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Production of sub-shot noise light via spin-damping in an RF atomic magnetometer[1] ORANG ALEM, George Mason University, MIKE V. ROMALIS, Princeton University, KAREN L. SAUER, George Mason University — Spin-damping is a technique to feedback part of the optical signal from an atomic magnetometer to orthogonal electromagnetic coils in order to damp out any unwanted signal. Using this technique, the optically pumped magnetometer can quickly be prepared to detect the RF signal of interest, for instance the femtoTesla signal emitted from an explosive during nuclear quadrupole resonance detection. In our K magnetometer, a linearly polarized probe beam measures, through Faraday rotation, the transverse K magnetization induced by the RF signal. In our study of spin-damping, we found a surprising result – the spin-damping suppresses not only the transients in the K atoms, but also the photon shot noise. Depending on the gain and phase in the negative feedback loop, we measure noise suppression levels up to an order of magnitude below photon shot noise. This sub-shot noise level demonstrates the correlation between the photons in the light and the K atoms in the atomic cell. While the current demonstration is in a closed loop, we will discuss the possibilities of creating an open-loop generation of a sub-shot noise beam.

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