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COHERENCE TRANSFER VIA CASCADES AT CAESIUM $7P_{3/2}$ EXCITATION

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We present studies of the coherence transfer via cascade transitions from the caesium $7P_{3/2}$ state, which has been excited in a single step with 455 nm laser radiation from the $6S_{1/2}$ state. Coherence transfers in cascade transitions to the ground state were first studied in potassium vapour [1], although in the past, cascade transitions among higher-lying levels in alkali atoms have been used to measure atomic parameters [2].

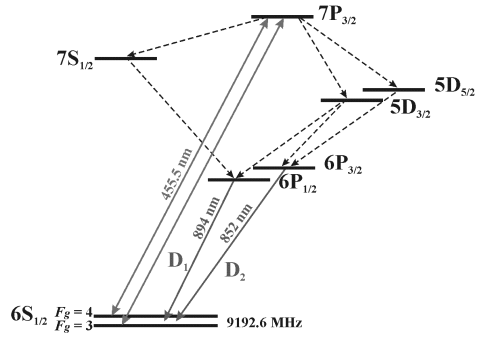

Fig. 1. Level scheme of cascade transitions induced by a 455 nm laser to the caesium $7P_{3/2}$ state. Solid lines depict excitation (455 nm) and observation (455 nm, 852 nm and 894 nm) lines while the dashed lines show coherence transfers via cascades.

The laser radiation induces coherences in the excited state and they are transferred to lower states via a number of cascade transitions. The level scheme and the involved transitions are depicted in Fig. 1. Radiation from a Toptica TA-SHG110 laser was linearly polarised and tuned to excite atoms from either of the two ground-state hyperfine levels while the fluorescence was registered as a function of magnetic field. One of three fluorescent wavelengths was selected by use of interference filters: the first option was to observe direct fluorescence at 455 nm from the $7P_{1/2}$ state. Also observed were indirect fluorescence via the D_1 line (894 nm) D_2 (852 nm) lines excited via cascade transitions, as depicted by dashed lines in Fig. 1. The atomic vapour cell was placed at the centre of three pairs of Helmholtz coils, two of which were used to compensate the ambient magnetic field, while the third pair was used to apply a magnetic field up to ±7G in a direction perpendicular to the exciting light polarisation. Two orthogonal components of the laser induced fluorescence were separated by a polarising beam splitter into two beams, one of which was polarised parallel to the exciting light, while the other was polarised perpendicularly to the exciting light; both components were perpendicularly polarised to the direction of applied magnetic field.

A theoretical model to describe the recorded signal has been developed; it is based on the optical Bloch equations, which were expanded to obtain rate equations for each involved atomic state [3]. The rate equations were solved for steady state conditions, considering the hyperfine structure (HFS) for each atomic state as well as the mixing of the HFS levels due to the nonlinear Zeeman effect. The Doppler effect was taken into account by averaging the results over the thermal velocity probability density profile.

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[2] C. Tai, W. Happer, and R. Gupta, *Phys. Rev. A* **12**, 736 (1972).
[3] K. Blush and M. Auzinsh, *Phys. Rev. A* 69, 063806 (2004).