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Precision measurement and calculation of the 3d ^{2}D-level lifetimes of $^{40}Ca^+$ MARIANNA SAFRONOVA, University of Delaware, A. KREUTER, C. BECHER, G.P.T LANCASTER, A.B. MUNDT, C. RUSSO, H. HÄFFNER, C. ROOS, W. HÄNSEL, F. SCHMIDT-KALER, R. BLATT, Institut für Experimentalphysik, Universität Innsbruck — We report measurements of the lifetimes of the 3d $^2D_{5/2}$ and 3d $^2D_{3/2}$ metastable states of a single laser-cooled $^{40}Ca^+$ ion in a linear Paul trap. The result for the natural lifetime of the $D_{5/2}$ state of 1168(9) ms agrees excellently with the most precise published value. The lifetime of the $D_{3/2}$ state is measured with a single ion for the first time and yields 1176(11) ms which improves the statistical uncertainty of previous results by a factor of four. We perform high-precision *ab initio* all-order calculation of these lifetimes and conduct a detailed study of their accuracy. The resulting theoretical values ($D_{3/2}$ state: 1196(11) ms, $D_{5/2}$ state: 1165(11) ms) are in very good agreement with experimental values. These calculations represent an excellent test of high-precision atomic theory and will serve as a benchmark for the study of parity nonconservation in Ba^+ which has similar atomic structure.

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