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A change of perspective in quarkonium production: all data are equal, but some are more equal than others

Quarkonium polarization data, usually considered a difficult challenge for the QCD description of quarkonium production and relegated to an a posteriori test of predictions exclusively driven by cross-section measurements (with puzzling results), provide in reality the most fundamental, direct and model-independent connection to the production mechanisms. Simultaneously fitting charmonium and bottomonium differential cross sections and polarizations, reliably measured at the LHC up to higher transverse momentum (pT) values than ever before, as a superposition of colour-singlet and colour-octet contributions perturbatively calculated up to next-to-leading order, we see that all the measurements are very well reproduced, except for the lowest pT cross-section data, where factorization between short-distance and long-distance QCD effects is not expected to be applicable. Besides providing a straightforward solution to the so-called quarkonium polarization puzzle (a 19-year-old problem), our study shows that quarkonium production is completely dominated by the unpolarized 1S0 octet term, a very interesting and unexpected observation that opens a new and surprisingly simple path towards the understanding of hadron formation in QCD.

Summary

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