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Double quarkonium production at the LHC

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We study the production of two S-wave heavy quarkonia at the LHC in the framework of nonrelativistic QCD. We consider the double quarkonium production of same flavour, $J/\psi+J/\psi$ or $Y+Y$ as well as that of different flavour, $J/\psi+Y$. We calculate the short-distance coefficients in the colour-octet model completely for the first time. Our results for the differential cross section for the $J/\psi+J/\psi$ or $Y+Y$ production imply that the previous results carried out under the gluon fragmentation approximation greatly overestimated the cross section. This confirms that the gluon fragmentation approximation is valid only at large transverse momentum. Nevertheless we conclude that the colour-octet mechanism can be tested at the LHC in these channels. We also suggested the double quarkonium production of different flavour, $J/\psi+Y$. We show that the tree-level and one-loop level contribution to this channel in the colour-octet model is much suppressed compared to that in the colour-singlet model. Thus the $J/\psi+Y$ production at the LHC will provide probes of the colour-octet mechanisms with less backgrounds and without the colour-singlet contamination. If we can not observe the events at a expected level, it would imply that the current values of the colour-octet matrix elements are overestimated.

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