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Characterization of Nuclear Recoils in High-Pressure Xenon Gas: Towards a Simultaneous Search for WIMP Dark Matter and Neutrinoless Double Beta Decay

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(On behalf of the NEXT Collaboration) Xenon has recently been the medium of choice in several large scale detectors searching for WIMP dark matter and neutrinoless double beta decay. Though present-day large scale experiments use liquid xenon, the gas phase offers advantages favorable to both types of searches such as improved intrinsic energy resolution and fewer fluctuations in the partition of deposited energy between scintillation and ionization channels. We recently constructed a high pressure xenon gas TPC as a prototype for the NEXT (Neutrino Experiment with a Xenon TPC) neutrinoless double beta decay experiment and have demonstrated the feasibility of 0.5% FWHM energy resolution at the 136Xe double beta Q-value with 3-D tracking capabilities. We now present results from this prototype on the simultaneous observation of scintillation and ionization produced by nuclear recoils at approximately 14 bar pressure. The recoils were produced by neutrons of approximately 2-6 MeV emitted from a radioisotope plutonium-beryllium source, and primary scintillation (S1) and electroluminescent photons produced by ionization (S2) were observed by an array of 19 PMTs. We discuss the potential of gaseous xenon to distinguish between electron and nuclear recoils through the ratio of these two signals S2/S1. From these results combined with the possibility of using columnar recombination to sense nuclear recoil directionality at high pressures we envision a dual-purpose, ton-scale gaseous xenon detector capable of a combined search for WIMP dark matter and neutrinoless double beta decay.

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