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Searching for Dark Matter with XENON100 and XENON1T

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A large amount of evidence supports the theory that 25% of the universe is composed of cold dark matter. The XENON project has conducted several experiments using a liquid xenon target in a dual phase time projection chamber (TPC) in an attempt to detect dark matter in the form of Weakly Interacting Massive Particles (WIMPs) by looking for nuclear recoils in the xenon target.

The current experiment, XENON100, has conducted dedicated dark matter searches using a xenon TPC with a 62 kg target in the LNGS laboratory in Italy. The lack of significant signal above background has led to the most stringent limit on the WIMP-nucleon cross section to date, at $\sigma < 2.0\times 10^{-45}$ cm^2. This result constrains the regions of phase space favored by many theoretical models such as supersymmetry (SUSY) and rules out some exotic models like inelastic dark matter scattering.

The XENON project is rapidly transitioning to the next phase, XENON1T, which is now under construction and will utilize a ton scale xenon TPC to increase the sensitivity to WIMP-nucleon scattering by 2 orders of magnitude. Such a sensitivity will probe the most favored regions predicted by SUSY and has a high discovery potential. Scaling to such a large detector requires technological improvements to instrument and operate the detector, but also requires a background reduction by two orders of magnitude. These systems, which are in advanced stages of R&D and are beginning to be installed, will allow for physics results at the designed sensitivity by 2017.

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