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S-Wave Clock Shift for Fermions E.L. HAZLETT, Y. ZHANG, R.W. STITES, K. GIBBLE, K.M. O'HARA, The Pennsylvania State University — Optical lattice clocks use ultracold fermionic atoms to minimize density-dependent frequency shifts since s-wave scattering of identical fermions is forbidden. Indeed, frequency shifts are absent in a Fermi gas if a spatially homogeneous clock field interrogates the atoms. However, any spatial inhomogeneity in the clock field produces distinguishable fermions and density-dependent frequency shifts. This is directly pertinent for optical lattice clocks since inhomogeneities are naturally larger for optical frequency fields (in comparison to microwave or radio-frequency fields). We study collisional frequency shifts in a Fermi gas for which we control and characterize both the interactions and the spatial inhomogeneity of the clock field. The frequency shifts we observe exhibit novel density dependences that are different from the mean-field shifts of homogeneously excited bosons. Our description provides a physical picture of the origin of the frequency shift and indicates the experimental parameters that must be controlled to eliminate density-dependent clock shifts.

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