

Ton-scale Xenon Gas TPC Concept for Simultaneous Searches for WIMP Dark Matter with Directional Sensitivity and Neutrino-less Double Beta Decay

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(On behalf of the NEXT Collaboration)

Xenon is an especially attractive candidate for both direct WIMP and $0\nu\beta\beta$ decay searches; current sensitivity goals indicate the need for ton-scale active masses for both searches. Although the current experimental trend has emphasized the liquid phase, gas phase xenon displays much smaller deposited energy fluctuations between scintillation and ionization, and hence offers substantial performance advantages for energy resolution and discrimination between electron and nuclear recoils. Remarkably, gas phase xenon may also display directional sensitivity to nuclear recoils—even at densities far above one bar, a plausible advance in monolithic active mass of more than three orders of magnitude relative to current low-pressure TPC concepts. For the $0\nu\beta\beta$ decay search in ^{136}Xe , our results, obtained within the NEXT Collaboration, support the practicality of 0.5% FWHM energy resolution at the 2457.83 keV Q-value in this decay, and with 3-D topology visualization for γ -ray rejection. NEXT-100 provides an essential springboard to reach ton-scale active mass with xenon gas for both goals. I describe a scenario for performing both searches in a single high-pressure ton-scale xenon gas detector, without significant compromise to either. In an era of deepening fiscal austerity, such a dual-purpose detector—realizable at acceptable cost and within the time frame of interest—deserves our collective attention.

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