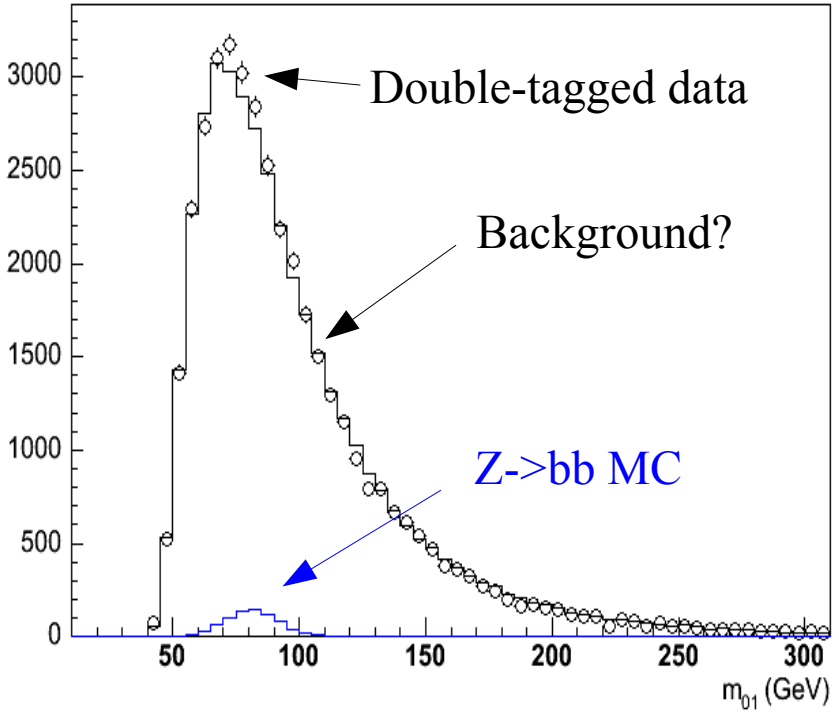
p14 Z->bb for ICHEP

Andy Haas (Columbia U. / Nevis Labs)
Per Jonsson (Imperial, UK)

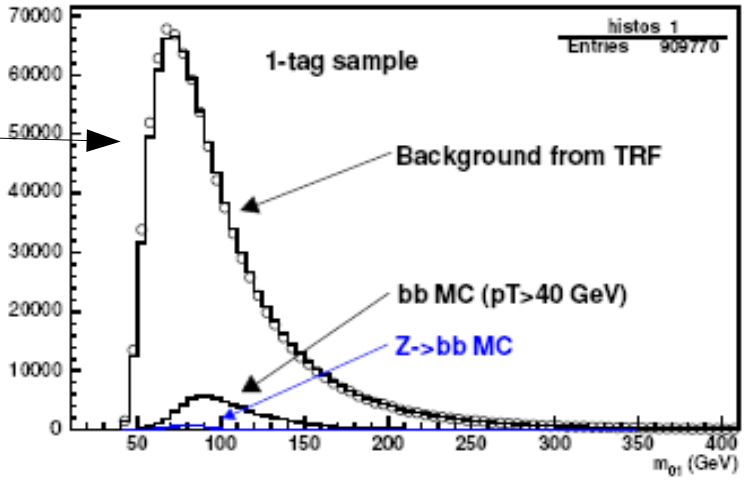
- Method reminder
- Signal expectation
- Cross-checks

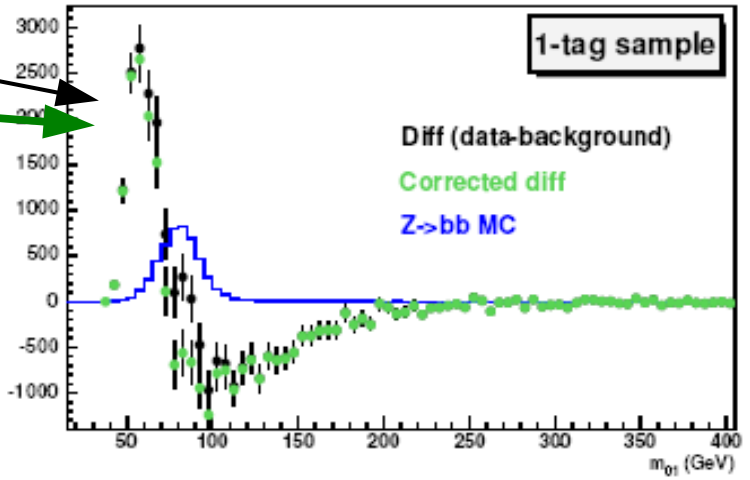


We're trying to pull a signal out of a HUGE background !!!

The 0->1 shift

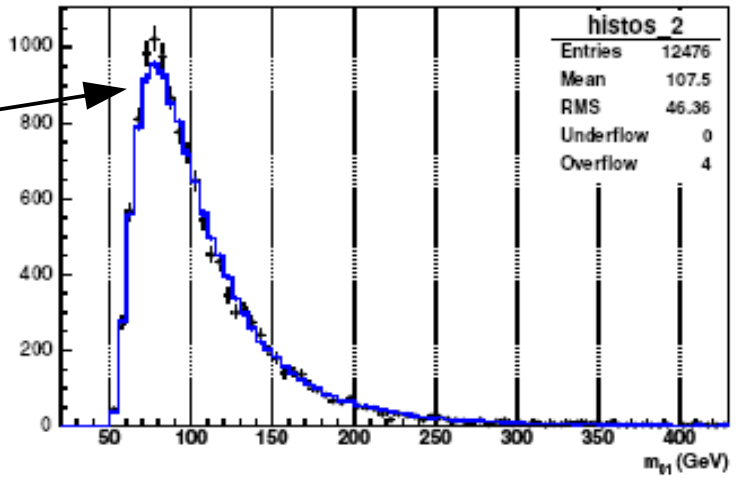
- Derive a TRF from the untagged data
- Apply back to the untagged data
  - You don't get back the single-tagged inv. mass spectrum !!!
- There is a shift in inv. mass, coming from correlations between the jet kinematics and b-tagging rates within events
  - difference between b- / light- jet energy scale?
  - difference between bbbar / light-qqbar cross-section vs. inv. mass?
  - ???
- The shift is not the result of Z->bb, to first order
- Measure this shift, and call it the "0->1 shift"
- The effect of Z->bb is accounted for, and we call it the "corrected 0->1 shift"
  - (details on later slide...)

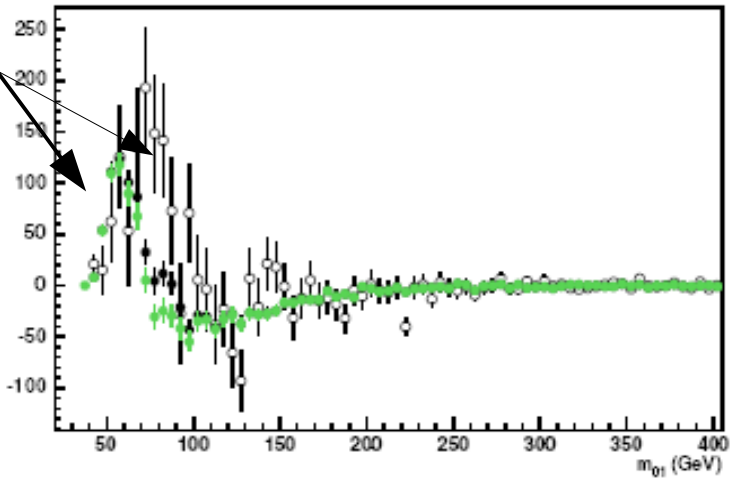




The 1->2 inv. mass difference

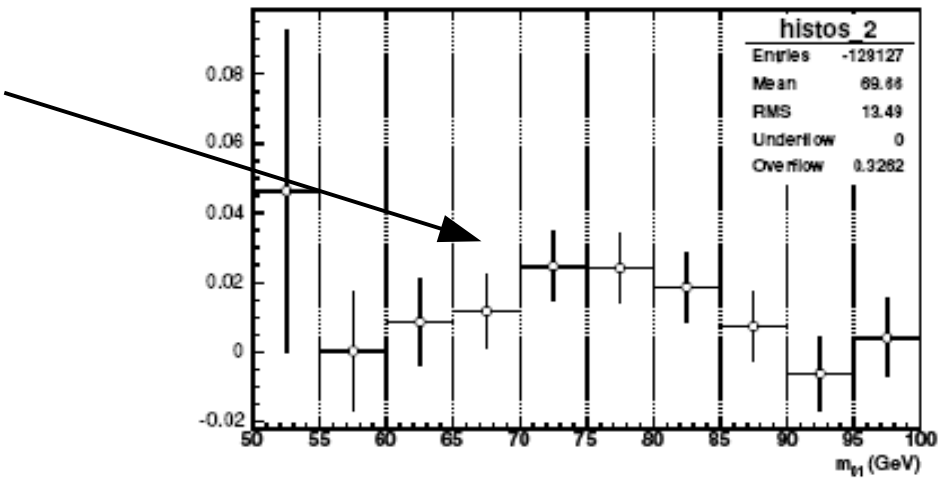
- Derive a TRF from the single-tagged data
- Apply back to the single-tagged data
  - You don't get back the double-tagged inv. mass spectrum !!!
- There is a shift in inv. mass, coming from correlations between the jet kinematics and b-tagging rates within events
  - This shift is assumed to be the result of the same effects which caused the 0->1 shift
- After *removing* the 0->1 shift, *there* is also evidence of a remaining peak, assumed to be from Z->bb
- The effect of Z->bb is accounted for, and we call it the "corrected diff"
  - (details on next slide...)

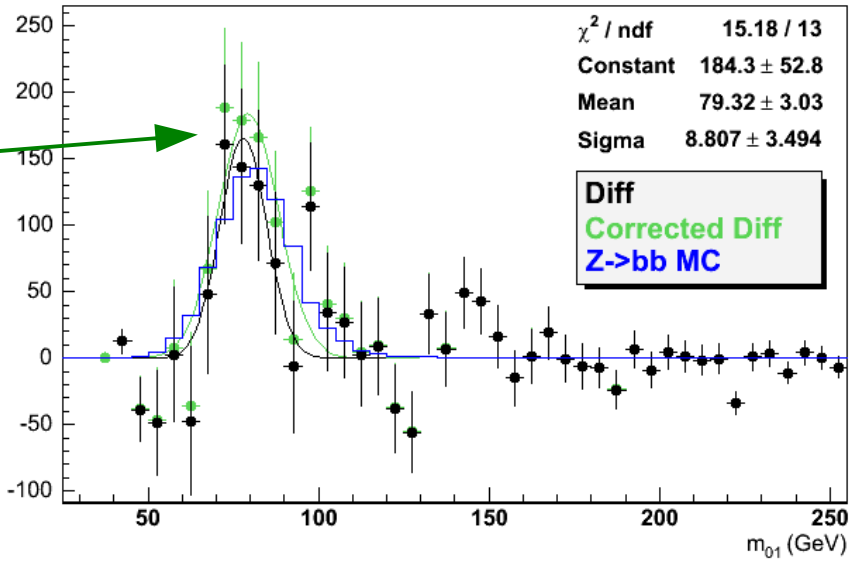




Correcting for Z->bb in 0, 1 – tag samples

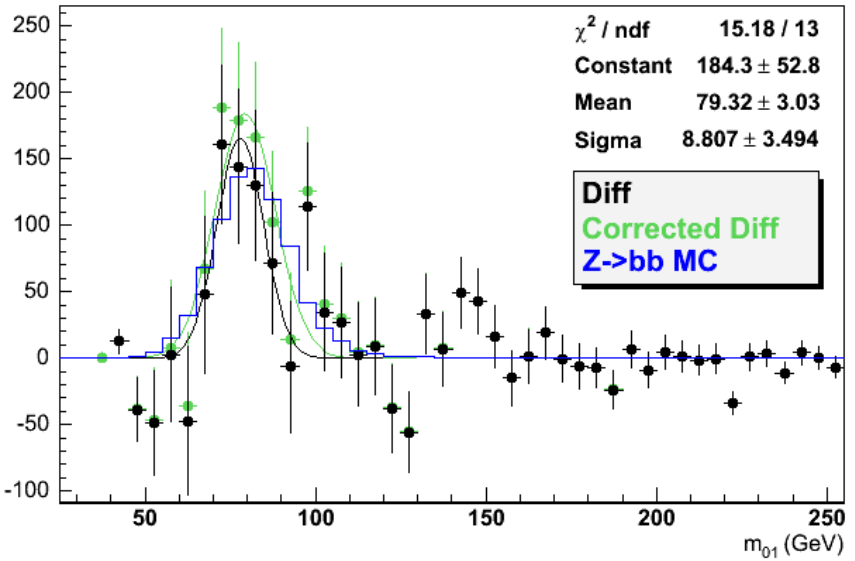
- An initial measurement of the Z->bb peak is made
- The fraction of Z->bb in the untagged and single-tagged samples is estimated from the fraction measured in the double-tagged sample, using Z->bb MC
  - The MC is only used for estimating the b-tagging rates! It is not used for measuring the shape of the signal at all!!!
- This Z->bb fraction is then removed from each event used to derive the TRFs in the untagged and single-tagged samples
  - Each event is weighted when deriving a TRF by 1-f, where "f" is the fraction of Z->bb events in that sample for that inv. mass bin
- Since the corrections are made to the TRFs, they correct the 0->1 shift and also the expected background in the double-tagged sample
- The correction affects slightly the observed size and shape of the excess in the double-tagged sample
  - Therefore, this new excess is then used to re-derive the correction, which changes slightly the size and shape of the expected excess again, so this new excess is used to derive the correction…
  - After 3 iterations, the size and shape of the excess is stable





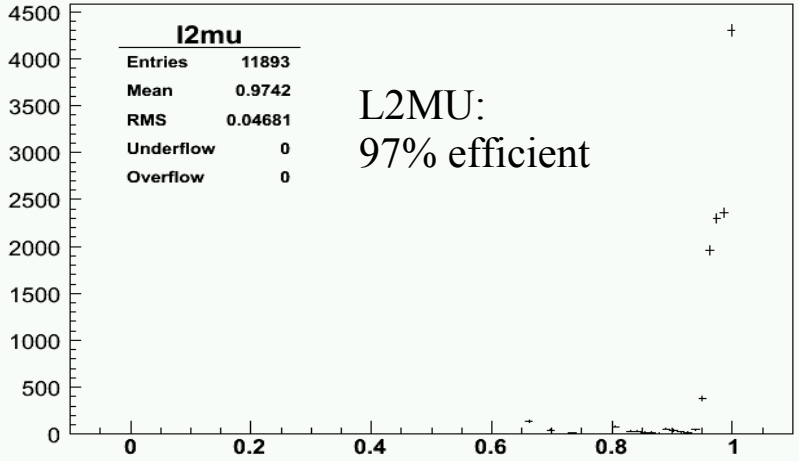
Signal Observed vs. Expectation

- What do we expect from Z->bb in the SM ?
- Selection efficiency is: 732/244250 = 0.3%
- Expected events is: 0.3% * 1180 *300 = 1061
- However, this does not account for trigger efficiency
  - We are not selecting by trigger, so are using a giant OR of terms
  - Main term is muon+jet triggers, like MU_JT20_L2MO: MUW scint + CJT(1,3)
    - MUW scint term is 82% efficient per loose offline muon, averaged over phi (large degredation at bottom hole), as determined from J/Psi in p14 muon certification note
    - L2/L3 terms are >95% efficient after offline selections
  - Final trigger efficiency is estimated to be: 80+-20%
- So, we finally get: 1061 *0.80 = 850 events



810+-230 events observed

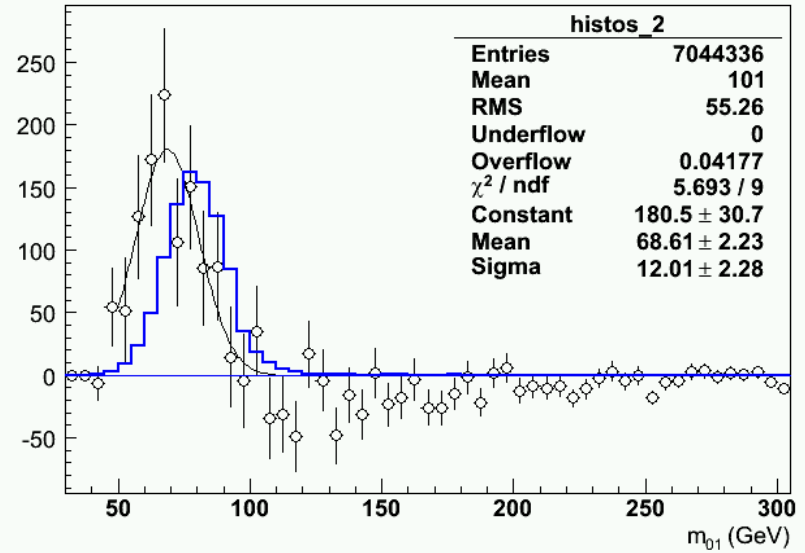
Analysis Cut	Number of Events Passing Cut, pre-v13
No selection	244250
At least one PV	242963
PV ntrk >=4	240900
PV z in ±35 cm	208153
Exactly 2 jets	103201
Both jets' p_T>20 GeV	77982
$\Delta\phi$>2.9	59097
Double b-tag	5828
Loose muon match (p_T>4 GeV)	732

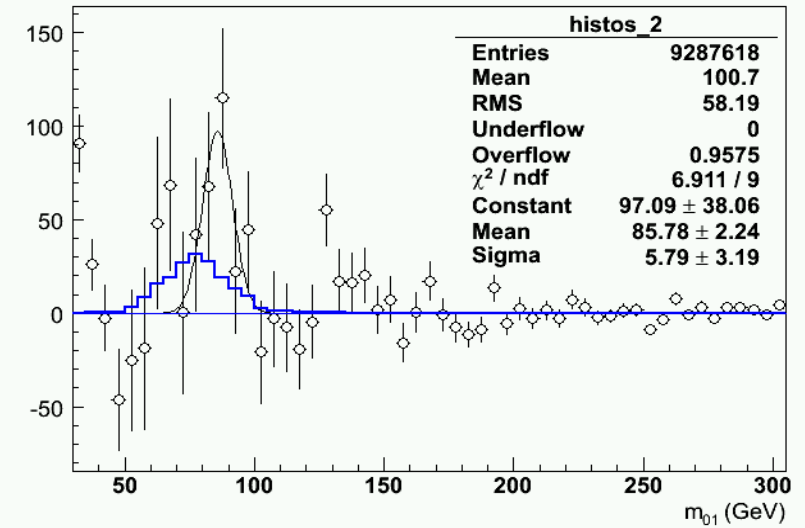


L2MU:
97% efficient

Cross-checks

- A variety of checks on the signal peak have been performed
  - Removing the muon-JES corrections
    - peak gets wider
    - shifts down in mass
    - MC does not shift much because it is not selected for offline muons (to increase statistics)
  - We've tested for the influence of W->cs in the untagged and single-tagged samples
  - We've reversed the dphi cut (to <2.9)
    - peak mostly goes away, consistent with MC





Cross-checks

- We've just selected either central (|eta|<1) or forward (|eta|>1) jet events
  - results are consistent with MC
- We've widened the dphi cut to >2.5
  - gives an even nicer result
  - consistent with MC