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# Reconstruction of $B^0 \to J/\psi K^0_S$

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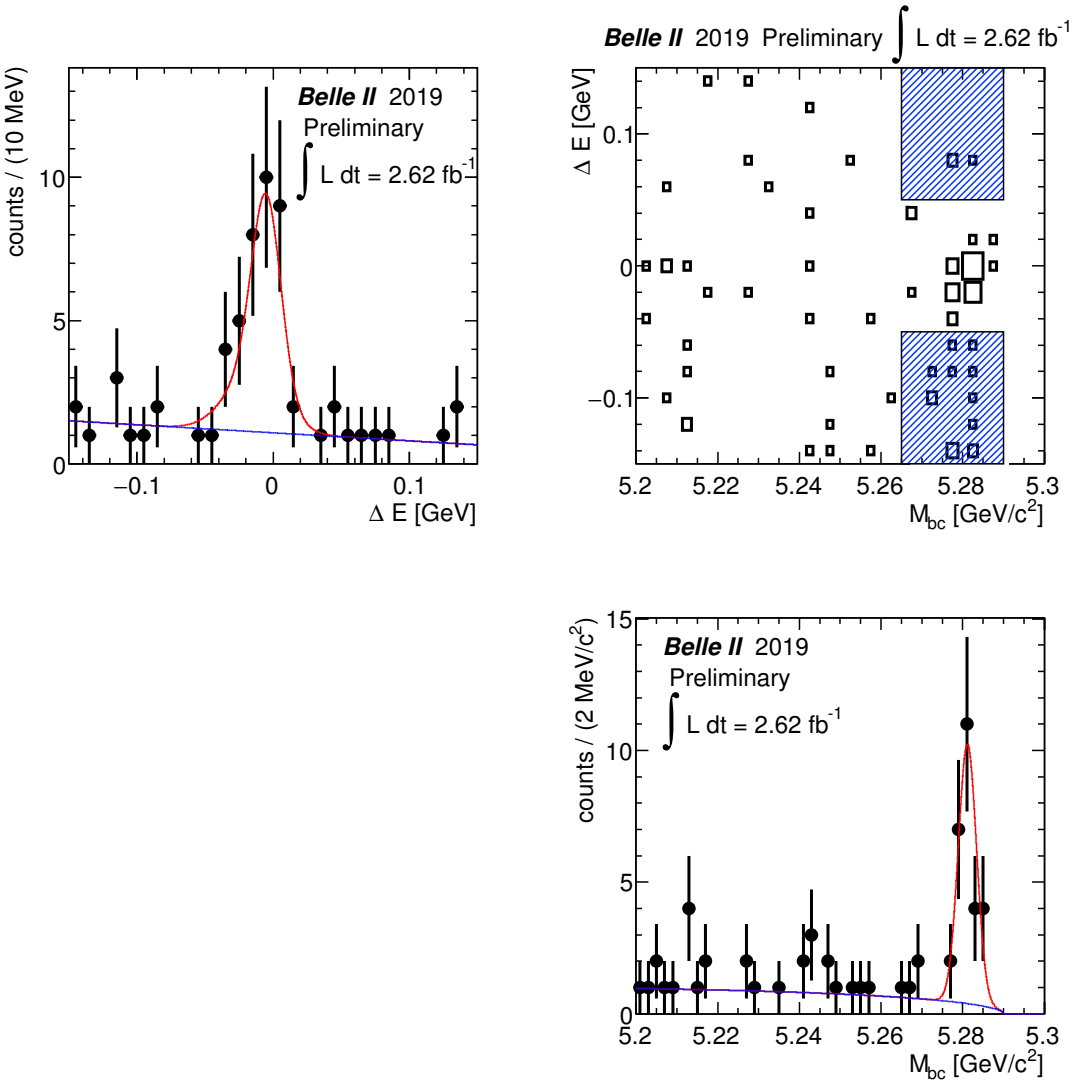


FIG. 1: $\Delta E$ (left top), $M_{\rm bc}$ (right bottom) and 2-dimensional plot of reconstructed $B^0 \to J/\psi K^0_S, J/\psi \to \ell^+\ell^-, K^0_S \to \pi^+\pi^-$ from 2019 data sample (phase 3). To extract signal yield, we perform 2-dimensional un-binned maximum likelihood fit to these samples. Gaussian and ARGUS [1] functions are used for the probability density functions (PDFs) of the $M_{\rm bc}$ for the signal and background, respectively, while double Gaussian and linear functions are used for the $\Delta E$. All of the parameters except for the fraction of two Gaussian functions of $\Delta E$ signal PDF are floated together with signal and background yields when performing the fit. We excluded from the fit the shaded regions of (5.265 GeV/$c^2$ < $M_{\rm bc}$ < 5.290 GeV/$c^2$, -0.15 GeV < $\Delta E$ < -0.05 GeV) and (5.265 GeV/$c^2$ < $M_{\rm bc}$ < 5.290 GeV/$c^2$, 0.05 GeV < $\Delta E$ < -0.15 GeV) to remove background candidates mainly due to $B^0 \to J/\psi K^{*0}$. Fit results are shown with solid curves in each projection.


[1] H. Albrecht *et al.* (ARGUS Collaboration), Phys. Lett. B **241** 278 (1990).
[2] A. Abashian, *et al.* (Belle Collaboration), Phys. Rev. Lett. **86** 2509 (2001).

TABLE I: $B^0 \to J/\psi K^0_S, J/\psi \to \ell\ell, K^0_S \to \pi^+\pi^-$ yields in the signal region of $M_{\rm bc} > 5.27$ GeV/$c^2$ and $|\Delta E| < 40$ MeV extracted from 2-dimensional fit to the $M_{\rm bc}$ and $\Delta E$. Number of the sample used for the first $\sin 2\phi_1$ measurement in the Belle [2] is also listed as a reference.

| Mode | Belle II, 2019 data | | Belle II, MC expectation | | Belle, 2001 data [2] | |
|---|---|---|---|---|---|---|
| | 2.62 fb$^{-1}$ | 1 fb$^{-1}$ | 2.62 fb$^{-1}$ | 1 fb$^{-1}$ | 10.5 fb$^{-1}$ | 1 fb$^{-1}$ |
| $B^0 \to J/\psi K^0_S$ | 26.9 ± 5.2 | 10.3 ± 2.0 | 27.5 | 10.5 | 123 | 11.7 |