Hidden and open charm baryons with strangeness

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Hidden charm : c cbar ssn, $\eta_c\Xi(4298), \bar{D}_s\Xi'_c(4546), \bar{D}\Omega_c(4560)$ ......

c cbar sss ?

Open charm; cbar snnn, $\bar{D}_s N,\ \bar{D}\Lambda,\ \bar{D}\Sigma$

cbar ssnn $\bar{D}_s\Lambda,\ \bar{D}\Xi,$

cbar sssn ?

cbar ssss ?

Predictions for $\Lambda_b \to J/\psi\Xi^- K^+ \quad \Xi_b \to J/\psi\Xi^-\pi^+$

and comparison with LHCb experiment

We are now used to the pentaquarks Pc and Pcs of LHCb

Pc(4380), Pc(4312), Pc(4440), Pc(4457),Pc(4337)

Pcs(4459), Pcs(4338)

What we present here first are states Pcss, c cbar and two strange quarks

J. A. Mars´e-Valera, V. K. Magas, and A. Ramos, Phys. Rev. Lett. 130, 091903 (2023)

They use SU(4) symmetry and local hidden gauge with vector exchange

F. L. Wang, R. Chen, and X. Liu, Phys. Rev. D 103, 034014 (2021)

They use one boson exchange

P. G. Ortega, D. R. Entem, and F. Fernandez, Phys. Lett. B 838, 137747 (2023)

Quark models

K. Azizi, Y. Sarac, and H. Sundu, Eur. Phys. J. C 82, 543 (2022).

Sum rules

L. Roca, Jing Song and E. Oset,PHYSICAL REVIEW D 109, 094005 (2024)

X.~Liu, Y.~Tan, X.~Chen, D.~Chen, H.~Huang and J.~Ping,Phys. Rev. D 112, 014036 (2025)

S.~Clymton, H.~C.~Kim and T.~Mart, Phys. Rev. D 112, 034015 (2025)

Z.~Y.~Wang and Z.~W.~Long, [arXiv:2508.21474 [hep-ph]].

$$PB[\bar{c}cssn]\left(\frac{1}{2}^-\right):\ \eta_c\Xi(4298), \bar{D}_s\Xi_c'(4546), \bar{D}\Omega_c(4560)$$

$$VB[\bar{c}cssn]\left(\frac{1}{2}^-, \frac{3}{2}^-\right):\ J/\Psi\Xi(4411), \bar{D}_s^*\Xi_c'(4690),$$

$$\bar{D}^*\Omega_c(4702)$$

$$PB^*[\bar{c}cssn]\left(\frac{3}{2}^-\right):\ \eta_c\Xi^*(4515), \bar{D}_s\Xi_c^*(4613), \bar{D}\Omega_c^*(4630)$$

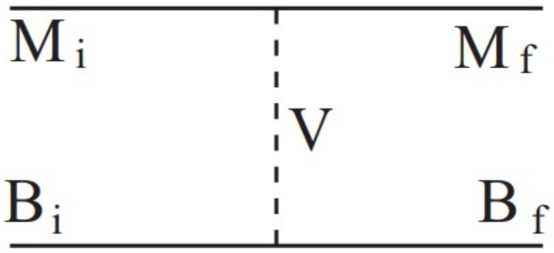
$$VB^*[\bar{c}cssn]\left(\frac{1}{2}^-, \frac{3}{2}^-, \frac{5}{2}^-\right):\ J/\Psi\Xi^*(4628), \bar{D}_s^*\Xi_c^*(4757),$$

$$\bar{D}^*\Omega_c^*(4773)$$

$$PB^*[\bar{c}csss]\left(\frac{3}{2}^-\right):\ \eta_c\Omega(4656), \bar{D}_s\Omega_c^*(4734)$$

$$VB^*[\bar{c}csss]\left(\frac{1}{2}^-, \frac{3}{2}^-, \frac{5}{2}^-\right):\ J/\Psi\Omega(4769), \bar{D}_s^*\Omega_c^*(4878),$$

We use the extended local hidden gauge approach, exchanging vector mesons



$$\mathcal{L}_{VPP} = -ig\langle [P, \partial_\mu P] V^\mu \rangle,$$

$$\mathcal{L}_{VVV} = ig\langle (V^\mu \partial_\nu V_\mu - \partial_\nu V^\mu V_\mu) V^\nu \rangle,$$

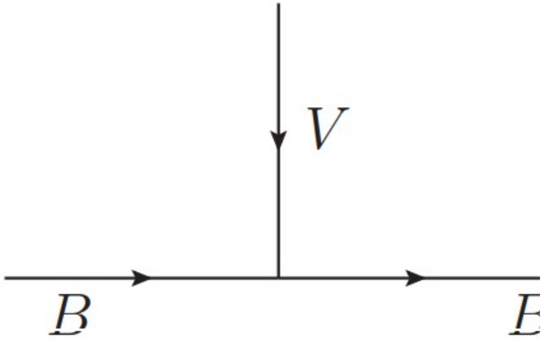
$$P = \begin{pmatrix} \frac{1}{\sqrt{2}}\pi^0 + \frac{1}{\sqrt{3}}\eta + \frac{1}{\sqrt{6}}\eta' & \pi^+ & K^+ & \bar{D}^0 \\ \pi^- & -\frac{1}{\sqrt{2}}\pi^0 + \frac{1}{\sqrt{3}}\eta + \frac{1}{\sqrt{6}}\eta' & K^0 & D^- \\ K^- & \bar{K}^0 & -\frac{1}{\sqrt{3}}\eta + \sqrt{\frac{2}{3}}\eta' & D_s^- \\ D^0 & D^+ & D_s^+ & \eta_c \end{pmatrix} \quad V = \begin{pmatrix} \frac{1}{\sqrt{2}}\rho^0 + \frac{1}{\sqrt{2}}\omega & \rho^+ & K^{*+} & \bar{D}^{*0} \\ \rho^- & -\frac{1}{\sqrt{2}}\rho^0 + \frac{1}{\sqrt{2}}\omega & K^{*0} & \bar{D}^{*-} \\ K^{*-} & \bar{K}^{*0} & \phi & D_s^{*-} \\ D^{*0} & D^{*+} & D_s^{*+} & J/\psi \end{pmatrix}$$

g=Mv/2f ,   Mv =800 MeV, f=93 MeV

S. Capstick and N. Isgur, Phys. Rev. D 34, 2809 (1986)

TABLE IV. Wave functions of baryon states.

State	I, J	Flavor	Spin
Ξ_{cc}^{++}	1/2, 1/2	ccu	$\chi_{MS}(12)$
Ξ_{cc}^{+}	1/2, 1/2	ccd	$\chi_{MS}(12)$
Ω_{cc}^{+}	0, 1/2	ccs	$\chi_{MS}(12)$
Ξ_{c}^{+}	1/2, 1/2	$\frac{1}{\sqrt{2}}c(us-su)$	$\chi_{MA}(23)$
Ξ_{c}^{0}	1/2, 1/2	$\frac{1}{\sqrt{2}}c(ds-sd)$	$\chi_{MA}(23)$
$\Xi_{c}^{\prime +}$	1/2, 1/2	$\frac{1}{\sqrt{2}}c(us+su)$	$\chi_{MS}(23)$
$\Xi_{c}^{\prime 0}$	1/2, 1/2	$\frac{1}{\sqrt{2}}c(ds+sd)$	$\chi_{MS}(23)$
Ω_{c}^{0}	0, 1/2	css	$\chi_{MS}(23)$
Ξ_{bb}^{0}	1/2, 1/2	bbu	$\chi_{MS}(12)$
Ξ_{bb}^{-}	1/2, 1/2	bbd	$\chi_{MS}(12)$
Ω_{bb}^{-}	0, 1/2	bbs	$\chi_{MS}(12)$
Ξ_{b}^{0}	1/2, 1/2	$\frac{1}{\sqrt{2}}b(us-su)$	$\chi_{MA}(23)$
Ξ_{b}^{-}	1/2, 1/2	$\frac{1}{\sqrt{2}}b(ds-sd)$	$\chi_{MA}(23)$
$\Xi_{b}^{\prime 0}$	1/2, 1/2	$\frac{1}{\sqrt{2}}b(us+su)$	$\chi_{MS}(23)$
$\Xi_{b}^{\prime -}$	1/2, 1/2	$\frac{1}{\sqrt{2}}b(ds+sd)$	$\chi_{MS}(23)$
Ω_{b}^{-}	0, 1/2	bss	$\chi_{MS}(23)$
Ω_{bc}^{0}	0, 1/2	$\frac{1}{\sqrt{2}}b(cs-sc)$	$\chi_{MA}(23)$
$\Omega_{bc}^{\prime 0}$	0, 1/2	$\frac{1}{\sqrt{2}}b(cs+sc)$	$\chi_{MS}(23)$
Ξ_{bc}^{+}	1/2, 1/2	$\frac{1}{\sqrt{2}}b(cu-uc)$	$\chi_{MA}(23)$
$\Xi_{bc}^{\prime +}$	1/2, 1/2	$\frac{1}{\sqrt{2}}b(cu+uc)$	$\chi_{MS}(23)$
Ξ_{bc}^{0}	1/2, 1/2	$\frac{1}{\sqrt{2}}b(cd-dc)$	$\chi_{MA}(23)$
$\Xi_{bc}^{\prime 0}$	1/2, 1/2	$\frac{1}{\sqrt{2}}b(cd+dc)$	$\chi_{MS}(23)$
Ξ_{cc}^{*++}	1/2, 3/2	ccu	χ_S
Ξ_{cc}^{*+}	1/2, 3/2	ccd	χ_S
Ω_{cc}^{*+}	0, 3/2	ccs	χ_S
Ξ_{c}^{*+}	1/2, 3/2	$\frac{1}{\sqrt{2}}c(us+su)$	χ_S
Ξ_{c}^{*0}	1/2, 3/2	$\frac{1}{\sqrt{2}}c(ds+sd)$	χ_S
Ω_{c}^{*0}	0, 3/2	css	χ_S
Ξ_{bb}^{*0}	1/2, 3/2	bbu	χ_S
Ξ_{bb}^{*-}	1/2, 3/2	bbd	χ_S
Ω_{bb}^{*-}	0, 3/2	bbs	χ_S
Ξ_{b}^{*0}	1/2, 3/2	$\frac{1}{\sqrt{2}}b(us+su)$	χ_S
Ξ_{b}^{*-}	1/2, 3/2	$\frac{1}{\sqrt{2}}b(ds+sd)$	χ_S
Ω_{b}^{*-}	0, 3/2	bss	χ_S
Ξ_{bc}^{*+}	1/2, 3/2	$\frac{1}{\sqrt{2}}b(cu+uc)$	χ_S
Ξ_{bc}^{*0}	1/2, 3/2	$\frac{1}{\sqrt{2}}b(cd+dc)$	χ_S



$$\tilde{\mathcal{L}}_{VBB} = g q\bar{q}\gamma^{\mu}\epsilon_{\mu}$$

and we keep only the time component of $\gamma^{\mu}\epsilon_{\mu} \sim \gamma^{0}\epsilon^{0} \sim \epsilon^{0}$, valid for slow baryons.

$$\mathcal{L}_{VBB} \equiv g\left\langle B' \left| \begin{Bmatrix} \frac{1}{\sqrt{2}}(u\bar{u} - d\bar{d}), & \rho^{0} \\ \frac{1}{\sqrt{2}}(u\bar{u} + d\bar{d}), & \omega \\ s\bar{s}, & \phi \end{Bmatrix} \right| B \right\rangle \epsilon^{0}$$

$$\mathcal{L}_{\phi\Omega\Omega} \equiv g\langle sss\,\chi_s |\, s\bar{s}\, | sss\,\chi_s\rangle = 3g$$

If B, B' contain c quarks, they are spectators in the matrix element.

$$<\Xi_c^+ \mid \frac{1}{\sqrt{2}}(u\bar{u} - d\bar{d})\ \Xi_c^+> = \quad < \frac{1}{\sqrt{2}} c(us - su)\, \frac{1}{\sqrt{2}}(u\bar{u} - d\bar{d})\ \ \frac{1}{\sqrt{2}} c(us - su)>$$

$$= \frac{1}{\sqrt{2}}($$

The interaction does not depend on the c quarks → Heavy quark symmetry

$$V_{ij} = g^{2} C_{ij}(p^{0} + p'^{0})$$

TABLE I. C_{ij} coefficients of the PB interaction in the $\bar{c}cssn$ sector.

	$\eta_c\Xi$	$\bar{D}_s\Xi_c'$	$\bar{D}\Omega_c$
$\eta_c\Xi$	0	$\frac{1}{\sqrt{6}m^2_{D_s^*}}$	$-\frac{1}{\sqrt{3}m^2_{D^*}}$
$\bar{D}_s\Xi_c'$		$\frac{1}{m^2_\phi}-\frac{1}{m^2_{J/\Psi}}$	$\frac{\sqrt{2}}{m^2_{K^*}}$
$\bar{D}\Omega_c$			$-\frac{1}{m^2_{J/\Psi}}$

TABLE II. C_{ij} coefficients of the PB^* interaction in the $\bar{c}cssn$ sector.

	$\eta_c\Xi^*$	$\bar{D}_s\Xi_c^*$	$\bar{D}\Omega_c^*$
$\eta_c\Xi^*$	0	$\sqrt{\frac{2}{3}}\frac{1}{m^2_{D_s^*}}$	$\frac{1}{\sqrt{3}m^2_{D^*}}$
$\bar{D}_s\Xi_c^*$		$\frac{1}{m^2_\phi}-\frac{1}{m^2_{J/\Psi}}$	$\frac{\sqrt{2}}{m^2_{K^*}}$
$\bar{D}\Omega_c^*$			$-\frac{1}{m^2_{J/\Psi}}$

Coupled channel dynamics is responsible for the appearance of bound states

TABLE III. C_{ij} coefficients of the PB^* interaction in the $\bar{c}csss$ sector.

	$\eta_c\Omega$	$\bar{D}_s\Omega_c^*$
$\eta_c\Omega$	0	$\frac{1}{m_{D_s^*}^2}$
$\bar{D}_s\Omega_c^*$		$\frac{2}{m_\phi^2} - \frac{1}{m_{J/\Psi}^2}$

$$T = (1 - VG)^{-1} V,$$

$$G_l(\sqrt{s}) = \int_{q<\Lambda} \frac{d^3q}{(2\pi)^3} \frac{1}{2\omega_l(q)} \frac{M_l}{E_l(q)} \cdot \frac{1}{\sqrt{s} - \omega_l(q) - E_l(\vec{q}) + i\epsilon},$$

$$T_{ij} = \frac{g_i g_j}{\sqrt{s} - \sqrt{s_R}}$$

$$X_i = -g_i^2 \frac{\partial G_i}{\partial \sqrt{s}}\bigg|_{\sqrt{s}}$$

TABLE IV. Results for the mass, M, width, Γ, couplings, g_i, and the compositeness $|X_i|$ for the different channels. The upper number in the numerical cells represent the value obtained with the cutoff $\Lambda = 600$ MeV and the lower one using $\Lambda = 800$ MeV. (Masses and widths in MeV).

	Flavor	$I(J^P)$	M	Γ		g_i	$\lvert g_i\rvert$	$\lvert X_i\rvert$
PB	$\bar{c}cssn$	$\frac{1}{2}(\frac{1}{2}^-)$	4535	9	$\eta_c \Xi$	$0.39 + i0.01$	0.39	0.01
			4479	12		$0.64 - i0.00$	0.64	0.03
			M_{th}=4546		$\bar{D}_s \Xi_c'$	$-1.47 - i0.16$	1.48	0.44
						$-2.56 - i0.07$	2.56	0.38
					$\bar{D}\Omega_c$	$2.12 + i0.20$	2.13	0.53
						$3.42 + i0.09$	3.42	0.59
VB	$\bar{c}cssn$	$\frac{1}{2}(\frac{1}{2}^-, \frac{3}{2}^-)$	4675	10	$J/\Psi \Xi$	$0.41 + i0.01$	0.41	0.01
			4617	12		$0.66 - i0.00$	0.66	0.04
					$\bar{D}_s^* \Xi_c'$	$-1.59 - i0.17$	1.60	0.42
						$-2.70 - i0.08$	2.70	0.38
					$\bar{D}^* \Omega_c$	$2.25 + i0.21$	2.26	0.56
						$3.58 + i0.11$	3.58	0.60
PB^*	$\bar{c}cssn$	$\frac{1}{2}(\frac{3}{2}^-)$	4602	0	$\eta_c \Xi^*$	$0.02 + i0.00$	0.02	0.04
			4548	0		$0.01 + i0.00$	0.01	0.00
			M_{th}=4613		$\bar{D}_s \Xi_c^*$	$-1.42 - i0.00$	1.42	0.45
						$-2.48 - i0.00$	2.48	0.38
					$\bar{D}\Omega_c^*$	$2.13 - i0.00$	2.13	0.49
						$3.37 - i0.00$	3.37	0.57
VB^*	$\bar{c}cssn$	$\frac{1}{2}(\frac{1}{2}^-, \frac{3}{2}^-, \frac{5}{2}^-)$	4743	0	$J/\Psi \Xi^*$	$0.02 + i0.00$	0.02	0.02
			4686	0		$0.00 + i0.00$	0.00	0.00
					$\bar{D}_s^* \Xi_c^*$	$-1.56 - i0.00$	1.56	0.43
						$-2.63 - i0.00$	2.63	0.38
					$\bar{D}^* \Omega_c^*$	$2.27 - i0.00$	2.27	0.52
						$3.54 - i0.00$	3.54	0.58

NO STATES ARE FOUND WITH S=-3

J.~Song and E.~Oset, %``Exotic multistrange-anticharm baryon systems,"2506.09262”, PRD

- **Octet baryons:**

$$S=-1,\ \text{channels}: \quad \bar{D}_sN,\ \bar{D}\Lambda,\ \bar{D}\Sigma, \quad \text{with isospin}\ \ I=1/2; \quad \bar{D}\Sigma, \quad \text{with isospin}\ \ I=3/2,$$
$$S=-2,\ \text{channels}: \quad \bar{D}_s\Lambda,\ \bar{D}\Xi, \quad I=0; \quad \bar{D}\Xi, \quad I=1,$$
$$S=-3,\ \text{channel}: \quad \bar{D}_s\Xi, \quad I=1/2,$$

- **Decuplet baryons:**

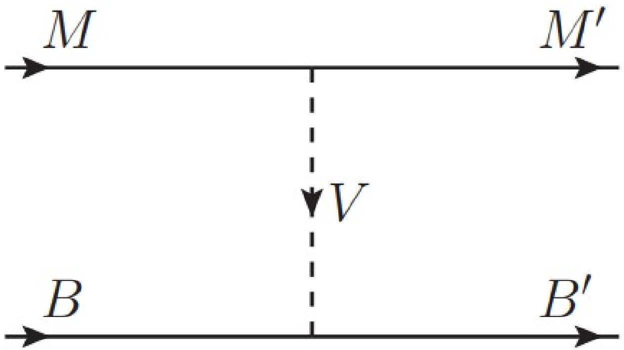
$$S=-1,\ \text{channels}: \quad \bar{D}\Sigma^*, \quad \text{with isospin}\ \ I=1/2; \quad \bar{D}_s\Delta,\ \bar{D}\Sigma^*, \quad \text{with isospin}\ \ I=3/2;$$
$$S=-2,\ \text{channels}: \quad \bar{D}\Xi^*, \quad I=0 \quad \bar{D}_s\Sigma^*,\ \bar{D}\Xi^*, \quad I=1;$$
$$S=-3,\ \text{channel}: \quad \bar{D}_s\Xi^*,\ \bar{D}\Omega \quad I=1/2,$$
$$S=-4,\ \text{channel}: \quad \bar{D}_s\Omega, \quad I=0.$$

$$\Xi=\begin{pmatrix}\Xi^{*0}\\ \Xi^{*-}\end{pmatrix}, \quad \Sigma=\begin{pmatrix}\Sigma^{*+}\\ \Sigma^{*0}\\ \Sigma^{*-}\end{pmatrix}$$

We construct states with $I=1/2$ and $I=0$ using isospin multiplets:

$$D=\begin{pmatrix}D^+\\ -D^0\end{pmatrix}, \quad \bar{D}=\begin{pmatrix}\bar{D}^0\\ D^-\end{pmatrix}, \quad K=\begin{pmatrix}K^+\\ K^0\end{pmatrix}, \quad \bar{K}=\begin{pmatrix}\bar{K}^0\\ -K^-\end{pmatrix}, \quad \Xi=\begin{pmatrix}\Xi^0\\ -\Xi^-\end{pmatrix}, \quad \Sigma=\begin{pmatrix}-\Sigma^+\\ \Sigma^0\\ \Sigma^-\end{pmatrix}$$

$$
\begin{aligned}
|\bar{D}\Sigma,\ I=1/2,\ I_3=1/2\rangle &= \frac{1}{\sqrt{3}}|\bar{D}^0\Sigma^0\rangle + \frac{\sqrt{2}}{\sqrt{3}}|D^-\Sigma^+\rangle, \\
|\bar{D}\Xi,\ I=0\rangle &= -\frac{1}{\sqrt{2}}\left(|\bar{D}^0\Xi^-\rangle + |D^-\Xi^0\rangle\right), \\
|\bar{D}\Sigma^*,\ I=1/2,\ I_3=1/2\rangle &= \frac{1}{\sqrt{3}}|\bar{D}^0\Sigma^{*0}\rangle - \frac{\sqrt{2}}{\sqrt{3}}|D^-\Sigma^{*+}\rangle, \\
|\bar{D}\Xi^*,\ I=0\rangle &= \frac{1}{\sqrt{2}}\left(|\bar{D}^0\Xi^{*-}\rangle - |D^-\Xi^{*0}\rangle\right).
\end{aligned}
$$



$$
\mathcal{L}_{\mathrm{VPP}} = -ig\,\langle [P, \partial_\mu P]\, V^\mu \rangle
$$

The vector-baryon coupling for baryons of the SU(3) octet is described by the Lagrangian:

$$\mathcal{L}_{BBV'} = g\left(\langle\bar{B}\gamma_\mu[V'^\mu, B]\rangle + \langle\bar{B}\gamma_\mu B\rangle\langle V'^\mu\rangle\right),$$

$$V' = \begin{pmatrix} \frac{1}{\sqrt{2}}\rho^0 + \frac{1}{\sqrt{2}}\omega & \rho^+ & K^{*+} \\ \rho^- & -\frac{1}{\sqrt{2}}\rho^0 + \frac{1}{\sqrt{2}}\omega & K^{*0} \\ K^{*-} & \bar{K}^{*0} & \phi \end{pmatrix} \qquad B = \begin{pmatrix} \frac{1}{\sqrt{2}}\Sigma^0 + \frac{1}{\sqrt{6}}\Lambda & \Sigma^+ & p \\ \Sigma^- & -\frac{1}{\sqrt{2}}\Sigma^0 + \frac{1}{\sqrt{6}}\Lambda & n \\ \Xi^- & \Xi^0 & -\frac{2}{\sqrt{6}}\Lambda \end{pmatrix}$$

$$V_{ij} = C_{ij}\frac{1}{4f_\pi^2}(k^0 + k'^0) \qquad T = (1 - VG)^{-1}V$$

$$G_i(\sqrt{s}) = 2M_i \int_{|\vec{q}|<q_{\max}} \frac{d^3q}{(2\pi)^3}\frac{\omega_1(\vec{q}) + \omega_2(\vec{q})}{2\omega_1(\vec{q})\omega_2(\vec{q})}\frac{1}{s - [\omega_1(\vec{q}) + \omega_2(\vec{q})]^2 + i\epsilon},$$

TABLE XII: The pole (in MeV) and its coupling constants g_i and g_iG_i (in MeV) to the channels in the $S=-1$ sector with issopin $I=1/2$.

$q_{\max}$		Pole		$\bar{D}_s N$	$\bar{D}\Lambda$	$\bar{D}\Sigma$
550	2906.62	**2906**	g_i	0.91	0.72	1.43
			g_iG_i	-7.62	-2.85	-3.94
600		**2898**	g_i	2.51	1.64	3.59
			g_iG_i	-17.89	-7.23	-11.52
630		**2888**	g_i	3.10	1.85	4.26
			g_iG_i	-20.43	-8.45	-14.71
650		**2880**	g_i	3.40	1.95	4.59
			g_iG_i	-21.7	-9.09	-16.39

The pole (in MeV) and its coupling constants g_i and g_iG_i (in MeV) to the channels in the $I=1/2,\ S=-1$ sector.

$q_{\max}$		Pole		$\bar{D}\Sigma^*$
550	3250.08	**3246.38**	g_i	1.86
			g_iG_i	-17.25
600		**3241.99**	g_i	2.35
			g_iG_i	-21.82
630		**3238.39**	g_i	2.63
			g_iG_i	-24.47
650		**3235.56**	g_i	2.82
			g_iG_i	-26.22

The pole (in MeV) and its coupling constants g_i and $g_i G_i$ (in MeV) to the channels in the $S = -2$ sector with isospin $I = 0$.

$q_{\rm max}$	Pole		$\bar{D}_s\Lambda$	$\bar{D}\Xi$
560 3084.03	**3083**	g_i	0.92	2.71
		$g_i G_i$	−8.70	−10.05
600	**3071**	g_i	2.12	5.15
		$g_i G_i$	−15.72	−20.63
630	**3057**	g_i	2.55	5.72
		$g_i G_i$	−17.09	−23.73
650	**3046**	g_i	2.79	6.03
		$g_i G_i$	−17.82	−25.49

The pole (in MeV) and its coupling constants g_i and $g_i G_i$ (in MeV) to the channels in the $I = 0,\ S = -2$ sector.

$q_{\rm max}$	Pole		$\bar{D}\Xi^*$
550 3399.05	**3393**	g_i	2.03
		$g_i G_i$	−18.80
600	**3388**	g_i	2.49
		$g_i G_i$	−23.16
630	**3383**	g_i	2.77
		$g_i G_i$	−25.72
650	**3380**	g_i	2.95
		$g_i G_i$	−27.42

TABLE XX: The pole (in MeV) and its coupling constants g_i and g_iG_i (in MeV) to the channels in the $S=-1$ sector.

$q_{\max}$		Pole		$\bar{D}_s^* N$	$\bar{D}^*\Lambda$	$\bar{D}^*\Sigma$
550	3050.47	**3049**	g_i	1.37	1.06	2.13
			g_iG_i	−10.44	−3.96	−5.55
600		**3039**	g_i	2.74	1.75	3.89
			g_iG_i	−17.87	−7.27	−11.76
630		**3028**	g_i	3.31	1.94	4.53
			g_iG_i	−20.05	−8.33	−14.71
650		**3020**	g_i	3.62	2.04	4.86
			g_iG_i	−21.19	−8.91	−16.28

TABLE XXI: The pole (in MeV) and its coupling constants g_i and g_iG_i (in MeV) to the channels in the $S=-2$ sector.

$q_{\max}$		Pole		$\bar{D}_s^*\Lambda$	$\bar{D}^*\Xi$
550	3227.88	**3227**	g_i	0.86	2.59
			g_iG_i	−7.73	−8.84
600		**3211**	g_i	2.31	5.48
			g_iG_i	−15.42	−20.57
630		**3196**	g_i	2.72	6.01
			g_iG_i	−16.59	−23.33
650		**3184**	g_i	2.97	6.32
			g_iG_i	−17.27	−24.96

The pole (in MeV) and its coupling constants g_i and g_iG_i (in MeV) to the channels in the $I = 1/2,\ S = -1$ sector.

$q_{\max}$		Pole		$\bar{D}^*\Sigma^*$ (Th = 3391 MeV)
550	3391.39	**3386**	g_i	2.03
			g_iG_i	−17.46
600		**3381**	g_i	2.52
			g_iG_i	−21.76
630		**3377**	g_i	2.81
			g_iG_i	−24.27
650		**3374**	g_i	3.00
			g_iG_i	−25.93

The pole (in MeV) and its coupling constants g_i and g_iG_i (in MeV) to the channels in the $I = 0,\ S = -2$ sector.

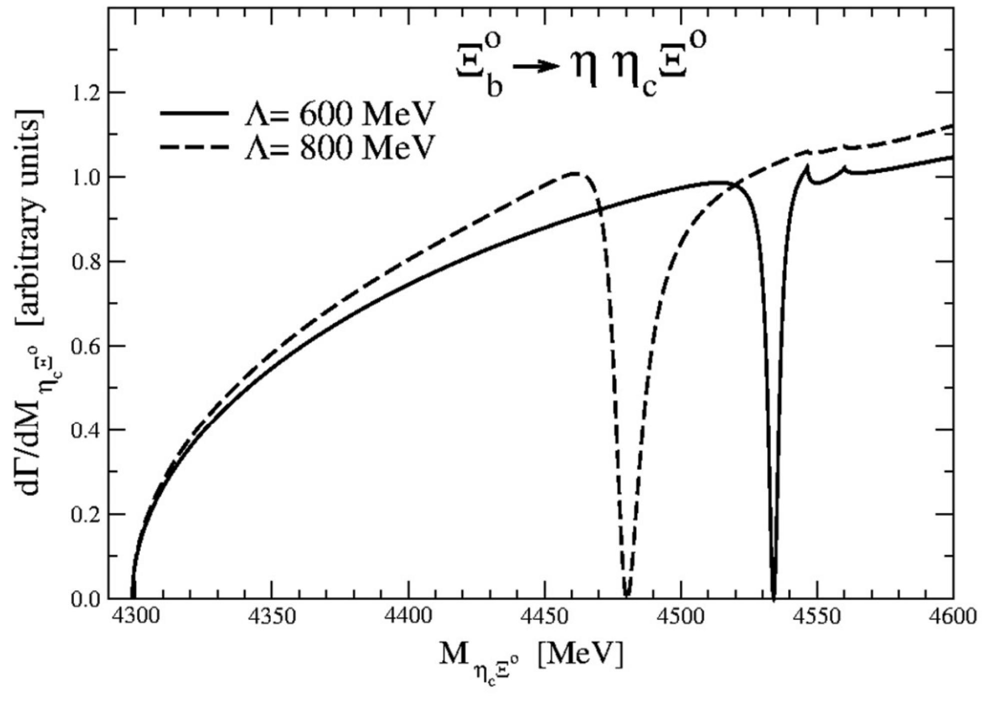
$q_{\max}$		Pole		$\bar{D}^*\Xi^*$ (Th = 3540.36 MeV)
550	3540.36	**3533**	g_i	2.18
			g_iG_i	−18.83
600		**3527**	g_i	2.66
			g_iG_i	−22.96
630		**3523**	g_i	2.94
			g_iG_i	−25.41
650		**3519**	g_i	3.13
			g_iG_i	−27.03

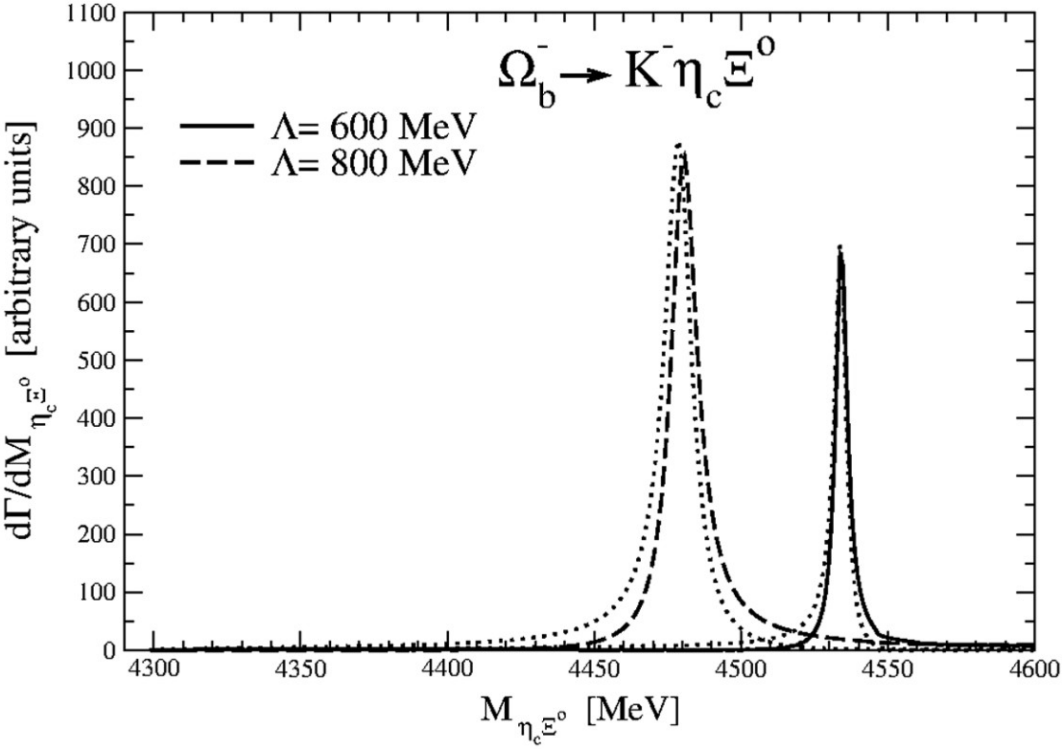
No states are found in the S=-3 (D_s Ξ) and S=-4 (D_s Ω)

The interaction is repulsive

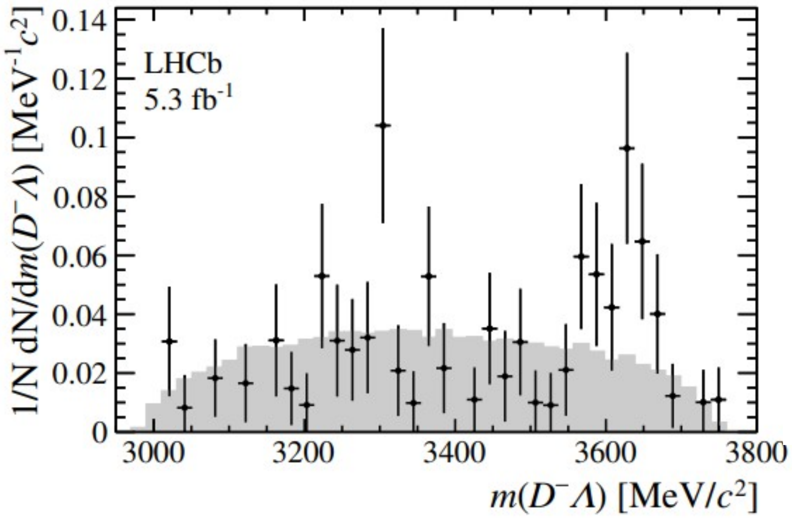
Production of pentaquarks with hidden charm and double strangeness in Ξ_b and Ω_b decays

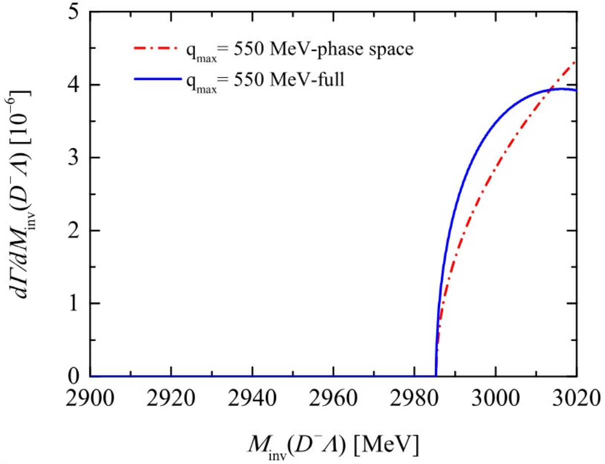
E. Oset, L. Roca, M. Whitehead   PHYS. REV. D 110, 034016 (2024)





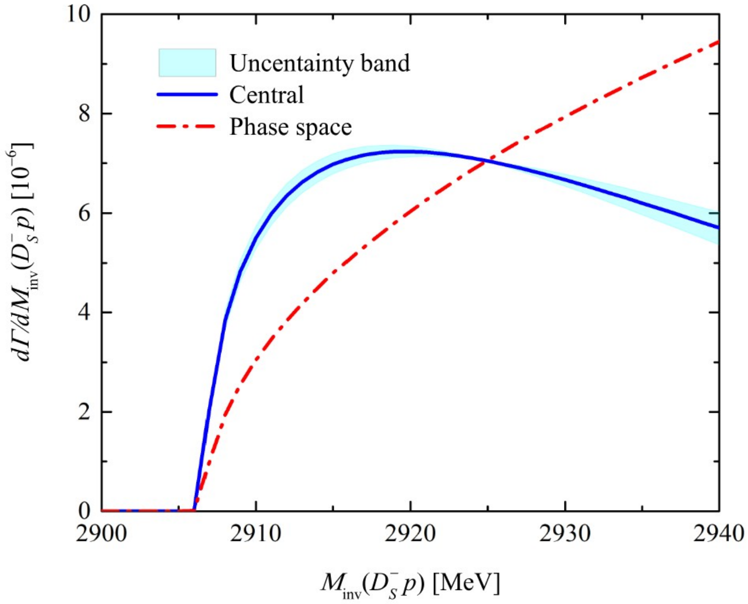
The $\Lambda_b \to D^+ D^- \Lambda,\ D^0 D_s^- p$ Reaction has been measured at LHCb   JHEP 07 (2024) 140

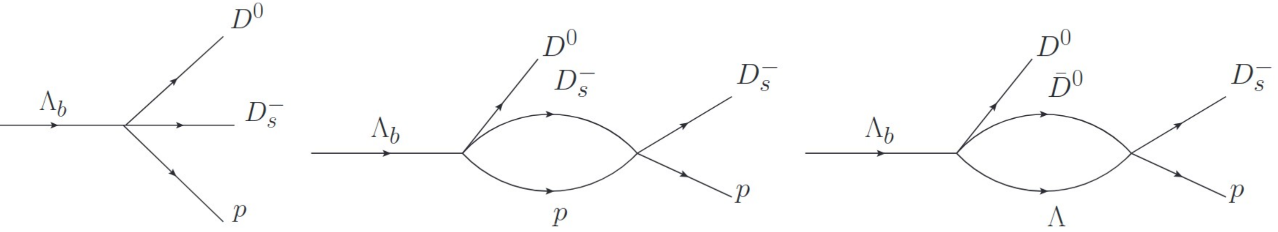




Study close to threshold done in

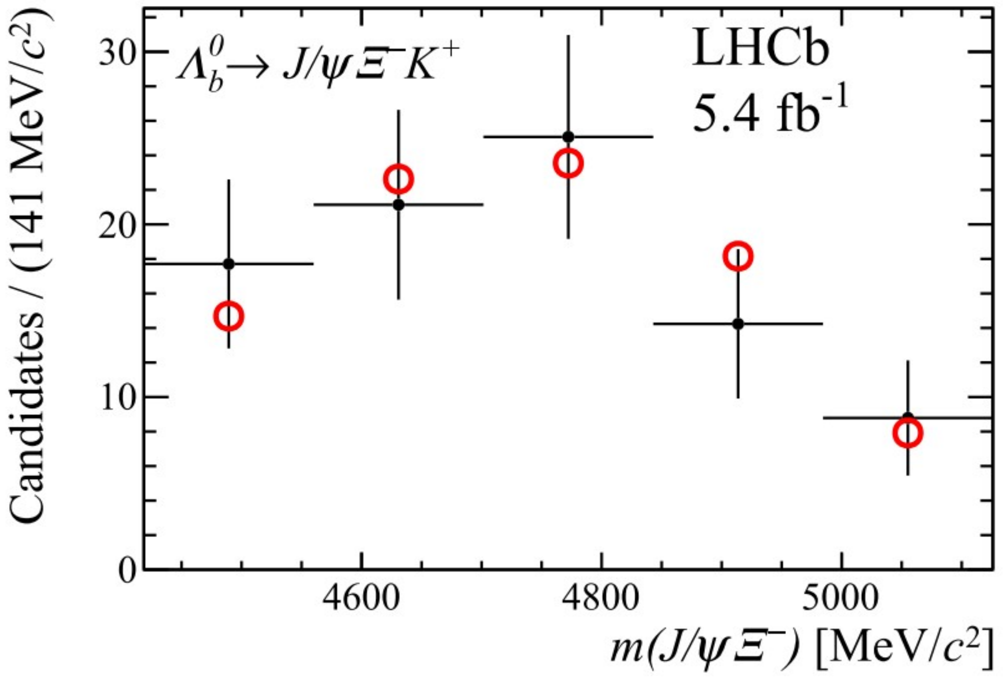
J Song, M. Bayar, E. Oset
2507.01865, PRD

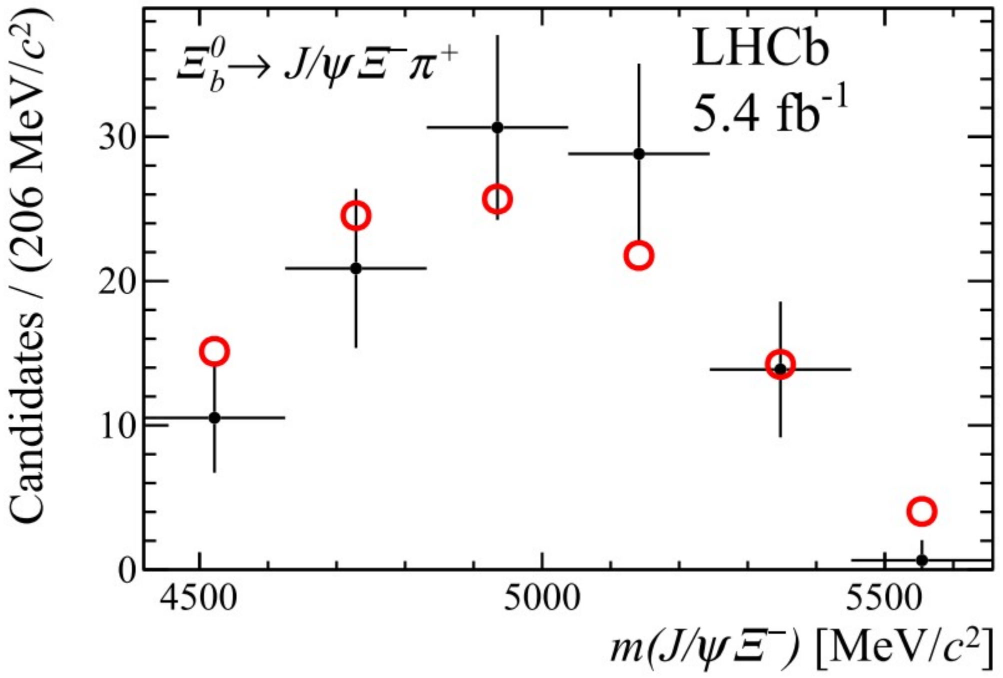




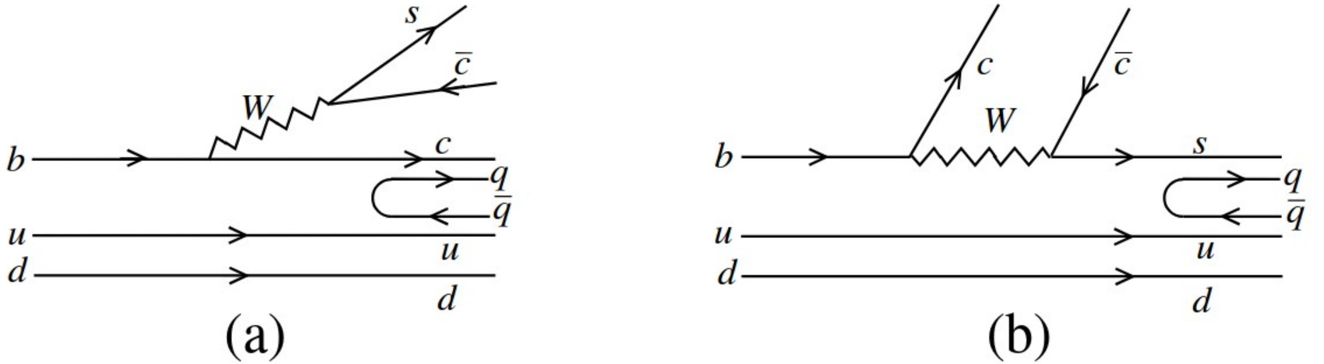
Connection to experiment LHCb has measured the reactions

$$\Lambda_b \rightarrow J/\psi \Xi^- K^+ \qquad \Xi_b \rightarrow J/\psi \Xi^- \pi^+$$

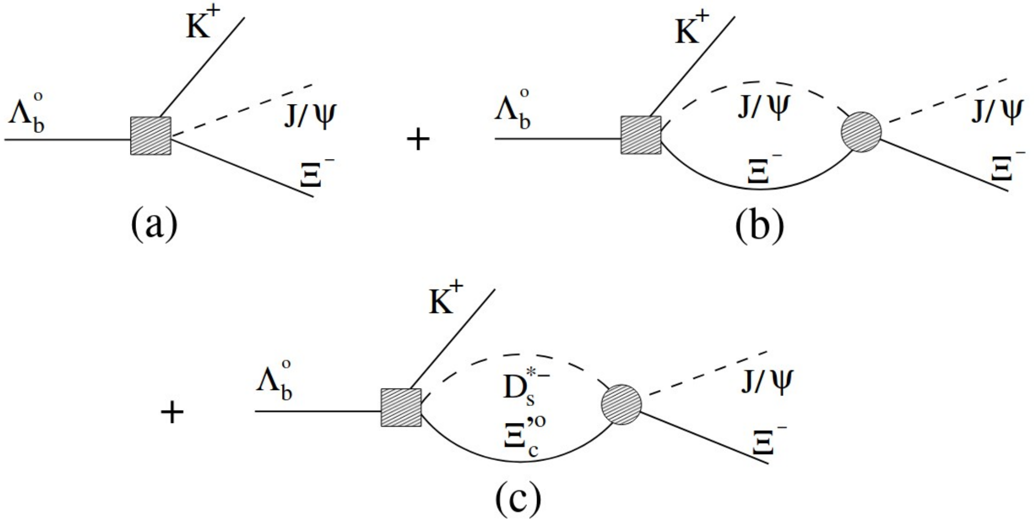




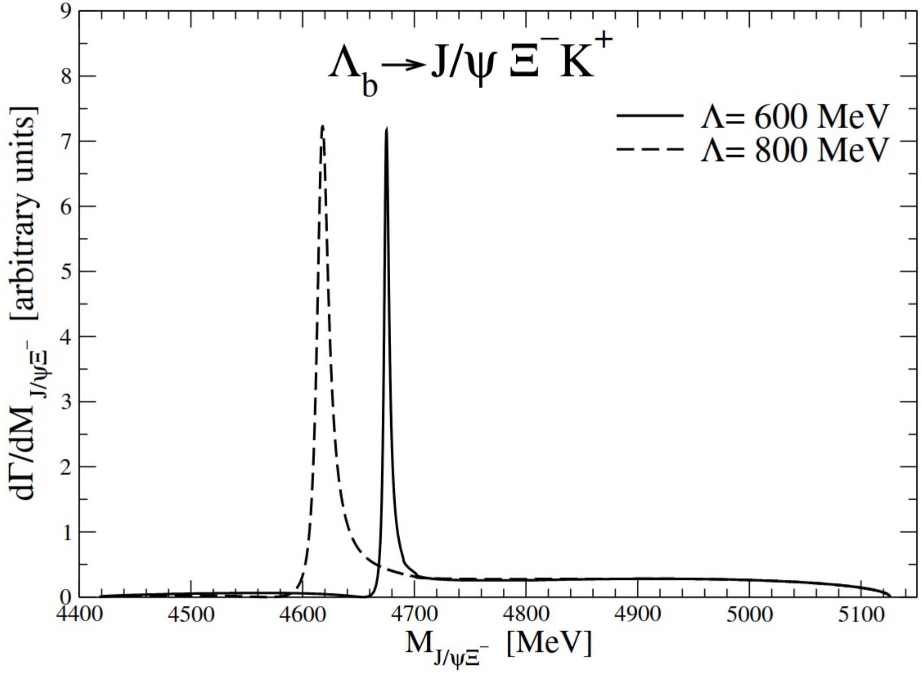
Results compatible with phase space (red circles) BUT THE BINS ARE VERY LARGE



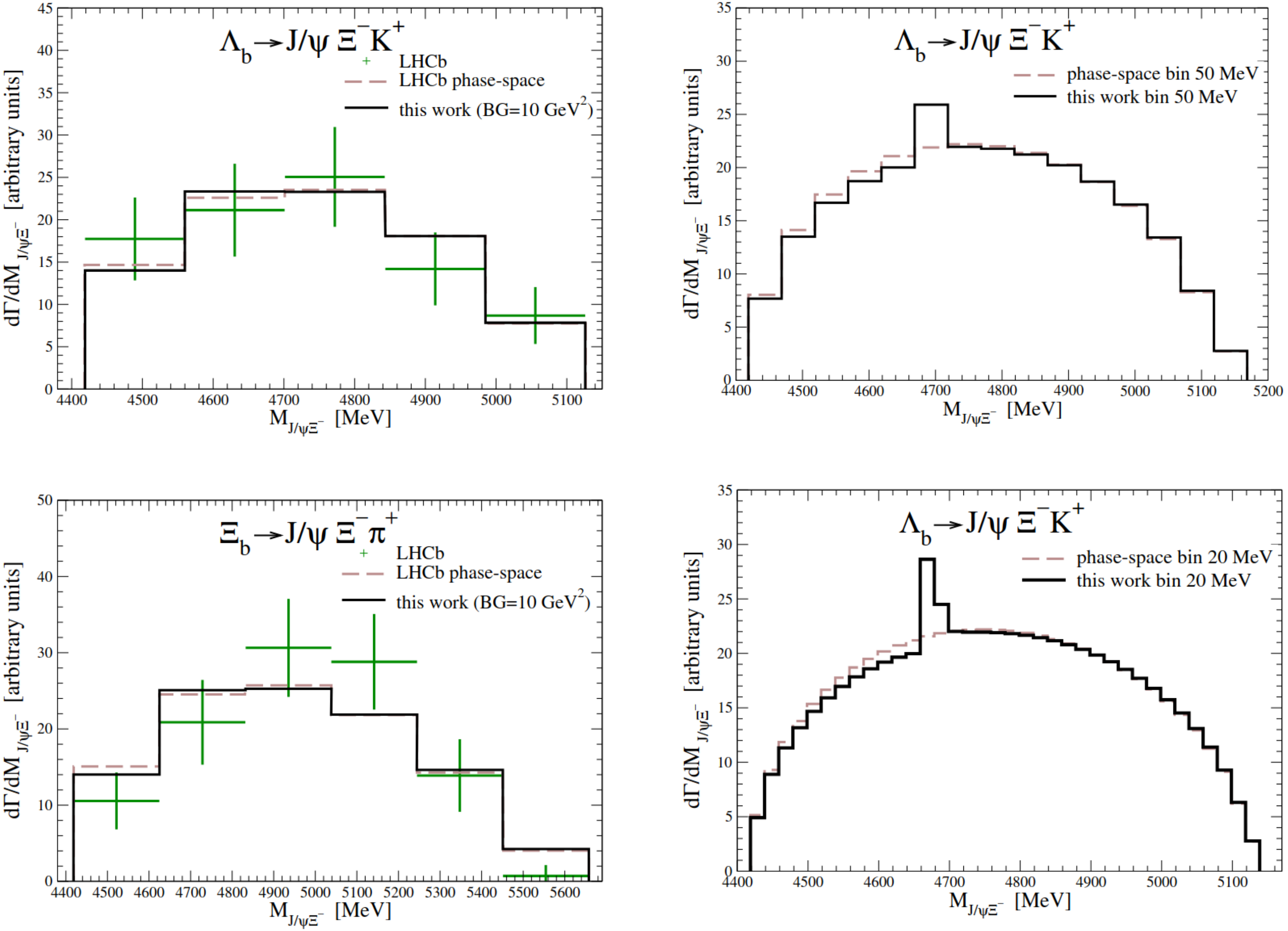
s
c̄
W
b
c
q
q̄
u
u
d
d
(a)
c
c̄
W
b
s
q
q̄
u
u
d
d
(b)



K^+
Λ_b^o
J/ψ
Ξ^-
(a)
+
(b)
+
D_s^{*-}
$\Xi_c^{'o}$
(c)



$\Lambda_b \to J/\psi\ \Xi^- K^+$
Λ= 600 MeV
Λ= 800 MeV
$d\Gamma/dM_{J/\psi\Xi^-}$ [arbitrary units]
$M_{J/\psi\Xi^-}$ [MeV]



$\Lambda_b \to J/\psi\ \Xi^- K^+$
LHCb
LHCb phase-space
this work (BG=10 GeV^2)
$d\Gamma/dM_{J/\psi\Xi^-}$ [arbitrary units]
$M_{J/\psi\Xi^-}$ [MeV]
$\Lambda_b \to J/\psi\ \Xi^- K^+$
phase-space bin 50 MeV
this work bin 50 MeV
$d\Gamma/dM_{J/\psi\Xi^-}$ [arbitrary units]
$M_{J/\psi\Xi^-}$ [MeV]
$\Xi_b \to J/\psi\ \Xi^- \pi^+$
LHCb
LHCb phase-space
this work (BG=10 GeV^2)
$d\Gamma/dM_{J/\psi\Xi^-}$ [arbitrary units]
$M_{J/\psi\Xi^-}$ [MeV]
$\Lambda_b \to J/\psi\ \Xi^- K^+$
phase-space bin 20 MeV
this work bin 20 MeV
$d\Gamma/dM_{J/\psi\Xi^-}$ [arbitrary units]
$M_{J/\psi\Xi^-}$ [MeV]

Conclusions

We find 4 pentaquarks of c cbar and two ss quarks of molecular nature coming from PB, VB, PB*, VB* coupled channels

c cbar sss is found not bound

We also find 8 pentaquarks of molecular nature coming from PB, VB, PB*, VB* coupled channels, corresponding to cbar snnn, and cbar ssnn

cbar sssn and cbar ssss states are found not bound

We study the LHCb reactions $\Lambda_b \rightarrow J/\psi \Xi^- K^+$ $\Xi_b \rightarrow J/\psi \Xi^- \pi^+$

and show that with higher statistics one should see the predicted VB state around 4700 MeV.