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Gyroscopes based on nitrogen-vacancy centers in diamond

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We propose solid-state gyroscopes based on ensembles of negatively charged nitrogen-vacancy (${\rm NV^-}$) centers in diamond. In one scheme, rotation of the nitrogen-vacancy symmetry axis will induce Berry phase shifts in the ${\rm NV^{-}}$ electronic ground-state coherences proportional to the solid angle subtended by the symmetry axis. We estimate sensitivity in the range of $5\times10^{-3} {\rm rad/s/\sqrt{Hz}}$ in a 1 ${\rm mm^3}$ sensor volume using a simple Ramsey sequence. Incorporating dynamical decoupling to suppress dipolar relaxation may yield sensitivity at the level of $10^{-5} {\rm rad/s/\sqrt{Hz}}$. With a modified Ramsey scheme, Berry phase shifts in the ${\rm ^{14}N}$ hyperfine sublevels would be employed. The projected sensitivity is in the range of $10^{-5} {\rm rad/s/\sqrt{Hz}}$, however the smaller gyromagnetic ratio reduces sensitivity to magnetic-field noise by several orders of magnitude. Reaching $10^{-5} {\rm rad/s/\sqrt{Hz}}$ would represent an order of magnitude improvement over other compact, solid-state gyroscope technologies.

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