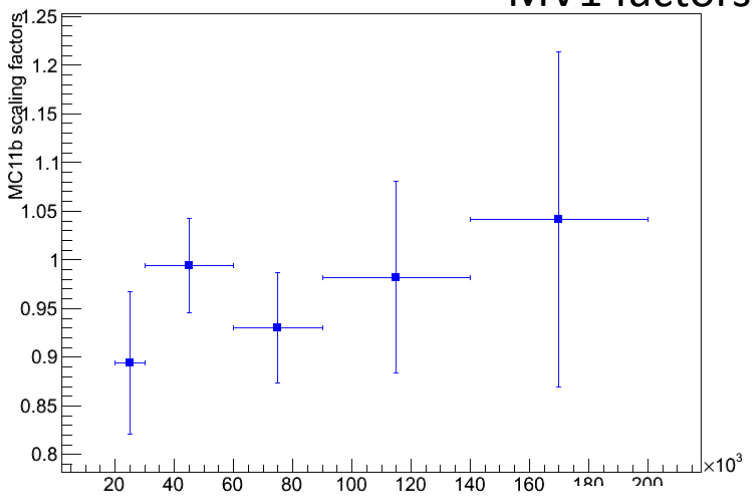
HSG5: work towards Moriond

- H->bb paper for Moriond:
  - WH->lvbb and ZH->llbb:
    - Analysis seems ready. See status here: https://indico.cern.ch/getFile.py/access?contribId=6&resId=0&materialId=slides&confId=167393
    - Possible pitfalls:
      - Fit to W+bb and ttbar to be done inside Roostats – Lianliang promised to do this
      - Use of b-tagging scale factors (MV1) – discussion to happen in editorial board on our proposed method: average pT-dependent SFs and propagate errors?
      - Combination: last time we were kicked out… don't want that to happen again ☺
  - ZH->vvbb:
    - Now meeting twice a week (Tue and Fri)
    - Cut-flow comparison progressing fast
    - Possible pitfalls: Time! Time! Time!
- Boosted VH:
  - Would like to start a note independent of the more urgent issues
    - Data/MC comparisons; comparison with inclusive analysis (expected limit)
    - If possible would like to keep ed.board as much as possible
    - If not done for Moriond then still ok -
  - Plan is to converge with the inclusive analyses for ICHEP
    - Main open question is what we gain from using jet substructure

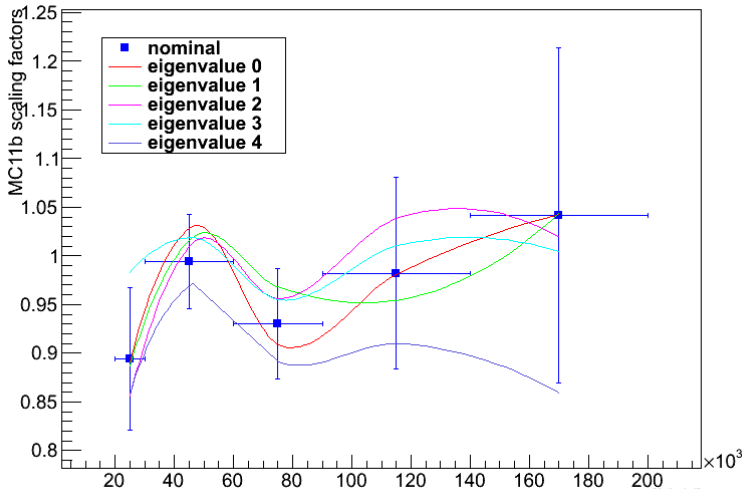
New b-tagging scale factors

- Fresh from the H.F. group:
  - Preliminary!
  - pTrel method only for now
  - May still get updated factors in early February
- We moved to MV1
  - Larger pT dependence now
  - What do we do with our recipe to apply SFs and estimate uncertainties?

MV1 factors

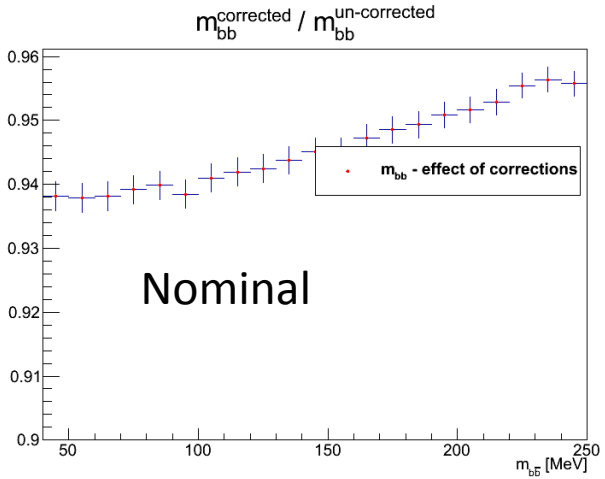


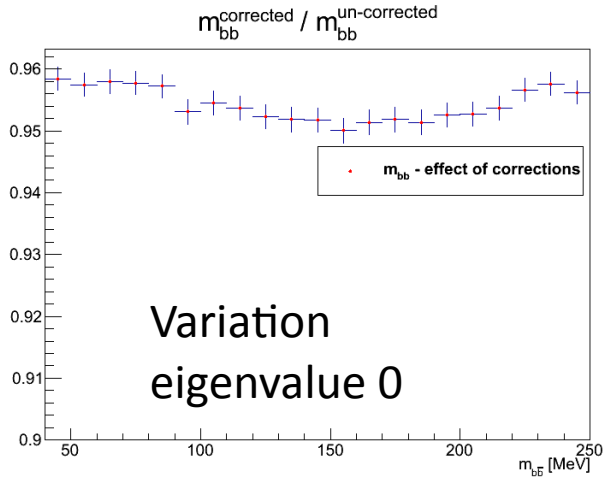
pT [MeV]

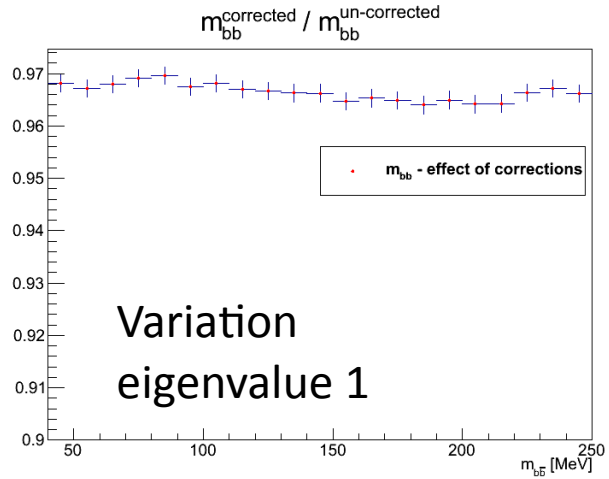


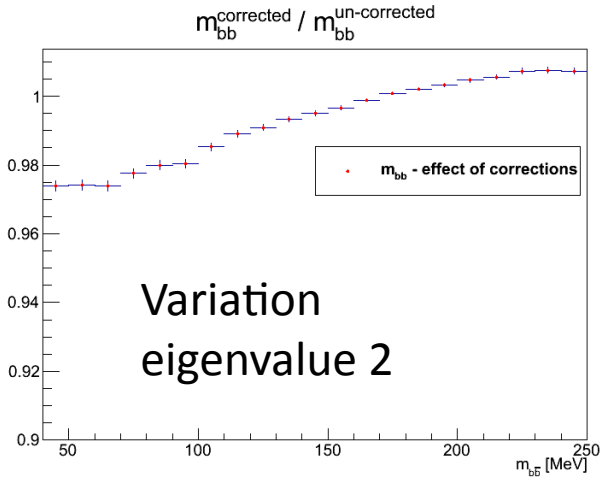
pT [MeV]

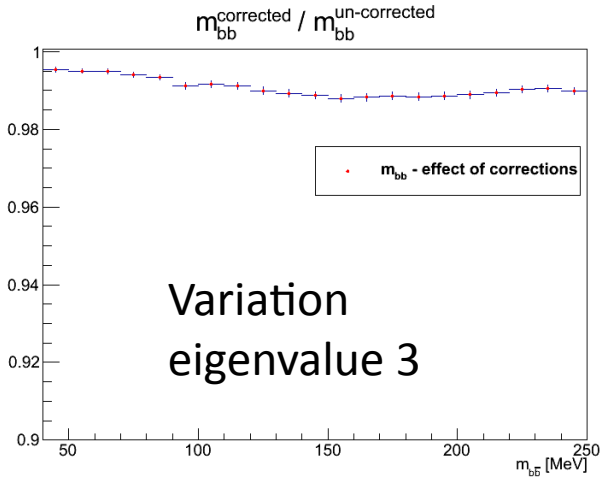
Effect of new b-tagging scale factors

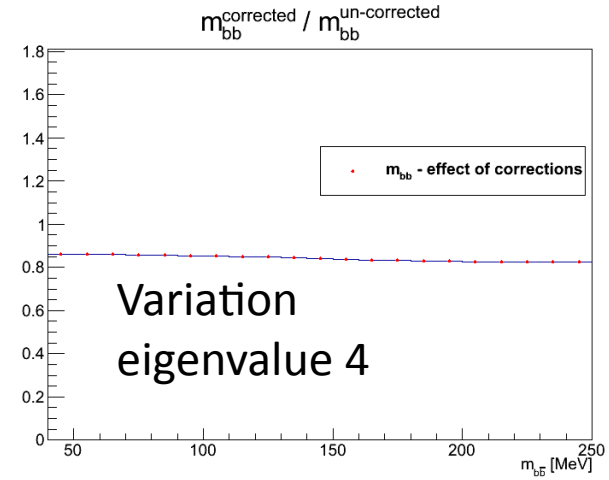








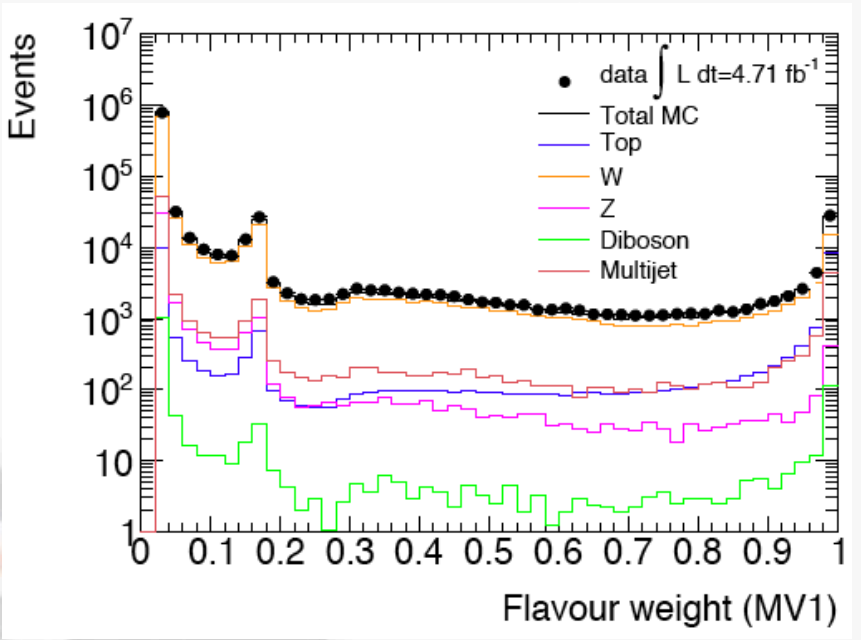


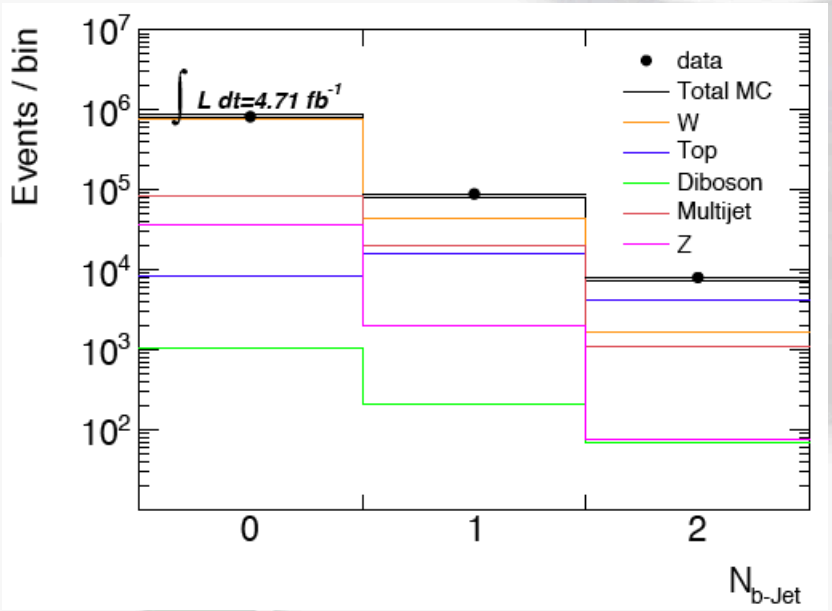


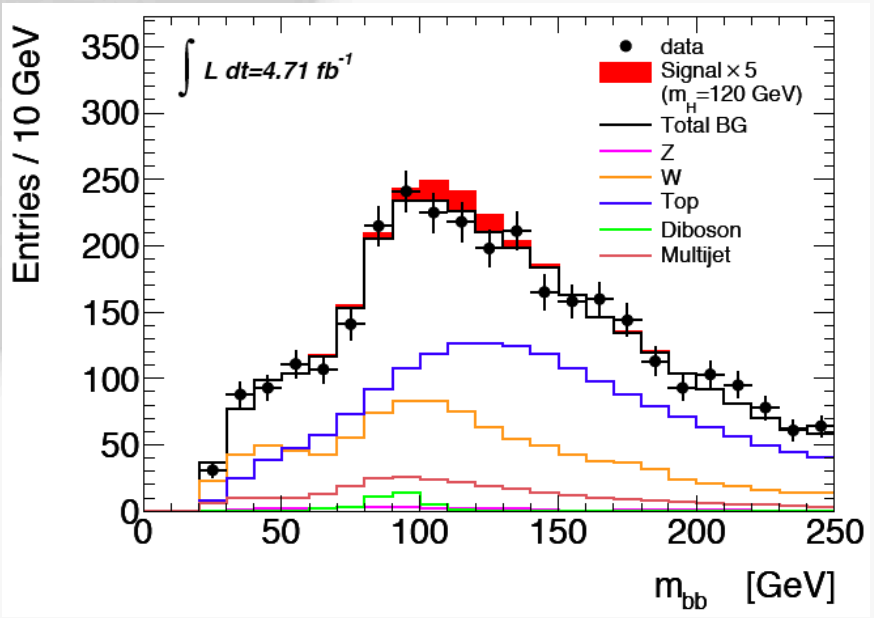
Backup

Current status

- Expect exclusion of around 3.5-4 x SM for m(H)=120GeV
- ZH/WH analyses just moved to MV1 and all looks ok so far
- But lots still to do before Moriond…

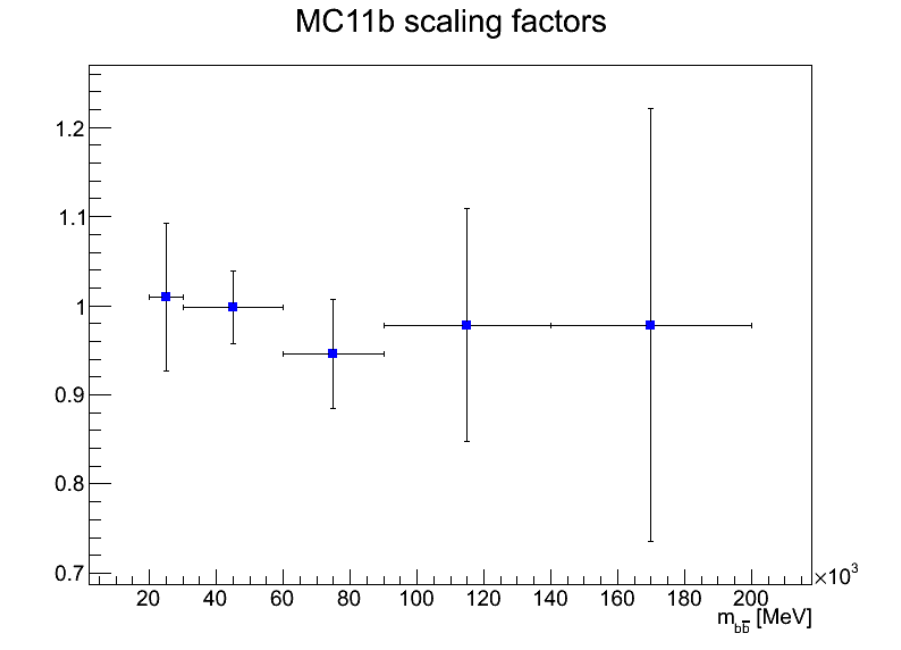






Effect of *b*-tagging Scale Factors on M_{bb} distribution

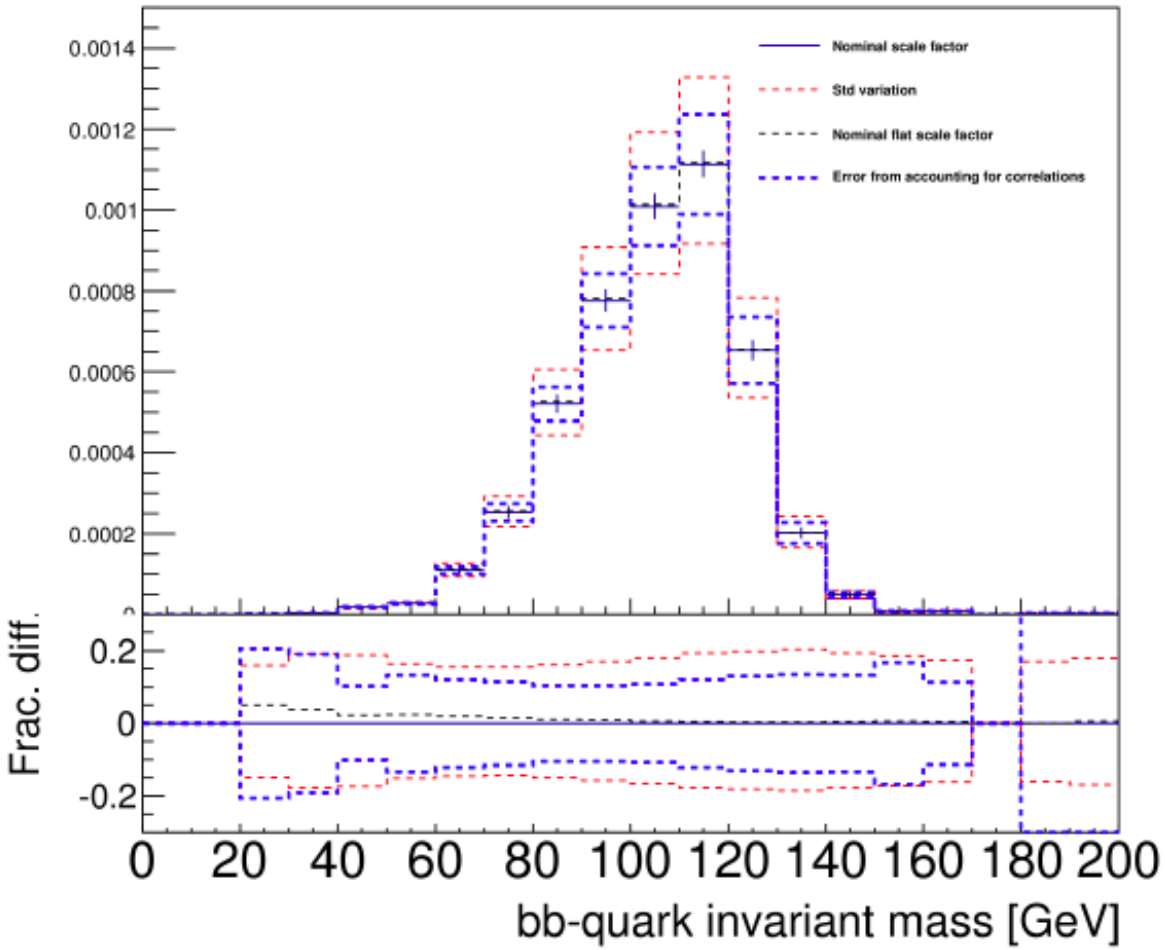
- B-tagging scale factors enter the analysis as a weight for each b-jet, and depends on jet p_T
- This introduces a distortion in the jet p_T distribution
- …which potentially introduces a distortion on the shape of the invariant mass
- May be important since we are looking for a small excess in the form of a wide peak in m(bb)
- We propose to average scaling factors propagate SF uncertainties into systematic uncertainties
- The MC11b scaling factors at present show little evidence of a p_T dependence
- But such a dependence would clearly be possible



Effect on WH signal

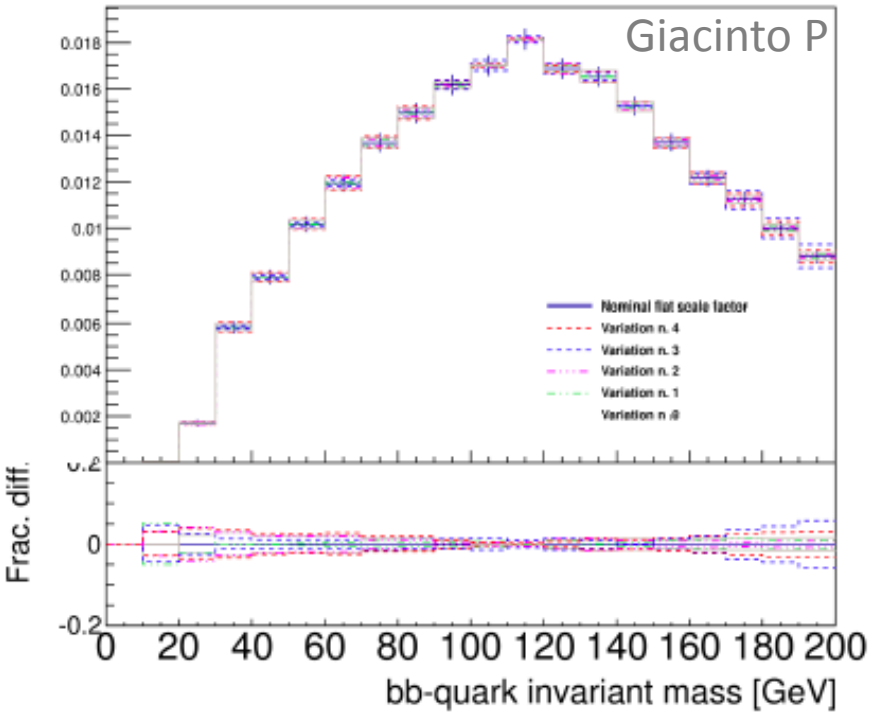
Giacinto P

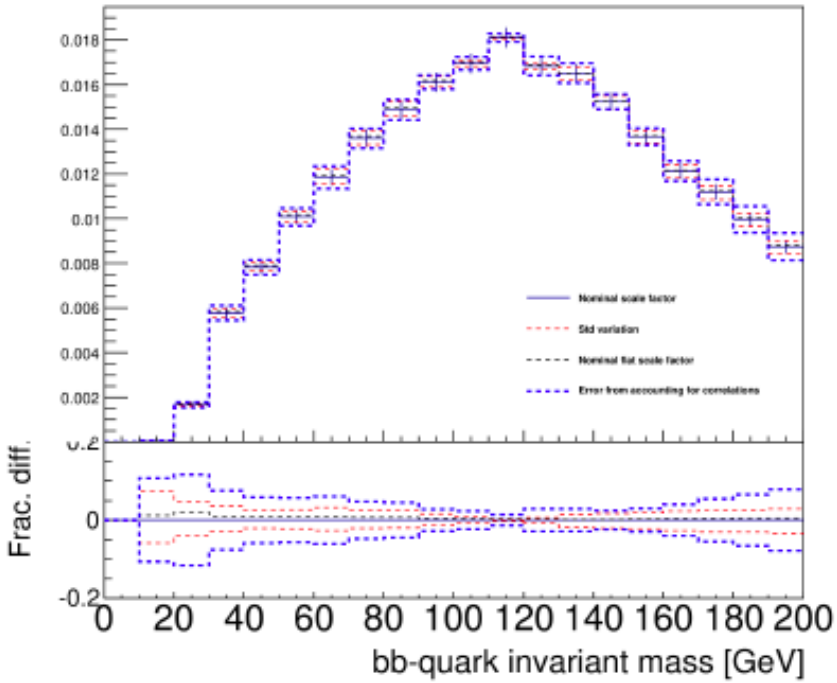
- Estimate b-tagging uncertainty on true b- and c-jets:
  - vary scale factors 5 times up and down according to eigenvectors of measured covariance matrix from pTrel
- Compare:
  - Red: „std“ method
  - Blue: new method
- The overall signal uncertainty changes from **~18%** to **~11%**.
- B-tagging scale factor uncertainty among bins is largely uncorrelated (e.g. due to MC statistics)



Effect on ttbar background

- Here what matters for us is the effect induced on the shape, not the normalization
- To estimate the effect, normalize again after each variation.
- Combine by summing up in quadrature and compare **new** with **old** method
- Systematic uncertainty on shape increased by factor ~2
- Similar behaviour expected for the Wbb background

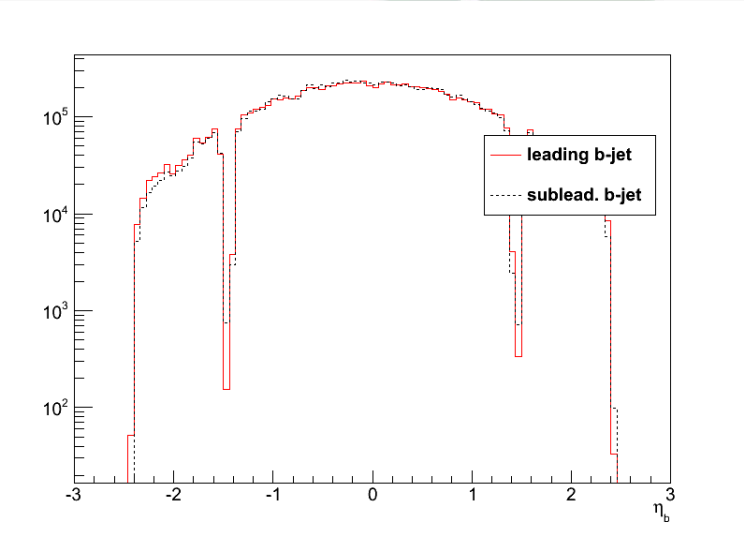


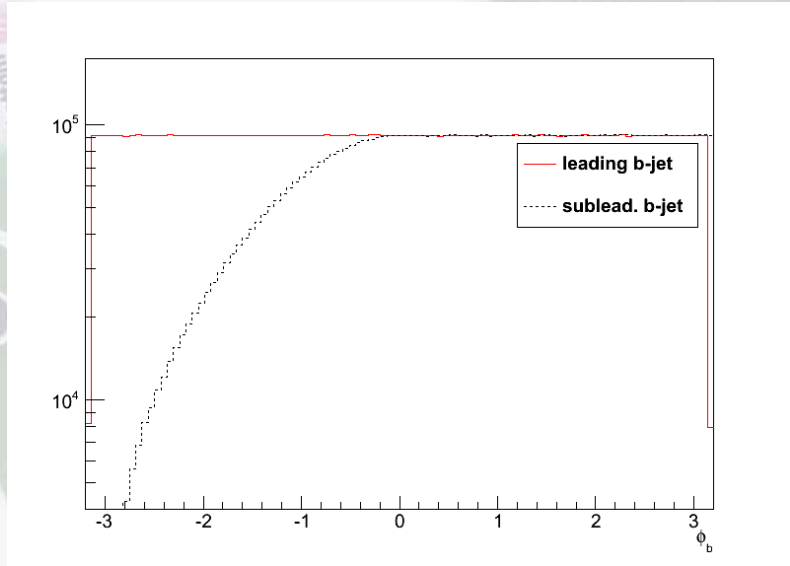


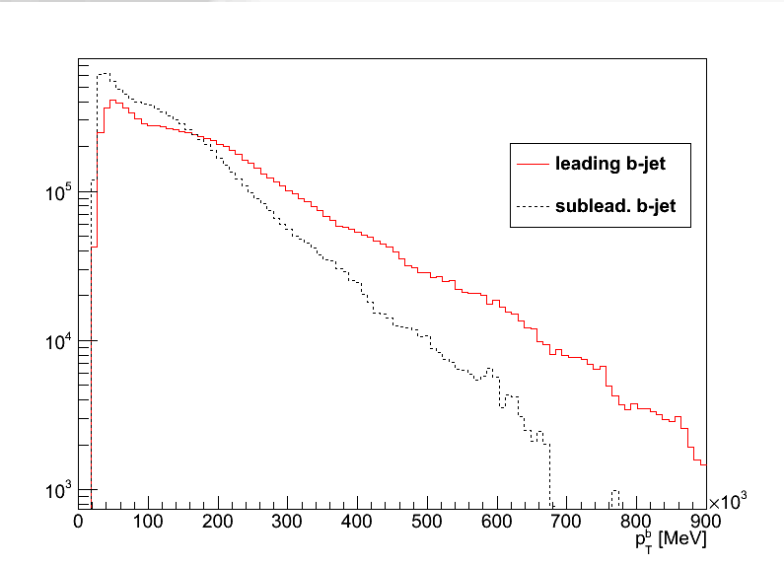
Toy Monte Carlo study of mass distortion

- Toy MC to study the effect of b-tag scale factors
- Caveat: first study done with di-photon MC kinematics – a look at bb background later

1. Sample p_T and η of leading and subleading b-jets
2. Generate flat $\phi_{\text{lead b-jet}}$ and flat mass distribution
3. Calculate $\phi_{\text{sublead b-jet}}$ to be consistent with generated mass (and reject unphysical solutions

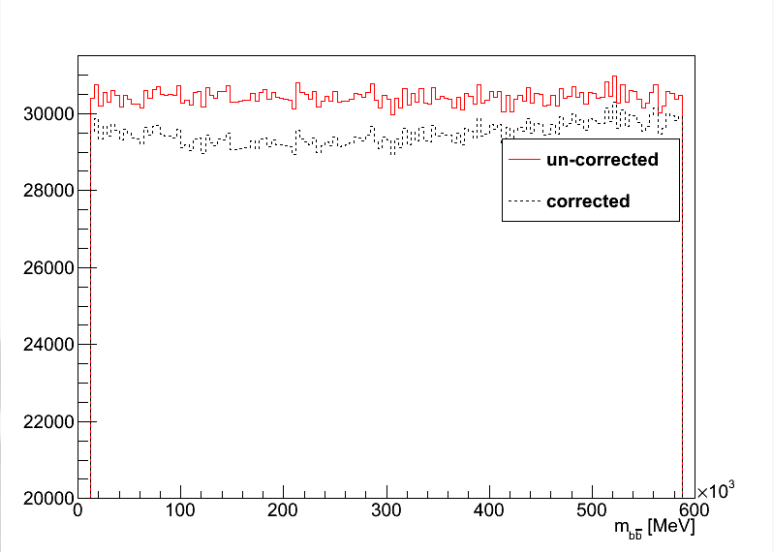


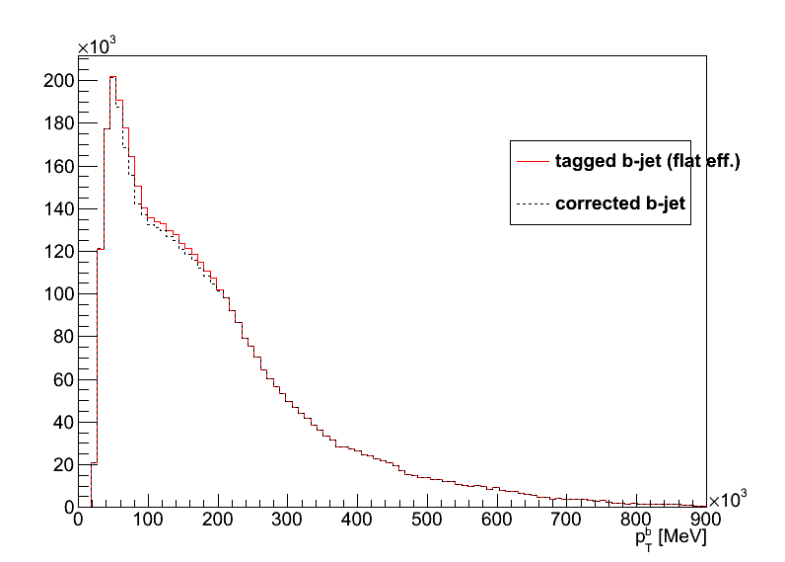


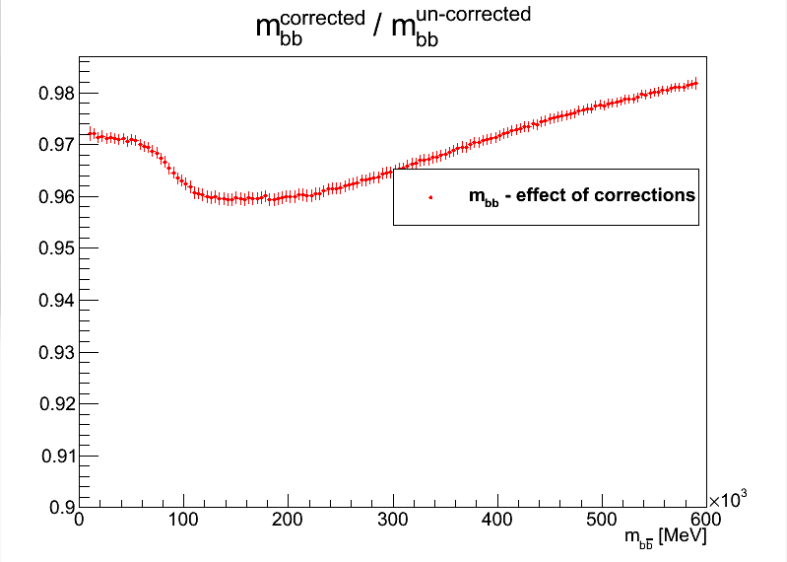


Effect of MC11b scaling factors

- The reweighting causes a distortion in the flat invariant mass distribution (plus constant term)
- The distortion is small, but then so is our signal compared to the background
- May be more serious if width comparable to m_{bb} resolution, as in our case ($\sigma_{m(bb)} \approx 20$GeV)

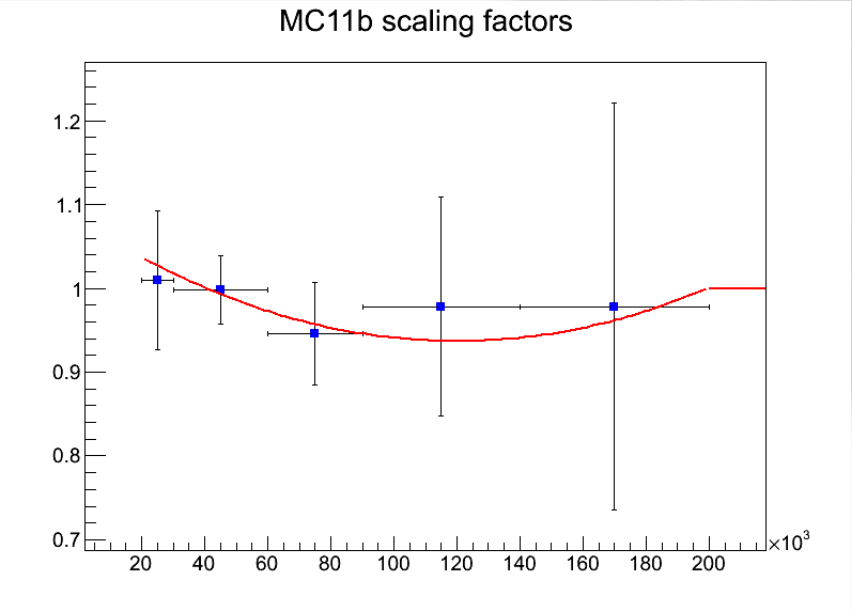


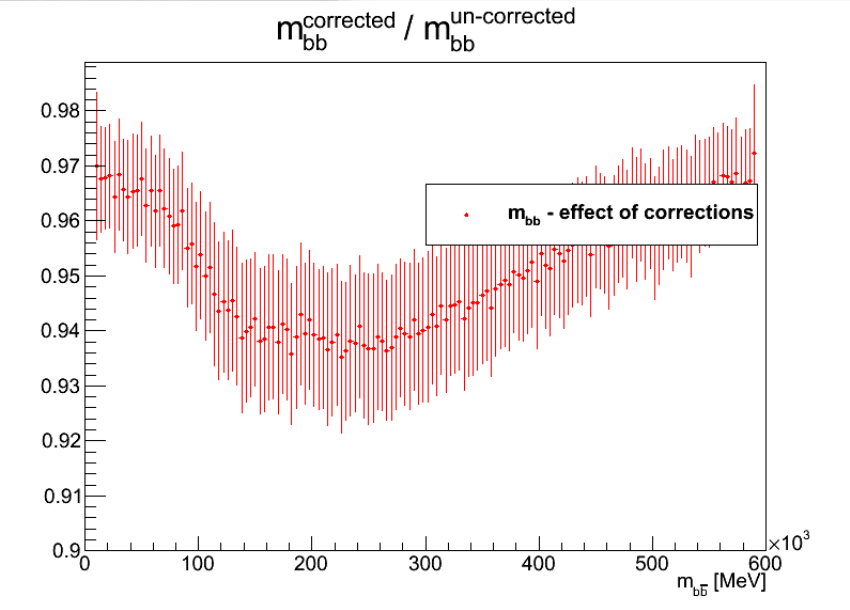




Binning effect?

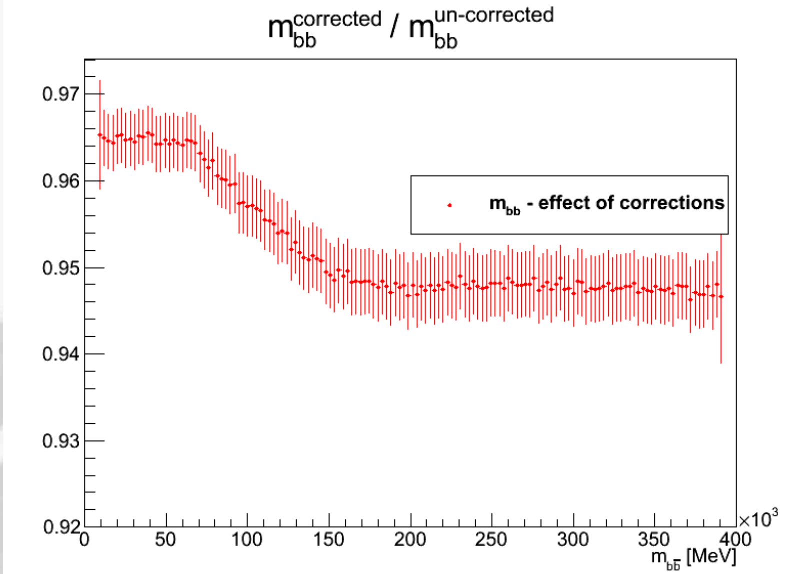
- To see whether this is an effect of the binning, fitted scaling factors (SF) with a parabola (and $\mathbf{W_b}$=1 for p_T^b>200GeV)
- Still get similar distortion => not (only) binning effect

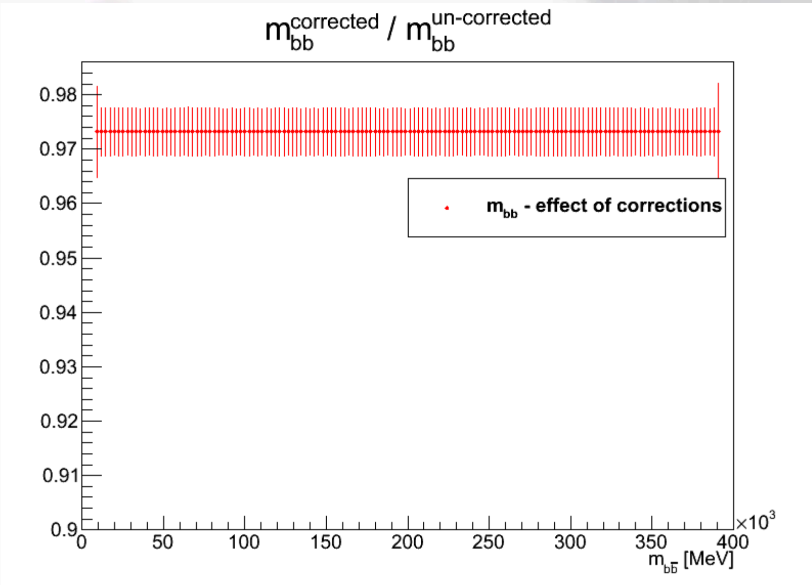


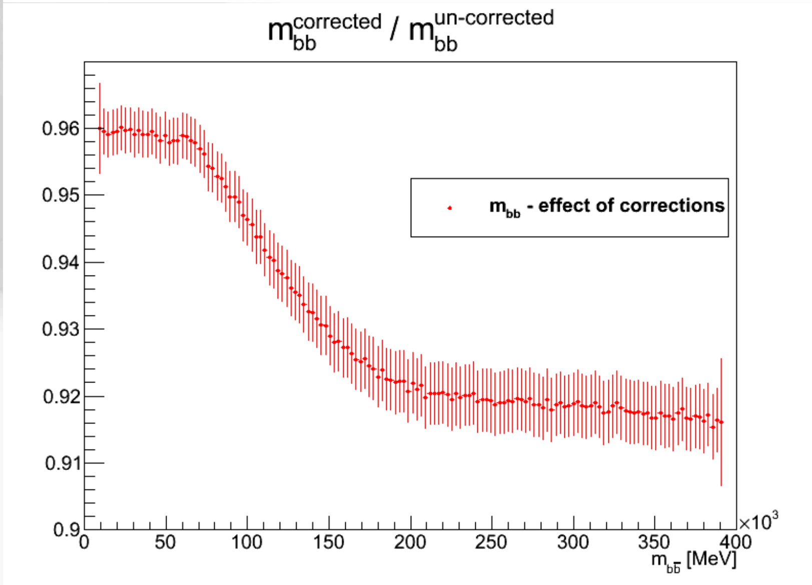


Results using background kinematics

- Basically same conclusion:
- MC11b scaling factors distort mass distribution (top right)
- Even if a parametrization is used (bottom right)
- Our averaging procedure removes shape distortion (bottom left) – note zero distortion in this case only due to jet pT cutoff at 200 GeV!

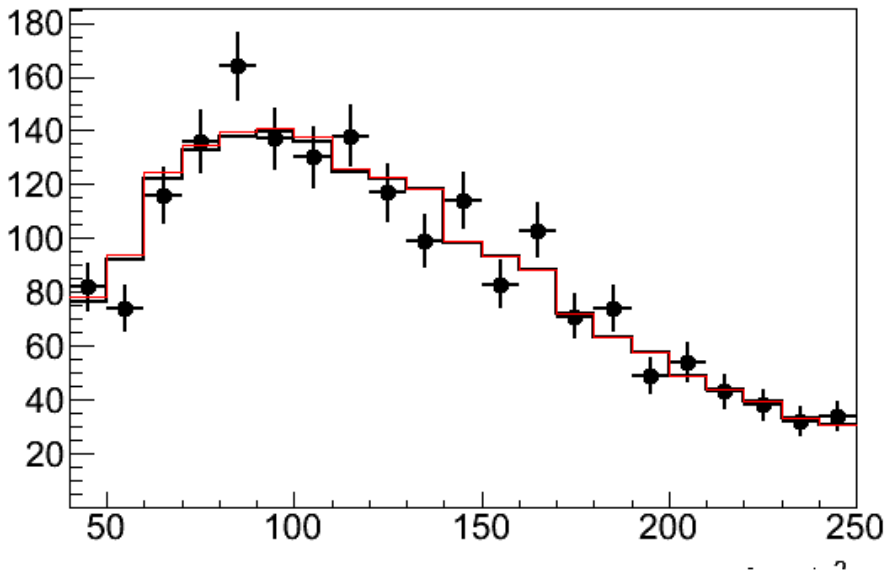


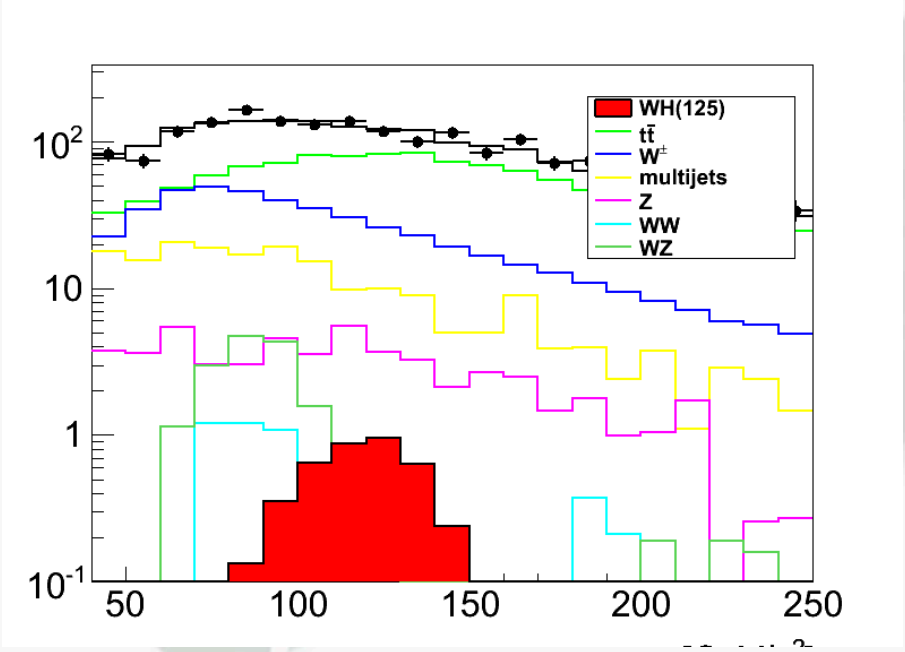


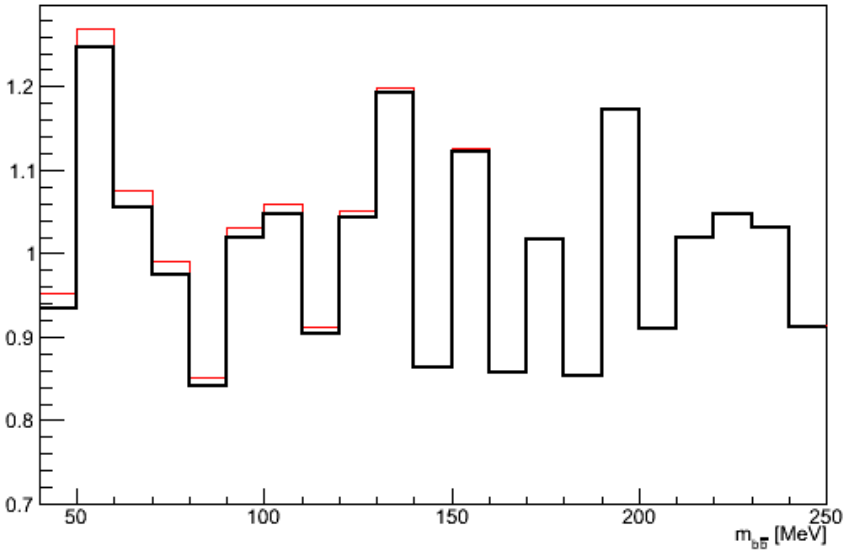


Effect on final distribution

- Well… the effect is small, but is there
- Tried applying distortion on 1fb^{-1} mass distribution







Conclusions

- These are interesting times for Higgs and H->bb!
- We depend critically on the b-tagging performance (BIG THANKS everyone!!!)
- Looked at distorting effects from p_T dependence of the b-tagging scale factors
- A method for removing the mass distortion in JFC scale factors exists and works
- May need to think again depending on what you find for MV1