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## Time-dependent CP-violation in rare $B_s^0 \rightarrow \phi(1020) \mu^+ \mu^-$ decays at FCC-ee

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Rare decays are widely recognized as an excellent laboratory for testing the Standard Model at high precision and searching for the New Physics phenomena [1]. The flavor-changing neutral currents, like  $b \rightarrow s l^+ l^-$  transitions, are of special interest. They are forbidden at the tree level in the Standard Model and, therefore, can only proceed via higher-order diagrams. If experimental deviation from the Standard Model prediction is observed for these decays, it would indicate the presence of new phenomena. The rare decay branching ratio measurements give direct access to the real part of Wilson coefficients. However, such measurements integrate out the complex part, leaving minimal sensitivity to the complex phases of Wilson coefficients. On the contrary, the time-dependent CP-violation is a powerful probe for complex observables because it directly accesses the complex CP-violating phases in the Standard Model and beyond [2]. Combining the power of the time-dependent CP-violation probe and rare decay's sensitivity to the New Physics opens the door to an imaginary part of the Wilson coefficients and potentially New Physics, otherwise barely accessible.

In the Standard Model, the time-dependent CP-violation in the  $B_s^0 \rightarrow \phi(1020) \mu^+ \mu^-$  decays is zero at the leading order. Therefore, a significant deviation from zero would indicate non-zero complex phases of Wilson coefficients. In current machines, it is challenging to get a statistically significant measurement of the time-dependent CP-violation in the  $B_s^0 \rightarrow \phi(1020) \mu^+ \mu^-$  decays. However, the future FCC-ee machine provides a unique opportunity to collect a large QCD-background-free dataset for flavor physics measurements, enabling high-precision time-dependent measurements of the rare decays [3]. Assuming the IDEA detector design, we present expected experimental sensitivity to the branching, untagged time-dependent, and tagged time-dependent measurements of the rare  $B_s^0 \rightarrow \phi(1020) \mu^+ \mu^-$  decays [4]. We show the expected sensitivity to the time-dependent CP-violating phase and the sensitivity to the real and imaginary parts of the Wilson coefficients.

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