Spin-Exchange Relaxation Free Magnetometer using Hybrid Pumping for GNOME

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A network of optical magnetometers has the potential to detect proposed pseudo magnetic effects of exotic spin coupling as Earth passes through a topological defect in a coherent field of ultra-light axion-like particles (a proposed candidate for dark matter). The Global Network of Optical Magnetometers to search for Exotic Physics (GNOME) is searching for such a transient signal, using contributions from multiple magnetometer stations to eliminate false positives [1]. We provide an update on the construction of the Oberlin magnetometer: a Rb-K-3He spin-exchange relaxation free (SERF) magnetometer, which has recently been upgraded to include hybrid pumping, where a pump laser polarizes Rb atoms in a vapor cell, which in turn polarizes K atoms through spin exchange collisions. The polarization of a probe laser resonant with the K D1 transition through the cell is then monitored as an indicator of magnetic field strength. This process decreases the amount of scattered light from the K atoms, which can be reabsorbed by the surrounding K atoms and cause them to losing their polarization, and is thus expected to improve the sensitivity of the magnetometer.

[1] S. Pustelny, D. F. J. Kimball, C. Pankow, M. P. Ledbetter, P. Wlodarczyk, P. Wcislo, M.Pospelov, J. R. Smith, J. Read, W. Gawlik, and D. Budker, Ann. Phys. 525, 659 (2013).