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Neutron conversions to antineutrons and sterile neutrons¹

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Searches for free neutrons converting to antineutrons and/or sterile neutrons play a distinctive role in the program of baryon number violation searches. These searches test a global symmetry of the Standard Model that must be violated to generate the observed matter-antimatter asymmetry in the universe and offer a unique portal to a dark sector. There is increasing interest in searches for “mirror” and other dark neutrons as a possible component of dark matter or as a solution to the so-called “neutron lifetime anomaly”. A diverse, ongoing suite of experimental studies and new experimental efforts have been proposed to probe these phenomena. Small-scale searches for neutron oscillations also provide a chance for technical development which will inform future high-sensitivity searches for free neutron-antineutron oscillation searches, which could illuminate the process by which our universe evolved to contain only matter. Next generation neutron sources such as the European Spallation Source and kilo-ton-scale detectors such as the Deep Underground Neutrino Experiment, as well as other new concepts and technological advances, create a timely opportunity to enhance the sensitivity of such a search compared to previous limits by three orders of magnitude or more. Here, we will review current efforts worldwide to search for these rare processes and the bright outlook for this burgeoning field.

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