What is sin2ϕB?

M. Kobayashi and T. Maskawa were awarded the 2008 Nobel Prize in physics for their Kobayashi-Maskawa theory. Belle experiment contributed greatly to confirmation of the theory. The measured parameter is CP-violation parameter sin2ϕB.

sin2ϕB was measured through the Y(4S) decay. We need to know initial state of neutral B meson for the measurement of CP-violation in the B meson (flavor tagging). In Y(4S) decay, the flavor of B meson (BCP) in a CP side is tagged from B meson (Btag) in a tag side using quantum interference.

e+e− → Y(4S) → B0B0

The excellent flavor tagging algorithm and precise vertexing produced precise measurement of sin2ϕB. sin2ϕB can be observed in proper time (Δτ) distribution.

<table>
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<tr>
<th>Missing mass (GeV)</th>
<th>(d) B0 → J/ψK0</th>
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<th>sin2ϕB = 0.642 ± 0.031 ± 0.017</th>
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<td>(Phys. Rev. Lett. 98, 031802(2007) @ Belle experiment)</td>
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Analysis procedures

1. Reconstruct neutral B meson from J/ψ Ks.
2. Combine reconstructed B meson with direct π± and calculate the missing mass.
3. Simultaneous fit the data tagged as B0B0π± and B0B±π, and extract sin2ϕB from Acharge:

\[
\sin^2\phi_B = \frac{1 + x^2}{x} \frac{N_{Y(5S)} - N_{\pi^-}}{N_{Y(5S)} + N_{\pi^-}}
\]

| N+: # of Y(5S) → B0 B+ π+ |
| N−: # of Y(5S) → B0 B− π− |

Charge asymmetry (Acharge)

Evaluate the measurement accuracy of sin2ϕB

The expected measurement accuracy of sin2ϕB was estimated with 6 Montecarlo datasets. Simultaneous fit the missing mass distribution.

Measurement accuracy of Acharge (sin2ϕB)

sin2ϕB error is about twice Acharge error because 1 + x^2 is about 2.

Summary

Bπ-tagging method is a flavor tagging method used in Y(5S) decay. can produce independent physics results. The measurement accuracy of sin2ϕB was estimated with Montecarlo datasets.

- sin2ϕB error is about 0.8.
- Belle is upgrading to Belle II.