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Quarkonium production and polarization in pp collisions with the CMS detector

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Studies of the production of heavy quarkonium states are very important to improve our understanding of QCD and hadron formation, given that the heavy quark masses allow the application of theoretical tools less sensitive to nonperturbative effects.

Thanks to a dedicated dimuon trigger strategy, combined with the record-level energy and luminosity provided by the LHC, the CMS experiment could collect large samples of pp collisions at 7 and 8 TeV, including quarkonium states decaying in the dimuon channel. This allowed the CMS collaboration to perform a series of systematic measurements in quarkonium production physics, including double-differential cross sections and polarizations, as a function of rapidity and pT, for five S-wave quarkonia: J/psi, psi(2S), Y(1S), Y(2S), and Y(3S). Some of these measurements extend well above pT~50 GeV, probing regions of very high pT/mass, where the theory calculations are supposed to be the most reliable. Thanks to its high-granularity silicon tracker, CMS can reconstruct low-energy photons through their conversions to e+e- pairs, thereby accessing the radiative decays of the P-wave quarkonium states, with an extremely good mass resolution, so that the J=1 and J=2 1P states can be resolved. This allows CMS to determine cross-section ratios and feed-down decay fractions involving the chi states, in both the charmonium and bottomonium families. Such measurements provide crucial inputs to a better understanding of quarkonium production as a signal of new physics in Pb-Pb collisions.

This talk presents the CMS quarkonium production results, in pp collisions, placing emphasis on the most recent measurements, which include the polarizations of all five S-wave states, the most comprehensive measurement of quarkonium polarization made so far. We will also present brand-new results on P-wave quarkonium production in the bottomonium family. It is likely that other preliminary results on quarkonium production in pp collisions, of particular relevance for the understanding of heavy-ion measurements, will be shown at this conference for the first time.

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