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Mechanisms of $D\bar{D}$ pair production in $e^+e^- \to e^+e^- D\bar{D}$ and $AA \to AAD\bar{D}$ reactions and production of exotic charmonia

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We discuss the production of $D\bar{D}$ pairs in e^+e^- collisions,
where D refers to either D^0 or D^+ [1].
The continuum mechanism with the t/u-channel vector-meson D^*
exchanges are considered. The results of the calculation depend
on the parameter of the off-shell form-factor for the virtual D^*
mesons. The $D^*D\gamma$ coupling constants are found from
the $D^* \to D\gamma$ decays.
We find relatively large contribution for the $D^0\bar{D}^0$ channel
and much smaller contribution in the D^+D^- channel.
In the second case we consider also the $D^\pm$ exchanges.
We conclude that the bump at $M_{D^0\bar{D}^0} = 3.8$~GeV
observed by the Belle and BaBar Collaborations has rather
continuum origin than it corresponds to the broad resonance
$\chi_{c0}(3860)$.
We discuss also production of the $\chi_{c2}(3930)$ resonance
which is a candidate for the $\chi_{c2}(2P)$ state.
This state can decay into both $D\bar{D}$ channels, however
the branching fractions are not well known at present.
From a comparison of our model results to the BaBar data we find
$B(\chi_{c2}(3930) \to D\bar{D}) = 0.58 \pm 0.13$
using the two-photon width $\Gamma_{\gamma\gamma} = 0.544$~keV
(obtained for the Buchm{\"u}ller-Tye potential)
evaluated within the light-front approach (NRQCD limit).
Our finding of
$\Gamma_{\gamma\gamma} \times B(\chi_{c2}(3930) \to D\bar{D}) = 0.32 \pm 0.07$~keV
is close to the Belle and BaBar results.
Realistic predictions of the differential distributions in several variables
and integrated cross-sections are given for the Belle~II kinematics.

We discuss also a possibility to measure $D\bar{D}$ production in
ultraperipheral heavy ion collisions.

1) I. Babiarz, P. Lebiedowicz, W. Sch\"afer and A. Szczurek,
"Competition of $\chi_c(2P)$ quarkonia and continuum in $e^+e^- \to e^+e^- D\bar{D}$",
Phys. Let. B75 (2026) 140307.

Collaboration

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