The COHERENT Experiment

Spallation Neutron Source, Oak Ridge National Laboratory
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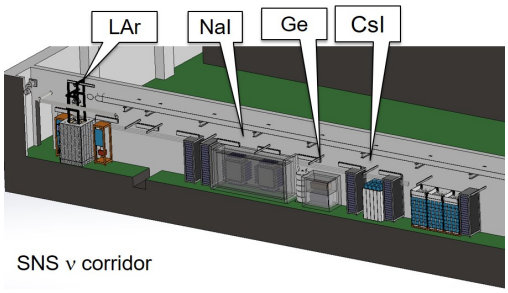
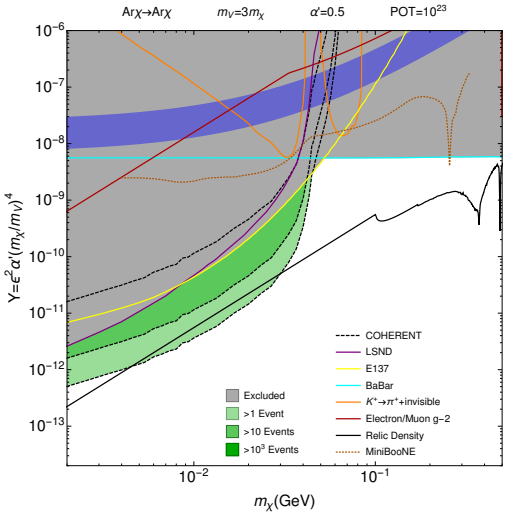


Experiment and Physics The primary goal of the COHERENT experiment is to measure the CEvNS (Coherent Elastic Neutrino Nucleus Scattering) process and to demonstrate the N^2 dependence of the cross section using $\mathcal{O}(10$ MeV) neutrinos provided by the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory. A neutron-quiet area has been located in a basement hallway of the SNS target building and outfitted with infrastructure to support a suite of neutrino detectors. Currently running detectors include a 14-kg CsI[Na] scintillating crystal, a 185 kg array of NaI[Tl] crystal detectors, and a 35 kg single-phase LAr scintillation detector. An array of 10 kg p-type point-contact germanium detectors are planned for installation in 2017. After a succesfull first stage of running with these detectors, a larger LAr detector or NaI array may be built to enable an expanded program of particle and nuclear physics. A notable part of this expanded physics reach would be a search for dark matter in the 1-10 MeV mass range. The world-class intensity of the SNS, with 5000 MWhr/year, equivalent to 2×10^{23} protons delivered to the Hg target, enables high sensitivity to dark matter.

Expected results The expected event sensitivity of a 1 ton LAr or NaI detector at ≈ 20 m from the SNS has been calculated using a benchmark model for light dark matter. [2]. In this model, dark matter may be produced via the decay of a dark photon that kinetically mixes with the photon from π^0s that are produced copiously in the SNS target. The dark matter may then interact via coherent scattering in the detector leading to a detectable nuclear recoil. As can be seen in the figure, the event sensitivity covers new parameter space not explored by previous experiments and in a region overlapping the relic density solution. It is also important to note that the dark matter produced in this experiment is assumed to couple to quarks/baryons, not leptons, thus providing a complementary search to those planned at electron facilities.



Status The $\mathcal{O}(10$ kg) detectors are currently running in the SNS ν corridor and collecting data through 2017. A 1-ton experiment with LAr or NaI could be mounted as early as 2019 and would require an equipment investment in the \$1M range.

References

[1] `http://sites.duke.edu/coherent/`

[2] P. deNiverville, M. Pospelov and A. Ritz, Phys. Rev. D **92**, no. 9, 095005 (2015), [arXiv:1505.07805 [hep-ph]].