Resonant nonstationary amplification of polychromatic laser pulses and conical emission in an optically dense ensemble of neon metastable atoms April 3, 2003

S. N. Bagayev Institute of Laser Physics, Siberian Branch of the Russian Academy of Sciences, Lavrentyeva 13/3, 630090 Novosibirsk, Russia V. S. Egorov I. B. Mekhov P. V. Moroshkin I. A. Chekhonin St. Petersburg State University, Department of Optics, Ulianovskaya 1, Petrodvorets, 198504 St. Petersburg, Russia E. M. Davliatchine E. Kindel Institut für Niedertemperatur-Plasmaphysik, Friedrich-Ludwig-Jahn-Str. 19, 17489 Greifswald, Germany

abstract Experimental and numerical investigation of single-beam and pump-probe interaction with a resonantly absorbing dense extended medium under strong and weak field-matter coupling is presented. Significant probe beam amplification and conical emission were observed. Under relatively weak pumping and high medium density, when the condition of strong coupling between field and resonant matter is fulfilled, the probe amplification spectrum has a form of spectral doublet. Stronger pumping leads to the appearance of a single peak of the probe beam amplification at the transition frequency. The greater probe intensity results in an asymmetrical transmission spectrum with amplification at the blue wing of the absorption line and attenuation at the red one. Under high medium density, a broad band of amplification appears. Theoretical model is based on the solution of the Maxwell-Bloch equations for a two-level system. Different types of probe transmission spectra obtained are attributed to complex dynamics of a coherent medium response to broadband polychromatic radiation of a multimode dye laser.