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Mechanisms of production of exotic $X(3872)$ in proton-proton and e^+e^- collisions and its structure.

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We calculate the total cross section and transverse momentum distributions for the production of the enigmatic $\chi_{c1}(3872)$ (or X(3872)) (see [1]) assuming different scenarios:
$c\bar{c}$ state and $D^{0*}\bar{D}^0 + D^0\bar{D}^{0*}$ molecule.
The derivative of the $c\bar{c}$ wave function needed in the first
scenario is taken from a potential $c\bar{c}$ model calculations.
Compared to earlier calculations of molecular state we include not only
single parton scattering (SPS) but also double parton scattering (DPS)
contributions.
The latter one seems to give smaller contribution than the SPS one.
The upper limit for the DPS production of
$\chi_{c1}(3872)$ is much below the CMS data.
We compare results of our calculations with existing experimental data
of CMS, ATLAS and LHCb collaborations.
Reasonable cross sections can be obtained in either $c\bar{c}$
or molecular $D\bar{D}^*$ scenarios for $X(3872)$, provided one takes
into account both directly produced D^0, $\bar{D}^0$, as well as
D^0, $\bar{D}^0$ from the decay of D^*. However, arguments related to
the lifetime of D^* suggest that the latter component is not active.
With these reservations, also a hybrid scenario is not excluded.

We propose to study the structure of the enigmatic $\chi_{c1}(3872)$
axial vector meson through its $\gamma^*\gamma\chi_{c1}(3872)$
transition form factor (see [2]). We derive a light-front wave function
representation of the form factor for the lowest $c\bar{c}$ Fock-state.
We found that the reduced width of the state is well within the current
experimental bound recently published by the Belle collaboration.
This strongly suggests a crucial role of the $c\bar{c}$ Fock-state in
the photon-induced production. Our results for the Q^2 dependence can
be tested by future single tagged e^+e^- experiments, giving further
insights into the short-distance structure of this meson.

[1] A. Cisek, W. Sch\"afer and A. Szczurek,
"Structure and production mechanism of the enigmatic $X(3872)$ in
high-energy hadronic reactions",
Eur. Phys. Jour. {\bf C882}, (2022) 1062.

[2] I. Babiarz, R. Pasechnik, W. Sch\"afer and A. Szczurek,
"Probing the structure of $\chi_{c1}(3872)$ with photon transition
form factors",
arXiv:2303.09175, accepted in Phys. Rev. D.

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