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Abstract

Using the ARGUS detector at the e^+e^- storage ring DORIS II at DESY, we have made two measurements of the mixing parameter χ_d using kaons as flavour tags. Using D^{*+} $K^\pm$ correlations we found $\chi_d = 0.20 \pm 0.13 \pm 0.12$ and from the study of $(D^{*+}\ell^-)$ $K^\pm$ correlations we obtained $\chi_d = 0.19 \pm 0.07 \pm 0.09$. The branching ratio for $B \to D^{*+}$ X has been updated: $Br(\bar{B} \to D^{*+}$ $X) = (19.6 \pm 1.9)\%$. We have also determined the average multiplicity of charged kaons in B^0 decays to be 0.78 ± 0.08.

In this paper, we exploit the possibility of tagging the B meson flavour from the charge of the kaon coming from the $c \to s$ transition. The motivation comes from the measurement of the number of kaons in $\Upsilon(4S)$ decays [1], which indicates that making use of kaons for flavour tagging provides much higher statistics than the lepton tagging technique. In the first method, D^{*+} $K^\pm$ [1] correlations are studied in an attempt to extract a value for the mixing parameter χ_d. The flavour of one of the B mesons is tagged from the charge of the D^* meson, while for the other B meson the charge of the kaon is used. As a by-product of the analysis, the inclusive branching ratio for D^{*+} production in B decays is updated. In the second method, the flavour of one of the B mesons is tagged in the decay $\bar{B}^0 \to D^{*+}\ell^-\nu$ using partial D^{*+} reconstruction as in [2]. However, whereas in the previous analysis [2] the flavour of the other B meson was tagged using the charge of the lepton originating from the semileptonic B decay, here, in order to achieve a larger sample, the charge of the kaon coming from the $b \to c \to s$ decay is used. Using the sample of B^0 mesons tagged in the $\bar{B}^0 \to D^{*+}\ell^-\nu$ decay we are able to measure the inclusive charged kaon production rate in B^0 decays.

The data used for this analysis were taken on the $\Upsilon(4S)$ resonance and in the nearby continuum using the ARGUS detector at the e^+e^- storage ring DORIS II. The integrated luminosity used in this analysis is $246pb^{-1}$, corresponding to 209000 ± 9500 $B\overline{B}$ pairs. The ARGUS detector, its trigger requirements and identification capabilities are described in detail elsewhere [3].

Particle identification is based on a likelihood ratio calculated from measurements of specific ionization and time-of-flight for the allowed mass hypotheses (e,μ,π,K and p). Each particle is used as a pion or kaon if the corresponding likelihood ratio exceeds 1%. For lepton identification, the size and lateral spread of the associated energy deposition in the calorimeter, or the quality of the match between the projected particle track and associated hits in the muon chambers located outside the magnet return yoke are included in the calculation of the electron and muon likelihood ratios respectively. In particular, for muons, at least one hit in an outer layer of muon chambers is required. An electron or muon hypothesis was accepted if the appropriate

[1] Throughout this work whenever reference to a specific charge state is made, the charge conjugate state is also implied, unless mentioned otherwise.

likelihood ratio exceeded 70% and the lepton polar angle satisfied the requirement $|\cos\theta_\ell| < 0.9$. Converted photons were rejected by excluding all e^+e^- pairs with mass less than 100 MeV/c^2, as well as e^+e^- pairs from secondary vertices.

For this analysis, events were required to have at least 5 charged tracks originating from the interaction region and to contain no track with momentum greater than 3.0 GeV/c which is the kinematical limit for tracks originating from B decays.

D^{*+} mesons were reconstructed through the decay modes:

$$D^{*+} \longrightarrow D^0\,\pi^+, \quad D^0 \to K^-\,\pi^+ \qquad (1) \qquad\qquad \text{and} \qquad\qquad D^{*+} \longrightarrow D^0\,\pi^+, \quad D^0 \to K^-\,\pi^+\,\pi^+\,\pi^- \qquad (2)$$

D^0 candidates from the decays (1) and (2) had to have a mass lying within 40 MeV/c^2 and 30 MeV/c^2, respectively, of the nominal D^0 mass. It was further required that the D^{*+} candidate have a scaled momentum $x_{p_{D^*}} < 0.5$, where $x_{p_{D^*}}$ is defined as $x_{p_{D^*}} = \frac{|\vec{p}_{D^*}|}{p_{max}}$ and $p_{max} = \sqrt{(E_{cms}/2)^2 - M_{D^*}^2}$. This $x_{p_{D^*}}$ cut enriches the sample with D^* mesons coming from B decays since $x_p = 0.5$ is approximately the upper kinematical limit for B meson daughter particles. The contribution from continuum events was determined using data collected at energies below the $\Upsilon(4S)$ resonance, taking into account the difference in cross sections and collected luminosities.

The inclusive branching ratios for D^{*+} were then calculated from

$$Br(\bar{B} \to D^{*+}\,X) \;=\; \frac{N_{D^{*+}}}{N_B \cdot Br(D^{*+} \to D^0\pi^+) \cdot Br(D^0 \to (i)) \cdot \eta_i},$$

where $(i) = K^-\pi^+$ or $K^-\pi^+\pi^+\pi^-$, respectively. $N_{D^{*+}}$ is the number of events resulting from the fit of the invariant mass spectra for $D^0\pi^+$ combinations and η_i the D^{*+} reconstruction efficiency for the corresponding decay modes. Using the CLEO measurement [4] for $Br(D^{*+} \to D^0\,\pi^+) = (68.1\ \pm 1.0\ \pm 1.3)\%$ and for the D^0 decays $Br(D^0 \to K^-\pi^+) = (4.01 \pm 0.14)\%$ and $Br(D^0 \to K^-\pi^+\pi^+\pi^-) = (8.1 \pm 0.5)\%$ as given in [5], the following values were obtained for the branching ratio :

$$Br(\bar{B} \to D^{*+}\,X) = (19.8 \pm 1.4 \pm 1.6 \pm 0.8)\%$$

for D^* mesons reconstructed via decay mode (1) and

$$Br(\bar{B} \to D^{*+}\,X) = (18.6 \pm 2.7 \pm 3.5 \pm 1.2)\%$$

for D^* mesons reconstructed via decay mode (2). The second systematic error quoted above is the propagated error on $Br(D^{*+} \to D^0\pi^+)$ and the D^0 meson decay branching ratio.

These measurements lead to a combined average value of

$$Br(\bar{B} \to D^{*+}\,X) = (19.6 \pm 1.9)\%.$$

The result is in good agreement with published measurements by ARGUS [6] and CLEO [7], when the same branching ratios for D^{*+} and D^0 are applied. This value is obtained using a superset of the data in [6] and replaces that result.

Events with a D^{*+} candidate were further required to have at least one kaon which has momentum $0.2 \le p_K \le 0.8$ GeV/c and a combined likelihood ratio for the kaon hypothesis, determined by dE/dx and TOF measurements, exceeding 80%. The kaon used to reconstruct the D^* candidate was not selected as a $K^\pm$ candidate for B tagging. To suppress background from $D^{*+}\,K^\pm$ combinations where both particles come from the same B meson, a cut was applied on the angle between the D^{*+} and the $K^\pm$, $\cos\theta(D^{*+}K^\pm) > -0.5$.

To study $D^{*+}\,K^\pm$ correlations, one has to take into account that both the charged D^* and the charged kaon are not "perfect" flavour tags. In B^0 meson decays, a certain fraction of "wrong" charged D^* mesons is also produced due to the fragmentation of the quark pair created by the virtual W from the $b \to c$ transition. For the same reason, and also due to the decays of higher excited $D^*_{(J)}$ states produced in B meson decays, a number of $D^{*\pm}$ mesons arising from the decay of the $B^\pm$ is also present. Therefore, exact knowledge of the $D^{*\pm}$ and kaon production rates is important.

Since there exists no experimental information on these production rates, the corresponding values from the Monte Carlo simulation are used in this study. Semileptonic B meson decays are simulated according to the GISW model [8], using the measured branching ratios into D, D^* and D^{**} mesons, while the WBS model [9] is used for semileptonic D meson decays. Hadronic two body decays are implemented with their measured branching ratios [5]. Other hadronic decays are generated as multibody phase space, using the flavour contents as predicted in the spectator model. For this purpose, a number of consistency checks were performed. The D^{*+} meson momentum spectrum obtained for $B\bar{B}$ events from data was compared to the one derived from the simulation and is shown in Figure 1a. The latter also includes D^{*+} meson production arising from the virtual W. The kaon momentum spectrum obtained for $B\bar{B}$ events from the data was also compared to the Monte Carlo simulation (Figure 1b). Good agreement between the data and the simulation was observed for both the D^{*+} and the kaon momentum spectra. In addition, the charged kaon multiplicity in B decays in the simulation is 1.54 kaons per $\Upsilon(4S)$ decay, in good agreement with the measured value of 1.56 ± 0.06 [1]. For the D^{*+} and $K^\pm$ production rates the values used are hence taken from the Monte Carlo simulation and are presented in Tables 1 and 2 respectively.

To extract the mixing parameter χ_d using $D^{*+}\,K^\pm$ correlations the ratio of events with a

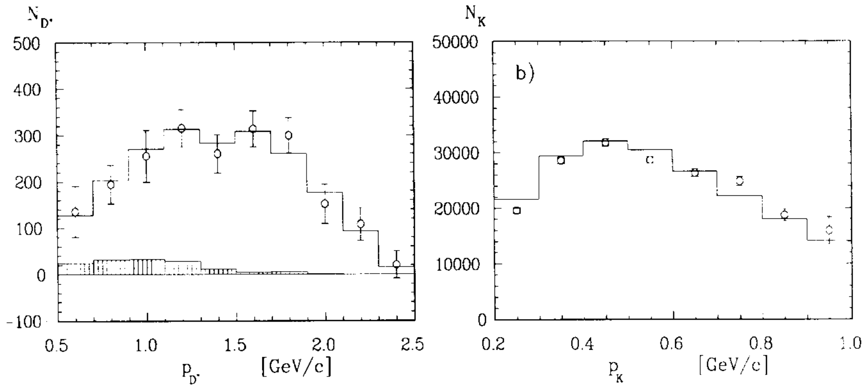


Figure 1: a)Efficiency corrected momentum spectrum for charged D^* mesons produced in B decays as obtained from data (points with error bars) and through Monte Carlo simulation (histogram). The momentum distribution of the D^{*+} mesons coming from the virtual W for Monte Carlo simulated events is also shown (hatched histogram). b) comparison of the kaon momentum spectrum extracted from the data (points with error bars) and from the Monte Carlo simulation (histogram).

Decay modes	$B^0, B^+ \to D^{*+}X$	:	$B^0 \to D^{*-}X$	:	$B^+ \to D^{*-}X$
Ratio of branching ratios	0.05 ± 0.03	:	1	:	0.28 ± 0.11

Table 1: Ratio of branching ratios for the different D^{*+} production mechanisms. The error on the contribution from D^{*+} mesons coming from the virtual W was estimated using the branching ratio reported in [10] for the decay $B \to D_s^+ X$ and the contribution of the two body component resulting from the fit of the D_s x_p spectrum.

Decay modes	$B^0, B^+ \to K^-X$	:	$B^0 \to K^+X$	:	$B^+ \to K^+X$
Ratio of branching ratios	0.21 ± 0.04	:	0.82 ± 0.17	:	1

Table 2: $K^\pm$ production rates considered for this analysis. The error quoted corresponds to the systematic uncertainty due to the different momentum spectra predicted for right and wrong charge kaons and the influence of the momentum dependence of the acceptance in the selected momentum interval. This effect is included in the systematic error.

D^{*+} meson accompanied by a K^- or a K^+, $N(D^{*+}K^-)/N(D^{*+}K^+)$, must be calculated:

$$\frac{N(D^{*+}K^-)}{N(D^{*+}K^+)} = \frac{N^+_{+-} + (1-\chi_d)\cdot N^0_{+-} + \chi_d \cdot N^0_{++}}{N^+_{++} + (1-\chi_d)\cdot N^0_{++} + \chi_d \cdot N^0_{+-}} \quad (1)$$

where N^+_{++}, N^+_{+-}, N^0_{++} and N^0_{+-} are the numbers of same and opposite sign D^{*+} $K^\pm$ combinations coming from charged and neutral B mesons respectively, in the absence of mixing. These numbers depend on the products of the branching ratios for the processes $B^{0,+} \to D^{*+,-}X$ and $B^{0,+} \to K^{+,-}X$ [11]. Using the values presented in Tables 1 and 2 for these ratios, χ_d can be expressed as:

$$\chi_d = 2.57 \cdot \frac{N(D^{*+}K^-)/N(D^{*+}K^+)}{1 + N(D^{*+}K^-)/N(D^{*+}K^+)} - 0.63 \quad (2)$$

The number $N(D^{*+}K^\pm)$ was extracted by fitting the invariant mass distribution of the D^{*+} candidates for events having a tagged kaon which fulfils the selection requirements noted above. After subtracting the continuum contribution, the invariant mass spectra shown in Figures 2 and 3 for the cases where the D^{*+} is reconstructed through the channels $D^0(\to K\pi)\pi$ and $D^0(\to K3\pi)\pi$, respectively, were obtained.
The fits yield

$$N_{D^{*+}K^-} = 54 \pm 12$$
$$N_{D^{*+}K^+} = 116 \pm 15$$

for decay channel (1) and

$$N_{D^{*+}K^-} = 68 \pm 25$$
$$N_{D^{*+}K^+} = 132 \pm 27$$

when decay channel (2) is used.

From these yields one has to subtract the contribution from events with a D^{*+} accompanied by a fake kaon. The hard likelihood cut applied on the kaon hypothesis guarantees that the fake rate is very low. For the momentum interval considered here, only $\pi - K$ misidentification needs to be taken into account. The $\pi - K$ fake rate was estimated using pions from K_s^0 mesons with reconstructed secondary vertices and found to contribute no greater than one event to each of the numbers yielded by the fit. After subtraction of these contributions, the D^{*+} yields quoted above transform to the following values for the ratio $N(D^{*+}K^-)/N(D^{*+}K^+)$:

$$\frac{N(D^{*+}K^-)}{N(D^{*+}K^+)} = 0.46 \pm 0.12$$

when reconstructing the D^{*+} through decay channel (1) and

$$\frac{N(D^{*+}K^-)}{N(D^{*+}K^+)} = 0.52 \pm 0.22$$

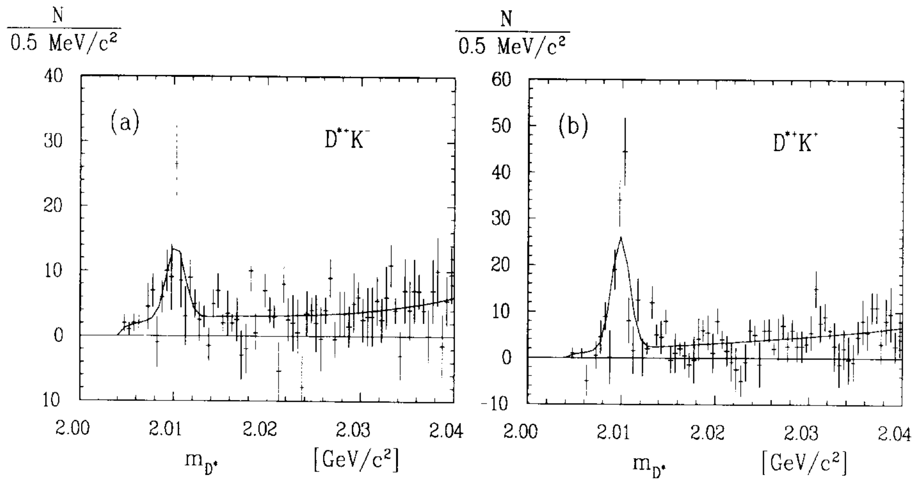


Figure 2: Invariant mass spectra for $D^0\pi^+$ combinations accompanied by a K^- (a) or K^+ (b) for continuum subtracted $\Upsilon(4S)$ events. The D^0 is reconstructed through its $K\pi$ decay channel.

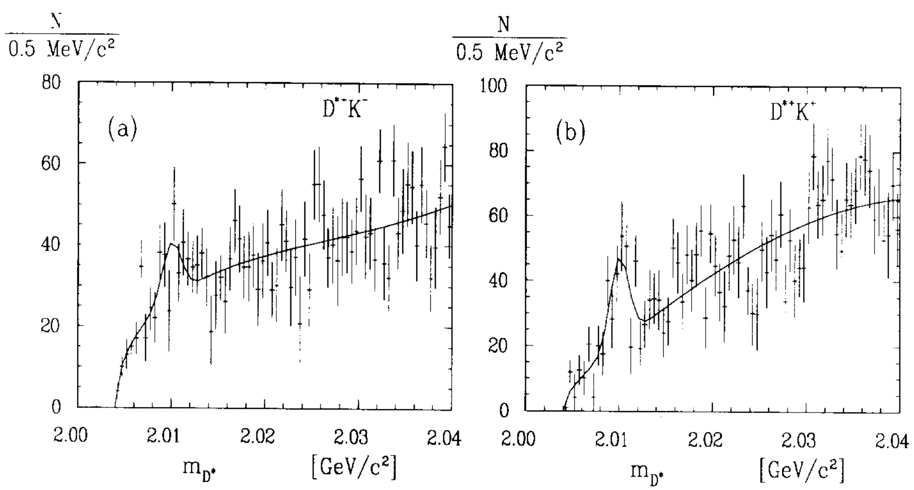


Figure 3: Invariant mass spectra for $D^0\pi^+$ combinations accompanied by a K^- (a) or K^+ (b) for continuum subtracted $\Upsilon(4S)$ data. The D^0 was reconstructed via the $K3\pi$ decay channel.

when decay channel (2) is used for the D^{*+} reconstruction.

Averaging these two values, the ratio obtained is:

$$\frac{N(D^{*+}K^-)}{N(D^{*+}K^+)} = 0.47 \pm 0.11$$

which in turn, using equation (2), leads to the following value for χ_d:

$$\chi_d = 0.20 \pm 0.13 \pm 0.12$$

The largest contribution to the systematic error is the uncertainty in the fraction of D^{*+} mesons originating from the virtual W, as given in 1. Also included are uncertainties in the background estimation and fitting procedure, the influence of the cut on the difference of the mass of the D^0 candidate from the nominal D^0 mass, the production ratio for right charged $D^*_{(J)}$ and D^*, and the branching ratio for the processes $(B^0, B^+ \rightarrow K^+ \text{ or} K^- X)$. For the last contribution, the branching ratios for the processes $B \rightarrow D^\pm X$, $D^+ \rightarrow K^+ X$, $D^+ \rightarrow K^- X$ and $B \rightarrow D^0, \bar{D}^0 X$, $D^0 \rightarrow K^+ X$, $D^0 \rightarrow K^- X$ obtained from Monte Carlo were compared with the ones reported in [5] and were found to be in good agreement. A change of 20% in these branching ratios was made to account for a 1σ variation of the product of branching ratios $Br(B \rightarrow D^+ X) \cdot Br(D^+ \rightarrow K^+ \text{ or } K^- X)$ and $Br(B \rightarrow D^0 X) \cdot Br(D^0 \rightarrow K^+ \text{ or } K^- X)$ and the resulting difference was accounted for in the systematic error.

Better knowledge of the $K^\pm$, $D^{*\pm}$ production rates in B decays would result in a significant reduction of the error on the background which arises from "wrong" charge tags and would strongly reduce the systematic uncertainty of the result.

The second method to measure the $B^0\bar{B}^0$ mixing parameter χ_d is based on tagging one B meson in the $\bar{B}^0 \rightarrow D^{*+}\ell^-\bar{\nu}$ mode. The flavour of the other B meson is tagged using the charge of the daughter kaon.

In order to reconstruct a B^0 meson in the decay mode $B^0 \rightarrow D^{*-}\ell^+\nu$, the partial reconstruction technique described in detail in [2] was used. This technique takes advantage of the fact that B^0 mesons are produced almost at rest in $\Upsilon(4S)$ decays. The neutrino is unobserved but can be inferred from the D^* and ℓ kinematical quantities. Neglecting the momentum of the B meson, the recoil mass squared against the $D^{*+}\ell^-$ system, M^2_{recoil}, should be consistent with zero:

$$M^2_{recoil} = (E_{beam} - E_{D^*} - E_\ell)^2 - (\vec{p}_{D^*} + \vec{p}_\ell)^2.$$

Here, only the slow π^+ from the decay $D^{*+} \rightarrow D^0\pi^+$ is used and the D^0 is not reconstructed. The D^{*+} momentum is derived from the slow pion momentum according to:

$$p_{D^*} = \alpha p_\pi + \beta$$

with $\alpha = 8.23$ and $\beta = 0.41\ GeV/c$ [2]. A lepton with momentum $1.4 \leq p_\ell \leq 2.5\ GeV/c$ and a pion with momentum $p_\pi \leq 200\ MeV/c$ were selected. An additional tagging kaon with momentum lying in the interval $0.2 \leq p_K \leq 0.8\ GeV/c$ and combined likelihood ratio for the kaon hypothesis exceeding 80% was required. To extract the mixing parameter using $(D^*\ell)K$ correlations the number of events with $(D^{*-}\ell^+)K^\pm$, $N((D^{*-}\ell^+)\ K^\pm)$, must be calculated:

$$\frac{N((D^{*-}\ell^+)\ K^+)}{N((D^{*-}\ell^+)\ K^+) + N((D^{*-}\ell^+)\ K^-)} =$$

$$\frac{[(1-\chi_d)\cdot Br(B^0 \to K^-) + \chi_d \cdot Br(B^0 \to K^+)]}{Br(B^0 \to K^\pm)}. \quad (3)$$

Using the values presented in Table 2 for the branching ratios $(B \to K^\pm X)$, χ_d is given by:

$$\chi_d = 1.71 \cdot \frac{N((D^{*-}\ell^+)\ K^+)/N((D^{*-}\ell^+)\ K^-)}{1 + N((D^{*-}\ell^+)\ K^+)/N((D^{*-}\ell^+)\ K^-)} - 0.36. \quad (4)$$

To extract the mixing parameter χ_d, the M^2_{recoil} distribution for $\ell^+ - \pi^-$ combinations accompanied by a K^- or by a K^+ was studied. Using Monte Carlo simulation, the shape of the uncorrelated background for $(\ell^+ - \pi^-)$ accompanied by a K^-/K^+ was compared with the recoil mass distribution obtained for wrong-charge combinations $(\ell^+ - \pi^+)K^-/K^+$. By this means it was found that $(\ell^+ - \pi^+)K^-$ and $(\ell^+ - \pi^+)K^+$ combinations provide a good description of the shape of the uncorrelated background for the $(\ell^+ - \pi^-)K^+$ and $(\ell^+ - \pi^+)K^-$ samples respectively.

The peak at recoil masses $M^2_{rec} > -2.0\ GeV^2/c^4$ also contains contributions from background sources of the type:

$$B_1 \longrightarrow D^*_{(J)}\ \ell^-\ \bar\nu \quad \text{and} \quad B_2^0 \to K^+/K^-X$$
$$\quad \hookrightarrow D^{*+}\pi$$

and

$$\bar B_1 \longrightarrow D^{*+}\ell^-\ \bar\nu X \quad \text{and} \quad B_2 \to \text{anything}$$
$$\quad \hookrightarrow D^0\pi^+$$
$$\qquad \hookrightarrow K^+/K^-X$$

The first source is taken into account when performing the fit of the M^2_{recoil} distributions. The contribution from the second background source can be estimated and depends on the branching ratio for $D^0 \to K^\pm\ X$. However, the current values for $Br(D^0 \to K^\pm X)$ taken from the PDG [5] and reported from the MARK III Collaboration [12] are not in agreement. This difference produces a large systematic uncertainty because the number of background events cannot be

estimated reliably due to its strong dependence on the value assumed for $Br(D^0 \to K^\pm X)$. Therefore, suppression of these background events is important. For this purpose, a cut on the angle between the slow π and the selected K must be applied. Monte Carlo studies show that requiring events with $\cos\theta(\pi, K) < 0.5$ results in a significant reduction of this background. Hence, only events with $\cos\theta(\pi, K) < 0.5$ were selected. The remaining contribution was taken into account when performing the fit to the signal observed in the recoil mass spectra.

To extract $N((D^{*-}\ell^+)K^+)$ and $N((D^{*-}\ell^+)K^-)$ the relative contributions to the D^{*+} and $D^*_{(J)}$ need to be taken into account when constructing the fitting algorithm. One also needs to consider the dependence on the different $B \to K^\pm X$ branching ratios.

The fit, shown in Figure 4, yielded for $\bar B^0_1 \to D^{*+}\ell^-\bar\nu$:

$$N\ ((\ell^+ - \pi^-)\ K^+) = 380 \pm 31$$
$$\text{and} \quad N\ ((\ell^+ - \pi^-)\ K^-) = 412 \pm 37.$$

These numbers are valid only for the D^{*+} channel.

To estimate the number of pions which are misidentified as kaons, the recoil mass spectrum for $(\ell^+ - \pi^-)$ combinations accompanied by a pion was examined for different intervals of the π momentum. The numbers resulting from the fit were then multiplied with the fake rate for each momentum interval separately and the results summed to give the fake kaon contribution.

Background from events where both the π and the K originate from the same D^* meson is still present, despite the angle requirement $\cos\theta(\pi, K) < 0.5$. Use of Monte Carlo simulation was made in order to find the fraction of background events that survive the angular cut applied. The contribution from these events to the signal was estimated using

$$N(\bar B^0 \to \ell^-\bar\nu D^{*+}(D^{*+} \to \pi^+ D^0)(D^0 \to K^+ \text{ or } K^-X))$$
$$= N_{D^{*+}_{\text{fit}}} \cdot (Br(D^0 \to K^+X) \text{ or } Br(D^0 \to K^-X)) \cdot \eta_K, \quad (5)$$

where $N_{D^{*+}_{\text{fit}}}$ is the number of D^{*+} mesons resulting from the fit of $(\ell^+ - \pi^-)$ combinations. Using equation (5) with the kaon efficiency $\eta_K = 0.365$, we found 192 ± 12 background events contributing to $N((\ell^+ - \pi^-)K^+)$ and 14 ± 1 background events contributing to $N((\ell^+ - \pi^-)K^-)$. MARK III [12] values are used for the D^0 decays: $Br(D^0 \to K^-X) = (60.9 \pm 3.2 \pm 5.2)\%$ and $Br(D^0 \to K^+X) = (2.8 \pm 0.9 \pm 0.4)\%$

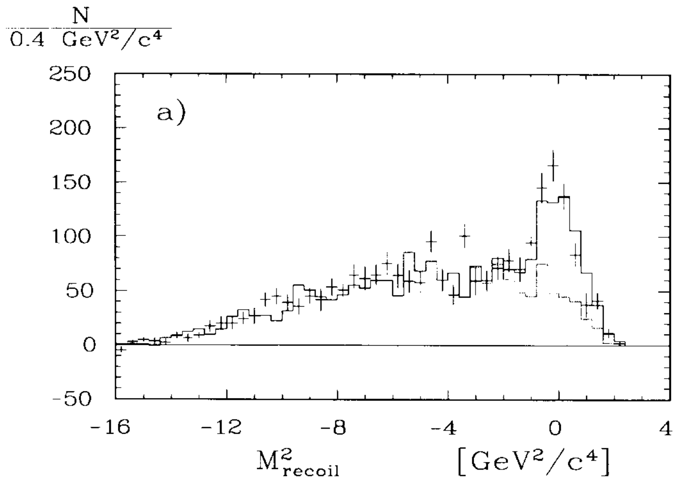
The results are summarized in Table 3:

These yields give:

$$\frac{N((\ell^+ - \pi^-)\ K^+)}{N((\ell^+ - \pi^-)\ K^-)} = 0.47 \pm 0.09$$

which in turn, using equation (4), transforms to the following value for χ_d:

$$\chi_d = 0.19 \pm 0.07 \pm 0.07 \pm 0.05.$$



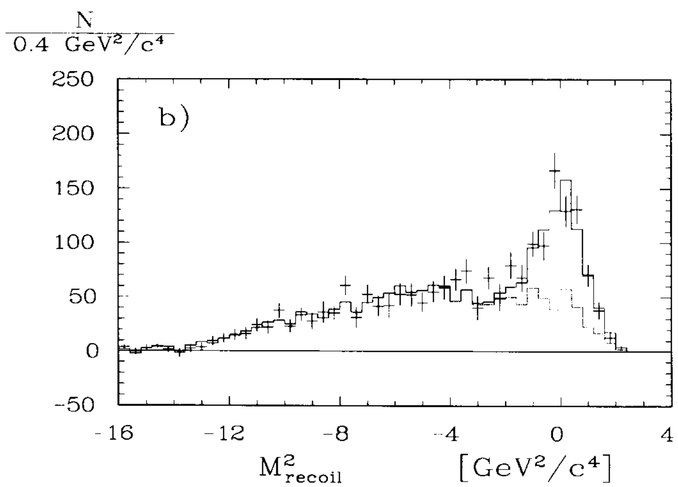


Figure 4: M^2_{recoil} spectra (points with error bars) for $\ell^+ - \pi^-$ combinations a) accompanied by a K^+, and b) accompanied by a K^-. The result of the fit (histogram) as well as the expected background contribution (dotted histogram) estimated using $(\ell^+ - \pi^+)K$ combinations are also indicated.

	$N((\ell^+ - \pi^-)\ K^+)$	$N((\ell^+ - \pi^-)\ K^-)$
$\Upsilon(4S)$ – *Continuum(scaled)*	380 ± 31	412 ± 37
Fakes	3.7 ± 0.3	3.0 ± 0.3
estimated background	192 ± 12	14 ± 1
resulting yields for $\bar{B}^0 \to D^{*+}\ell^-\bar{\nu}$	184 ± 33	395 ± 37

Table 3: Observed numbers of events and backgrounds

The first systematic error includes uncertainties in the background estimation and fitting procedure, the ratio of $D^*_{(J)}$ to D^* contributions, the branching ratio for the processes ($B^{0,+} \to K^+$ or K^- X) and the influence of the $\cos\theta(\pi, K)$ cut. The last error reflects the uncertainty on the branching ratio for the processes $D^0 \to K^{\pm}X$.

The values obtained for the mixing parameter χ_d using kaon tagging are in good agreement with previous ARGUS [13], [14], [2] and CLEO [15], [16] measurements.

The measurement of χ_d obtained with the second method, and the value of χ_d reported in [2] which was extracted by tagging one of the B^0 mesons in the decay $\bar{B}^0 \to D^{*+}\ell^-\bar{\nu}$ and employing lepton tagging for the flavour of the other B meson, were averaged, resulting in:

$$\chi_d = 0.17 \pm 0.06.$$

Correlations have been determined using Monte Carlo samples following [17], and are taken into account in the error. The measurement performed by investigating $D^{*+}\ K^{\pm}$ correlations was not considered because of the small statistical significance of the result.

The value extracted for χ_d can be converted to x_d using the relation $x_d^2 = \frac{2\chi_d}{1-2\chi_d}$. Thus the mixing x_d is determined:

$$x_d = 0.70 \pm 0.18.$$

In addition using the sample of B^0 mesons tagged in the $\bar{B}^0 \to D^{*+}\ell^-\bar{\nu}$ mode we can make a measurement of the average multiplicity of charged kaons in neutral B meson decays. This can be estimated from:

$$N_{K^{\pm}} = \frac{N((\ell^+ - \pi^-)\ K^{\pm}) \cdot (4/3)}{N(\ell^+ - \pi^-) \cdot \eta_K}, \quad (6)$$

where $N_{K^{\pm}}$ is the number of $K^{\pm}$ per B^0 meson. The factor 4/3 is used to account for the angular cut applied and $N(\ell^+ - \pi^-) = N_{D^{*+}_{fit}}$. We find the average multiplicity of charged kaons in B^0 meson decays to be 0.78 ± 0.08.

In summary, we have made two measurements of $B^0\bar{B}^0$ mixing, both using the charge of the kaon to tag the flavour content of the parent B meson. For the mixing parameter χ_d we obtained

the values: $\chi_d = 0.20 \pm 0.13 \pm 0.12$ and $\chi_d = 0.19 \pm 0.07 \pm 0.07 \pm 0.05$, from a study of $D^{*+} K^{\pm}$ and $(D^{*+} \ell^-)\ K^{\pm}$ correlations respectively. The main advantage of this kaon tagging technique is the higher statistics provided. The main drawback is that the experimental information currently available on kaon rates is very limited. However, this situation could improve in the near future as the number of fully reconstructed B mesons becomes larger, thus making inclusive measurements of the type $\bar{B} \to K^+ X$ and $\bar{B} \to K^- X$ possible.
In addition, we found $Br(\bar{B} \to D^{*+}\ X)$ to be $(19.6 \pm 1.9)\%$. Finally, using the sample of tagged B^0 mesons in the $\bar{B}^0 \to D^{*+} \ell^- \bar{\nu}$ mode, the average multiplicity of charged kaons in B^0 meson decays was found to be 0.78 ± 0.08.

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