

VBF Higgs to Invisible

HIG-14-038, AN-14-243

Overview

Reminder

- ▶ First signal MC comparisons between run 1 and run 2 performed
- ▶ Jet η “ears” problem seen
 - to be improved in CMSSW_7_4_2

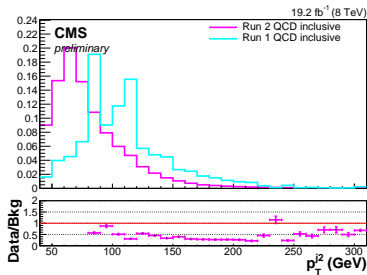
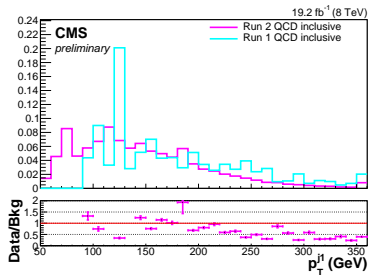
New Today

- ▶ Some technical problems with dcache necessitated rerunning QCD ntuples
- ▶ Now complete: first control plots today
- ▶ Have also remade DM interpretation plot with parked result

QCD and signal comparison: run 1 vs run 2

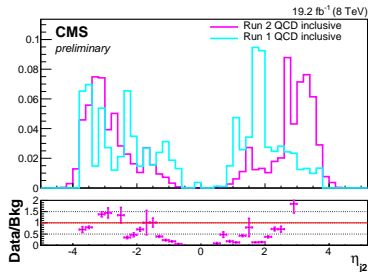
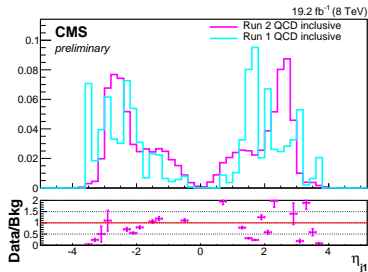
- ▶ Run2 QCD is inclusive PU20B25
- ▶ As in run 1 very little QCD MC in signal region so start from loose region: $\eta_{j1} \cdot \eta_{j2} < 0$, $\eta_{j1} < 4.7$, $\eta_{j2} < 4.7$,
 $p_T^{j1} > 50 \text{ GeV}$, $p_T^{j2} > 40 \text{ GeV}$, $\Delta\eta_{jj} > 3.6$, $M_{jj} > 800 \text{ GeV}$,
 $MET > 90 \text{ GeV}$, $MET_{sig} > 3$.
- ▶ Data/Bkg is Run 2 QCD inc/Run 1 QCD inc
- ▶ As last time trigger weighting etc. as in parked analysis
- ▶ All distributions normalised to 1

Signal comparison: run 1 vs run 2: Jet p_T



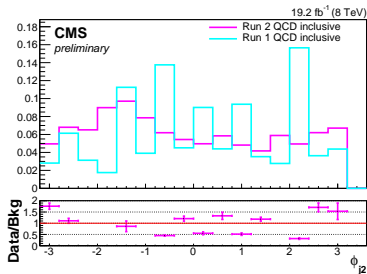
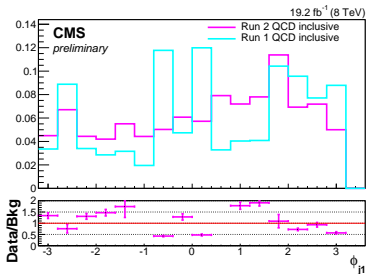
- Low statistics in run 1 MC but appears higher in pt

Signal comparison: run 1 vs run 2: Jet η



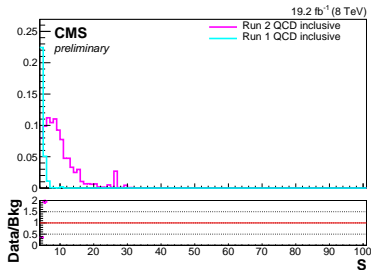
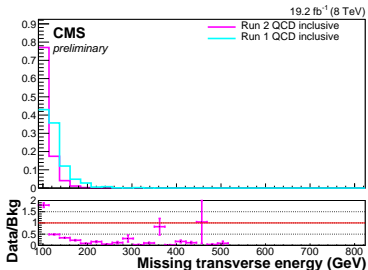
- ▶ Jet 1 has ears from 2.5-3 as well
- ▶ Jet 2 has a lot of events in the HF

Signal comparison: run 1 vs run 2: Jet ϕ



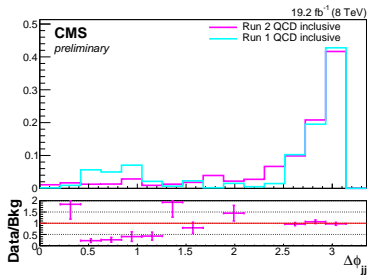
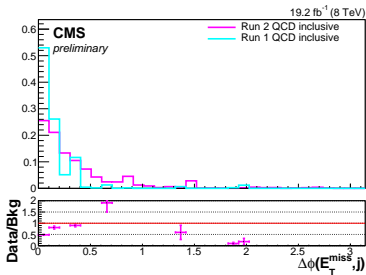
- ϕ distributions look similar within stat error

Signal comparison: run 1 vs run 2: Met



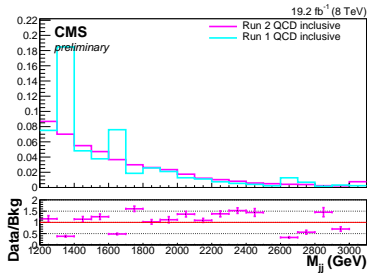
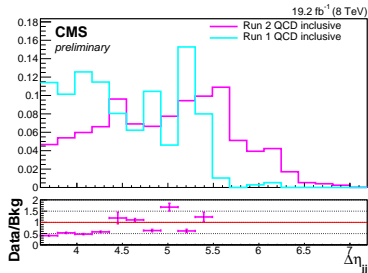
- ▶ QCD Met lower for run 2 although no fake met in inclusive samples
- ▶ Met significance is a different variable in miniAOD to the one we used in run 1

Signal comparison: run 1 vs run 2: $\Delta\phi$ variables



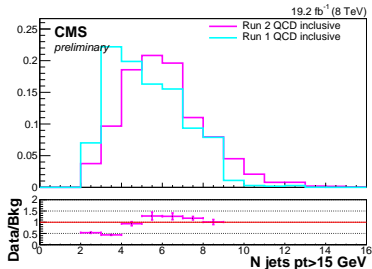
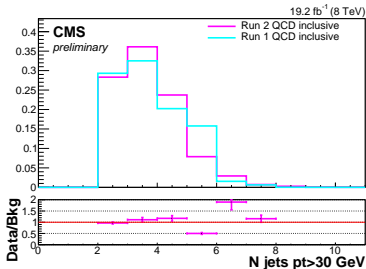
- Both similar but limited by low stats

Signal comparison: run 1 vs run 2: dijet variables



- ▶ $\Delta\eta_{jj}$ larger for run 2: could be due to HF
- ▶ M_{jj} similar

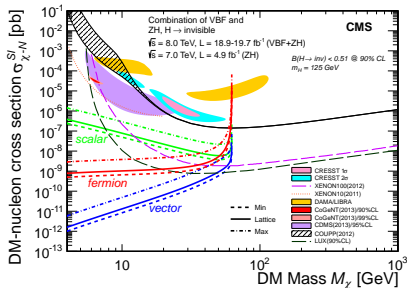
Signal comparison: run 1 vs run 2: N jets



- Number of high pt jets similar, run 2 has more low pt jets

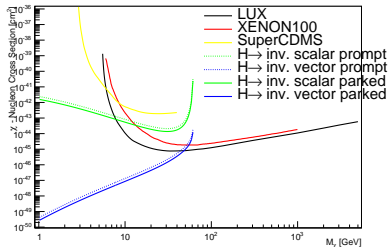
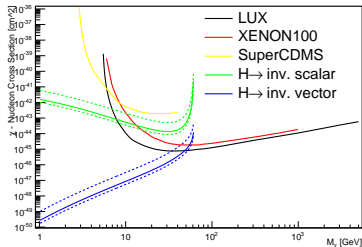
Higgs Portal DM interpretation - recap

- For prompt paper made a DM limit using EFT described [here](#)
- Since then the fermion line has been found to be invalid
- Other two lines should still be ok: I will double check this



Higgs Portal DM interpretation - update

- ▶ Used direct detection data from **Brown DM tools**
- ▶ Use 90% CL observed limit from HIG14038 result: 0.4048
- ▶ Left plot has three values of f_N as in paper
- ▶ Right plot is prompt (dashed) vs parked plus EXO (solid)



Combination with EXO result

- ▶ Working with Nick to combine VBF, ZH and EXO result
- ▶ At first there was ~ 0.02 difference in expected limit between our results
- ▶ My numbers: expected) 0.2998
- ▶ Two differences identified:
- ▶ Nick using $\Delta LL = 4$, I was using 95% C.L.
 - On both using 95% C.L. difference went to 0.004
- ▶ I was running the 7 TeV Z(II)H cards and Nick wasn't
 - When I take out the 7 TeV cards this difference goes away

Summary

- ▶ First look at QCD samples:
 - Limited stats especially in run 1 so hard to draw conclusions
 - Also neither set models fake met so we will still need Joao's samples
- ▶ DM plot remade:
 - Double checking validity of scalar and vector lines
 - Can add other experiments if desired
- ▶ Combination with EXO:
 - Synchronising with Nick
 - PAS waiting on approval of EXO result

Backup