Gamma-2*Beta determination via Bs Oscillation at CEPC

**Introduction**

SM - CKM & CPV

Bs-Oscillation & Gamma (Gamma - 2*Beta) angle determination (could be extended to an independent session, App, cite…)

CEPC introduction & Characteristic

Bs Yield, Decay branching ratio, clean environments, etc

Main logic & works of this manuscript

ToC

**Methodology Detector model & Software, Sample**

Method: Fast Sim & Toy model (Could go 1.4)

Toy model to extract the anticipated Key distribution (Eff. Bkgrd. Resolutions): Truth Conv Eff Conv Reso.

Fit to the key distribution

Truth level distribution via generator (Whizard, etc) //Key points: interference handling?

Anticipated Accuracy V.S. Relevant Performance

Relevant Performance quantification Via Full Simulation.

Samples, etc.

**Main Results:**

Relevant detector performance quantification;

VTX Timing;

Event Reco. Efficiency - purity;

Jet Charge Effective Tagging power;

Establishment of the reconstucted key distribution;

Anticipated accuracies evaluation: Fit & Extraction of Gamma-2*Beta.

// CKM Fitter, comparing to LHCb projecting @ HL-LHC;

M.Zhao: Summary of discussion from 0716:

Two strategy:

1. Projection
2. Full simulation

Projection:

Advantages: fast

Disadvantages: not reliable as full simulation

1. Projection with equation:

Bs->JPsi phi

$$h_k(t|B_s) = N_k e^{-\Gamma_s t}\left[a_k \cosh(\frac{1}{2}\Delta\Gamma_s t) + b_k \sinh(\frac{1}{2}\Delta\Gamma_s t) + c_k \cos(\Delta m_s t) + d_k \sin(\Delta m_s t)\right],$$

$$h_k(t|\bar{B}_s) = N_k e^{-\Gamma_s t}\left[a_k \cosh(\frac{1}{2}\Delta\Gamma_s t) + b_k \sinh(\frac{1}{2}\Delta\Gamma_s t) - c_k \cos(\Delta m_s t) - d_k \sin(\Delta m_s t)\right],$$

$$
\begin{aligned}
P_{++} &\propto e^{-\Gamma t}\left(\cosh\left(\frac{\Delta\Gamma}{2}t\right) - C\cos(\Delta m t) + D_{\bar{f}}\sinh\left(\frac{\Delta\Gamma}{2}t\right) - S_{\bar{f}}\sin(\Delta m t)\right) \\
P_{+-} &\propto e^{-\Gamma t}\left(\cosh\left(\frac{\Delta\Gamma}{2}t\right) + C\cos(\Delta m t) + D_{f}\sinh\left(\frac{\Delta\Gamma}{2}t\right) - S_{f}\sin(\Delta m t)\right) \\
P_{-+} &\propto e^{-\Gamma t}\left(\cosh\left(\frac{\Delta\Gamma}{2}t\right) + C\cos(\Delta m t) + D_{\bar{f}}\sinh\left(\frac{\Delta\Gamma}{2}t\right) + S_{\bar{f}}\sin(\Delta m t)\right) \\
P_{--} &\propto e^{-\Gamma t}\left(\cosh\left(\frac{\Delta\Gamma}{2}t\right) - C\cos(\Delta m t) + D_{f}\sinh\left(\frac{\Delta\Gamma}{2}t\right) + S_{f}\sin(\Delta m t)\right)
\end{aligned}
$$

$$
C = \frac{1-r^2}{1+r^2},
$$

$$
D_f = \frac{-2r\cos(\delta-(\gamma-2\beta_s))}{1+r^2}, \qquad D_{\bar{f}} = \frac{-2r\cos(\delta+(\gamma-2\beta_s))}{1+r^2},
$$

$$
S_f = \frac{2r\sin(\delta-(\gamma-2\beta_s))}{1+r^2}, \qquad S_{\bar{f}} = \frac{-2r\sin(\delta+(\gamma-2\beta_s))}{1+r^2}.
$$

Gamma in Bs->Ds K in a similar position with beta in Bs->JPsi phi: should follow a similar law, but better to validate it with a toy MC.

Scaling:

$$
\xi = \frac{1}{\sqrt{N_{b\bar{b}} \times \varepsilon} \times \sqrt{p} \times \exp\left(-\frac{1}{2}\Delta m_s^2 \sigma_t^2\right)}.
$$

1. Perfect case: From toy MC of Ji: Without detector effects, the uncertainty of γ−2βs is estimated to be 0.0016 (i.e. 0.092°) .
2. Acceptance * efficiency: not clear, Ji is working on it.
3. Vertex resolution: not to worry, the factor is almost 1.
4. Tagging: exactly same as the Bs->JPsi phi, with naïve algorithm already 20%, with new method could be 40%.
5. Looks too optimistic

Full simulation:

Disadvantages: complex

1. Need generator, could write a toy one with the equation of Bs->DsK. Mingrui is working on it.
2. Simulation and track reconstruction are ready.
3. Vertex reconstruction (I have a toy one)? PID? Tagging? Fitting?

**Summary**

Conclusion on Gamma-2*Beta measurement

Recap of the key performance of CEPC

Compare CEPC performance with other facility, discuss its complementarity… impacts

Outlook, towards global CKM measurements at Z factory