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Search for CP violation and $b \to sg$ in inclusive B decays*

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Abstract

We present preliminary results on two analyses performed by the SLD Collaboration using inclusive B decays: a search for CP violation and a search for the $b \to sg$ transition.

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1 Search for CP violation in inclusive B decays

Because they involve large branching fractions and sizable CP asymmetries, (semi-) inclusive B decays have been proposed[1] as a means of searching for CP violation, and extracting measurements of CKM parameters. The totally inclusive asymmetry provides a measurement of the CP observable $a = \mathcal{I}m\frac{\Gamma_{12}}{M_{12}}$. It is the focus of this analysis. Its time dependence is[1]:

$$\mathcal{A}(t) = \frac{\Gamma(B^0(t) \to all) - \Gamma(\bar{B}^0(t) \to all)}{\Gamma(B^0(t) \to all) + \Gamma(\bar{B}^0(t) \to all)} = a\left(\frac{\Delta m\ \tau_B}{2} \sin \Delta m\ t - \sin^2 \frac{\Delta m\ t}{2}\right).$$

A non-zero value of a implies CP violation. Due to the large value of Δm_s, this analysis is only sensitive to asymmetries in B_d decays for which a_d is expected to be $\approx 10^{-3}$ in the Standard Model.

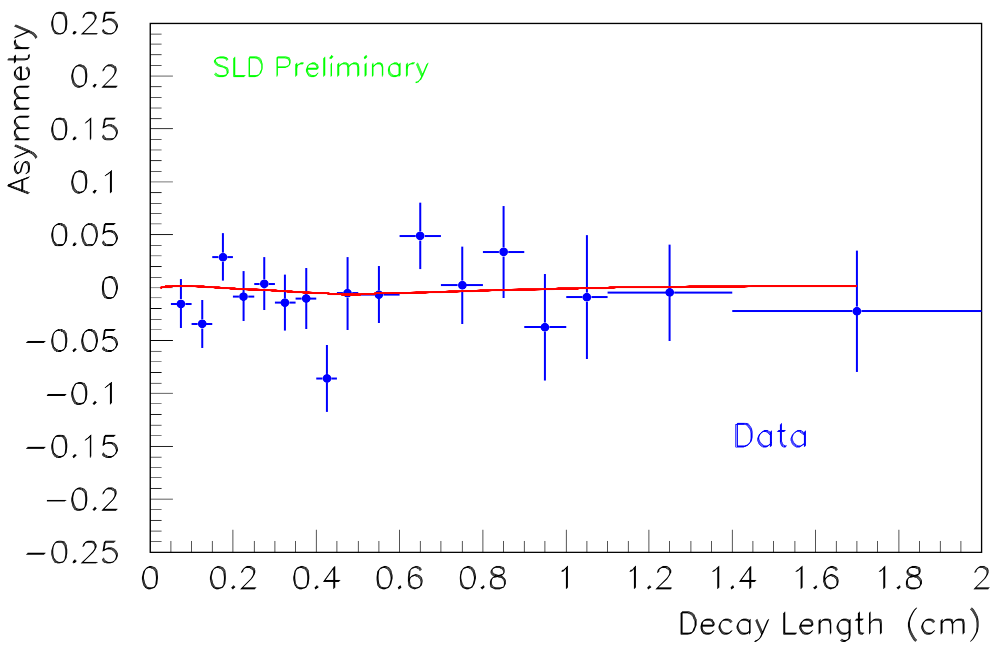

Fig.1. Asymmetry as a function of decay length.

B-decay vertices are reconstructed using a topological technique[2]. From the 1993-96 data sample ($200k$ Z^0's), about $11k$ neutral and $19k$ charged vertices are selected, with a B_d content of 50% and 35%, respectively. The crucial part of the analysis is tagging the flavor of the b quark at production. This is done mainly using the left-right forward-backward asymmetry (given by the electron beam longitudinal polarization and the thrust axis polar angle) and the opposite hemisphere momentum-weighted jet charge. These two tags which have an efficiency of 100%, are complemented by additional information from the opposite hemisphere when it is available (vertex charge, sign of a high-p_T lepton, charge sum for kaons from a B-decay). The overall b-flavor tag purity is estimated to be 84%.

The measured asymmetry is shown in Fig. 1 as a function of decay length. A binned χ^2 fit is performed and a value of $a_d = -0.04 \pm 0.12(stat) \pm 0.05(sys)$ is obtained. This gives a 95% C.L. limit of $-0.29 < a_d < 0.22$.

2 Search for enhanced $b \to sg$ in inclusive B decays

It was suggested recently that a branching ratio $\sim 10\%$ for the $b \to sg$ transition (0.2% in the Standard Model) could resolve a variety of B decay puzzles (e.g., b semileptonic branching ratio, number of c quarks produced per B decay, etc)[3]. The search strategy consists of looking for an excess in kaon production at high p_T, where the signal-to-background ratio is expected to be of the order of 1:1 (for a 10% branching ratio).

Table 1. Number of kaons with $p_T > 1.8$ GeV/c

	1-Vertex		2-Vertex	
	All	No Lepton	All	No Lepton
Data	35.0	30.0	30.0	23.0
M.C.	22.1	14.1	27.5	20.3
Diff.	12.9 ± 5.9	15.9 ± 5.5	2.5 ± 5.5	2.7 ± 5.5

At SLD, we select B vertices that contain an identified $K^{\pm}$ using the Čerenkov Ring Imaging Detector. We measure the kaon transverse momentum w.r.t. the direction defined by the small SLC interaction point and the well-reconstructed B decay vertex. The signal is enhanced by: *i*) separating the data into a one-vertex sample (signal) and a two-vertex sample (control) according to the probability for all B-decay tracks to originate from a single point, *ii*) rejecting decays that contain an identified lepton. The efficiency for isolating true one-vertex decays (e.g., charmonium) is estimated at 80%, whereas only 45% of standard $b \to c$ transitions satisfy the one-vertex requirement. We compare the $K^{\pm}$ transverse momentum spectrum observed in the data to that in the Monte Carlo and look for an excess above 1.8 GeV/c. Our modeling of the p_T resolution is cross-checked using leptons whose spectrum is well known. The results are summarized in Table 1. We observe in the 1993-95 data ($150k$ Z^0's) an excess of $12.9 \pm 5.9(stat) \pm 3.1(syst)$ decays, without lepton rejection. The systematic error is dominated by the uncertainty in the modeling of the D^0 momentum spectrum and its two-body decay branching fractions. The result for the case with lepton rejection is also given in Table 1 (statistical error only). This analysis will be significantly improved with the addition of an anticipated large data sample in the near future.

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