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First experimental results in High Pressure Xe+TMA mixtures towards supra-intrinsic performance in Dark Matter and $0\nu\beta\beta$ decay searches

High Pressure Gaseous Xenon shows outstanding intrinsic energy resolutions when compared with the liquid phase due to the smaller (˜20x) Fano factor. The gaseous phase should also show better electron to nuclear recoil discrimination based on the ratio of ionization to scintillation signals (S2/S1).

The addition of trimethylamine (TMA) may further improve the energy resolution due to the Penning effect with atoms of xenon. Good energy resolution is of particular importance for $0\nu\beta\beta$ decay searches. Molecular interactions may shift the 172 nm light from pure xenon to the 280 −320 nm range, in which TMA fluoresces, matching the excitation peak of wavelength-shifting commercial plastic. High light collection efficiency and better SNR of S1 and S2 may thus be possible, leading to even better electron to nuclear recoil discrimination. In addition, TMA may also be the key for sensing directionality of nuclear recoils induced by Weakly Interacting Massive Particles (WIMPs) without the need of track imaging in monolithic massive (ton-scale) detectors, by making use of columnar recombination. Nuclear recoil directionality may be the path for a definite discovery of the WIMP nature of Dark Matter.

An ionization chamber has been constructed to explore the properties of high pressure gaseous Xe + TMA mixtures. Charge and light signals (primary scintillation and electroluminescence) are measured as functions of pressure, electric field and additive concentration. We present preliminary results for pressures up to 8 bar and additive concentrations up to 1%.

This work has been carried out within the context of the NEXT collaboration.

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