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Testing the feasibility to measure acausally wrong displaced vertices from Lee-Wick particle decays with CMS experiment open data

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Lee-Wick (LW) standard model (LWSM) renormalizes the Standard model with the addition of new partner fields with negative metric. The model predicts a phenomenon denominated as wrong displaced vertices (WDV) also known as acuasally displaced vertices. In this work, we modeled and characterized the signal coming from the pair production of electron LW-partners (LW-electrons) emitted from the neutral current sector of LWSM, allegedly the best candidates to be observed with nowadays experiments. We calculated the cross-section and average flight distances for a mass value of the LW-electron equal to 200 GeV; these values amount to 5.97 fb-1 and 2.7e-2 mm, respectively. We found that the signal for mass values of 300, 400, and 500 GeV are less likely to be observed. The studied signal was obtained given that each LW-electron decays into one electron and a Z-boson in a vertex wrongly displaced from the point of interaction. The signal data was simulated for a proton-proton collisions at 8 TeV using the full CMS experiment software infrastructure. We partially characterized the final topology, and we contrasted the results with similar simulated topologies and experimental CMS open data. For the first time, we defined the quantity parellelity as the dot product between total momentum of the decaying products and vector connecting the point of interaction with the displaced vertex. Predominant negative values in the parallelity distribution suggest the feasibility to identify acausally displaced vertices at the LHC, if present.

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