

Nonlinear Coherent Modes and Atom Optics

V I YUKALOV¹, E P YUKALOVA², AND V S BAGNATO³

¹*Bogolubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Dubna, Russia*

²*Laboratory of Information Technologies, Joint Institute for Nuclear Research, Dubna, Russia*

³*Institute of Physics in Sao Carlos, University of São Paulo, São Carlos, Brazil*

Contact Email: yukalov@theor.jinr.ru

A survey is given of the properties of trapped Bose-condensed systems with nonlinear coherent modes generated by modulating external fields. The analogies between these systems and finite-level atoms are emphasized. Similarly to atoms, trapped Bose-condensates with coherent modes possess such properties as resonant generation, interference patterns, internal Josephson current, mode locking, Rabi oscillations, Ramsey fringes, harmonic generation, parametric conversion, atomic squeezing, state entanglement, entanglement production, and quantum turbulence. Nonequilibrium states of bosonic systems can be characterized by injected energy, Fresnel number, and Mach number. Inverse Kibble-Zurek scenario is described. A method for creating directed beams from atom lasers is discussed.