Measurement of the Drell-Yan Angular Coefficients in pp Collisions at $\sqrt{s}$ =13 TeV with the CMS Experiment at the LHC

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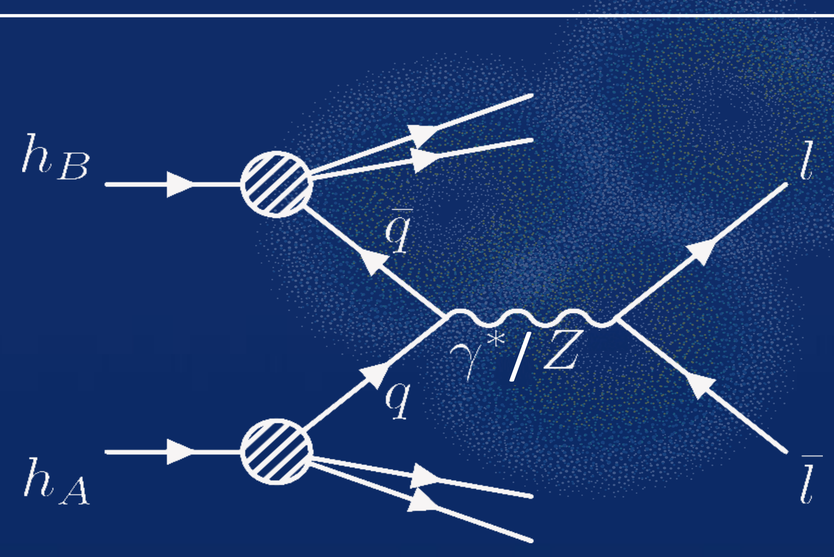
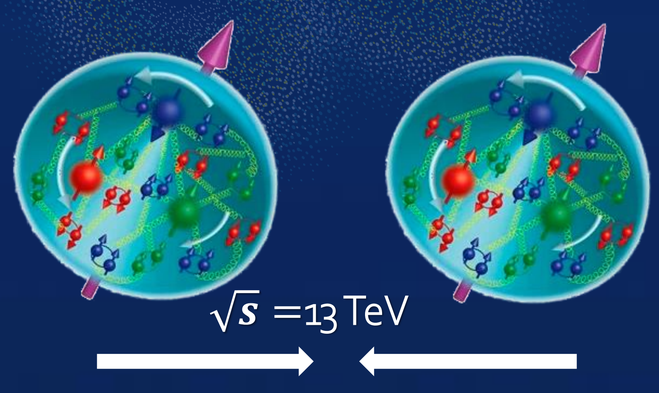
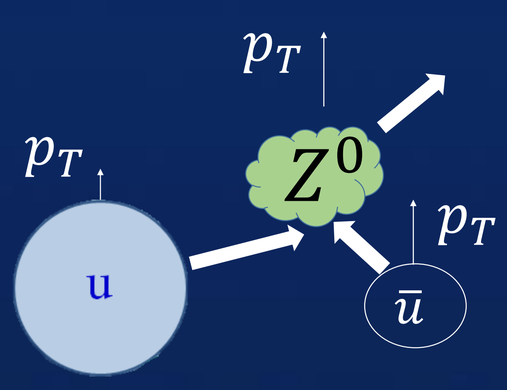
Motivation and Formalism

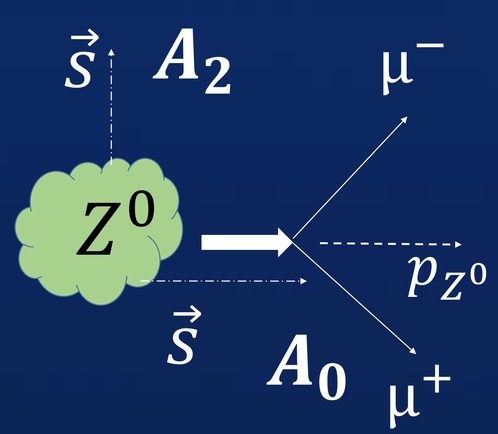
The Drell-Yan (MMT) process [1,2] is sensitive to the electroweak nature of the γ^*/Z decay, but also provides unique information about lepton-hadron correlations. Such correlations are essential for understanding the dynamics of initial-state partons and the effects of pQCD, offering a window into PDFs and their influence on the angular structure of the final states. This influence could be described in terms of eight angular polarization coefficients A_i $(i = 0, 1.., 7)$

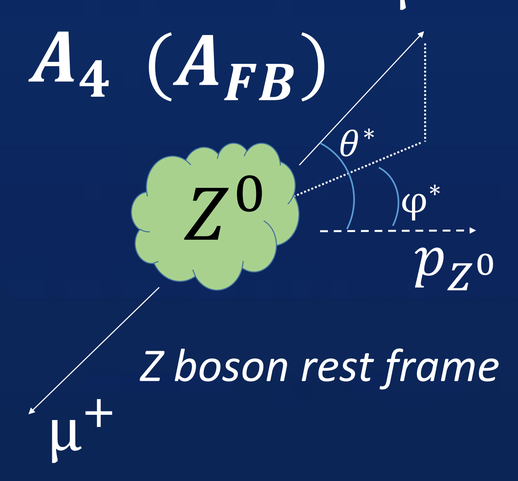


The Drell-Yan (MMT) process









Z boson rest frame

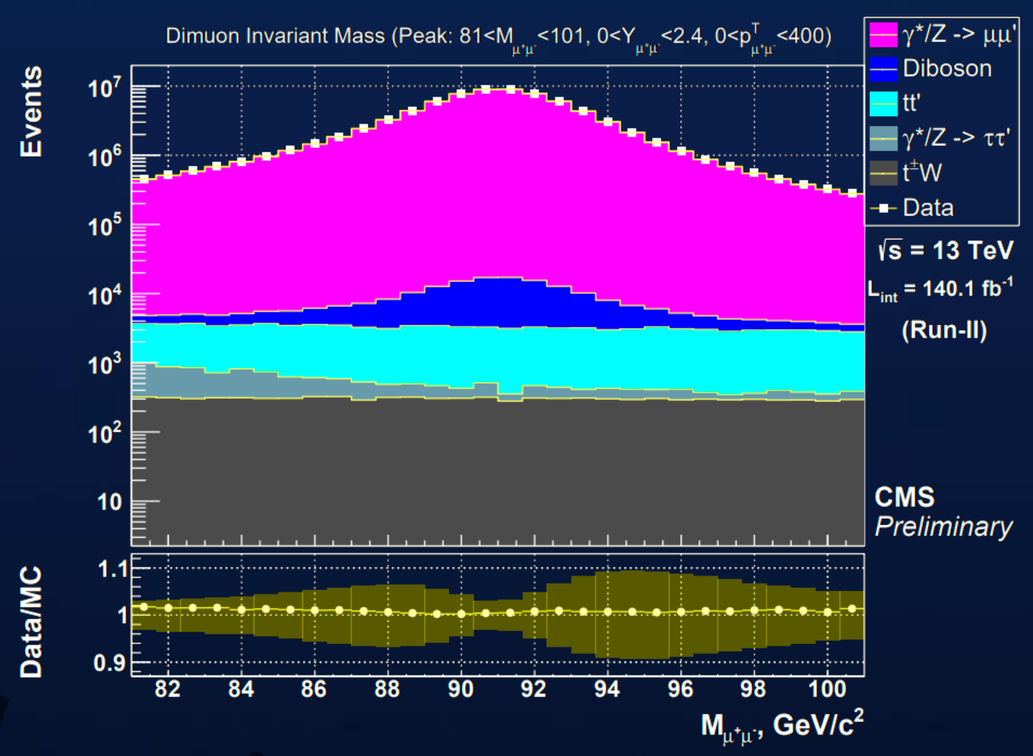
$$\frac{d^2\sigma}{d\theta^* d\phi^*} \propto (1+\cos^2\theta^*) + A_0\frac{1}{2}(1-3\cos^2\theta^*) + A_1\sin(2\theta^*)\cos\phi^* + A_2\frac{1}{2}\sin^2\theta^*\cos(2\phi^*) +$$
$$+ A_3\sin\theta^*\cos\phi^* + A_4\cos\theta^* + A_5\sin^2\theta^*\sin(2\phi^*) + A_6\sin(2\theta^*)\sin\phi^* + A_7\sin\phi^*\sin\theta^*$$

- All A_i depends on PDF
- A_i are functions of p_T^{ll}, y^{ll}
- At LO only $A_4(A_{FB})$ is non-zero at $p_T^{ll} \to 0$
- $A_0 - A_2$ related to the Z-boson polarization
- $A_0 = A_2$ at LO QCD (Lum-Tung relation) but it is violated at higher orders
- A_5 - A_7 define the contribution of T-odd asymmetries and may appear non-zero in processes at NNLO pQCD

Measurement

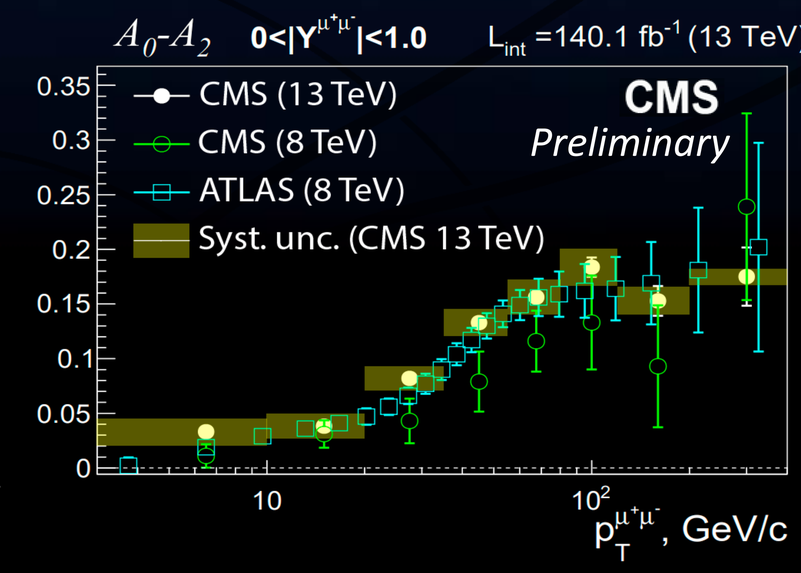
The measurement is based on proton-proton collision data collected by the CMS detector at the LHC at $\sqrt{s}$=13 TeV ($L_{int} = 140.1\ fb^{-1}$).

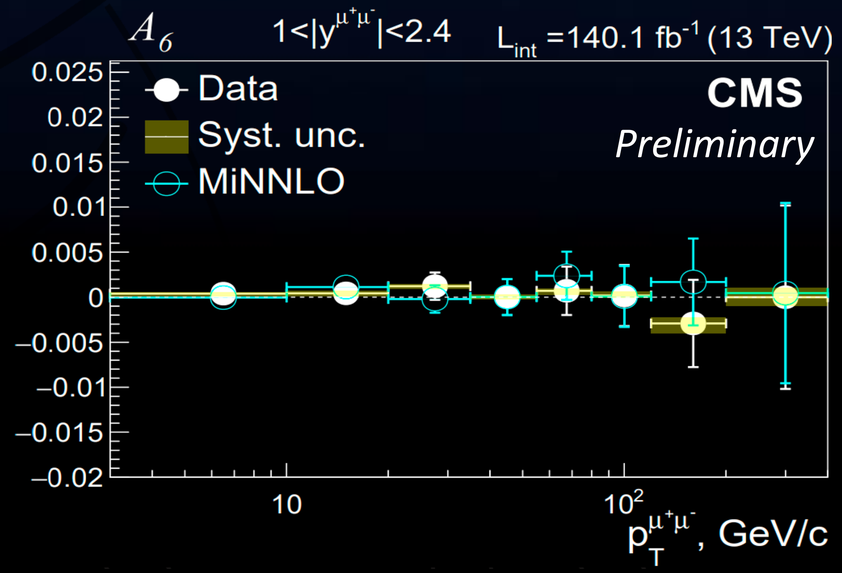
The A_i were extracted from data with Maximum Likelihood approximation, after procedures of selection, correction and background events subtraction were done [3, 4].



Dimuon invariant mass distribution

The coefficients A_i were measured in muon channel in eight $p_T^{\mu\mu}$ and two $|y^{\mu\mu}|$ intervals. Events with $81 < M_{\mu\mu} < 101$ GeV/c^2 were used. Results were compared with Standard Model predictions up to NNLO (pQCD) and NLO (EW) [5], as well as ATLAS and CMS results at $\sqrt{s}$=8 TeV [6, 7].





$A_0 - A_2$ *relation in comparison with* results at $\sqrt{s}$=8 TeV (left) [4]. A_6 coefficient in comparison with *SM predictions at NNLO (pQCD) NLO (EW) [3]0.*

Conclusions

The full set of angular polarization coefficients A_i were measured for the first time at $\sqrt{s}$=13 TeV in $|y^{ll}|$<2.4. The results are in a good agreement with Standard Model predictions and relevant results at $\sqrt{s}$=8 TeV.

Bibliography

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