POLARIZABILITY AND TUNE-OUT WAVELENGTH FOR THE HELIUM 1s2s ^{3}S STATE

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There has been considerable recent interest in measurements of the tune-out wavelength in atomic systems as a high-precision test of quantum electrodynamics (QED), other than the transition frequencies such as the Lamb shift. The tune-out wavelength is the wavelength at which the frequency-dependent polarizability vanishes. It has recently been measured for the helium 1s2s $^3S_1$ to be 413.0938(20) nm (5 ppm) [1] and calculated by a relativistic configuration-interaction method [2]. In this paper we present an alternative method of calculation based on the nonrelativistic Schroedinger equation and with relativistic corrections included by perturbation theory. The advantage is that fully correlated Hylleraas coordinates can be used to obtain higher accuracy for the contributions from electron correlation. Our result for the static scalar polarizability of the $M = 0$ state, including relativistic corrections of order α^2 and finite nuclear mass corrections, is 315.716 092 95(1) a_0^3, as compared with 315.7165(4) a_0^3 from Ref. [2], where α is the fine structure constant, a_0 is the Bohr radius, and the uncertainty is the convergence uncertainty in our final figure quoted. Further relativistic recoil corrections and comparisons with experiment for the tune-out wavelength will be discussed at the conference.

[1] B. M. Henson, R. I. Khakimov, R. G. Dall, K. G. H. Baldwin, L.-Y. Tang, and A. G. Truscott, Phys. Rev. Lett. 115, 043004 (2015).

[2] Y.-H. Zhang, L.-Y. Tang, X.-Z. Zhang, and T.-Y. Shi, Phys. Rev. A 93, 052516 (2016).