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## Interplay of inert doublet and vector-like lepton triplet with displaced vertices at the LHC/FCC and MATHUSLA

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We study the interaction between the inert Higgs doublet (IDM) dark matter and a vector-like  $SU(2)$  triplet lepton (VLL), both of which are  $Z$ -odd. The vector current of the VLL with the  $Z$ -boson rules out a fermionic or two-component dark matter scenario. However, a compressed mass spectrum and a sufficiently small Yukawa coupling allows co-annihilation and late decay of the VLL into the IDM sector, affecting the relic density of the pseudoscalar darkmatter. The same two factors enable displaced decay of the VLL states, providing novel signatures involving hadronically quiet displaced multi-lepton final states. Such signatures to probe the model are studied at the 14 and 27 TeV LHC, as well as the 100 TeV FCC-hh. In addition to being detectable at the CMS/ATLAS experiments, if the new particles have sub-100 GeV masses, signals can also be seen at the proposed MATHUSLA detector

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