Impact of detector design on H→hadrons

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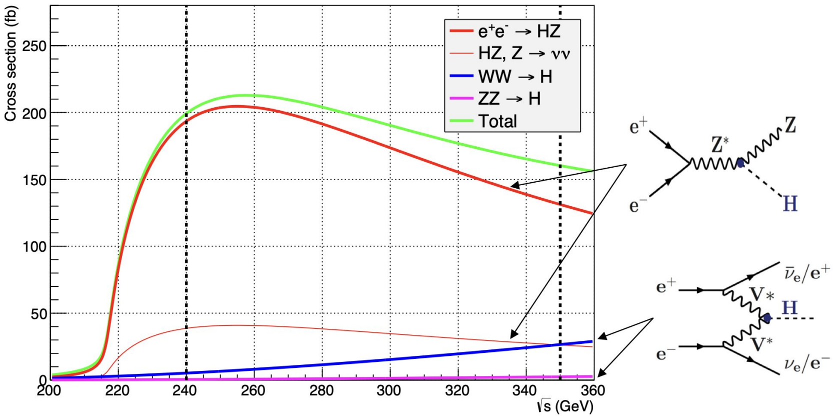
Intro

Physical Overview and Motivation



FCCee @ $\sqrt{s}$ = 240 GeV → Higgs factory

Measure Higgs couplings

Sensitivity on coupling strength modifiers $\kappa_{b,c,s,g}$?

σ(νvH) = 46.2 fb (from Whizard, includes VBF and Z(νν)H)

BR(H→bb) = 0.582
BR(H→cc) = 0.0289
BR(H→ss) = 2.4e-04
BR(H→gg) = 0.819

Most of the sensitivity comes from Z(νν)jj final state

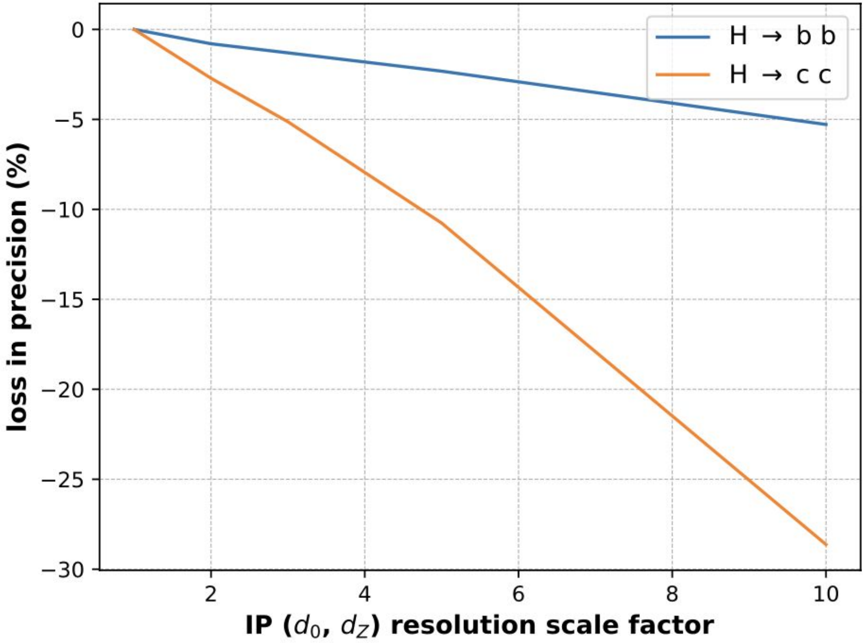
Recap

- H→jj sensitivity (b,c,s) at FCC-ee is expected to be sensitive to detector assumptions, and we ought to design detectors that provide max sensitivity to the channels

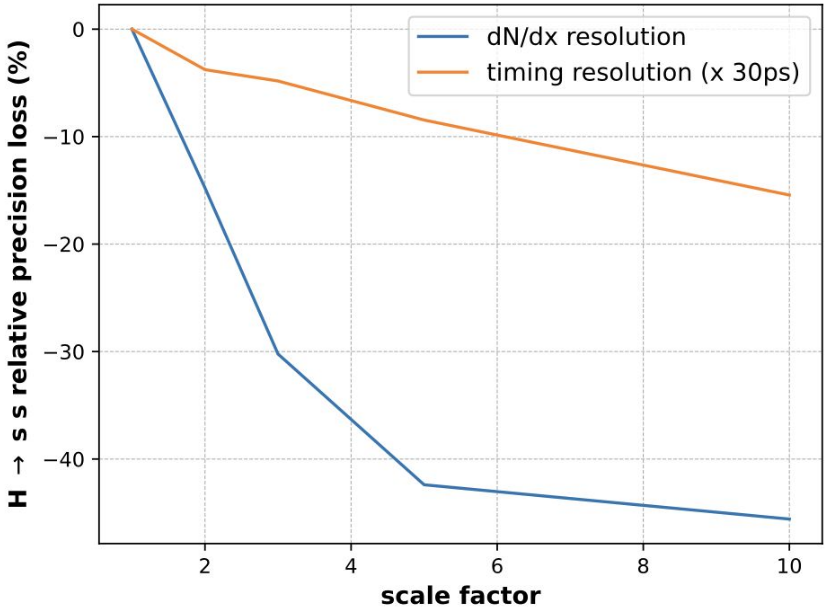
- For the midterm report we studied the impact of on Higgs BR determination:
  - Transverse and longitudinal IP resolution (charm/b-tagging)
  - HCAL stochastic term (visible resolution)
  - Cluster counting and TOF resolution (PID and strange tagging)

- We have been
  - producing alternative scenarios by rescaling/smearing the nominal detector resolution by some varying rescale factor
  - evaluating the jet flavor tagger prediction for the different scenarios.
  - propagating the impact on the measurements

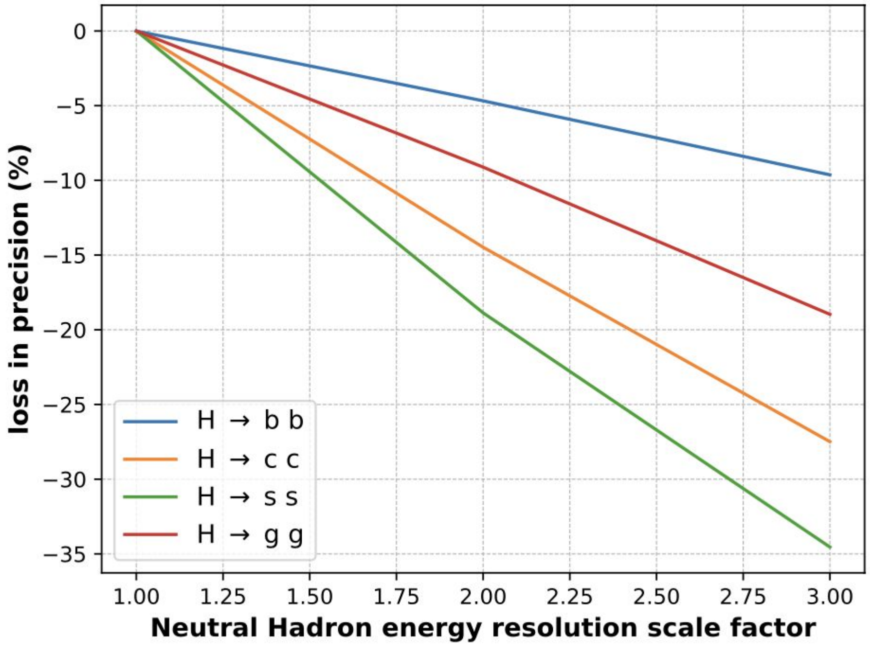
Recap (MTR) - IP resolution



Recap (MTR) - PID performance Hss



Recap (MTR) - HCAL resolution (ALL)



Caveats

- For the PID and Vertex resolution the flavor tagging algorithm was not retrained
    - expected impact on analysis therefore expected to be pessimistic
- The HCAL performance variations have been performed after nominal DELPHES Particle-Flow algorithm
    - sub-optimal since PF needs to be aware of the nominal performance to assign momentum to neutral and charged candidates

Current approach for the FSR

- Present approach for the FSR:
  - Produce samples in DELPHES with actual detector variations (not rescaling)
  - Re-train flavor tagging algorithm with "varied" detectors confgurations
    - caveat: tagger trained with limited statistics and over few epochs
  - Re-run full analysis using tagger tuned to each variation on each varied sample

- Considered set of discrete variations:

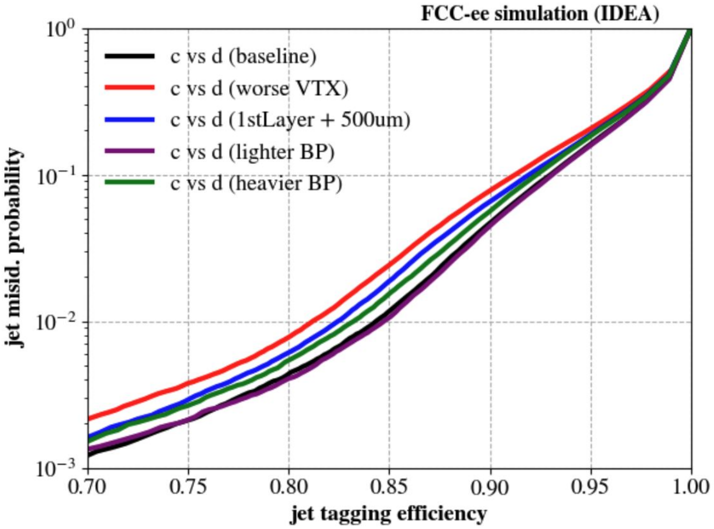
- Vertex/Beampipe
  - Baseline (IDEA)
  - Heavier Beampipe (2x)
  - Lighter Beampipe (0.5x)
  - Worse VTX detector (6 um , and 2x material budget)
  - Distant VTX detector (+0.5 cm al layers)

- PID variations
  - Baseline (IDEA)
  - No PID
  - No mTOF (only dNdX)
  - No dNdx (only mTOF)
  - Perfect PID

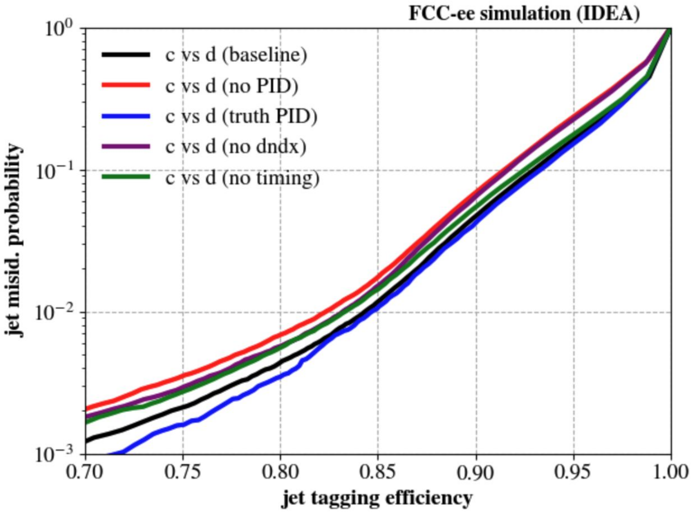
- HCAL variations
  - 30% / √E Baseline (IDEA)
  - 50% / √E (ATLAS-like)
  - 100 % / √E (CMS-like)

Charm Tagger performance

Andrea Sciandra



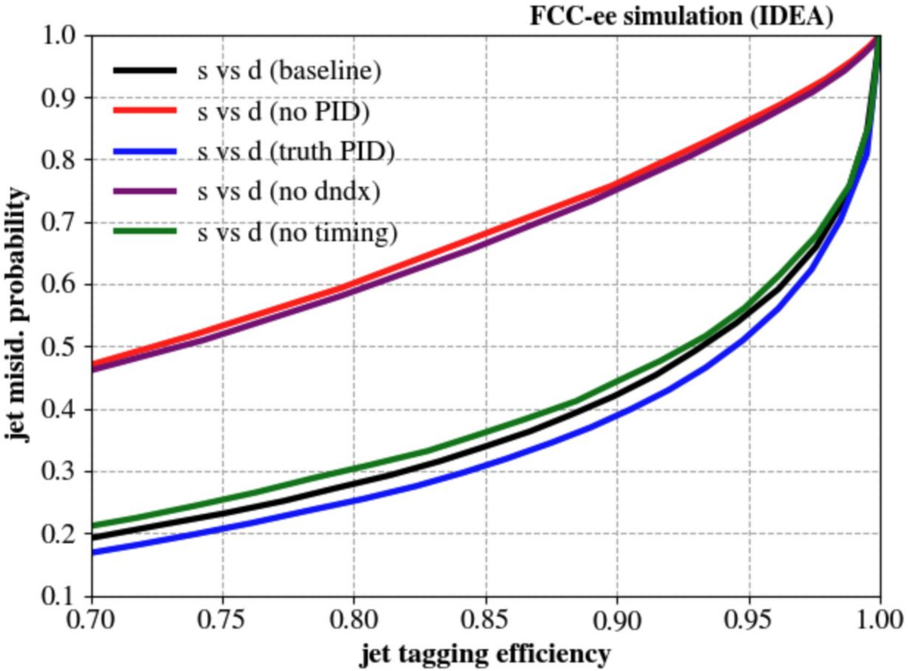
Vertexing



PID

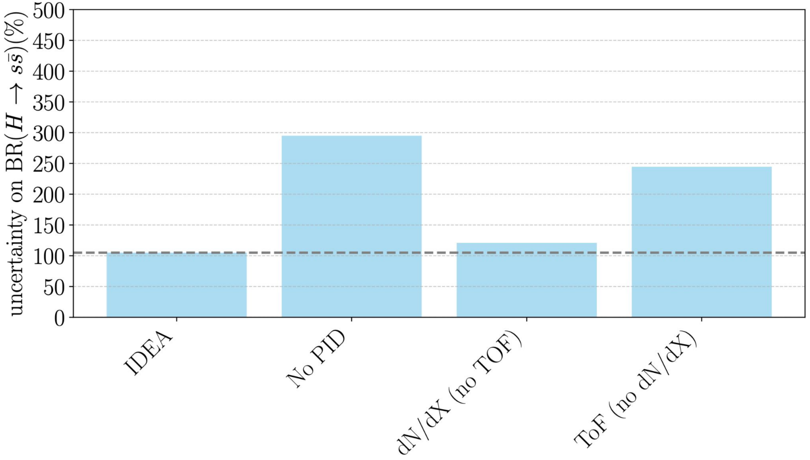
Strange tagger performance

Andrea Sciandra

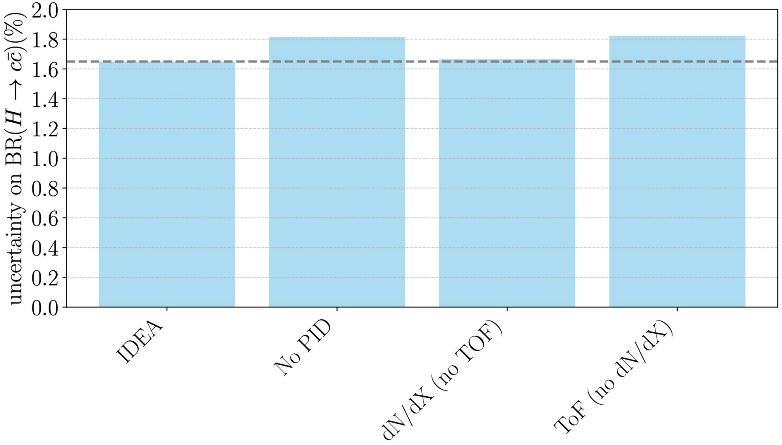


Impact of PID on Higgs precision in Z(vv)jj channel

H→ss



H→cc



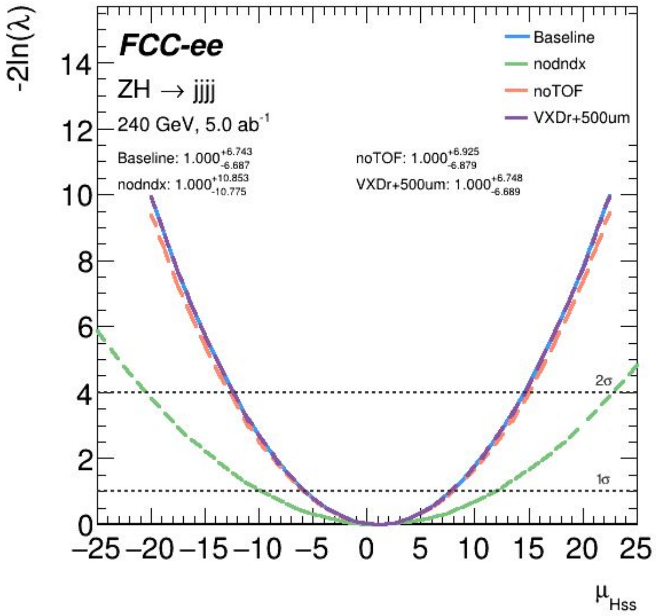
George Iakovidis

Impact on the ZH fully hadronic analysis

Removing PID information

- TOF no significant impact on tagging
- Very large impact from removing dNdX information on Hss coupling
    - 300% worse measurement precision at 68% CL

ZH→jjjj analysis



Iza Veliscek

FUTURE CIRCULAR COLLIDER

Conclusion

- PID has (as expected) large impact on $H \to ss$, mild effect on $H \to cc$
    - Next: re-run the analysis with perfect PID (K/pi from truth)

To DO:

- assess impact of VTX configurations on $H \to cc$ and $H \to bb$
- assess impact of HCAL configurations on all $H \to jj$