# Semileptonic B meson Tagging with Missing Energy: Performance of Full Event Interpretation Algorithm at Belle II

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At Belle II, $B$ mesons are produced in pairs nearly at rest. The Full Event Interpretation (FEI), a machine-learning based background-suppression method, reconstructs one of the $B$ mesons in a well-known decay mode (the tag side). The remaining particles in the event are then used to reconstruct the signal $B$ meson.

The Semileptonic FEI uses a hierarchical decay-chain reconstruction in which intermediate particle candidates are ranked with gradient-boosted decision trees, allowing reconstruction of tag-side Semileptonic decays such as $B \to D^* \ell \nu$. In this study, we extend the scope of the tag-side reconstruction by adopting tagging modes that tolerate missing soft photons and slow pions from $D^* \to D \pi / \gamma$ decays. The performance of this extended SL tag is evaluated using Monte Carlo simulation and $365 \, \text{fb}^{-1}$ of Belle II data, with the well-known benchmark decays $B \to D^{(*)} \ell \nu$ used for comparison. This work reports a sensitivity estimate of the extended Semileptonic tagging algorithm and provides a comparison to the conventional FEI tag at Belle II.

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