Update on $Z \rightarrow e^+e^-$ analysis

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*on behalf of **Z Signal Extraction** team*

For Egamma meeting
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Electron Id performance metric

✦Evaluate the general performance of three classes of electron Id currently available in the market:

- •Egamma/VBTF Working Points (WP),
- •Egamma Cuts-in-Categories (CiC)
- •Egamma likelihood (LH)

For ECAL-seeded electrons

✦ Just for fun I also show how much improvement one can possibly get if one sacrifices simplicity and uses multi-variate (a.k.a "kitchen sink") approach

- •used boosted decision tree for this purpose (plots labeled as "KM")

✦Use the following signal and background samples to evaluate the signal efficiency and fake rates:

Signal:
Probe leg of $Z \rightarrow ee$ when tag≡WP80 and $80 < m_Z < 100$ GeV and pfmet<20 GeV
Signal purity >98%

Background:
Probe leg of Z when tag fails WP95 and $m_Z < 80$ GeV
[also tried fake electrons in QCD jet triggered events in data, the results remain same]
Signal contamination ~ 10^{-3} – 10^{-4}

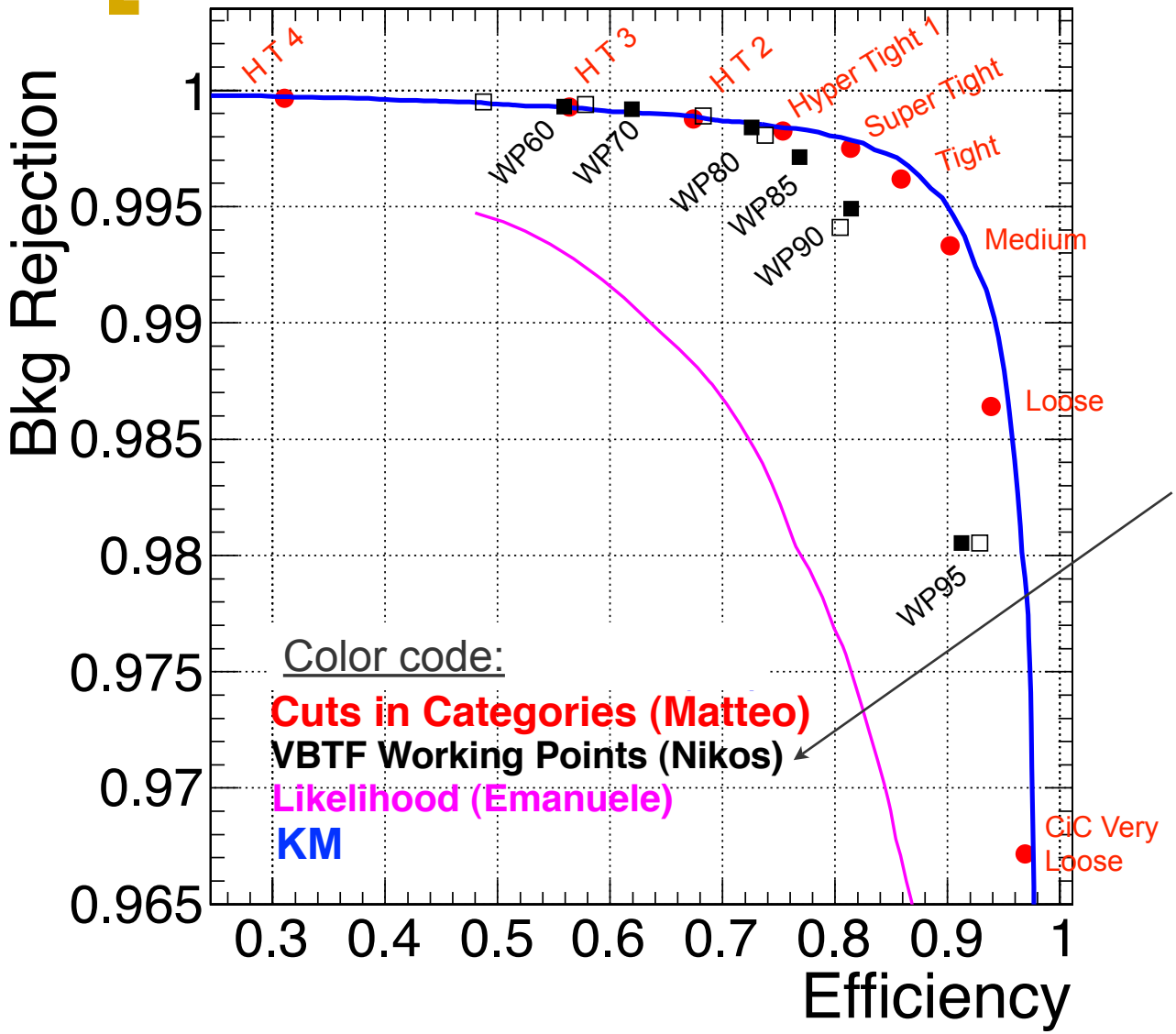
Some details on comparison

- All electron Id selections have been treated on equal footing.
  - -efficiency computed exact same way in all cases
  - -Apply selections as advertised by developers on twiki/hypernews
  - -In case of CiC select events which pass all isolation, id, conversion, and impact parameter flags (i.e., bit ==15)

- The following caveats apply
  - -In general the performance depends on the choice of background sample and kinematics
  - -In the comparison on next slide the background sample is dominated by generic QCD events (almost no heavy flavor), electron E_T>20 GeV

- To conclude on the performance of each Id we need to look at
  - •missing E_T plot for W→ev candidates
    - -Bkg in that sample has more heavy flavor
  - •Tag+Failed super cluster invariant mass distribution in Z→ee candidates for various electron Id on tag.

Performance: signal efficiency vs bkg rejection



- The higher the curve/ point, the better performing it is
- Bkg rejection = 1 – bkg efficiency

Also, graph with empty squares: WP tuned on data (privately provided by N Rompotis)

Many thanks to Matteo Sani and Nikos Rompotis for providing me the tuned parameters and feedback

Validation of the above study

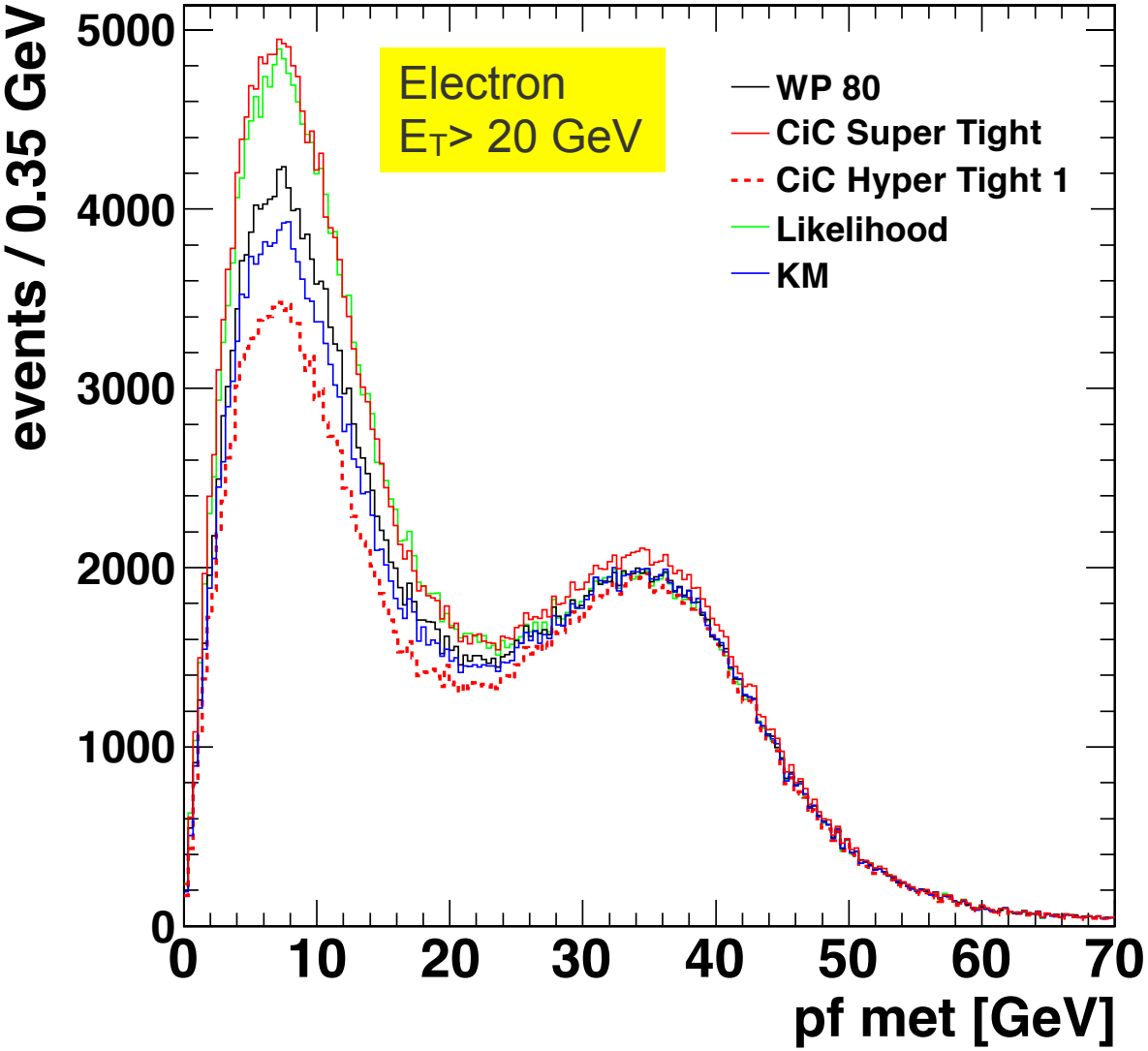
Further, evaluate performance of “80% efficiency point” in two samples:

W→ev: Missing E_T distribution.

- pick “WP80” as reference for comparison, i.e., compare performance of other Ids with respect to WP80
- for eid likelihood and “KM” the strictness cuts are not defined
  - -choose the cut so that it has same efficiency as WP80
  - -this way we can compare the background rejection rate

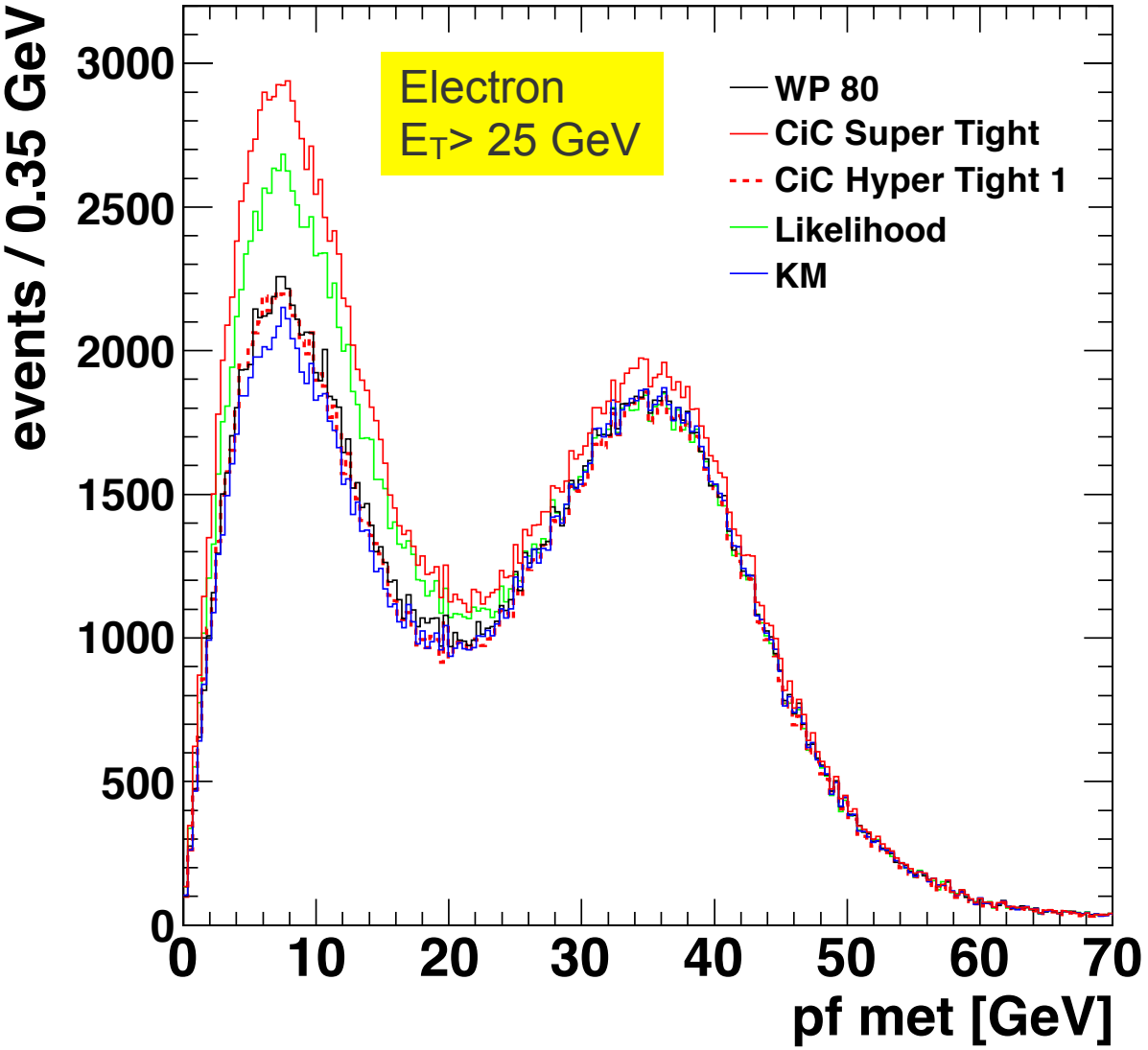
Z→ee: Invariant mass distribution in Tag+Fail super cluster sample which is the major source of systematics in efficiency measurement (and therefore all precision electroweak analysis).

Id performance: W→ev distribution (E_T>20)



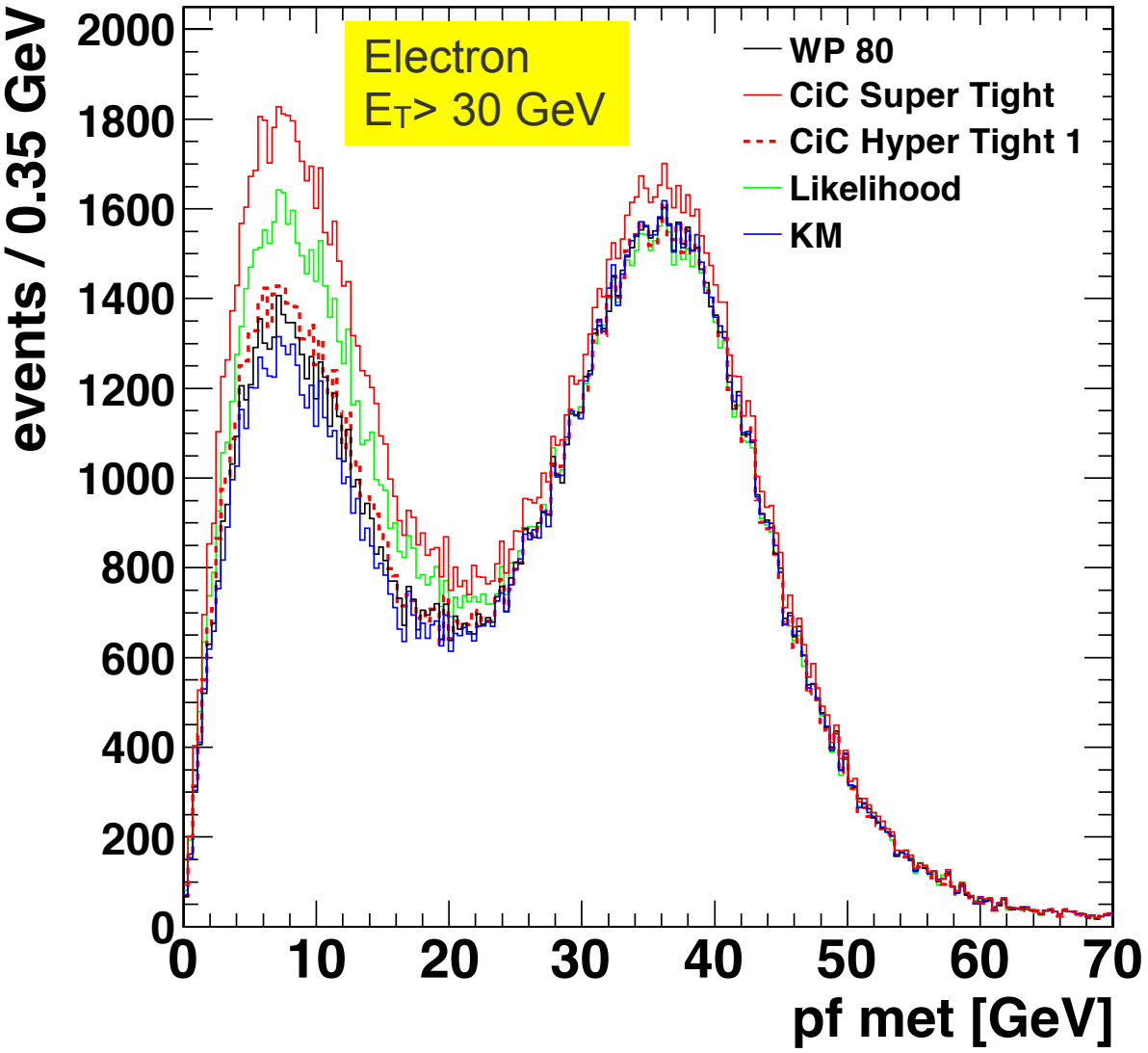
- Among the three Ids WP80 and CiC are performing about the same:
  - CiC Super Tight is significantly looser than WP80 whereas CiC Hyper Tight1 is significantly tighter
- Likelihood has worse performance than WP80.

Id performance: W→ev distribution (E_T>25)



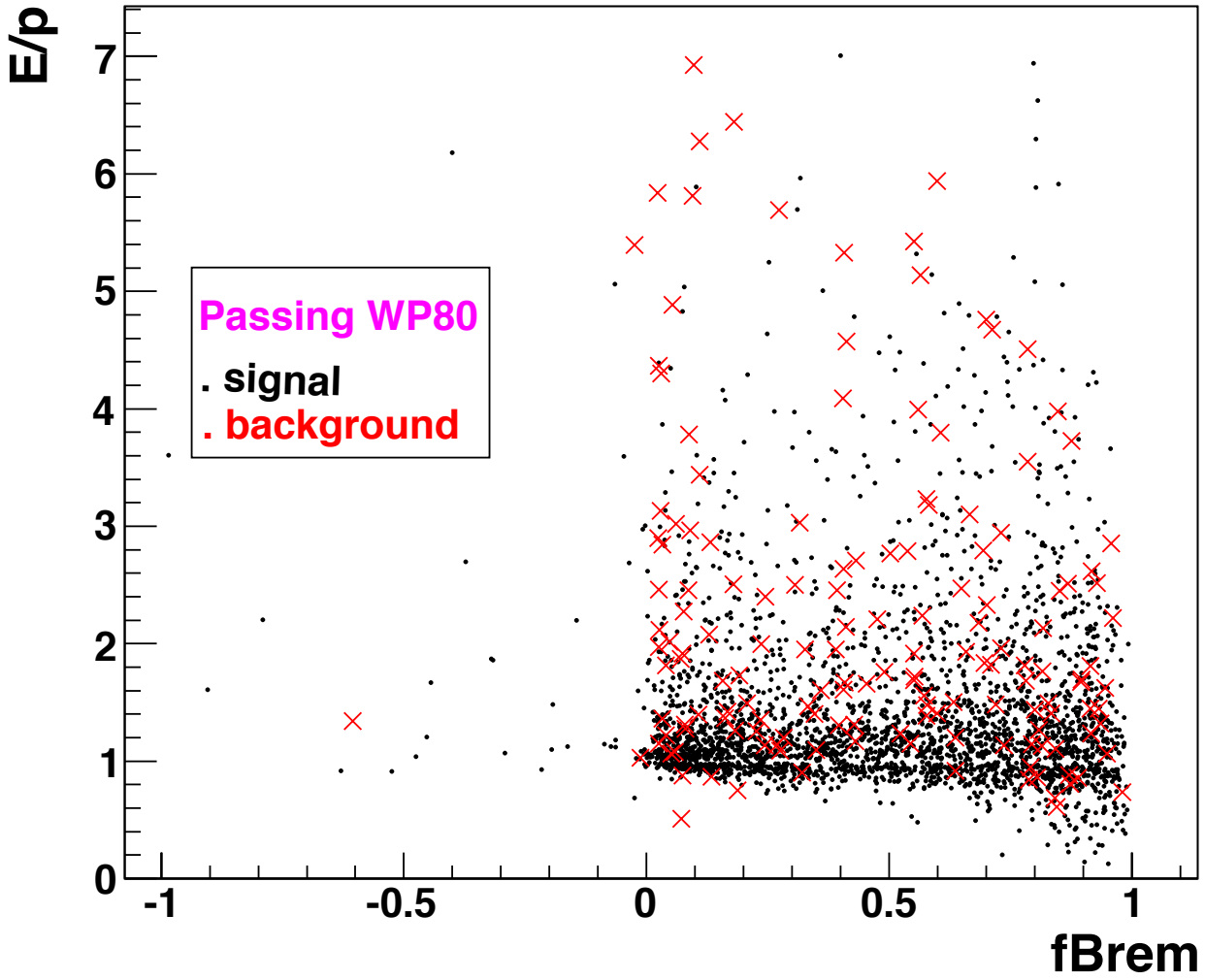
Same conclusions as last slide although higher kinematic cut has improved the signal purity

Id performance: W→ev distribution (E_T>30)



- Now all Ids are performing about the same.
- It seems that for electrons in W,Z sample the E_T-dependent cut in CiC is not any more effective than applying higher E_T threshold and then applying simple cut on isolation, shower shape, and track-cluster matching (+conversion, TIP).

Why dividing in categories helps little for tight select.



- There is some structure to exploit here
  - high E/P low fBrem looks background enriched
  - but not nearly enough.
- Applying cuts in categories does not help much for already quite pure electrons
  - no low-hanging fruit beyond WP80

However, in high efficiency and low purity region the categorization helps. This is where CiC is performing better than WP.