



廣西大學
GUANGXI UNIVERSITY

A Study of $X(6900)$ as a $[cc][\bar{c}\bar{c}]$ Tetraquark State Decaying into $2J/\psi$

物理科学与工程技术学院 卢多多

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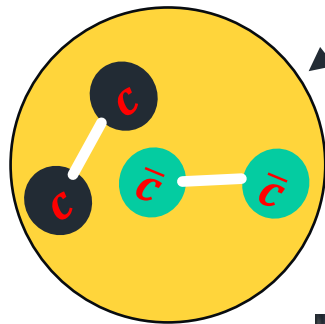
总结

背景介绍

INTRODUCTION



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X(6900)

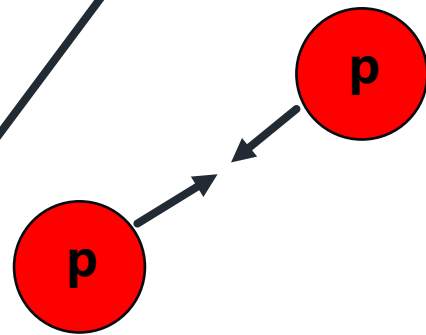
随后确认

2024年
CMS实验

2023年
ATLAS实验

首次发现

2020年
LHCb实验





Covariant quark model



相互作用的拉格朗日量

$$\mathcal{L}_{\text{int}} = g_X X(x) \cdot J_X(x) + g_{J/\psi} \psi_\mu(x) \cdot J_{J/\psi}^\mu(x) + h.c.$$

四夸克流

$$J_X(x) = \int d^4 x_1 \dots \int d^4 x_4 \delta\left(x - \sum_{i=1}^4 w_i x_i\right) \\ \times \Phi_X\left(\sum_{i<j} (x_i - x_j)^2\right) \mathbf{j}_{4c}(\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3, \mathbf{x}_4)$$

矢量介子流

$$J_{J/\psi}^\mu(x) = \int d^4 y \Phi_{J/\psi}(y^2) \\ \times \bar{c}_a(x + y/2) \gamma^\mu c_a(x - y/2)$$



Covariant quark model



四夸克流 j_{4c}

$$J^{PC} = 0^{-+} : \quad j_1 = i[c_a^T C c_b][\bar{c}_a \gamma^5 C \bar{c}_b^T] + i[c_a^T C \gamma^5 c_b][\bar{c}_a C \bar{c}_b^T]$$

$$J^{PC} = 0^{--} : \quad j_2 = [c_a^T C c_b][\bar{c}_a \gamma^5 C \bar{c}_b^T] - [c_a^T C \gamma^5 c_b][\bar{c}_a C \bar{c}_b^T]$$

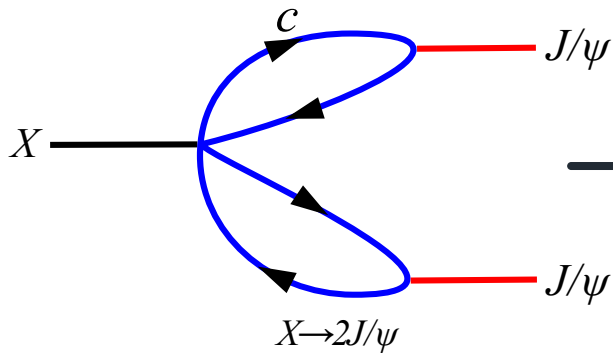
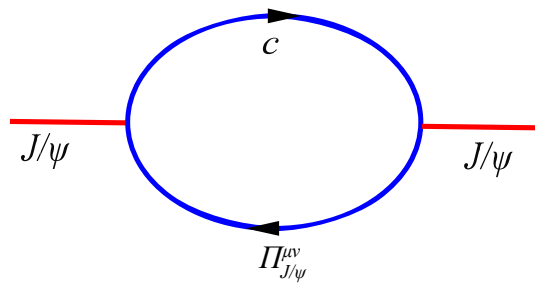
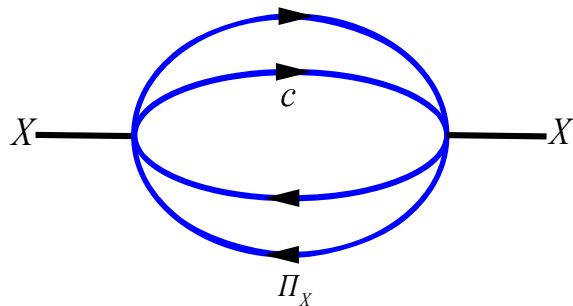
$$J^{PC} = 1^{-+} : \quad j_3^\mu = i[c_a^T C \gamma^\mu \gamma^5 c_b][\bar{c}_a \gamma^5 C \bar{c}_b^T] + i[c_a^T C \gamma^5 c_b][\bar{c}_a \gamma^\mu \gamma^5 C \bar{c}_b^T]$$

$$J^{PC} = 1^{--} : \quad j_4^\mu = [c_a^T C \gamma^\mu \gamma^5 c_b][\bar{c}_a \gamma^5 C \bar{c}_b^T] - [c_a^T C \gamma^5 c_b][\bar{c}_a \gamma^\mu \gamma^5 C \bar{c}_b^T]$$



計算結果

CALCULATION RESULTS



$$J^{PC} = 0^{-+}$$

$$\Gamma = \frac{I^2}{8\pi} \left(\frac{m_X^2}{4} - m_{J/\psi}^2 \right)^{3/2}$$

$$J^{PC} = 1^{-+}$$

$$\Gamma = \frac{K_1^2}{192\pi} \frac{(m_X^2/4 - m_{J/\psi}^2)^{3/2}}{m_{J/\psi}^2}$$

$$J^{PC} = 0^{--}, 1^{--} \quad \Gamma = 0$$

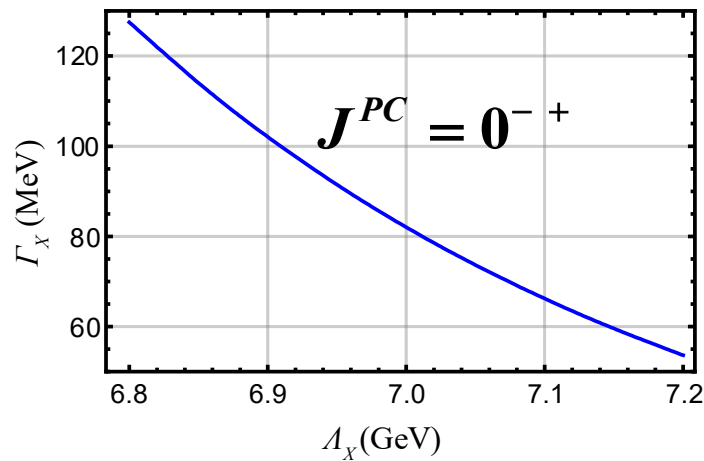
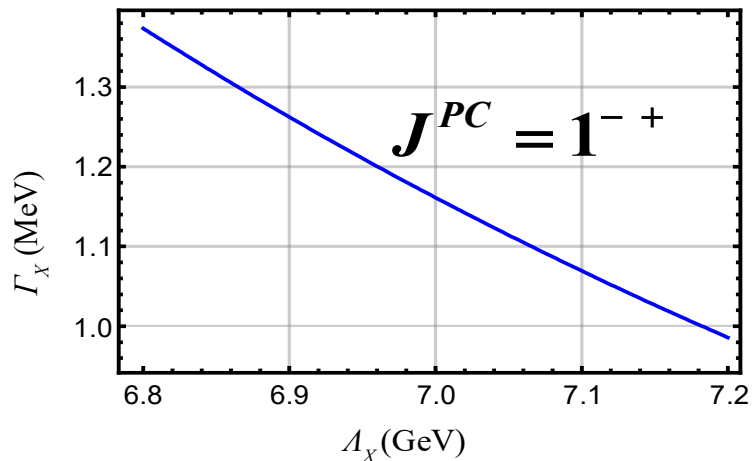


計算結果

CALCULATION RESULTS



Collaboration	Model	m (MeV)	Γ (MeV)	Observed Channel
LHCb	No-Interference	$6905 \pm 11 \pm 7$	$80 \pm 19 \pm 33$	$2J/\psi$
	Interference	$6886 \pm 11 \pm 11$	$168 \pm 33 \pm 69$	
ATLAS	Model A	$6860 \pm 30^{+10}_{-20}$	$110 \pm 50^{+20}_{-10}$	$2J/\psi$
	Model B	$6910 \pm 10 \pm 10$	$150 \pm 30 \pm 10$	
CMS	Interference	6847^{+44+48}_{-28-20}	191^{+66+25}_{-49-17}	$2J/\psi$
	No-Interference	$6927 \pm 9 \pm 4$	$122^{+24}_{-21} \pm 18$	





研究对象 $\longrightarrow$ $X(6900) \rightarrow 2J / \psi$



研究方法 $\longrightarrow$ Covariant quark model

研究结论 $\longrightarrow$

$J^{PC} = 0^{--}, 1^{--}$	不发生衰变
$J^{PC} = 1^{-+}$	不符合实验
$J^{PC} = 0^{-+}$	符合实验



谢谢

Thank you