LepHad QCD Background





 8^{th} April 2016 HH \rightarrow bbtt Meeting

Method (1)

- We need to take QCD background from data. There are two possible methods:
- "Fake factor" like used by run 1 analysis
 - FF_{QCD} = N_d^{CR} (ID tau)/ N_d^{CR} (anti-ID tau) in inverted lepton isolation CR
 - N_d is data after subtracting small non-QCD from MC (just true taus or all?)
 - N_{QCD} = $[N_d^{SR}(anti-ID tau) N_{MC}^{SR}(anti-ID tau)] * FF_{QCD} now with SR cuts$
 - Sinned in some kinematic var e.g. tau p_T and separate for e/μ and 1/3p
- In run 1 FF was done at preselection level without b-tagging according to INT note
 - Would have thought subsequent cuts and b-tagging would affect FF
- Likely not enough stats in 2 b-tag \rightarrow Use 0 or 1 b-tag?
- In general would be a "combined" FF with other backgrounds 08/04/16

Method (2)

We need to take QCD background from data. There are two possible methods:

۲	"AE •	SCD method" as used by CMS Take shape from data in SS CR	Isol I	A: SR	B: QCD Template
	•	Normalise in inverted lepton isolation CR $N_{QCD}(A) = N_d(B) * N_d(C)/N_d(D)$ Again, subtract non-QCD bkg from MC and bin in e.g. tau p _T for e/µ and 1/3p	Non-Isol l	C: QCD norm	D: QCD norm
e	May not be enough data for template in 2 tag			OS	SS

- CMS in fact reversed tau isolation to get enough stats for template
 - We can't do that
 - Again, use 0 or 1 tag?
 - Does this describe 1 tag?

First attempt

Use method (1)

- Bin in tau p_T
- Subtract all non-QCD from MC (fake + true)
 - Quite possibly biased
 - Esp. for higher ntag with more non-QCD if we don't believe MC well describes fakes
- Use template for correct b-tag multiplicity at correct point in cut flow
 - Might be too low in stats for 2 tag but looks OK
- Use FF from 1 tag for 2 tag and always from preselection
 - Not sure how OK this if for 2 tag
 - Need to look at cut dependence

Very much WIP

Results < 1 hour before meeting</p>

FF (tau p_T)

- Binning maybe too coarse
- Low stats for 2 tag as expected
 - O/1b agree quite well for 3p
 - Also for 1p for e but not μ

Fake Factors (Muon)





FF (tau n)

- Mostly no clear n dependence
 - Exception is 1p µ ۲
- Still to look at other variables

Fake Factors (Muon)



Fake Factors (Elec)



08/04/16

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Results: tau p_T

- Unfortunately don't have tau
 p_T split by e/μ
- Not perfect even though parameterised in this
 - This has m_{vis} cut unlike FF!
 - Too coarse?







Results: elec p_T

- Elec 0 tag very nice
- 1 and 2 tag less so
 - Might be due to caveats earlier





Results: muon p_T



χ²

KS





ATLAS Internal

Results: elec m_{vis}

- After m_⊤ cut
- Shape seems maybe OK
- Note: no DY here so don't trust below 40 GeV
 - Need to try Sh/Po DY samples now we have them







Results: muon m_{vis}





m_u [GeV]



Results: m_T

- Seems to well describe Otag m_T but for 2 tag QCD m_T peaks at ~80 GeV
 - Seems picking up some W/top
 - Top as not see in 0 tag?
 - Likely why overestimated here



Summary

First look at QCD using FF seems reasonably promising

But lots still to look at

- 2 tag stats
- $1 \rightarrow 2$ tag extrapolation
- non-QCD subtraction
- FF with m_{vis} cut (and/or with DY in place)
- Variance with cuts

Do we want to do full "combined FF"?

- Seems overkill as we are only interested in 2 tag
- Maybe take non-QCD from MC, scaled in CRs (not FF)
- However, FF is well established

Do we want to try CMS-like ABCD method?