Time dependent CP Violation

\[ L = \beta \gamma ct \]

\( \mathbf{B}^0 \)

\( \mathbf{\bar{B}} \)

\( \mathbf{PV} \)

\( J/\psi \)

\( \mathbf{K}_s \)

\( \mu^- \)

\( \mu^+ \)

\( \pi^- \)

\( \pi^+ \)

Signal \( B \)

(flavor specific decay)

\[ m^2 = \left( \sum p_i \right)^2 \]

Invariant mass:

Opposite \( B \)

Can be used for flavor tagging

Count recorded \( J/\psi K_s \) events as function of the decay time \( t \), separately for originally produced \( (t=0) \) \( \mathbf{B}^0 \) or \( \mathbf{\bar{B}}^0 \) → calculate asymmetry as function of \( t \).
Time dependent CP asymmetry

⇒ time dependent CPV:

\[ A_{CP}(t) \sim \eta_{CP} \sin 2\beta \sin(\Delta m t) \]

\[ \sin 2\beta = 0.731 \pm 0.035 \pm 0.020 \]

"Golden decay" \( B^0 \rightarrow J/\psi(\mu\mu)K_s \) (42560 evts)

sin2β “diluted” due to non-ideal tagging
Time dependent CPV in $B^0 \rightarrow J/\psi K^0$

$\eta_{CP} = -1$

$\eta_{CP} = +1$
2016

\[ \sin 2\beta \]

\[ \Delta m_d \text{ & } \Delta m_s \]

\[ \epsilon_K \]

\[ |V_{ub}| \]

\[ \alpha \]

\[ \beta \]

\[ \gamma \]

\[ \rho \]

excluded area has CL > 0.95

solution with \( \cos 2\beta < 0 \) (excl. at CL > 0.95)