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Interaction between J/ψJ/ψ from di-pion exchange with coupled channel FSI and possible bound state of J/ψJ/ψ.

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In a recent measurement LHCb reported pronounced structures in the $J/\psi J/\psi$ spectrum. One of the various possible explanations of those is that they emerge from non-perturbative interactions of vector charmonia. It is thus important to understand whether it is possible to form a bound state of two charmonia. Two charmonia interact through the exchange of gluons, which hadronise into two pions at the longest distance. In this paper, we demonstrate that, given our current understanding of hadron-hadron interactions, the exchange of correlated light mesons (pions and kaons) is able to provide sizeable attraction to the di-J/ψ system, and it is possible for two J/ψ mesons to form a bound state. As a side result we find from an analysis of data for $\psi(2S) \to J/\psi\pi\pi$ including both $\pi\pi$ and $K\bar{K}$ final state interactions with $|\alpha_{\psi(2S)J/\psi}| = (1.575 \pm 0.012)$ GeV^{-3}, an improved value for the $\psi(2S) \to J/\psi$ transition chromo-electric polarisability.

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