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Ionization-only analysis for low energy signals in PandaX-4T

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In the PandaX-4T experiment, the nuclear recoil energy threshold is above 1keV in the conventional search window requiring paired scintillation and ionization signals. This constrains detection sensitivity for low energy signals, such as solar B8 neutrinos and sub-GeV dark matter. By exploiting ionization-only events, we successfully reduce the detection threshold down to 0.33 keV, enabling enhanced sensitivity for low-energy signal detection. Within this low-energy window, two types of instrumental backgrounds are dominate and constitute the primary obstacle for ionization-only analysis. Based on 259 days of data from PandaX-4T, we establish accurate modeling and effective suppression strategies for the two background components. With this optimized low-energy analysis framework, PandaX-4T has achieved breakthrough in searching for solar B8 neutrinos and light dark matter.

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