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SuperSUN and PanEDM: a new superthermal UCN source for a new nEDM measurement

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The most severe difficulty in measuring the neutron EDM is low achievable density of ultracold neutrons; this is addressed by the new source SuperSUN, currently under construction at the Institut Laue-Langevin. The intense primary cold beam H523 will be shaped by a unique tapered guide geometry, and guided for a further three meters inside an 11-liter converter volume with circular cross-section. UCNs produced by downscattering in the converter medium of ultrapure superfluid ^{4}He will be trapped by a combination of magnetic and neutron-optical potentials; they can be released by a cold mechanical valve for extraction into room-temperature experimental environments. The source will be commissioned in two phases: Phase I with only material trapping of UCNs, and Phase II introducing a superconducting octupole magnet to achieve long storage times and automatic polarization.

PanEDM, the first experiment planned for the SuperSUN source, directly addresses the second key experimental limitation: systematic errors arising from magnetic field inhomogeneity. A five-layer magnetic shield in two dismountable parts reduces the magnitude and drift of magnetic field gradients over the cubic volume of ~125 liters that contains the storage cells for Ramsey spectroscopy. Residual field homogeneity and temporal stability for weak external perturbations have been respectively demonstrated at the levels of 100 pT/m absolute, and 1 pT/m over hours. Systems of atomic magnetometers and fluxgates monitor the magnetic environment, providing crucial systematic checks and diagnostic information.

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