Approved plots of untagged $B \rightarrow D^*l\nu_l$ decays with $5.15 \text{ fb}^{-1}$
Proc9 and bucket7 early Phase III Data

The Belle II Collaboration

Abstract
We report the plots approved for Beauty 2019 conference for untagged $B \rightarrow D^*l\nu_l$ result using $5.15 \text{ fb}^{-1}$ of early phase III DATA. Details are in the internal note BELLE2-NOTE-PH-2019-019.
**FIG. 1:** The Maximum likelihood fit to $\cos\theta_{BY} = \frac{2E_{\nu_{\tau}}E_{\nu_{\mu}} - m_{\mu}^2 - m_{\nu_{\mu}}^2}{2p_{\nu_{\mu}}p_{\nu_{\tau}}}$ and $m_{miss}^2 = \left( \frac{E_{\nu_{\tau}}}{2} - P_{Y} \right)^2$ distributions of untagged $B^0 \rightarrow D^{*+} l^- \bar{\nu}_l$ (charge conjugate modes taken in to account) candidates using 5.15 fb$^{-1}$ of collision Data, where $E_{\nu_{\tau}}$, $p_{\nu_{\mu}}$, $P_{Y}$, and $m_{Y}$ are the center-of-mass (CM) energy, three momentum, four momentum and invariant mass of the $D^{*+}l$ system, $p_{\nu_{\tau}}$ is the four momentum of the beam particles, $M_B$ is the nominal $B$ mass, and $E_B$, $p_B$ are the CM energy and momentum of the $B$, inferred from the CM machine energy. For correctly reconstructed $B$ candidates, ignoring detector resolution effects and the spread in machine energy, $\theta_{BY}$ is the CM angle between the $B$ and $D^{*}l$ momenta. Here Data are shown with points with error bars with different components overlaid for $B^0 \rightarrow D^{*+} e^- \bar{\nu}_e$ (top) and $\bar{B}^0 \rightarrow D^{*+} \mu^- \bar{\nu}_\mu$ (bottom) channels. $D^0$ candidates are reconstructed from $K^- \pi^+$ pairs, selected without particle identification requirements, within the invariant mass range $1.85$ GeV/c$^2 < m_{K\pi} < 1.88$ GeV/c$^2$. $D^{*+}$ candidates are reconstructed from a $D^0$ candidate and a $\pi^+$ candidate track, with the invariant-mass difference between $D^{*+}$ and $D^0$ candidates in the range $0.144$ GeV/c$^2 < \Delta m < 0.148$ GeV/c$^2$. The CM momentum of the $D^{*+}$ candidate is required to satisfy $p_{D^{*+}}^2 < 2.5$ GeV/c. Continuum $e^+e^- \rightarrow q\bar{q}$ background is suppressed with the Fox-Wolfram moment ratio $R_2 < 0.25$. The CM momentum of the lepton candidate is required to be in the range $1.2$ GeV/c $< p_l^* < 2.4$ GeV/c. Electron and muon candidates are selected with requirements on the combined variables, electronID $> 0.85$ and muonID $> 0.9$ respectively. We observe O(1100) $B^0 \rightarrow D^{*+} e^- \bar{\nu}_e$ and O(1200) $\bar{B}^0 \rightarrow D^{*+} \mu^- \bar{\nu}_\mu$ events.
FIG. 2: Projection of $\Delta M$ and $p_\nu^*$ in the signal enhanced region of $|m_{miss}^2| < 1.5$ GeV/c. Here Data are shown with points with error bars with different components overlaid for $\bar{B}^0 \to D^{*+} e^- \bar{\nu}_e$ (top) and $\bar{B}^0 \to D^{*+} \mu^- \bar{\nu}_\mu$ (bottom) channels.