The Search for Particle Dark Matter with Imaging Liquid Xenon Time Projection Chambers

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The worldwide race towards direct dark matter detection has been dramatically accelerated by the remarkable progress and evolution of Liquid Xenon Time Projection Chambers (LXeTPCs).

They have shifted the scale of target mass from a few to tens of kilograms whilst simultaneously reducing both electronic and nuclear recoil backgrounds to unprecedented low levels, well below those achieved by scintillators and cryogenic bolometer detectors.

The XENON Dark Matter program has demonstrated the effective scaling of LXeTPCs with phased detectors of increasing sensitivity of at least an order of magnitude, and is currently moving to the ton scale with the XENON1T detector.

XENON1T will provide the sensitivity to probe a particularly favourable region of electroweak physics on a timescale compatible with complimentary ground and satellite based indirect searches and with accelerator dark matter searches at the LHC. I will review the characteristics of two-phase TPCs as 3D radiation imaging detectors developed within the XENON program.