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Primary Vertex Selection in VBF Higgs to Invisibles at mu 200 with the ATLAS Experiment

Vertex selection algorithms at the LHC have thus far relied primarily upon the hardness of the hard-scatter (HS) vertex relative to vertices from pileup (PU). The high PU environment at the HL-LHC will, however, introduce major experimental challenges for the correct selection of the HS vertex. In particular, the expected average PU vertex density of $2\ vtx/mm$ at $z = 0$ can often lead to the merging of nearby PU vertices resulting in PU vertices with very large summed transverse momentum (p_{T}) that can be incorrectly identified as HS by the standard algorithm.
This is especially relevant for vector boson fusion (VBF) invisible final state topologies where the HS process does not have very high visible p_{T} activity, resulting in a low selection efficiency as a function of pileup density when using the standard algorithm.
ATLAS has developed a new approach for vertex selection in VBF invisible events at HL-LHC conditions, exploiting its new forward tracking capabilities, integrating calorimeter and tracking information to mitigate the impact of pileup vertex merging, and introducing a new way to apply pile-up jet suppression methods for the selection of VBF jets. The new algorithm is insensitive to pileup density and improves the average vertex selection efficiency from 80% to 94-96%.

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