WZ Background Study

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Overview

- Isolate and study WZ events to understand kinematics
  - Njets excess in data
- For same-sign dilepton events, WZ$\rightarrow \ell^+\ell^-\ell^{\pm}\nu$ is a prevalent background if the right lepton goes missing, as the Z products guarantee a same sign pair with the W lepton
  - Compare yields in 8 signal regions (+ a baseline) with AN2013_120 to understand some systematics for this background

Lepton Selections

- Look at events with 3 leptons (no taus) that have passed loose selections
  - `passElectronSelection_Stop2012_v3()` or `muonId( …, ZMet2012_v1)`
  - $|\eta| < 2.4$
  - $p_T > 20$ GeV
- Identify same-flavor, opposite-sign lepton pair with mass within 15 GeV of the Z mass
- Finally, impose a tighter requirement on the 3rd lepton (from the W)
  - `samesign::isNumeratorLepton()`

Jet Requirements

- $|\eta| < 2.4$
- $p_T > 40$ GeV
- `passesLoosePFJetID()`
- $\Delta R > 0.4$ between jet and any good lepton

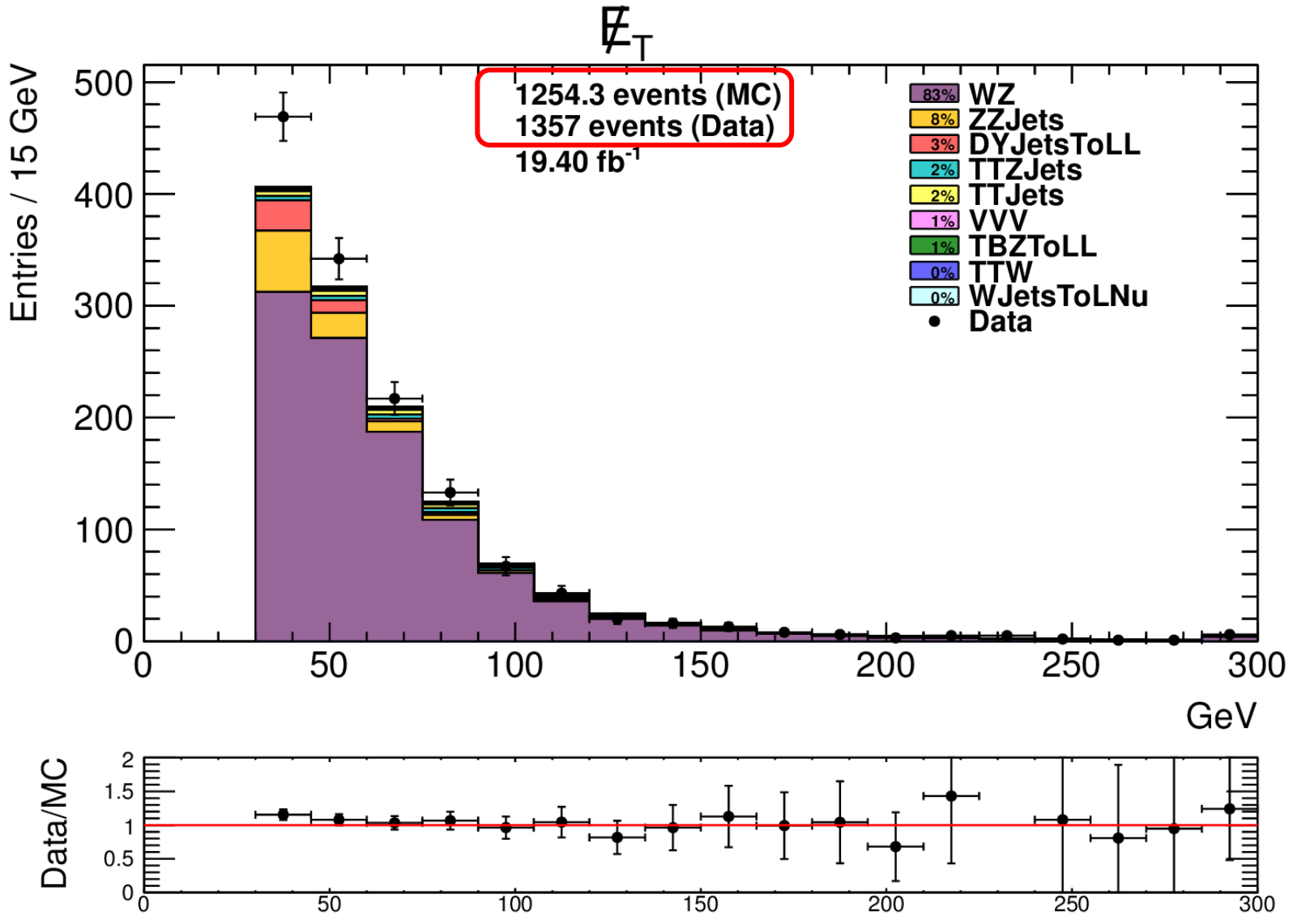
Samples

- Data
  - 2012A-D dilepton trigger datasets
  - Filtered duplicate events due to overlapping triggers
  - 19.4 /fb
- MC
  - WZ+jets
  - DY
  - tt+jets
  - ttZ
  - ttW
  - W+jets
  - ZZ+jets
  - VVV
  - TbZ

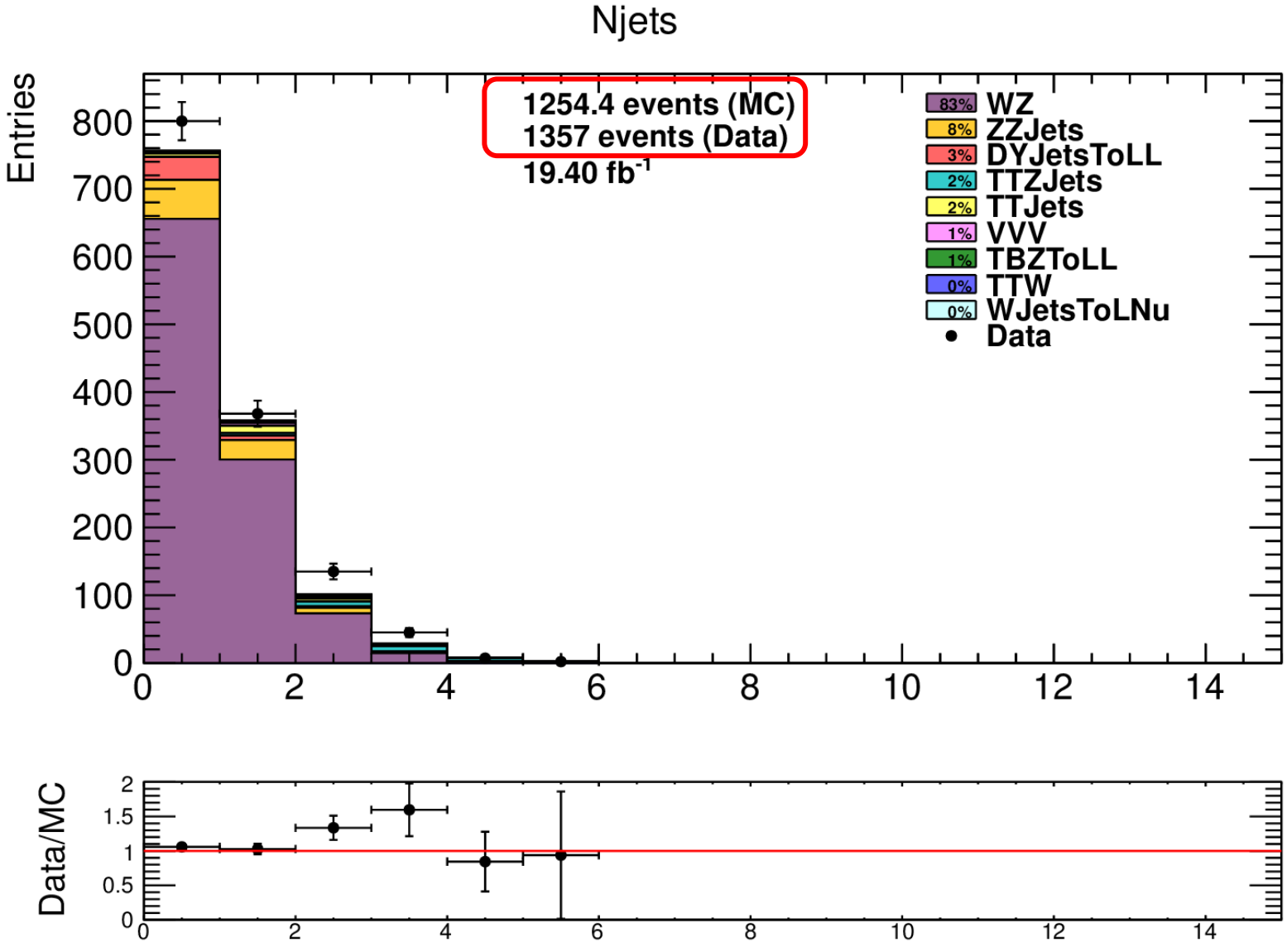
Initial Yield

- Region: same as SR0 described later with no requirement on Njets or H_T
  - Lepton p_T > 20 GeV
  - MET > 30 GeV
- Data
  - **1357** events in 19.4 /fb
- MC
  - **1254** ± 10 events scaled to 19.4 /fb

Unscaled Distributions



Unscaled Distributions

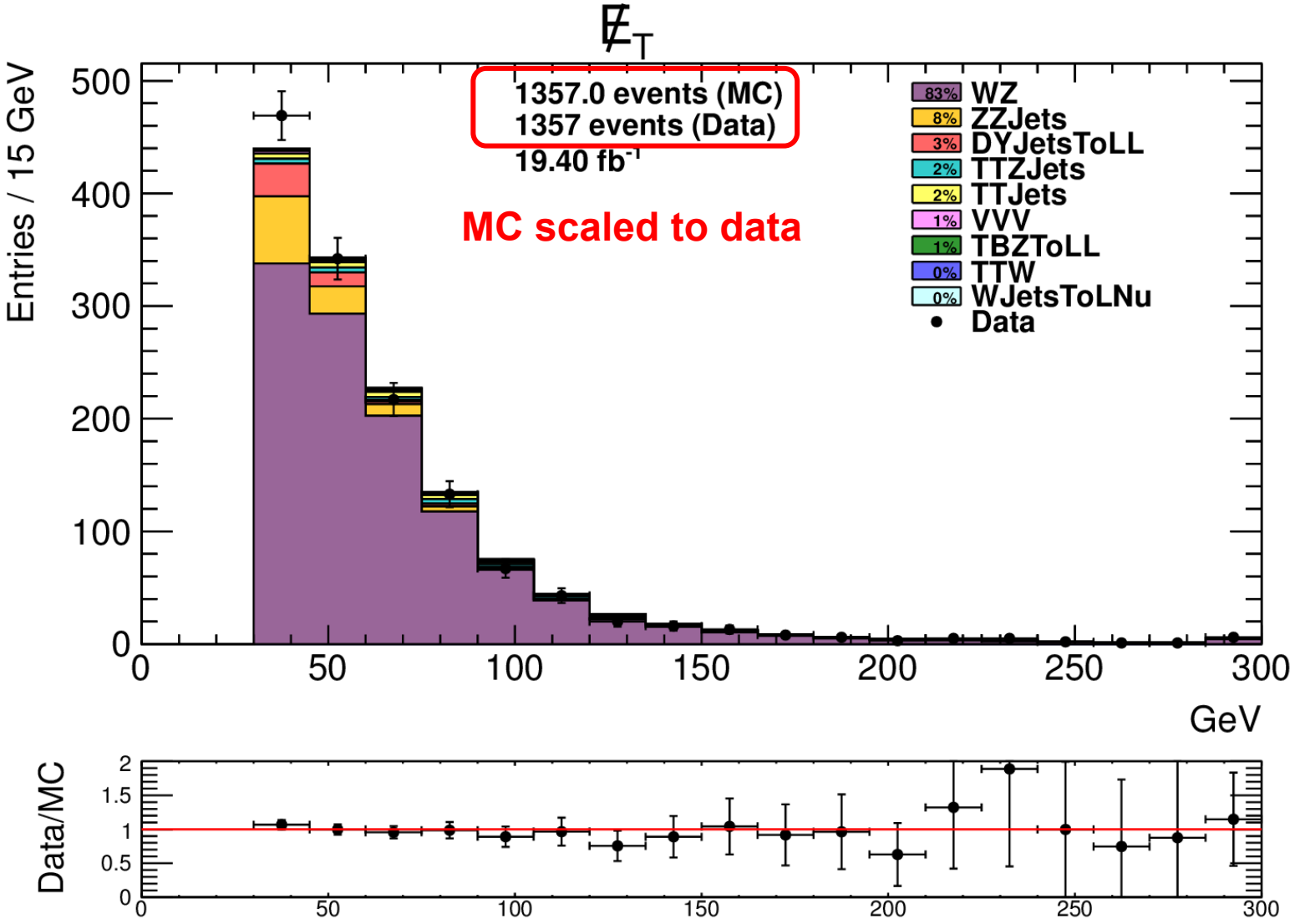


Njets Unscaled

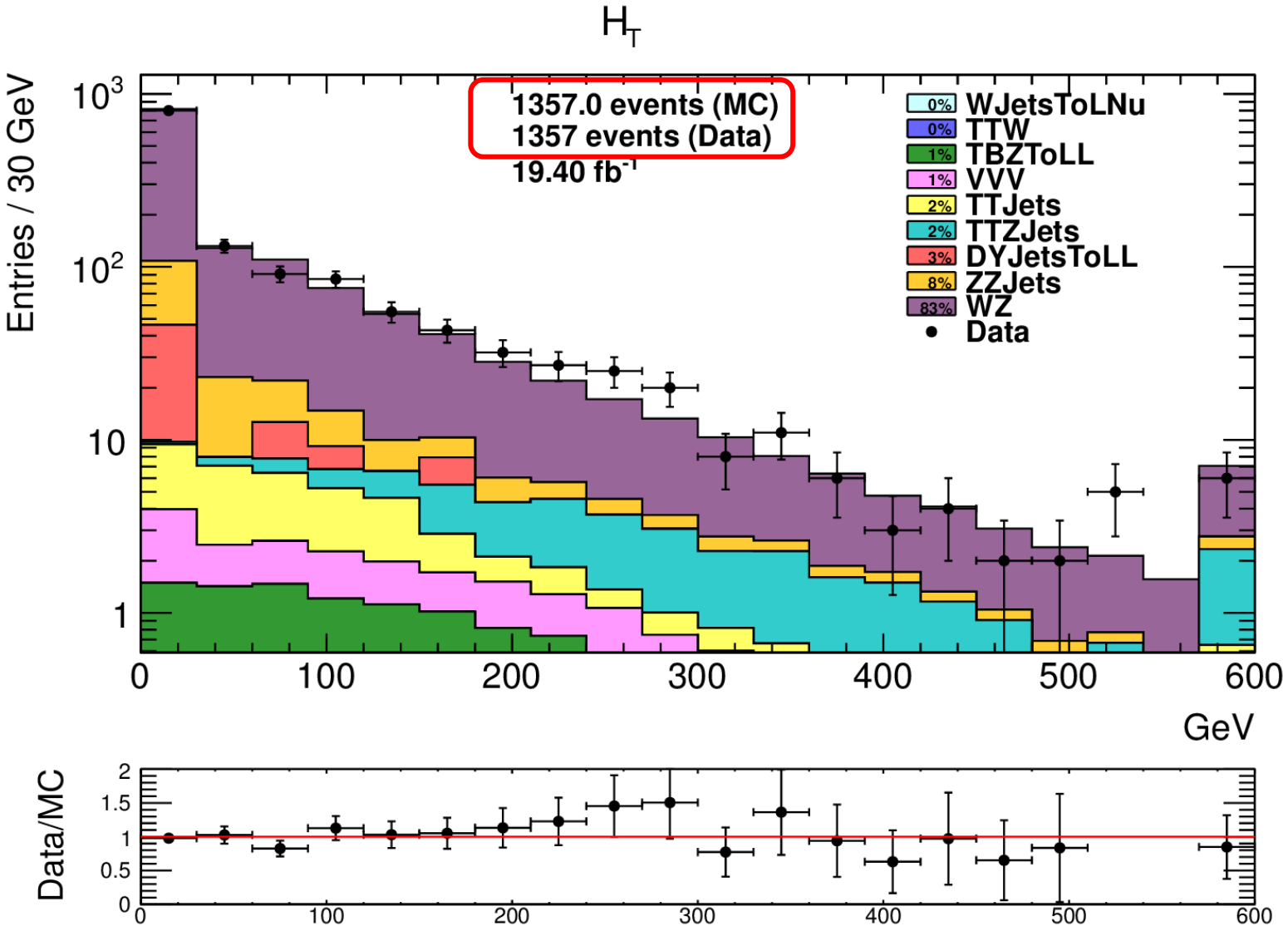
Njets	Data	MC	Data Excess
0	800	756	**5.8%**
1	368	358	**2.8%**
2	135	101	**33.7%**
3	45	28.2	**59.6%**
4	7	8.3	**-15.7%**

- Excess in Njets = 2, 3 observed
- Overall excess in data, so now we normalize MC to data to look at shapes

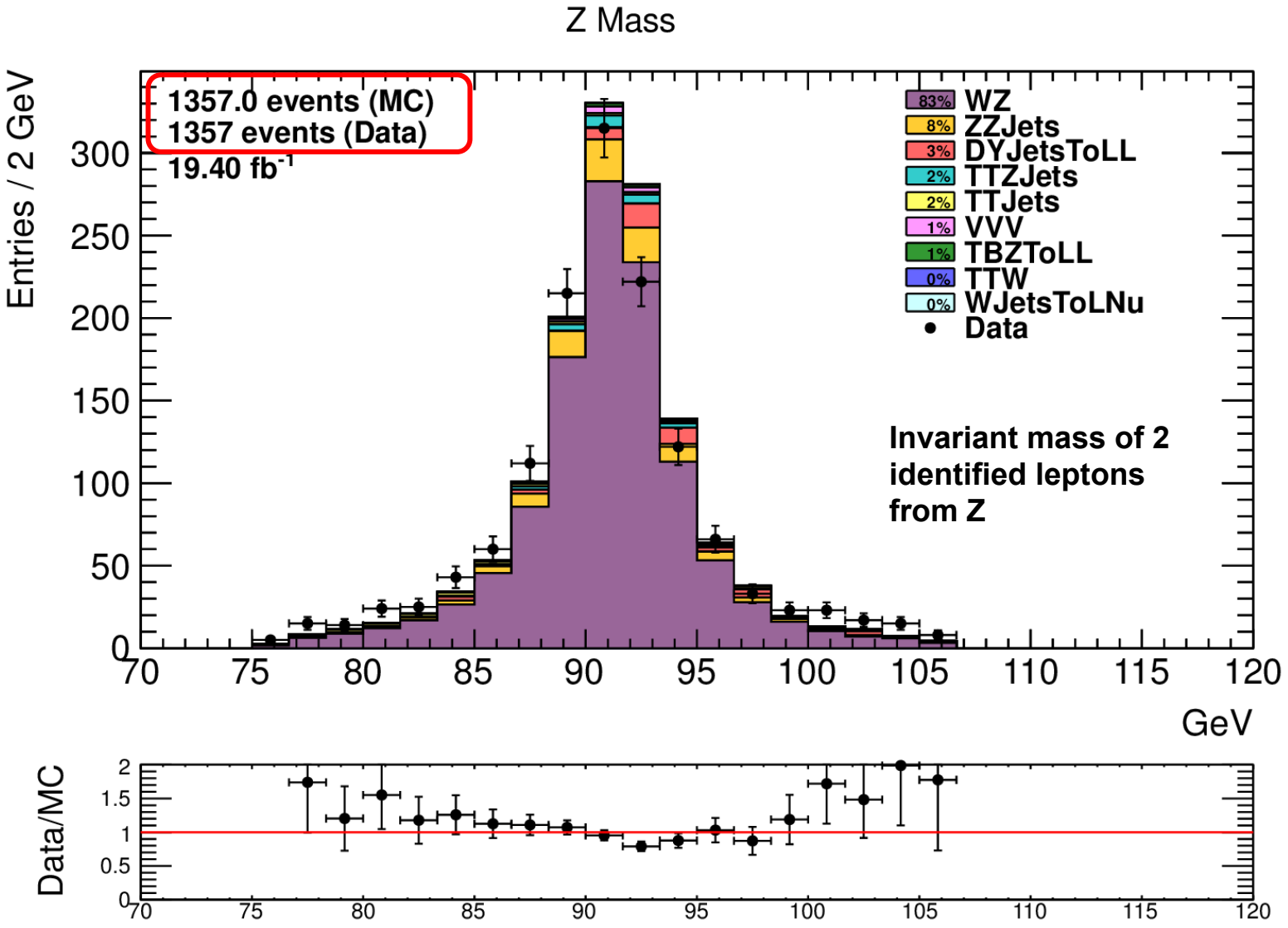
Final Distributions



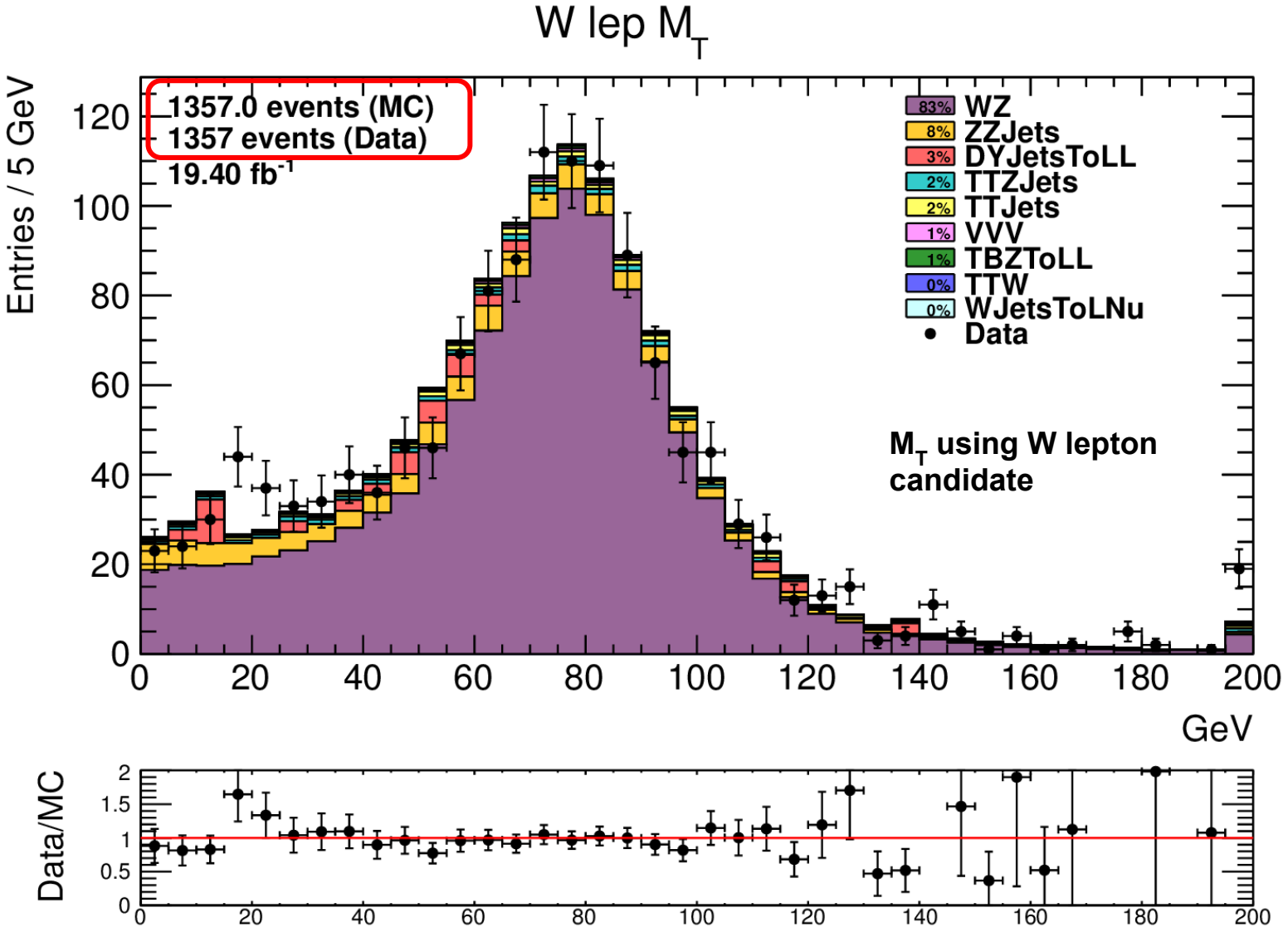
Final Distributions



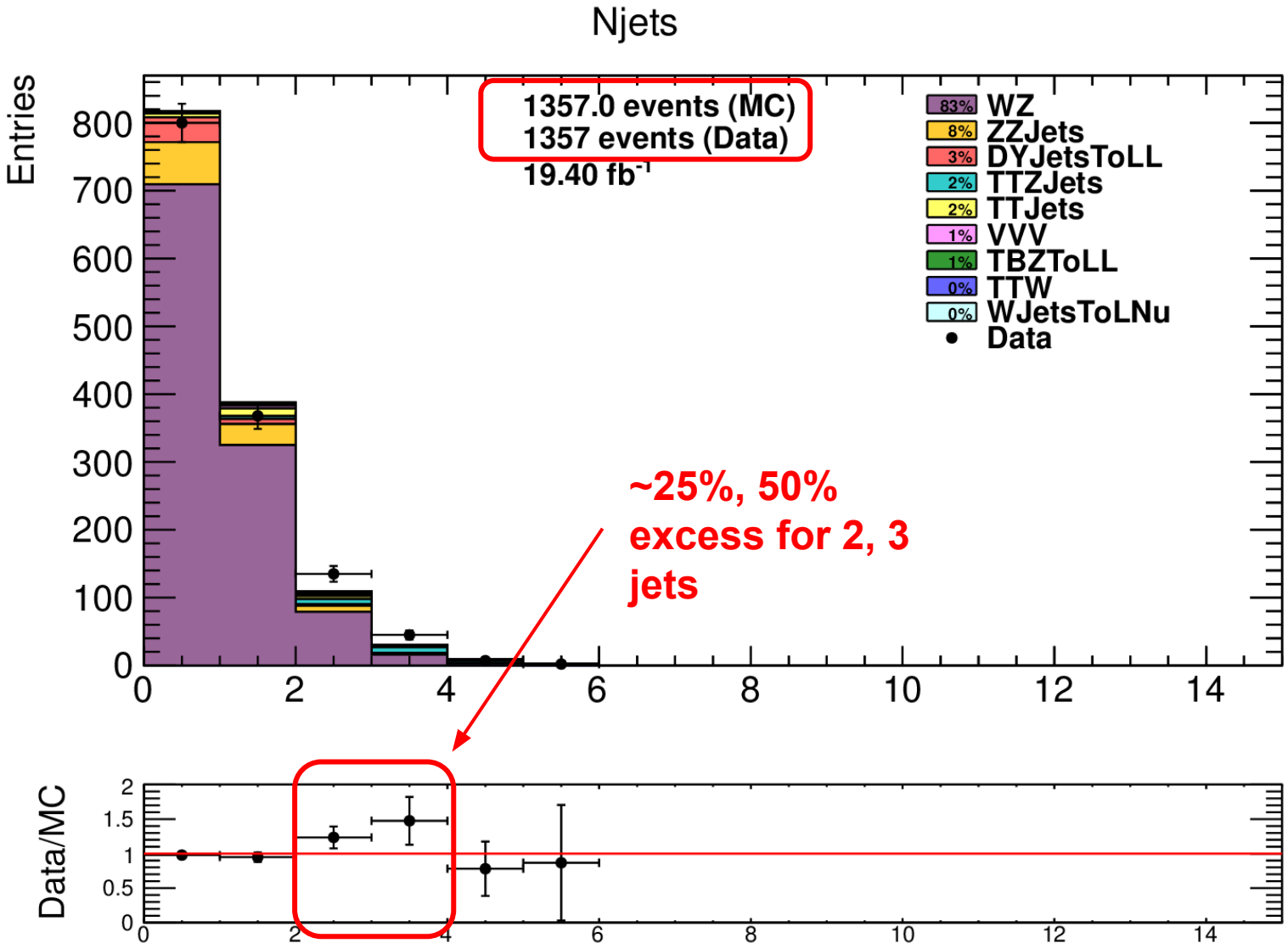
Final Distributions



Final Distributions



Final Distributions



Njets Normalized

Njets	Data	Scaled MC	Data Excess
0	800	818	**-2.2%**
1	368	388	**-5.2%**
2	135	109	**23.9%**
3	45	30.5	**47.5%**
4	7	9.0	**-22.2%**

- No discernible cause for excess from looking at kinematics for events with ≥2 jets

(Rest of plots at http://web.physics.ucsb.edu/~namin/final/WZplots.pdf
and http://web.physics.ucsb.edu/~namin/final/WZplots_unscaled.pdf)

Comparison with AN

- Count unnormalized events in various signal regions from AN
  - SR0
    - Lepton p_T > 20 GeV
    - MET > 30 GeV
    - H_T > 80 GeV
    - Njets ≥ 2
    - **Additionally, "SR0b0"** has # b-tagged jets = 0
  - SR1-SR8

# b-tagged jets	$\not{E}_T$	# jets	H_T[200-400]	H_T[> 400]
= 0	50-120	2-3	SR1	SR2
		≥ 4	SR3	SR4
	> 120	2-3	SR5	SR6
		≥ 4	SR7	SR8

Comparison with AN

lose 3rd lepton | **find** 3rd lepton

Region	WZ SS $\ell\ell$ AN yield	$\ell\ell\ell$ Data	$\ell\ell\ell$ All MC	WZ MC
SR0	72.35 ± 0.93	189	140.2 ± 2.6	90.8
SR0b0	-	142	108 ± 10.4	84.6
SR1	11.93 ± 0.39	36	19.32 ± 0.45	16.2
SR2	2.13 ± 0.17	5	4.58 ± 0.21	3.9
SR3	0.75 ± 0.11	0	1.17 ± 0.12	0.67
SR4	0.56 ± 0.09	1	1.04 ± 0.11	0.64
SR5	4.78 ± 0.25	8	7.54 ± 0.28	6.36
SR6	2.25 ± 0.17	2	3.80 ± 0.20	3.15
SR7	0.16 ± 0.05	0	0.37 ± 0.07	0.23
SR8	0.50 ± 0.09	3	0.69 ± 0.09	0.49

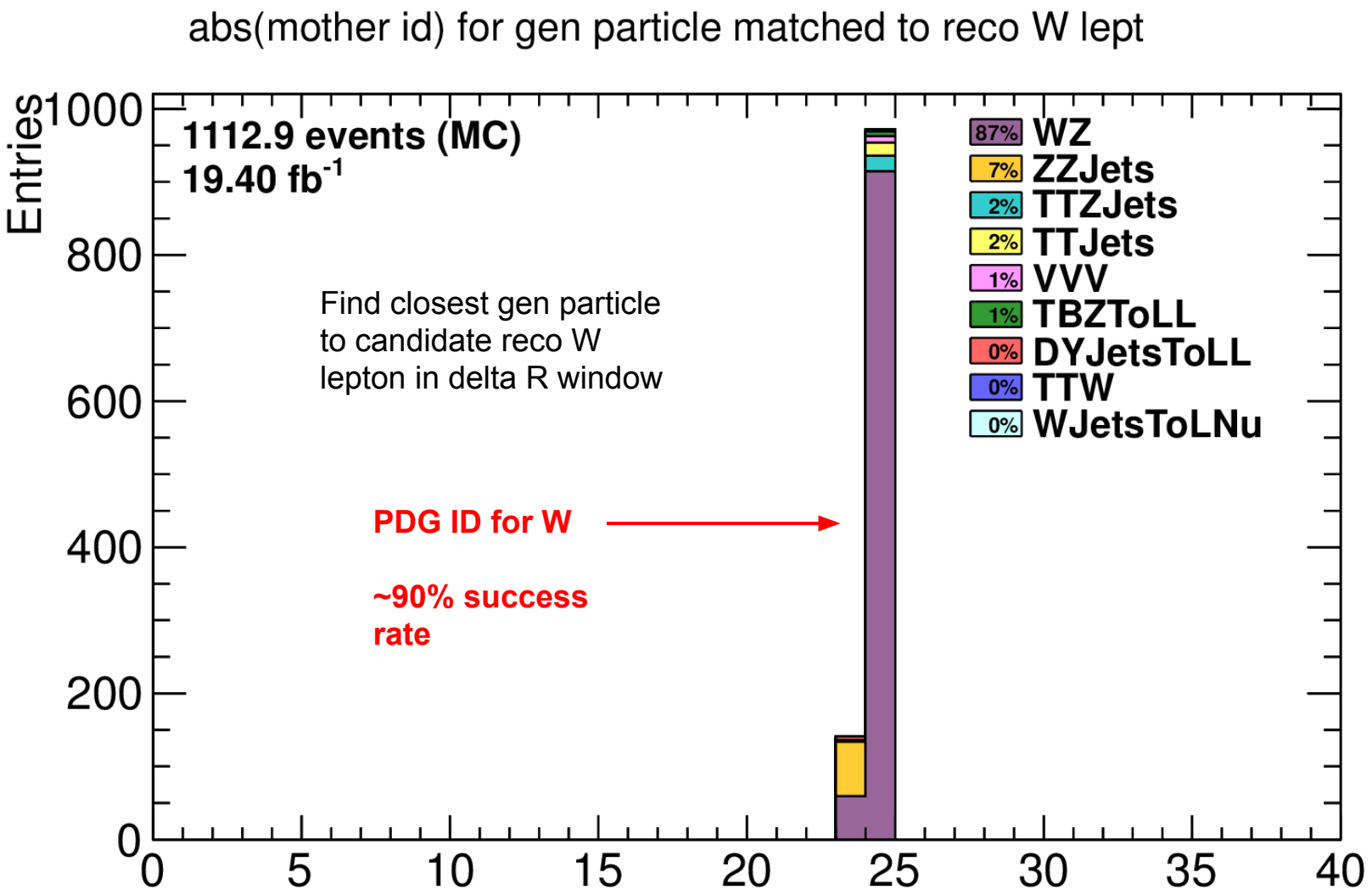
- Njets excess seen here
- Data/MC scale factor of ~1.4 for SR0b0

Conclusions

- Njets discrepancy between MC and data, but nothing interesting in distributions to suggest a particular venue for investigation
- Due to excess of 2-3 jet events in data, we can scale the AN MC yield up to account for this using the ratio from baseline SR0 or loose SR1
- For tighter/lower statistics SRs, we can extrapolate from MC yields

Backup

W ID Efficiency



Datasets (MC)

/WZJetsTo3LNu_TuneZ2_8TeV-madgraph-tauola/Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/TTJets_FullLeptMGDecays_8TeV-madgraph/Summer12_DR53X-PU_S10_START53_V7A-v2/AODSIM

/TTWJets_8TeV-madgraph/Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/TTZJets_8TeV-madgraph_v2/Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/WJetsToLNu_TuneZ2Star_8TeV-madgraph-tarball/Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/DYJetsToLL_M-50_TuneZ2Star_8TeV-madgraph-tarball/Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/TBZToLL_4F_TuneZ2star_8TeV-madgraph-tauola_Summer12_DR53X-PU_S10_START53_V7C-v1/AODSIM

/ZZJetsTo2L2Nu_TuneZ2star_8TeV-madgraph-tauola_Summer12_DR53X-PU_S10_START53_V7A-v3/AODSIM

/ZZJetsTo4L_TuneZ2star_8TeV-madgraph-tauola_Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/ZZJetsTo2L2Q_TuneZ2star_8TeV-madgraph-tauola_Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/WWGJets_8TeV-madgraph_Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/WWWJets_8TeV-madgraph_Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/WWZNoGstarJets_8TeV-madgraph_Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/WZZNoGstarJets_8TeV-madgraph_Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

/ZZZNoGstarJets_8TeV-madgraph_Summer12_DR53X-PU_S10_START53_V7A-v1/AODSIM

Datasets (Data)

/DoubleMu_Run2012A-13Jul2012-v1/AOD

/DoubleElectron_Run2012A-13Jul2012-v1/AOD

/MuEG_Run2012A-13Jul2012-v1/AOD

/DoubleMu_Run2012B-13Jul2012-v4/AOD

/DoubleElectron_Run2012B-13Jul2012-v1/AOD

/MuEG_Run2012B-13Jul2012-v1/AOD

/DoubleMu_Run2012C-24Aug2012-v1/AOD

/DoubleElectron_Run2012C-24Aug2012-v1/AOD

/MuEG_Run2012C-24Aug2012-v1/AOD

/DoubleMu_Run2012C-PromptReco-v2/AOD

/DoubleElectron_Run2012C-PromptReco-v2/AOD

/MuEG_Run2012C-PromptReco-v2/AOD

/DoubleMu_Run2012D-PromptReco-v1/AOD

/DoubleElectron_Run2012D-PromptReco-v1/AOD

/MuEG_Run2012D-PromptReco-v1/AOD

/DoubleMu_Run2012D-16Jan2013-v2/AOD

/DoubleElectron_Run2012D-16Jan2013-v1/AOD

/MuEG_Run2012D-16Jan2013-v2/AOD