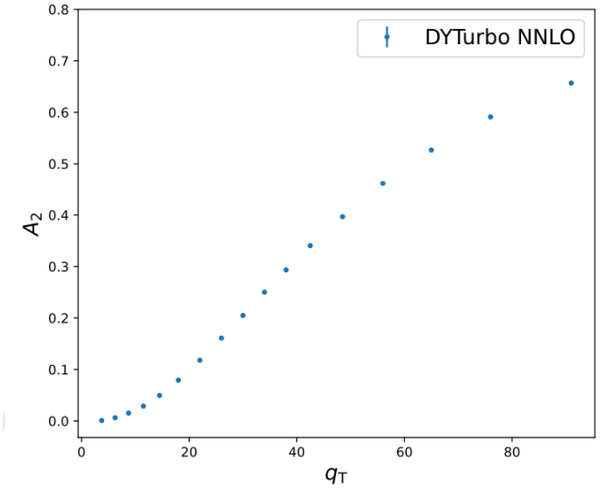
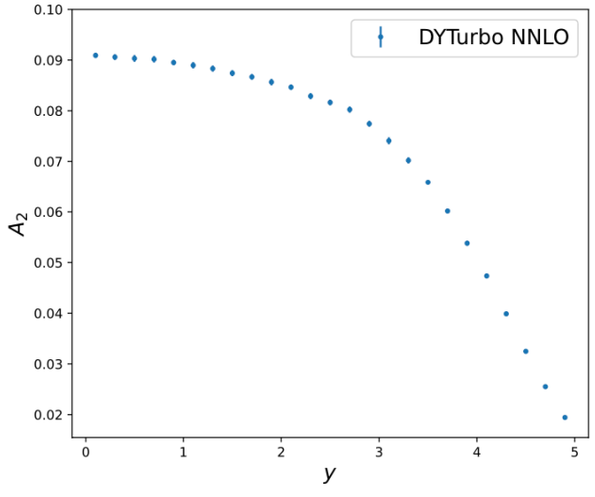
QCD modelling

Ai predictions for low-μ W-mass analysis

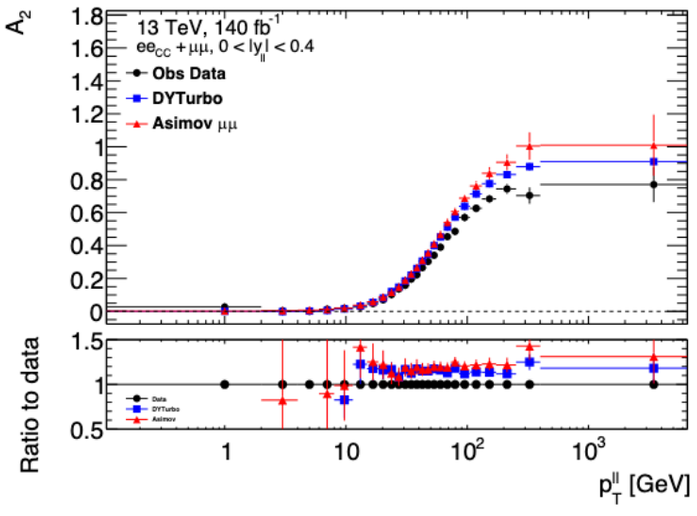
- Angular distributions of W, Z decay leptons are determined by the boson polarisation state.
- Polarisation is induced at orders above tree level by initial-state QCD interactions.
- A_i's ≡ boson helicity cross-sections / boson unpolarised cross section.

$$\frac{d\sigma}{dp_T^2 dy dm d\cos\theta d\phi} = \frac{3}{16\pi}\frac{d\sigma}{dp_T^2 dy dm} \times [(1+\cos^2\theta) + A_0\frac{1}{2}(1-3\cos^2\theta) + A_1 \sin 2\theta\cos\phi + A_2\frac{1}{2}\sin^2\theta\cos 2\phi + A_3 \sin\theta\cos\phi + A_4\cos\theta + A_5\sin^2\theta\sin 2\phi + A_6\sin 2\theta\sin\phi + A_7\sin\theta\sin\phi]$$





- Finalising DYTurbo fixed-order predictions for $W^{\pm}, Z$ at 5 and 13 TeV with multiple NNLO PDF sets.
- Validation of DYTurbo NNLO Ai's against Z-Ai data at 13 data (Ludovica and Craig's analysis)



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 low-mass Drell-Yan 13 TeV data and Z-pT 8 TeV data** (largest constraining power) to 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