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Hyperfine structure splitting and the Zeeman effect of 83Kr in laser absorption spectroscopy investigated at the linear plasma device PSI-2

Magnetic-field-induced transitions have recently seen an enormous increase in interest. They arise due to the mixing of magnetic sublevels that start to occur in the non-linear region of the Zeeman effect. Especially concerning highly charged ions, the modeling is based on MCDHF calculations that are perturbed by the diagonalization of the full Zeeman interaction matrix [1].
However, this is not the only approach since, in the early days of quantum mechanics, C. G. Darwin correctly modeled the line splitting and line intensities of fine structure atoms from the weak field through the Paschen-Back regime [2]. Goudsmit and Bacher extended this model to hyperfine structure (HFS) atoms [3].
In this talk, laser absorption spectra measured at the linear plasma device PSI-2 from the metastable Kr I 5s levels are investigated using both methods. The magnetic field strength (20 mT to 90 mT) provides different conditions for the isotopes of krypton. Regarding the even-numbered isotopes, the magnetic field is just a small perturbation on top of the fine structure. However, ^{83}Kr has a much finer level splitting (HFS) due to its non-zero nuclear spin generating substantial magnetic sublevel mixing. The corresponding analysis reveals the non-linear dependency of the magnetic sublevel splitting on the field strength and a substantially changing relative intensity distribution of the magnetic subtransitions.

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