Noble gas spin relaxation in silicon wafer-based cells for inertial sensors

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We investigate two processes which offer improvements in the performance of an inertial sensor, operating with a silicon wafer-based cell containing Cs, ^{129}Xe, ^{131}Xe and N_2 buffer gas. First, we observe changes in the relaxation dynamics of the Xe nuclear spins through the dependence of their FID signal on buffer-gas pressure. Second, we investigate the electric quadrupole shift of the ^{131}Xe frequency, where its non-zero nuclear quadrupole moment interacts with electric field gradients generated by the cell walls. These shifts have a known dependence on cell geometry, cell materials and measurement geometry. We study and eliminate the shift by exploiting the latter: tuning the angle between the symmetry axis of the cell and the bias field. The requirements imposed by the quadrupole shift begin a broader discussion on challenges with cell geometry and material choices.