Weekly report

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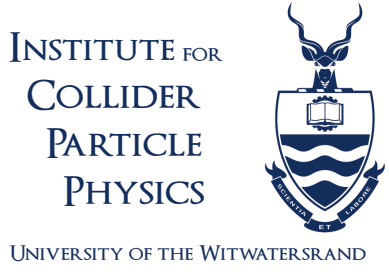
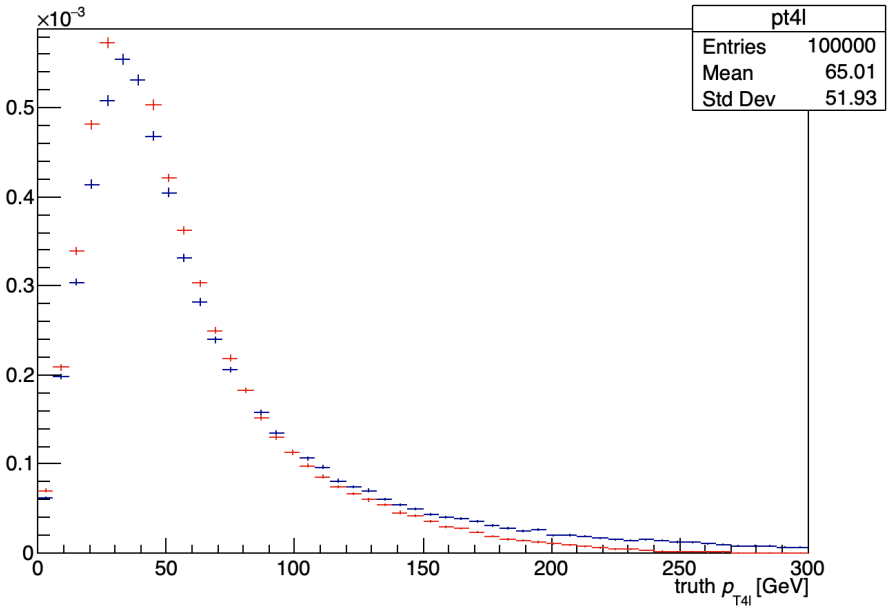
January 18, 2021



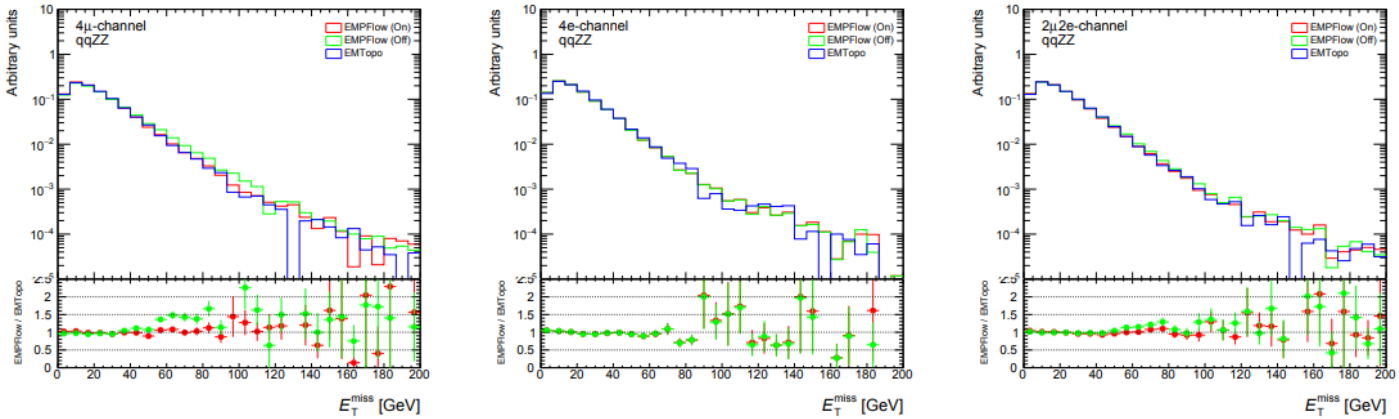
Theory systematic: PDFs, QCD and α_s



- Herwing is too soft so it gives larger uncertainty (Xifeng)
- 0.3% migration in the QCD, and 1.0% in the PDFs and α_S

Muon-jets overlap bug on EMPFlow

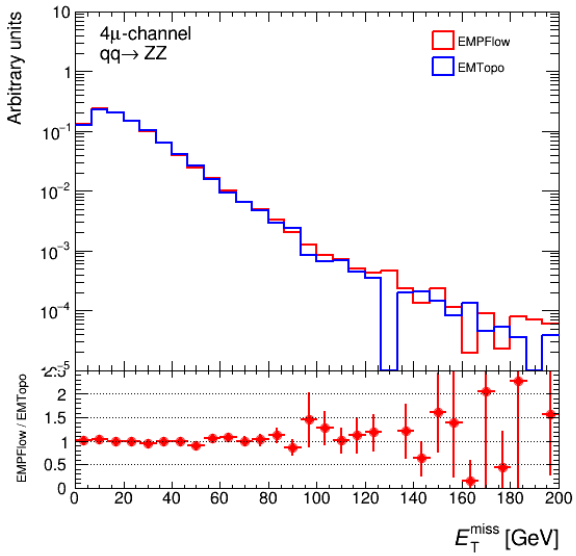
- Muon-jets overlap bug on EMPFlow: the bug is finally fixed

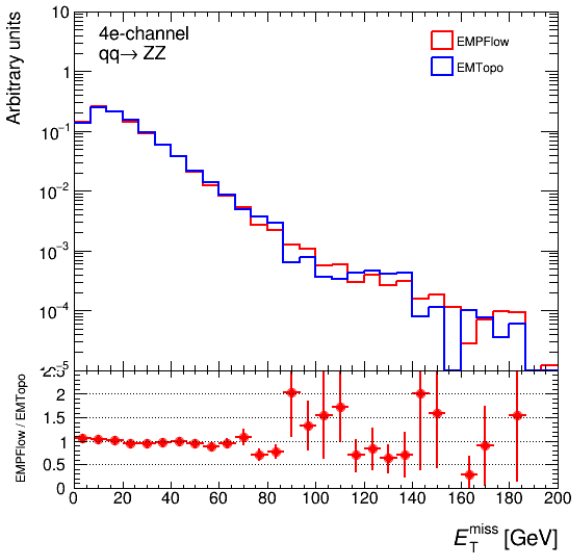


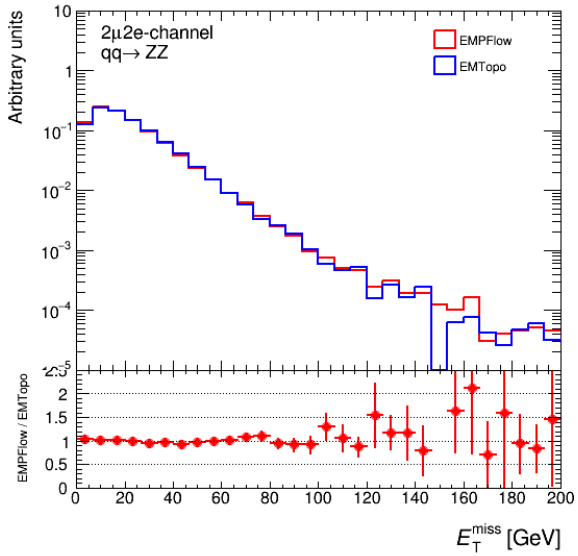
- Due to the bug we still use EMTopo, and we'll switch to EMPFlow soon.
- We requested new data and MC background samples with p4222 p-tag.
- In order to be able to use the implemented bug fix with $\geq$ 21.2.124 release.
- Since the bug only affects the $E_{\mathrm{T}}^{\mathrm{miss}}$ a study was done here to make sure other variables are not affected by the bug fix implementation.

Checking the bug with the official code

EMPFlow vs EMTopo: $E_{\mathrm{T}}^{\mathrm{miss}}$ for $qq \rightarrow ZZ$

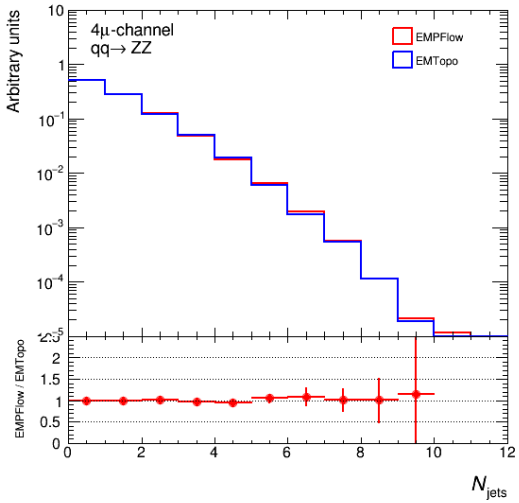


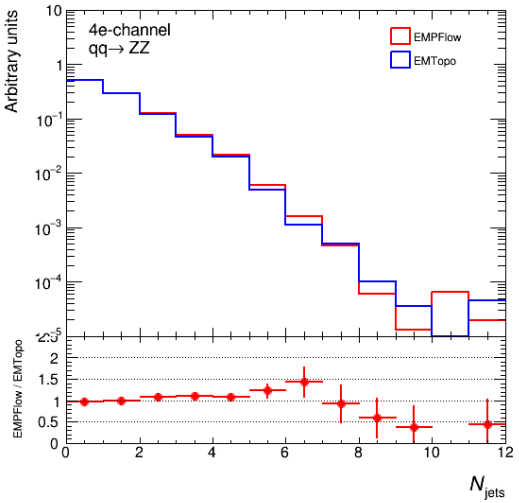


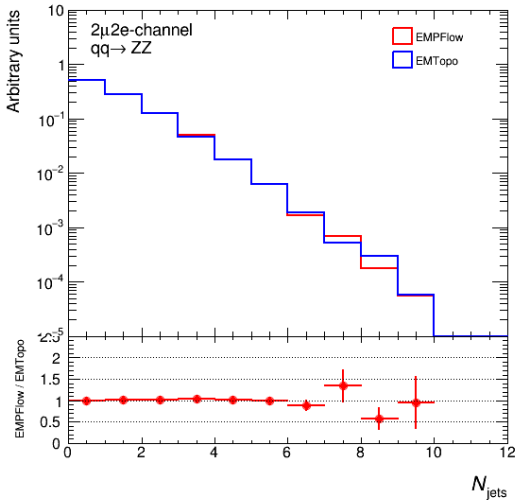


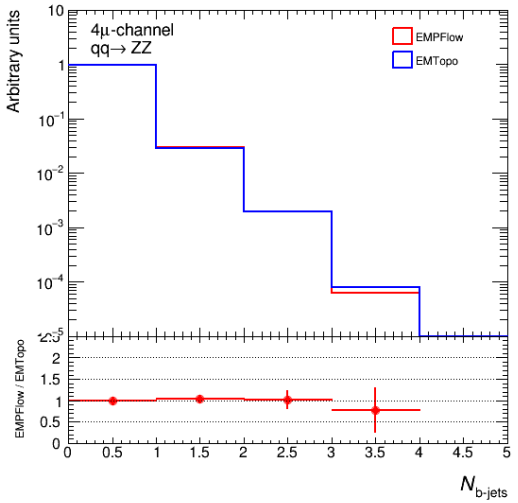
Checking the bug with the official code

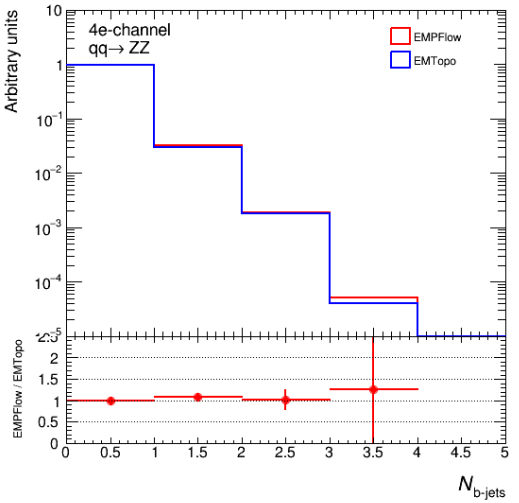
EMPFlow vs EMTopo: N_{jets} for $qq \rightarrow ZZ$

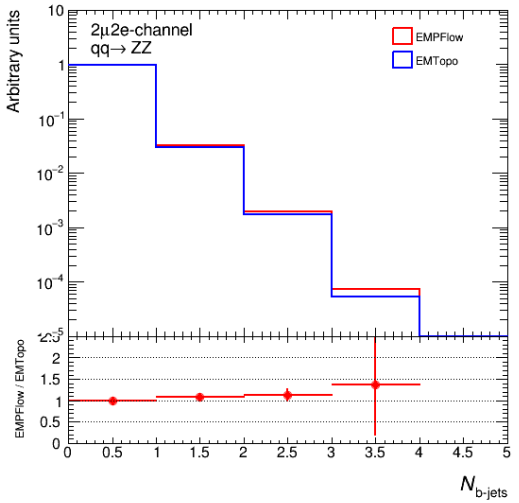






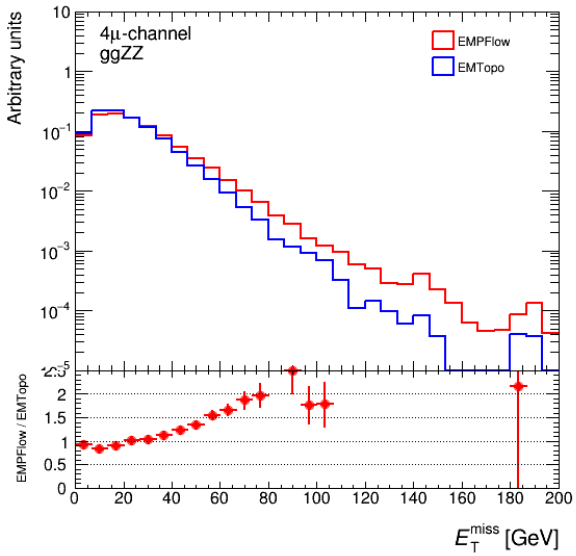


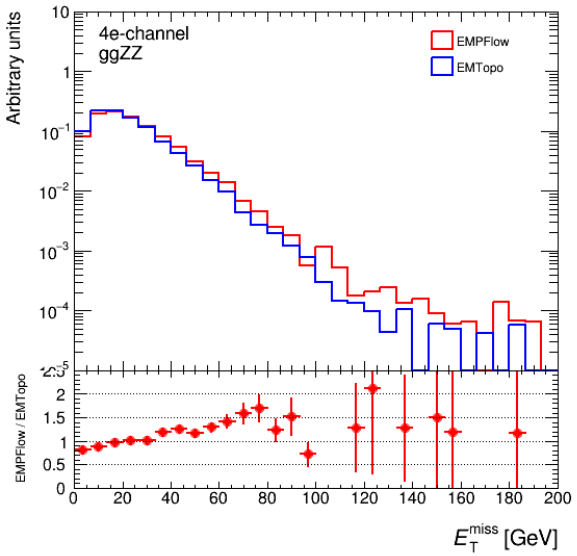


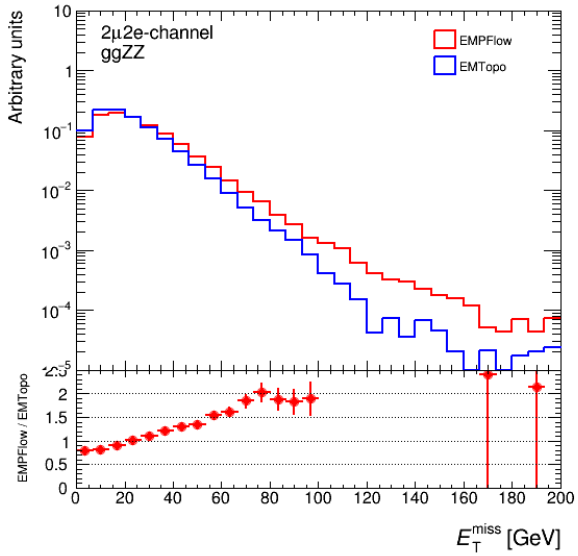


Checking the bug with the official code

EMPFlow vs EMTopo: $E_{\mathrm{T}}^{\mathrm{miss}}$ for $gg \rightarrow ZZ$

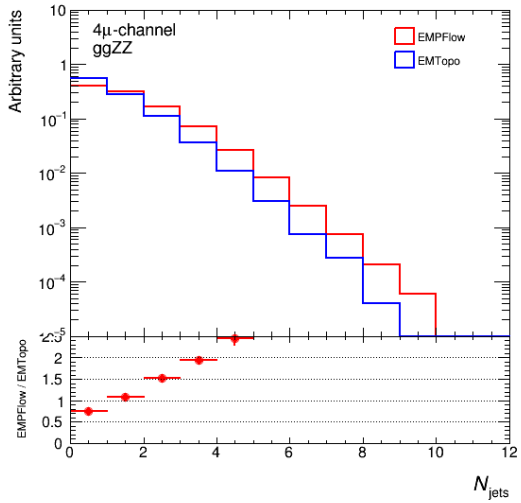


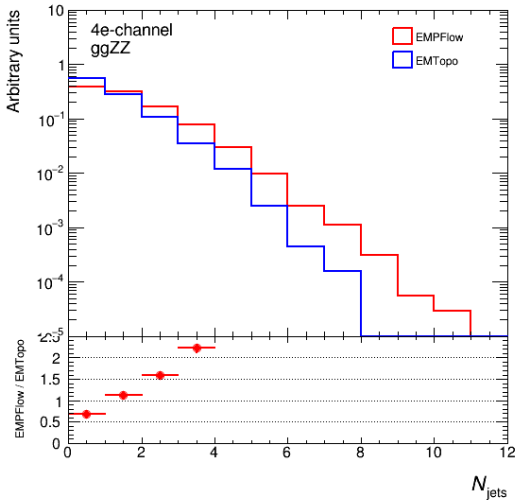


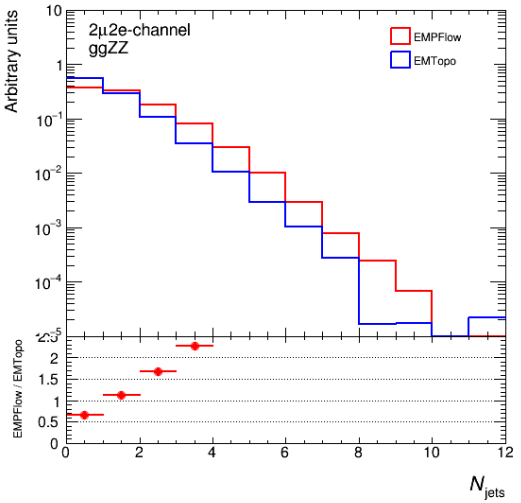


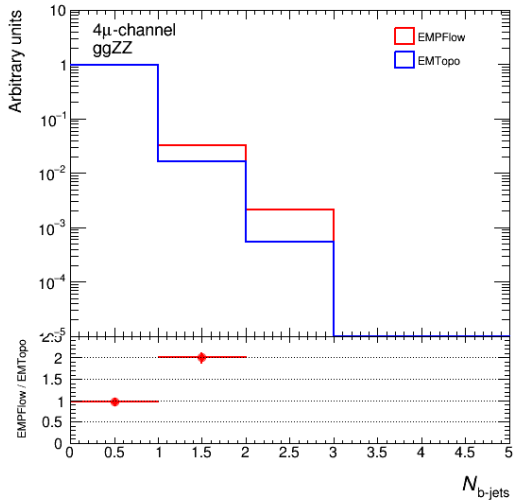
Checking the bug with the official code

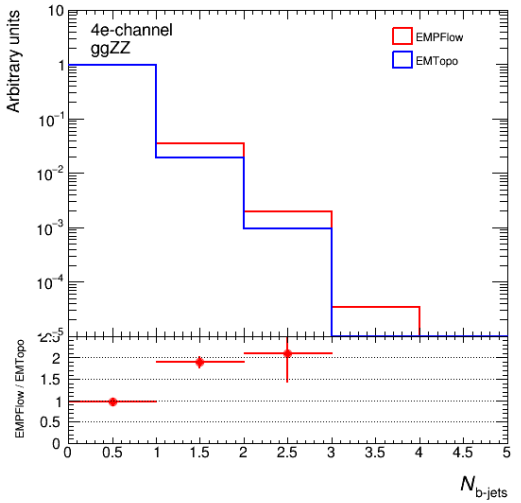
EMPFlow vs EMTopo: N_{jets} for $gg \to ZZ$

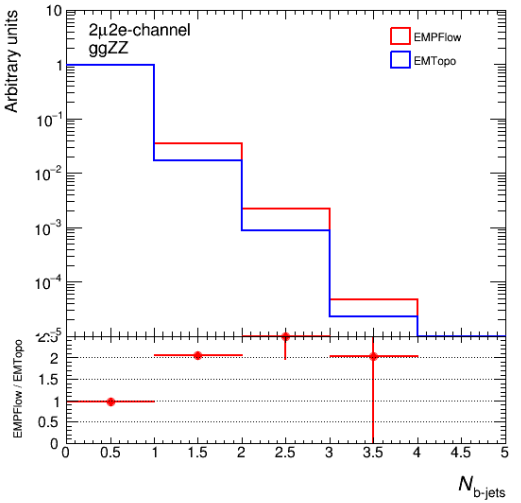












Summary

- We're not dominated by theory systematic, but few problems for Herwig shower need to be fixed.
- The new official samples work well with the qqZZ sample.
- But we see hug difference between Pflow and Topo for ggZZ sample.
- What we should be doing next is to check samples from the HZZ group.
- Then compare them to both 21.2.91 and 21.2.39 cases.
- If the problem still exist then we need to contact the 4ℓ experts.

DiHiggs to 4ℓ . . .

- Working on the new samples so I submitted some jobs.
- Few DSID are missing from the provided replicas.
- There's a heavy jobs failure in which I'm investigating.

Thank you!

Additional slides
Pre-event selection

Event Selection	
Quadruplet Selection	- Require at least one quadruplet of leptons consisting of two pairs of same-flavour opposite-charge leptons fulfilling the following requirements: - p_T thresholds for three leading leptons in the quadruplet: 20, 15 and 10 GeV - At most 1 calo-tagged, stand-alone or silicon-associated muon per quadruplet - Leading di-lepton mass requirement: $50 < m_{12} < 106$ GeV - Sub-leading di-lepton mass requirement: $m_{\text{threshold}} < m_{34} < 115$ GeV - $\Delta R(\ell, \ell') > 0.10$ for all lepton pairs in the quadruplet - Remove quadruplet if alternative same-flavour opposite-charge di-lepton gives $m_{\ell\ell} < 5$ GeV - Keep all quadruplets passing the above selection
Isolation Needs updating	- Contribution from the other leptons of the quadruplet is subtracted - Muon track isolation ($\Delta R = 0.30$): $\Sigma p_T / p_T < 0.15$ - Muon calorimeter isolation ($\Delta R = 0.20$): $\Sigma E_T / p_T < 0.30$ - Electron track isolation ($\Delta R = 0.20$) : $\Sigma E_T / E_T < 0.15$ - Electron calorimeter isolation ($\Delta R = 0.20$) : $\Sigma E_T / E_T < 0.20$
Impact Parameter Significance	- Apply impact parameter significance cut to all leptons of the quadruplet - For electrons: $d_0/\sigma_{d_0} < 5$ - For muons: $d_0/\sigma_{d_0} < 3$
Best Quadruplet	- If more than one quadruplet has been selected, choose the quadruplet with highest Higgs decay ME according to channel: 4μ, $2e2\mu$, $2\mu2e$ and $4e$
Vertex Selection	- Require a common vertex for the leptons: - $\chi^2/\text{ndof} < 5$ for 4μ and < 9 for others decay channels

Additional slides
Systematic uncertainty

Normalisation	Shape
Electrons	
EL_EFF_ID_CorrUncertaintyNP[0-15]	EG_RESOLUTION_ALL
EL_EFF_ID_SIMPLIFIED_UncorrUncertaintyNP[0-17]	EG_SCALE_ALLCORR
EL_EFF_Iso_TOTAL_1NPCOR_PLUS_UNCOR	EG_SCALE_E4SCINTILLATOR
EL_EFF_Reco_TOTAL_1NPCOR_PLUS_UNCOR	EG_SCALE_LARCALIB_EXTRA2015PRE
	EG_SCALE_LARTEMPERATURE_EXTRA2015PRE
	EG_SCALE_LARTEMPERATURE_EXTRA2016PRE
Muons	
MUON_EFF_ISO_STAT	
MUON_EFF_ISO_SYS	MUON_ID
MUON_EFF_RECO_STAT	MUON_MS
MUON_EFF_RECO_STAT_LOWPT	MUON_SAGITTA_RESBIAS
MUON_EFF_RECO_SYS	MUON_SAGITTA_RHO
MUON_EFF_RECO_SYS_LOWPT	MUON_SCALE
MUON_EFF_TTVA_STAT	
MUON_EFF_TTVA_SYS	
Jets	
	JET_BJES_Response
	JET_EffectiveNP_[1-7]
	JET_EffectiveNP_8restTerm
	JET_EtaIntercalibration_Modelling
	JET_EtaIntercalibration_NonClosure_highE
	JET_EtaIntercalibration_NonClosure_negEta
	JET_EtaIntercalibration_NonClosure_posEta
	JET_EtaIntercalibration_TotalStat
	JET_Flavor_Composition
	JET_Flavor_Response
	JET_JER_DataVsMC
	JET_JER_EffectiveNP_[1-6]
	JET_JER_EffectiveNP_7restTerm
	JET_Pileup_OffsetMu
	JET_Pileup_OffsetNPV
	JET_Pileup_PtTerm
	JET_Pileup_RhoTopology
	JET_PunchThrough_MC16
	JET_SingleParticle_HighPt
Missing transverse energy	
	MET_SoftTrk_ResoPara
	MET_SoftTrk_ResoPerp
	MET_SoftTrk_Scale
Other	
HOEW_QCD_syst	
HOEW_syst	
HOQCD_scale_syst	
PRW_DATASF	