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Generation of atomic spin squeezed states in nanophotonic waveguides using QND measurement XIAODONG QI[1], University of New Mexico, JONGMIN LEE, YUAN-YU JAU, Sandia National Labs, IVAN DEUTSCH, University of New Mexico — Nanophotonic waveguides strongly enhance the entangling strength of the atom-light interface. We study their application to the generation of spin squeezed states of trapped ultracold cesium atoms in two geometries — cylindrical optical nanofibers and square waveguides. We consider two different protocols — squeezing the clock transition by the birefringence coupling and squeezing a spin coherent state via the Faraday interaction. We unify our analysis based on a universal parameter — the optical depth per atom. In calculating the spin squeezing parameter, we have established a set of stochastic master equations to describe the individual and collective spin dynamics. Our simulation shows that ˜10 dB of spin squeezing may be achievable with a few thousands of atoms on these nanophotonic waveguides. Our result can be generalized to other nanophotonic platforms, for implementing non-Gaussian states, and to improve quantum sensing precision using spin squeezing techniques.

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