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Improved measurement of *CP* observables in $B^{\pm} \rightarrow D^0_{CP} K^{\pm}$ decays

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We present a study of the decay $B^-\to D^0_{(CP)}K^-$ and its charge conjugate, where $D^0_{(CP)}$ is reconstructed in both a non-CP flavor eigenstate and in CP (CP-even and CP-odd) eigenstates, based on a sample of 382 million $\Upsilon(4S)\to B\overline{B}$ decays collected with the *BABAR* detector at the PEP-II e^+e^- storage ring. We measure the direct CP asymmetries $A_{CP\pm}$ and the ratios of the branching fractions $R_{CP\pm}$: $A_{CP+} = 0.27 \pm 0.09(\text{stat}) \pm 0.04(\text{syst})$, $A_{CP-} = -0.09 \pm 0.09(\text{stat}) \pm 0.02(\text{syst})$, $R_{CP+} = 1.06 \pm 0.10(\text{stat}) \pm 0.05(\text{syst})$, $R_{CP-} = 1.03 \pm 0.10(\text{stat}) \pm 0.05(\text{syst})$. We also express the results in terms of the so called Cartesian coordinates x_+, x_-, and r^2: $x_+ = -0.09 \pm 0.05(\text{stat}) \pm 0.02(\text{syst})$, $x_- = 0.10 \pm 0.05(\text{stat}) \pm 0.03(\text{syst})$, $r^2 = 0.05 \pm 0.07(\text{stat}) \pm 0.03(\text{syst})$. These results will help to better constrain the phase parameter $\gamma = \arg(-V_{ud}V^*_{ub}/V_{cd}V^*_{cb})$ of the Cabibbo-Kobayashi-Maskawa quark mixing matrix.

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The angle $\gamma = \arg(-V_{ud}V_{ub}^*/V_{cd}V_{cb}^*)$ is one of the least precisely known parameters of the corresponding unitarity triangle of the Cabibbo-Kobayashi-Maskawa matrix [1]. There are many proposals on how to measure γ involving charged B decays. The $B^-\rightarrow D^{(*)0}K^{(*)-}$ decay mode [2], which exploits the interference between $b \rightarrow c\bar{u}s$ and $b \rightarrow u\bar{c}s$ decay amplitudes, is one of the most important of these [3, 4]. In this paper we use a theoretically clean measurement technique suggested by Gronau, London, and Wyler (GLW). It exploits the interference between $B^-\rightarrow D^0K^-$ and $B^-\rightarrow \overline{D}{}^0K^-$ decay amplitudes, where the D^0 and $\overline{D}{}^0$ mesons decay to the same *CP* eigenstate [3]. We express the results in terms of the commonly used ratios $R_{CP\pm}$ of charge-averaged partial rates and of the partial-rate charge asymmetries $A_{CP\pm}$,

$$R_{CP\pm} = \frac{\Gamma(B^-\rightarrow D^0_{CP\pm}K^-) + \Gamma(B^+\rightarrow D^0_{CP\pm}K^+)}{\left[\Gamma(B^-\rightarrow D^0K^-) + \Gamma(B^+\rightarrow \overline{D}{}^0K^+)\right]/2}\,, \quad (1)$$

$$A_{CP\pm} = \frac{\Gamma(B^-\rightarrow D^0_{CP\pm}K^-) - \Gamma(B^+\rightarrow D^0_{CP\pm}K^+)}{\Gamma(B^-\rightarrow D^0_{CP\pm}K^-) + \Gamma(B^+\rightarrow D^0_{CP\pm}K^+)}\,. \quad (2)$$

Here, $D^0_{CP\pm} = (D^0 \pm \overline{D}{}^0)/\sqrt{2}$ are the *CP* eigenstates of the neutral D meson system, following the notation in Ref. [5]. Neglecting D^0–$\overline{D}{}^0$ mixing [6], the observables $R_{CP\pm}$ and $A_{CP\pm}$ are related to the angle γ, the magnitude ratio r of the amplitudes for the processes $B^-\rightarrow \overline{D}{}^0K^-$ and $B^-\rightarrow D^0K^-$, and the relative strong phase δ of these amplitudes through the relations $R_{CP\pm} = 1 + r^2 \pm 2r\cos\delta\cos\gamma$ and $A_{CP\pm} = \pm 2r\sin\delta\sin\gamma/R_{CP\pm}$ [3]. Theoretical predictions for r are on the order of 0.1 [3], in agreement with recent results by *BABAR* ($r = 0.091 \pm 0.059$ [7]) and Belle ($r = 0.159 \pm 0.074$ [8]), obtained through the study of $B^-\rightarrow D^0K^-$, $D^0 \rightarrow K^+\pi^-\pi^0$ and $D^0 \rightarrow K^0_S\pi^+\pi^-$ decays.

This analysis, based on 348 fb^{-1} of data collected at the $\Upsilon(4S)$ resonance, updates a previous *BABAR* study based on 211 fb^{-1} of data [9]. Belle recently presented a similar measurement of $R_{CP\pm}$ and $A_{CP\pm}$ based on 251 fb^{-1} of data [10].

The ratios $R_{CP\pm}$ are computed under the assumption $R_{CP\pm} = R_\pm/R$, which holds neglecting a factor of $r_\pi \lesssim 0.012$ as discussed later. The quantities R_+, R_-, and R are defined as:

$$R_{(\pm)} = \frac{\mathcal{B}(B^-\rightarrow D^0_{(CP\pm)}K^-) + \mathcal{B}(B^+\rightarrow \overline{D}{}^0_{(CP\pm)}K^+)}{\mathcal{B}(B^-\rightarrow D^0_{(CP\pm)}\pi^-) + \mathcal{B}(B^+\rightarrow \overline{D}{}^0_{(CP\pm)}\pi^+)}\,. \quad (3)$$

Several systematic uncertainties affect the D^0K and $D^0\pi$ final states in the same way and therefore cancel in the double ratios R_{CP+} and R_{CP-}, for instance the uncertainties on charged particle reconstruction efficiencies, and the uncertainties on the secondary branching ratios of the D^0 decays. We express the *CP*-sensitive observables in terms of three independent quantities x_+, x_-, and r:

$$x_\pm = \frac{R_{CP+}(1 \mp A_{CP+}) - R_{CP-}(1 \mp A_{CP-})}{4}\,, \quad (4)$$

$$r^2 = x_\pm^2 + y_\pm^2 = \frac{R_{CP+} + R_{CP-} - 2}{2}\,, \quad (5)$$

where $x_\pm = r\cos(\delta \pm \gamma)$ and $y_\pm = r\sin(\delta \pm \gamma)$ are the so called Cartesian coordinates related to the *CP* parameters that are measured using a Dalitz analysis of $B^-\rightarrow D^0K^-$, $D^0 \rightarrow K^0_S\pi^-\pi^+$ decays [8, 11]. This choice allows the results of the two measurements to be expressed in a consistent manner.

The measurements use a sample of 382 million $\Upsilon(4S)$ decays into $B\overline{B}$ pairs collected with the *BABAR* detector [12] at the PEP-II asymmetric-energy B factory. Charged-particle tracking is provided by a five-layer double-sided silicon vertex tracker and a 40-layer drift chamber (DCH). A ring-imaging Cherenkov detector (DIRC) provides additional particle identification (PID). Photons are identified by the electromagnetic calorimeter (EMC), which is comprised of 6580 thallium-doped CsI crystals. These systems are mounted inside a 1.5 T solenoidal superconducting magnet. We use the GEANT [13] software to simulate interactions of particles traversing the detector, taking into account the varying accelerator and detector conditions.

We reconstruct $B^-\rightarrow D^0h^-$ decays, where the prompt track h^- is either a kaon or a pion. The D^0 candidates are reconstructed in the *CP*-even eigenstates $\pi^-\pi^+$ and K^-K^+ (D^0_{CP+}), in the *CP*-odd eigenstates $K^0_S\pi^0$ and $K^0_S\omega$ (D^0_{CP-}), and in the (non-*CP*) flavor eigenstate $K^-\pi^+$. The ω candidates are reconstructed in the $\pi^-\pi^+\pi^0$ channel, and K^0_S candidates in the $\pi^+\pi^-$ channel. Compared to the previous analysis [9], the current study does not include the decay mode $D^0 \rightarrow K^0_S\phi$, since it is going to be explored by a *BABAR* Dalitz analysis of $B^- \rightarrow D^0K^-$, $D^0 \rightarrow K^0_SK^+K^-$ decays. Excluding the $K^0_S\phi$ channel from the present analysis will allow the results of both studies to be more easily combined in the future.

We optimize our event selection to minimize the statistical error on the $B^-\rightarrow D^0K^-$ signal yield, determined for each D^0 decay channel using simulated signal and background events. We reject a candidate track if its Cherenkov angle does not agree within four standard deviations (σ) with either the pion or kaon hypothesis [14], or if it is identified as an electron by the DCH and the EMC. Neutral pions are reconstructed by combining pairs of photon candidates with energy deposits larger than 30 MeV that are not matched to charged tracks. The photon pair invariant mass is required to be in the range 115–150 MeV/c^2 and the total π^0 energy must be greater than 200 MeV in the laboratory frame. To improve momentum resolution, the invariant mass of the two photons from candidate π^0's is constrained to the nominal π^0 mass [14]. Neutral kaons are reconstructed from pairs of oppositely charged tracks with invariant mass within 7.8 MeV/c^2 ($\sim 3\,\sigma$) of the nominal K^0_S mass. The ratio between the candidate K^0_S flight length and its uncertainty must be greater than 2. The ω mesons are reconstructed from $\pi^+\pi^-\pi^0$ combinations with invariant mass in the range $0.763 < M(\pi^+\pi^-\pi^0) < 0.799$ GeV/c^2. We define θ_N as the angle between the normal to the ω decay plane and the D^0 momentum in the ω rest frame, and $\theta_{\pi\pi}$ as the angle between the flight direction of one of the three pions in the ω rest frame and the flight direction of one of the other two pions in the two-pion rest frame. The quantities $\cos\theta_N$ and $\cos\theta_{\pi\pi}$ follow $\cos^2\theta_N$ and $\sin^2\theta_{\pi\pi}$ distributions for the signal and are almost flat for wrongly reconstructed or false ω candidates. We require the product $\cos^2\theta_N \sin^2\theta_{\pi\pi} > 0.08$. The invariant mass of a D^0 candidate $M(D^0)$ must be within $2.5\,\sigma$ of the mean fitted mass, with σ ranging from 4 to 20 MeV/c^2 depending on the D^0 decay mode. To improve the D^0 momentum resolution, the candidate invariant mass is then constrained to the nominal D^0 mass [14] for all D^0 decay channels. For $D^0\to\pi^-\pi^+$, the invariant mass of the $(h^-\pi^+)$ system, where π^+ is the pion from the D^0 and h^- is the prompt track from B^- taken with the kaon mass hypothesis [14], must be greater than 1.9 GeV/c^2 to reject background from $B^-\to D^0\pi^-$, $D^0\to K^-\pi^+$ and $B^-\to K^{*0}\pi^-$, $K^{*0}\to K^-\pi^+$ decays. We reconstruct B meson candidates by combining a D^0 candidate with a track h. For the $D^0\to K^-\pi^+$ mode, the charge of the track h must match that of the kaon from the D^0 meson decay, selecting $b\to c$ mediated B decays.

We select B meson candidates using the energy difference $\Delta E = E^*_B - E^*_{ee}/2$ and the beam-energy-substituted mass $m_{\rm ES} = \sqrt{(E^{*2}_{ee}/2 + \mathbf{p}_{ee}\cdot\mathbf{p}_B)^2/E^2_{ee} - p^2_B}$, where the subscripts ee and B refer to the initial e^+e^- system and the B candidate, respectively, and the asterisk denotes the e^+e^- center-of-mass (CM) frame. The $m_{\rm ES}$ distributions for $B^-\to D^0h^-$ signals are Gaussian functions centered at the B mass with a resolution of 2.6 MeV/c^2, and do not depend on the D^0 decay mode or on the nature of the prompt track. In contrast, the ΔE distributions depend on the mass assigned to the prompt track. We evaluate ΔE with the kaon mass hypothesis so that the peaks of the distributions are centered near zero for $B^-\to D^0K^-$ events and shifted by approximately 50 MeV for $B^-\to D^0\pi^-$ events. The ΔE resolution depends on the momentum resolutions of the D^0 meson and the prompt track h^-, and is typically 16 MeV for all D^0 decay modes under study. All B candidates are selected with $m_{\rm ES}$ within $2.5\,\sigma$ of the mean value and with ΔE in the range $-0.15 < \Delta E < 0.20$ GeV.

To reduce background from $e^+e^-\to q\bar{q}$ events (with $q=u,d,s,c$), denoted $q\bar{q}$ in the following, we construct a linear Fisher discriminant [15] based on the four event-shape quantities $L_2^{\rm ROE}$, $|\cos\theta^*_T|$, $|\cos\theta^*_B|$ and $R_2^{\rm ROE}$. The ratio $L_2^{\rm ROE}$ between $L_2 = \sum_i p_i\cos^2\theta_i$ and $L_0 = \sum_i p_i$ is evaluated in the CM frame, where the $\mathbf{p}_i$ are the momenta of charged tracks and neutral clusters not used to reconstruct the B (i.e., the rest of the event, ROE), and the θ_i are their angles with respect to the thrust axis of the B candidate's decay products. The angle θ^*_T is measured between the thrust axis of the B candidate's decay products and the beam axis, and is evaluated in the CM frame. The angle θ^*_B is measured between the B candidate momentum and the beam axis, again evaluated in the CM frame. The ratio $R_2^{\rm ROE}$ of the Fox-Wolfram moments H_2 and H_0, is computed using tracks and photons in the ROE [16]. The efficiency of the requirement on the value of the Fisher discriminant ranges from 74% to 78% for $B^-\to D^0K^-$signal events and from 17% to 23% for $q\bar{q}$ background events. For the $K\pi$ channel, the values are 87% for signal and 42% for background events.

For events with multiple $B^-\to D^0h^-$candidates (0.4%–7.7% of the selected events, depending on the D^0 decay mode), we choose the B candidate with the smallest $\chi^2 = \sum_c (M_c - \langle M_c\rangle)^2/(\sigma^2_{M_c} + \Gamma^2_c)$ formed from the measured and true masses of the composite candidates c, M_c and $\langle M_c\rangle$, scaled by the resolution σ_{M_c} and width Γ_c of the reconstructed mass distributions. Composite candidates considered are the B candidate itself ($m_{\rm ES}$), D^0, π^0, and ω candidates. Also Γ_ω is the only non-negligible width.

The total reconstruction efficiencies, based on simulated $B\to D^0K$ events, are 36% ($K^-\pi^+$), 29% (K^-K^+), 29% ($\pi^-\pi^+$), 15% ($K^0_S\pi^0$), and 6% ($K^0_S\omega$).

The main contributions to the background from $B\overline{B}$ events come from the processes $B^-\to D^*h^-$, $B^-\to D^0\rho^-$, misreconstructed $B^-\to D^0h^-$, and from charmless B decays to the same final state as the signal: for instance, the process $B^-\to K^-K^+K^-$ is a background for $B^-\to D^0K^-$, $D^0\to K^-K^+$. These charmless backgrounds have similar ΔE and $m_{\rm ES}$ distributions as the D^0K^- signal and are referred to in the following as peaking $B\overline{B}$ backgrounds ($B^-\to X_1X_2K^-$).

We determine the signal and background yields for each D^0 decay mode independently from a two-dimensional extended unbinned maximum-likelihood fit to the selected data events. The fit is performed simultaneously on the B^+ and B^- subsamples. The input variables to the fit are ΔE and the Cherenkov angle θ_C of the prompt track as measured by the DIRC. The extended likelihood $\mathcal{L}$ for N candidates is given by the product of the probabilities for each individual candidate i and a Poisson factor:

$$\mathcal{L} = \frac{e^{-N'}(N')^N}{N!}\prod_{i=1}^{N}\mathcal{P}_i(\Delta E, \theta_C). \qquad (6)$$

The probability $\mathcal{P}_i$ is the sum of the signal and background terms,

$$\mathcal{P}_i(\Delta E, \theta_C) = \sum_J \frac{N_J}{N'} \mathcal{P}^J_{\Delta E,i}\, \mathcal{P}^J_{\theta_C,i} \quad , \qquad (7)$$

where J denotes the seven signal and background hypotheses D^0h, $q\bar{q}(h)$, $B\bar{B}(h)$, and X_1X_2K. N' is the total event yield estimated by the fit, and N_J is the event yield in each category. We fit directly for the ratios $R' \equiv R_{(\pm)}$ and asymmetries $A_{CP\pm}$, as appropriate to the decay mode; they enter Eq. (7) through

$$N_{D^0\pi^\pm} = \frac{1}{2}\left(1 \mp A^{D^0\pi}_{CP}\right) N_{D^0\pi} \ , \qquad (8)$$

$$N_{D^0K^\pm} = \frac{1}{2}\left(1 \mp A_{CP}\right) N_{D^0\pi} R' \ , \qquad (9)$$

where $N_{D^0\pi} = N_{D^0\pi^+} + N_{D^0\pi^-}$ and $A^{D^0\pi}_{CP\pm}$ is defined analogously to Eq. 2.

The ΔE distribution for $B^\pm \to D^0K^\pm$ signal is parameterized with a double Gaussian function. The fraction of the wide component of the signal shape, its offset from the narrow component and the ratio between the widths of the two components are fixed to values obtained from simulation. The ΔE probability density function (PDF) for $B^\pm \to D^0\pi^\pm$ is the same as the $B^\pm \to D^0K^\pm$ one, but with an additional shift, $\Delta E_{\rm shift}$, which arises from the wrong mass assignment to the prompt track. The shift is computed event by event as a function of the prompt track momentum p and a Lorentz factor $\gamma_{\text{PEP-II}} = E_{ee}/E^*_{ee}$ characterizing the boost to the e^+e^- CM frame:

$$\Delta E_{\rm shift} = \gamma_{\text{PEP-II}} \left(\sqrt{m_K^2 + p^2} - \sqrt{m_\pi^2 + p^2} \right) . \qquad (10)$$

The ΔE distributions for the continuum background are parameterized with a straight line. The ΔE distribution for the $B\overline{B}$ background is empirically parametrized with a Gaussian peak with an exponential tail [17]. The parameters of the background shapes are determined from simulated events ($B\overline{B}$) and off-resonance data ($q\overline{q}$) and are fixed in the fit. The number of peaking background events $N_{X_1X_2K}$ is fixed to values obtained from a study of the D^0 mass sidebands. The particle identification PDF is a double Gaussian as a function of $\theta_C^{\rm pull}$, which is the difference between the measured Cherenkov angle θ_C and its expected value for a given mass hypothesis, divided by the estimated error. The PID shape parameters are obtained from simulation. To summarize, the floating parameters in each of the five the fits are the D^0K and $D^0\pi$ signal yield asymmetries, the total number of signal events in $D^0\pi$, the appropriate ratios R and $R_\pm$, eight background yields (one for each charge), and two parameters of the ΔE signal shape (common for positive and negative samples).

The results of the fits, expressed in terms of signal yields, are summarized in Table I. Figure 1 shows the distributions of ΔE for the $K^-\pi^+$, *CP*+ and *CP*− modes after enhancing the $B^- \to D^0K^-$ purity by requiring that the prompt track be consistent with the kaon hypothesis. This requirement is 88% (1%) efficient for $h^- = K^-$ ($h^- = \pi^-$).

TABLE I: Uncorrected yields as obtained from the maximum likelihood fit. The quoted uncertainties are statistical.

D^0	CP	$N(D\pi^+)$	$N(D\pi^-)$	$N(DK^+)$	$N(DK^-)$
$K^-\pi^+$		12745 ± 120	12338 ± 120	954 ± 36	918 ± 36
K^-K^+	$+$	1109 ± 36	1051 ± 35	51 ± 10	113 ± 13
$\pi^-\pi^+$	$+$	390 ± 24	378 ± 24	39 ± 9	36 ± 9
$K^0_S\pi^0$	$-$	1102 ± 37	1134 ± 38	100 ± 13	88 ± 12
$K^0_S\omega$	$-$	422 ± 24	403 ± 26	29 ± 8	18 ± 8

The ratios $R_{(\pm)}$, as measured by each fit, are corrected to take into account small differences in the selection efficiency between $B \to DK$ and $B \to D\pi$. The efficiency ratios range from 1.013 ± 0.006 to 1.037 ± 0.010. Their uncertainties are due to the statistics of the simulated samples and are considered in the study of systematic uncertainties. In the case of $D^0 \to K^0_S\omega$, $\omega \to \pi^+\pi^-\pi^0$, the values of $R^{K^0_S\omega}_{CP-}$ and $A^{K^0_S\omega}_{CP-}$ need to be corrected to take into account a possible dilution from a non-resonant *CP*-even background arising from $B^- \to D^0h^-$, $D^0 \to K^0_S(\pi^-\pi^+\pi^0)_{\text{non}-\omega}$ decays. There is little information on this background. We estimate the corrections using a fit to the ω helicity angle in the selected data events and find the correction factors to be 1.12 ± 0.14 for $A^{K^0_S\omega}_{CP-}$ and 1.00 ± 0.01 for $R^{K^0_S\omega}_{CP-}$. The uncertainties in the correction factors are included in the systematic errors. After applying all corrections, the quantities $R_\pm/R$ and $A_{CP\pm}$ are computed by means of a weighted average over the *CP*+ and *CP*− modes. The results for the *CP*-even and *CP*-odd combinations are reported in Table II.

Systematic uncertainties in $R_{CP\pm}$ and $A_{CP\pm}$ are listed in Table III. The uncertainties on the fitted signal yields are due to the imperfect knowledge of the ΔE and PID PDFs and of the peaking background yields, and are evaluated in test fits by varying the parameters of the PDFs and the peaking background yields by $\pm 1\sigma$ and taking the difference in the fit results. A possible $\pm 20\%$ *CP* asymmetry in the peaking background is considered in the same way. In the $K^0_S\omega$ channel we also take into account the uncertainties in the correction factors due to the *CP*-even backgrounds from $D^0 \to K^0_S(\pi^-\pi^+\pi^0)_{\text{non}-\omega}$ decays. A possible bias in the measured $A_{CP\pm}$ comes from an intrinsic detector charge asymmetry due to asymmetries in acceptance or tracking and particle identification efficiencies. An upper limit on this bias is obtained from the measured asymmetries in the processes $B^- \to D^0h^-$, $D^0 \to K^-\pi^+$ and $B^- \to D^0_{CP\pm}\pi^-$, where *CP* violation is expected to be negligible. From the average

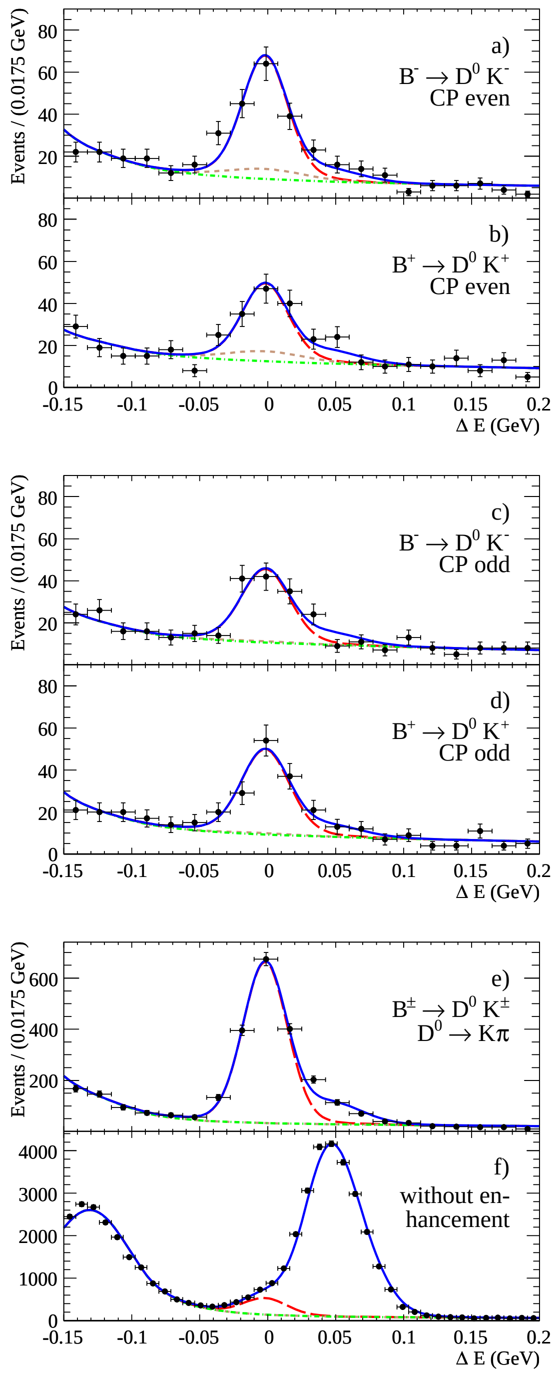

FIG. 1: Distributions of ΔE for events enhanced in $B^{\pm} \to D^0 K^{\pm}$ signal: a) $B^- \to D^0_{CP+} K^-$; b) $B^+ \to D^0_{CP+} K^+$; c) $B^- \to D^0_{CP-} K^-$; d) $B^+ \to D^0_{CP-} K^+$; $B^{\pm} \to D^0 K^{\pm}$, $D^0 \to K^{\pm}\pi^{\mp}$ with (e) and without (f) signal enhancement. Blue (continuous) curve: projection of the full PDF of the maximum likelihood fit. Red (long-dashed): $B^{\pm} \to D^0 K^{\pm}$ signal on all backgrounds. Brown (short-dashed): peaking component on $q\bar{q}$ and $B\bar{B}$ background. Green (dash-dotted): $q\bar{q}$ and $B\bar{B}$ background.

asymmetry, $-(1.6 \pm 0.6)\%$, we obtain the limit $\pm 2.2\%$ for the bias. For the branching fraction ratios $R_{CP\pm}$, an additional source of uncertainty is associated with the assumption that $R_{CP\pm} = R_{\pm}/R$. This assumption holds only if the magnitude of the ratio r_π between the amplitudes of the $B^- \to \overline{D}^0\pi^-$ and $B^- \to D^0\pi^-$ processes is neglected [18]. r_π is expected to be small: $r_\pi \sim r\frac{\lambda^2}{1-\lambda^2} \lesssim 0.012$, where $\lambda \approx 0.22$ [14] is the sine of the Cabibbo angle. This introduces a relative uncertainty $\pm 2 r_\pi \cos\delta_\pi \cos\gamma$ on $R_{CP\pm}$, where δ_π is the relative strong phase between the amplitudes $\mathcal{A}(B^- \to \overline{D}^0\pi^-)$ and $\mathcal{A}(B^- \to D^0\pi^-)$. Since $|\cos\delta_\pi \cos\gamma| \leq 1$ and $r_\pi \lesssim 0.012$, we assign a relative uncertainty $\pm 2.4\%$ to $R_{CP\pm}$, which is completely anti-correlated between R_{CP+} and R_{CP-}. We quote the measurements in terms of $x_\pm$ and r^2,

$$x_+ = -0.09 \pm 0.05(\text{stat}) \pm 0.02(\text{syst})\,, \quad (11)$$

$$x_- = +0.10 \pm 0.05(\text{stat}) \pm 0.03(\text{syst})\,, \quad (12)$$

$$r^2 = +0.05 \pm 0.07(\text{stat}) \pm 0.03(\text{syst}). \quad (13)$$

The correlations between the different sources of systematic errors, when non-negligible, are considered when calculating $x_\pm$ and r^2. The measured values of $x_\pm$ are consistent with those found from $B^- \to D^0 K^-$, $D^0 \to K^0_S \pi^-\pi^+$ decays, and the precision is comparable [11].

TABLE II: Measured ratios $R_{CP\pm}$ and $A_{CP\pm}$ for CP-even ($CP+$) and CP-odd ($CP-$) D decay modes. The first error is statistical; the second is systematic.

D^0 mode	R_{CP}	A_{CP}
$CP+$	$1.06 \pm 0.10 \pm 0.05$	$0.27 \pm 0.09 \pm 0.04$
$CP-$	$1.03 \pm 0.10 \pm 0.05$	$-0.09 \pm 0.09 \pm 0.02$

TABLE III: Systematic uncertainties on the observables $R_{CP\pm}$ and $A_{CP\pm}$ in absolute terms.

source	ΔR_{CP+}	ΔR_{CP-}	ΔA_{CP+}	ΔA_{CP-}
fixed fit parameters	0.036	0.019	0.010	0.002
peaking background	0.029	0.037	0.031	0.003
detector charge asym.	-	-	0.022	0.022
opp. CP bkg. in $K^0_S\omega$	-	0.002	-	0.007
$R_{CP\pm}$ vs. $R_\pm$	0.026	0.025	-	-
K/π efficiency	0.002	0.007	-	-
total	0.053	0.049	0.039	0.023

In conclusion, we have reconstructed $B^- \to D^0 K^-$ decays with D^0 mesons decaying to non-CP, CP-even and CP-odd eigenstates. The combined uncertainties we find for $A_{CP\pm}$ ($R_{CP\pm}$) are smaller by a factor of 0.7 (0.9) and 0.6 (0.6) than the previous *BABAR* [9] and Belle [10] measurements, respectively. We find A_{CP+} to deviate by 2.8 standard deviations from zero. We express the results in terms of the Cartesian coordinates $x_\pm$ and r^2 (Eqs. 4, 5). These measurements, combined with the existing measurements from $B^-\to D^0K^-$decays, will improve our knowledge of the angle γ and the parameter r.

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