Abstract Submitted
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Rayleigh Scattering View of the Tune-out Wavelength: Application to the 1s2s ^{3}S - 1s3p ^{3}P Transition of Helium[1] GORDON DRAKE, University of Windsor, JACOB MANALO, University of Ottawa, ARC DISCOVERY GRANT COLLABORATION[2] — The tune-out wavelength is usually viewed a zero in the frequency-dependent polarizability [1,2]. This view is appropriate for an atom in an optical lattice that is fixed in space. However, for an atom interacting with a traveling plane wave from a laser, it is more appropriate to view the tune-out wavelength as a zero in the Rayleigh scattering cross section for coherent scattering. In lowest order, the two approaches are equivalent, but not when higher-order retardation corrections are taken into account. This paper presents a development of the theory, starting from the relativistic scattering matrix of QED to obtain a formulation of the problem in the velocity gauge [3]. Gauge invariance is discussed, and an equivalent length form is obtained for the leading retardation correction for S-states. The xp_z retardation correction to the tune-out wavelength of helium near 304 nm is calculated to be 0.000 560 0236 nm.
[1] B. M. Henson et al., Phys. Rev. Lett. **115**, 043004 (2015).
[2] Y.-H. Zhang et al., Phys. Rev. A **93**, 052516 (2016).
[3] G. W. F. Drake et al. Hyperfine Int. submitted (2019).

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[2]Stealth for Atoms: Tune-out Wavelengths to Test Quantum Electrodynamics

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