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Optimized design of a polarization spectroscopy experiment to measure collective spin projection noise ENRIQUE MONTANO, PASCAL MICKELSON, University of Arizona, IVAN DEUTSCH, University of New Mexico, POUL JESSEN, University of Arizona — We optimize the design of an experiment to measure the projection noise of the collective spin of an atomic ensemble. In our setup, a weak probe beam interacts with a trapped sample of cesium atoms, leading to Faraday rotation of the probe light proportional to the collective atomic magnetization. If the ensemble-light coupling is strong enough, polarimetry of the probe light provides a measurement of the magnetization with resolution better than the spin projection noise, at which point measurement back-action becomes significant and can be used for quantum control of the collective spin. Here, we discuss two aspects of the experiment: first, the "mode matching" between the incident probe beam and the light scattered by the atoms, and second, the trapping laser parameters required to produce suitable atom clouds. Our modeling indicates that the probe beam waist size and the aspect ratio of the atomic cloud are the most important parameters for good mode matching.

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