Recent D^{**} and D_s^{**} observations at Belle

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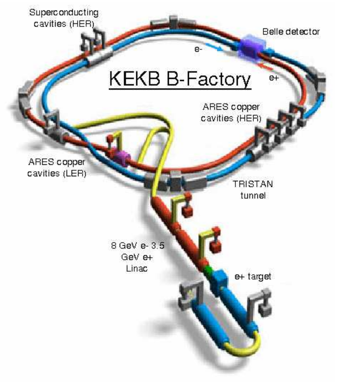
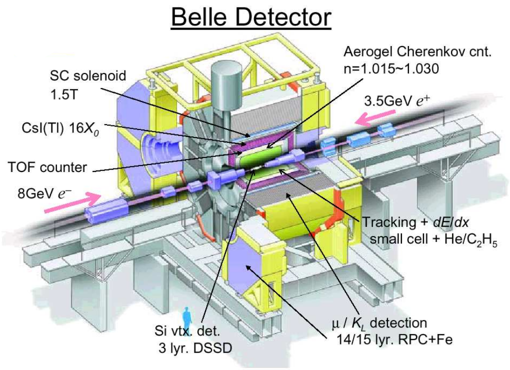
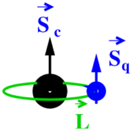
Belle experiment





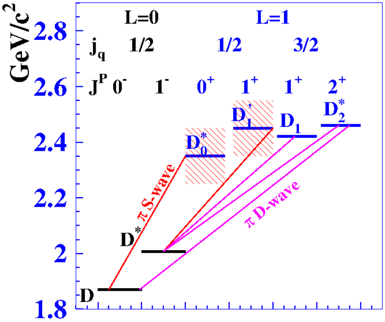
- Asymmetric beam energies: $E_{e^-} = 8\,\text{GeV}$, $E_{e^+} = 3.5\,\text{GeV}$
- Peak luminosity: $\mathcal{L} = 2.1 \times 10^{34}\text{cm}^{-2}\text{s}^{-1}$
- $B\bar{B}$ luminosity: $\int \mathcal{L}\,dt \approx 711\,\text{fb}^{-1}$ corresponds to $(772 \pm 11) \times 10^6$ $B\bar{B}$ pairs produced.
- Reported analyses use the full $B\bar{B}$ data sample collected at Belle.

P-wave excitations of the D-mesons



$\vec{j}_q = \vec{L} + \vec{S}_q$

$\vec{J} = \vec{j}_q + \vec{S}_c$

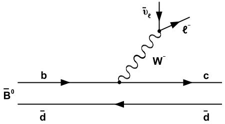


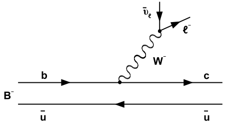
$D_0^* \to$	$D\pi$		in S-wave
$D_1' \to$		$D^*\pi$	in S-wave
$D_1 \to$		$D^*\pi$	in D-wave
$D_2^* \to$	$D\pi$	$D^*\pi$	in D-wave

	$D_0^*(2400)$	$D_1(2420)$	$D_1(2430)$	$D_2^*(2460)$
J_j^P	$0^+_{1/2}$	$1^+_{3/2}$	$1^+_{1/2}$	$2^+_{3/2}$
PDG14 mass (MeV/c^2)	2318 ± 29	2421.4 ± 0.6	2427 ± 40	2662.6 ± 0.6
Naive quark model mass (MeV/c^2)	2400	2440	2490	2500
PDG14 width (MeV/c^2)	267 ± 40	27.4 ± 2.5	384 ± 117	49.0 ± 1.3
Naive quark model width (MeV/c^2)	225	28	225	79

D^{**} production in semileptonic B decays

Phys. Rev. D **77**, 091503 (2008) (Belle)
Phys. Rev. Lett. **101**, 261802 (2008) (BaBar)
Phys. Rev. Lett. **103**, 051803 (2009) (BaBar)





'1/2' vs '3/2' Problem

$|V_{cb}|$ **inclusive**

$|V_{cb}|$ exclusive

?

gap **inclusive** vs exclusive

measured **1P** states

$1/2$ vs. $3/2$ semileptonic puzzle: huge discrepancy between theory and experiment for the relative semileptonic $j = 1/2$ and $j = 3/2$ decay rates!

State	PDG14 $\mathcal{B}(B \to D^{**} l \nu_l)$, 10^{-3}
$D_0^*(2400)^0$	2.5 ± 0.5
$D_0^*(2400)^\pm$	3.0 ± 1.2
$D_1'(2430)^0$	2.7 ± 0.6
$D_1'(2430)^\pm$	3.1 ± 0.9
$D_1(2420)^0$	3.03 ± 0.20
$D_1(2420)^\pm$	2.80 ± 0.28
$D_2^*(2460)^0$	1.53 ± 0.16
$D_2^*(2460)^\pm$	1.21 ± 0.33

HQET & QCD sum rules predict the suppression of $j = 1/2$ states relative to the $j = 3/2$.

$$\frac{d\Gamma(B \to D_J^{1/2} l\nu)}{dw} \propto G_F^2 |V_{cb}|^2 K_J^{1/2}(w) |\tau_{1/2}(w)|^2, \qquad J = 0, 1$$

$$\frac{d\Gamma(B \to D_J^{3/2} l\nu)}{dw} \propto G_F^2 |V_{cb}|^2 K_J^{3/2}(w) |\tau_{3/2}(w)|^2, \qquad J = 1, 2$$

where K_J^j are known kinematical factors and $\tau_j(w)$ are Isgur -Wise functions with $\tau_{1/2}(w) << \tau_{3/2}(w)$.

Solution (??):

1. Mixing between $1^+_{1/2}$ & $1^+_{3/2}$ states induced by $1/m_c$ corrections (?), Phys. Rev. D **91**, 09434 (2015)
2. Radial excitation $D' = D(2550)$ (?), CKM 2014 report, arXiv:1411.3563

Importance of non-leptonic decays to elucidate the problem

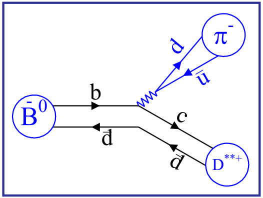
D^{**} production in hadronic B decays (1)

Class I hadronic decays

Phys. Rev. D, **76**, 012006 (2007) (Belle)

arXiv:hep-ex/0412072 (Belle)

Phys. Rev. D **92**, 032002 (2015) (LHCb)

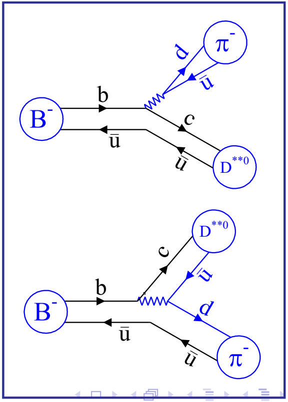


Class III hadronic decays

Phys. Rev. D, **69**, 112002 (2004) (Belle)

Phys. Rev. D **79**, 112004 (2009) (BaBar)

Phys. Rev. D **87**, 092001 (2013) (LHCb)

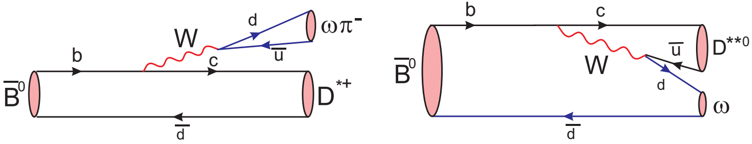


D^{**} production in hadronic B decays (2)

Class I & Class III BF products (PDG14)	Value
$\mathcal{B}(\bar{B}^0 \to D_0^*(2400)^+\pi^-) \times \mathcal{B}(D_0^*(2400)^+ \to D^0\pi^+)$	$(6.0 \pm 3.0) \times 10^{-5}$
$\mathcal{B}(\bar{B}^0 \to D_1(2430)^+\pi^-) \times \mathcal{B}(D_1(2430)^+ \to D^{*0}\pi^+)$	$< 7 \times 10^{-5}$
$\mathcal{B}(\bar{B}^0 \to D_1(2420)^+\pi^-) \times \mathcal{B}(D_1(2420)^+ \to D^{*0}\pi^+)$	$(3.7 \pm 0.9) \times 10^{-4}$
$\mathcal{B}(\bar{B}^0 \to D_2^*(2460)^+\pi^-) \times \mathcal{B}(D_2^*(2460)^+ \to D^0\pi^+)$	$(2.2 \pm 0.4) \times 10^{-4}$
$\mathcal{B}(\bar{B}^0 \to D_2^*(2460)^+\pi^-) \times \mathcal{B}(D_2^*(2460)^+ \to D^{*0}\pi^+)$	$(2.5 \pm 0.6) \times 10^{-4}$
$\mathcal{B}(\bar{B}^- \to D_0^*(2400)^0\pi^-) \times \mathcal{B}(D_0^*(2400)^0 \to D^-\pi^+)$	$(6.4 \pm 1.4) \times 10^{-4}$
$\mathcal{B}(\bar{B}^- \to D_1(2430)^0\pi^-) \times \mathcal{B}(D_1(2430)^0 \to D^{*-}\pi^+)$	$(5.0 \pm 1.3) \times 10^{-4}$
$\mathcal{B}(\bar{B}^- \to D_1(2420)^0\pi^-) \times \mathcal{B}(D_1(2420)^0 \to D^{*-}\pi^+)$	$(6.8 \pm 1.5) \times 10^{-4}$
$\mathcal{B}(\bar{B}^- \to D_2^*(2460)^0\pi^-) \times \mathcal{B}(D_2^*(2460)^0 \to D^-\pi^+)$	$(3.5 \pm 0.4) \times 10^{-4}$
$\mathcal{B}(\bar{B}^- \to D_2^*(2460)^0\pi^-) \times \mathcal{B}(D_2^*(2460)^0 \to D^{*-}\pi^+)$	$(2.2 \pm 1.1) \times 10^{-4}$

Class I & III data confirm the theoretical expectations

$\bar{B}^0 \to D^{**}\omega \to (D^{*+}\pi^-)\omega$ decays



Class II hadronic decays

- 1. What are the $j = 1/2$ and $j = 3/2$ rates in class II decays?
- 2. What is the tensor $j = 3/2$ rate in class II decays?
  Soft Collinear Effective Theory (SCET) (Phys. Rev. D **70**, 114006 (2004))
  predicts equal rates and strong phases for $D_1(2420)$ and $D_2^*(2460)$ ($j = 3/2$)
  in the $\bar{B}^0 \to D^{**}M$ decays, $M = \pi, \rho, K$ or $M = K^*$ with long. polarization.

Advantage of $\bar{B}^0 \to D^{**}\omega$ study

- Lower fractions of $q\bar{q}$ continuum and combinatorial $B\bar{B}$ backgrounds than in $B \to D^{**0}\pi^0$.
- Possibility to measure the polarizations and partial-wave fractions of D^{**}-states.
- Possibility to perform the coherent study of $\rho(770)$, $\rho(1450)$ and $\rho(1700)$ in the $\omega\pi$ final state.

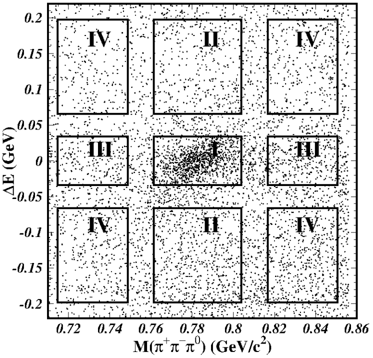
$\bar{B}^0 \to D^{*+}\omega\pi^-$ analysis strategy

$$M_{\rm bc} = \sqrt{(E_{\rm beam}^{\rm CMS})^2/c^4 - |\sum_i \mathbf{p}_{\rm i}^{\rm CMS}|^2/c^2}$$

$$\Delta E = \sqrt{|\mathbf{p}_{\rm i}^{\rm CMS}|^2 c^2 + m_i^2 c^4} - E_{\rm beam}^{\rm CMS}$$

$$5.2725\,{\rm GeV}/c^2 < M_{\rm bc} < 5.2845\,{\rm GeV}/c^2$$

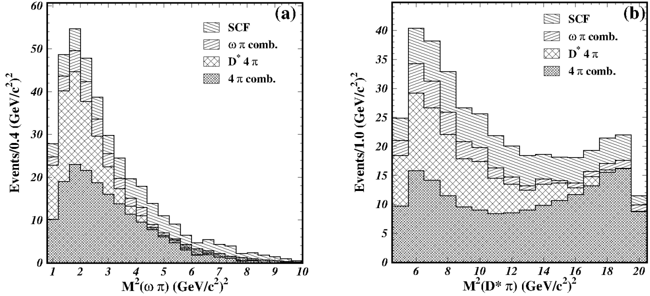
Region I — signal
Regions II, III, IV — sidebands



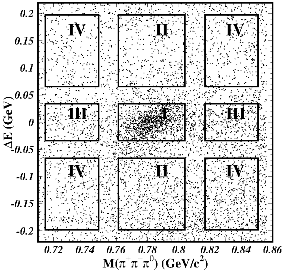
Coherent amplitude analysis

- Coherent amplitude analysis as an efficient tool for distinguishing the contributions for narrow & broad D^{**} states.
- Unbinned likelihood fit in the decay kinematic phase space.
- Likelihood function constructed from the background and signal PDF functions.

$\bar{B}^0 \to D^{*+}\omega\pi^-$ background

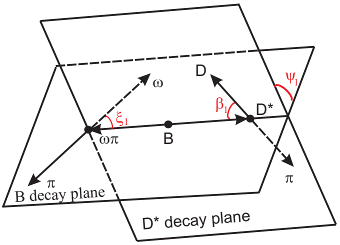


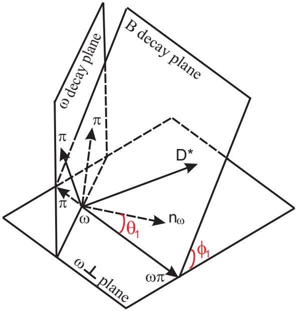
- SCF (Self Cross-Feed) (regions I, II, III and IV) — misreconstruction of true signal
- $\omega\pi$ comb. (regions I and III) — combinatorial $B\bar{B}$ bkg w/ correctly reconstructed ω
- $D^*4\pi$ (regions I and II) — peaking bkg from $\bar{B}^0 \to D^{*+}\pi^+\pi^-\pi^0\pi^-$ w/o ω contribution (basically $\bar{B}^0 \to D^{*+}a_1(1260)\pi$)
- 4π comb. (regions I, II, III and IV) — combinatorial $B\bar{B}$ bkg w/ misreconstructed ω



$\bar{B}^0 \to D^{*+}\omega\pi^-$ matrix element

Two angular bases $[\xi_1, \theta_1, \phi_1, \beta_1, \psi_1]$ for the $\omega\pi$ and $[\xi_2, \theta_2, \phi_2, \beta_2, \psi_2]$ for the D^{**} productions.

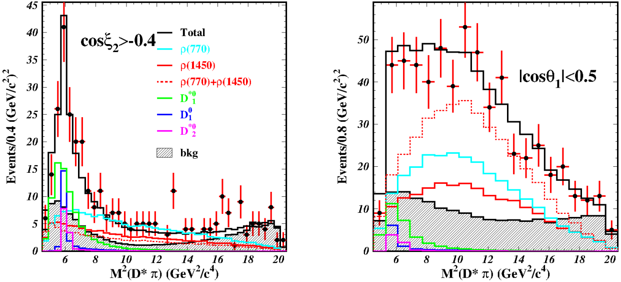




- An amplitude of the three-body $\bar{B}^0 \to D^{*+}\omega\pi^-$ decay is written as a sum of the contributions corresponding to quasi-two-body resonances, D^{**} and $\omega\pi$ (sum of Breit-Wigner functions).
- The fixed quantum numbers of the initial state (B-meson) allow one to parametrize the resonant amplitude with fixed angular orbital momenta in B and resonance rest frames.
- All the D^{**} are well distinguished by their angular distributions.

$m^2_{D^*\pi}$ structure

Phys. Rev. D **92**, 012013 (2015)



Total BF consistent with CLEO and BaBar but with higher precision

D^{**} BFs for the first time

$\delta = \sqrt{2(\Delta\mathcal{L})}$

$$\boxed{\mathcal{B}(\bar{B}^0 \to D^{*+}\omega\pi^-) = (2.31 \pm 0.11\,(\text{stat.}) \pm 0.14\,(\text{syst.})) \times 10^{-3}}$$

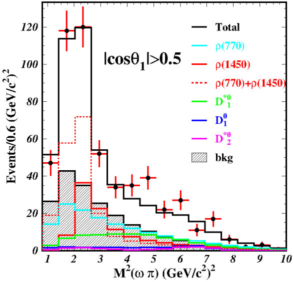
$$\boxed{\mathcal{B}_{D_1(2430)^0} = (2.5 \pm 0.4\,(\text{stat.})\,^{+0.7}_{-0.2}\,(\text{syst.})\,^{+0.4}_{-0.1}\,(\text{model})) \times 10^{-4}} \qquad \boxed{\delta = 8.6\sigma}$$

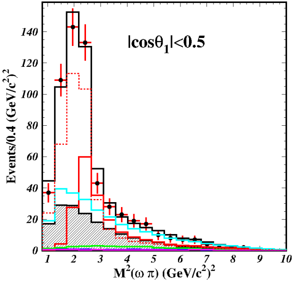
$$\boxed{\mathcal{B}_{D_1(2420)^0} = (0.7 \pm 0.2\,(\text{stat.})\,^{+0.1}_{-0.0}\,(\text{syst.}) \pm 0.1\,(\text{model})) \times 10^{-4}} \qquad \boxed{\delta = 5.5\sigma}$$

$$\boxed{\mathcal{B}_{D_2^*(2460)^0} = (0.4 \pm 0.1\,(\text{stat.})\,^{+0.0}_{-0.1}\,(\text{syst.}) \pm 0.1\,(\text{model})) \times 10^{-4}} \qquad \boxed{\delta = 5.0\sigma}$$

$m^2_{\omega\pi}$ structure

Phys. Rev. D **92**, 012013 (2015)





- ρ-like BFs for the first time
- FCC — First-Class Currents, coherent sum of $\rho(770)$ and $\rho(1450)$ states
- SCC – Second-Class Currents, $b_1(1235)$ contribution
- $\delta = \sqrt{2(\Delta\mathcal{L})}$

$$\mathcal{B}_{\rho(770)^-} = (1.48 \pm 0.27\,(\text{stat.})\,^{+0.15}_{-0.09}\,(\text{syst.})\,^{+0.21}_{-0.56}\,(\text{model})) \times 10^{-3}$$

$\delta = 10.5\sigma$

$$\mathcal{B}_{\rho(1450)^-} = (1.07\,^{+0.15}_{-0.31}\,(\text{stat.})\,^{+0.06}_{-0.13}\,(\text{syst.})\,^{+0.40}_{-0.02}\,(\text{model})) \times 10^{-3}$$

$\delta = 15.0\sigma$

$$\mathcal{B}_{\text{FCC}} = (1.90 \pm 0.11\,(\text{stat.})\,^{+0.11}_{-0.13}\,(\text{syst.})\,^{+0.02}_{-0.06}\,(\text{model})) \times 10^{-3}$$

$\delta = 29.8\sigma$

$$\mathcal{B}_{SCC} < 0.7 \times 10^{-4}\ (90\%\ \text{C.L.})$$

D^{**} polarizations and partial-wave fractions

Phys. Rev. D **92**, 012013 (2015)

(Value) ± (statistical) ± (systematic) ± (model)

D^{**} longitudinal polarizations are less than factorizable QCD estimations

State	Long. polarization, $\mathcal{P}\%$
$D_1(2430)^0$	$63.0 \pm 9.1 \pm 4.6^{+4.6}_{-3.9}$
$D_1(2420)^0$	$67.1 \pm 11.7^{+0.0+2.3}_{-4.2-2.8}$
$D_2^*(2460)^0$	$76.0^{+18.3}_{-8.5} \pm 2.0^{+2.9}_{-2.0}$

Phys. Rev. D **84**, 112007 (2011) (BaBar)

Long. polarization	$\bar{B}^0 \to D^{*0}\omega$
$\mathcal{P}$, %	$66.5 \pm 4.7 \pm 1.5$

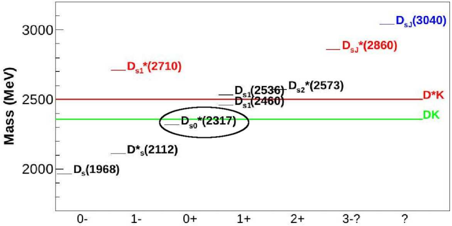
S-, P-, D-wave rates are comparable for D^{**} production

Partial wave	$D_1(2430)^0$ rate, %
S	$38.9 \pm 10.8^{+4.3+1.2}_{-0.7-1.1}$
P	$33.1 \pm 9.5^{+2.4+3.0}_{-5.5-4.0}$
D	$28.3 \pm 8.9^{+3.0+3.9}_{-0.8-2.9}$

$\rho(1450)$ shape parameters

Parameter	Value, MeV$/c^2$
Mass	$1544 \pm 22^{+11+1}_{-1\ -46}$
Width	$303^{+31+3+69}_{-52-4-6}$

$D^*_{s0}(2317)$-state



Experimental facts

Discovery by BaBar and CLEO-2 in 2003

$$M_{\mathrm{PDG14}} = (2318 \pm 29)\,\mathrm{MeV}/c^2 < M(D^0) + M(K^+) = 2358.6\,\mathrm{MeV}/c^2$$

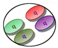
$$\Gamma_{\mathrm{PDG14}} < 3.8\,\mathrm{MeV}/c^2 \;(95\%\mathrm{C.L.})$$

$D^*_{s0}(2317)$ content (??)

Conventional $c\bar{s}$ state

$\boxed{\cancel{M(D^*_{s0}) < M(D) + M(K)}}$

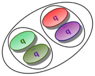
$\boxed{\cancel{\frac{\Gamma(D^*_{s0}\to D^*_s\gamma)}{\Gamma(D^*_{s0}\to D_s\pi^0)} \lesssim 0.059}}$



Tetraquark $[(c\bar{s})(q\bar{q})]$ state

$\boxed{M(D^*_{s0}) < M(D) + M(K)}$

$\boxed{\frac{\Gamma(D^*_{s0}\to D^*_s\gamma)}{\Gamma(D^*_{s0}\to D_s\pi^0)} << 0.059 \text{ for } I = 1, I_3 = 0}$



Molecular DK state

$\boxed{M(D^*_{s0}) < M(D) + M(K)}$

$\boxed{\frac{\Gamma(D^*_{s0}\to D^*_s\gamma)}{\Gamma(D^*_{s0}\to D_s\pi^0)} \lesssim 0.059 \text{ for } I = 0}$

Is the $D^*_{s0}(2317)$ molecule or tetraquark?

$D^*_{s0}(2317)^+$ as candidate for DK molecule with $I = 0$

- Hadronic decays $\longrightarrow \Gamma(D^*_{s0} \to D_s\pi^0) = (122 \pm 33)\,\mathrm{KeV}/c^2$
- Radiative decays $\longrightarrow \Gamma(D^*_{s0} \to D^*_s\gamma) = (10.1 \pm 4.3)\,\mathrm{KeV}/c^2$
- Predictions: BK and B^*K molecules should exist.
  Radiative decays to $B_s^{(*)}\gamma$ are the best chance for discovery.

$D^*_{s0}(2317)^+$ as $c\bar{s}q\bar{q}$ $(q = u, d)$ tetraquark with $I = 1$, $I_3 = 0$

- It is difficult to satisfy the requirement $\Gamma(D^*_{s0} \to D_s\gamma)/\Gamma(D^*_{s0} \to D\pi^0) < 0.059$ with $I = 0$ tetraquark hypothesis
- Hadronic decays $\longrightarrow \Gamma(D^*_{s0} \to D_s\pi^0) \sim 4 - 5\,\mathrm{MeV}/c^2$
- Radiative decays $\longrightarrow \Gamma(D^*_{s0} \to D^*_s\gamma) \sim 0.8\,\mathrm{KeV}/c^2$
- Predictions: Isospin partners, $\mathbf{z}^{++}$ and $\mathbf{z}^0$, should exist.

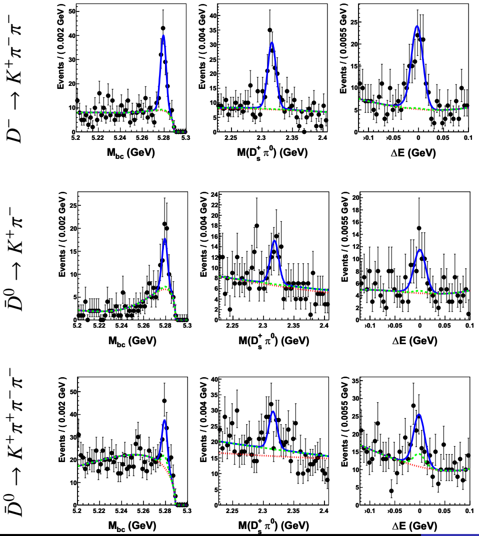
Measurement of $B \to \bar{D}D_{s0}^{*+}(2317)$

Unbinned three-dimensional likelihood fits ($M_{\rm bc}\%\Delta E\%M(D_s^+\pi^0)$) to the selected data

Smooth background: ARGUS $\times\,\mathcal{P}_2$ ($M_{\rm bc}$), $\mathcal{P}_3$ (ΔE and $M(D_s^+\pi^0)$)

Peaking background: $\mathcal{G}(\mu,\sigma_1,\sigma_2)$ ($M_{\rm bc}$), Crystal Ball (ΔE) and $\mathcal{P}_1$ ($M(D_s^+\pi^0)$)

Signal: $\mathcal{G}(\mu,\sigma_1,\sigma_2)$ ($M_{\rm bc}$), Crystal Ball (ΔE) and $\mathcal{G}(\mu,\sigma)$ ($M(D_s^+\pi^0)$))



Phys. Rev. D 91, 092011 (2015) (Belle)

	$\mathcal{B}(B^0 \to D^- D_{s0}^*(2317)^+)\times$ $\mathcal{B}(D_{s0}^*(2317)^+ \to D_s^+\pi^0$, 10^{-3}
Belle'03	$0.86^{+0.33}_{-0.26} \pm 0.26$
BaBar'04	$1.8 \pm 0.4^{+0.7}_{-0.5}$
Belle'15	$1.02^{+0.13}_{-0.12} \pm 0.11$

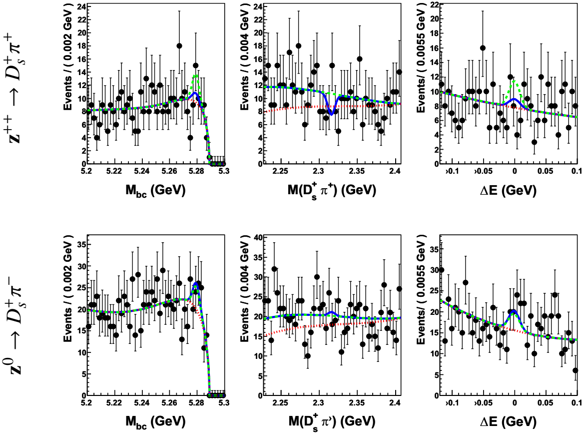
	$\mathcal{B}(B^+ \to \bar{D}^0 D_{s0}^*(2317)^+)\times$ $\mathcal{B}(D_{s0}^*(2317)^+ \to D_s^+\pi^0$, 10^{-3}
Belle'03	$0.81^{+0.30}_{-0.27} \pm 0.24$
BaBar'04	$1.0 \pm 0.3^{+0.4}_{-0.2}$
Belle'15	$0.80^{+0.13}_{-0.12} \pm 0.12$

Search for $\mathbf{z}^{++} \rightarrow D_s^+\pi^+$ & $\mathbf{z}^0 \rightarrow D_s^+\pi^-$

13 three-dimensional likelihood fits $(M_{\rm bc}\%\Delta E\%M(D_s^+\pi^0))$ to the selected data
Scan for $\mathbf{z}^{++}$ and $\mathbf{z}^0$ signals in 13 adjacent mass bins

Smooth background: ARGUS $\times \mathcal{P}_2$ $(M_{\rm bc})$, $\mathcal{P}_3$ (ΔE and $M(D_s^+\pi^0)$)
Peaking background: $\mathcal{G}(\mu,\sigma_1,\sigma_2)$ $(M_{\rm bc})$, Crystal Ball (ΔE) and $\mathcal{P}_1$ $(M(D_s^+\pi^0))$
Signal: $\mathcal{G}(\mu,\sigma_1,\sigma_2)$ $(M_{\rm bc})$, Crystal Ball (ΔE) and $\mathcal{G}(\mu,\sigma)$ $(M(D_s^+\pi^0))$

Phys. Rev. D 91, 092011 (2015) (Belle)
$\Delta M = M_{\rm ctr} - m_{D_{s0}^{*+}}$, $M_{\rm ctr}$ is the center of the 5 MeV mass window



ΔM MeV	$\mathcal{B}^{\rm UL}_{++}$ (10^{-4}) 90% (C.L.)	$\mathcal{B}^{\rm UL}_{0}$ (10^{-4}) 90% (C.L.)
−30	0.52	0.34
−25	0.52	0.69
−20	0.32	0.69
−15	0.25	0.65
−10	0.25	0.66
−5	0.25	0.66
0	0.27	0.64
5	0.28	0.52
10	0.51	0.44
15	0.57	0.43
20	0.56	0.47
25	0.50	0.67
30	0.50	0.65

All $\mathcal{B}^{\rm UL}$ are more than one order of magnitude smaller than tetraquark predictions with $I = 1$

Conclusion

D^{**} production in the $\bar{B}^0 \to D^{*+}\omega\pi^-$ decay

- $\bar{B}^0 \to D^{*+}\omega\pi^-$ decay rate is consistent with the CLEO and BaBar measurements but it has higher precision.
- The measurements show the relative dominance of the broad $D_1(2430)^0$ production in comparison with the narrow $D_1(2420)^0$ (in agreement with HQET studies).
- The significant non-factorizable $\bar{B}^0 \to D_2(2460)^0\omega$ decay rate has been observed.
- The non-factorizable polarizations and partial-wave rates have been measured in the D^{**} sector.
- The first consistent study of the $\rho(770)$ and $\rho(1450)$-states in B meson decays has been performed. An upper limit for the second-class currents has been obtained.

New $B \to \bar{D}D_{s0}^{*+}(2317)$ measurements and search for isospin partners of the $D_{s0}^{*+}(2317)$

- New $B \to \bar{D}D_{s0}^{*+}(2317)$ measurements are consistent with the previous Belle and BaBar results but they have higher precisions.
- 90% C.L. upper limits for the $\mathbf{z}^{++}$ and $\mathbf{z}^0$ decay rates have been obtained. The results are more than one order of magnitude smaller than the $D_{s0}^{*+}(2317)$-tetraquark predictions with $I = 1$.

Backup

Systematics in the $\bar{B}^0 \to D^{*+}\omega\pi^-$ BF

Source	Error (%)
Signal yield, N_S	
—$M(\pi^+\pi^-\pi^0)$ signal region	1.3
—Definition of SCF and CR components	0.9
—ΔE signal shape	2.2
—ΔE background shape	1.3
Signal efficiency, ϵ_S	
—Track reconstruction efficiency	3.9
—π^0 reconstruction efficiency	2.3
—Kaon identification efficiency	0.9
—$\bar{B}^0$ signal decay model	1.1
—MC statistics	0.8
Number of neutral B mesons, N_B	1.4
Secondary branching fractions, $\mathcal{B}_{\text{sec}}$	1.7
Quadratic sum	6.1

Systematics for the $\bar{B}^0 \to D^{*+}\omega\pi^-$ parameters

Contribution	Parameter	Systematic uncertainties		Dominant model uncertainties		
		Background description	Signal region	$A(q^2)$ form factor	r parameter	Mixing effect
$\rho(770)^- D^{*+}$	Resonance fraction, %	$^{+0.8}_{-0.1}$	$+4.9$	$+6.1$	$^{+8.7}_{-24.0}$	-0.9
$\rho(1450)^- D^{*+}$	Mass, MeV/c^2	± 1	$+11$	-17	$^{+1}_{-42}$	0
	Width, MeV/c^2	$^{+2}_{-4}$	$+3$	$+69$	$^{+55}_{-6}$	$+2$
	Resonance fraction, %	± 1.9	-4.4	$+9.9$	$^{+17.4}_{-0.8}$	$+0.7$
	FCC fraction, %	-0.2	-3.6	$+0.3$	$^{+0.3}_{-1.8}$	-0.5
$D_1(2430)^0\omega$	Resonance fraction, %	$+0.1$	$+2.7$	-0.4	$^{+1.1}_{-0.2}$	$+1.3$
	S-wave fraction, %	$^{+4.2}_{-0.7}$	$+0.9$	-0.3	-1.0	$+1.2$
	P-wave fraction, %	$^{+1.2}_{-5.5}$	$+2.1$	-0.3	$^{+2.9}_{-0.1}$	$+0.8$
	D-wave fraction, %	-0.8	$+3.0$	$+0.5$	$^{+0.2}_{-2.0}$	-2.1
	Long. polarization, %	$^{+4.6}_{-1.2}$	-4.4	$+0.4$	$^{+0.6}_{-3.5}$	-1.8
$D_1(2420)^0\omega$	Resonance fraction, %	$+0.2$	$+0.4$	-0.2	$^{+0.0}_{-0.1}$	$+0.5$
	Long. polarization, %	-3.7	-2.0	-0.9	$+2.0$	-2.8
$D_2^*(2460)^0\omega$	Resonance fraction, %	$^{+0.0}_{-0.1}$	0.0	0.0	$^{+0.0}_{-0.1}$	$+0.1$
	Long. polarization, %	$^{+0.2}_{-2.0}$	$+2.0$	$+1.5$	$^{+1.4}_{-0.3}$	-1.5

Systematics in the $B \to \bar{D}D_{s0}^{*+}(2317)$ BF

	$B^0 \to D^- D_{s0}^{*+}$ $D^- \to K\pi\pi$ (%)	$B^+ \to D^0 D_{s0}^{*+}$ $\bar{D}^0 \to K\pi$ (%)	$B^+ \to \bar{D}^0 D_{s0}^{*+}$ $\bar{D}^0 \to K3\pi$ (%)
$D\&D_s^+$ BFs	4.4	4.1	4.7
$N_{B\bar{B}}$	1.4	1.4	1.4
MC model dep.	3.6	2.3	5.9
MC stat.	1.2	1.0	1.4
Particle ID	6.9	5.2	8.4
Tracking	2.1	1.8	2.5
Fit params.	4.4	5.8	4.7
π^0	4.0	4.0	4.0
Quad. sum	10.2	9.4	12.4