Multijet estimation for mono-V DM search

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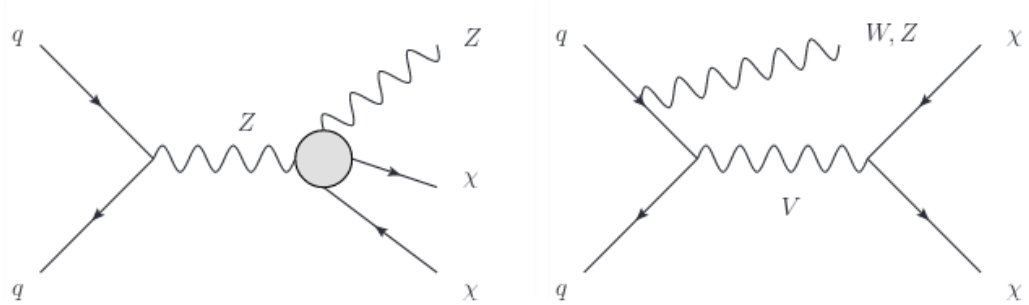
mono-V Dark Matter search



Search for events with large missing transverse momentum with detected W/Z boson

mono-V Dark Matter search

Event selection

Merged Regime		Resolved Regime
	Trigger (xe70, xe90) Trigger (e24, mu24, ...)	
	0 loose e + μ 1 tight μ 1 loose + 1 medium μ	
$E_{\mathrm{T}}^{\mathrm{miss}} > 250\,\mathrm{GeV}$	$p_{\mathrm{T}}^{\mathrm{miss}} > 30\,\mathrm{eV}$	$E_{\mathrm{T}}^{\mathrm{miss}} > 150\,\mathrm{GeV}$
at least one large-R jet		2 - 3 central jets 0 forward jets
	$\Delta\phi(\mathrm{E_T^{miss}}, \mathrm{p_T^{miss}}) < \pi/2$ min $\{\Delta\phi(j, E_{\mathrm{T}}^{\mathrm{miss}}\} < 0.35$	
$\Delta\phi(J, E_{\mathrm{T}}^{\mathrm{miss}}) > 2.1$		$\Delta\phi(\mathrm{dijet}, E_{\mathrm{T}}^{\mathrm{miss}}) > 2.1$ $\Delta\phi(j,j) > 2.4$ leading j $p_{\mathrm{T}} > 45\,\mathrm{GeV}$ $j_{\mathrm{T}}^1 + j_{\mathrm{T}}^2 > 120\,\mathrm{GeV}$ oder $j_{\mathrm{T}}^1 + j_{\mathrm{T}}^2 + j_{\mathrm{T}}^3 > 150\,\mathrm{GeV}$

Event Selection

Zero Lepton (merged regime)

- $E_{\mathrm{T}}^{\mathrm{miss}} > 100\,\mathrm{GeV}$ (for final analysis: $E_{\mathrm{T}}^{\mathrm{miss}} > 100\,\mathrm{GeV}$)
- $p_{\mathrm{T}}^{\mathrm{miss}} > 30\,\mathrm{GeV}$
- no leptons
- $n_{\text{large-}R\text{ jets}} > 0$ for large-R jets with $p_{\mathrm{T}}^{J} > 250\,\mathrm{GeV}$, $|\eta| < 1.2$ and > 2 ghost-associated track jets

Input

Input files and reconstruction options:

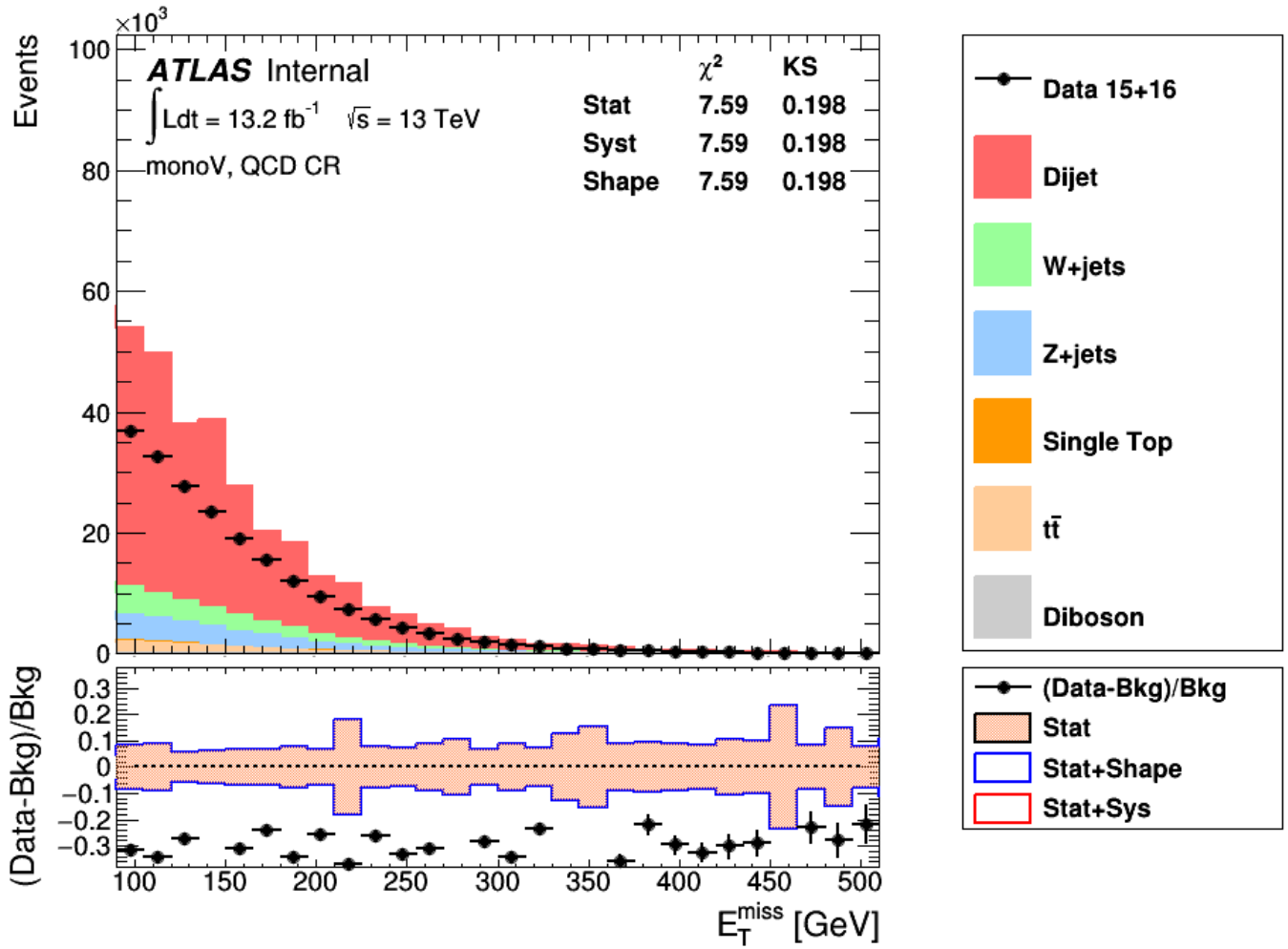
- Latest CxAOD production ($\int \mathcal{L}\,\mathrm{d}t = 13.2\,\mathrm{fb}^{-1}$ data):
  - `/eos/atlas/unpledged/group-tokyo/users/yenari/20160708/HIGGD1_13TeV/CxAOD_00-24-07`
  - `/eos/atlas/unpledged/group-tokyo/users/yenari/20160719/HIGG5D1_13TeV/CxAOD_00-24-10`
- CxAOD Framework analysis options:
  - Blinded analysis, pile-up weight recomputed and applied, MET scale factors applied

Event selection (only 0 lepton, merged regime) :

- $E_{\mathrm{T}}^{\mathrm{miss}} > 100\,\mathrm{GeV}$
- $p_{\mathrm{T}}^{\mathrm{miss}} > 30\,\mathrm{GeV}$
- no leptons
- $n_{\text{large-}R\text{ jets}} > 0$ for large-R jets with $p_{\mathrm{T}}^{J} > 250\,\mathrm{GeV}$, $|\eta| < 1.2$ and > 2 ghost-associated track jets

Kinematic distributions

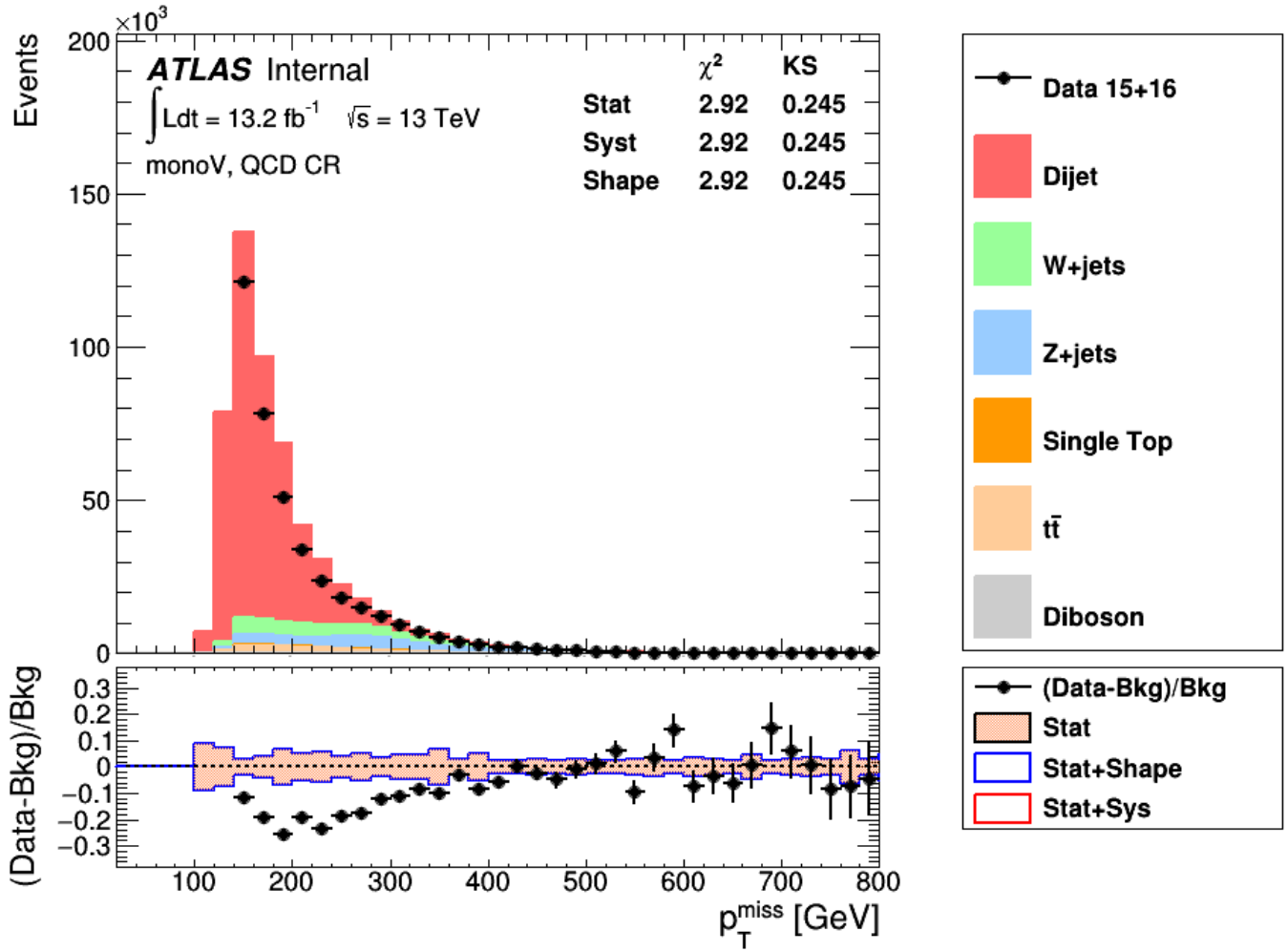
Missing transverse momentum (MET)



Moderate data/MC agreement, dominant contribution from dijet sample

Kinematic distributions

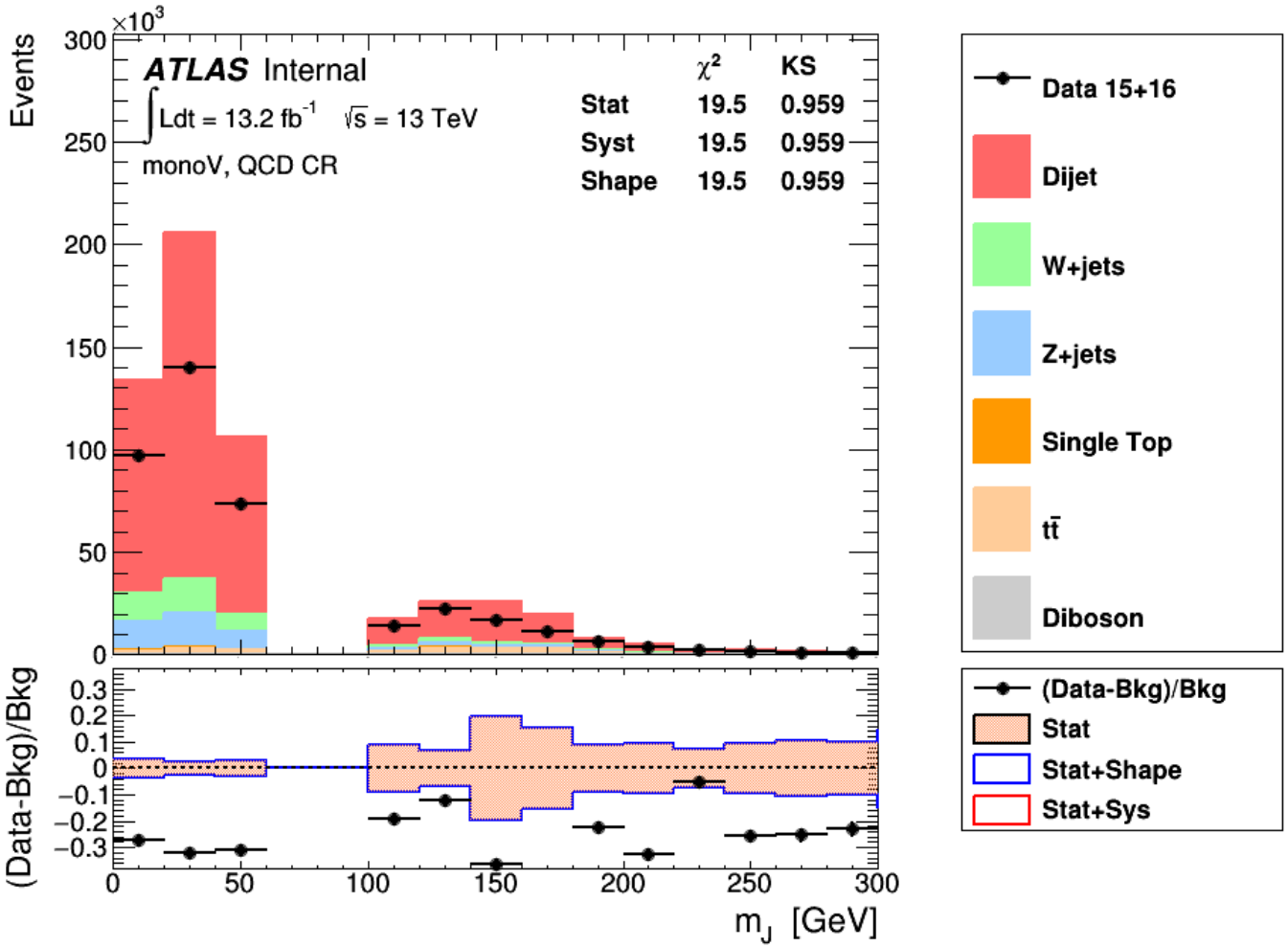
Missing transverse momentum (MPT)



Reasonable data/MC agreement for $p_{\mathrm{T}}^{\mathrm{miss}} > 200\,\mathrm{GeV}$ (bad modeling of QCD fragmentation)

Kinematic distributions

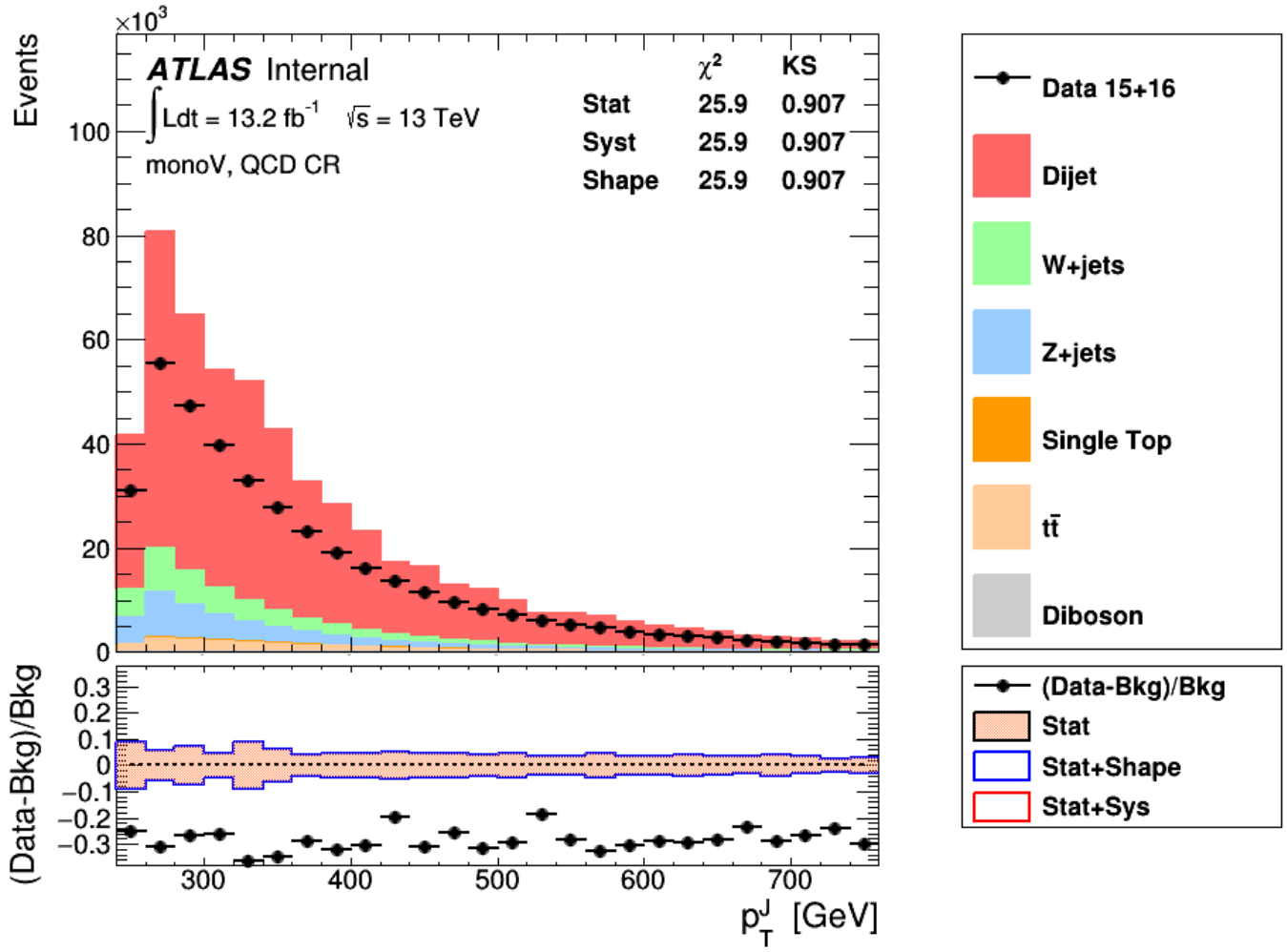
Large-R jet: m



Reasonable data/MC agreement

Kinematic distributions

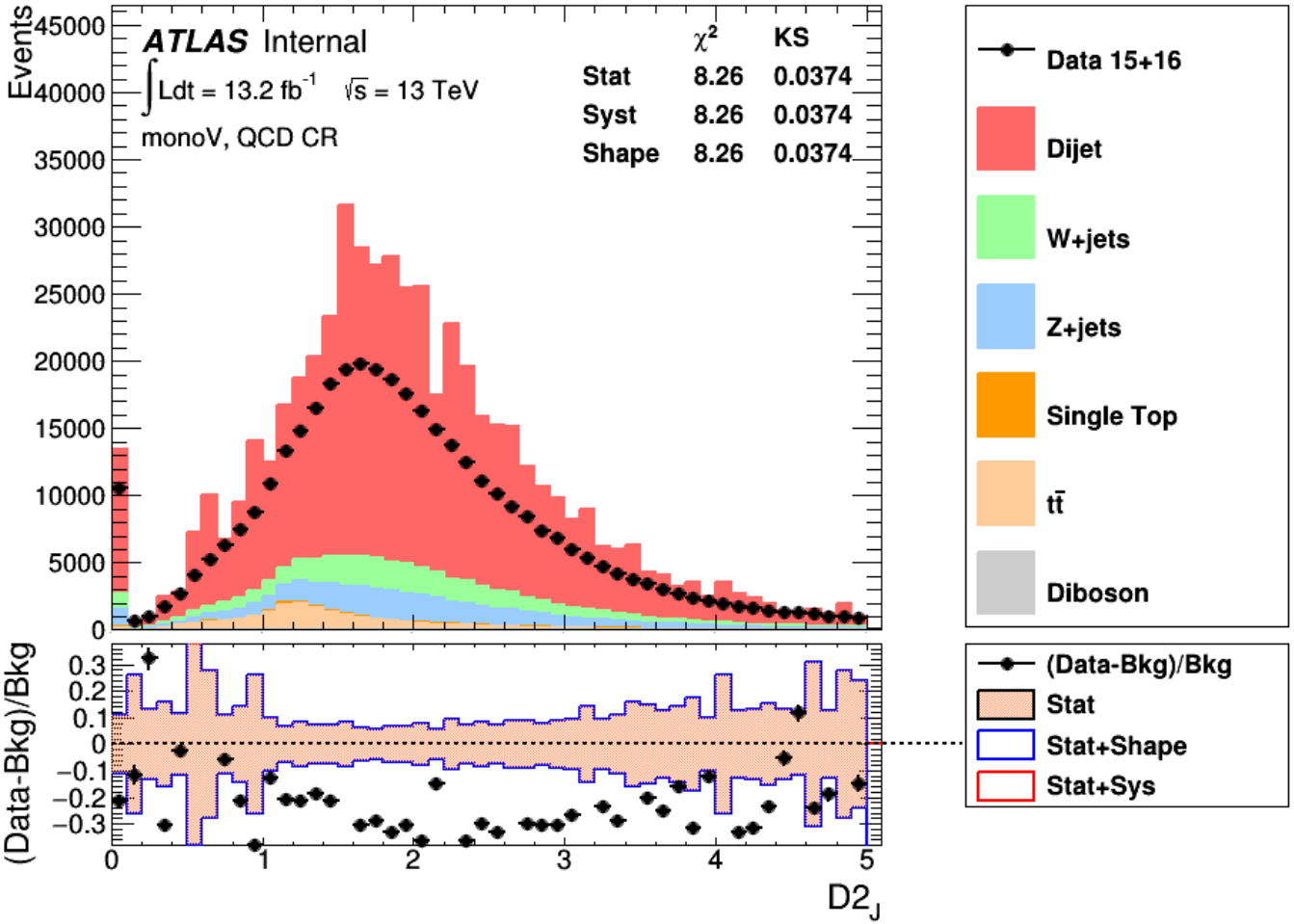
Large-R jet: p_{T}



Reasonable data/MC agreement up to $p_{\mathrm{T}} < 400\,\mathrm{GeV}$

Kinematic distributions

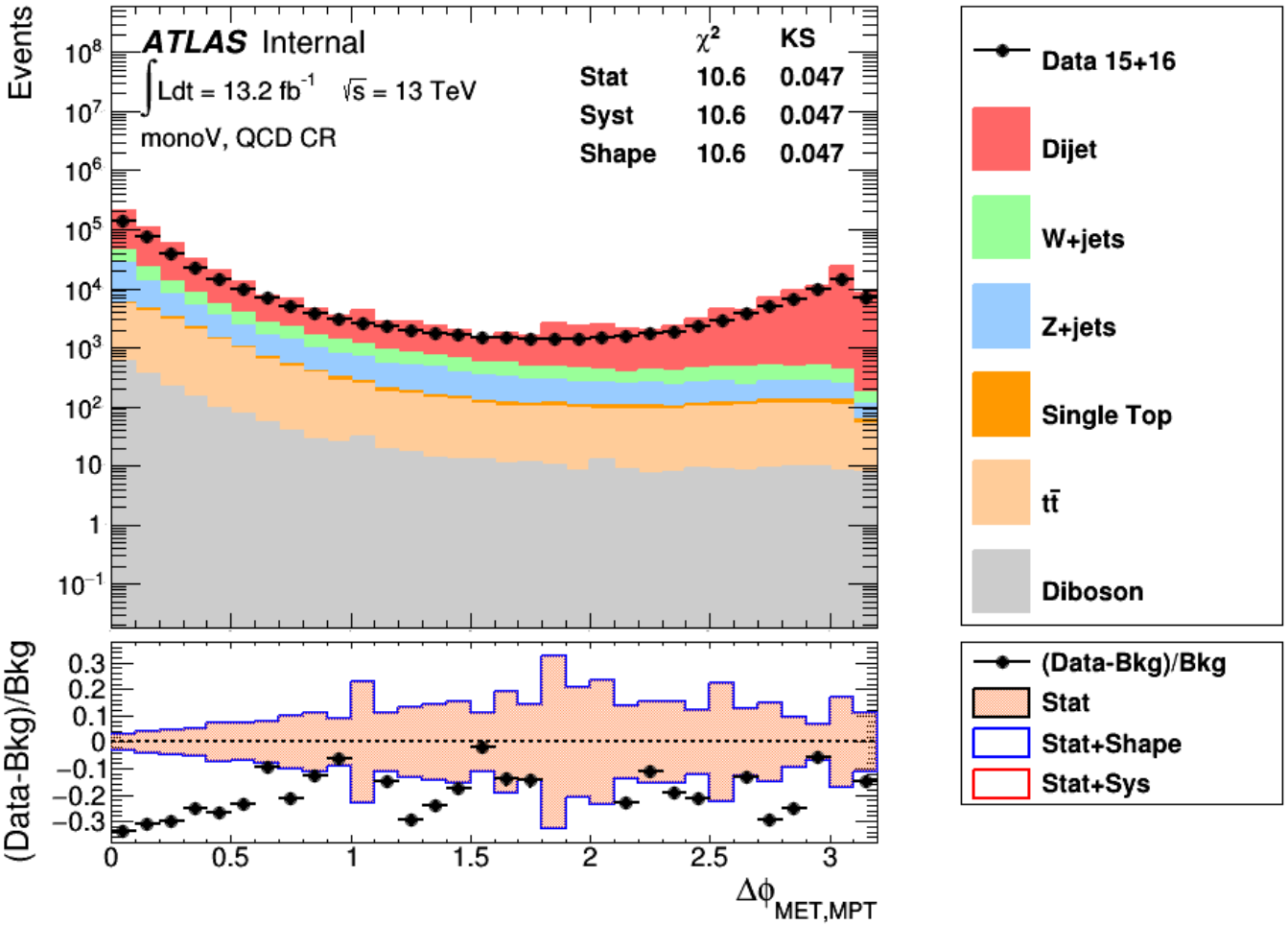
Large-R jet: D_2



Reasonable data/MC agreement

Anti-QCD variables

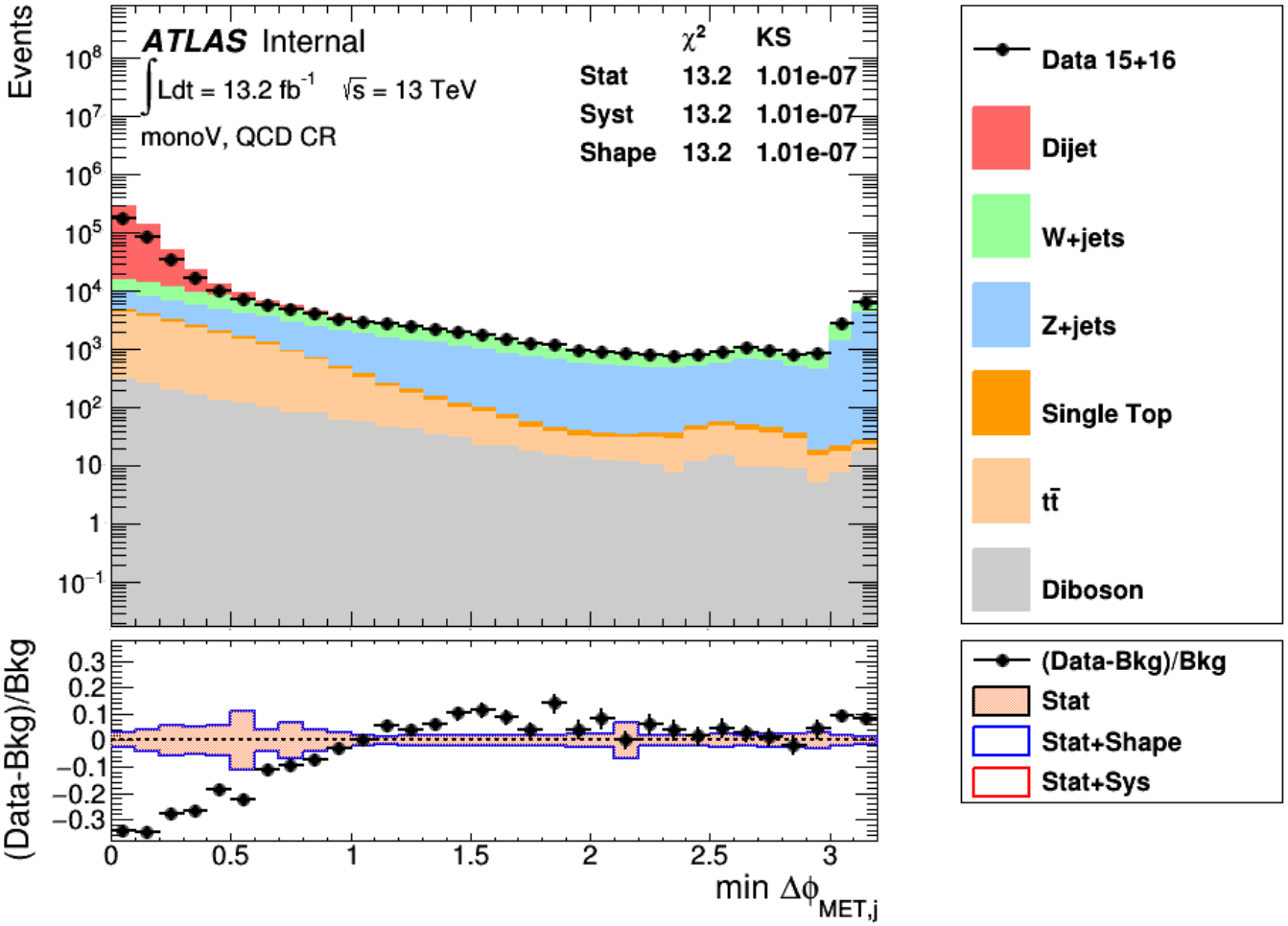
Azimuthal distance between E_{T}^{miss} and p_{T}^{miss} $\Delta\phi(E_{\mathrm{T}}^{miss}, p_{\mathrm{T}}^{miss})$



Reasonable data/MC agreement

Anti-QCD variables

Minimal azimuthal distance between jet and E_T^{miss} min $\Delta\phi(j, E_T^{miss})$



Reasonable data/MC agreement

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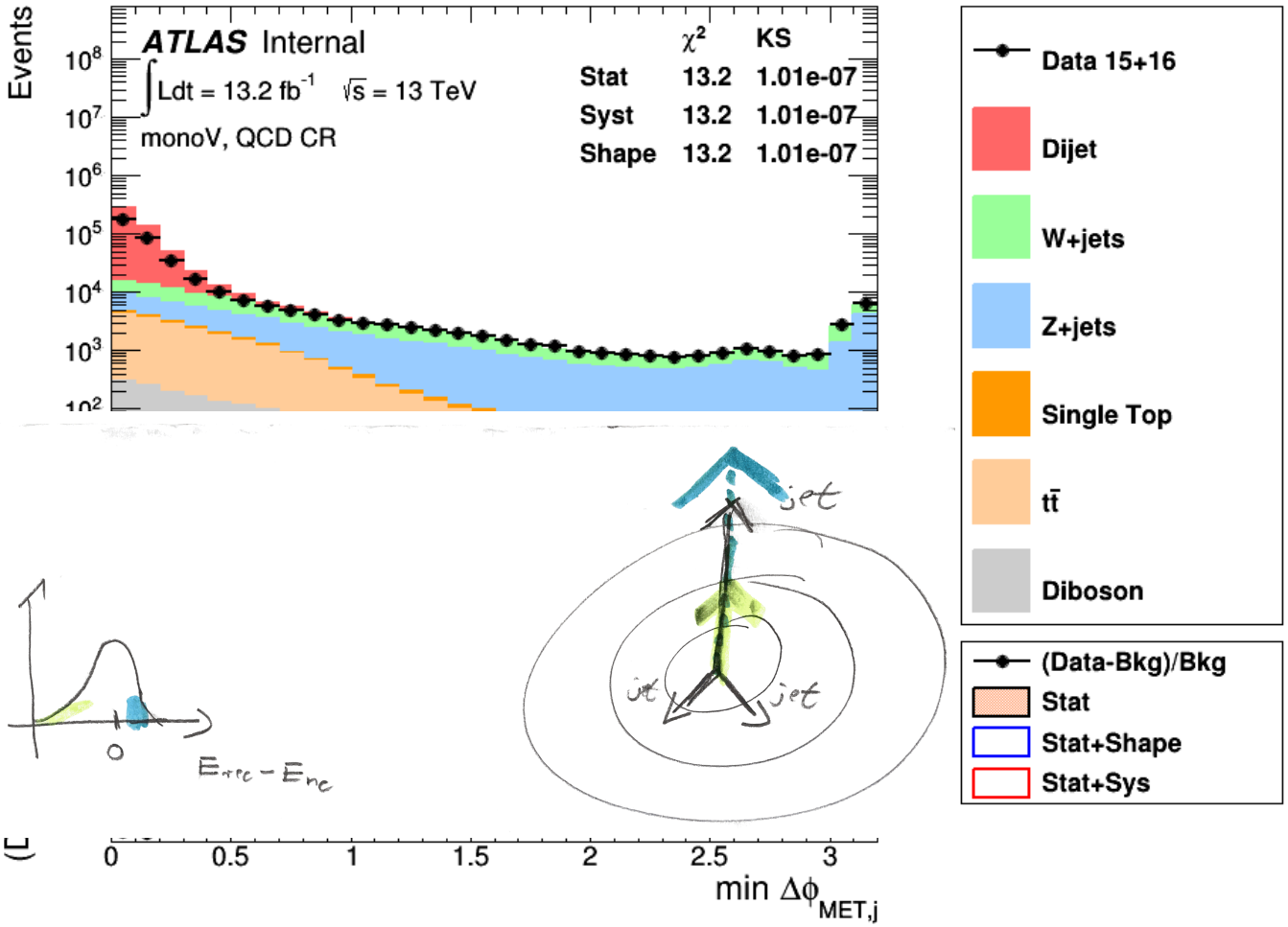

Reasonable data/MC agreement

Anti-QCD variables

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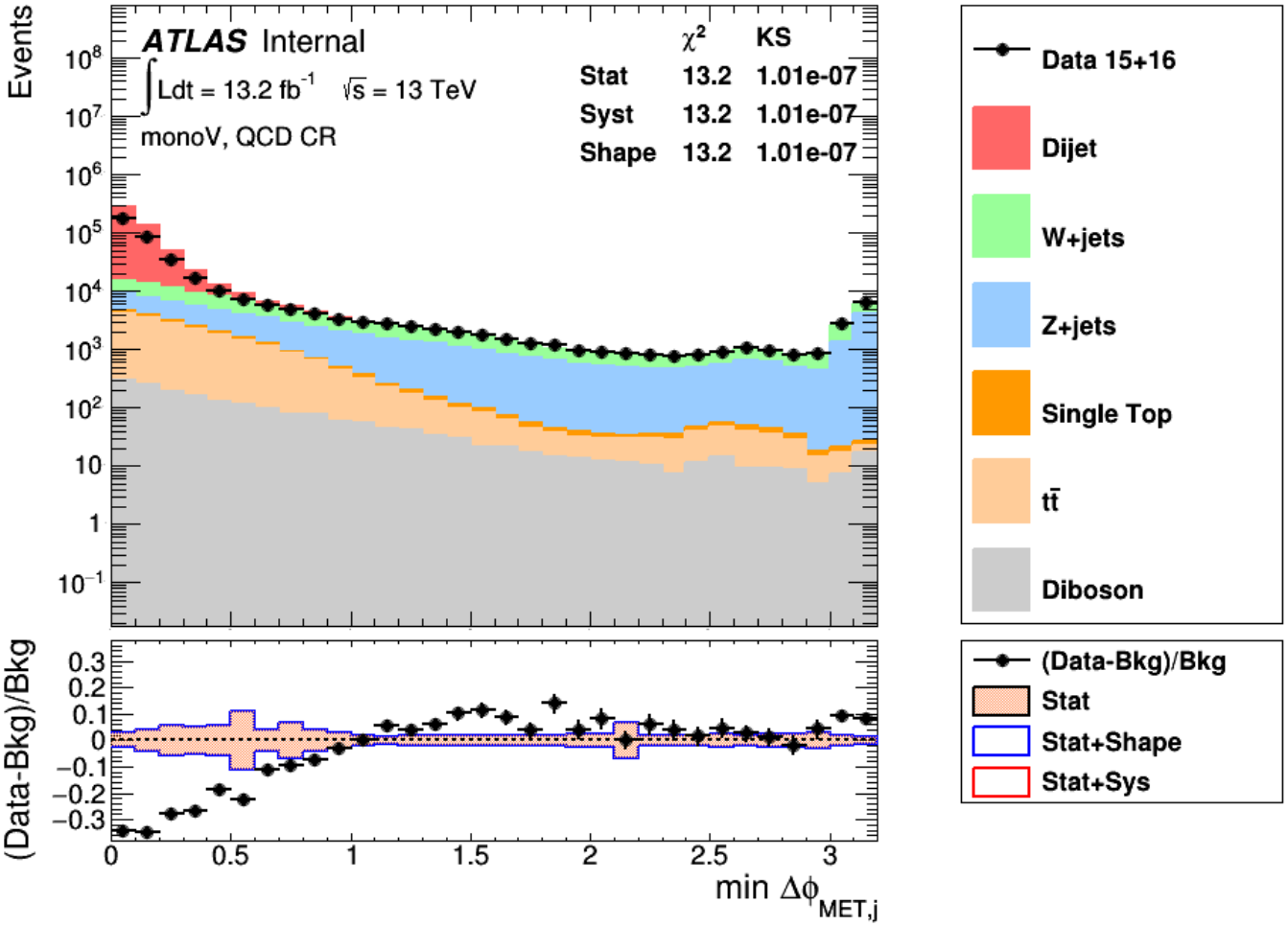
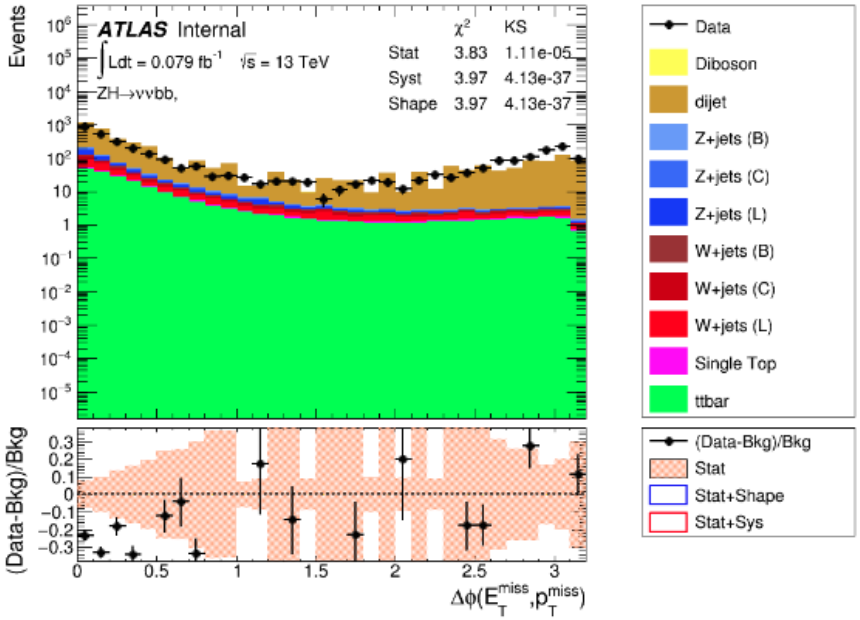
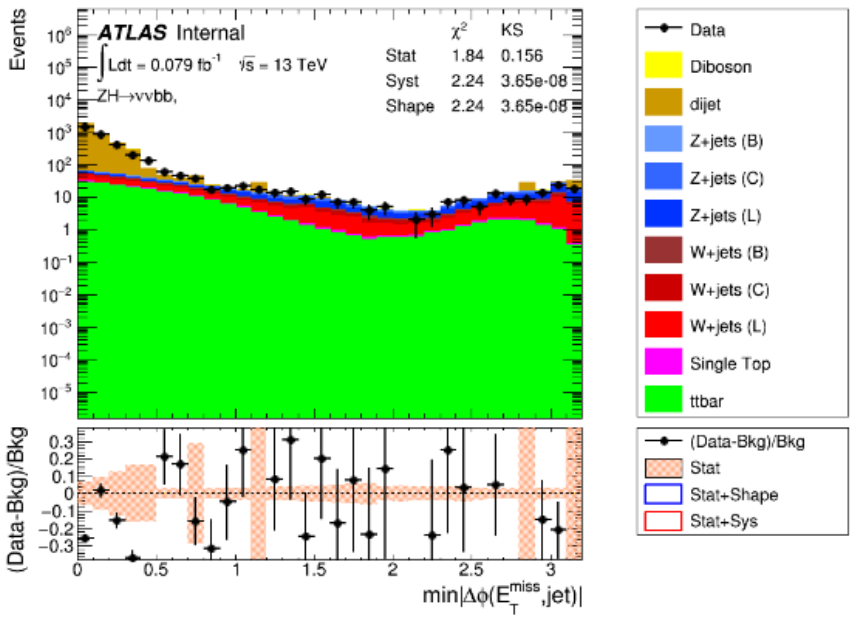


Reasonable data/MC agreement

Anti-QCD variables

Comparison to figures from ATL-COM-PHYS-2015-1231

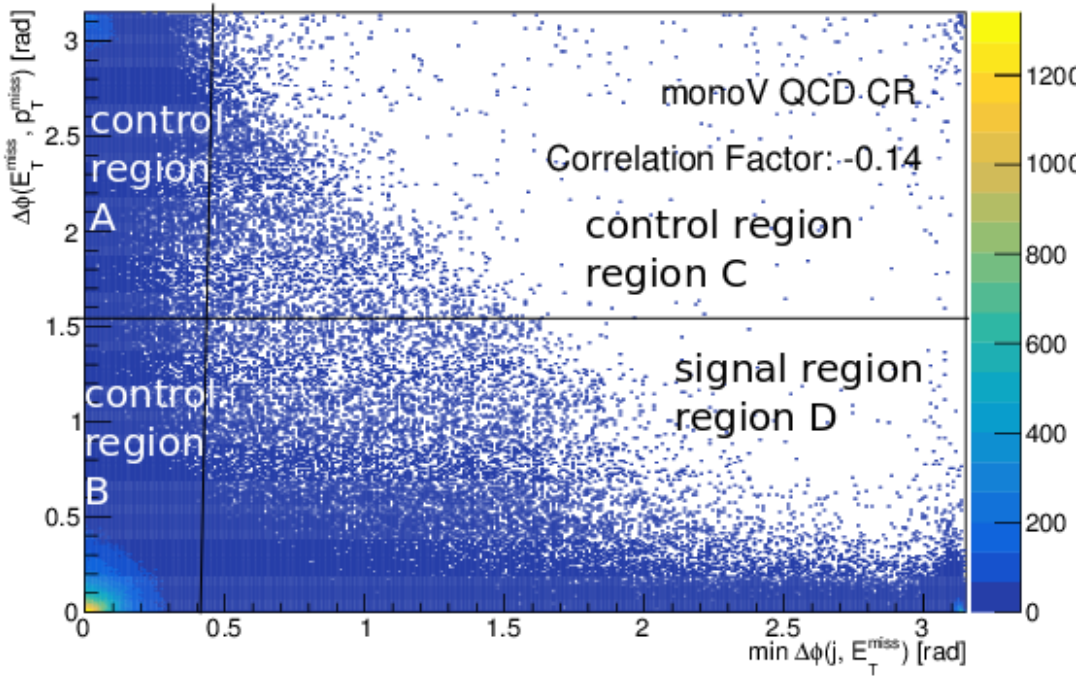




Similar distributions in current analysis as in old supporting note.

Data-driven QCD estimate

ABCD-Method

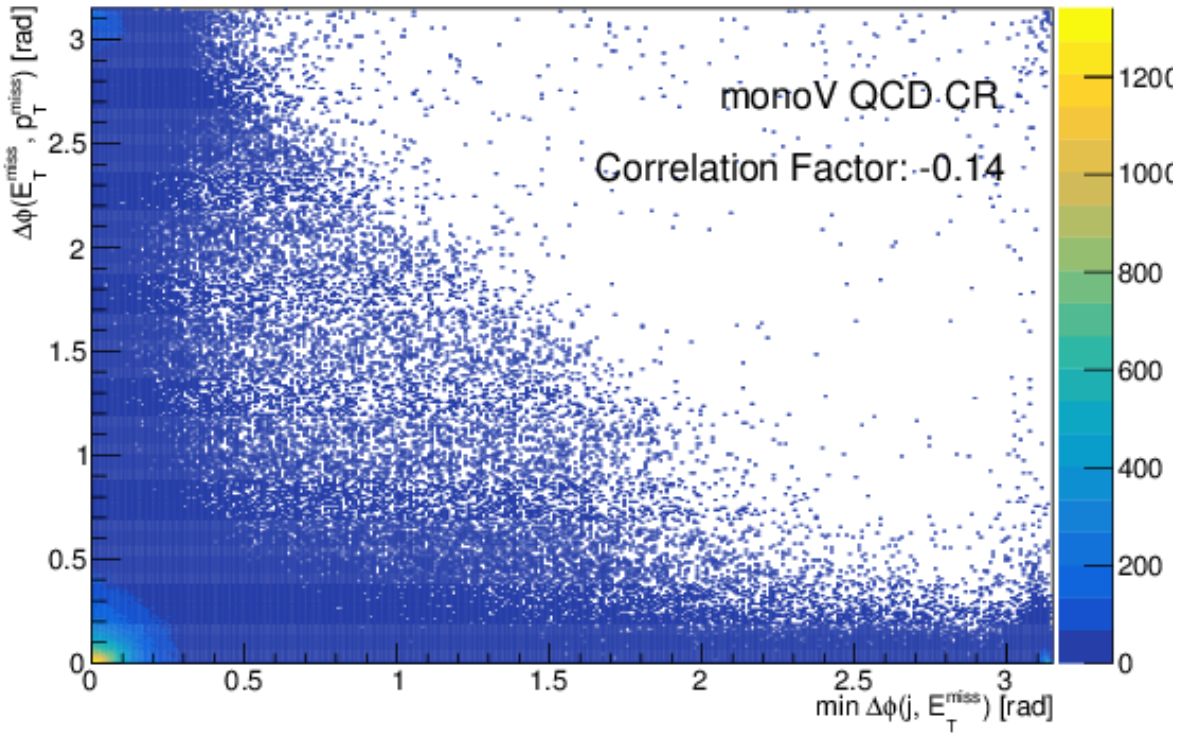


Divide in 4 regions according to QCD rejection variables, if variables are uncorrelated it holds that:

$$\frac{n_A}{n_B} = \frac{n_C}{n_D}$$

Anti-QCD variables

Correlation between Anti-QCD variables



- Correlation factor of -0.14 not negligible (compared to supporting note: 0.07)
- Fewer events in control region C than in signal region: method questionable

Summary

- mostly reasonable data/MC agreement in kinematic distributions
- data-driven QCD estimate with ABCD method seems questionable

Next steps:

- alternative methods: largest-error estimation: show that dijet-contribution to distributions is negligible
- implement resolved region, then work on 1-lepton