

## Prospect for measurement of the CP-violating phase $\phi_s$ in the $B_s \rightarrow J/\psi\phi$ channel at a future $Z$ factory

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The CP-violating phase  $\phi_s$ , the  $B_s$  decay width ( $\Gamma_s$ ), and the  $B_s$  decay width difference ( $\Delta\Gamma_s$ ) are sensitive probes to new physics and can constrain the heavy quark expansion theory. The potential for the measurement at future  $Z$  factories is studied in this manuscript. It is found that operating at Tera- $Z$  mode, the expected precision can reach:  $\sigma(\phi_s) = 4.6$  mrad,  $\sigma(\Delta\Gamma_s) = 2.4$  ns<sup>-1</sup> and  $\sigma(\Gamma_s) = 0.72$  ns<sup>-1</sup>. The precision of  $\phi_s$  is 40% larger than the expected precision with the LHCb experiment at HL-LHC. If operating at 10-Tera- $Z$  mode, the precision of  $\phi_s$  can be measured at 45% of the precision obtained from the LHCb experiment at HL-LHC. However, the measurement of  $\Gamma_s$  and  $\Delta\Gamma_s$  cannot benefit from the excellent time resolution and tagging power of the future  $Z$ -factories. Only operating at 10-Tera- $Z$  mode can the  $\Gamma_s$  and  $\Delta\Gamma_s$  reach an 18% larger precision than the precision expected to be obtained from LHCb at HL-LHC. The control of penguin contamination at the future  $Z$ -factories is also discussed.

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