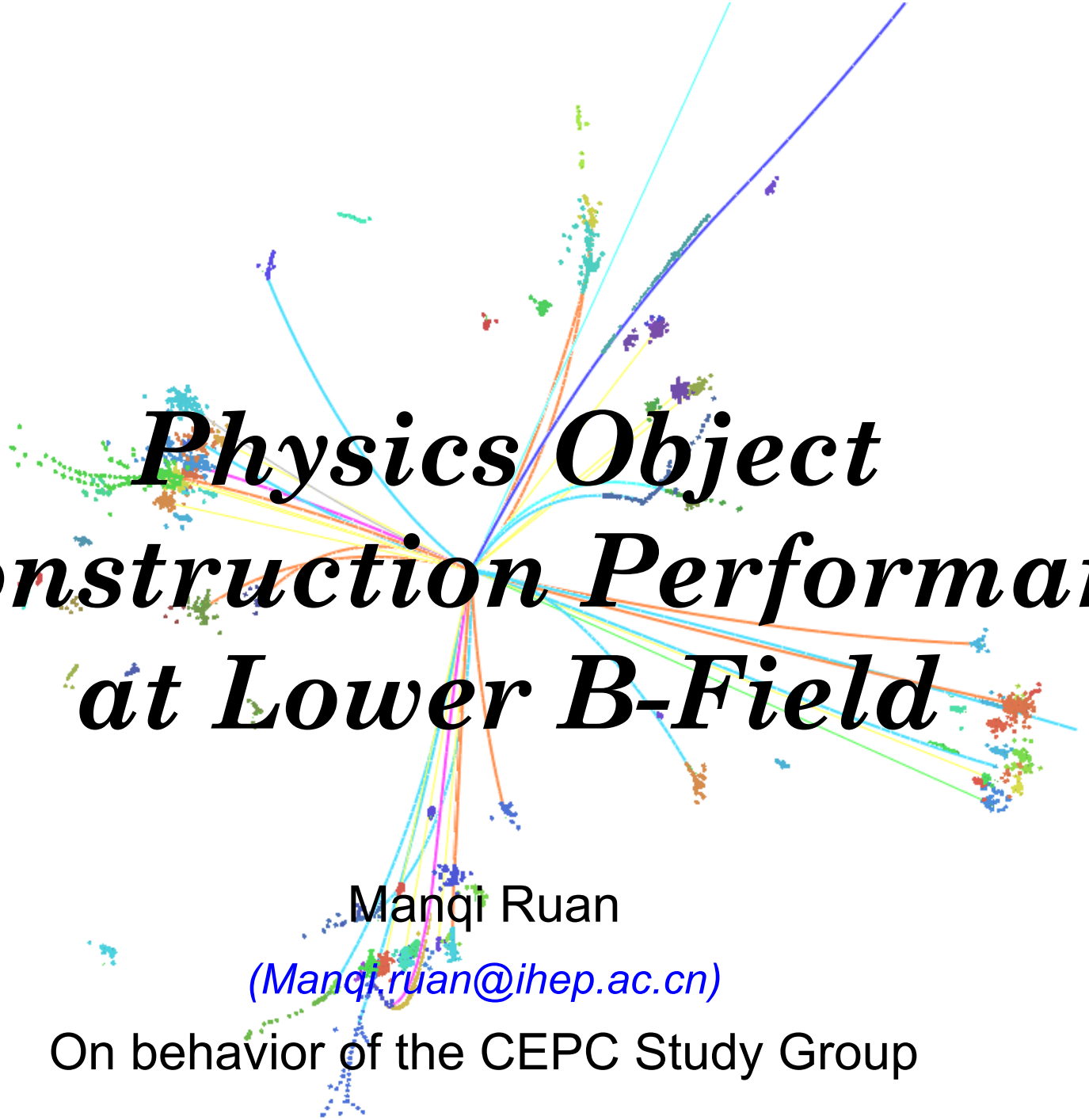

Physics Object Reconstruction Performance at Lower B-Field

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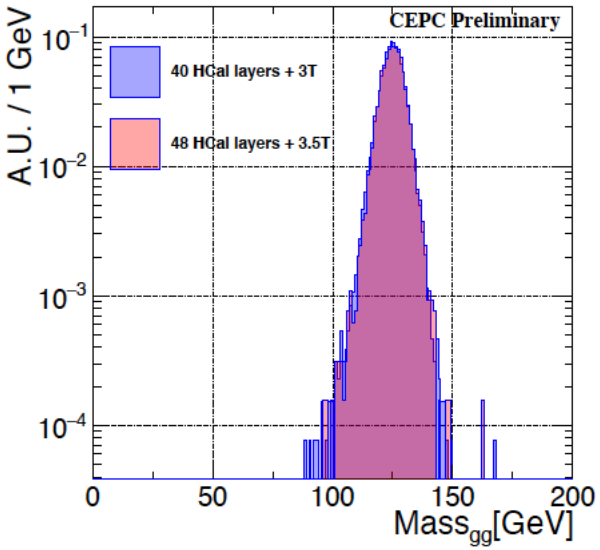
On behavior of the CEPC Study Group

Reducing B from 3T -> 2T

- Tracking: ~30%
  - Momentum resolution degraded up-to 50%.
  - Low momentum track eff. Improves.
- Leptons: No impact
- Kaons: No impact (actually marginally benefit from better tracking efficiency)
- Photon: No impact
- Tau: 5%
  - Separation marginally degraded: as the closest distance set by pi_0
- Jet: < 5%
- Jet Flavor: ~ 10%
  - If the inner radius increased by 50% (as proportional to the 1/B)

JET: characterized by Higgs mass resolution at vvH, H->gluons events



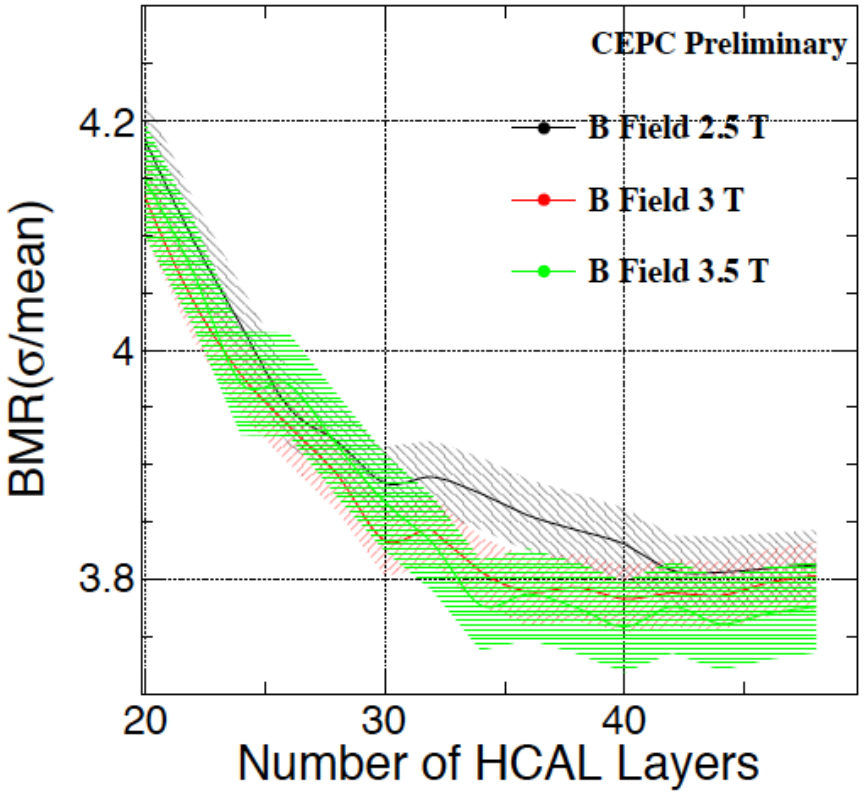


Figure 5.10: The invariant mass resolution of 250GeV $\nu\nu gg$ events in CEPC for different number of HCAL layers.

We have not yet scanned the BMR at 2 Tesla. However I assume the relative difference is smaller than 5%

Zhigang. Wu: Flavor Tagging at different B, Almost flat

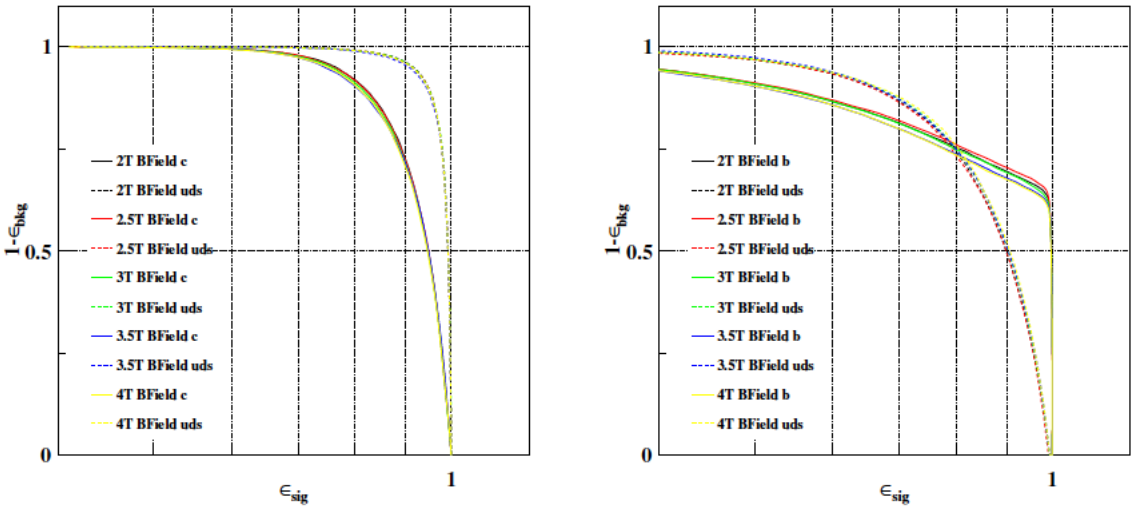


Figure 12: BROC (a) and CROC (b) curve versus magnetic field.

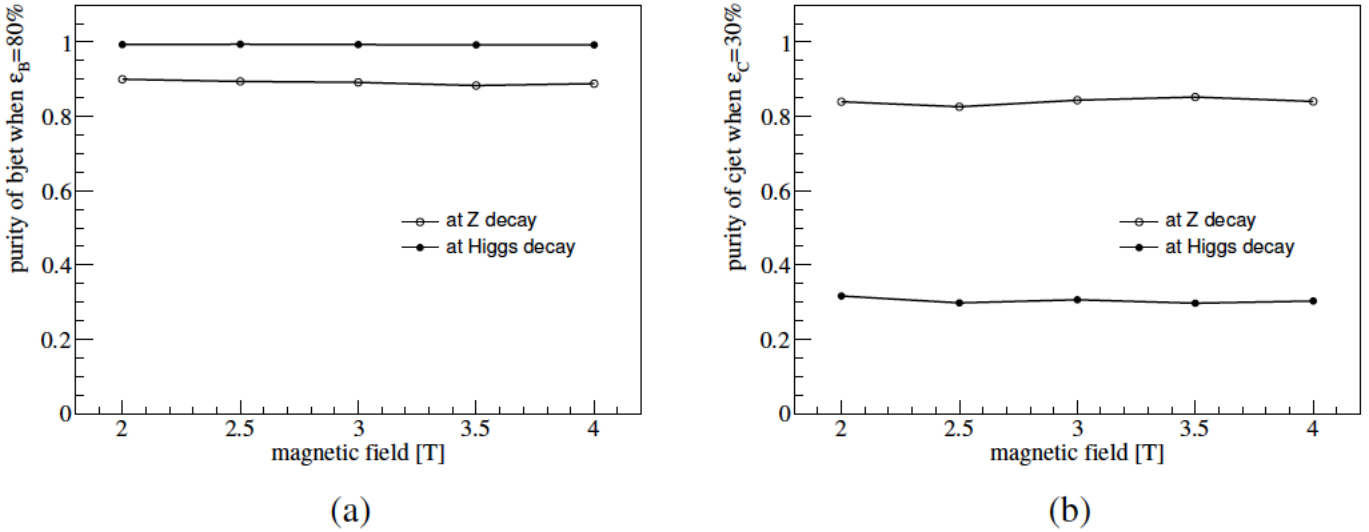


Figure 13: The purity of bjet as function of magnetic field when b efficiency is 80% at Z and Higgs decay (a), the purity of cjet as function of magnetic field for different c efficiency at Z and Higgs decay (b).

Zhigang. Wu: Flavor Tagging at different R_in

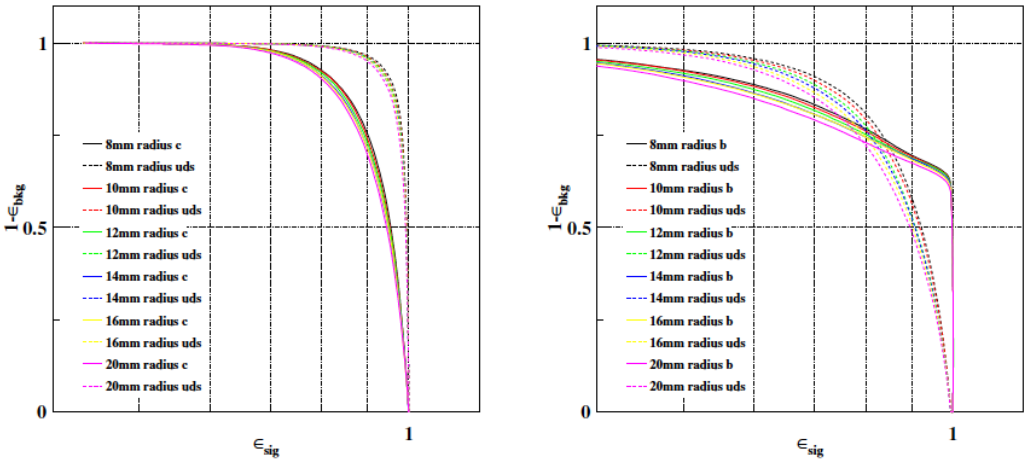


Figure 9: BROC (a) and CROC (b) curve versus inner radius.

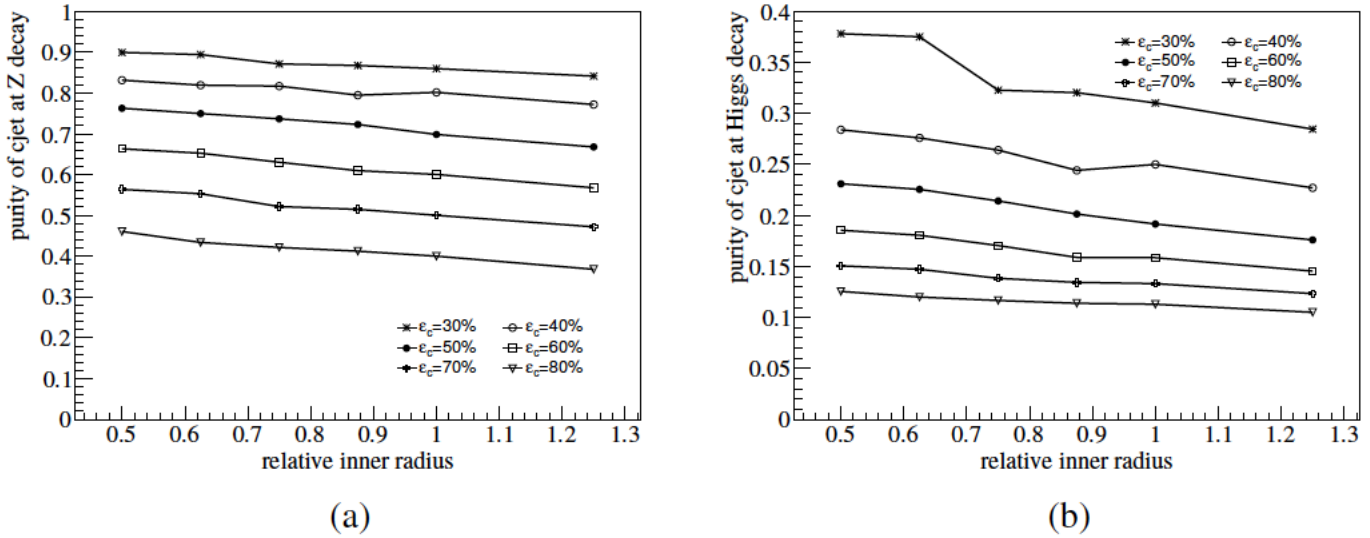


Figure 11: The purity of cjet as function of inner radius for different c efficiency at Z (a) and Higgs (b) decay.

At Z pole

$$Purity_{Z->c\bar{c}} = (1-0.076\frac{\Delta x_{material}}{x_{material}})(1-0.114\frac{\Delta x_{resolution}}{x_{resolution}})(1-0.187\frac{\Delta x_{radius}}{x_{radius}})(1.369-1.135\varepsilon-\frac{0.05355}{\varepsilon}) \quad (2)$$

If the R_in scales as 1/B:

At same efficiency:

Purity of c-jets could be degraded by 10%;

Purity of b-jets could be degraded by 6%

Overall, the performance degrading is smaller than 10%

Conclusion

- A equal-weight average degrading ~ 7%, thus could be compensated by 15% more luminosity
  - Tracks: 30%
  - Lepton: 0
  - Kaon: 0
  - Photon: 0
  - Tau: 5%
  - Jet: 5%
  - Flavor: 10%
- High Lumi: Appreciated by exotic searches
- The impact on systematic & noise should be further evaluated

- A priori: Recommendation 2-Tesla, High Lumi operation for Z pole (As it doubles the luminosity)

Back up

For Higgs, reduce the B-Field

Increase the inner radius would severely reduce the c-tagging performance,

Making extremely difficult for g(Hcc), an already very difficult measurement

Reducing the B-Field also degrade the H->mumu measurement.

$$Purity_{H->c\bar{c}} = \frac{0.092(1 - 0.10\frac{\Delta x_{material}}{x_{material}})(1 - 0.21\frac{\Delta x_{resolution}}{x_{resolution}})(1 - 0.33\frac{\Delta x_{radius}}{x_{radius}})}{\varepsilon}$$

Gut feeling: at Higgs, if the B-Field is reduced by 50%, the luminosity needs to be increased by 50% to compensate its lose in these two channels (but others will benifit)