A Noble Attack on Dark Matter

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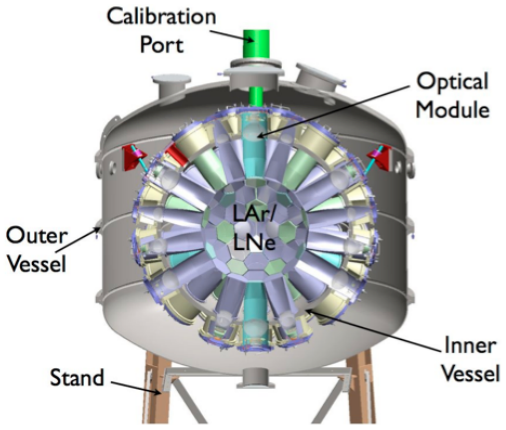
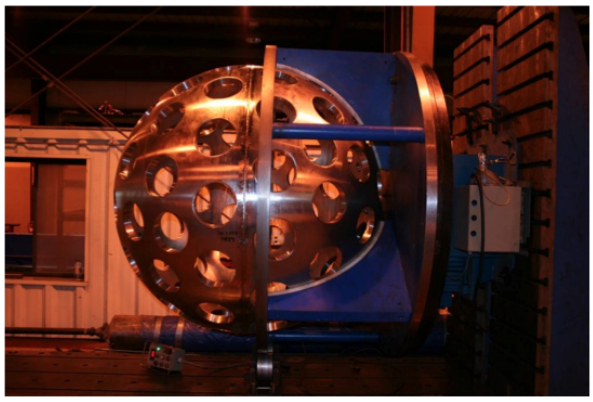
It is firmly established that the matter content of the universe is largely composed of an unknown and non-luminous form. This mysterious "dark matter" must be exotic and not the ordinary stuff that constructs the world we see. Extensions of the Standard Model that unify the fundamental forces of nature predict new and stable particles with just the right properties to "freeze out" in the early universe and provide a cold, dark relic of the Big Bang. Such particles could be directly detected as they interact with massive, ultra-sensitive detectors operating deep beneath the Earth's surface.

Due to the extremely feeble interaction of the dark matter particles with ordinary matter, direct detection has thus far eluded the most sensitive of modern experiments. Progress hinges on our ability to improve sensitivity by a factor of ~100 beyond the existing state-of-the-art. This requires the development of novel detector technologies capable of achieving multi-tonne target masses and reaching unprecedented levels of radio-purity and background rejection. For this reason, much interest has been directed to the use of noble liquids as a practical and economic means to meet the scalability and sensitivity requirements of next-generation dark matter detectors. Liquid argon, is a particularly attractive target material.





The MiniCLEAN dark matter experiment will exploit a single-phase liquid-argon detector instrumented with photomultiplier tubes submerged in the cryogen with 4π coverage of a 500 kg (150 kg) target (fiducial) mass. The high light yield and unique properties of the scintillation time-profile provide effective defense against radioactive background through pulse-shape discrimination and event position reconstruction. The ability to inject radioactive spikes into the target and to exchange liquid argon with liquid neon provides a unique capability to measure all salient backgrounds that can otherwise masquerade as a dark matter signal. The status of the MiniCLEAN project will be discussed in the context of the global search for dark matter.