DØnote 4733-CONF

Update of the Upper Limit on the Rare Decay $B_s^0 \to \mu^+\mu^-$ with the DØ Detector*

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We present in this note an update of the upper limit of the rare decay $B_s^0 \to \mu^+\mu^-$ using about 300 pb^{-1} of Run II data collected with the DØ detector at Tevatron. In order to calculate a branching ratio or limit, the events are normalized to $B^\pm \to J/\psi K^\pm$. The obtained upper limit at 95% C.L. is now $3.7 \cdot 10^{-7}$.

Preliminary Results for Spring 2005 Conferences

* In this note the charge conjugated states are included implicitly.

In a previous analysis [1] an upper limit of the rare decay $B_s^0 \to \mu^+\mu^-$ of 5.0×10^{-7} at 95% C.L. has been obtained. The analysis at that time used 240 pb^{-1} of data. Including the additional available data through June 2004 with trigger the list v12, the full data set now contains 300 pb^{-1}. For the limit update, the event selection was unchanged. The selection cuts are described in detail in Reference [1]. The events passing all mentioned selection criteria before are shown in Figure 1. No new candidate event in the signal region has been observed, but the expected background in the signal region changed - as anticipated due to the increased statistics - from 3.7 ± 1.1 to 4.3 ± 1.2 events.

The selection of the normalization channel is also unchanged and explained in detail in [1].

The mass spectrum of the reconstructed $B^\pm \to J/\psi K^\pm$ for the full data sample is shown in Figure 2. A fit using a Gaussian function for the signal and a second order polynomial for the background yields now $906 \pm 35 \pm 22$ $B^\pm$ events compared to $741 \pm 31 \pm 22$ events in Reference [1]. The first error is the statistical uncertainty, and the second uncertainty is due to the systematics estimated by varying the fit range and background shape hypothesis. The mass resolution of the $B^\pm$ is 40.7 MeV, which compares well to the resolution of the MC simulation of 36 MeV. The $B^\pm$ mass in the data for the $J/\psi K^\pm$ selection turns out to be 5278 MeV, which is just 1 MeV below the PDG mean value of the $B^\pm$ [2].

To calculate the upper limit using the full available data sample, the same procedure as in [1] was used. The number of candidate events in the signal region is four and the expected background is 4.3±1.2. This yields a new upper limit of $\mathcal{B}(B_s^0 \to \mu^+\mu^-) < 3.7\,(3.0) \cdot 10^{-7}$ at 95% (90%) C.L., including statistical and systematic uncertainties. Using a Bayesian approach with a flat prior, the limit is then $\mathcal{B}(B_s^0 \to \mu^+\mu^-) < 4.0\,(3.2) \cdot 10^{-7}$ at 95% (90%) C.L.

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[1] V. M. Abzov *et al.*, Phys. Rev. Lett. **94** 071801 (2005), hep-ex/0410039.
[2] S. Eidelman *et al.* Phys. Lett B **592**, 1 (2004)

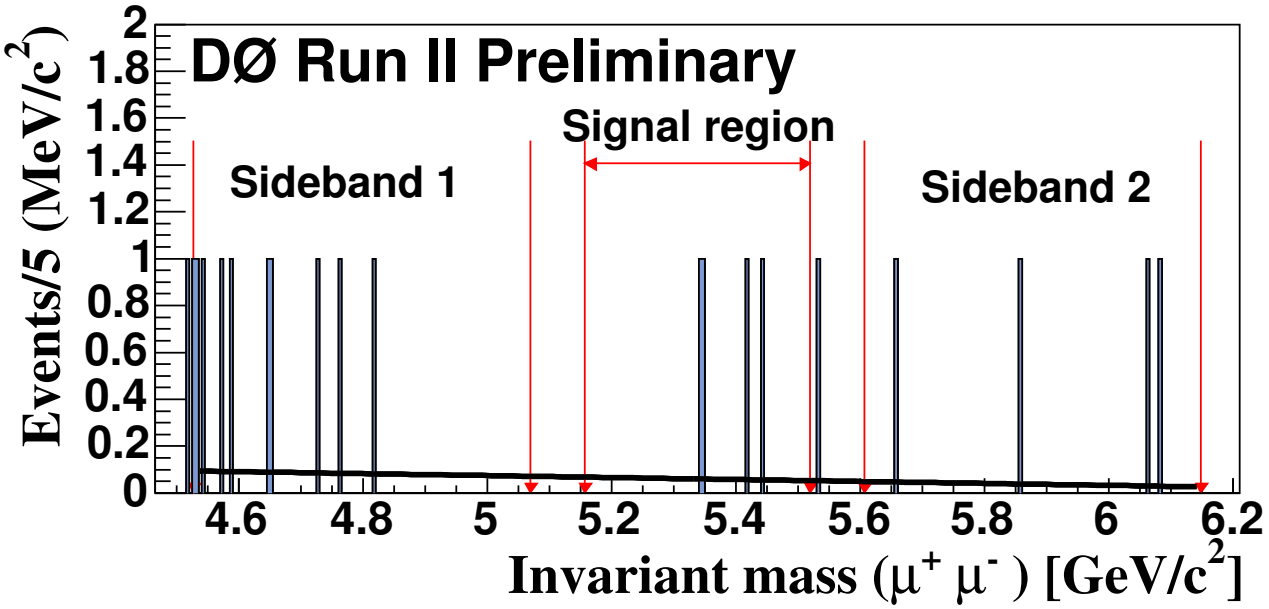

FIG. 1: The mass distribution for the full data sample with the standard discriminating variables. Four events were found in the signal region.

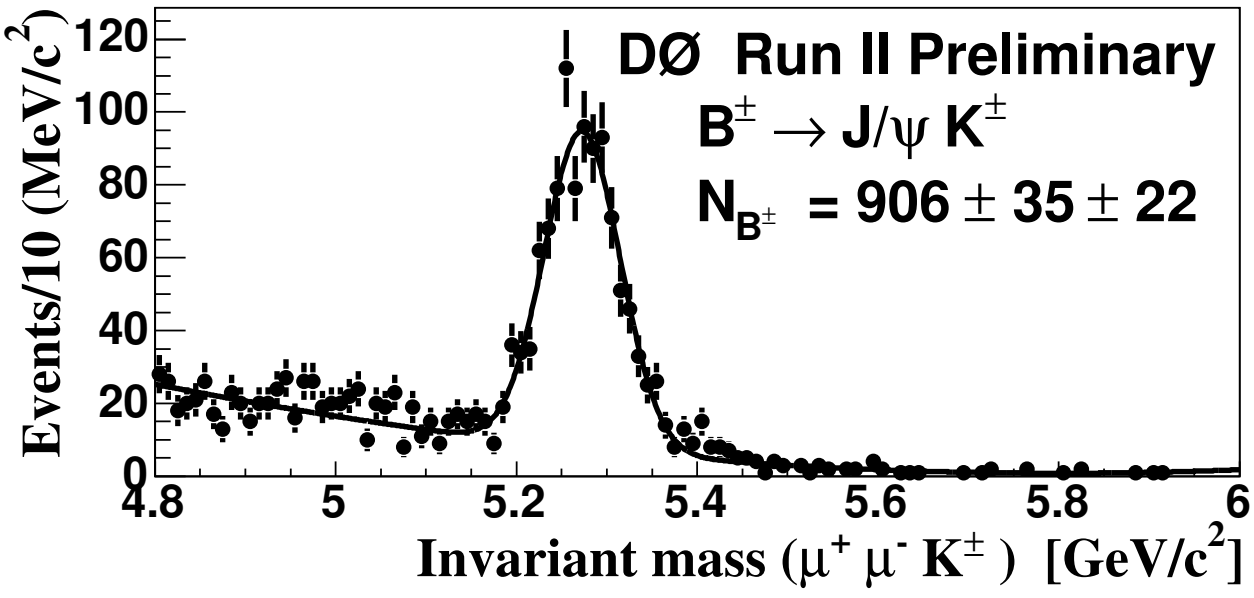

FIG. 2: The normalization channel $B^\pm \to J/\psi K^\pm$ for the full data sample.

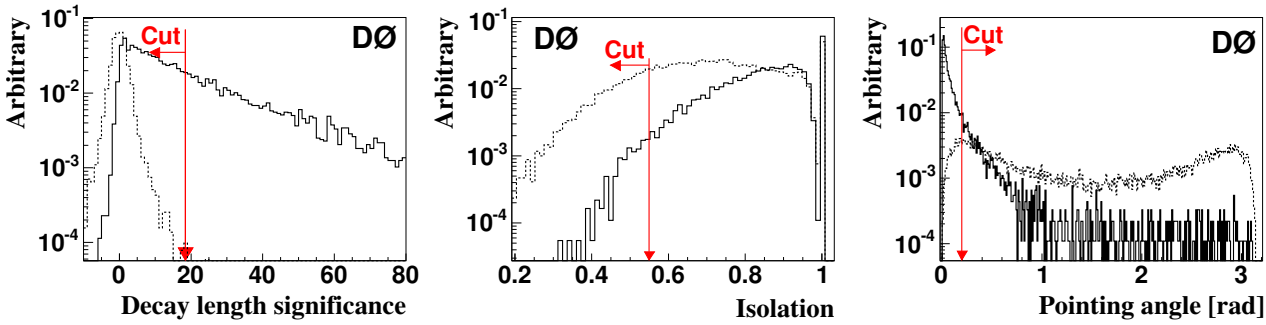

FIG. 3: Discriminating variables after the preselection for signal MC (solid line) and data events (dashed line) from the sidebands. The arrows indicate the discriminating values that were obtained after optimization. The normalization is done on the number of signal MC and sideband data events after preselection.