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The PICO Experiment

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Dark matter is hypothesized to make up 85\% of the matter of the Universe, yet, despite much cosmological evidence for its existence, its fundamental nature remains unknown, making it one of the most pressing open questions in modern physics. SNOLAB, 2000 metres underground in a nickel mine near Sudbury, Ontario, hosts the PICO-40L detector, which uses bubble chamber technology for spin-dependent direct detection of Weakly Interacting Massive Particles (WIMPs). The chamber consists of a quartz jar, filled with superheated C_3F_8, and is surrounded by four cameras. Particles passing through the C_3F_8 with energy above the set thermodynamic threshold produce one or more bubbles. The cameras see these bubbles and save a sequence of images of the bubble forming. A limitation of the detector is the cameras' blind spots in the lower region of the detector. Events in this region are not well understood because they cannot be seen clearly in the images, making position reconstruction difficult. Understanding these events and backgrounds is pivotal, as PICO-40L serves as an engineering run for the next-generation PICO-500 detector, which is under assembly at the moment, and is expected to be operational in 2026. This talk will overview PICO before delving into the work I have conducted to better understand backgrounds in preparation for PICO-500. This work includes a piece of software that optically identifies plume-like features from the camera blind spots, and will give a summary of additional analyses I have performed aimed at improving our understanding of the backgrounds of PICO-40L.

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