



Approved plots of R_2 distribution in Early Phase 3 Data

C. Cecchi*

Università di Perugia and INFN-PG, Perugia, Italy

G. De Nardo[†] and M. Merola[‡]

Università di Napoli Federico II and INFN-NA, Napoli, Italy

E. Manoni[§] and A. Selce[¶]

INFN Sezione di Perugia, Perugia, Italy

Abstract

We present the approved plots of the event shape variable R_2 represented by the ratio of the second and zeroth Fox-Wolfram moment. The variable R_2 is a good indicator to understand if the collision data of the SuperKEKB are occurring at the $\Upsilon(4S)$ resonance. The study on the shape variable R_2 is used to derive the total number of produced $B\bar{B}$ pairs and is summarized in the physics note BELLE2-NOTE-PH-2019-025.

*Electronic address: claudia.cecchi@pg.infn.it

[†]Electronic address: guglielmo.denardo@na.infn.it

[‡]Electronic address: mario.merola@na.infn.it

[§]Electronic address: elisa.manoni@pg.infn.it

[¶]Electronic address: andrea.selce@pg.infn.it

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1. R_2 DEFINITION AND PLOT

The Fox-Wolfram moments H_l , $l = 0, 1, 2, \dots$ are defined by

$$H_l = \sum_{i,j} \frac{|P_i||P_j|}{E_j^{vis}} P_l(\cos\theta_{ij}) \quad (1)$$

where θ_{ij} is the opening angle between charged tracks or photons i and j , E_{vis} is the total visible energy of the event, P_l are the Legendre polynomials and $|P_i|$ and $|P_j|$ are the momenta of the charged tracks or photons. R_2 is defined as the ratio of the second and zeroth moment, H_2/H_0 .

Results presented here are obtained with Phase 3 data collected in 2019 corresponding to the following run numbers and luminosities:

- exp 7, $\Upsilon(4S)$: runs 1006-1155, 1372-4120 (integrated luminosity: 641.9 pb⁻¹)
- exp 8, $\Upsilon(4S)$: runs 43-1022, 1036-1554 (integrated luminosity: 1982.3 pb⁻¹)
- exp 8, off-resonance: runs 1703-1835 (integrated luminosity: 827.0 pb⁻¹)

for a total luminosity of 2624.2 pb⁻¹ (rounded to 2.62 fb⁻¹) on-peak. On-peak and off-resonance data have been reprocessed and calibrated, the used global tags are `data_reprocessing_proc9`.

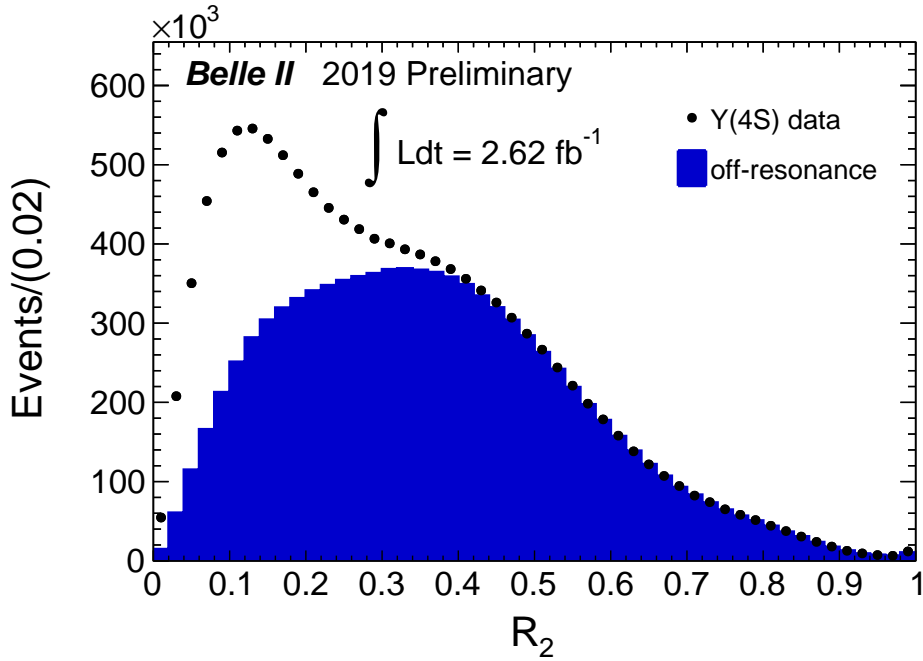


FIG. 1: R_2 distribution for $\Upsilon(4S)$ data, $B\bar{B}$ MC simulation and off-resonance data. The event selection requires at least three tracks and two clusters in the event, with transverse momentum greater than 100 MeV/ c and cluster energy greater than 100 MeV, respectively. Additional requirements on tracks, clusters and event variables are described in detail in the note BELLE2-NOTE-PH-2019-025. The overall selection efficiency on the $B\bar{B}$ sample is 98.8%. The MC and off-resonance contributions are normalized to the yields obtained from a template fit to this variable.