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First observation of positron emission decay of Xe-125 in a noble liquid detector from the LUX-ZEPLIN Experiment

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We report the first observation of the positron emission process, $^{125}\mathrm{Xe} \rightarrow e^{+} + \nu + ^{125}\mathrm{I}$ (Q=1.6 MeV), in a noble liquid detector using post-calibration data from the LUX-ZEPLIN (LZ) detector. We detect this decay and provide an independent measurement of the branching fraction. ^{125}Xe is a short-lived ($\tau_{1/2} \sim 17$ h) isotope of xenon which can be produced by neutron activation on the stable and naturally abundant ^{124}Xe, primarily decaying by electron capture. The positron emission decay mode has been previously indirectly measured through triple coincidence of annihilation and de-excitation gammas, but no direct measurement of the kinetic energy deposited by the emitted positron has been previously made. This analysis shows the ability of LXe TPCs to search for more complex event topologies than the single-scatter expected from dark matter interactions, particularly the higher order decay of ^{124}Xe, the two neutrino electron capture with positron emission ($2\nu\mathrm{EC}\beta^{+}$).

Collaboration you are representing

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