PROCEEDINGS OF SCIENCE

Measurements of $B \to X_s \ell^+ \ell^-$ and Forward-Backward Asymmetry in $B \to K^* \ell^+ \ell^-$ at Belle

Akimasa Ishikawa[*†]

High Energy Accelerator Research Organization(KEK), Japan

E-mail: akimasa@bmail.kek.jp

We present measurements of $B \to X_s \ell^+ \ell^-$ and forward-backward asymemtry in $B \to K^* \ell^+ \ell^-$ with a large data sample accumulated on the $\Upsilon(4S)$ resonance by Belle detector at the KEKB asymmetric energy e^+e^- collider.

International Europhysics Conference on High Energy Physics
July 21st - 27th 2005
Lisboa, Portugal

*Speaker.
†on behalf of the Belle Collatoration

PoS(HEP2005)279

1. Introduction

The $b \to s$ processes are sensitive to new physics effect. If new heavy particles can contribute to the decays, their amplitudes will interfere with the Standard Model (SM) amplitudes and thereby modify the decay rate as well as decay distributions.

To evaluate the new physics contributions in $b \to s$ processes, Wilson coefficients are used [1]. These coefficients parameterize the strength of the short distance interaction. If new physics contributes to the $b \to s$ processes, the relevant coefficients will deviate from the SM values. For electroweak penguin decays, the effective Wilson coefficients $C_7^{\rm eff}$, $C_9^{\rm eff}$ and $C_{10}^{\rm eff}$ appear in the partial decay width. A next-to-next-to-leading order (NNLO) calculation for these effective coefficients has many correction terms [2], so leading coefficients A_7, A_9 and A_{10} are usually used for the evaluation.

Measurements of $B \to X_s\gamma$ decay, which are consistent with the SM prediction [**?**], strongly constrain the magunitude of the Wilson coefficient A_7 [4]. However sign of A_7 cannot determined from $B \to X_s\gamma$. The $b \to s\ell^+\ell^-$ process is promising from this point of view, since not only the photonic penguin diagram but also the Z-penguin and box diagrams contribute to this decay mode. As a result, we can determine the relative signs of the Wilson coefficients A_7, A_9 and A_{10} as well as their absolute values.

2. Measurement of $B \to X_s\ell^+\ell^-$

We use a 253 fb^{-1} data sample containing 275×10^6 B meson pairs for $B \to X_s\ell^+\ell^-$ analysis [6]. A semi-inclusive technique is utilized to reconstruct $B \to X_s\ell^+\ell^-$. The X_s system is reconstructed from one neutral or charged kaon and zero to four pions. We require the invariant mass of X_s to be less than 2.0 GeV. We select an electron or muon pair with invariant mass greater than 0.2 GeV. We obtain the branching fraction to be

$$\mathscr{B}(B \to X_s\ell\ell) = (4.11 \pm 0.83\,^{+0.85}_{-0.81}) \times 10^{-6},$$

We also measure the M_{X_s} and q^2 distributions. Clean prediction of the branching fraction of $B \to K^*\ell\ell$ for $1 < q^2 < 6$ GeV^2 is available. Combining this result with Babar result [7], we can set the allowed area in $C_9 - C_{10}$ plane. Sign of C_7 flipped case with SM C_9 and C_{10} is excluded at 90% confidence level [8].

3. Measurement of Forward-Backward Asymmetry in $B \to K^*\ell^+\ell^-$

The data sample corresponds to 357 fb^{-1} which contains 386 million $B\overline{B}$ pairs is used for measurement of forward-backward asymmetry in $B \to K^*\ell^+\ell^-$. $B^0 \to K^{*0}\ell^+\ell^-$ and $B^+ \to K^{*+}\ell^+\ell^-$ decays are reconstructed, where ℓ stands for an electron or a muon. We observe 113.6 ± 13.0 $B \to K^*\ell^+\ell^-$ signal events with a purity of 44%.

To extract ratios of Wilson coefficients, we perform an unbinned maximum likelihood fit with probability density function that includes the normalized double differential decay width $(1/\Gamma)d^2\Gamma/dq^2 d\cos\theta$ [9], where $\cos\theta$ is the cosine of the angle between negative (positive) charged lepton and B^0 or B^+ ($\overline{B}^0$ or B^-) meson momenta in the dilepton rest frame. The forward-backward asymmetry is defined as

$$A_{\rm FB}(q^2) = \frac{\int_0^1 \frac{d^2\Gamma}{dq^2 d\cos\theta} d\cos\theta - \int_{-1}^0 \frac{d^2\Gamma}{dq^2 d\cos\theta} d\cos\theta}{\int_0^1 \frac{d^2\Gamma}{dq^2 d\cos\theta} d\cos\theta + \int_{-1}^0 \frac{d^2\Gamma}{dq^2 d\cos\theta} d\cos\theta}.$$

The A_7 is fixed to SM value, -0.330, since the measurement of the branching fraction of $B \to X_s \gamma$ is consistent with the prediction within the SM, while the A_9/A_7 and A_{10}/A_7 are allowed to float in the fit. We measure the ratios of Wilson coefficients,

$$A_9/A_7 = -15.3^{+3.4}_{-4.8} \pm 1.1,$$
$$A_{10}/A_7 = 10.3^{+5.2}_{-3.5} \pm 1.8,$$

which are consistent with the SM values -12.3 and 12.8, respectively. Figure 1 shows fit results projected on the background-subtracted forward-backward asymmetry distribution in bins of q^2.

In Fig. 2, we show confidence level(C.L.) contours in the A_9/A_7-A_{10}/A_7 based on fit likelihood smeared by systematic error, which is assumed to have a Gaussian distribution. We also calculate an interval on $A_9 A_{10}/A_7^2$ at 95% C.L. for any allowed A_7 value,

$$-1401 < A_9 A_{10}/A_7^2 < -26.4.$$

We determine the sign of $A_9 A_{10}$ to be negative, and exclude solutions in the first or third quadrant with more than 95% C.L. Both second and fourth quadrant solutions are allowed, so the sign of $A_7 A_{10}$ cannot be determined yet. We exclude new physics scenarios shown by the red and magenta curves in figure 1, which have positive $A_9 A_{10}$.

4. Conclusion

We have measured the branching fraction of $B \to X_s \ell^+ \ell^-$ and forward-backward asymmetry in $B \to K^* \ell^+ \ell^-$. The measured Wilson coefficients are consistent with the SM prediction.

Acknowledgments

The author wish to thank the KEKB accelerator group for the excellent operation of the KEKB accelerator.

References

[1] G. Buchalla, A. Buras and M. Lautenbacher, *Rev. Mod. Phys.* **68**, 1125 (1996) for example.

[2] H. H. Asatryan *et al. Phys. Lett.* B **507**, 162 (2001).

[3] P. Koppenburg *et al.* (Belle Collaboration), *Phys. Rev. Lett.* **93**, 061803 (2004); S. Chen *et al.* (CLEO Collaboration), *Phys. Rev. Lett.* **87**, 251807 (2001); R. Barate *et al.* (ALEPH Collaboration), *Phys. Lett.* B **429**, 169 (1998).

[4] T. Besmer, C. Greub, T. Hurth, hep-ph/0105292; M. Ciuchini *et al.*, *Nucl. Phys.* B **534**, 3 (1998); C. Bobeth, M. Misiak and J. Urban, *Nucl. Phys.* B **567**, 153 (2000); F. Borzumati *et al.*, *Phys. Rev.* D **62**, 075005 (2000); T. Goto *et al.*, *Phys. Rev.* D **58**, 094006 (1998).

[5] A. Abashian *et al.* (Belle Collaboration), *Nucl. Instrum. Meth.* **A479**, 117 (2002).

[6] M. Iwasaki *et al.* (Belle Collaboration), arXiv:hep-ex/0503044, accepted by *Phys. Rev.* D.

[7] B. Aubert *et al.* (Babar Collaboration), *Phys. Rev. Lett.* **91**, 221802 (2003).

[8] P. Gambino, U. Haisch and M. Misiak, *Phys. Rev. Lett.* **94**, 0618003 (2005).

[9] A. Ali, P. Ball, L. T. Handoko and G. Hiller, *Phys. Rev.* D **61**, 074024 (2000).

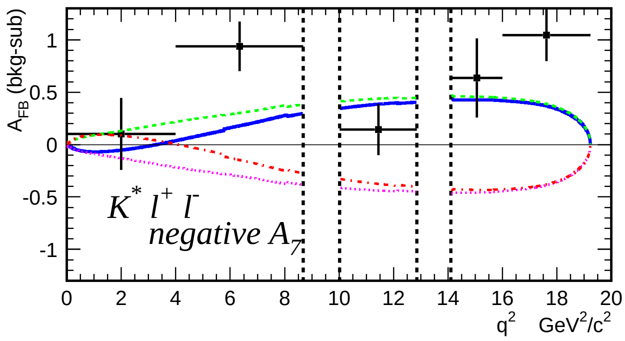

Figure 1: Fit results for the negative A_7 solution projected to forward-backward asymmetry(solid blue) and forward-backward asymmetry curves with several input parameter including efficiency effect; A_7A_{10} sign flipped (dashed green), both A_7A_{10} and A_9A_{10} signs flipped (dash-dot red) and A_9A_{10} sign flipped(dotted magenta) to SM value. The new physics scenarios shown by the red and magenta curves are excluded.

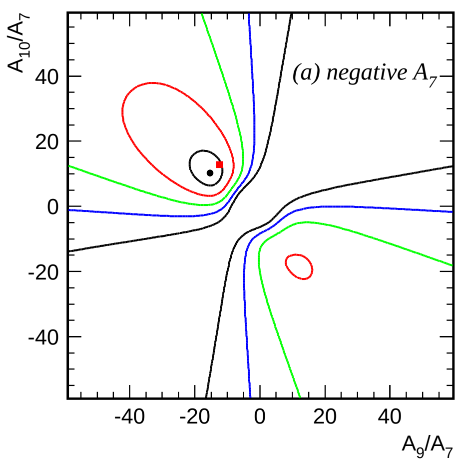

Figure 2: Confidence level contours for negative A_7. Black, red, green, blue and black curves show 1 to 5 σ contours. Black and red points show the best fit and the SM value.