APPENDIX A

Configuration file for the SCT TOM Deamon

```
###
###    sctTOM.cfg
###
###

#################                SCT          ############################

## sctcalibns (noisy strips RAW, c0 for BLK)

#########################################################

spp tom sctcalibns username sctcalib

spp tom sctcalibns bunchFion bunchByNumberSize
spp tom sctcalibns bunchsize 2000000000000

spp tom sctcalibns inputdsspecsignoff \
  "type ='CALRAW' AND runnr > 175333 AND \
  datasetname like 'data11\%calibration_SCTNoise.daq.RAW\%' "
spp tom sctcalibns signoffmode on
spp tom sctcalibns inputdsspecautomatic \
  "type ='CALRAW' AND totevents > 10000 AND   runnr > 175333 AND \
  datasetname like 'data11_\%calibration_SCTNoise.daq.RAW\%' "
spp tom sctcalibns automaticmode on

spp tom sctcalibns taskstep sct_NoisyStrip

spp tom sctcalibns maxattempt 5
spp tom sctcalibns priority 2000
spp tom sctcalibns tasktype sctns
spp tom sctcalibns trfcpu 15000
spp tom sctcalibns tasktag 'c0'
spp tom sctcalibns tasktransinfo trfsetupcmd \
  '/afs/cern.ch/user/s/sctcalib/testarea/latest/cmthome/setup.sh'
spp tom sctcalibns tasktransinfo trfpath \
  '/afs/cern.ch/user/s/sctcalib/testarea/latest/\
  InnerDetector/InDetCalibAlgs/SCT_CalibAlgs/scripts/sct_calib_trf.py'
spp tom sctcalibns trfname 'sct_calib_trf.py'
```

```
spp tom sctcalibns inputs input "!{'metatype' : 'inputLFNlistDA'}"

spp tom sctcalibns outputs prefix \
  "!{ 'dstype': 'SCTCALIB', \
    'dsnamefion': 'replace daq.RAW sct_NoisyStrip.SCTCALIB', \
  }"

spp tom sctcalibns phconfig SCTCalibConfig  \
  "!{'value': \
    ['/afs/cern.ch/user/s/sctcalib/testarea/latest/\
     InnerDetector/InDetCalibAlgs/SCT_CalibAlgs/share/SCTCalibConfig.py'], \
  }"
spp tom sctcalibns phconfig part \
  "!{'value': ['doNoisyStrip'],}"
spp tom sctcalibns phconfig doRunSelector  "!{'value': 'True',}"
spp tom sctcalibns phconfig doRunInfo "!{'value': 'True',}"

spp tom sctcalibns eeconfig maxEvents "!{'value': -1,}"

addp1 tom sctcalibns 300

################################################
```

APPENDIX B

Validation at preselection

In the following, a comparison of variables between data and Monte Carlo predictions are performed at the preselection stage described in section 5.3. The two main backgrounds, $Z \to \tau\tau$ and QCD-jet events, are normalised using the fitted $\Delta\eta(\tau_1, \tau_2)$ distribution of the selection τ-candidates as explained in section 7.4. The QCD jet events are modeled using not-opposite-sign events in data. Only statistical errors and the uncertainties from the normalisation procedure are included in the errorbars in the ratio plots.

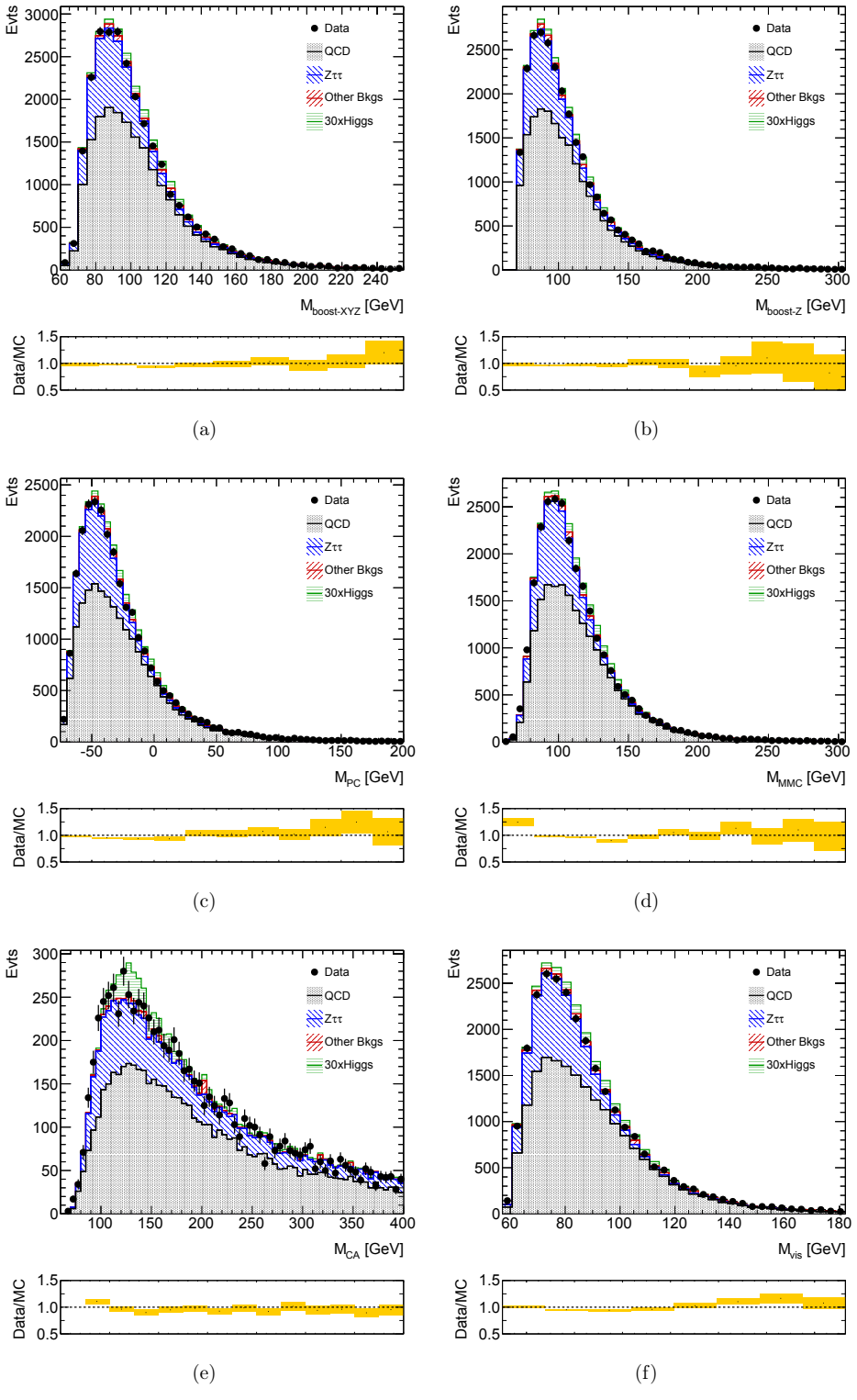


Figure B.1: Mass variables

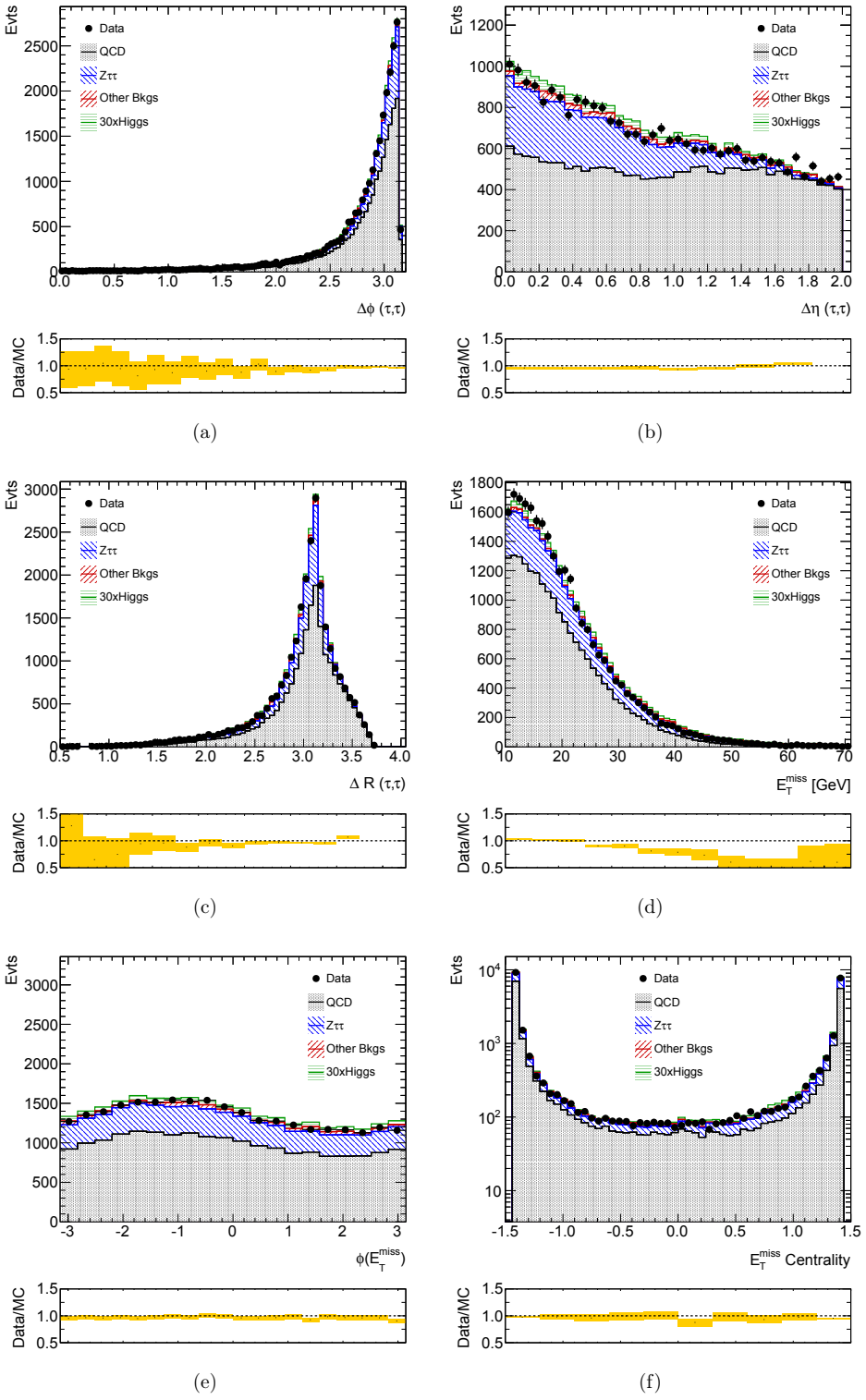


Figure B.2: MET and τ-pair variables

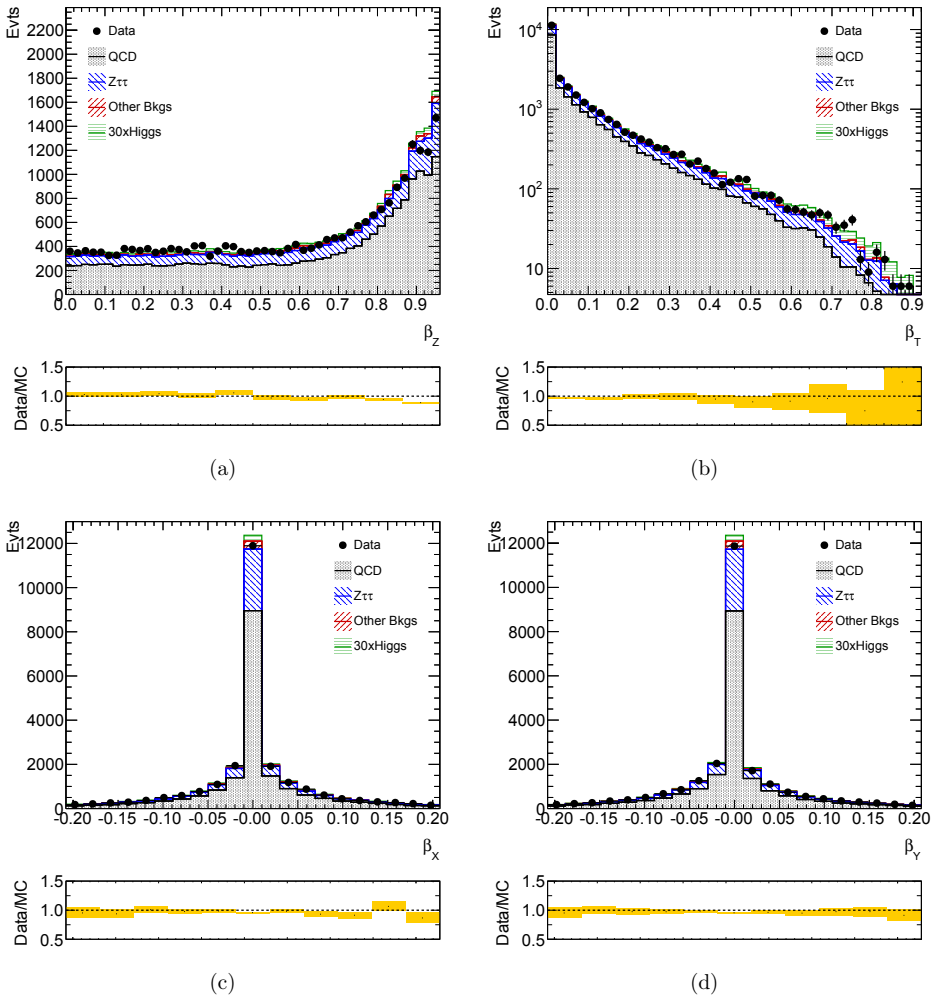
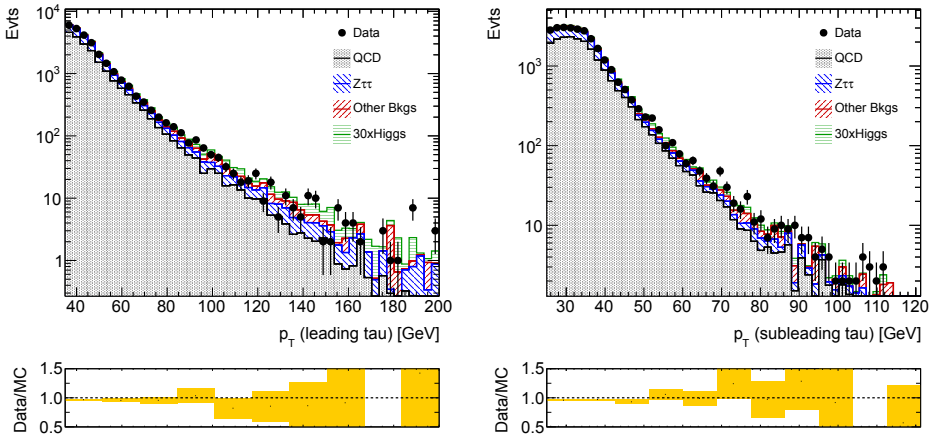
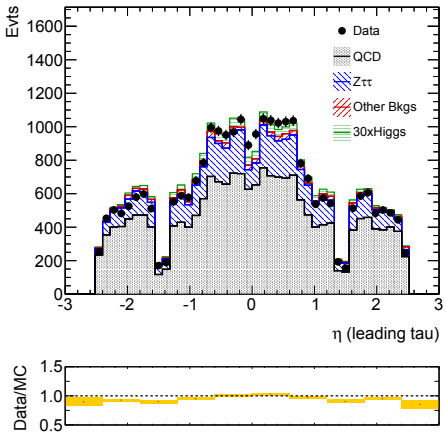


Figure B.3: Boost variables

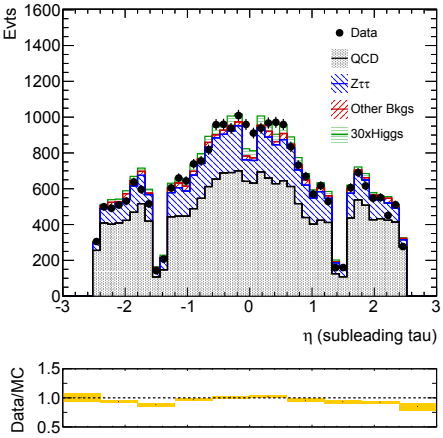


(a)

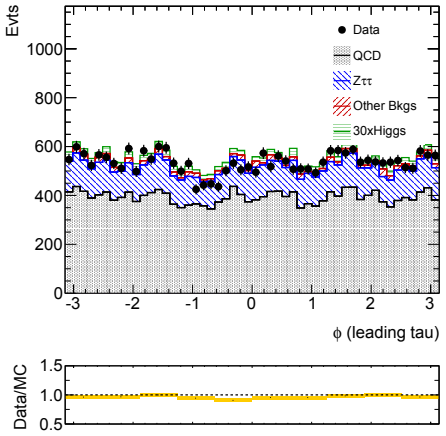
(b)



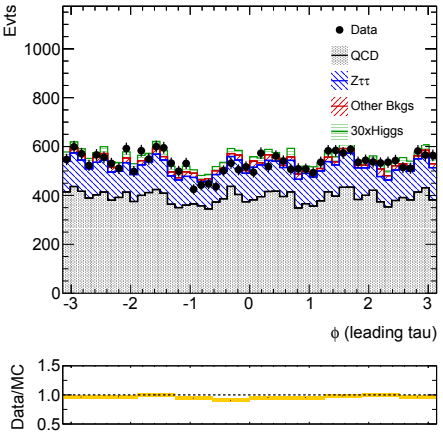
(c)



(d)

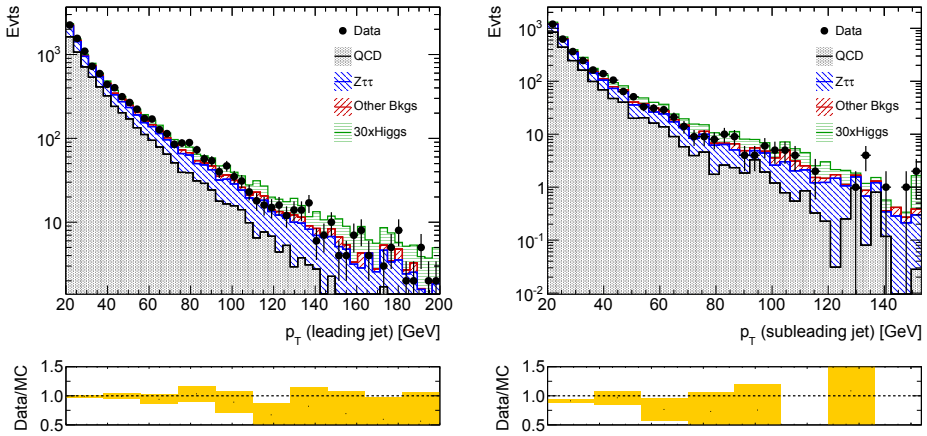


(e)



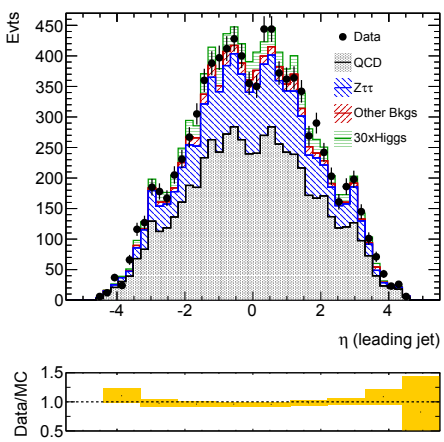
(f)

Figure B.4: τ-candidate variables

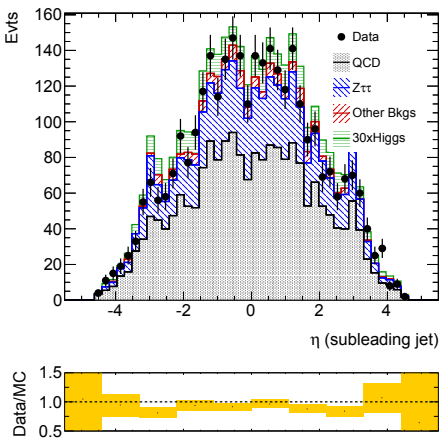


(a)

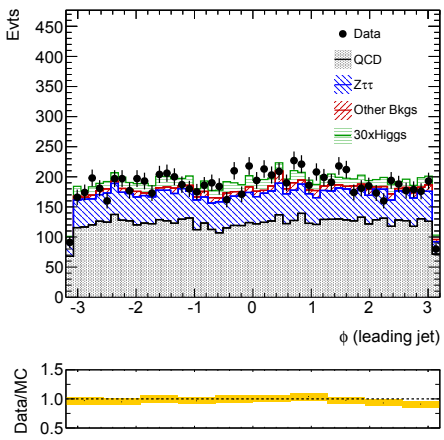
(b)



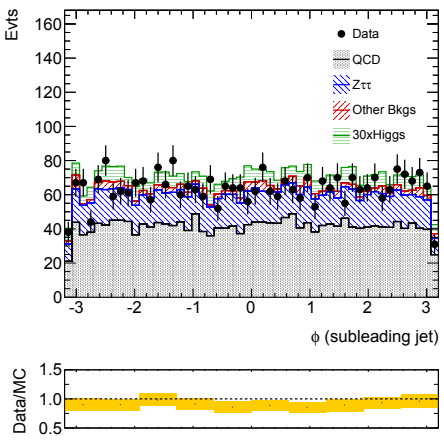
(c)



(d)



(e)



(f)

Figure B.5: Jet variables

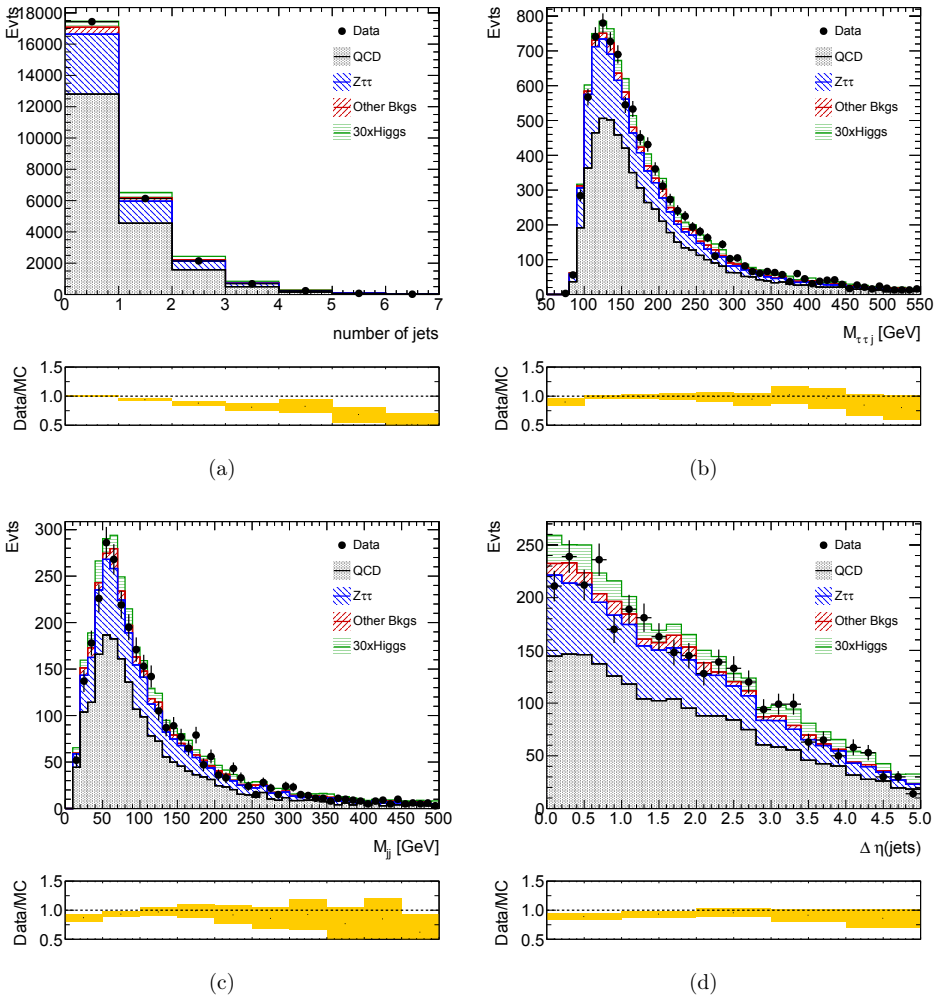


Figure B.6: Combined jet variables

APPENDIX C

Re-optimised Selection of τ-pair

Selection	Cuts
Good Events	Trigger: `EF_tau29_medium1_tau20_medium1` or `EF_tau29T_medium1_tau20T_medium1` Same Event Cleaning and Data Qualty cuts as in the present analysis
Preselection	No muons or electrons in the event Exactly 2 τ candidates, $\|\eta\| < 2.5$, BDT Medium and matched to the trigger Leading τ-jet $p_T \geq 40$ GeV and sub-leading τ-jet with $p_T \geq 25$ GeV Product of the electric charges = -1 and 1 or 3 tracks in $\Delta R \leq 0.6$ $\Delta R(\tau_1, \tau_2) \leq 3.2$
VBF	leading jet with $p_{\mathrm{T}} > 50$ GeV and sub-leading jet with $p_{\mathrm{T}} > 30$ GeV $\eta_{j1} \times \eta_{j2} < 0$, $\Delta\eta(j_1, j_2) > 2.6$ and invariant mass $m_{jj} > 350$ GeV $\Delta R(\tau_1, \tau_2) < 2.8$, $\min(\eta_{j1}, \eta_{j2}) < \eta_{\tau 1}, \eta_{\tau 2} < \max(\eta_{j1}, \eta_{j2})$ $E_{\mathrm{T}}^{\mathrm{miss}} > 20$ GeV ($E_{\mathrm{T}}^{\mathrm{miss}}$-vector pointing in between the two τ-jets) OR $\min\left\{\Delta\phi(E_{\mathrm{T}}^{\mathrm{miss}}, \tau_1), \Delta\phi(E_{\mathrm{T}}^{\mathrm{miss}}, \tau_2)\right\} < 0.2\pi$
Boosted	Not accepted for the VBF category At least one jet with $p_{\mathrm{T}} > 50$ GeV At least one of the two taus must be identified as tight and $\Delta R(\tau_1, \tau_2) < 1.9$ $E_{\mathrm{T}}^{\mathrm{miss}} > 20$ GeV ($E_{\mathrm{T}}^{\mathrm{miss}}$-vector pointing in between the two τ-jets) OR $\min\left\{\Delta\phi(E_{\mathrm{T}}^{\mathrm{miss}}, \tau_1), \Delta\phi(E_{\mathrm{T}}^{\mathrm{miss}}, \tau_2)\right\} < 0.1\pi$
Rest	Not accepted for the VBF or Boosted category At least one of the two τ-candidates has to be identified as BDT Tight

Table C.1: Re-optimised selection proposed in the $H \to \tau_{\mathrm{had}}\tau_{\mathrm{had}}$ working group.

Process	VBF	Boosted	Rest
$Z \to \tau\tau$	20.1	361	5410
QCD events	10	176	12090
Other Bkg,.	3.13	13.3	340
Total Bkg.	33.5	551	17840
Total Higgs ($m_H = 130$ GeV)	1.45	3.18	34.3

Table C.2: Predicted number of events in all signal categories.