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WIMPs at High Energy Muon Colliders ZHEN LIU, University of Minnesota, TAO HAN, University of Pittsburgh, XING WANG, University of California, San Diego, LIAN-TAO WANG, University of Chicago — The Weakly Interacting Massive Particle (WIMP) paradigm is one of the most compelling scenarios for particle dark matter (DM). We show in this paper that a high energy muon collider can make decisive statements about the WIMP DM, and this should serve as one of its main physics driver cases. We demonstrate this by employing the DM as the lightest member of an electroweak (EW) multiplet, which is simple, yet one of the most challenging WIMP scenarios given its minimal collider signature and high thermal target mass scale of 1 TeV-23 TeV. We perform a first study of the reach of high energy muon colliders, focusing on the simple, inclusive, and conservative signals with large missing mass, through the mono-photon, VBF di-muon, and a novel mono-muon channel. Using these inclusive signals, it is possible to cover the thermal targets of doublet and triplet with a 10 TeV muon collider. Higher energies, 14 TeV-75 TeV, would ensure a 5 reach above the thermal targets for the higher EW multiplets. We also estimate the reach of a search for disappearing tracks, demonstrating the potential significant enhancement of the sensitivity.

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