

Hadronic B to charm decays



Section Editors

BaBar: Richard Kass

Theory: Martin Beneke

I am still getting up to speed.....

Includes: Branching fractions & angular distributions



+ other D and D^* states (D^*_{01} , D_{11} , etc)



+ other D_s and D_s^* states (D_{s0}^* , D_{s1} , etc)



Does not include CPV analyses

Probably does not include $B \rightarrow$ charmed baryons

Hadronic B to charm decays

Organization

PDG10 is organized in terms of charged & neutral B 's:

For charged B 's the PDG is organized:

D, D^* or D_s modes: $\Gamma_{41} - \Gamma_{172}$ only mesons decay products

Charmonium modes: $\Gamma_{173} - \Gamma_{229}$

Baryon modes: $\Gamma_{405} - \Gamma_{424}$ A few modes contain charm

$\Gamma_{405} D^+ p \bar{p}$ $\Gamma_{417} \Lambda_c^+ \Lambda_c^- K^+$

About 200 different modes (Γ 's) are listed for charged B 's!

About $\frac{3}{4}$ of B decays fall into the Hadronic B to charm category....

BUT we feel that it makes sense to organize as follows:

Final states with 1-charm particle ($D\pi, D^*\pi, D_s\pi, \text{etc}$)

2-body modes (e.g. $D\pi$),

3-body modes (e.g. $D\pi\pi$), etc

Final states with 2 charm particles (DD, DD^*, etc)

2-body modes (e.g. DD)

3-body modes (e.g. DDK), etc

Hadronic B to charm decays

Organization/Outline

I) Introductory remarks

a) Why these decays are "useful" (or annoying)

insight into strong interaction dynamics

provide a tagged (i.e. high purity) sample of B mesons useful for CKM studies

b) challenges to theorists trying to calculate decay rates

c) challenges to the experimentalists in measuring these decay modes

e.g. many modes with small ($<1\%$) branching fractions and high multiplicity

II) Theory overview

brief discussion (or else a very long one) on the models for these decay modes

Classify a few typical decays according to spectator, W -exchange, etc. diagrams

III) Discussion of specific types of final states:

(I think the challenge here is not to just replicate the BR values in the PDG.

In each of the subsections comment on how well the current models "predict" the branching fractions)

IIIa) Decays with a single D decay (D , D^* , D_s)

$W \rightarrow ud$

$W \rightarrow us$

IIIb) Decays with 2 D 's

$W \rightarrow cs$

$W \rightarrow cd$

IIIc) $B \rightarrow$ charmonium X

$W \rightarrow cs$

$W \rightarrow cd$

IIIId) $B \rightarrow$ charm baryon X ??????

Hadronic B to charm decays

Papers (as of 7/2011):

There are a lot of papers on the subject from Belle/BaBar!
list of BaBar & Belle papers in “extra slides” (11 pages)

By the numbers from the BaBar/Belle public pages:

	PRL	PRD/PRD-RC	PLB	~20% of published papers...
BaBar	22	44	0	
Belle	27	34	5	
Total	49	78	5	

The trend is to publish long(er) papers in PRD with several modes

A few papers on the websites are submitted and not yet published

There are also new papers in the pipeline....

Some Issues:

Some BFs have been measured several times by BaBar/Belle ($B \rightarrow D^0 K^*$)

Some modes may be shared or belong to another PBF group:

charm baryons: “Study of inclusive B^- and \bar{B}^0 decays to flavor-tagged D , D_s and Λ_c^+ ”

radiative decays: “Search for the rare decay $B^0 \rightarrow D^* \gamma$ ”

Hadronic B to charm decays

some Progress



Email discussions with Martin B. over outline & content

Uploaded to SVN outline & introduction

Contacted several people to help with sections...

several "too busy"

V. Poireau will help with $D^{(*)}D^{(*)}K$

waiting to hear from others...

will contact more people

I can devote a fair amount of time between now & new year

no teaching...

no DOE stuff

ATLAS off

good excuse to ignore holidays...

14.3 Hadronic B to charm decays

Editors:

Richard Kass (BABAR)

Martin Beneke (theory)

14.3.1 Introduction

B meson decays into all hadronic final states containing charm or charmonium account for almost three quarters of all decays. Despite being the majority of final states these decays pose a challenge to both experiment and theory. The large available phase space in a B meson decay means that there are hundreds of possible final states all with rather small branching fractions, typically a few tenths of a percent. Therefore to study in detail any particular final state a very large sample of B mesons is necessary as well as a detector capable of measuring the energy, momentum, and identity of the final state particles to high precision. Since these are all hadronic final states decay rate calculations must be done using non-perturbative QCD . To date, even the decay rate of the simplest hadronic decay to charm, $B \rightarrow D\pi$, can not be calculated from first principles using QCD .

In spite of the above drawbacks hadronic B decays to charm play an important role in the more glamorous aspects of B physics, i.e. the determination of the CKM parameters, measurements of CP violation, and search for physics beyond the standard model. If for no other reason these decay modes must be measured in order to understand the possible backgrounds involved in a measurement of a CKM parameter. Although the branching fractions here are small it is still possible to collect very clean samples of "tagged" B events using modes such as $B \rightarrow D_s\pi$, $B \rightarrow D^*\pi$, etc. as the "tag." Finally, precision measurements of modes such as $B \rightarrow D^{(*)}\pi$, $D^{(*)}\pi\pi$ can serve as standard candles for precision QCD calculations.

14.3.2 Theory overview

14.3.3 Specific final states

14.3.3.1 Decays with a single D decay (D , D^* , D_s)

$W \rightarrow ud$

$W \rightarrow us$

14.3.3.2 Decays with 2 D 's

$W \rightarrow cd$

Hadronic B to charm decays

Summary



This section is (still) a work in progress.

Coming to grips with scope & amount of information available

15- 20 pages for the section

Some unresolved issues with organization of this section

don't duplicate material in other sections: charmed baryons, $B \rightarrow D^{*0}\gamma$

Could use suggestions for experimentalists to contact for help with (e.g.) DD, charmonium experimentalist experts...

Will touch base with Martin on theory issues



Extra Slides..

Submitted BaBar Papers: From BaBar Public Website-I

https://oraweb.slac.stanford.edu/pls/slacquery/BABAR_DOCUMENTS.DISPATCH?P_TYPE=7&QFCN=INDEX

[PUB-10/018](#) Measurement of $B \rightarrow D^{(*)} D^{(*)} K$ Branching Fractions PRD 83, 032004 (2011)

[PUB-10/001](#) Search for $B^+ \rightarrow D^+ K_S^0$ and $B^+ \rightarrow D^+ K^{*0}$ decays PRD 82, 092006 (2010)

[PUB-08/048](#) Dalitz Plot Analysis of $B^- \rightarrow D^+ \pi^- \pi^-$ PRD 79, 112004 (2009)

[PUB-08/034](#) Observation of $B^0 \rightarrow \chi_{c0} K^{*0}$ and evidence for $B^+ \rightarrow \chi_{c0} K^{*+}$ PRD-RC 78, 091101 (2008)

[PUB-08/030](#) Evidence for $X(3872) \rightarrow \psi(2S) \gamma$ in $B^{+/-} \rightarrow X(3872) K^{+/-}$ Decays, and a Study of $B \rightarrow c\bar{c} \gamma K$ PRL 102, 132001 (2009)

[PUB-08/009](#) Measurement of the branching fractions of the rare decays $B^0 \rightarrow D_s^{(*)+} \pi^-$, $B^0 \rightarrow D_s^{(*)+} \rho^-$, and $B^0 \rightarrow D_s^{(*)-} K^{*+}$ PRD 78, 032005 (2008)

[PUB-08/008](#) Study of B-meson decays to $\eta' K^{(*)}$, $\eta_c(2S) K^{(*)}$ and $\eta_c \gamma K^{(*)}$ PRD 78, 012006 (2008)

[PUB-08/007](#) Study of $B \rightarrow X(3872) K$, with $X(3872) \rightarrow J/\psi \pi^+ \pi^-$ PRD-RC 77, 111101 (2008)

[PUB-07/049](#) Study of resonances in exclusive B decays to $D\bar{D}^{(*)} K$ PRD-RC 77, 011102 (2008)

[PUB-07/044](#) Observation of $Y(3940) \rightarrow J/\psi \omega$ in $B \rightarrow J/\psi \omega K$ at BABAR PRL 101, 082001 (2008)

Submitted BaBar Papers: From BaBar Website-II

[PUB-07/017](#) Branching fraction and charge asymmetry measurements in $B \rightarrow J/\psi \pi \pi$ decays
PRD-RC 76, 031101 (2007)

[PUB-07/009](#) Measurement of decay amplitudes of $B \rightarrow J/\psi K^*$, $\psi(2S) K^*$, and $\chi_{c1} K^*$ with an angular analysis
PRD-RC 76, 031102 (2007)

[PUB-06/066](#) Evidence for the Rare Decay $B^+ \rightarrow D_s^+ \pi^0$ PRL 98, 171801 (2007)

[PUB-06/057](#) Measurement of the absolute branching fractions $B \rightarrow D \pi$, $D^* \pi$, $D^{**} \pi$ with a missing mass method
PRD-RC 74, 111102 (2006)

[PUB-06/046](#) Branching fraction measurement of $B_0^{\text{bar}} \rightarrow D^{(*)+} \pi^-$ and $B^- \rightarrow D^{(*)0} \pi^-$ and isospin analysis of $B^{\text{bar}} \rightarrow D^{(*)} \pi$ decays
PRD-RC 75, 031101 (2007)

[PUB-06/041](#) Search for $B^+ \rightarrow X(3872) K^+$, $X(3872) \rightarrow J/\psi \gamma$
PRD-RC 74, 071101 (2006)

[PUB-06/026](#) Observation of Decays $B_0 \rightarrow D_s^{(*)+} \pi^-$ and $B_0 \rightarrow D_s^{(*)-} K^+$ PRL 98, 081801 (2007)

[PUB-06/021](#) Study of the decay $B_0^{\text{bar}} \rightarrow D^{*+} \omega \pi^-$ PRD 74, 012001 (2006)

[PUB-06/020](#) Study of inclusive B^- and \bar{B}^0 decays to flavor-tagged D , D_s and Λ_c^+
PRD 75, 072002 (2007)

[PUB-06/018](#) Study of $B \rightarrow D^{(*)} D_s(J)^{(*)}$ decays and measurement of D_s^- and $D_s J(2460)^-$ branching fractions
PRD-RC 74, 031103 (2006)

[PUB-06/014](#) Measurement of branching fractions and CP-violating charge asymmetries for B -meson decays to $D^{(*)} D^{(*)\text{bar}}$, and implications for the CKM angle γ
PRD 73, 112004 (2006)

Submitted BaBar Papers: From BaBar Website-III

[PUB-06/013](#) Measurements of the decays $B^0 \rightarrow D^0 \bar{p} p$, $B^0 \rightarrow D^{*0} \bar{p} p$, $B^0 \rightarrow D^- p \bar{p} \pi^+$, and $B^0 \rightarrow D^{*-} p \bar{p} \pi^+$ PRD-RC 74, 051101 (2006)

[PUB-06/003](#) Measurement of the $B^- \rightarrow D^0 K^{*-}$ branching fraction PRD-RC 73, 111104 (2006)

[PUB-06/002](#) Measurement of $B^0 \bar{p} \rightarrow D^{(*)0} K^{(*)0} \bar{p}$ branching fractions PRD-RC 74, 031101 (2006)

[PUB-05/054](#) Measurements of the branching fraction and time-dependent CP asymmetries of $B^0 \rightarrow J/\psi \pi^0$ decays PRD-RC 74, 011101 (2006)

[PUB-05/048](#) Search for the rare decays $B^0 \rightarrow D_s^{(*)+} a_0(2)^-$ PRD-RC 73, 071103 (2006)

[PUB-05/047](#) Search for rare quark-annihilation decays, $B^- \rightarrow D_s^{(*)-} \phi$ PRD-RC 73, 011103 (2006)

[PUB-05/044](#) Search for the W-exchange decays $B^0 \rightarrow D_s^{(*)-} D_s^{(*)+}$ PRD-RC 72, 111101 (2005)

[PUB-05/043](#) Measurement of Branching Fractions and Resonance Contributions for $B^0 \rightarrow D^0 \bar{p} K^+ \pi^-$ and Search for $B^0 \rightarrow D^0 K^+ \pi^-$ Decays PRL 96, 011803 (2006)

[PUB-05/041](#) Measurements of the Absolute Branching Fractions of $B^{+-} \rightarrow K^{+-} X_{cc} \bar{p}$ PRL 96, 052002 (2006)

[PUB-05/038](#) Study of the $X(3872)$ and $Y(4260)$ in $B^0 \rightarrow J/\psi \pi^+ \pi^- K^0$ and $B^- \rightarrow J/\psi \pi^+ \pi^- K^-$ decays PRD-RC 73, 011101 (2006)

[PUB-05/016](#) Measurement of the branching fraction and decay rate asymmetry of $B^- \rightarrow D_{\{\pi^+ \pi^0\}}^- K^-$ PRD-RC 72, 071102 (2005)

[PUB-05/014](#) Search for the rare decays $B^+ \rightarrow D^{(*)+} K^0_s$ 31PRD-RC 72, 011102 (2005)

Submitted BaBar Papers: From BaBar Website-IV

[PUB-05/009](#) Search for the rare decay $B_0\text{bar} \rightarrow D^0 \gamma$ PRD-RC 72, 051106 (2005)

[PUB-05/005](#) Search for $B \rightarrow J/\psi D$ decays PRD-RC 71, 091103 (2005)

[PUB-05/002](#) Measurement of the $B_0 \rightarrow D^{*-} D_s^{*+}$ and $D_{s+} \rightarrow \phi \pi^+$ branching fractions PRD-RC 71, 091104 (2005)

[PUB-04/046](#) Search for Factorization-Suppressed $B \rightarrow \chi_c K^*$ Decays PRL 94, 171801 (2005)

[PUB-04/044](#) Measurement of Branching Fractions and Charge Asymmetries for Exclusive B Decays to Charmonium PRL 94, 141801 (2005)

[PUB-04/043](#) Search for a charged partner of the $X(3872)$ in the B meson decay $B \rightarrow X^- K$, $X^- \rightarrow J/\psi \pi^- \pi^0$ PRD-RC 71, 031501 (2005)

[PUB-04/040](#) Measurement of Branching Fractions and Dalitz Distributions for $B_0 \rightarrow D^{(*)\pm} K_0 \pi^{\mp}$ Decays PRL 95, 171802 (2005)

[PUB-04/033](#) Measurement of Branching Fractions for Inclusive B^- and $B_0\text{bar}$ Decays to Flavor-tagged D , D_s and Λ_c PRD-RC 70, 091106 (2004)

[PUB-04/026](#) Measurement of the ratio $B(B^- \rightarrow D^0 K^-)/B(B^- \rightarrow D^0 \pi^-)$ and of the CP asymmetry of $B^- \rightarrow D^0_{\text{CP}^+} K^-$ decays PRD-RC 71, 031102 (2005)

[PUB-04/024](#) Study of B to $D_{S J}^{(*)+} D\text{bar}^{(*)}$ Decays PRL 93, 181801 (2004)

[PUB-04/011](#) Study of the $B^- \rightarrow J/\psi K^- \pi^+ \pi^-$ decay and measurement of the $B^- \rightarrow X(3872) K^-$ branching fraction. PRD-RC 71, 071103 (2005)

[PUB-03/047](#) Observation of the Decay $B^- \rightarrow J/\psi \eta K$ and Search for $X(3870) \rightarrow J/\psi \eta$ PRL 93, 041801 (2004)

Submitted BaBar Papers: From BaBar Website-V

- [PUB-03/043](#) Branching Fraction Measurements of $B \rightarrow \eta_c K$ decays PRD-RC 70, 011101 (2004)
- [PUB-03/042](#) Study of $B^{+-} \rightarrow J/\psi \pi^{+-}$ and $B^{+-} \rightarrow J/\psi K^{+-}$ Decays: Measurement of the Ratio of Branching Fractions and Search for Direct CP Violation PRL 92, 241802 (2004)
- [PUB-03/035](#) Measurement of the branching fraction for $B^- \rightarrow D^0 K^{*-}$ PRD-RC 69, 051101 (2004)
- [PUB-03/032](#) Measurement of $B^- \rightarrow D^0_{(CP)} K^-$ decays with the BaBar detector PRL 92, 202002 (2004)
- [PUB-03/026](#) Measurement of the Branching Fraction for $B^+ \rightarrow \chi_{c0} K^+$ PRD-RC 69, 071103 (2004)
- [PUB-03/024](#) Measurement of the Branching Fraction and Polarization for the Decay B^- to $D^{*0} K^-$ PRL 92, 141801 (2004)
- [PUB-03/020](#) Measurement of Branching Fractions of Color-Suppressed Decays of the B^0 Meson to $D^{(*)0} \pi^0$, $D^{(*)0} \eta$, $D^{(*)0} \omega$, and $D^0 \eta'$ PRD 69, 032004 (2004)
- [PUB-03/016](#) Measurement of wrong-flavor to right-flavor amplitude ratio in $B \rightarrow J/\psi K^*$ PRL 93, 081801 (2004)
- [PUB-03/010](#) Measurement of the Branching Fractions for the Exclusive Decays of B^0 and B^+ to $D^{(*)} D^{(*)} K$ PRD 68, 092001 (2003)
- [PUB-03/007](#) Evidence for the decay $B^+ \rightarrow J/\psi p^+ \Lambda$ and search for $B^0 \rightarrow J/\psi p^+ p^-$ PRL 90, 231801 (2003)
- [PUB-03/004](#) Measurement of the branching fraction and CP-violating asymmetries in $B^0 \rightarrow D^{*} D$ decays PRL 90, 221801 (2003)
- [PUB-03/001](#) $B^0 \rightarrow D_s^{(*)+} D^{*-}$ Branching Fractions and Polarization with a Partial Reconstruction Technique PRD-RC 67, 092003 (2003)
- [PUB-02/010](#) A study of the rare decays $B^0 \rightarrow D_s^{(*)+} \pi^-$ and $B^0 \rightarrow D_s^{(*)+} K^-$ PRL 90, 181803 (2003)

Submitted BaBar Papers: From BaBar Website-VI

[PUB-02/007](#) Rare B decays to states containing a J/psi meson PRL 91, 071801 (2003)

[PUB-02/006](#) A measurement of the $B^0 \rightarrow J/\psi \pi^+ \pi^-$ branching fraction PRL 90, 091801 (2003)

[PUB-02/004](#) Study of Inclusive Production of Charmonium Mesons in B Decay PRD 67, 032002 (2003)

[PUB-01/024](#) Measurement of the branching fraction and CP content for the decay $B^0 \rightarrow D^{*+} D^{*-}$ PRL 89, 061801 (2002)

[PUB-01/017](#) Measurement of D_s^+ and D_s^{*+} production in B meson decays and from continuum e^+e^- annihilation at $\sqrt{s}=10.6$ GeV PRD-RC 65, 091104 (2002)

[PUB-01/014](#) Measurement of the ratio of branching fractions $BF(B^{+/-} \rightarrow J/\psi \pi^{+/-})/BF(B^{+/-} \rightarrow J/\psi K^{+/-})$ PRD-RC 65, 091101 (2002)

[PUB-01/007](#) Measurement of branching fractions for exclusive B decays to charmonium final states PRD 65, 032001 (2002)

[PUB-01/005](#) Measurement of the $B \rightarrow J/\psi K^*(892)$ decay amplitudes PRL 87, 241801 (2001)

Submitted Belle Papers: From Belle Public Website-I

http://belle.kek.jp/bdocs/b_journal.html

- 341 Study of $B^\pm \rightarrow K^\pm(K_S K \pi)^0$ Decay and Determination of η_c and $\eta_c(2S)$ Parameters
- 340 Observation of $X(3872) \rightarrow J/\psi \gamma$ and search for $X(3872) \rightarrow \psi' \gamma$ in B decays
- 337 Evidence for the Suppressed Decay $B^- \rightarrow DK^-$, $D \rightarrow K^+ \pi^-$ [PRL 106, 231803 \(2011\)](#)
- 336 Observation of $B_s^0 \rightarrow J/\psi f_0(980)$ and Evidence for $B_s^0 \rightarrow J/\psi f_0(1370)$ [PRL 106, 121802 \(2011\)](#)
- 335 Study of the decays $B \rightarrow D_{s1}(2536)^+ \text{ anti-}D^{(*)}$ [PRD 83, 051102\(R\) \(2011\)](#)
- 327 Study of the $K^+ \pi^+ \pi^-$ Final State in $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ and $B^+ \rightarrow \psi\text{-prime } K^+ \pi^+ \pi^-$ [PRD 83.032005\(2011\)](#)
- 323 Measurements of Branching Fractions for $B^0 \rightarrow D_s^+ \pi^-$ and $B^0\text{-bar} \rightarrow D_s^+ K^-$ [PRD 82, 051103\(R\) \(2010\)](#)
- 304 Measurement of the branching fractions for $B^0 \rightarrow D_s^{*+} \pi^-$ and $B^0 \rightarrow D_s^{*-} K^+$ decays [PRD 81, 031101\(R\) \(2010\)](#)
- 302 Study of the $B \rightarrow X(3872)(\rightarrow D^{*0\text{bar}} D^0) K$ decay [PRD 81, 031103 \(2010\)](#)
- 285 Measurement of $B \rightarrow D_s^{(*)} K \pi$ branching fractions [PRD 80, 052005 \(2009\)](#)
- 283 Improved measurement of the polarization and time-dependent CP violation in the decay $B^0 \rightarrow D^{*+} D^{*-}$ [PRD 80, 111104\(R\) \(2009\)](#)
- 274 Evidence for $B^0 \rightarrow \chi_{c1} \pi^0$ at Belle [PRD\(RC\) 78, 091104 \(2008\)](#)
- 268 Observation of $B^{+-} \rightarrow \psi(2S) \pi^{+-}$ and search for direct CP-violation [PRD\(RC\) 78, 051104 \(2008\)](#)
- 267 Observation of two resonance-like structures in the $\pi^+ \chi_{c1}$ mass distribution in exclusive $B^0\text{-bar}$ to $K^- \pi^+ \chi_{c1}$ decays [PRD 78, 072004 \(2008\)](#)
- 262 Search for $B \rightarrow J/\psi \phi$ decays [PRD\(RC\) 78, 011106 \(2008\)](#)

Submitted Belle Papers: From Belle Website-II

- 258 Study of the Suppressed B meson Decay $B^- \rightarrow D K^-$, $D \rightarrow K^+ \pi^-$ [PRD\(R\) 78, 071901 \(2008\)](#)
- 257 Search for $B^+ \rightarrow D^{*+} \pi^0$ decay [PRL 101, 041601 \(2008\)](#)
- 253 Measurement of the branching fraction and charge asymmetry of the decay $B^+ \rightarrow D^+ D_0^-$ and search for $B^0 \rightarrow D^0 D_0^-$ [PRD\(R\) 77, 091101 \(2008\)](#)
- 227 Observation of a new DsJ meson in $B^+ \rightarrow D_0^- D_0^+ K^+$ decays [PRL 100, 092001 \(2008\)](#)
- 219 Measurement of Branching Fraction and Time-Dependent CP Asymmetry Parameters in $B^0 \rightarrow D^{*+} D^{*-} K_s$ Decays [PRD 76, 072004 \(2007\)](#)
- 215 Observation of $B_0^- \rightarrow D_s^+ \Lambda_b^-$ decay [PRD 76, 051102 \(2007\)](#)
- 208 Improved measurement of $B_0^- \rightarrow D_s^- D^+$ and search for $B_0^- \rightarrow D_s^+ D_s^-$ [PRD 75, 091102 \(2007\)](#)
- 195 Observation of the decay $B^0 \rightarrow J/\psi \eta$ [PRL 98, 131803 \(2007\)](#)
- 193 Study of $B_0^- \rightarrow D^0 \pi^+ \pi^-$ decays [PRD 76, 012006 \(2007\)](#)
- 186 Study of decay mechanisms in $B^- \rightarrow \Lambda_c^+ \bar{p} \pi^-$ decay and observation of anomalous structure in the $(\Lambda_c^+ \bar{p})$ system [PRL 97, 242001 \(2006\)](#)
- 184 Search for $B^+ \rightarrow J/\psi \eta' K^+$ and $B^0 \rightarrow J/\psi \eta' K_s$ Decays [PRD 75, 017101 \(2007\)](#)
- 180 Study of the charmed baryonic decays B_0^- to $\Sigma_c^{++} \bar{p} \pi^-$ and B_0^- to $\Sigma_c^0 \bar{p} \pi^+$ [PRD\(RC\) 75, 011101 \(2007\)](#)
- 177 Improved Measurements of Color-suppressed Decays $B_0^- \rightarrow D^0 \pi^0$, $D^0 \eta$, $D^0 \omega$, $D^{*0} \pi^0$, $D^{*0} \eta$ and $D^{*0} \omega$ [PRD 74, 092002 \(2006\)](#)
- 176 Observation of $B^+ \rightarrow \chi_{c1} \pi^+$ and Search for Direct CP Violation [PRD\(RC\) 74, 051103 \(2006\)](#)
- 175 Observation of near-threshold enhancement in the $D^0 D_0^- \pi^0$ invariant mass in $B \rightarrow D^0 D_0^- \pi^0 K$ Decay [PRL 97, 162002 \(2006\)](#)

Submitted Belle Papers: From Belle Website-III

- 170 Search for the h_c meson in $B_{\pm} \rightarrow h_c K_{\pm}$ [PRD 74, 012007 \(2006\)](#)
- 158 Study of $B_{\pm} \rightarrow D_{CP} K_{\pm}$ and $D_{CP}^* K_{\pm}$ decays [PRD 73, 051106\(R\) \(2006\)](#)
- 157 Observation of $B^+ \rightarrow \Lambda_c^+ \Lambda_c^- K^+$ and $B^0 \rightarrow \Lambda_c^+ \Lambda_c^- K^0$ decays [PRL 97, 202003 \(2006\)](#)
- 150 Observation of $B^+ \rightarrow \Xi_c^- \Lambda_c^+$ and Evidence for $B^0 \rightarrow \Xi_c^- \Lambda_c^+$ [PRD\(RC\) 74, 111105](#)
- 147 Measurement of Branching Fractions for $B \rightarrow \chi_{c1}(2) K(K^*)$ at Belle [PLB 634, 155 \(2006\)](#)
- 143 Observation of $B^- \rightarrow J/\psi \Lambda_c^+ \bar{p}$ and searches for $B^- \rightarrow J/\psi \Sigma_c^0 \bar{p}$ and $B^0 \rightarrow J/\psi p \bar{p}$ Decays [PRD 72, 051105\(R\) \(2005\)](#)
- 141 Charm Hadrons from Fragmentation and B decays in e^+e^- Annihilation at $\sqrt{s}=10.6$ GeV [PRD 73, 032002 \(2006\)](#)
- 128 Search for $B^0 \rightarrow J/\psi D_0^+ \bar{p}$ and $B^+ \rightarrow J/\psi D_0^+ \pi^+$ decays [PRD 71, 091107\(R\) \(2005\)](#)
- 121 Evidence for $B^0 \rightarrow D^+ D^-$ and Observation of $B^- \rightarrow D^0 D^-$ and $B^- \rightarrow D^0 D^{*-}$ Decays [PRL 95, 041803 \(2005\)](#)
- 119 Branching Fraction, Polarization and CP -Violating Asymmetries in $B^0 \rightarrow D^{*+} D^{*-}$ Decays [PLB 618, 34 \(2005\)](#)
- 118 Observation of $B \rightarrow D_0 \eta'$ and $B \rightarrow D^{*0} \eta'$ [PRD 72, 011103\(R\) \(2005\)](#)
- 116 Observation of a near-threshold ω - J/ψ mass enhancement in exclusive $B \rightarrow K \omega J/\psi$ decays [PRL 94, 182002 \(2005\)](#)
- 110 Study of the Suppressed Decays $B^- \rightarrow [K^+ \pi^-]_D K^-$ and $B^- \rightarrow [K^+ \pi^-]_D \pi^-$ [PRL 94, 091601\(2005\)](#)
- 108 Observation of $B_0^+ \rightarrow D_s J^{*(2317)+} K^-$ decay [PRL 94, 061802\(2005\)](#)

Submitted Belle Papers: From Belle Website-IV

- 102 Observation of $B^0 \rightarrow D^{*-}(5\pi)^+$, $B^+ \rightarrow D^{*-}(4\pi)^{++}$ and $B^+ \rightarrow D\bar{K}^0(5\pi)^+$ [PRD\(R\)70, 111103\(2004\)](#)
- 81 Observation of $B^+ \rightarrow \psi(3770) K^+$ [PRL93,051803\(2004\)](#)
- 71 Search for $B^- \rightarrow J/\psi \lambda \bar{p}$ [PRD 69, 017101 \(2004\)](#)
- 65 Observation of $D_s J(2317)$ and $D_s J(2457)$ in B decays [PRL 91, 262002 \(2003\)](#)
- 63 Study of $B^- \rightarrow D^{*0} \pi^-(D^{*0} \rightarrow D^{*+} \pi^-)$ decays [PR D69, 112002 \(2004\)](#)
- 58 Measurement of branching fraction ratios and CP asymmetries in $B^{+-} \rightarrow D_{cp} K^{+-}$ [PRD 68, 051101 \(2003\)](#)
- 53 Observation of $B^0 \bar{K}^0 \rightarrow D^0 K^0 \bar{K}^0$ and $B^0 \bar{K}^0 \rightarrow D^0 K^{*0} \bar{K}^0$ decays [PRL 90, 141802 \(2003\)](#)
- 52 Observation of $B^0 \bar{K}^0 \rightarrow \Lambda_c^+ \bar{p}$ decay [PRL 90, 121802 \(2003\)](#)
- 49 Measurement of Branching Fractions and Charge Asymmetries for Two-Body B Meson Decays with Charmonium [PRD 67, 032003 \(2003\)](#)
- 48 Study of $B^0 \bar{K}^0 \rightarrow D^{*0} \pi^+ \pi^-$ Decays [PLB 553, 159 \(2003\)](#)
- 45 Measurement of Branching Fractions for $B \rightarrow \eta_c K^{(*)}$ Decays [PRL 90, 071801 \(2003\)](#)
- 44 Study of Exclusive B Decays to Charmed Baryons [PRD 66, 091102\(R\) \(2002\)](#)
- 40 Observation of $D_s^+ K^-$ and evidence for $D_s^+ \pi^-$ final states in neutral B decays [PRL 89, 231804 \(2002\)](#)
- 38 Observation of $B \rightarrow D^{(*)} K^- K^0$ decays [PLB 542, 171 \(2002\)](#)
- 34 Studies of the Decay $B^{+-} \rightarrow D_{cp} K^{+-}$ [PRL 90, 131803 \(2003\)](#)
- 32 Observation of the decay $B^0 \rightarrow D^{*+} D^{*-}$ [PRL 89, 122001 \(2002\)](#)
- 30 Observation of the $\eta_c(2S)$ in exclusive $B \rightarrow K K_s K^- \pi^+$ decays [PRL 89, 102001 \(2002\)](#)
- 28 Observation of $B^0 \bar{K}^0 \rightarrow D^{*0} p \bar{p}$ [PRL 89, 151802 \(2002\)](#)

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26 Measurements of Branching Fractions and Decay Amplitudes in $B \rightarrow J/\psi K^*$ decays [PLB 538, 11 \(2002\)](#)

23 Observation of χ_{c2} Production in B-meson Decay [PRL 89, 011803 \(2002\)](#)

13 Observation of $B^+ \rightarrow \chi_{c0} K^+$ [PRL 88, 031802 \(2002\)](#)

11 Observation of Color-suppressed $B^0 \rightarrow D^0\pi^0$, $D^{*0}\pi^0$, $D^0\eta$, and $D^0\omega$ Decays [PRL 88, 052002 \(2002\)](#)

7 Observation of $B \rightarrow J/\psi K_1(1270)$ [PRL 87, 161601 \(2001\)](#)

6 Observation of Cabibbo suppressed $B \rightarrow D^{(*)}K^-$ decays at Belle [PRL 87, 111801 \(2001\)](#)