Control of dipole–dipole interactions in dense resonance medium by fast switching of optical excitation using intense laser radiation

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Dipole–dipole interactions in a dense gas between identical two-level atoms, one of which is in excited state, leads with a certain probability (depending on the distance between the atoms) to a process of excitation exchange. The probability of this process depends on the ground state atomic density, so the dipole–dipole interactions can be controlled by a change of the ground state population. Here we discuss experiments on rapid change of ground state atomic population by fast optical excitation using laser radiation with intensity much higher than saturation intensity. In the experiments the window of a Rb vapor cell is irradiated by a strong pump laser beam which can be rapidly switched on or off. The dipole–dipole interactions decay or build-up time can be determined by measuring the reflectivity of a probe laser beam directed to the pump beam spot. The probability nature of the excitation exchange process leads to diffusion of the excitation, this process of non-radiative excitation transport is dominant for the considered gas densities. It is shown that for high gas density the excitation transport become independent on gas temperature. The research is supported by the Russian Science Foundation (grant No. 23-22-00200).