



BELLE2-NOTE-PL-2019-xxx  
Version 1.0  
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**Approved plots for the analysis**  
**Measurement of the mixed-unmixed yield asymmetry as a**  
**function of  $|\Delta t|$ , using partially reconstructed  $B^0 \rightarrow D^{*-}\ell^+\nu$  decays**  
**with the Early Phase3 dataset**

A. Gaz\*

*KMI, Nagoya University, Nagoya, Japan*

Abstract

This note contains the approved plots and results for the analysis documented in BELLE2-NOTE-PH-2019-016.

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\*Electronic address: [gaz@hepl.phys.nagoya-u.ac.jp](mailto:gaz@hepl.phys.nagoya-u.ac.jp)

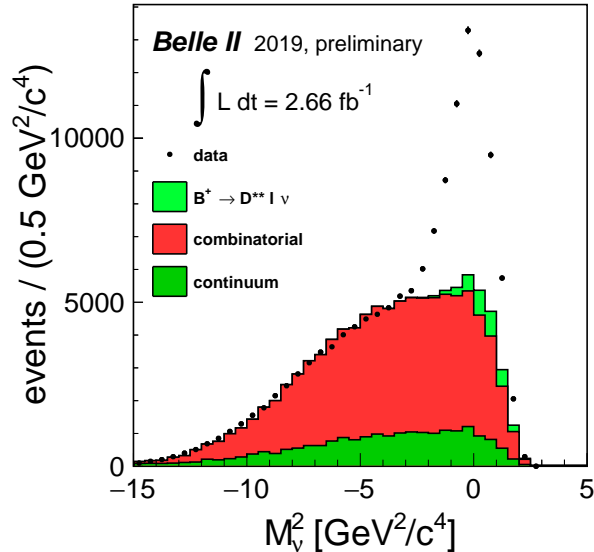


FIG. 1:  $M_\nu^2$  distributions for untagged events (using either  $e$  or  $\mu$  as lepton candidates). The points with error bars represent the data, the dark green histogram is the continuum component (taken from the off-resonance data sample), the red histogram is the  $B\bar{B}$  combinatorial, and the light green histogram represents the peaking  $B^\pm \rightarrow D^{**} l \nu$  component.

TABLE I: Yields for the signal component in the `proc9` data. For both the untagged and the lepton tagged sample, at most one candidate per event has been selected. The fraction of mixed events (last row) has been computed taking into account the correction factor  $\varepsilon_U/\varepsilon_M = 1.35 \pm 0.10$ , where  $\varepsilon_U$  ( $\varepsilon_M$ ) is the efficiency for selecting a correctly reconstructed unmixed (mixed) signal event.

Channel	Data
Untagged $e$ only	$18514 \pm 1128$
Untagged $\mu$ only	$16625 \pm 1111$
Untagged ( $e$ or $\mu$ )	$35492 \pm 2209$
Tagged unmixed ( $N_U$ )	$1642 \pm 133$
Tagged mixed ( $N_M$ )	$253 \pm 45$
$(\varepsilon_U/\varepsilon_M)$ correction factor	$1.35 \pm 0.10$
$\chi_d$ (fraction of mixed events)	$(17.2 \pm 3.6)\%$

$$\chi_d = \frac{N_M/\varepsilon_M}{N_U/\varepsilon_U + N_M/\varepsilon_M} = \frac{N_M \cdot \left(\frac{\varepsilon_U}{\varepsilon_M}\right)}{N_U + N_M \cdot \left(\frac{\varepsilon_U}{\varepsilon_M}\right)} \quad (1)$$

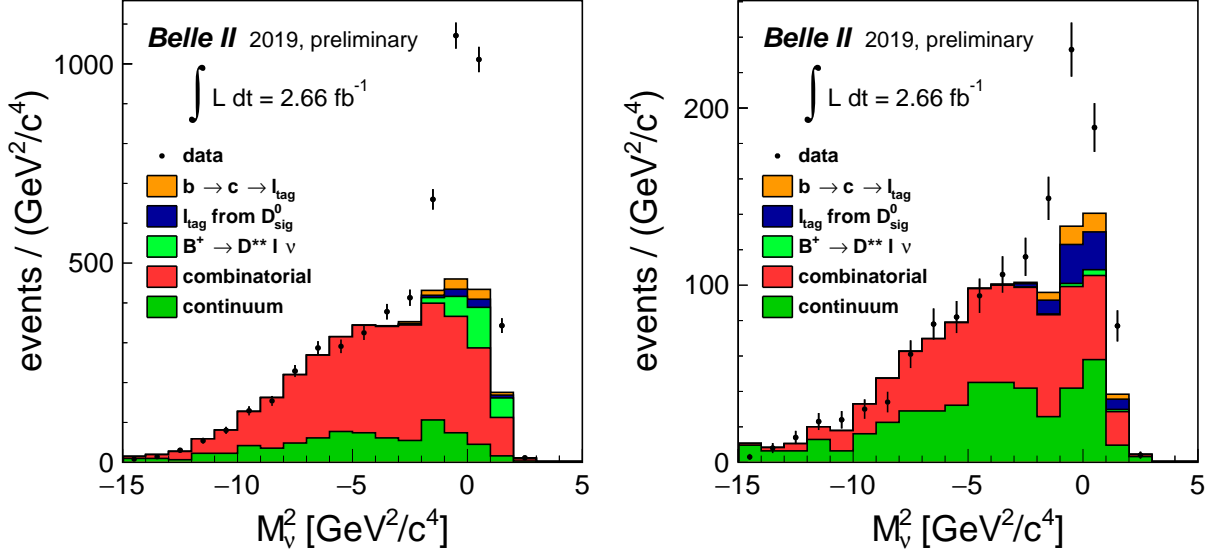


FIG. 2:  $M_\nu^2$  distributions for events in the lepton tagged unmixed (left plot) and mixed (right) samples in the proc9 dataset. The points with error bars represent the data, the dark green histogram is the continuum component, the red histogram is the  $B\bar{B}$  combinatorial background. The following peaking components are also shown:  $B^\pm \rightarrow D^{**} l \nu$  events (light green), events in which the candidate tag-side lepton originate from the decay of the signal side  $D^0$  (dark blue), and events in which the candidate tag-side lepton comes from the  $b \rightarrow c \rightarrow \ell$  decay chain.

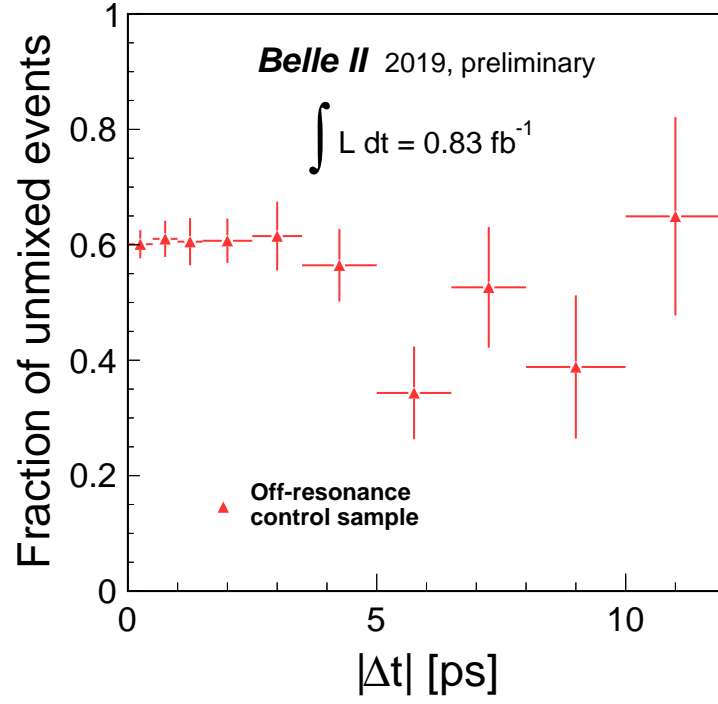


FIG. 3:  $|\Delta t|$  dependent fraction of unmixed events for the off-resonance data. In order to increase the statistics the cut on the  $R2$  variable has been loosened to 0.6, and no cut on  $M_V^2$  is applied. The distribution is compatible with a flat behavior: a fit with a flat line gives a  $\chi^2/\text{ndf} = 1.541$  (corresponding to  $\text{pValue} = 0.127$ ).

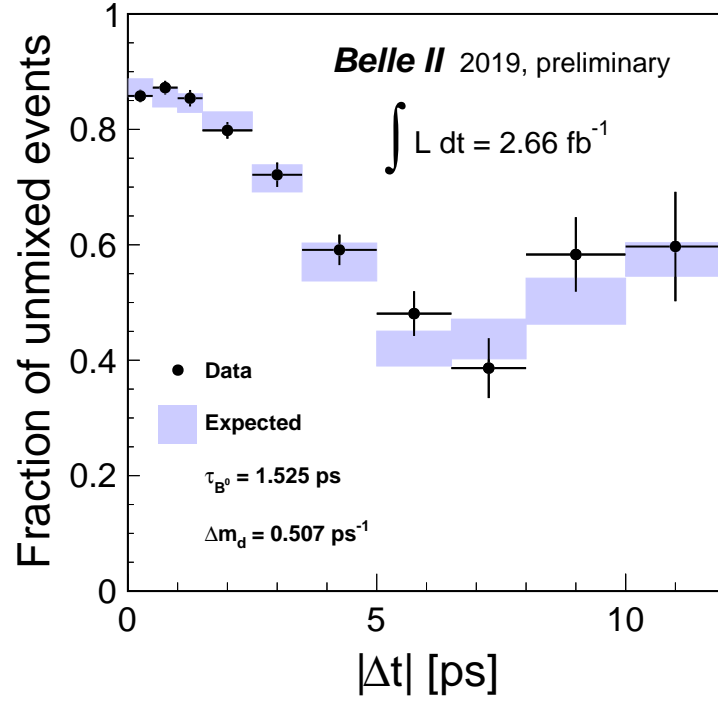


FIG. 4:  $|\Delta t|$  dependent fraction of unmixed events for the on-resonance data  $M_{\nu}^2 > -3 \text{ GeV}^2$  signal enriched region. Good agreement is seen between the data and the expectations, proving that the physics capabilities of the Belle II detector are sufficient to observe the expected pattern of  $B^0\bar{B}^0$  oscillations.