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Picosecond Ramsey spectroscopy of a short-lifetime dipole transition[1] MICHAEL IP, ANTHONY RANSFORD, CONRAD ROMAN, WESLEY CAMPBELL, ucla, UCLA AMO DEPARTMENT TEAM — Ramsey spectroscopy is a powerful technique that continues to evolve and prove useful for a wide variety of applications in quantum information and precision spectroscopy. Using a single trapped atomic ion, we demonstrate Ramsey spectroscopy of a short-lived, electric dipole allowed transition via picosecond pulses from a frequency-doubled mode-locked laser. The first pulse localizes the valence electron to one side of the nucleus and the arrival of the second pulse either adds constructively to this polarization or depolarizes the atom, depending upon its arrival time relative to the electron's motion. By scanning the time delay, we measure Ramsey fringes with a period of about 1 fs that show the valence electron of this single trapped atomic ion orbiting its nucleus. We discuss how this process can be used to execute high-speed single qubit gates, despite the short T1 time of the excited state. This work is supported by the US Army Research Office.

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