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# Investigating Bottom Quark Energy Loss, Hadronization, and B Meson Nuclear Modification Factors in $B^+$ and $B_s^0$ Decays: Insights from CMS in pp, pPb, and PbPb Collisions

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The exclusive decay channels  $B_s^0 \rightarrow J/\psi\phi$  and  $B^+ \rightarrow J/\psi K^+$  are investigated. The differential cross sections of  $B_s^0$  and  $B^+$  mesons as a function of their transverse momenta ( $p_T$ ) in proton-proton collisions at 5.02 TeV are well-described by fixed-order plus next-to-leading logarithm calculations, using an integrated luminosity of  $302.3 \text{ pb}^{-1}$ . By utilizing previous lead-lead collision data at the same nucleon-nucleon (NN) center of mass energy,  $R_{AA}$  factors for the B mesons are determined. Additionally, the measurement of the  $B^+$  meson production cross section is presented with respect to meson  $p_T$  inclusively and, for the first time, in different charged particle multiplicity ranges. This study is conducted in proton-lead collisions at NN center-of-mass energy of 8.16 TeV, utilizing data collected by the CMS detector in 2016 with an integrated luminosity of  $175 \text{ nb}^{-1}$ . The analysis focuses on the exclusive decay channel  $B^+ \rightarrow J/\psi K^+$ . Inclusive results demonstrate good agreement with fixed-order next-to-leading log calculations, and the ratio of nuclear modification factors is measured for different charged particle multiplicities. These studies provide a comprehensive understanding of  $B_s^0$  and  $B^+$  meson production, shedding light on their behavior in different collision environments and offering insights into the nuclear modification factors associated with these mesons.

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