Formation of multiple dressed states in hyperfine level systems of Na

A. Cinins[1], T. Kirova[1], N. Bezuglov[1,2], M. Bruvelis[1], K. Miculis[1], A. Ekers[1], L. Kalvans[1], M. Auzinsh[1], D. K. Efimov[2] and I. I. Ryabtsev[3]

[1]*Laser Centre and Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia*

[2]*Faculty of Physics, St. Petersburg State University, 198904 St. Petersburg, Russia*

[3]*Institute of Semiconductor Physics, SB RAS, 630090 Novosibirsk, Russia*

arturs.cinins@lu.lv

We discuss the formation of dressed states [1] in a system of atomic states with hyperfine (HF) structure upon coupling by a strong laser field. In the case of a generalized ladder scheme of three hyperfine manifolds multiple dark states are created by increasing the laser field coupling. We perform numerical calculations for the typical Autler-Townes type experiments in a three-level ladder system, where a weak probe field is used in the first excitation step and a strong coupling field is used in the second step (Fig. 1). Depending the involved HF levels, the coupling by a sufficiently strong laser field can lead to the formation of dark states. The dependence of the dark state formation on the configuration of strongly coupled HF levels has dramatic effects on addressability of the dressed-state components by a weaker probe field. We have obtained an explicit representation for bright and dark states for a number of excitation ladder schemes in sodium atoms [2]. By examining the specific case of the selection rule $\Delta F \equiv 0$ in two-photon transitions that result from strong interference of the atomic states in the middle step of the ladder, we suggests schemes for selective addressing of unresolved or partly resolved HF components.

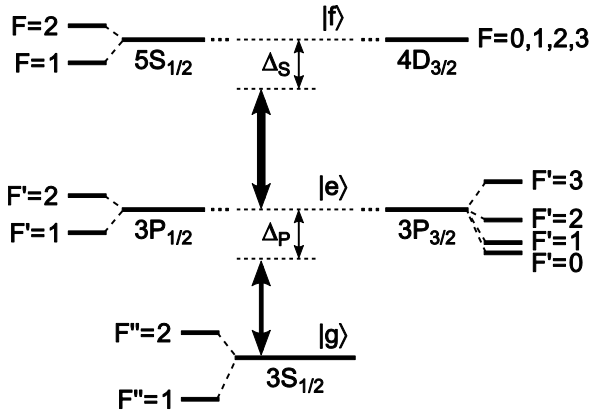

Figure 1: Ladder excitation scheme in sodium.

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References:

[1] A. A. Rangelov, N. V. Vitanov, and B. W. Shore, Phys. Rev. A **74**, 053402 (2006).

[2] I. Sydoryk, N. N. Bezuglov, I. I. Beterov, K. Miculis, et al., Phys. Rev. A **77**, 042511 (2008).