

$X(3872)$

- discovered September 2003 by the Belle Collaboration

$$B^+ \longrightarrow K^+ + X, \quad X \longrightarrow J/\psi \pi^+ \pi^-$$

- confirmed December 2003 by CDF Collaboration

$$p \bar{p} \longrightarrow X + \text{anything}, \quad X \longrightarrow J/\psi \pi^+ \pi^-$$

for $p_T(J/\psi) > 4$ GeV, $84 \pm 5\%$ come from prompt QCD mechanisms

Mass and Width

- Particle Data Group, 2009

$$M_X - (M_{D^{*0}} + M_{D^0}) = +0.4 \pm 0.9 \text{ MeV}$$

$$\Gamma_X = 3.0_{-1.7}^{+2.1} \text{ MeV}$$

- in $J/\psi \pi^+ \pi^-$ channel CDF, Belle, Babar, D0

$$M_X - (M_{D^{*0}} + M_{D^0}) = -0.42 \pm 0.39 \text{ MeV}$$

$$\Gamma_X < 2.2 \text{ MeV} \quad \text{at 90\% CL}$$

- in $D^{*0} \bar{D}^0, D^0 \bar{D}^{*0}$ channel Belle, Babar

$$M_X - (M_{D^{*0}} + M_{D^0}) = +2.1 \pm 1.2 \text{ MeV}$$

$$\Gamma_X = 3.5_{-1.0}^{+1.6} \text{ MeV}$$

Decay Modes

channel	branching ratio	experiment
$J/\psi \pi^+ \pi^- \approx J/\psi \rho^*$	$\equiv 1$	Belle, CDF, Babar, D0
$J/\psi \pi^+ \pi^- \pi^0 \approx J/\psi \omega^*$	1.0 ± 0.5	Belle
$J/\psi \gamma$	0.29 ± 0.07	Belle, Babar
$\psi(2S) \gamma$	1.3 ± 0.4	Babar
$D^0 \bar{D}^0 \pi^0$	$8.8_{-3.6}^{+3.1}$	Belle
$D^{*0} \bar{D}^0, D^0 \bar{D}^{*0}$	12.5 ± 3.1	Babar, Belle

Quantum Numbers

- $X \longrightarrow J/\psi \gamma$
Belle, Babar
 $\implies C = +$
- $X \longrightarrow J/\psi \pi^+ \pi^-$
CDF
momentum distributions
 $\implies J^P = 1^+ \text{ or } 2^-$
- $X \longrightarrow D^0 \bar{D}^0 \pi^0$
Belle
(only 7 MeV above threshold)
 $\implies J = 0 \text{ or } 1$

$\implies \mathbf{J^{PC} = 1^{++}}$