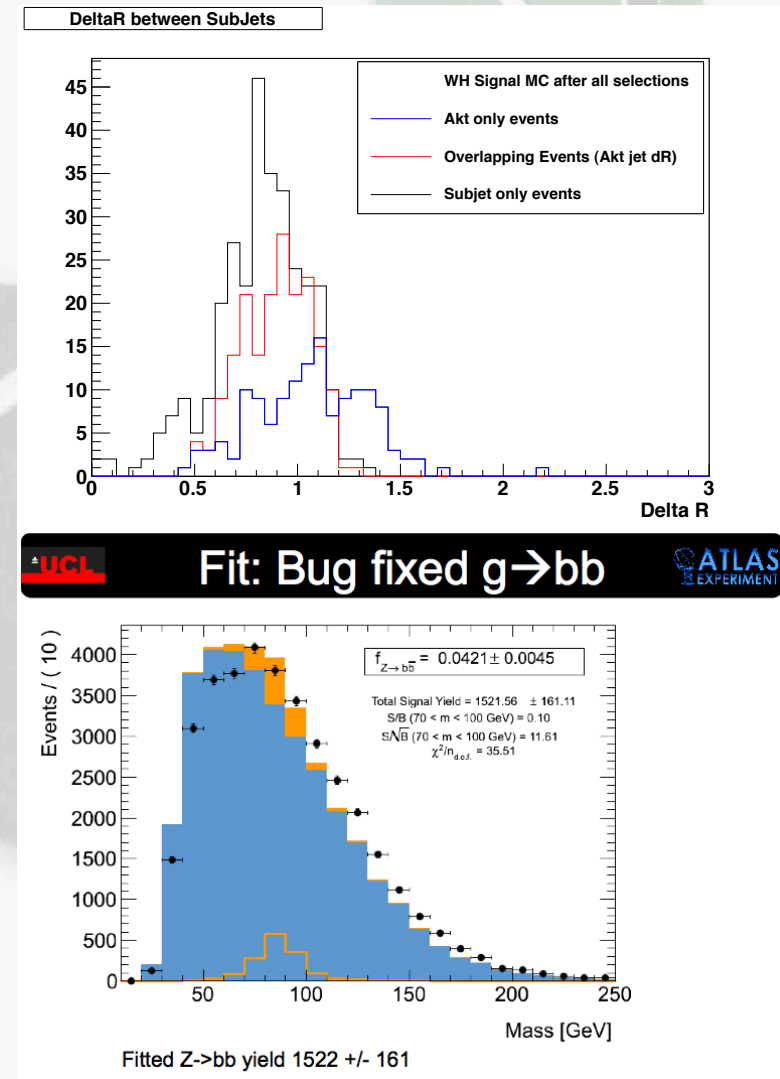# Introduction

Ricardo Gonçalo (RHUL)
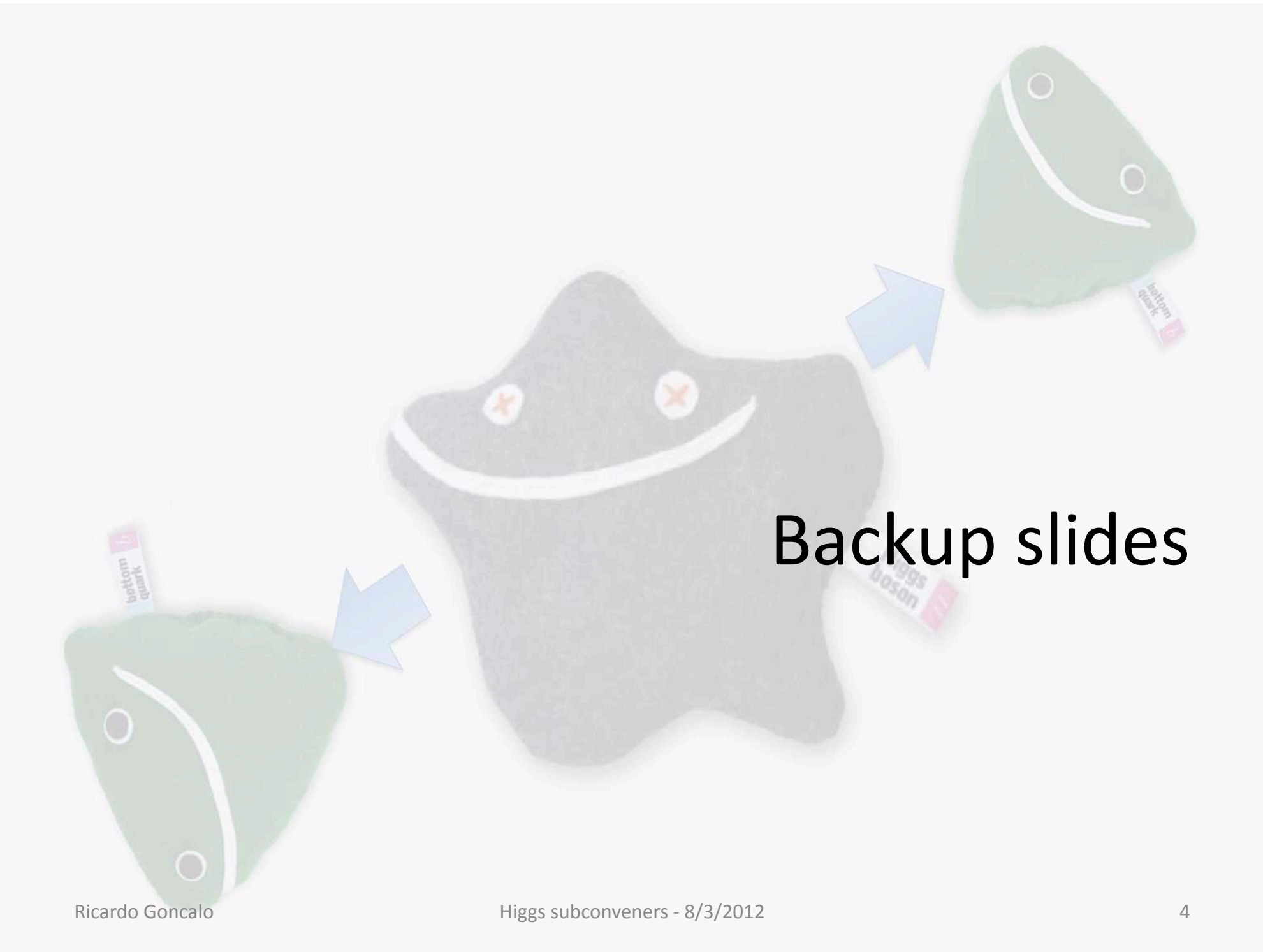Higgs Weekly Meeting – 8 March 2012

To do list for paper

- b-tagging scale factors:
  - Will use SFs in 5 bins and do 5 (x2) eigenvector variations to get systematic uncertainties
  - Will need a couple of days to put new SFs in the right interface code
  - Will need ≈3 days to run analyses once SFs are available plus a couple of days to test analysis results
- METUtility version changed:
  - Both pileup terms (note used since we use mu rescaling) and soft jet and cell out terms have changed
  - No impact on schedule – we'll do this once we have new b-tagging SFs
- b-jet energy scale:
  - llbb/lvbb used Scott's rescaling of jet p_T as in HSG2; vvbb used 1.05 scaling of m(bb)
  - Will meet with Tancredi tomorrow 11:30am to find out what his objections are
  - Would be ok with moving to 1.05 rescaling, but not so much with no rescaling, since this would imply moving sidebands down by 5%
- The theory uncertainties should be revisited slightly:
  - We used LO (Pythia) signal MC and assigned a flat 10% theory uncertainty (acceptance modelled at LO)
  - Apply uncertainty equal to difference between the LO and NLO QCD cross sections
  - Apply EW NLO corrections as a multiplicative factor to cross section in each bin (no effect on acceptance)
  - Cross-check size of uncertainties on pT(W/Z) and Njets distributions
- Variation of single-top, Wc and Zc backgrounds missing from vvbb analysis (in principle small)
  - Jike will estimate size of single-top uncertainty in vvbb – neglect if small
  - Andy will apply the Wc and Zc variations to the output of the vvbb analysis
- Update text:
  - Explain better the methods used in analyses, especially concerning multiple scale factors and fits to data etc
  - Should we aim for longer paper or to remove much of the information and aim for a shorter paper?
  - Smoothing of the backgrounds in llbb/lvbb: should be mentioned in support note
- **Time scale for combination paper??**

Plans for Summer

- Boosted H->bb
  - Add to WH analysis (maybe ZH) at highest $p_T^{W/Z}$
- Multivariate analyses
  - Already stared, but needs to be pushed
- More interaction with CP groups:
  - Jets and MET – need to work more on this!
    - Would benefit (a lot!!) from better understanding of jet energy scale, MET, di-jet mass resolution
  - Already useful interaction with b-tagging
    - Improved H->bb b-tagging uncertainty
  - Useful interaction with Trigger:
    - vvbb, VBF H->bb, b(b)H, boosted Z->bb trigger
- ttH activity ramping up
  - Stat-only limits of ≈15xSM with 1fb-1
  - But very affected by systematics (but early days)
  - Kinematic fit may improve things (also early days)
- Z->bb having difficulties:
  - Bug found in g->bb samples – being re-generated
  - Re-produced AFII g->bb – bad description of data
- Other channels to continue working:
  - VBF H->bb (MC hungry!), b(b)H

DeltaR between SubJets

WH Signal MC after all selections
Akt only events
Overlapping Events (Akt jet dR)
Subjet only events

Delta R

UCL Fit: Bug fixed g→bb ATLAS EXPERIMENT

$f_{Z\to b\bar{b}} = 0.0421 \pm 0.0045$

Total Signal Yield = 1521.56 ± 161.11
S/B (70 < m < 100 GeV) = 0.10
S/√B (70 < m < 100 GeV) = 11.61
$\chi^2/n_{d.o.f.} = 35.51$

Mass [GeV]

Fitted Z->bb yield 1522 +/- 161

Backup slides

Bug in g→bb Samples

- Pythia tells us that the multijet background to this analysis is dominated by two b-hadrons within the fat-jet that are resolved as two subjets i.e. g→bb splitting.
- We wrote a filter to produce a Pythia sample enriched in these events:
  - Events passed only if at least two b-hadrons could be associated to a C-A 1.2 truth fat-jet.
- Have since discoved a bug in this filter:
  - When labelling b-hadrons the filter was taking only those with positive PDG ID.
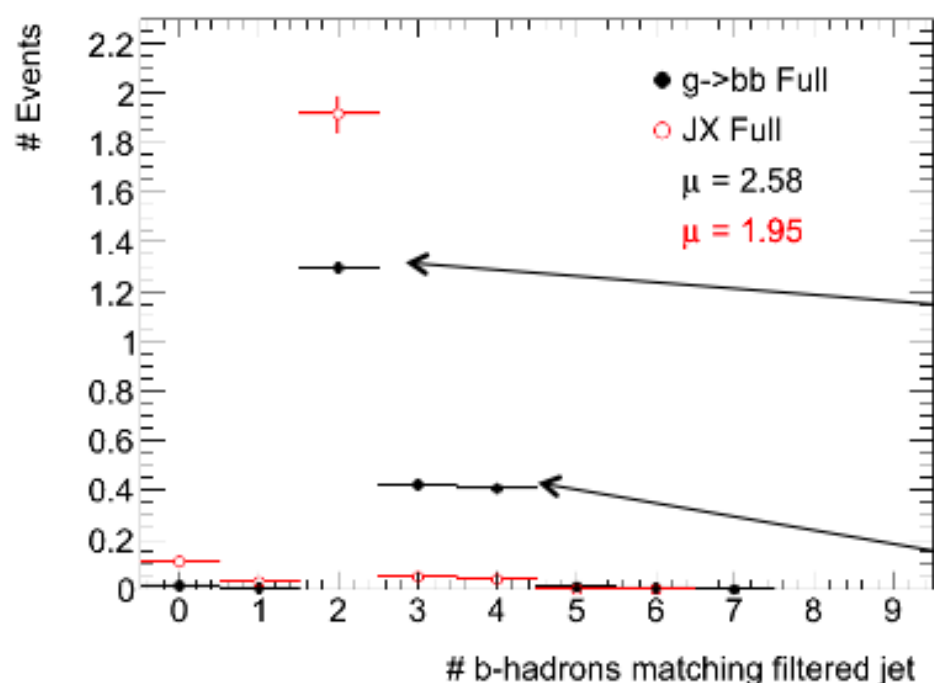
Those events with 2 b-hadrons are dominated by meson-baryon as opposed to meson-meson.

Much greater fraction of fat-jet with 3 or more b-hadrons (dominant biasing effect)

Boosted Z->bb

- Z->bb analysis with jet substructure in HSG5
  - Perfect calibration for boosted H->bb!

- An exciting Z->bb peak can be seen after background subtraction
  - And (perhaps even more exciting?!) there is a shoulder just above the Z mass... at around 126GeV ☺
  - Caveat: get excited, but don't get too excited!
  - A lot of work has been going on to test the results

- Much progress made so far
  - But many questions remain and must be answered
  - Observing the Z->bb in this analysis would be fantastic!

- Current status:
  - Now looking at full simulation MC
  - Observations in D-J is still there in periods K-M!
    - D – J with trigger EF_j100_a4tc_EFFS_ht350
    - K – M with trigger EF_j100_a4tc_EFFS_ht400
    - See Luke Lambourne's talk at HSG5 meeting: https://indico.cern.ch/conferenceDisplay.py?confId=167396