# Discussion: extraction of NP contribution with $\rm pTW/Z$

LHC EW precision sub-group meeting (pT W/Z benchmarking)

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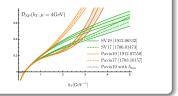
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$$\frac{d\sigma}{d^2q_T} = \sigma_0 \sum_q z_q \int \frac{d^2b}{(2\pi)^2} e^{i(bq_T)} \underbrace{R[b;Q,Q^2 \to \text{ref}]}_{\text{evolution factor.}} \underbrace{f_{1q}(x_1,b;\text{ref})}_{\text{TMDPDF}} \underbrace{f_{1\bar{q}}(x_2,b;\text{ref})}_{\text{TMDPDF}} \tag{1}$$

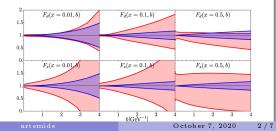
Evolution factor

- ▶ Single equations  $\rightarrow$  Different realizations/ref.scales (CS-like,  $\zeta$ -prescription, etc.)
- ▶ Dependent on non-perturbative function  $\mathcal{D} = -K/2 = \text{CS-kernel}$
- ▶ Non-perturbative CS-kernel ⇒ structure of vacuum [AV;2003.02288]



#### TMDPDFs

- Match to PDFs at small-b (perturbative)
- ▶ Non-perturbative at large-b



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I will try to answer the following question: which regions of vector-boson production  $p_T$  spectrum are most sensitive for NP-input?

 $\begin{array}{l} \text{Correlation coefficient} = \rho[\sigma,O] = \frac{\langle \sigma O \rangle - \langle \sigma \rangle \langle O \rangle}{\Delta \sigma \Delta O} \\ \text{measures correlation between NP-parameter and cross-section} \\ \text{Sensitivity coefficient} = S[\sigma,O] = \rho[\sigma,O] \frac{\Delta O}{\Delta O_{\text{exp.}}} \\ \text{reweigh the correlation by expected experimental uncertainty and shows feasible regions} \end{array}$ 



Nonperturbative input  $\rightarrow$  SV19 model [I.Scimemi, AV; 1912.06532]

 $\triangleright$  CS-kernel = 1 parameter

$$\mathcal{D}(b,\mu) = \mathcal{D}_{\text{resum}}(b,\mu) + c_0 b b^*$$
(2)

 $\blacktriangleright$  TMDPDF = 5 parameters (no-flavor dependence)

$$f_1(x,b) = C \otimes f_1(x) \exp\left(-\frac{\lambda_1 \bar{x} + \lambda_2 x + x \bar{x} \lambda_5}{\sqrt{1 + \lambda_3 x^{\lambda_4} b^2}} b^2\right)$$
(3)

▶ Distribution of 300 replicas fitted to DY+SIDIS data (ATLAS,LHCb,CMS,COMPASS,HERMES,...)

#### Data

I did not know that there exists pseudo data....

- $\blacktriangleright \sqrt{s} = 13$  TeV
- ▶ y-bins like in ATLAS 8 TeV Z-boson
- ▶ Q-bins 9 bins from  $30 \text{GeV} \rightarrow 540 \text{ GeV}$
- $\blacktriangleright \ q_T/Q < 0.25$

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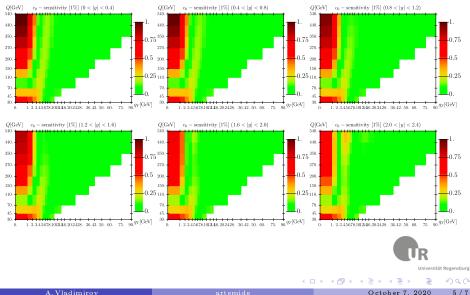
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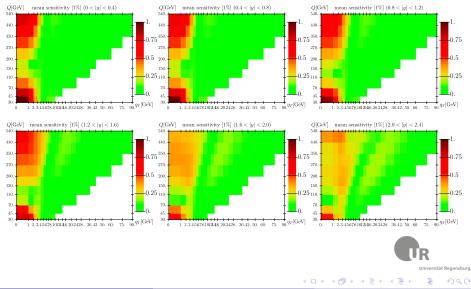
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Experimental uncertainty = 1 %

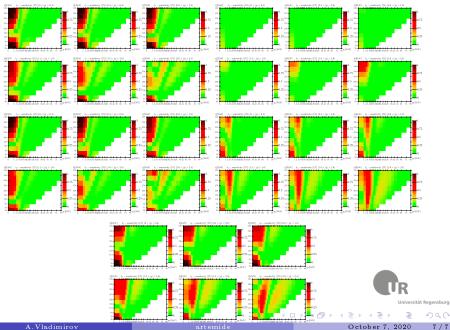


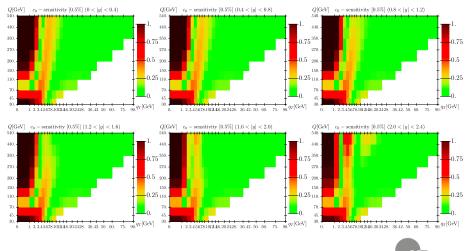
Experimental uncertainty = 1 %



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## Experimental uncertainty = 1 %





#### Experimental uncertainty = 0.5 %

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#### Q[GeV] mean sensitivity [0.5%] (0 < |y| < 0.4)Q[GeV] mean sensitivity [0.5%] (0.4 < |y| < 0.8)Q[GeV] mean sensitivity [0.5%] (0.8 < |y| < 1.2)540. 540 440. 440 0.75<sup>350.</sup> 350. -0.75 $^{350}$ -0.75270. 270. -0.5 200. 0.5 200 200. 150 150. 150 $-0.25_{110}$ -0.25 m -0.25110 70 70 70. $q_T[GeV]$ $q_T[GeV]$ $1.\ 2.3.45678.1012446.20.2428.\ 36.42.\ 50.\ 60.\ 75.\ 90.9r[{\rm GeV}]$ 1. 2.3.45678.1012146.20.2428. 0. 1. 2.3.4.5678.101214.6.20.2428. 36.42. 50. 60. 75. 0. 36.42.50.60. 75. Q[GeV] mean sensitivity [0.5%] (1.2 < |y| < 1.6) Q[GeV] mean sensitivity [0.5%] (1.6 < |y| < 2.0)Q[GeV] mean sensitivity [0.5%] (2.0 < |y| < 2.4)540 540440. $40.75^{350.1}$ 350. -0.75-0.75270. 270. -0.5 200. -0.5-0 200. 200 150. 150. 150 $-0.25_{110}$ -0.25 11 -0.25110 70-0 45 45 30 30 $\overline{q}_{90}q_T[\text{GeV}]$ $q_T[GeV]$ 1. 2.3.45678.1012.46.20.2428. 36.42. 50. 60. 75. $90.q_T[\text{GeV}]$ 0. 0. 1. 2.3.45678.1012146.20.2428. 36.42.50.60. 75. 0. 1. 2.3.45678.1012146.20.2428. 36.42.50.60. 75.

#### Experimental uncertainty = 0.5 %

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### Experimental uncertainty = 0.5 %

