Imperial College
London

Imperial College - Dimuon bump cross check

Introduction

- A bump in the dimuon mass spectrum was presented to this meeting several weeks ago
- The VBF H→invisible group have the full single mu primary dataset processed for our trigger efficiency studies
  - Ntuples have no skimming so all events are present
- We have cross-checked the original analysis:
  - Common framework and ntuple format with Imperial H→ $\tau\tau$ has been used

Object ID

	Original analysis	IC crosscheck
Data	22Jan2013 ReReco	
Global Tag	FT53_V21A_AN6	
Trigger	HLT_IsoMu24_eta2p1 or HLT_IsoMu24	
Muon isolation	Track iso$<$ 0.1	PF iso$<$ 0.2
MuScle Fit applied	Yes	No
Muon-jet overlap pt threshold	5 GeV	10 GeV
PU ID version	52X	53X
b-tagging	CSVMVA$>$0.783	CSV$>$0.898

Selection

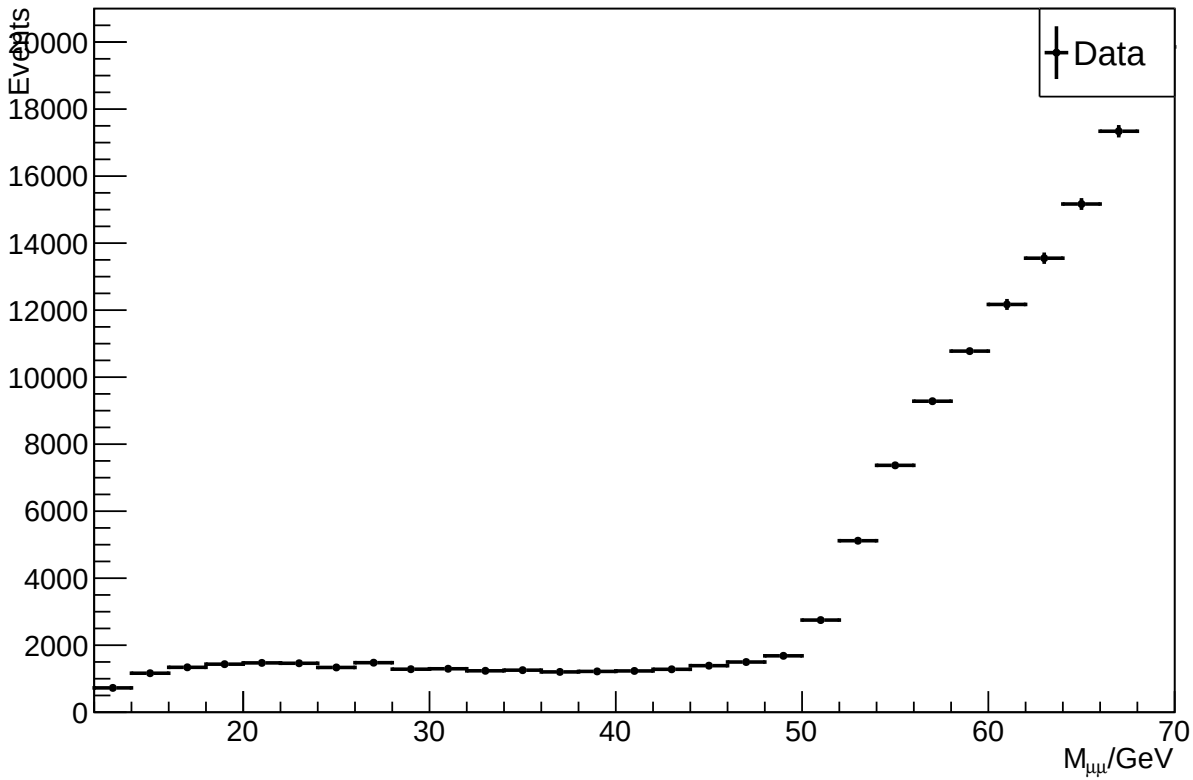
Step name	Cuts
Muon pair	Two OS muons, $\mu_1\ p_T > 25$ GeV, $\mu_2\ p_T > 25$ GeV
Any central jet	At least one jet, $p_T > 30$ GeV, $\lvert\eta\rvert < 2.4$
Any central b jet	At least one jet, $p_T > 30$ GeV, $\lvert\eta\rvert < 2.4$, CSV>0.898
Other central jet veto (CJV)	Only one jet, $p_T > 30$ GeV, $\lvert\eta\rvert < 2.4$
Forward jet	At least one jet, $p_T > 30$ GeV, $\lvert\eta\rvert > 2.4$
Mass window	$26 < M_{\mu\mu} > 32$ GeV

Cut flow

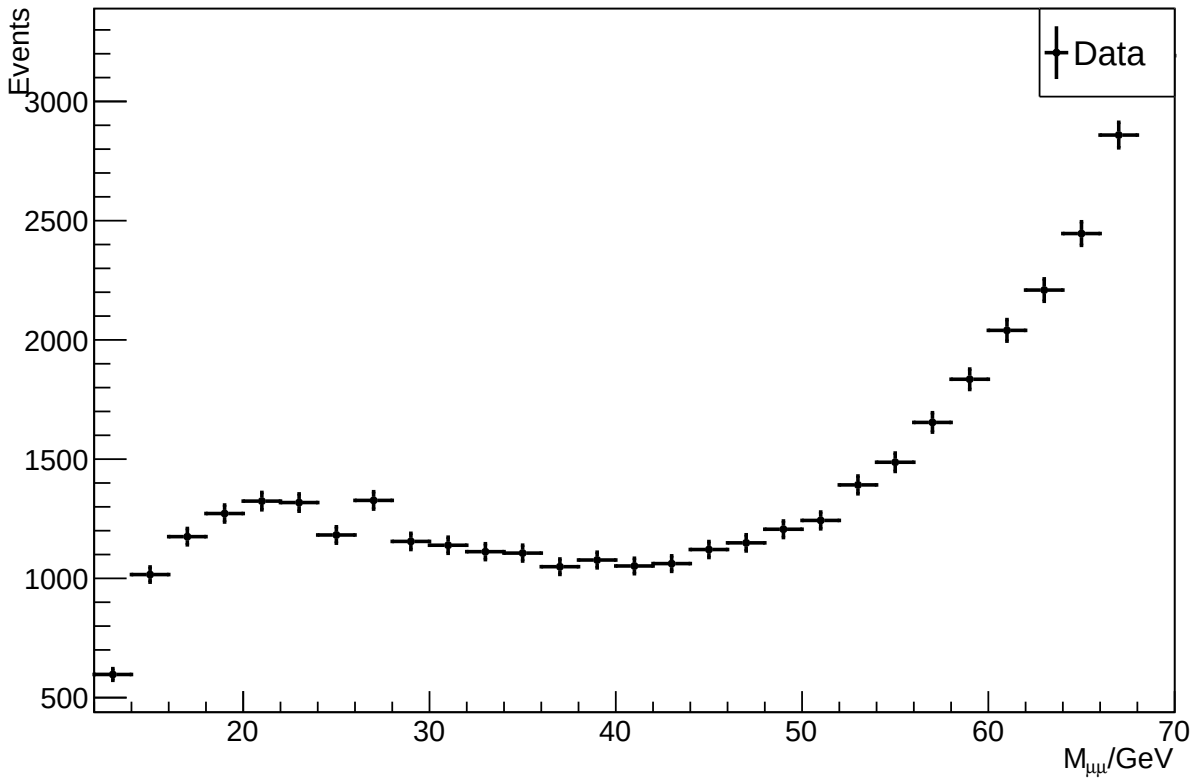
- Yields compared at each cut step
- IC crosscheck yield close but consistently slightly lower
- At final step IC crosscheck has 23/28 events in common
  - 5 events present not in original analysis
  - 10 events in original analysis don't pass our selection

Cut step	Original analysis	IC crosscheck
Muon pair	162483	138364
Any central jet	56788	41796
Any centrol b jet	4286	4111
Other central jet veto	1190	1055
Forward jet	186	163
Mass window	33	28

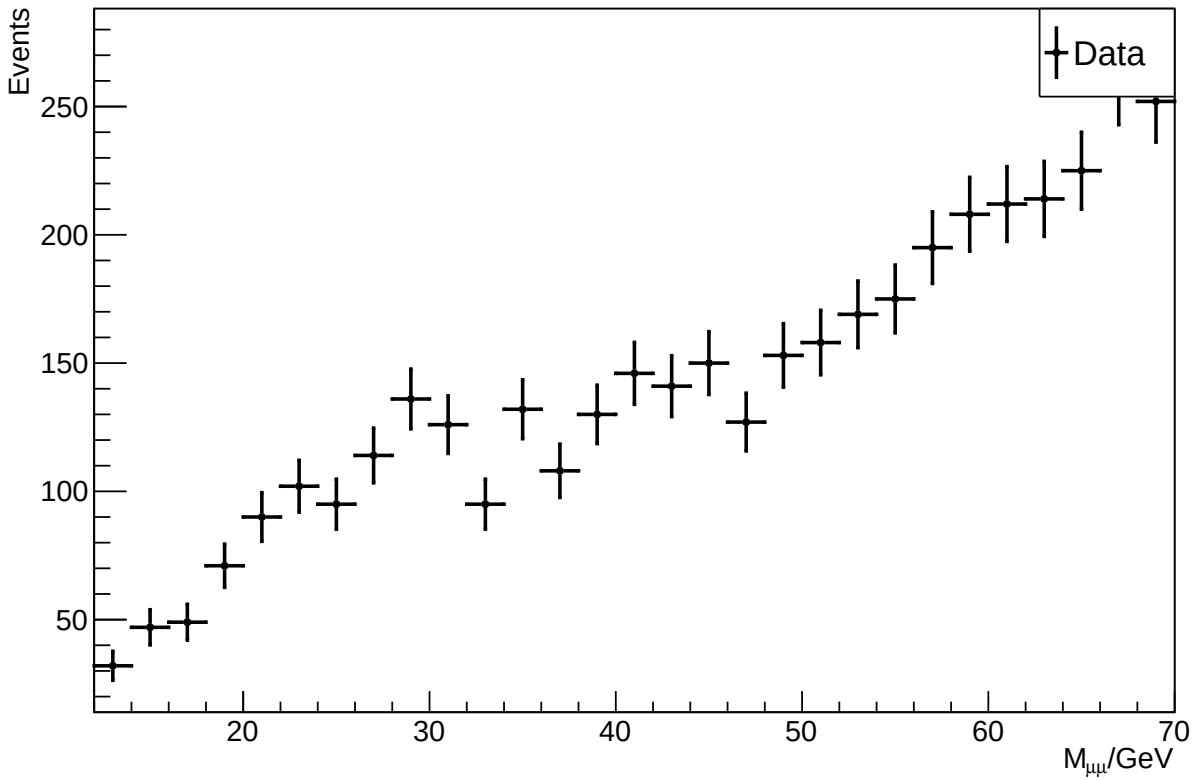
Dimoun mass distributions - Muon pair



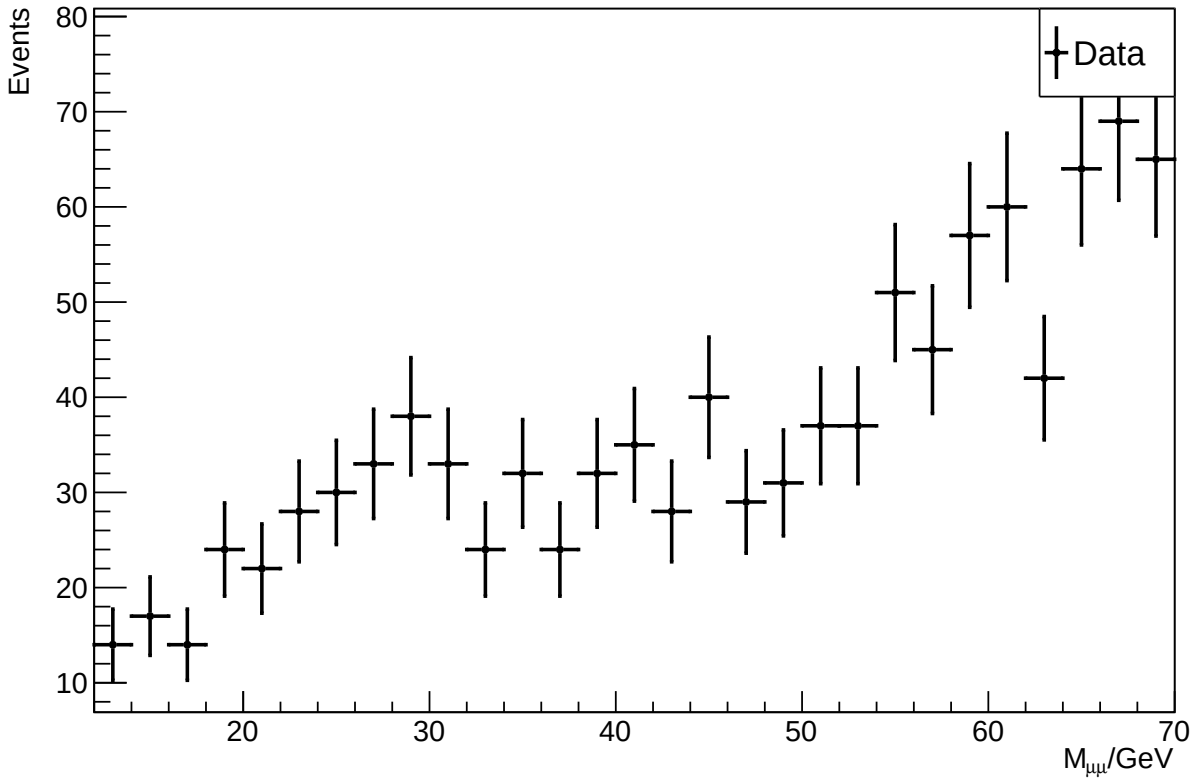
Dimoun mass distributions - Any central jet



Dimoun mass distributions - Any central b jet

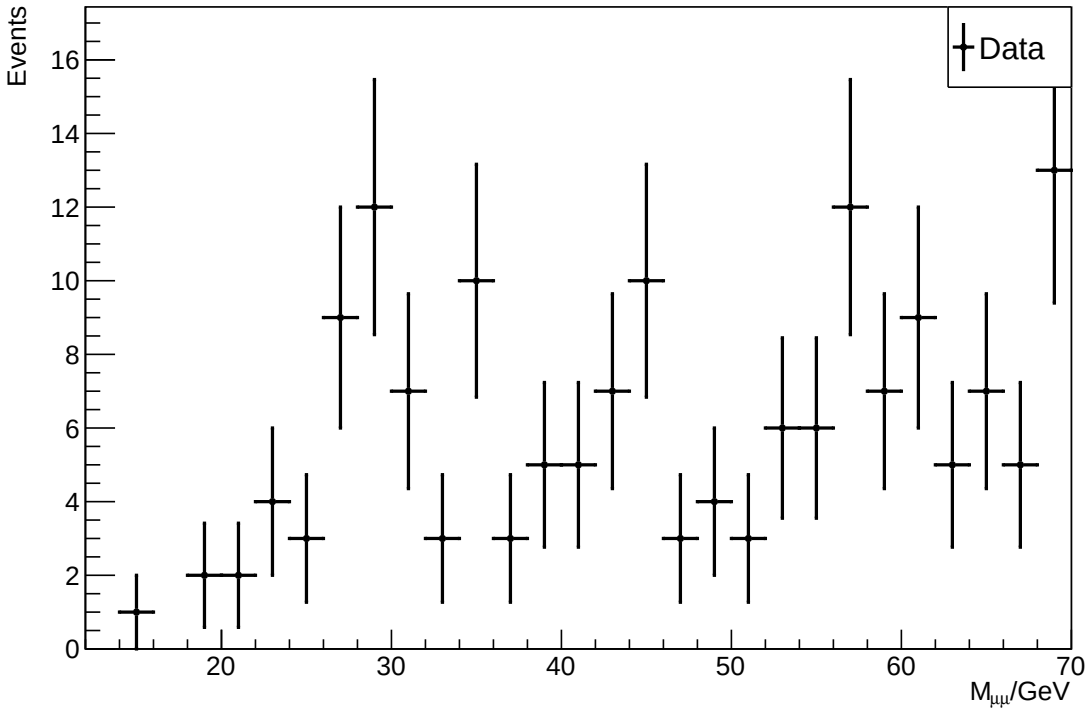


Dimoun mass distributions - Other central jet veto



Dimoun mass distributions - Forward jet

- Bumpy structure across whole mass range: 3 bins around 30 GeV slightly high
- Attempted second order polynomial plus gaussian fit:
  - No bump resolved by fit for several values of initial conditions
  - Tried 1 GeV binning, no bump at 30 GeV resolved by fit



Event by event comparison

- Compare events in 26-32 GeV with original analysis
- 10 events from original analysis fail my selection

6 events have no second muon

- Only known muon ID difference is isolation
- Suggests these events pass track iso but fail pf
- Consistent with yields being lower from dimuon selection
- Efficiency difference between isolations is small $\sim$ %

Event by event comparison - continued

4 events have additional central jets

- Some overlap with above 6 events
- Known differences are PU ID and muon overlap veto

1 event has no b jet

- Known different b-tag algorithm

1 event has dimuon mass outside window

- Known MuScle fit difference

Summary

- Imperial College H$\rightarrow \tau\tau$/inv. framework and ntuples have been used to crosscheck dimuon bump analysis
- Cut flow efficiency very similar to original analysis:
- Yields slightly lower
- No bump significant enough to be resolved by a polynomial plus gaussian fit
- Event by event comparison suggests muon isolation and additional central jets cause differences

Backup