# DESY SM Meeting

July 15, 2024

F. Dattola, S. Clawson

# General news

## W-mass workshop - July 1-3

### mW Workshop @ Liverpool

Jul 1, 2024, 12:30 PM → Jul 3, 2024, 3:00 PM Europe/Zurich

University of Liverpool

Fabrice Balli (Université Paris-Saclay (FR)), Jan Kretzschmar (University of Liverpool (GB)),
Ludovica Aperio Bella (Deutsches Elektronen-Synchrotron (DE)), Maarten Boonekamp (Université Paris-Saclay (FR)),
Maarten Boonekamp (CEA/Saclay)

Description

**Welcome to Liverpool: Home of the Beatles, two Cathedrals, excellent Pubs and Museums, and the Summer 2024 ATLAS mW workshop**

**WARNING: Agenda is set in CERN/Europe time - for local Liverpool time subtract 1h. E.g. first session on Monday starts 14:30 CERN time = 13:30 Liverpool time**

Please check the 'Practical information' and complete the 'Registration'

# General news

W-mass workshop - July 1-3

## FSR and line-shape energy tail studies

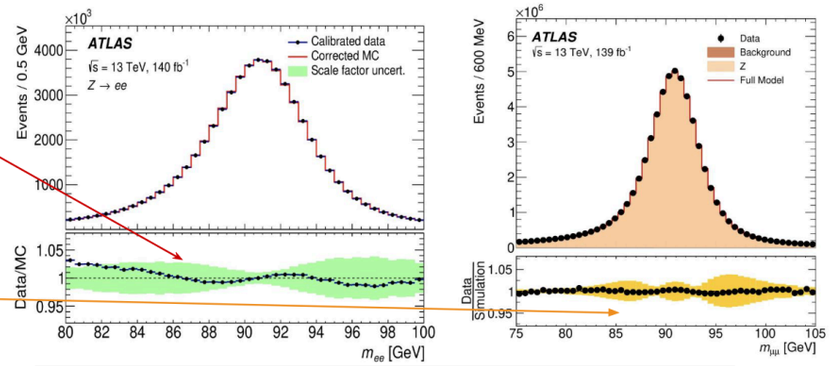
Josh Newell, Linghua Guo, Filippo Dattola, LAB

See Maarten slides : here

## Original idea and motivation

**Motivation:**

- **Z → ee** data show an excess of energy tails, since ever (Run1, Run2, sliding windows and supercluster reco) this generates energy scale systematics (from fit window variations) that limit the overall calibration precision.
- **Muons** behave better

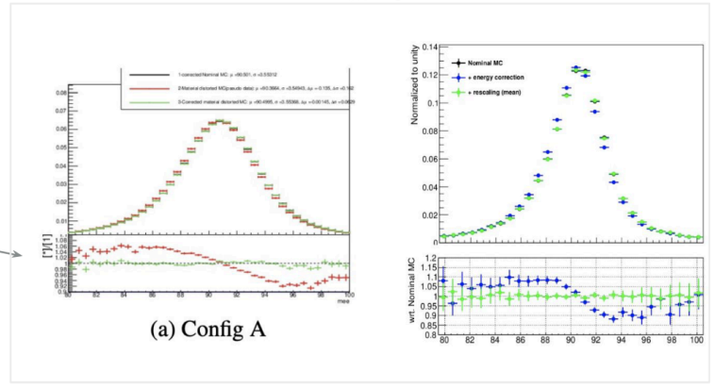



**Mainly affecting W&Z analysis**

**Possible causes studied over the years:**

- Intercalibration of the Presampler and the accordion layers, even S3
- Readout non-linearity
- Lateral shower shapes
- Passive Material variation

Nothing conclusive until now !




(a) Config A

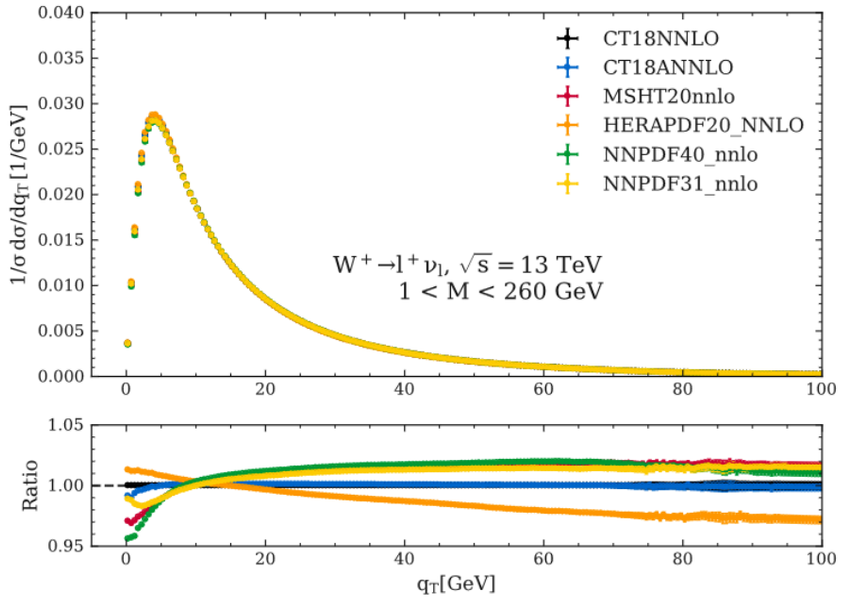
# General news

## W-mass workshop - July 1-3

### QCD predictions with DYTurbo

Status update

L. Aperio Bella, S. Camarda
F. Dattola, F. Giuli, C. Wang




### Modelling of *W* production and decay

#### Strategy

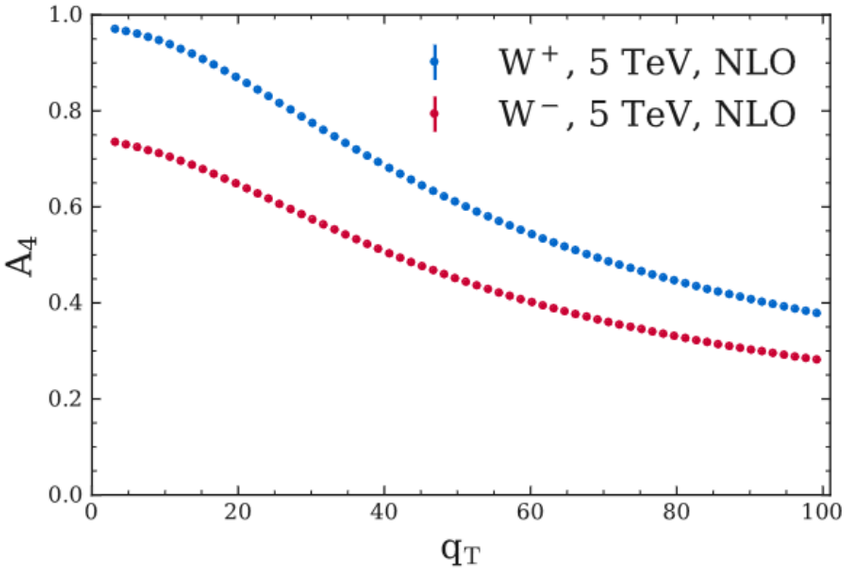
- Initial samples of inclusive *W* production use POWHEG + PYTHIA 8 for event generation.
- Higher-order QCD and EW corrections are introduced by reweighting the original samples.

#### Correction procedure

- **Factorise the full differential Drell-Yan cross section** into 4 terms representing the dynamic of the boson production and the kinematic of the decay and use the most accurate model to describe each of them

$$\frac{d\sigma}{dp_1 dp_2} = \frac{d^3\sigma}{dp_T dy dm}\left[(1+\cos^2\theta) + \sum_{i=0}^{7} A_i(p_T, y) P_i(\cos\theta, \phi)\right]$$

Use **DYTurbo** to compute QCD predictions up to NNLO.



# General news

## LHC EW Working Group General Meeting - July 10-12

### LHC EW WG General Meeting

Jul 10, 2024, 9:00 AM → Jul 12, 2024, 6:00 PM Europe/Zurich

40/S2-C01 - Salle Curie (CERN)

Alessandro Tricoli (Brookhaven National Laboratory (US)), Guillelmo Gomez Ceballos Retuerto (Massachusetts Inst. of Technology (US)), Oldrich Kepka (Czech Academy of Sciences (CZ)), Vieri Candelise (Universita e INFN Trieste (IT))

**Description** This General LHC EW Meeting will review the progress in Standard Model phsyics at the LHC, the activities of the LHC EW working groups, and especially will plan future activities of the group with the goal to set reccomendations for future precision measurements at the LHC.

If you work on Standard Model analyses at the LHC or plan to carry out precison physics measurements with Run-3 data, join the meeting and bring your contribution to the discussions and planning.

Audio_3rdday_12Ju... Audio_day1_10July.... Audio_day2_11july.... Video_3rdday_12Ju... Video_day1_10July.... Video_day2_12july....

**Videoconference** LHC EW WG General Meeting — Join

**Registration** Registration for attendance — 127 — Register

**Recordings also available**

# General news

## LHC EW Working Group General Meeting - July 10-12

**Very rich program from theory and experimental perspectives**

10:10 AM **Workshop introduction** 10m

**Speaker**: Guillelmo Gomez Ceballos Retuerto (Massachusetts Inst. of Technology (US))

20240710_LHC EW ...

10:20 AM **Monte-Carlo developments and Electroweak/mixed QCD-EW corrections** 40m

**Speaker**: Marco Zaro (Università degli Studi e INFN Milano (IT))

zaro_EWWG_july24_...

11:00 AM **qT resummation report**

**Speaker**: Luca Rottoli (University of Zurich (CH))

rottoli_ptZptW_EW...

11:35 AM **General PDF status and prospects**

**Speaker**: Amanda Sarkar (University of Oxford (GB))

pdf4EW.pdf

**Session: WG1/WG2 Common Topics (Drell-Yan physics and EW precision measurements, Jets and EW bosons+jets)** 40/S2-C01 - Salle C...

**Conveners**: Aram Apyan (Brandeis University (US)), Daniel Froidevaux (CERN), David d'Enterria (CERN), Deniz Sunar Cerci (Yildiz Technical University (TR)), Eram Syed Rizvi (Queen Mary, University of London), Fulvio Piccinini (Pavia University and INFN (IT)), Marek Schoenherr (Durham University), Mario Campanelli (UCL), Mika Vesterinen (University of Manchester), Simone Amoroso (Deutsches Elektronen-Synchrotron (DE)), William Barter (University of Edinburgh)

5:00 PM **Low-mu runs (ATLAS)** 15m

**Speaker**: Fabrice Balli (Université Paris-Saclay (FR))

LHCEWWG_202407...

5:15 PM **Low-mu runs (CMS)** 15m

**Speaker**: Jan Eysermans (Massachusetts Inst. of Technology (US))

CMS_mW_lowPU_L...

5:30 PM **Low-mu run (FWD perspective, CMS)** 10m

**Speaker**: Michael Pitt (The University of Kansas (US))

LowPU_withFWD.pdf

5:40 PM **Low-mu run (FWD perspective, ATLAS)** 10m

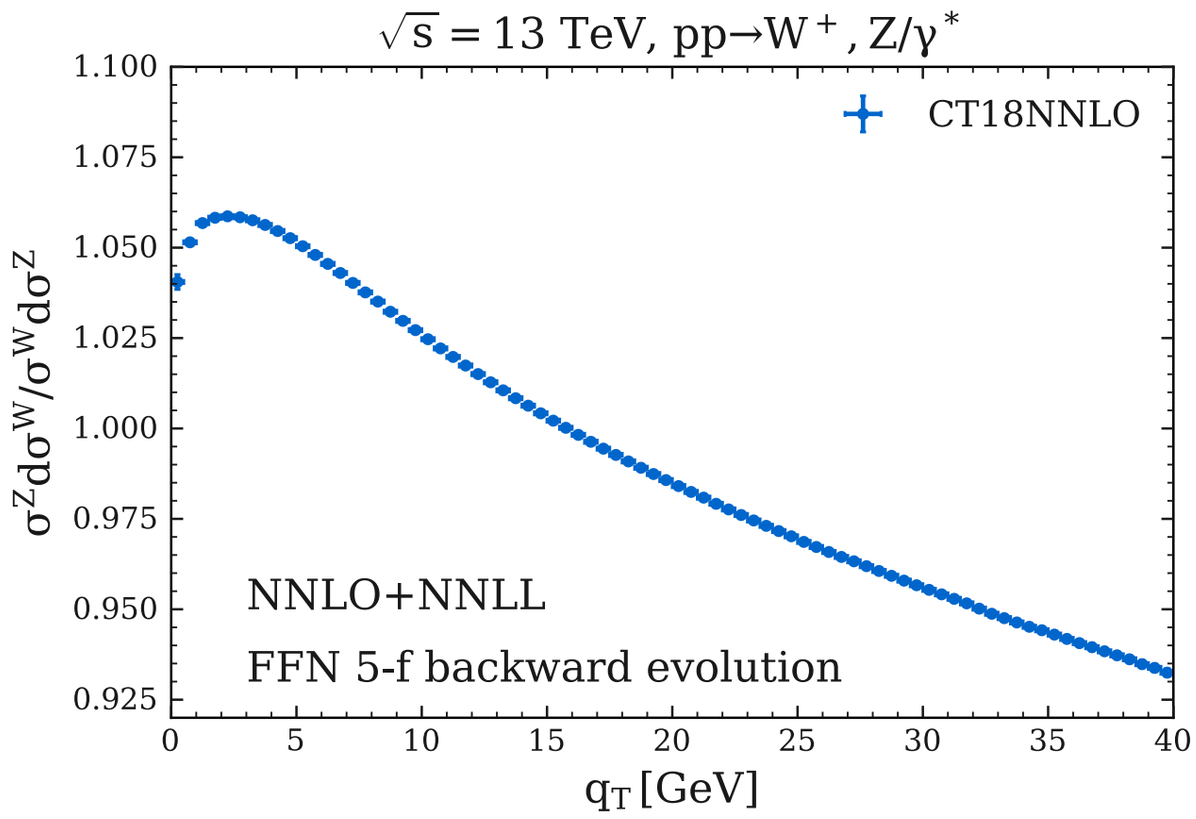
**Speakers**: Savannah Clawson, Savannah Clawson (Deutsches Elektronen-Synchrotron (DE))

AFP_low-mu_intere...

# QCD modelling

## Studies of $p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$

- A precise prediction of the ratio of *W*- and *Z*-$p_{\mathrm{T}}$ distributions, together with the measurement of *Z* $p_{\mathrm{T}}$, gives stringent constraints on the *W*-$p_{\mathrm{T}}$ spectrum.




- Since *Z* $p_{\mathrm{T}}$ is very well measured, the relevant theoretical uncertainties come from W/Z $p_{\mathrm{T}}$ modelling:
  - choice of PDF evolution
  - description of heavy-flavour-initiated (HFI) production → harder boson $p_{\mathrm{T}}$
  - effect of non-perturbative parameters (i.e. $g_1$ ) variations.

# QCD modelling

## QCD fits of low-mass Drell-Yan data

- $pp \to \gamma^*/Z \to \mu\mu$ measurement at $\sqrt{s} = 13$ TeV gives unique access to QCD non-perturbative regime.
- $p_{\mathrm{T}}^{\mu\mu}$ measured in 7 invariant mass bins in $12 < m_{\mu\mu} < 56$ GeV.
- Use xFitter + DYTurbo to fit the data and extract non-perturbative QCD parameters

### Non perturbative QCD model

- NP model is generally determined from the data, parameters values depend on the chosen prescription to avoid the Landau pole in b-space

$$b_\star = \frac{b}{1 + b^2/b_{\mathrm{lim}}^2}$$

$$S_{\mathrm{NP}}(b) = \exp\left[-g_j(b) - g_K(b)\log\frac{m_{\ell\ell}^2}{Q_0^2}\right] \quad \begin{cases} g_j(b) = \dfrac{g\,b^2}{\sqrt{1+\lambda\,b^2}} + \mathrm{sign}(q)\left(1 - \exp\left[-|q|\,b^4\right]\right) \\ g_K(b) = g_0\left(1 - \exp\left[-\dfrac{C_F\alpha_s(b_0/b_*)b^2}{\pi g_0\, b_{\mathrm{lim}}^2}\right]\right) \end{cases}$$

- $g_j$ functions include a quadratic and a quartic term, with g and q free parameters of the fit