Charmonium resonances in e^+e^- annihilation cross sections around the $\psi(4415)$ region

J. Segovia[(a),(b)], D. R. Entem[(a),(b)], F. Fernández[(a),(b)]

[(a)] Grupo de Física Nuclear, Universidad de Salamanca
[(b)] Instituto Universitario de Física Fundamental y Matemáticas (IUFFyM), Universidad de Salamanca

The Belle Collaboration has recently reported measurements of the exclusive cross section for the process $e^+e^- \to D^0D^-\pi^+$ through the $D\bar{D}_2^*(2460)$ channel [1] and the $e^+e^- \to D^0D^{*-}\pi^+$ in the $\psi(4415)$ energy region [2]. From the first reaction, asuming that the process goes through $\psi(4415) \to D\bar{D}_2^*(2460)$ channel and using a RBW fitted to the $e^+e^- \to \psi(4415) \to D\bar{D}_2^*(2460)$ amplitude, the Belle Collaboration obtains for the product $\sigma(e^+e^- \to \psi(4415)) \times B(\psi(4415) \to D\bar{D}_2^*(2460)) \times B(\bar{D}_2^*(2460) \to D\pi^+)$ the value $(0.74 \pm 0.17 \pm 0.08)$ nb. Combining this result with $\sigma(e^+e^- \to \psi(4415)) = 12\pi/m_{\psi(4415)} \times (\Gamma_{ee}/\Gamma_{tot})$ the authors estimate the values $B(\psi(4415) \to D\bar{D}_2^*(2460)) \times B(\bar{D}_2^*(2460) \to D\pi^+) = (10.5 \pm 2.4 \pm 3.8)\%$ for the $\psi(4415)$ PDG [3] parameters or $(19.5 \pm 4.5 \pm 9.2)\%$ for the $\psi(4415)$ parameters of Ref. [4]. Only cross sections are provided for the second reaction.

We calculate this reactions using the model of Ref [5] which successfully describes the $J^{PC} = 1^{--}$ $c\bar{c}$ sector. If we include only the resonance $\psi(4415)$ as intermediate state we are not able to reproduce the experimental data. A similar results is obtained if we use a different model for the description of the $c\bar{c}$ system [6].

Taken into account that the mass window around the nominal $\psi(4415)$ mass in the experiment is of ± 100 MeV, we introduce in the calculation the resonance $X(4360)$, assigned as a 1^{--} $c\bar{c}$ meson in Ref. [5]. The amplitudes of both resonances are parametrized as relativistic Breit-Wigner functions with energy dependent widths. The inclusion of this second resonance produces a remarkable agreement with the experimental data providing a new estimation for the $B(\psi(4415) \to D\bar{D}_2^*(2460)) \times B(\bar{D}_2^*(2460) \to D\pi^+)$ branching products.

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E-mail: segonza@usal.es