Measurement of the CKM Angle Alpha at the BABAR Detector Using B Meson Decays to Rho Final States

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MEASUREMENT OF THE CKM ANGLE ALPHA AT THE BABAR DETECTOR USING B MESON DECAYS TO RHO FINAL STATES

by

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Abstract

This thesis contains the results of an analysis of $B^0 \rightarrow \rho^+\rho^-$ using 232 million $\Upsilon(4S) \rightarrow B\bar{B}$ decays collected with the BABAR detector at the PEP-II asymmetric-energy $B$ Factory at SLAC. From a fitted signal yield of $617 \pm 52$ events, the longitudinal polarizations fraction, $j_L$, of the decay is measured to be $0.978 \pm 0.014$ (stat) $^{+0.021}_{-0.023}$ (syst).

The nearly fully longitudinal dominance of the $B^0 \rightarrow \rho^+\rho^-$ decay allows for a measurement of the time dependent $CP$ parameters $S_L$ and $C_L$, where the first parameter is sensitive to mixing induced $CP$ violation and the second one to direct $CP$ violation. From the same signal yield, these values are found to be $S_L = -0.33 \pm 0.24$ (stat) $^{+0.08}_{-0.14}$ (syst) and $C_L = -0.03 \pm 0.18$ (stat) $\pm 0.09$ (syst).

The CKM angle $\alpha$ is then determined, using these results and the branching fractions and polarizations of the decays $B^0 \rightarrow \rho^0\rho^0$ and $B^+ \rightarrow \rho^+\rho^0$. This measurement is done with an isospin analysis, in which a triangle is constructed from the isospin amplitudes of these three decay modes. A $\chi^2$ expression that includes the measured quantities expressed as the lengths of the sides of the isospin triangles is constructed and minimized to determine a confidence level on $\alpha$. Selecting the solution compatible with the Standard Model, one obtains $\alpha = 100^\circ \pm 13^\circ$. 
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