

How to Measure the Spin of Dark Matter in $e^+e^- \rightarrow \gamma + X$

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Dark Matter has eluded us for decades and continues to do so. Currently lepton colliders provide exclusion limits on individual dark matter models, but many models may have either identical or indistinguishable signals. Hence there is a need for new methods or observables to determine the nature of the dark matter, especially if more than one candidate is present. Using e^+e^- processes with a mono-photon signal and missing energy, we look into whether the helicities of the incoming beams and the outgoing photon can be used to differentiate between two dark matter models: Dark Photons and Axion-Like-Particles (ALPs). Due to the dark particles' spin and coupling structures, the two models have differing contributions and dependencies on the incoming fermions' spin. Focusing on Belle II and looking at a dark matter mass range of $[0.1, 9.75]$ GeV, we show how the helicities of the incoming beams, together with angular distributions, can be used to discriminate between the dark photon and ALP dark matter.

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