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D-5/2 to P-3/2 spectroscopy on a single trapped Ba-138 ion

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Performing quantum spectroscopy on a single trapped $^{138}Ba^{+}$ ion to determine $D_{5/2}-P_{3/2}$ transition frequency. A single isotope selected ions was loaded into a cryogenically cooled linear Paul trap which is subjected to a stable magnetic field. With an ion in the ground state, a narrow 1762 nm fiber laser was employed to address the quadrupole $S_{1/2}-D_{5/2}$ transition, preparing the ion in either the $m_j = -5/2$ or the $m_j = 5/2$ 'shelved' substate. The $D_{5/2}-P_{3/2}$ probe pulse was supplied by a 635 nm commercial diode laser cryogenically cooled to produce 614 nm light. Its optical frequency was stabilised by a wavemeter which in turn was calibrated against 633 nm, 650 nm, and 729 nm light sources simultaneously referenced to a frequency comb. Completed deshelving transitions were detected by observing 494 nm fluorescence induced by a Doppler cooling beam addressing the $S_{1/2}-P_{1/2}$ transition assisted by 650 nm repumper light addressing the $D_{3/2}-P_{1/2}$ transition. The $D_{5/2}-P_{3/2}$ resonance frequency was determined as the average of the substate transitions to 487.990 056(2) THz.

Authors: Mr CHATTERLEY, Adam (Ion Trap Group, Department of Physics and Astronomy, Aarhus University); THALUND, René Munk (Ion Trap Group, Department of Physics and Astronomy, Aarhus University)

Co-authors: Mr RAHN, Lennard (Ion Trap Group, Department of Physics and Astronomy, Aarhus University); Mr BARON, Maximilian (Ion Trap Group, Department of Physics and Astronomy, Aarhus University); DREWSEN, Michael (Aarhus University)

Presenter: THALUND, René Munk (Ion Trap Group, Department of Physics and Astronomy, Aarhus University)

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