Semileptonic B Decays into Orbitally Excited Charmed Mesons

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Contents

1.- Introduction

1.1.- Overview

- Accuracy on the knowledge of $|V_{cb}|$ and $|V_{ub}|$ demands detailed measurements of b-hadron decays.
- A substantial contribution to the semileptonic decay width of b-hadrons is provided by decays including orbitally excited charmed mesons in their final state.
- Additionally, the analysis of signals and backgrounds of inclusive and exclusive measurements of b-hadron decays calls for an improved understanding of these processes.
- In this scenario, data reported by Belle and BaBar offer new theoretical possibilities to test meson models as far as they include both weak and strong decays.

1.- Introduction

1.2.- Belle and BaBar measurements

	Belle [1] ($\times 10^{-3}$)	BaBar [2,3] ($\times 10^{-3}$)
$D_0^*(2400)$		
$\mathcal{B}(B^+ \to \bar{D}_0^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_0^{*0} \to D^- \pi^+)$	$2.4 \pm 0.4 \pm 0.6$	$2.6 \pm 0.5 \pm 0.4$
$\mathcal{B}(B^0 \to D_0^{*-} l^+ \nu_l)\mathcal{B}(D_0^{*-} \to \bar{D}^0 \pi^-)$	$2.0 \pm 0.7 \pm 0.5$	$4.4 \pm 0.8 \pm 0.6$
$D_1'(2430)$		
$\mathcal{B}(B^+ \to \bar{D}_1^{\prime 0} l^+ \nu_l)\mathcal{B}(\bar{D}_1^{\prime 0} \to D^{*-} \pi^+)$	< 0.7	$2.7 \pm 0.4 \pm 0.5$
$\mathcal{B}(B^0 \to D_1^{\prime -} l^+ \nu_l)\mathcal{B}(D_1^{\prime -} \to \bar{D}^{*0} \pi^-)$	< 5	$3.1 \pm 0.7 \pm 0.5$
$D_1(2420)$		
$\mathcal{B}(B^+ \to \bar{D}_1^0 l^+ \nu_l)\mathcal{B}(\bar{D}_1^0 \to D^{*-} \pi^+)$	$4.2 \pm 0.7 \pm 0.7$	$2.97 \pm 0.17 \pm 0.17$
$\mathcal{B}(B^0 \to D_1^- l^+ \nu_l)\mathcal{B}(D_1^- \to \bar{D}^{*0} \pi^-)$	$5.4 \pm 1.9 \pm 0.9$	$2.78 \pm 0.24 \pm 0.25$
$D_2^*(2460)$		
$\mathcal{B}(B^+ \to \bar{D}_2^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_2^{*0} \to D^- \pi^+)$	$2.2 \pm 0.3 \pm 0.4$	$1.4 \pm 0.2 \pm 0.2^{(*)}$
$\mathcal{B}(B^+ \to \bar{D}_2^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_2^{*0} \to D^{*-} \pi^+)$	$1.8 \pm 0.6 \pm 0.3$	$0.9 \pm 0.2 \pm 0.2^{(*)}$
$\mathcal{B}(B^+ \to \bar{D}_2^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_2^{*0} \to D^{(*)-} \pi^+)$	$4.0 \pm 0.7 \pm 0.5$	$2.3 \pm 0.2 \pm 0.2$
$\mathcal{B}(B^0 \to D_2^{*-} l^+ \nu_l)\mathcal{B}(D_2^{*-} \to \bar{D}^0 \pi^-)$	$2.2 \pm 0.4 \pm 0.4$	$1.1 \pm 0.2 \pm 0.1^{(*)}$
$\mathcal{B}(B^0 \to D_2^{*-} l^+ \nu_l)\mathcal{B}(D_2^{*-} \to \bar{D}^{*0} \pi^-)$	< 3	$0.7 \pm 0.2 \pm 0.1^{(*)}$
$\mathcal{B}(B^0 \to D_2^{*-} l^+ \nu_l)\mathcal{B}(D_2^{*-} \to \bar{D}^{(*)0} \pi^-)$	< 5.2	$1.8 \pm 0.3 \pm 0.1$
$\mathcal{B}_{D/D^{(*)}}$	0.55 ± 0.03	$0.62 \pm 0.03 \pm 0.02$

1 *D. Liventsev et al. (Belle Collab.) Phys.Rev.D**77** 091503 (2008).*

2 *B. Aubert et al. (BaBar Collab.) Phys.Rev.Lett.**101** 261802 (2008).*

3 *B. Aubert et al. (BaBar Collab.) Phys.Rev.Lett.**103** 051803 (2009).*

2.- Theoretical framework

2.1.- Constituent quark model. Main features

- Spontaneous chiral symmetry breaking (Goldstone-Boson exchange):

$$\mathcal{L} = \bar{\psi}\,(i\gamma^{\mu}\partial_{\mu} - MU^{\gamma_5})\,\psi \quad \rightarrow \quad U^{\gamma_5} = 1 + \frac{i}{f_{\pi}}\gamma^{5}\lambda^{a}\pi^{a} - \frac{1}{2f_{\pi}^{2}}\pi^{a}\pi^{a} + \ldots$$

$$M(q^2) = m_q F\left(q^2\right) = m_q\left[\frac{\Lambda^2}{\Lambda^2+q^2}\right]^{1/2}$$

- QCD perturbative effects (One-Gluon Exchange):

$$\mathcal{L} = i\sqrt{4\pi\alpha_s}\,\bar{\psi}\gamma_{\mu}G^{\mu}\lambda^{c}\psi$$

- Confinement (linear screened potential):

$$V_{CON}^{C}(\vec{r}_{ij}) = \left[-a_c(1-e^{-\mu_c r_{ij}}) + \Delta\right](\vec{\lambda}_i^c\cdot\vec{\lambda}_j^c)$$

$$V_{CON}^{C}(\vec{r}_{ij}) = \begin{cases}(-a_c\mu_c r_{ij} + \Delta)\,(\vec{\lambda}_i^c\cdot\vec{\lambda}_j^c) & r_{ij}\rightarrow 0\\ (-a_c+\Delta)(\vec{\lambda}_i^c\cdot\vec{\lambda}_j^c) & r_{ij}\rightarrow\infty\end{cases}$$

2.- Theoretical framework

2.1.- Constituent quark model. Model parameters

Quark masses	m_n (MeV)	313
	m_s (MeV)	555
	m_c (MeV)	1763
	m_b (MeV)	5110
Confinement	a_c (MeV)	507.4
	μ_c (fm^{-1})	0.576
	Δ (MeV)	184.432
	a_s	0.81
One-gluon exchange	α_0	2.118
	Λ_0 (fm^{-1})	0.113
	μ_0 (MeV)	36.976
	$\hat{r}_0$ (fm)	0.181
	$\hat{r}_g$ (fm)	0.259
GBE	taken from Ref. [1]	

[1] *J. Vijande, F. Fernández and A. Valcarce, J. Phys. G* **31**, *481 (2005).*

2.- Theoretical framework

2.1.- Constituent quark model. Wave functions ⇒ HQS vs. CQM

- Meson properties are characterized by the dynamics of the light quark:

$$\vec{j}_q = \vec{L} + \vec{s}_q$$
$$\vec{J} = \vec{j}_q + \vec{s}_Q$$

- P-wave mesons can be grouped into two doublets:

$$j_q = 1/2 \rightarrow J^P = 0^+,\ 1^+$$
$$j_q = 3/2 \rightarrow J^P = 1^+,\ 2^+$$

- Properties
  - doublets are degenerated
  - Strong decays of $D_J(j_q = 1/2)$ proceed only through S-waves ⇒ **Broad states**
  - Strong decays of $D_J(j_q = 3/2)$ proceed only through D-waves ⇒ **Narrow states**

	D_0^*	D_1	D_1'	D_2^*
$^3P_0$	$+$, 1.0000	-	-	-
$^1P_1$	-	$-$, 0.5903	$-$, 0.4097	-
$^3P_1$	-	$+$, 0.4097	$-$, 0.5903	-
$^3P_2$	-	-	-	$+$, 0.99993
$1/2, 0^+$	$+$1.0000	-	-	-
$1/2, 1^+$	-	$+$, 0.0063	$-$0.9937	-
$3/2, 1^+$	-	$+$, 0.9937	$+$0.0063	-
$3/2, 2^+$	-	-	-	$+$, 0.99993
	D_{s0}^*	D_{s1}	D_{s1}'	D_{s2}^*
$^3P_0$	$+$1.0000	-	-	-
$^1P_1$	-	$-$, 0.7210	$-$, 0.1880	-
$^3P_1$	-	$+$, 0.2770	$-$, 0.5570	-
$^3P_2$	-	-	-	$+$0.99991
$1/2, 0^+$	$+$, 1.0000	-	-	-
$1/2, 1^+$	-	$-$, 0.0038	$-$, 0.7390	-
$3/2, 1^+$	-	$+$, 0.9942	$-$, 0.0060	-
$3/2, 2^+$	-	-	-	$+$0.99991

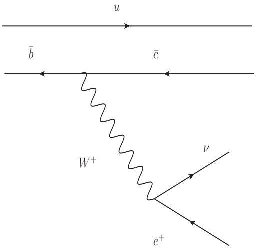
J. Segovia et al., Phys. Rev. D **80**, *054017 (2009).*

2.- Theoretical framework

2.2.- Weak decays

Study of the weak process based on:

- *Weak process at quark level* $\Rightarrow$ *light quark is an spectator.*
- *Helicity formalism allows us to evaluate easier matrix elements.*



- *E. Hernández, J. Nieves and J.M. Verde-Velasco, Phys. Rev. D* **74**, *074008 (2006).*
- *M.A. Ivanov, J.G. Körner and P. Santorelli, Phys. Rev. D* **73**, *054024 (2006).*

2.- Theoretical framework

2.2.- Weak decays (Continuation)

- $\langle D(0^+), \vec{P}_D | J_\mu^{bc}(0) | B(0^-), \vec{P}_B \rangle = P_\mu F_+(q^2) + q_\mu F_-(q^2)$

- $$\langle D(1^+), \lambda \vec{P}_D | J_\mu^{bc}(0) | B(0^-), \vec{P}_B \rangle = \frac{-1}{m_B + m_D} \epsilon_{\mu\nu\alpha\beta} \epsilon_{(\lambda)}^{\nu *}(\vec{P}_D) P^\alpha q^\beta A(q^2)$$
$$- i \left\{ (m_B - m_D) \epsilon^*_{(\lambda)\mu}(\vec{P}_D) V_0(q^2) - \frac{P \cdot \epsilon^*_{(\lambda)}(\vec{P}_D)}{m_B + m_D} \left[P_\mu V_+(q^2) + q_\mu V_-(q^2) \right] \right\}$$

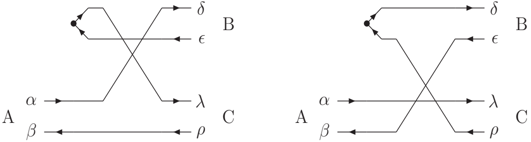
- $$\langle D(2^+), \lambda \vec{P}_D \left| J_\mu^{bc}(0) \right| B(0^-) \vec{P}_B \rangle = \epsilon_{\mu\nu\alpha\beta} \epsilon_{(\lambda)}^{\nu\delta *}(\vec{P}_D) P_\delta P^\alpha q^\beta T_4(q^2)$$
$$- i \left\{ \epsilon^*_{(\lambda)\mu\delta}(\vec{P}_D) P^\delta T_1(q^2) + P^\nu P^\delta \epsilon^*_{(\lambda)\nu\delta}(\vec{P}_D) \left[P_\mu T_2(q^2) + q_\mu T_3(q^2) \right] \right\}$$

F_+, F_-, A, V_0, V_+, V_- and T_1 are dimensionless, whereas T_2, T_3 and T_4 have dimension of E^{-2}.

2.- Theoretical framework

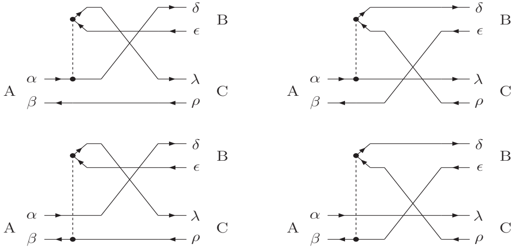
2.3.- Strong decays

- $^3P_0$ decay model



$$H_I = g \int d^3x \, \bar{\psi}(\vec{x}) \, \psi(\vec{x})$$

- Microscopic decay model



$$H_I = \frac{1}{2} \int d^3x \, d^3y \, J^a(\vec{x}) \, K(|\vec{x} - \vec{y}|) \, J^a(\vec{y})$$

2.- Theoretical framework

2.3.- Strong decays (Continuation)

- $^3P_0$ *decay model*
  - *L. Micu, Nucl. Phys. B* **10**, *521 (1969)*
  - *A. Le Yaouanc, L. Olivier, O. Pène, and J.C. Raynal, Phys. Rev. D* **8**, *2223 (1973)*
  - *R. Bonnaz, and B. Silvestre-Brac, Few-Body Syst.* **27**, *163 (1999)*

- *Microscopic decay model*
  - *E. Eichten et al. Phys. Rev. D* **17** *3090 (1978);* **21** *203 (1980)*
    → update: Phys. Rev. D **73** *014014 (2006)*
  - *E.S. Ackleh et al. Phys. Rev. D* **54**, *6811 (1996)*
  - *Yu.A. Simonov arXiv:1103.4028v1 [hep-ph] 21 Mar 2011*
  - *Bao-Fei Li et al. arXiv:1105.1620v1 [hep-ph] 9 May 2011*

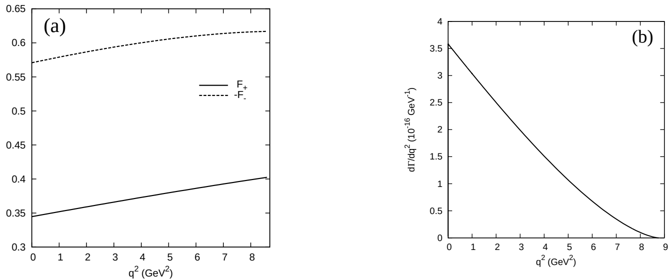
$$\Gamma_{A\to BC} = 2\pi \frac{E_B E_C}{M_A k_0} \sum_{J_{BC},l} |\mathcal{M}_{A\to BC}(k_0; J_{BC}, l)|^2$$

$$\mathcal{M}_{A\to BC} = M_{A\to BC} + (-1)^{l_B + l_C - l_A + J_B + J_C - J_{BC} + l} M_{A\to CB}$$

$$M_{A\to BC} = \mathcal{I}_{color}\ \mathcal{I}_{flavor}\ (\mathcal{I}_{signature}\ \mathcal{I}_{spin-space})$$

3.- Results. Semileptonic B decays

3.1.- Semileptonic $B \to D_0^* l \nu_l$ decay



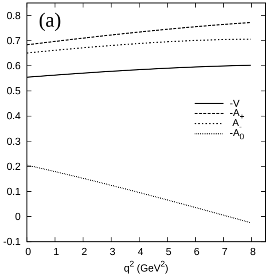
- Semileptonic decay widths

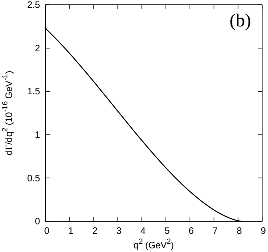
$$\Gamma(B^+ \to \bar{D}_0^{*0} l^+ \nu_l) = 1.2975 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^+ \to \bar{D}_0^{*0} l^+ \nu_l) = 3.2292 \times 10^{-3}$$
$$\Gamma(B^0 \to D_0^{*-} l^+ \nu_l) = 1.1626 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^0 \to D_0^{*-} l^+ \nu_l) = 2.6937 \times 10^{-3}$$

Only one open-charm decay $\Rightarrow \mathcal{B}(\bar{D}_0^{*0} \to D^- \pi^+) = \mathcal{B}(D_0^{*-} \to \bar{D}^0 \pi^-) = 2/3$

3.- Results. Semileptonic B decays

3.2.- Semileptonic $B \to D_1' l \nu_l$ decay





- Semileptonic decay widths

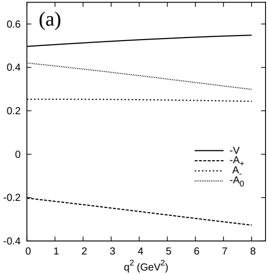
$$\Gamma(B^+ \to \bar{D}_1'^0 l^+ \nu_l) = 0.7947 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^+ \to \bar{D}_1'^0 l^+ \nu_l) = 1.9778 \times 10^{-3}$$

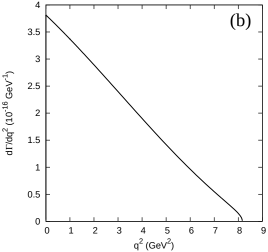
$$\Gamma(B^0 \to D_1'^- l^+ \nu_l) = 0.7952 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^0 \to D_1'^- l^+ \nu_l) = 1.8424 \times 10^{-3}$$

Only one open-charm decay $\Rightarrow \mathcal{B}(\bar{D}_1'^0 \to D^{*-}\pi^+) = \mathcal{B}(D_1'^- \to \bar{D}^{*0}\pi^-) = 2/3$

3.- Results. Semileptonic B decays

3.3.- Semileptonic $B \to D_1 l \nu_l$ decay





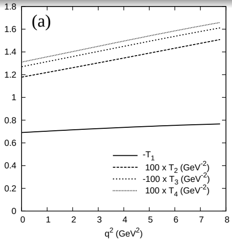
- Semileptonic decay widths

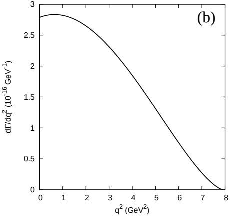
$$\Gamma(B^+ \to \bar{D}_1^0 l^+ \nu_l) = 1.5490 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^+ \to \bar{D}_1^0 l^+ \nu_l) = 3.8552 \times 10^{-3}$$
$$\Gamma(B^0 \to D_1^- l^+ \nu_l) = 1.5445 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^0 \to D_1^- l^+ \nu_l) = 3.5785 \times 10^{-3}$$

Only one open-charm decay $\Rightarrow \mathcal{B}(\bar{D}_1^0 \to D^{*-}\pi^+) = \mathcal{B}(D_1^- \to \bar{D}^{*0}\pi^-) = 2/3$

3.- Results. Semileptonic B decays

3.4.- Semileptonic $B \to D_2^* l \nu_l$ decay





- Semileptonic decay widths
  $\Gamma(B^+ \to \bar{D}_2^{*0} l^+ \nu_l) = 1.3388 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^+ \to \bar{D}_2^{*0} l^+ \nu_l) = 3.3320 \times 10^{-3}$
  $\Gamma(B^0 \to D_2^{*-} l^+ \nu_l) = 1.3454 \times 10^{-15}\,\mathrm{GeV} \Rightarrow \mathcal{B}(B^0 \to D_2^{*-} l^+ \nu_l) = 3.1172 \times 10^{-3}$
- Some results about strong decays

B	Exp.	$^3P_0$	Microscopic
$\frac{\Gamma(D_2^{*+} \to D^0 \pi^+)}{\Gamma(D_2^{*+} \to D^{*0} \pi^+)}$	$1.9 \pm 1.1 \pm 0.3$	1.80	1.97
$\frac{\Gamma(D_2^{*0} \to D^+ \pi^-)}{\Gamma(D_2^{*0} \to D^{*+} \pi^-)}$	1.56 ± 0.16	1.82	1.97
$\frac{\Gamma(D_2^{*0} \to D^+ \pi^-)}{\Gamma(D_2^{*0} \to D^{(*)+} \pi^-)}$	$0.62 \pm 0.03 \pm 0.02$	0.64	0.66

3.- Results. Semileptonic B decays

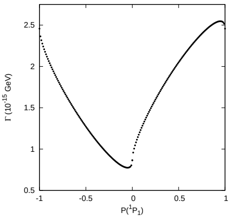
3.5.- Comparison with experiment

	Belle ($\times 10^{-3}$)	BaBar ($\times 10^{-3}$)	$^3P_0$ ($\times 10^{-3}$)	Mic. ($\times 10^{-3}$)
$D_0^*(2400)$				
$\mathcal{B}(B^+ \to \bar{D}_0^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_0^{*0} \to D^- \pi^+)$	$2.4 \pm 0.4 \pm 0.6$	$2.6 \pm 0.5 \pm 0.4$	2.1528	2.1528
$\mathcal{B}(B^0 \to D_0^{*-} l^+ \nu_l)\mathcal{B}(D_0^{*-} \to \bar{D}^0 \pi^-)$	$2.0 \pm 0.7 \pm 0.5$	$4.4 \pm 0.8 \pm 0.6$	1.7958	1.7958
$D_1^{\prime}(2430)$				
$\mathcal{B}(B^+ \to \bar{D}_1^{\prime 0} l^+ \nu_l)\mathcal{B}(\bar{D}_1^{\prime 0} \to D^{*-} \pi^+)$	< 0.7	$2.7 \pm 0.4 \pm 0.5$	1.3185	1.3185
$\mathcal{B}(B^0 \to D_1^{\prime -} l^+ \nu_l)\mathcal{B}(D_1^{\prime -} \to \bar{D}^{*0} \pi^-)$	< 5	$3.1 \pm 0.7 \pm 0.5$	1.2283	1.2283
$D_1(2420)$				
$\mathcal{B}(B^+ \to \bar{D}_1^0 l^+ \nu_l)\mathcal{B}(\bar{D}_1^0 \to D^{*-} \pi^+)$	$4.2 \pm 0.7 \pm 0.7$	$2.97 \pm 0.17 \pm 0.17$	2.5701	2.5701
$\mathcal{B}(B^0 \to D_1^- l^+ \nu_l)\mathcal{B}(D_1^- \to \bar{D}^{*0} \pi^-)$	$5.4 \pm 1.9 \pm 0.9$	$2.78 \pm 0.24 \pm 0.25$	2.3857	2.3857
$D_2^*(2460)$				
$\mathcal{B}(B^+ \to \bar{D}_2^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_2^{*0} \to D^- \pi^+)$	$2.2 \pm 0.3 \pm 0.4$	$1.4 \pm 0.2 \pm 0.2^{(*)}$	1.4338	1.4744
$\mathcal{B}(B^+ \to \bar{D}_2^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_2^{*0} \to D^{*-} \pi^+)$	$1.8 \pm 0.6 \pm 0.3$	$0.9 \pm 0.2 \pm 0.2^{(*)}$	0.7877	0.7470
$\mathcal{B}(B^+ \to \bar{D}_2^{*0} l^+ \nu_l)\mathcal{B}(\bar{D}_2^{*0} \to D^{(*)-} \pi^+)$	$4.0 \pm 0.7 \pm 0.5$	$2.3 \pm 0.2 \pm 0.2$	2.2215	2.2214
$\mathcal{B}(B^0 \to D_2^{*-} l^+ \nu_l)\mathcal{B}(D_2^{*-} \to \bar{D}^0 \pi^-)$	$2.2 \pm 0.4 \pm 0.4$	$1.1 \pm 0.2 \pm 0.1^{(*)}$	1.3373	1.3778
$\mathcal{B}(B^0 \to D_2^{*-} l^+ \nu_l)\mathcal{B}(D_2^{*-} \to \bar{D}^{*0} \pi^-)$	< 3	$0.7 \pm 0.2 \pm 0.1^{(*)}$	0.7406	0.7001
$\mathcal{B}(B^0 \to D_2^{*-} l^+ \nu_l)\mathcal{B}(D_2^{*-} \to \bar{D}^{(*)0} \pi^-)$	< 5.2	$1.8 \pm 0.3 \pm 0.1$	2.0779	2.0779
$\mathcal{B}_{D/D^{(*)}}$	0.55 ± 0.03	$0.62 \pm 0.03 \pm 0.02$	0.6454	0.6638

4.- Results. Semileptonic B_s decays

4.1.- Main properties

- The structure of the doublet $j_q = 1/2$ is still unknown:
  - Their masses are about 100 MeV below of the theoretical predictions and are situated just below the DK and D^*K thresholds.
  - Decay width for the $B_s^0 \to D_{s1}(2460)^- \mu^+ \nu_\mu$ decay as a function of the probability of $^1P_1$ partial wave:



- The mesons belonging to the doublet $j_q = 3/2$ appears to be $c\bar{s}$ states:
  - Following J. Vijande *et al.* Phys. Rev. D **73**, 034002 (2006), the Ref. J. Segovia *et al.* Phys. Rev. D **80**, 054017 (2009) explains the structure, mass and the strong decays of $D_{s1}(2536)$
  - Strong decay properties for D_{s2}^*:

$\mathcal{B}$	$^3P_0$	Microscopic
$D_{s2}^{*-} \to D^{*-}\bar{K}^0$	0.0470	0.0302
$D_{s2}^{*-} \to D^-\bar{K}^0$	0.4530	0.4698
$\frac{\Gamma(D_{s2}^* \to DK)}{\Gamma(D_{s2}^* \to D^{(*)}K)}$	0.9060	0.9396

4.- Results. Semileptonic B_s decays

4.2.- Comparison with experiment

	Experiment ($\times 10^{-3}$)	Theory ($\times 10^{-3}$)	
$D_{s0}^*(2318)$			
$\mathcal{B}(B_s^0 \to D_{s0}^*(2318)^- \mu^+ \nu_\mu)$	-	4.4282	
$D_{s1}(2460)$			
$\mathcal{B}(B_s^0 \to D_{s1}(2460)^- \mu^+ \nu_\mu)$	-	$1.74 - 5.70$	
$D_{s1}(2536)$		$^3P_0$	Mic.
$\mathcal{B}(B_s^0 \to D_{s1}(2536)^- \mu^+ \nu_\mu)\mathcal{B}(D_{s1}(2536)^- \to D^{*-} \bar{K}^0)$	2.4 ± 0.7	2.0491	2.2397
$D_{s2}^*(2573)$		$^3P_0$	Mic.
$\mathcal{B}(B_s^0 \to D_{s2}^*(2573)^- \mu^+ \nu_\mu)\mathcal{B}(D_{s2}^*(2573)^- \to D^- \bar{K}^0)$	-	1.7047	1.7680
$\mathcal{B}(B_s^0 \to D_{s2}^*(2573)^- \mu^+ \nu_\mu)\mathcal{B}(D_{s2}^*(2573)^- \to D^{*-} \bar{K}^0)$	-	0.1769	0.1136
$\mathcal{B}(B_s^0 \to D_{s2}^*(2573)^- \mu^+ \nu_\mu)\mathcal{B}(D_{s2}^*(2573)^- \to D^{(*)-} \bar{K}^0)$	-	1.8816	1.8816

5.- Summary and conclusions

- We have studied semileptonic B (B or B_s) decays into orbitally excited charmed mesons (D or D_s)
- These data offer new theoretical possibilities to test meson models as far as they include weak and strong processes
- Weak decays: Studied within spectator aproximation and in the helicity formalism.
- Strong decays: We study these processes within the context of the $^3P_0$ and microscopic models
- The predictions for B semileptonic decays into $D_0^*(2400)$, $D_1(2420)$ and $D_2^*(2460)$ are in good agreement with the latest experimental measurements. In the case of $D_1'(2430)$ the prediction lies a factor of two below BaBar data. However there is a disagreement between BaBar and Belle data.
- In the case of B_s semileptonic decays, our prediction for the product of branching fractions $\mathcal{B}(B_s^0 \to D_{s1}(2536)^- \mu^+ \nu_\mu)\mathcal{B}(D_{s1}(2536)^- \to D^{*-}\bar{K}^0)$ agrees with the experimental data. We also give predictions for decays into other D_s^{**} mesons which can be useful to test the $q\bar{q}$ nature of these states.