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Measurements of p-state fine structure and quantum defects for Rydberg states of potassium[1] CHARLES CONOVER, HUAN BUI, Colby College Department of Physics and Astronomy — We determined the fine-structure and quantum-defect expansion parameters for Rydberg p-states in potassium. We made measurements of the transition frequencies between $ns_{1/2}$ and $np_{1/2}$ and $np_{3/2}$ states in the hyperfine Paschen-Back limit for n = 30 to 37. The data provide a direct measure of the p-state fine-structure intervals and, using the previously measured s-state quantum defects, allow calculation of the p-state quantum defects. The experiments were done in a magneto-optical trap (MOT) where the cloud is centered at a location where the magnetic field could be adjusted by changing the relative intensities of the counter-propagating laser beams of the MOT. The cold atoms are excited to Rydberg states in steps from $4s$ to $5p$ and from $5p$ to nd_j states using crossed, focussed (waist size 100 μm), lasers at 405 nm and 980 nm. Within the excitation volume, the MOT magnetic field has a variation of about 0.15 G, broadening the mm-wave transitions by 100-300 kHz. Stray electric fields are nulled in three dimensions using potentials applied to a set of mutually perpendicular rods surrounding the MOT cloud. Fine structure intervals are measured to an accuracy of 5×10^{-5} and the s-p transitions are measured to an accuracy of 2×10^{-7}.

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Charles Conover
Colby College

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