D^0 Lifetime Plots with 2019 Data

The Belle II Collaboration

Preliminary plots of the D^0 lifetime for the $D^0 \to K^-\pi^+$, $D^0 \to K^-\pi^+\pi^0$ and $D^0 \to K^-\pi^+\pi^+\pi^-$ decays reconstructed in the data collected by Belle II during 2019, corresponding to $9.6\,\mathrm{fb}^{-1}$ of integrated luminosity. More details in BELLE2-NOTE-PH-2020-033.

We reconstruct $D^0 \to K^-\pi^+$, $D^0 \to K^-\pi^+\pi^0$ and $D^0 \to K^-\pi^+\pi^+\pi^-$ candidates from $D^{*+} \to D^0\pi_s^+$ decays in data collected by Belle II in 2019, and corresponding to a luminosity of 9.6 fb^1 of integrated luminosity. We extract the D^0 lifetime in each of the three signal channels with an unbinned maximum likelihood 2D fit to the proper time and proper time uncertainty distribution. The average lifetime is $\tau_{D^0} = (412.3 \pm 2.0)$ fs, in agreement with the world-average value of (410.1 ± 1.5) fs. A summary plot is shown in Figure 1. The proper-time projections of the three fits are shown in Figures 2, 3 and 4. The average decay-time resolution is estimated to be (97 ± 8) fs for the $D^0 \to K^-\pi^+$ channel, (128 ± 9) fs for the $D^0 \to K^-\pi^+\pi^0$ channel and (82 ± 9) fs) for the $D^0 \to K^-\pi^+\pi^+\pi^-$ channel.
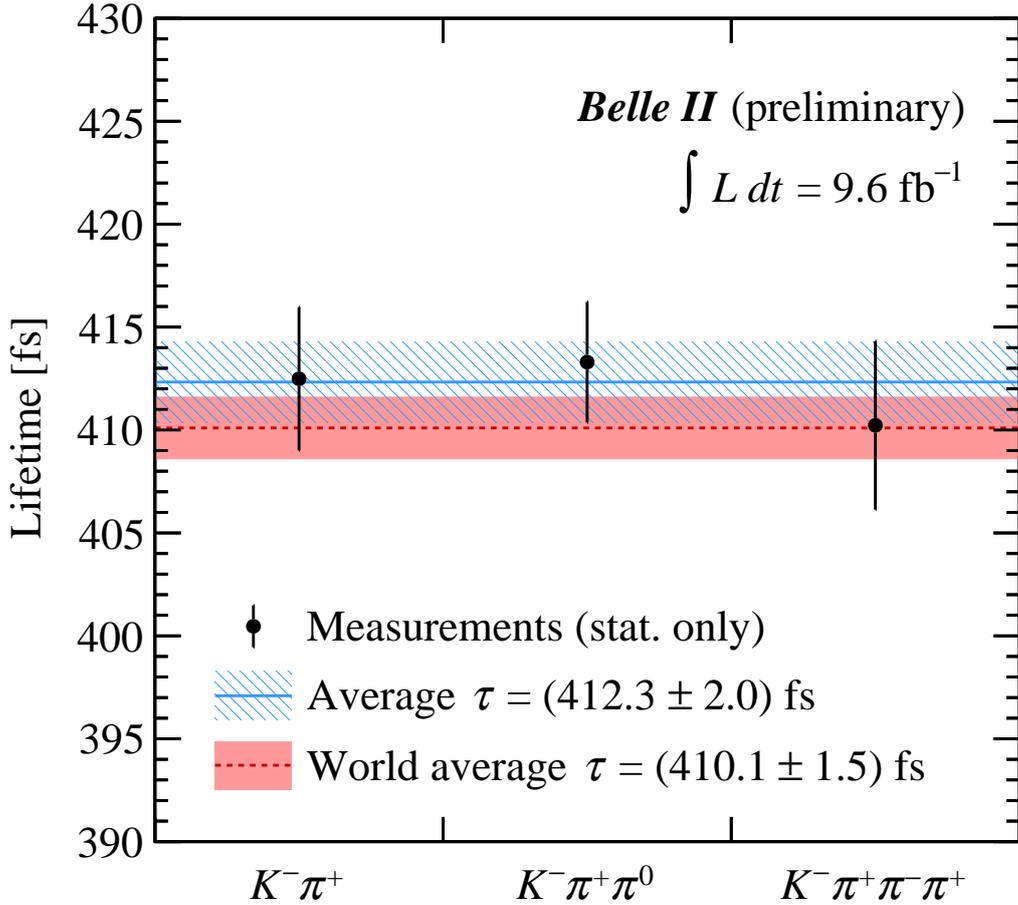

Figure 1: Comparison of the extracted lifetime in the three signal channels, compared to the world average. The average of the three extracted lifetimes is (412.3 ± 2.0) fs.
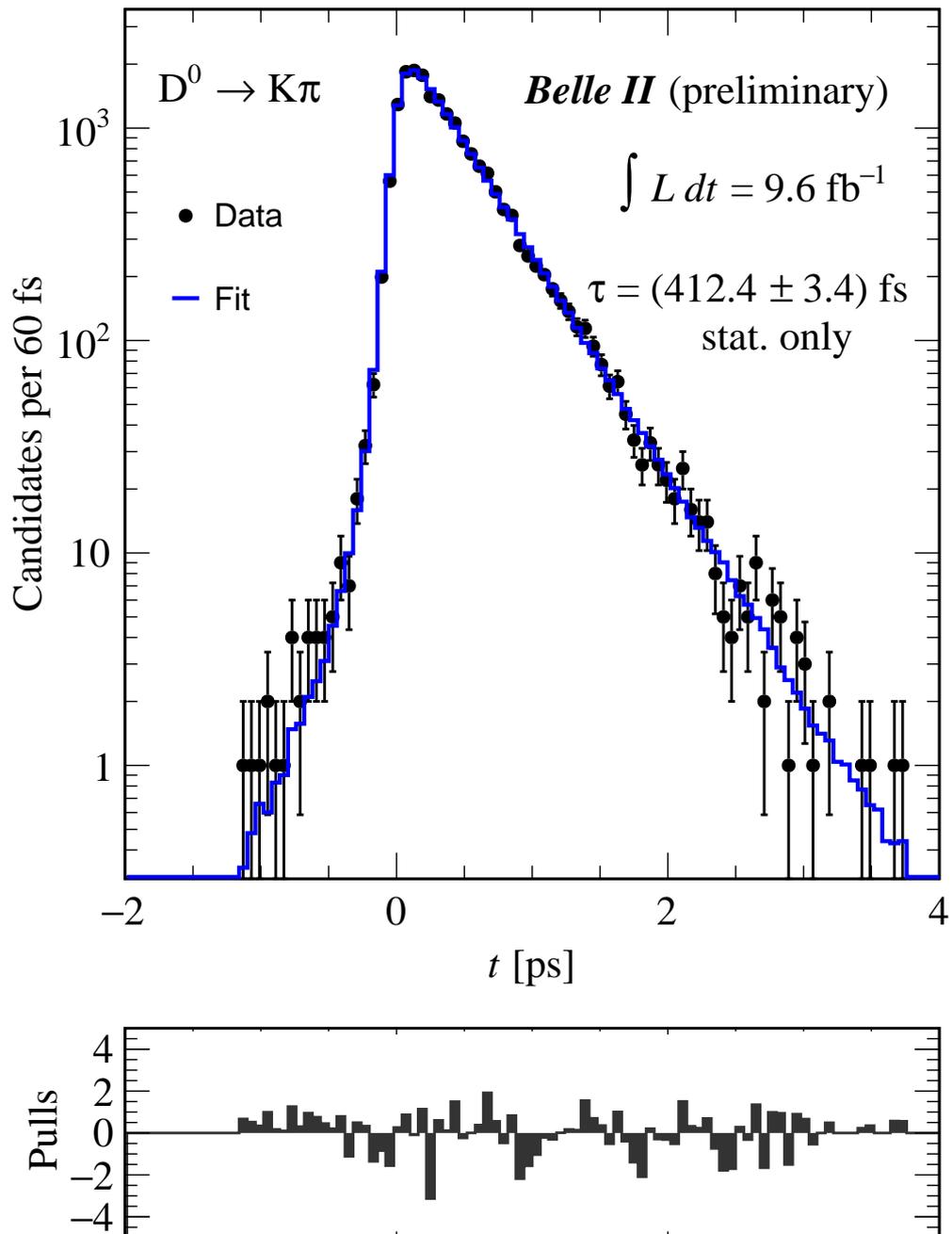
Figure 2: Fit to the proper-time distributions of D^*-tagged $D^0 \rightarrow K^-\pi^+$ candidates reconstructed with 2019 Belle II data. The extracted lifetime in this channel is (412.4 ± 3.4) fs, the estimated average proper time resolution is (97 ± 8) fs.
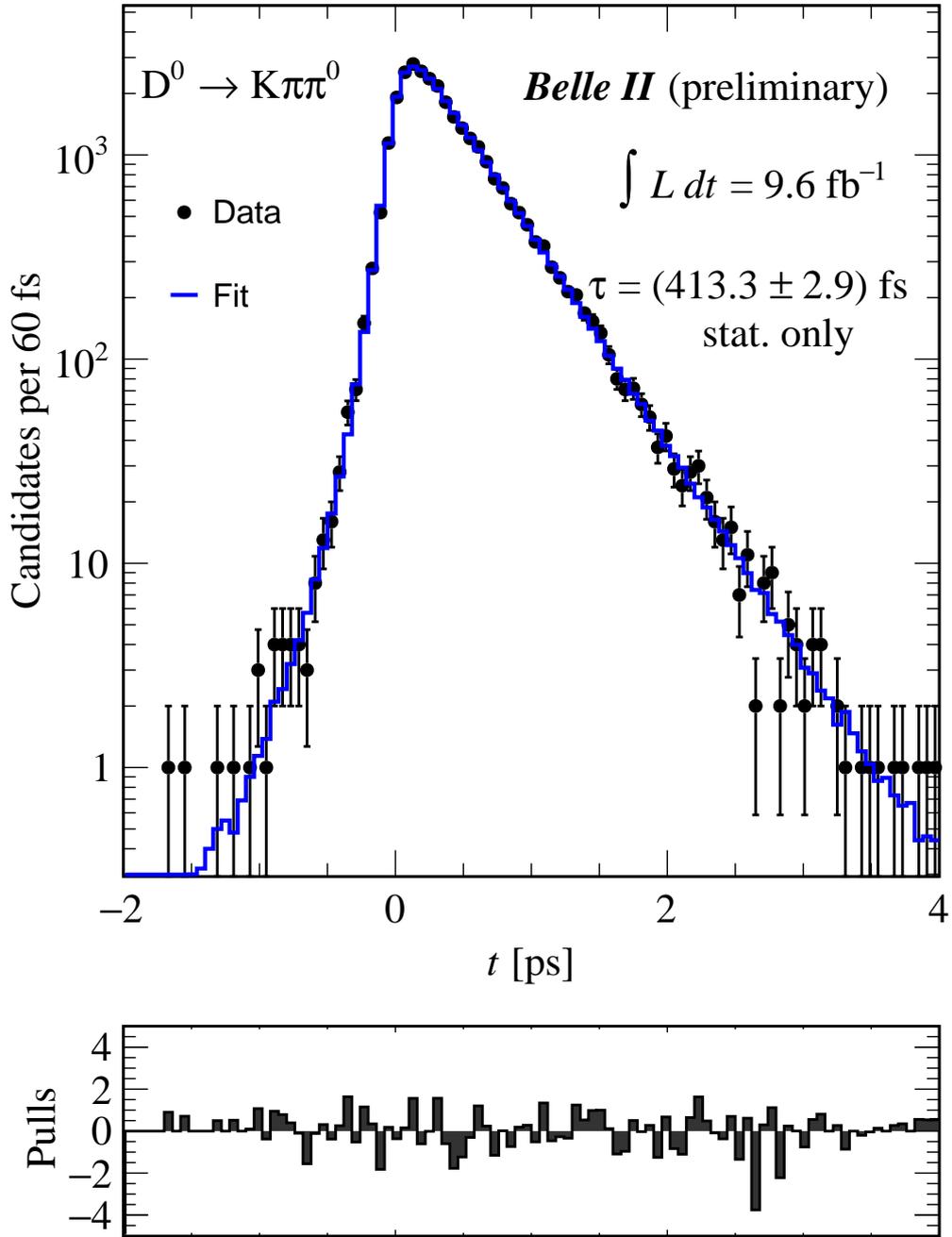
Figure 3: Fit to the proper-time distributions of D^*-tagged $D^0 \to K^-\pi^+\pi^0$ candidates reconstructed with 2019 Belle II data. The extracted lifetime in this channel is (413.3 ± 2.9) fs, the estimated average proper time resolution is (128 ± 9) fs.
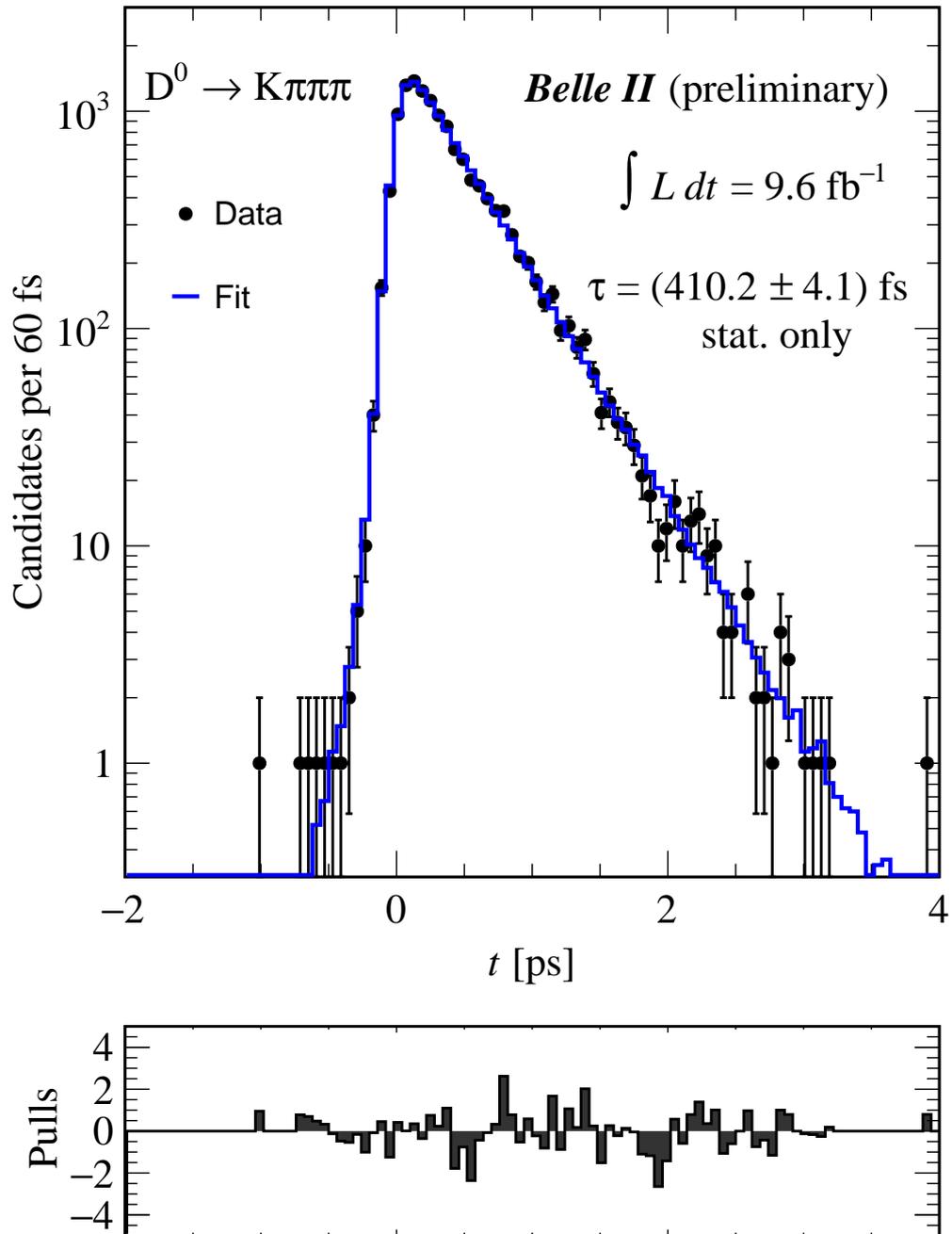
Figure 4: Fit to the proper-time distributions of D^*-tagged $D^0 \to K^-\pi^+\pi^+\pi^-$ candidates reconstructed with 2019 Belle II data. The extracted lifetime in this channel is (410.2 ± 4.1) fs, the estimated average proper time resolution is $(82 \pm 9)\,\text{fs}$.

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