Optically pumped magnetometers: a study with structured light

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Optically pumped atomic ensembles are versatile platforms for sensing, quantum optics, and spin physics [1]. In these systems, atomic polarization can be optically prepared with a polarized pump beam, and atomic spin coherence can be generated by rf fields and continuously monitored with an off-resonant probe beam. For experiments with warm mixtures of alkali and a buffer gas (such as a noble, or a diatomic gas), the presence of the latter can lead to a diffusive regime for the thermal atomic motion and non-trivial collective effects of the hybrid system [2]. Recent results from our group have explored the formation and coherent coupling of stable spatial diffusive modes of the collective atomic spin using a rf atomic magnetometer with Rb, Ne, and N_2 [3]. Here, we extend this work to explore the atomic response of our system in configurations that employ structured light fields [4]. We investigate the collective spin and multimode atomic dynamics using different spatial modes of the optical fields. These studies will allow us to exploit the internal and external degrees of freedom of atoms for applications in metrology and sensing.

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