

**Measurements of CP-Violating Asymmetries and Branching Fractions  
in the Decays of B Mesons to Charged Pions and Kaons  
at the Babar Detector**

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MEASUREMENTS OF  $CP$ -VIOLATING ASYMMETRIES  
AND BRANCHING FRACTIONS IN THE DECAYS OF B  
MESONS TO CHARGED PIONS AND KAONS AT THE  
BABAR DETECTOR

Morris Nicholas Danielson

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## Abstract

This dissertation describes the measurement of branching fractions and  $CP$  asymmetries in neutral  $B$  meson decays to charmless two-body final states of charged pions and kaons.  $CP$  violation is a poorly-constrained phenomenon in the Standard Model (SM) of particle physics and had been studied only in the kaon system before the Babar and Belle experiments. The decay of the neutral  $B$  meson to charged pions and kaons is particularly useful for the study of  $CP$  violation because they can be related to the Unitarity Triangle angle  $\alpha$ .

We use an extended maximum likelihood technique that incorporates kinematic, event-shape, and particle identification information to measure the branching fractions of the neutral  $B$  meson to  $\pi\pi$ ,  $K\pi$ . These branching fractions are found to be  $(5.6 \pm 0.4 \pm 0.3) \times 10^{-6}$  and  $(19.2 \pm 0.6 \pm 0.6) \times 10^{-6}$  respectively. The decay to  $KK$  is found to have a branching fraction of less than  $0.4 \times 10^{-6}$  at the 90% confidence level. We also measure the direct  $CP$ -violating asymmetry between decays to  $K^+\pi^-$  and  $K^-\pi^+$  to be  $-0.133 \pm 0.030 \pm 0.009$ . Decay time information and  $b$  quark flavor information are then added to determine the time-dependent  $CP$  violation parameters  $S$  and  $C$ , which we find to be  $-0.30 \pm 0.17 \pm 0.03$  and  $-0.09 \pm 0.15 \pm 0.04$ , respectively. For all measurements above the first error is statistical and the second is systematic.

The results are obtained from a data sample of 227 million decays of the  $\Upsilon(4S)$  to  $B^0\bar{B}^0$  collected between 1999 and 2004 with the Babar detector at the PEP-II asymmetric  $B$  factory located at the Stanford Linear Accelerator Center.

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