

Search for dark matter with the PICO-40L C3F8 bubble chambers

Friday, 14 February 2025 20:00 (15 minutes)

The PICO experiment uses bubbles chambers, where the fluid is superheated, to directly look out for the existence of WIMPs dark matter particles. Fluorocarbon material (CF3I or C3F8) is used as an active fluid that allow to study inelastic dark matter-nucleus scattering interaction. This technology is designed in such a way that it has the ability to reject electron-recoil interaction and be insensitive to gamma radiation which are major drawback background noise. The detectors are placed inside a water tank and are also operated 2 km underground in the SNOLAB clean room to provide shielding against neutrons from laboratory and cosmic rays respectively. Several piezoelectric sensors are carefully placed in a specific region of the system and are used as an acoustic shock wave discriminator to differentiate the noisier alpha signal due to the decay of ^{222}Rn and ^{218}Po from those due to nuclear recoil. The PICO-40L adopts the Right Side UP (RSU) geometry which eliminates the use of the buffer which can induce background effects. This has the disadvantage of having to implement a cold zone and a hot zone depending on whether the C3F8 is in exclusive contact with glass surface. The detector energy threshold was set at 2.855 keV (mainly), for about 72 live days, during 3 different phases, for about 3244 kg*days of exposure, in order to verify its stability before the physics run. There is currently a limiting factor in the experiment. The background noise rate on the walls is measured at 437 events per day, which affects the total lifetime. The causes of this issue are currently under investigation. The detector can be considered as a prototype to verify the viability of the RSU geometry for the upcoming ton-scale detector known as PICO-500, which is expected to be a magnitude lower in sensitivity with respect to the SD WIMP-proton cross section.

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