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Experimental and theoretical studies of excited-state angular-momentum alignment and orientation signals in atomic rubidium in the presence of an external magnetic field[1] MARCIS AUZINSH, ANDRIS BERZINS, RUVIN FERBER, FLORIAN GAHBAUER, LINARDS KALVANS, ARTURS MOZERS, AGRIS SPISS, Laser Centre, University of Latvia, Rainis Blvd. 19 LV-1586, Riga, Latvia — We present level-crossing signals for the hyperfine transitions of the D_2 line of rubidium and show that these signals can be described very precisely by a theoretical model that is based on optical Bloch equations. The crossings occur when the levels are shifted by the nonlinear Zeeman effect in an external magnetic field B, whose direction defines the quantization axis z. A coherent state is said to be aligned if the population of atoms varies as a function of $|m_F|$, the projection of the total atomic angular momentum F on the quantization axis z, but is equal for $+m_F$ and $-m_F$. When the energies of two magnetic sublevels for which $\Delta m_F = 2$ cross, an aligned state can be created by excitation with coherent radiation. An oriented state can be created for crossings with $\Delta m_F = 1$. Because the theoretical model has been extended to include the hyperfine structure of the atomic levels, strong magnetic sublevel mixing in an external magnetic field, and the Doppler effect, precise agreement between theory and experiment is possible even at excitation power densities where optical pumping plays a role. We present experimental results and theoretical calculations, showing their dependence on laser power density and frequency.

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