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Development of a photonic-integrated atomic magnetometer XUTING YANG, JOHN FLETCHER DOYLE, JENNIFER CHOY, University of Wisconsin - Madison — The optically-pumped atomic magnetometers, when operating in the spin-exchange-relaxation-free regime, provide femtotesla-level sensitivity and are therefore attractive for a host of applications including biological sensing, geosurveying and magnetic map-based navigation. Practical implementation of atomic magnetometers, especially in magnetic field imaging configurations involving multiple sensing channels, requires the sensor design to be compact, with tight integration between the atomic vapor cell and optical components. To address the need, we propose to implement metasurface-based nanophotonic components, instead of bulk birefringent optical elements, for polarization rotation and polarimetry of atomic spins in a rubidium-based magnetometer. We will present our progress on photonic component designs, material selection and fabrication, and magnetometer testbed development. Finally, we analyze the sensitivity and limits of the photonic-integrated atomic magnetometer, based on the projected and simulated performance of our optical designs.

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