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Type: **1st and 2nd weeks (Hadron structure and interactions)**

$c_J(2P)$ with hadronic molecules

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Some hadrons are hard to explain as normal hadrons made of quarks and antiquarks, or three quarks. These are called exotic hadrons. Since the Belle experiment reported $X(3872)$ in 2003, more exotic hadrons containing charm quarks have been found. Exotic hadrons are believed to have more complex structures than normal hadrons, but no conclusion has been reached yet.

The $X(3872)$ is one of the most famous exotic hadrons and has been seen in many experiments. It has the same quantum numbers as $c_1(2P)$, but its mass is different from what the quark model predicts. It is also very close in mass to the $D^0 \bar{D}^{*0}$ threshold, with a difference of 0.04 MeV.

In this study, we analyze $c_J(2P)$ as a mixture of a hadronic molecule state, like a deuteron, and a bare $c_J(2P)$ core, comparing it to $X(3872)$ and others. We consider one-boson-exchange and core-molecule mixture potentials.

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