

Pioneering Sub-GeV Dark Matter Limits with COSINE-100

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We report new constraints on the spin-dependent (SD) WIMP-proton cross section using the COSINE-100 experiment at the Yangyang Underground Laboratory. This analysis achieves a pioneering detection threshold of 3 and 4 pulse clusters corresponding to the measured photoelectrons. This allows us to access the unstudied few-photoelectron regime, significantly below the previous 8-photoelectron threshold. Using four years of stable data, we find no statistically significant evidence of annual modulation. Furthermore, we establish the world's most stringent SD WIMP-proton constraints for NaI(Tl) in the 1.75–2.25 GeV/ c^2 mass range. By incorporating the Migdal effect, we further extend our sensitivity into the 15–58 MeV/ c^2 regime, setting new world-leading limits. These results demonstrate the unique capability of NaI(Tl) targets to probe previously unexplored regions of the dark matter parameter space.

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