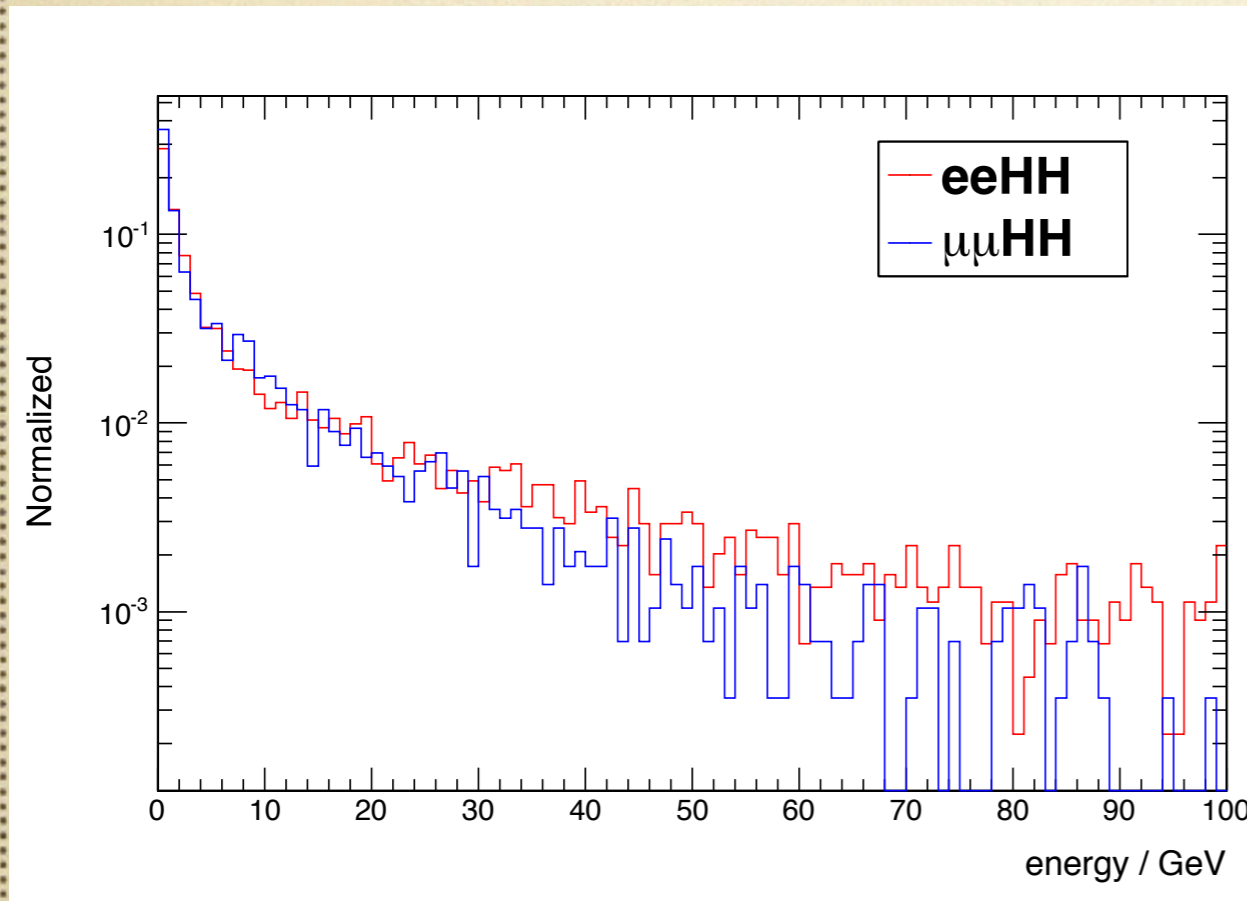(from cheated jet clustering)   μμHH

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 $\cos\theta_{\mathrm{Cone}} = 0.998$
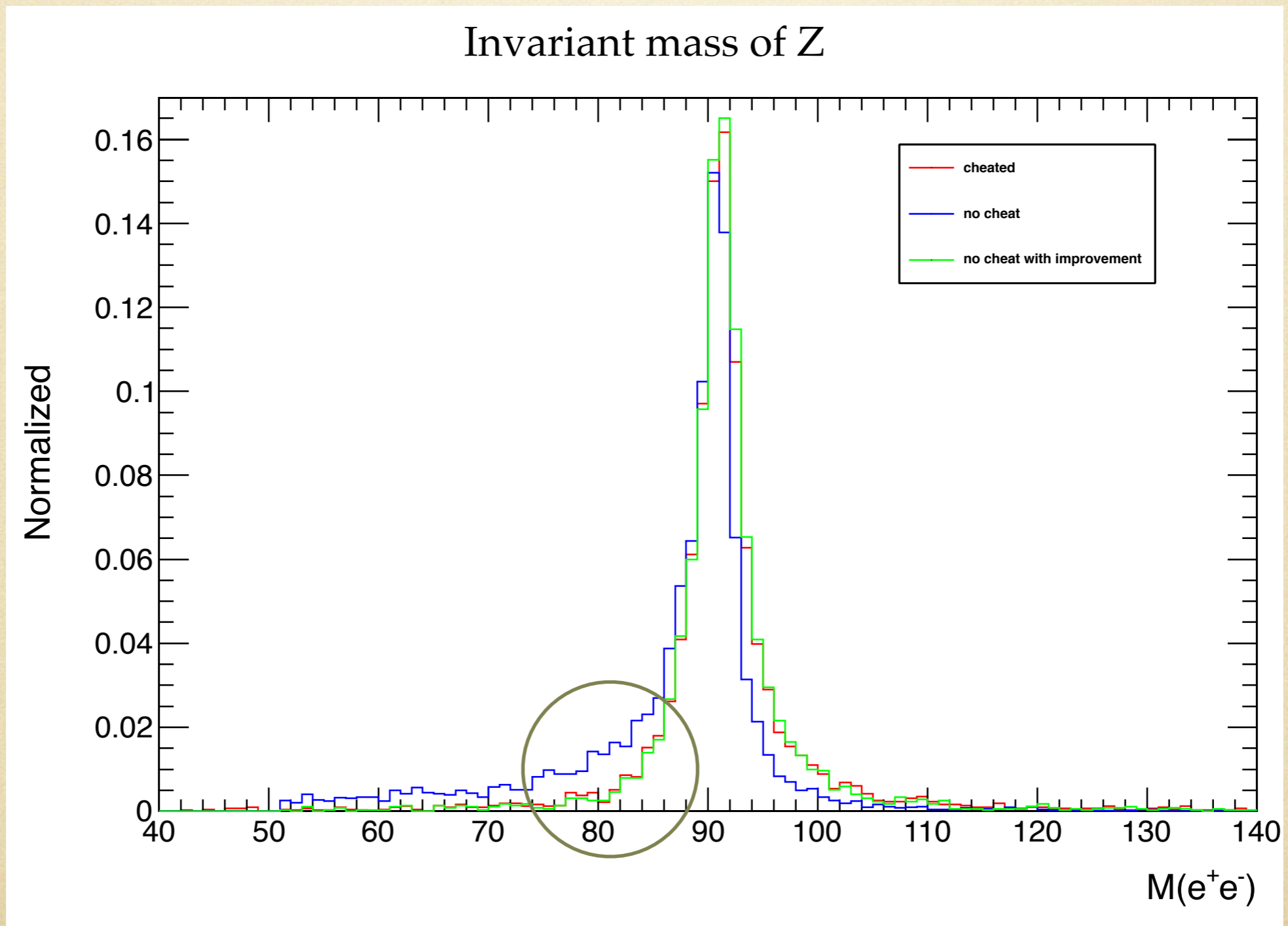
hint for the improvement of isolated lepton selection

(could improve the mass resolutions of both Z and H)

apply to the real analysis

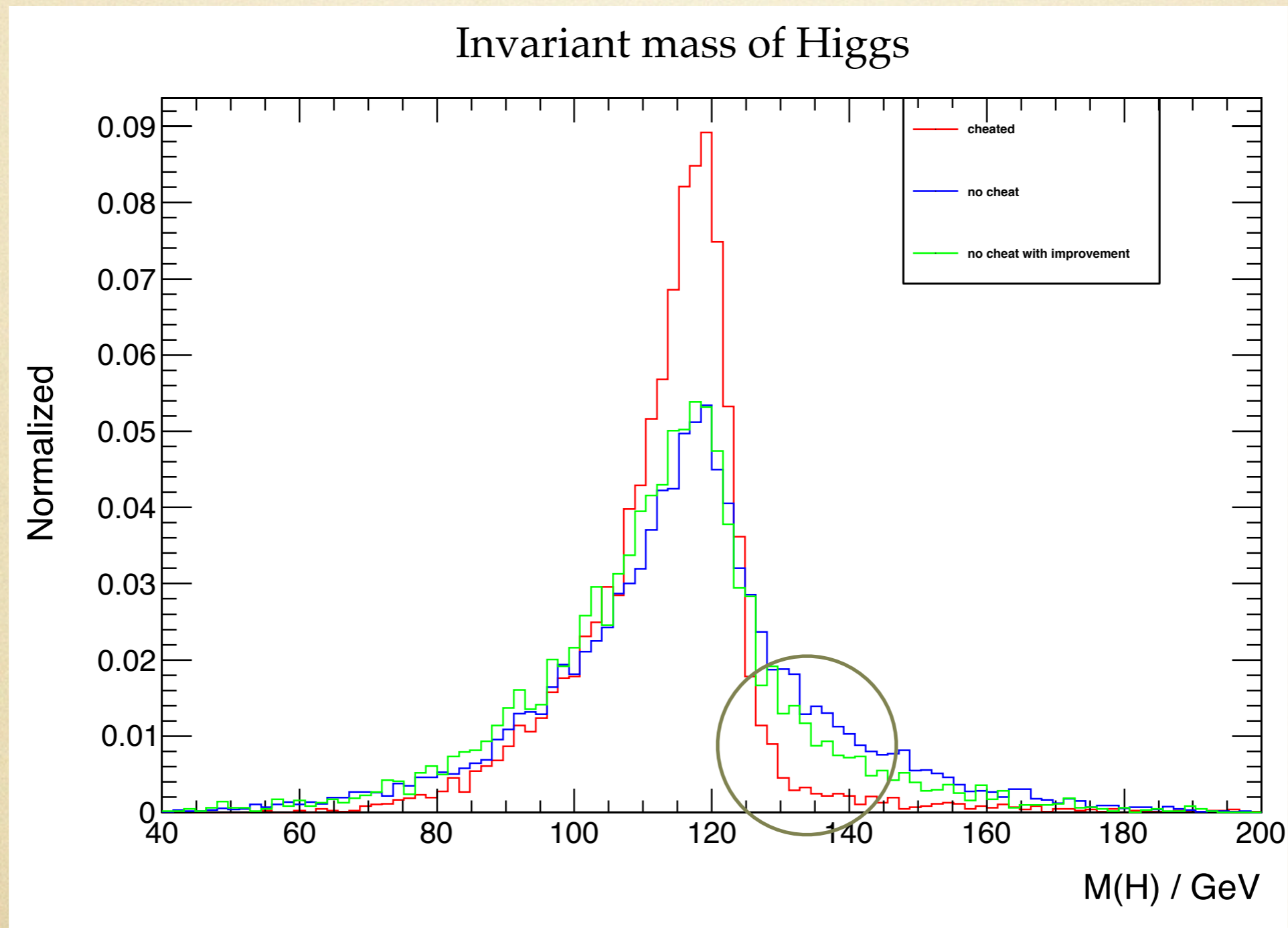(by combining the radiate photons to charged leptons)

$$\cos \theta_{\text{Cone}} = 0.998$$
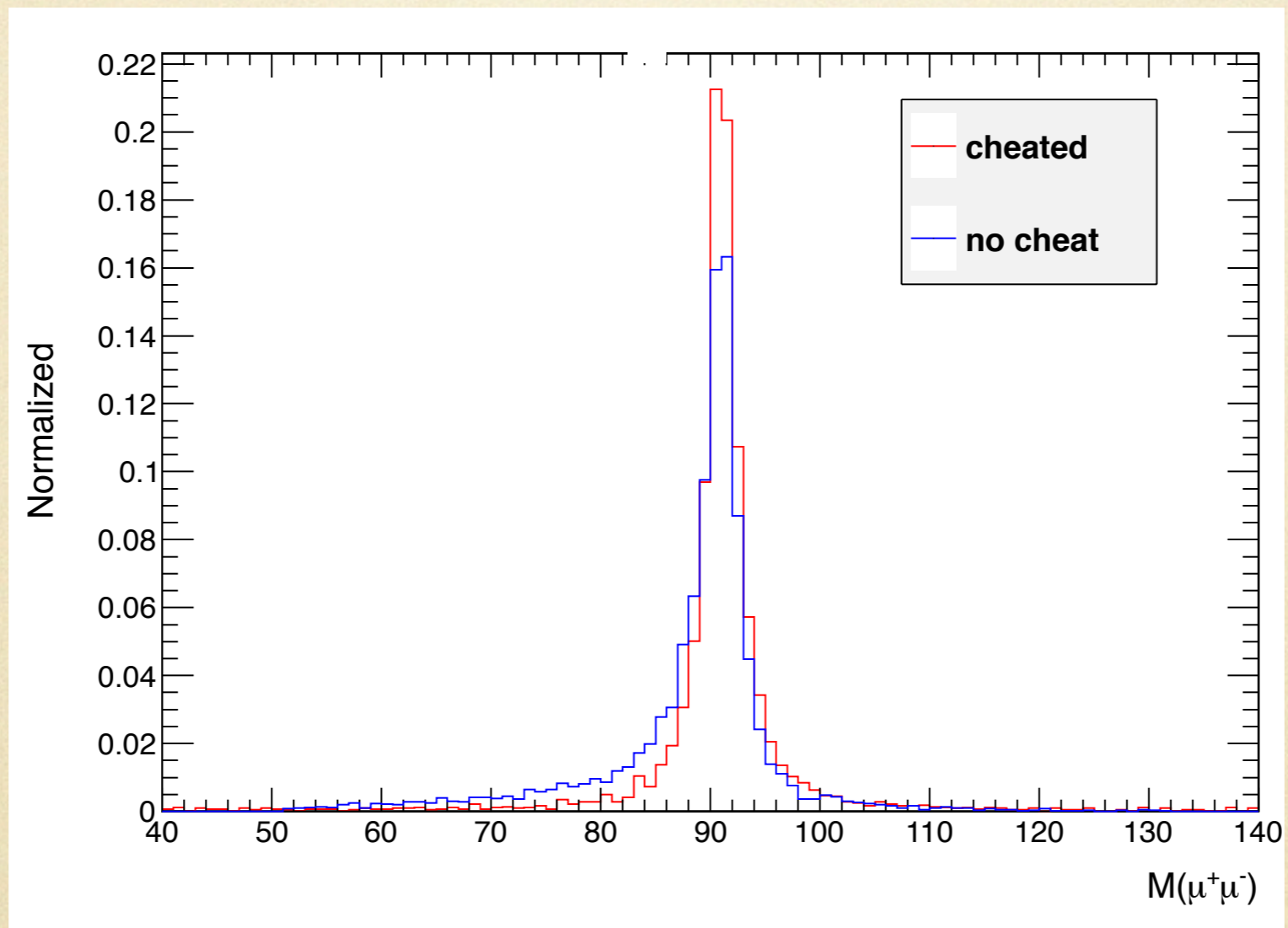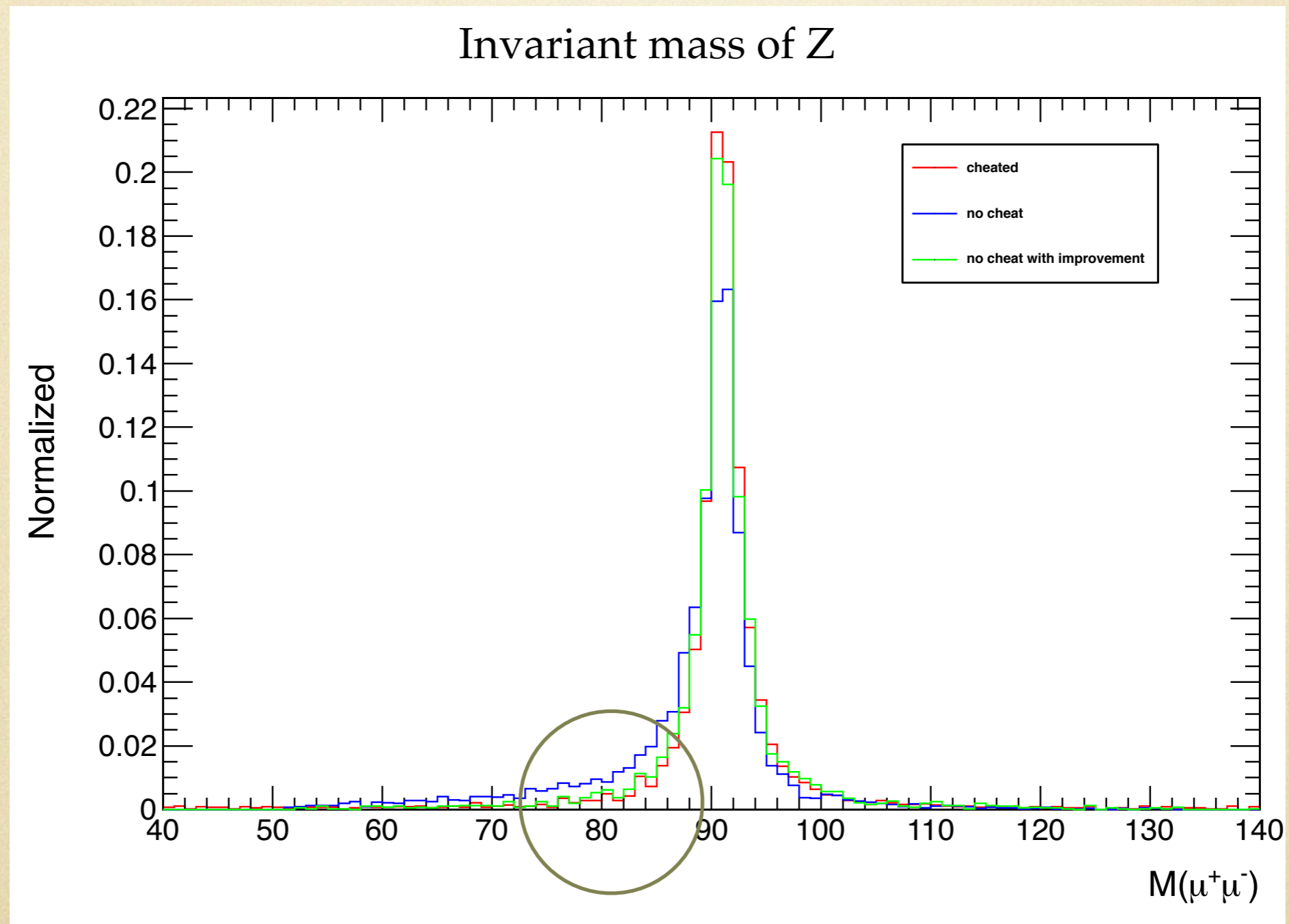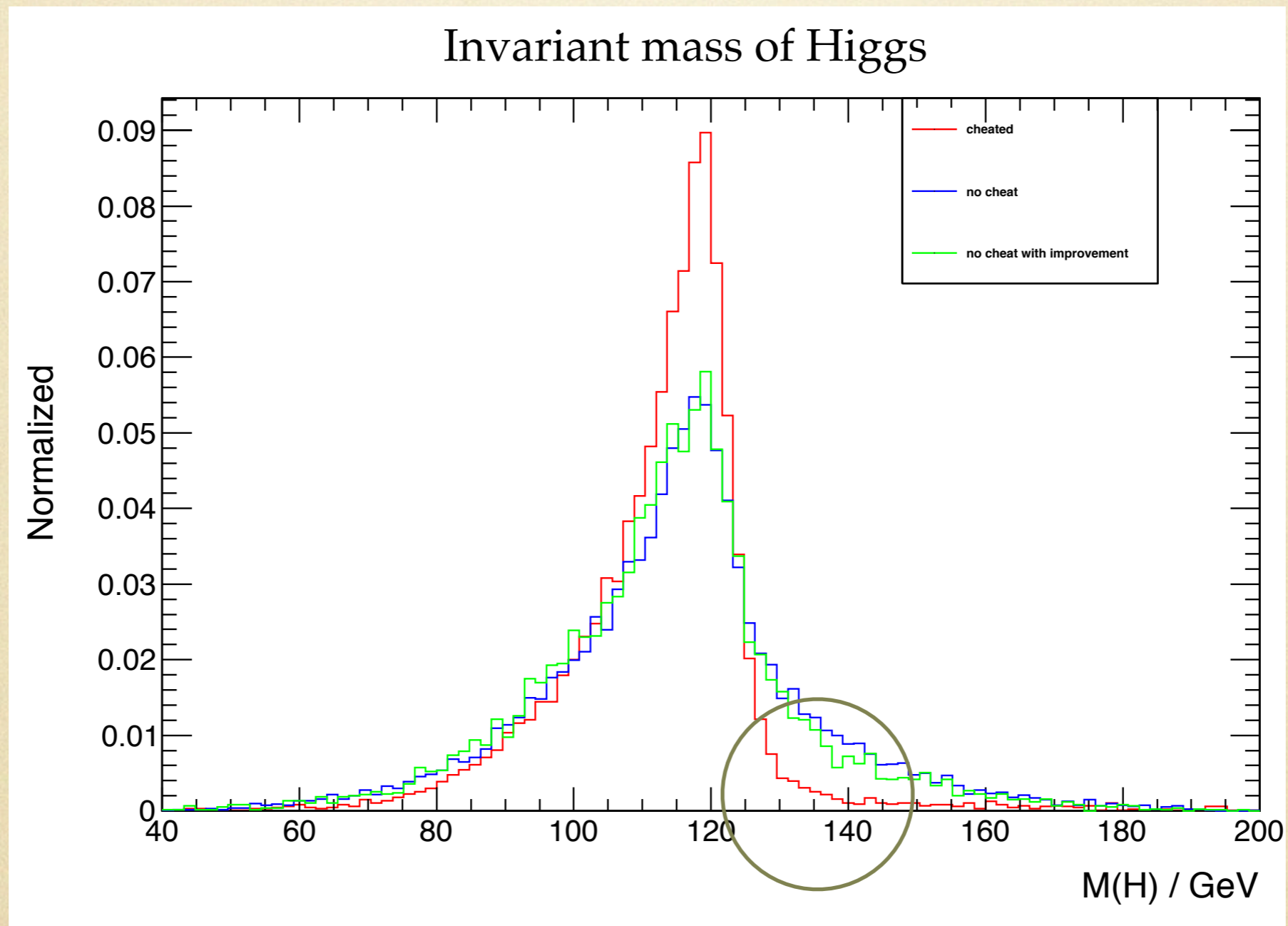
apply to the real analysis
(by combining the radiate photons to charged leptons)

$$\cos \theta_{\mathrm{Cone}} = 0.998$$

Invariant mass of Higgs

backup

muon mode

apply to the real analysis

(by combining the radiate photons to charged leptons)

$$\cos\theta_{\mathrm{Cone}} = 0.998$$

Invariant mass of Z

apply to the real analysis

(by combining the radiate photons to charged leptons)

$\cos\theta_{\mathrm{Cone}} = 0.998$

Invariant mass of Higgs

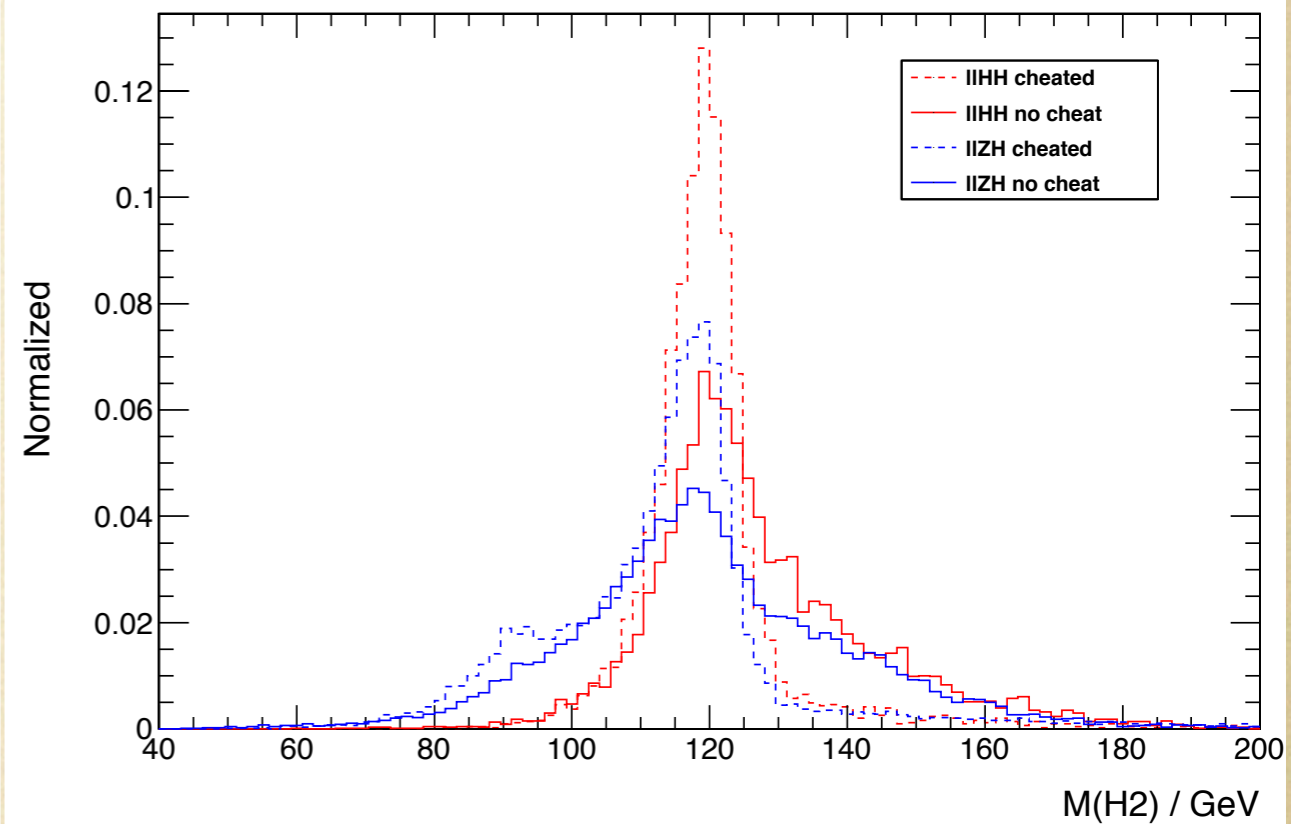# comparison with dominant backgrounds
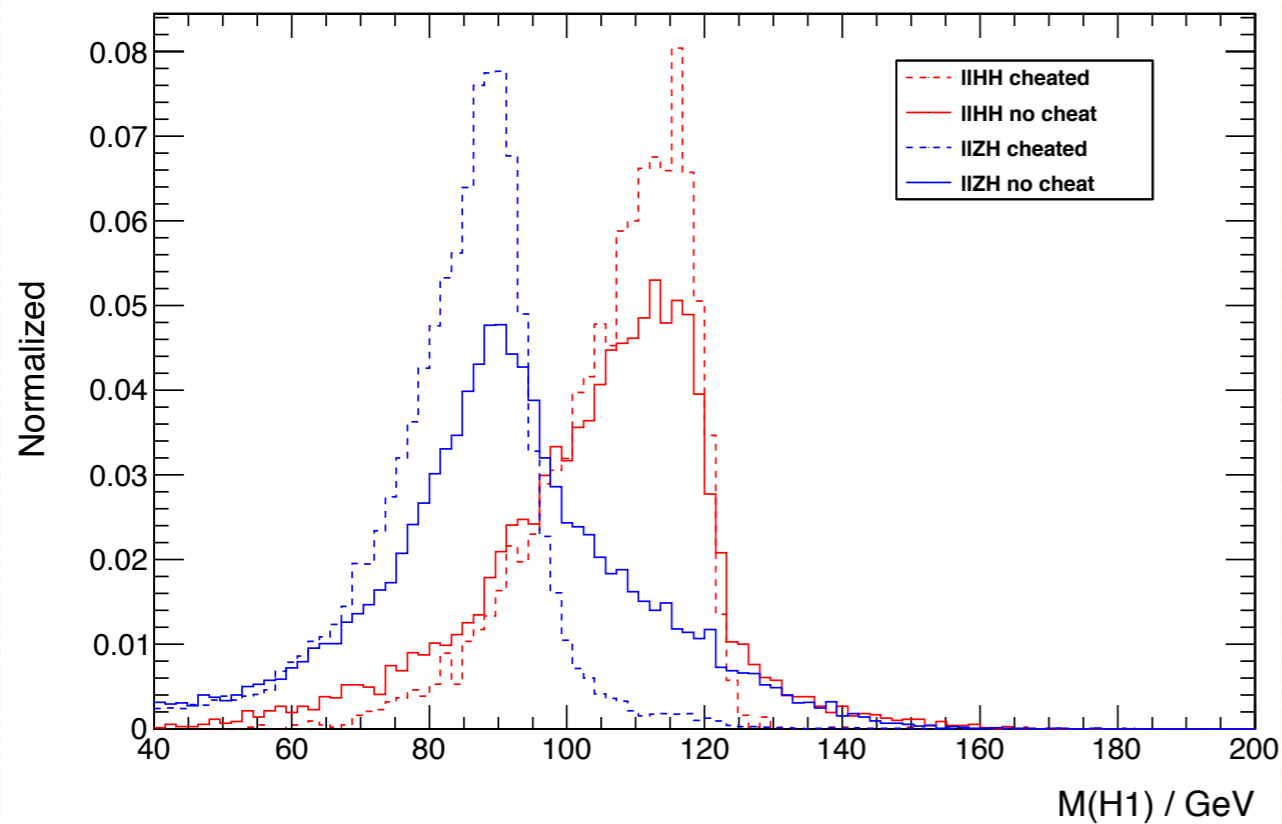
llHH mode: (ZZH)

single Higgs mass

smaller one   larger one

puzzle