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Increasing the sensitivity of LXe TPCs to dark matter by adding helium or neon (12' + 3')

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Next generation liquid xenon TPCs are poised to increase our sensitivity to dark matter by two orders of magnitude over a wide range of possible dark matter candidates. This abstract describes an idea to expand the reach and flexibility of such detectors even further, by adding helium and neon to the xenon to enable searches for very light dark matter and combining high and low Z targets in the same detector.

Adding helium or neon to LXe-TPCs has many advantages. First, the helium or neon target benefits from the excellent self-shielding provided by a large liquid xenon detector. Second, the same instrumentation, PMTs, and data acquisition can be used. Third, light nuclei are more robust to the systematic uncertainties that affect light WIMP searches. Fourth, helium and neon recoils will likely produce larger signals in liquid xenon than xenon recoils, achieving lower energy thresholds, and further increasing the sensitivity to light WIMPs. Lastly, by adding He/Ne in sequence after a Xe-only run, the source of any observed signal can be isolated.

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