Abstract Submitted
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Millimeter-wave precision spectroscopy of d-d transitions in potassium Rydberg states[1] HUAN BUI, CHARLES CONOVER, Colby College — We measure two-photon millimeter-wave transitions between nd_j and $(n+1)d_j$ Rydberg states for $30 \leq n \leq 35$ in ^{39}K to an accuracy of 5×10^{-8} to determine high-n d-state quantum defects and absolute energy levels. ^{39}K atoms are magneto-optically trapped and cooled to 2-3 mK, and excited from ground state $4s_{1/2}$ to $nd_{3/2}$ or $nd_{5/2}$ by frequency-stabilized 405 nm and 980 nm external-cavity diode lasers in succession. The magnetic-field insensitive $nd_j \rightarrow (n+1)d_j$ $\Delta m = 0$ transitions are driven by a 16 μs-long pulse of mm-waves before the atoms are selectively ionized for detection. The (n+1)d population is measured as a function of mm-wave frequency. Static electric fields in the MOT are nulled in three dimensions to eliminate DC Stark shifts. The two-photon transitions exhibit small but measurable AC Stark shifts in the resonance frequencies. We determine the field-free intervals both by extrapolating a sequence of measurements made as a function of mm-wave power to zero and directly without extrapolation by applying Ramsey's separated oscillating fields method. Our results give quantum defects for the high-n states that are an order of magnitude more accurate than earlier measurements of these quantities.

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